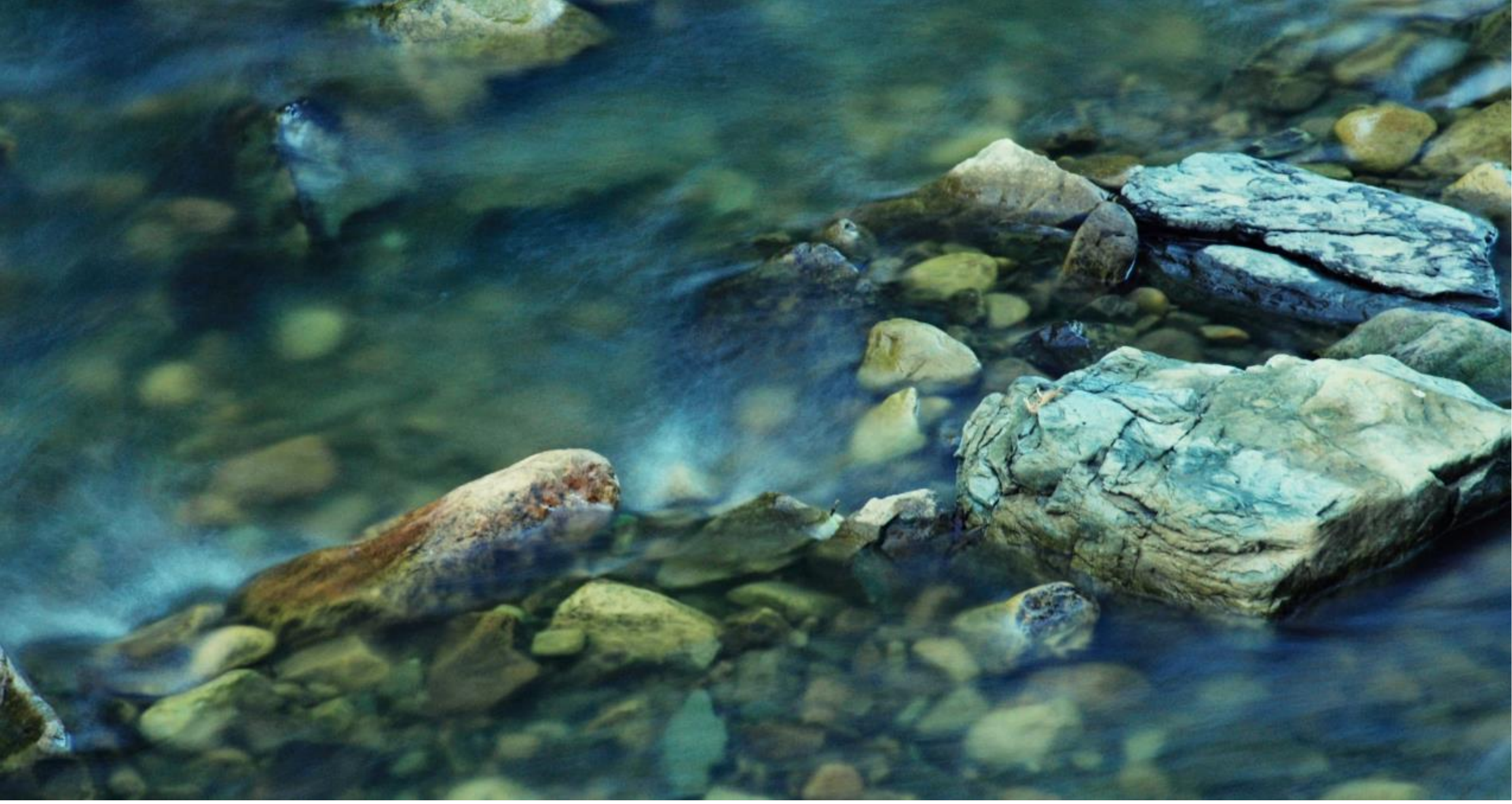
Appendix A
Data Reports

Appendix A-1
Data Memorandum



March 2019
Esquimalt Harbour

Data Memorandum
Wood Waste Remediation Project

Prepared for Public Works and Government Services Canada

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Prepared by
Anchor QEA, LLC

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ABBREVIATIONS

BC	British Columbia
cm	centimetre
DGPS	differential global positioning system
DGT	diffusive gradients in thin films
EGL	Anchor QEA Environmental Geochemistry Laboratory
m	metre
mg/L	milligram per litre
NAD	North American Datum
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl Aroclor
PEL	probable effects level
PSEP	Puget Sound Estuary Program
PWGSC	Public Works and Government Services Canada
R/V	research vessel
RMP	Risk Management Plan
SAP	Sampling and Analysis Plan
TOC	Total organic carbon
UTM	Universal Transverse Mercator
WWMA	Wood Waste Management Areas
WWRP	Wood Waste Remediation Project

1 Introduction and Background

This data memorandum presents the sediment sampling and dive survey results for the Wood Waste Remediation Project (WWRP). The WWRP includes wood-impacted areas in the central and northern portions of Esquimalt Harbour, Esquimalt, British Columbia (BC; Figure 1). Sediment sampling and diver surveys were performed in accordance with the Public Works and Government Services Canada-approved Sampling and Analysis Plan (SAP; Anchor QEA 2018a) and Supplemental SAP (Anchor QEA 2018b).

The purpose of the sampling was to obtain data to develop and implement a risk management and/or remediation strategy that addresses ecological risks associated with sediments historically affected by wood debris. This data memorandum provides a summary of the field activities conducted in Fall 2018 and the associated data results from those studies. The Remedial Options Analysis Memorandum (Anchor QEA 2019a) is a companion document that includes more detailed information about the site background and data interpretations relevant to potential remediation. The Treatability Recommendations Report (Anchor QEA 2019b) summarizes the results of the bench-scale treatability study.

Sampling activities occurred over two sampling events in October and December of 2018. Sediment collection, testing, and/or observations were conducted at 52 surface locations, 16 subsurface locations, 11 diver transects, 11 surface water locations, and 10 diver-collected surface sediment locations within a range of wood debris-impacted areas of Esquimalt Harbour.

As outlined in the SAP and Supplemental SAP, sediment sampling and diver survey locations were selected to fulfill one or more of the following objectives:

- Refine the spatial extent of porewater sulphide concentrations
- Further delineate wood waste surface coverage and thickness
- Characterize the post-dredge “leave surface” in areas with significant wood waste at depth to inform considerations for potential dredging
- Evaluate surface water chemistry to establish baseline conditions
- Provide representative sediment from areas with elevated porewater sulphide to conduct bench-scale treatability studies
- Support Risk Management Plan (RMP) sediment characterization efforts

The data memorandum is organized as follows:

- Section 2, Sampling Methods: This section describes the sampling methods used in this program, including any modifications from the SAPs
- Section 3, Data Quality Assessment: This section describes information on data quality including sample completeness and quality control measures

- Section 4, Investigation Results: This section provides a summary of diffusive gradients in thin films (DGT) porewater sulphide concentrations and chemical and bioassay results, including observations from the diver surveys
- Section 5, Statistical Evaluation: This section provides a summary of the results of the multivariate statistical evaluation to assess patterns in bioassay results, DGT porewater sulphide, and wood waste in Esquimalt Harbour
- Section 6, References: This section provides the references cited in this report

Appendices include field data (logs, photographs; Appendix A), laboratory data reports (Appendix B), data validation reports (Appendix C), bioassay report (Appendix D), and statistical evaluation (Appendix E).

2 Sampling Methods

Sampling was conducted in accordance with the Public Works and Government Services Canada-approved SAP and Supplemental SAP which provide the sample design, target sampling locations, procedures for sample collection and processing, data QC, and data reporting requirements. Daily field logs, collection logs, processing logs, photographs, and chain-of-custody forms are provided in Appendix A.

2.1 Surface Sediment Sampling and DGT Analysis

Surface sediment sampling and DGT analysis was conducted from October 1 to 5, 2018.

2.1.1 Sampling Vessel, Navigation, and Positioning

Surface sediment sample collection was conducted aboard the research vessel (R/V) *Sadie*, operated by the subcontractor Coastline Technologies Inc. Horizontal positioning was determined by the sampling vessel's onboard differential global positioning system (DGPS). Coordinates were recorded on grab collection logs in northing and easting as metres (m) to the nearest degree using Universal Transverse Mercator (UTM) Zone 10 Grid, North American Datum (NAD) 83 (Appendix A).

Water depth was measured to the nearest centimeter using a lead line from the bow. Observed tide heights based on the permanent Fisheries and Oceans Canada tide Gauge in Victoria, BC (Gauge 7120), were used to calculate the mudline elevation in Chart Datum by multiplying the water depth by -1, then adding the tidal elevation at time of collection.

2.1.2 Sample Collection and Processing

Forty-nine surface sediment grabs were collected and processed within the Wood Waste study area using a Power Grab in accordance with the SAP (Figure 2). Two reference sediment locations were collected in outer Esquimalt Harbour away from wood waste impacted areas. Surface samples were collected from the 0- to 10-centimetre (cm) biologically active zone at each sampling station. All accepted grabs were taken within three attempts except at the following locations:

- EHWW-05 was accepted on the fourth attempt due to wood waste and anthropogenic debris stuck in the Power Grab jaws.
- EHWW-21 was not collected after three attempts due to submerged rocky outcrops.
- EHWW-23 was accepted on the fifth attempt due to sand substrates that winnowed from the grab upon retrieval.

Immediately upon accepting the grab and to minimize potential hydrogen sulphide volatilization, sediment volume was collected for ex situ DGT testing and bioassay testing according to the SAP. One to three DGTs were analyzed per location at different exposure durations (0.5-, 2-, 24-hour).

After pulling aliquots for DGT testing and bioassay archive, all surface grabs[1] were logged for major lithological features, classified according to ASTM International Method D-2488, and photographed (Appendix A). Field measurements of sediment pH, temperature, and salinity were collected using handheld meters.

At select RMP chemistry testing locations, an aliquot of sediment volume was placed in a decontaminated stainless-steel bowl and mixed until homogeneous in color and texture using a decontaminated stainless-steel spoon. The sample was then spooned into laboratory-supplied jars for analyses.

Chain-of-custody forms were logged by the processing staff (Appendix A) and were relinquished via courier or overnight shipping to their respective laboratory:

- DGT samples – Anchor QEA Environmental Geochemistry Laboratory (EGL) in Portland, Oregon, USA
- Bioassay samples - Nautilus Environmental in Burnaby, BC
- RMP chemistry samples – AGAT in Burnaby, BC

Actual grab collection dates, attempts, station coordinates, mudline elevations, primary sample sediment lithology, wood debris abundance, sample ID, and Sample type are provided as Table 1.

2.1.3 DGT Testing

At several locations in October 2018, multiple DGTs were deployed for different time periods. Shorter exposure periods were used for sampling locations with anticipated high porewater sulphide concentrations and longer exposures were used for sampling locations with anticipated low porewater sulphide concentrations. Ex situ DGTs were analyzed at Anchor QEA's Environmental Geochemistry Laboratory via optical densitometry as summarized in the SAP.

2.1.4 Bioassay Toxicity Testing

Bioassay samples were collected from each DGT sampling location and archived for potential testing. Following receipt of the DGT results but within the 56-day hold time, 17 representative samples were triggered for the 48-hour bivalve larval development bioassay test (Table 1). Samples were selected to represent a range of DGT porewater sulphide results, wood waste abundance, wood waste type, and geographical locations across the investigation area.

Testing on all 17 samples was conducted according to procedures developed by Southern California Coastal Water Research Project (SCCWRP; 2009), incorporating screened chambers to separate the larvae from the sediment to reduce bias from physical impacts from fine wood particles. For

[1] Sample EHWW-31 was not photographed due to camera malfunction.

comparison purposes, 3 of the 17 samples were also tested following procedures described by the Puget Sound Estuary Program (PSEP; 1995) utilizing the resuspension method. A summary of test methods and results of the bioassay testing are included as Appendix D.

2.1.5 Analytical Program - Risk Management Plan Chemistry Testing

At select locations to support Phase 3 Harbour-Wide Risk Management, a surface sample was collected and analyzed for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl Aroclors (PCBs), metals, and dioxin/furans (Table 1). While these data are reported here, updates to the harbour-wide description of the nature and extent of sediment contamination is included in the updated RMP.

2.2 Subsurface Sediment Sampling

Subsurface sediment sampling was conducted from December 16 to 19, 2018.

2.2.1 Sampling Vessel, Navigation, and Positioning

Subsurface sediment borings were conducted aboard a support barge provided by Mercury Transport. Horizontal positioning was determined using a handheld DGPS. Coordinates were recorded on boring logs in northing and easting as metres to the nearest degree using UTM Zone 10 Grid, NAD 83 (Appendix A).

Water depth was measured to the nearest decimal foot[2] using a lead line through a moon pool located in the centre of the barge. Observed tide heights based on the permanent Fisheries and Oceans Canada tide Gauge in Victoria, BC (Gauge 7120) were using to calculate the mudline elevation in lower low water large tides by multiplying the water depth by -1, then adding the tidal elevation at time of collection.

2.2.2 Sample Collection and Processing

Sixteen subsurface borings were collected and processed within the Wood Waste investigation area (Figure 2) using sonic boring collection methods in accordance with procedures described in the Supplemental SAP. Sonic borings utilized a Geoprobe Sonic Drill Rig operated by Drillwell, Inc. Borings collected for bench-scale treatability testing utilized the Geoprobe DT45 Sampling System, in which borings are collected within 3-inch-diameter rigid plastic core tubes.

All accepted cores met target penetration goals (1 m below wood deposits) except for EHWW-57 which contained wood waste until bedrock. Many locations were accepted with less than 75% recovery due to difficulty retaining coarse wood debris and very soft, water saturated silt sediments.

[2] Drillers provided data in imperial units. Lengths were converted to metres in data tables.

All proposed boring locations and supplemental location EHWW-61 were collected, but supplemental locations EHWW-62, -63, -64, and -65 were not collected due to time constraints. Two locations were adjusted from target due to obstructions:

- Location EHWW-44 was located 85 m from target due to a stationary barge that prevented collection at the target location.
- EHWW-57 was located 22 m from target due to rocky outcrops in the vicinity.

Sediment borings were processed aboard the barge in accordance with the Supplemental SAP. All cores were logged for major lithological features, classified according to ASTM International Method D-2488, and photographed (Appendix A). Leave surface samples were collected at 0 to 0.5 m and 0.5 to 1.0 m below wood waste. If no wood waste was observed, samples were collected from 0 to 0.5 m and 1.0 m below mudline. At select locations a surface sample from 0 to 0.5 m below mudline was collected to support Phase 3 Harbour-Wide Risk Management. Sediment samples were placed in decontaminated stainless-steel bowls and mixed until homogenous in color and texture using a decontaminated stainless-steel spoon. The sample was then spooned into laboratory-supplied jars for analyses.

Core tubes collected for bench-scale treatability testing were subsectioned to approximately 0.75 m, capped, sealed in a Mylar bag with oxygen-absorbing packets, and placed on ice for transport to Anchor QEA's EGL. To facilitate bench-scale treatability testing additional surface water volume from Esquimalt Harbour was collected using a peristaltic pump and polyethylene tubing lowered to the middle of the water column at location EHWW-59 (mid-harbour). Four 20-litre plastic containers were filled and transported on ice to Anchor QEA's EGL along with the sediment cores.

Chain-of-custody forms were logged by the processing staff (Appendix A) and were relinquished via courier to AGAT in Burnaby, BC. Core tubes and water containers for bench-scale treatability testing were delivered by Anchor QEA field staff to Anchor QEA's EGL in Portland, OR. Actual core collection dates, station coordinates, mudline elevations, attempts, core penetration and recovery, Sample ID, sample intervals, sample lithology, wood debris abundance, and sample type are provided as Table 2.

2.2.2.1 Sampling Modifications

All target sample intervals were collected as prescribed in the Supplemental SAP with the following modifications:

- No RMP surface interval was collected at EHWW-16 due to poor recovery within wood waste
- No RMP surface interval was collected at EHWW-58 due to poor recovery in surface interval within wood waste
- RMP surface interval was collected at EHWW-36 to replace surface interval that was not collected at EHWW-58
- Opportunistic RMP surface interval was collected at EHWW-40 due to substantial wood fibres

- No RMP surface interval was collected at EHWW-44 due to insufficient sample volume and prioritization of the 17- to 67-cm leave surface sample.
- The RMP surface interval sample depth at EHWW-53 was 0 to 16 cm to prioritize sample volume for the 16- to 66-cm leave surface sample.
- No wood was encountered at EHWW-56, therefore samples were collected from 0 to 0.5 (analyzed) and 0.5 to 1.0 m (archived) below mudline
- No leave surface intervals were collected at EHWW-57 since wood waste was present down to bedrock

Cores for bench-scale treatability were collected at all proposed locations with the following modifications:

- Cores were not collected at EHWW-44 due to time and safety constraints due to an anchored barge
- Cores were collected at EHWW-59 to replace cores that were not collected at EHWW-44
- Additional cores were collected at EHWW-55 to obtain material within dense wood waste deposits

2.2.3 Analytical Programs – Leave Surface and Risk Management Plan Chemistry Testing

Subsurface leave surface sample intervals were analyzed using a tiered approach according to the Supplemental SAP. The first sample interval (0 to 0.5 m below wood waste) was initially analyzed for metals, PAHs, PCBs, dioxins/furans, bulk sulphides, ammonia, total volatile sulphides, grain size, total solids, and total organic carbon. Samples collected from 0.5 to 1 m below wood waste were archived. Upon receipt of preliminary data, two additional samples from the 0.5- to 1-m sample interval were triggered for total solids and metals analysis due to a Canadian Council of Ministers of the Environment guidance (CCME 1999) probable effects level (PEL) exceedance of cadmium.

At select locations to support Phase 3 Harbour-Wide Risk Management, a surface interval sample (0 to 0.5 m) was collected and analyzed for PAHs, PCB Aroclors, metals, and dioxin/furans. While these data are reported here, updates to the harbour-wide sediment contamination nature and extent description is included in the updated RMP.

A subset of surface and leave surface samples received additional geotechnical testing including Atterberg limits and moisture content to capture the range of physical conditions observed. A list of all samples collected, and their respective analyses are summarized in Table 2.

2.3 Diver Transect Surveys, Supplemental DGT Analysis, and Surface Water Depth Profiles

Diver transect surveys, supplemental DGT analysis, and surface water depth profiles were conducted from December 17 to 19, 2018.

2.3.1 Survey Methods, Navigation, and Positioning

Eleven 200-m diver transect surveys were conducted within the Wood Waste study area. Surveys were conducted by Hemmera using the R/V *Reservoir Dog* according to methods outlined in the Supplemental SAP. Each transect was delineated with a 200m weighted line and transect endpoints were georeferenced using a handheld DGPS.

All diver transects were collected as prescribed in the Supplemental SAP except for Transect 63, which was not collected due to a weather delay.

2.3.2 Diver Observations, Core Collection, and Core Processing

Diver observations were made at 25m intervals (0, 25, 50, 75, 100, 125, 150, 175, and 200 m) along each transect. At each of the transect observation locations, a 1m by 1m quadrat was places on the sediment surface and the diver noted the following observation:

- Substrate type (e.g. Silt, sand, woody waste)
- Wood waste percent cover and wood waste type
- Marine vegetation (% cover)
- *Beggiatoa sp.* (% cover)
- Diatoms (% cover)

The abundance of mobile invertebrates and fish were also documented as they were encountered along the transect. All transects were recorded using an underwater video camera. Video stills from the underwater camera are included in Appendix A.

To delineate the thickness of wood waste deposits, five diver cores were taken at 50m intervals (0, 50, 100, 150, 200 m) along each transect to a maximum depth of 1.0 m. Coring utilized either a PVC (0.8 m x 0.05 m diameter) or clear Lexan (1 m x 0.05 m diameter) tube pushed into the sediment by hand until refusal or maximum penetration was achieved. The core tube was capped, removed from the sediment, and a second cap was placed on the bottom to ensure the contents were not lost. Diver cores were processed aboard the dive vessel in accordance with the Supplemental SAP. All cores were logged for major lithological features, classified according to ASTM International Method D-2488, and photographed (Appendix A).

Diver cores were collected from all transects and locations with the following exceptions:

- Transect 59 at 0m due to no recovery

- Transect 59 at 150m due to no recovery
- Transect 61 at 0m due to no recovery
- Transect 67 at 0m due to no recovery
- Transect 68 at 0m due to refusal (bedrock outcropping)
- Transect 68 at 200m due to refusal (bedrock outcropping)
- Transect 69 at 200m due to no recovery
- Transect 70 at 200m due to no recovery

A summary of observations along each transect are provided as Table 3.

2.3.3 DGT Collection, Processing, and Testing

Additional diver cores were collected at pre-determined locations along certain transects to collect sediment volume for DGT analysis (Table 3). Cores collected for DGT analysis utilized a PVC short-core (0.3 m by 0.1 m diameter) collected as described in Section 2.3.2. Cores for DGT analysis were processed aboard the dive vessel in accordance with the Supplemental SAP. DGTs were delivered by Anchor QEA field staff to Anchor QEA's EGL in Portland, Oregon.

All proposed DGT samples were collected except at the following:

- EHWW-51 was not collected due to refusal of the core tube
- EHWW-60 was not collected due to a weather delay

A summary of diver cores collected for DGT testing including coordinates and Sample IDs are included in Table 2.

2.3.4 Surface Water Depth Profiling

To assess surface water conditions throughout the Esquimalt Harbour wood debris areas, a handheld YSI water quality SONDE meter was deployed from the dive support vessel in the vicinity of each dive transect location (Figure 2). Standard water quality parameters were measured through the water column (pH, conductivity, salinity, dissolved oxygen, temperature, oxidation reduction potential, and turbidity). Water quality parameters at each location are provided in Table 4.

Water quality parameters were collected approximately every metre from 0.5 m below the water surface to as close to mudline as practicable. Logistical constraints during diving operations resulted in fewer measurements at Transects 67, 68, 69, and 70.

Additionally, total free sulphides in surface water were measured using a handheld colorimetric testing kit. Utilizing a peristaltic pump and 1/4-inch polyethylene tubing attached to the YSI water quality SONDE, samples of water were taken for sulphide analysis at approximately 0.5 m below the surface, mid-water column, and as close to mudline as practicable.

3 Data Quality Assessment

This section provides information on data quality, including field and laboratory QC measures and completeness. The laboratory data reports are provided in Appendix B.

3.1 Field Data Quality

Field data consisted of field duplicates and matrix spike/matrix spike duplicate samples collected at a frequency of one per twenty samples. Field duplicates were collected by collecting additional volume from the sample homogenate and placing into a separate laboratory container with unique sample identification. Three field duplicate samples were collected and were analyzed for metals, PAHs, total PCB Aroclors, and dioxin/furans. The relative percent differences between the field duplicate and parent sample results fell within project requirements for 98% of analyses. The few detected results with relative percent differences greater than 50% indicate potential sample heterogeneity and data results were qualified as estimated (J-qualified).

3.2 Analytical Data Quality

The laboratory followed the specified analytical methods, and all requested analyses were completed within holding times. The laboratory followed its own standard operating procedures and did not report any internal QC discrepancies.

3.3 Sample Completeness

Completeness goals were met for this project. All analytical chemistry data were useable as reported or as qualified.

3.4 DGT Data Quality

Ex Situ DGTs were analyzed at Anchor QEA's Environmental Geochemistry Laboratory via optical densitometry as summarized in the SAP. Many DGTs were saturated, in which the absorptive capacity of the DGT membrane to adhere sulphides was exceeded.

For each sample location where multiple DGTs were deployed, the following result acceptance approach was applied:

- For locations with multiple DGT treatments, the non-saturated DGT value was accepted, if available
- If a 2-hour and 24-hour result were non-saturated, the 24-hour result was accepted since the 2-hour result may not have had enough time to diffuse to the gel membrane.
- If a 0.5-hour and 2-hour result are not-saturated, the results were averaged.
- If all DGTs were saturated, the result was reported as E-qualified, which indicates that the concentration exceeds the maximum value on the calibration curve.

4 Investigation Results

This section summarizes the DGT, bioassay, and chemistry sediment testing results, wood waste observations, and biophysical observations.

4.1 DGT Porewater Sulphide

The DGT porewater sulphide results for both October 2018 surface grab sampling (Section 2.1.3) and December 2018 Supplemental Sampling (Section 2.3.3) are provided as Table 5. Appendix B contains photographs of the laboratory processed DGTs. Porewater sulphide concentrations range from 0.3 to >206 milligrams per litre (mg/L) across the Wood Waste study area. The DGT concentrations were interpolated across the study area using Inverse Distance Weighted GIS methods and are presented in Figure 3. For locations with data points from both October and December, only the non-saturated value was included in the Inverse Distance Weighted GIS method (if available).

The interpolations indicate a porewater sulphide concentration gradient with the highest concentrations in isolated areas west of Richards Island in Thetis Cove and in the northwest reaches of the North Harbour between McCarthy Island and Cole Island (Figure 3). Porewater sulphide concentrations were lowest south and west of Inskip Islands.

Porewater sulphide concentrations were lower in December 2018 than in October 2018 at four locations (EHWW-08, EHWW-27, EHWW-39, and EHWW-50). Two locations contained higher concentrations in December 2018 than in October 2018 (EHWW-41, EHWW-43). Concentration trends were not discernable at two locations due to saturated DGT measurements from October 2018 (EHWW-24, EHWW-25)

4.2 Wood Waste Surface Coverage and Thickness

A range of wood waste coverage, thickness, and type was observed across the study area as part of the sediment grabs, borings, and diver surveys. The wood waste observations from this study were combined with those from previous investigations conducted by SNC Lavalin (2016) and Hemmera (2018) to further delineate and refine the spatial distribution of wood waste within Esquimalt Harbour. Using GIS interpolation methods, wood waste percent cover and thickness were projected across the study area (Figures 4 and 5, respectively).

Wood waste deposits within the study area have been grouped into Preliminary Wood Waste Management Areas (WWMA) and are summarized by the following characteristics:

WWMA – 1, Esquimalt Harbour North

- Wood waste observations predominantly include wood fibres, bark and wood fragments, and submerged logs.

- About 65,000 m^2 exceeds 10% wood waste coverage in surface sediment. Surface sediment has 100% wood waste coverage in a localized area (at two survey locations out of a total of 101).
- Relatively thin deposits of wood-waste-impacted sediment (average thickness is 0.4 m; up to 0.6 m maximum thickness). Area of sediment with greater than 0.2 m of wood waste is 106,000 m^2.
- WWMA-1 also contains a very soft layer of fine-grained, flocculent suspended sediments that appears to have a high fraction of organics and accumulates just above the more competent sediment surface. This sediment was hard to sample using traditional sediment sampling equipment, but was noted by divers as a layer similar to fluidized mud.
- Total organic carbon (TOC) concentration up to 12% and an average of 6% in all samples.
- Seasonal *Beggiatoa* mats from 50% to 96% coverage in the southern portion of the WWMA and none in the northern portion of the WWMA.
- Porewater sulphide concentrations exceed 10 mg/L in the entire WWMA, with more than half of the samples exceeding 50 mg/L and 75% of samples exceeding 30 mg/L.

WWMA – 2, Esquimalt Harbour Central

- Wood waste observations predominantly include wood fibres, bark and wood fragments, and submerged logs.
- About 60,000 m^2 of the area exceeds 10% wood waste in surface sediment. Surface sediment has 100% wood waste at one survey location (out of 66 total survey locations).
- Relatively thin deposits of sediment with wood waste (average thickness of 0.4 m; up to 0.9 m maximum thickness). Area of sediment with wood waste thicker than 0.2 m is 126,000 m^2.
- WWMA-1 also contains a very soft layer of fine-grained, flocculent suspended sediments that appears to have a high fraction of organics and accumulates just above the more competent sediment surface. This sediment was hard to sample using traditional sediment sampling equipment, but was noted by divers as a layer similar to fluidized mud.
- TOC ranges up to 31% with an average of 16% for all samples in the area.
- Seasonal *Beggiatoa* mats from 50% to 100% for much of the WWMA.
- Porewater sulphide concentrations exceed 10 mg/L in the entire WWMA with 70% of the samples exceeding 30 mg/L.

WWMA – 3, Richards Island South

- Wood waste observations predominantly include substantial fine wood fibres, large bark and wood fragments, and submerged logs.
- Nearly the entire area (33,000 m^2) exceeds 10% wood waste in surface sediment. Surface sediment has 100% wood waste at one survey location (out of 30 total survey locations).

- Relatively thick deposits of sediment with wood waste (average thickness of 1.1 m; up to 2.4 m maximum thickness). The entire area (39,000 m^2) contains sediment with wood waste thicker than 0.2 m.
- TOC ranges up to 24% with an average of 10% for all samples in the area
- Seasonal *Beggiatoa* mats from 50% to 100% for much of the WWMA.
- Porewater sulphide concentrations exceed 10 mg/L in the entire WWMA with 67% of the samples exceeding 30 mg/L.

WWMA – 4, Inskip Island West

- Wood waste observations predominantly include large bark fragments, small and large wood fragments, and submerged logs.
- About 111,000 m^2 of the area exceeds 10% wood waste in surface sediment. Surface sediment has 100% wood waste at four survey locations (out of 57 total survey locations).
- Relatively thick deposits of sediment with wood waste (average thickness of 0.7 m; up to 2.0 m maximum thickness). The area of sediment with wood waste thicker than 0.2 m is about 128,000 m^2.
- TOC was 16% in one sample (no other samples tested).
- Seasonal *Beggiatoa* mats from 13% to 100% for much of the WWMA.
- Porewater sulphide concentrations are high but slightly lower than WWMAs 1 through 3 with values up to 37 mg/L and 18% of samples exceeding 30 mg/L.

WWMA – 5, Inskip Island East

- Wood waste observations predominantly include large bark fragments, small and large wood fragments, submerged logs, and fine fibres.
- About 58,000 m^2 of the area exceeds 10% wood waste in surface sediment. Surface sediment has 100% wood waste at six survey locations (out of 57 survey locations).
- Relatively thick deposits of sediment with wood waste (up to 3.6 m). The area of sediment with wood waste thicker than 0.2 m is 107,000 m^2.
- TOC ranges up to 35% with an average of 7% in all samples in the area.
- Seasonal *Beggiatoa* mats were not observed in the WWMA but may be present based on data from adjacent areas.
- Seasonal sulphide concentrations are high but slightly lower than WWMAs 1 through 3, with 17% of samples exceeding 30 mg/L.

4.3 Bioassay Toxicity Testing

The results of the 48-hour bivalve (*M. galloprovincialis*) larval survival and development test are included in Appendix D. For samples run via the screen tube method, no statistical differences were present when comparing combined proportional normal (percent normal alive) against the reference locations, indicating no adverse effects (Table 6; Appendix D). Although the relevant endpoint for toxicity evaluation is normal survival, some significant differences were observed at select locations (EHWW-06, -15, -22, and -50) for proportion normal relative to one or both reference sites.

As part of the screen tube test procedure, overlying and interstitial water was measured for total sulphides and ammonia at the start and end of testing (48 hour). Concentrations of total sulphides in interstitial water were considerably lower than those measured in the field using the DGTs. It is possible that the bioassay chambers were not able to reproduce similar sulphide concentrations that were present in the field due to the relatively small sediment sample volume (100g), incidental aeration during chamber preparation, and the need to exclude coarse wood pieces due to the size of the chamber.

Three locations were analyzed via the resuspension method (PSEP method; EHWW-11, EHWW-39, and EHWW-50) to compare performance between the screen tube and resuspension methodologies. Statistical differences for combined normal survival results compared to one or more reference locations were present for all resuspension method samples. Samples run via the resuspension methodology exhibited a 9% to 20% reduction of average combined normal survival compared with the results using the screen tube method. Proportion normal was very similar between the screen tube and resuspension methods, but survival was lower for each sample in the resuspension method, likely because some larvae become entrained (physically smothered) by the fine-grained wood and sediment particles (Section 2.1.4). The presence of this fine grained, flocculent layer with high water content may contribute to reduced larval survival at the Study Area.

4.4 Risk Management Plan Surface Sediment Chemistry

Table 6 presents the results of the RMP surface sediment chemistry. Results are screened against the PEL screening level. No concentrations were greater than 6x PEL. PEL exceedances were observed at six locations for Cadmium (less than 2x PEL), two locations for total dioxin/furan Toxic Equivalents Quotient (less than 3x PEL), three locations for total PCB Aroclors (less than 2x PEL) and one location for pyrene (less than 2x PEL).

4.5 Post-Dredge Leave Surface Chemistry

Table 6 presents the results of the leave surface samples screened against the Canadian Council of Ministers of the Environment guidance (CCME 1999) PEL screening level. No concentrations were greater than 6x PEL. Six leave surface samples had PEL exceedances for cadmium (less than 2x PEL).

Two locations had PEL exceedances for cadmium in the surface 0-0.5 m RMP surface sediment interval and underlying leave surface sample (EHWW-53, and -54). To confirm that cadmium concentrations did not increase further with depth, the second leave surface archive sample was triggered for metals analysis at these locations. The tier 2 results were below PEL, indicating that cadmium does not increase with depth.

4.6 Diver Surveys

The biophysical results of the subtidal diver surveys are summarized below. Visual observations along each transect including thickness of wood waste deposits extrapolated from the diver cores are provided in Table 3 and incorporated into Figures 4 and 5. A photolog of relevant observations along each transect is included in Appendix A. Observations of *Beggiatoa* (percent cover) from these surveys and previous (Hemmera 2018) surveys are provided as Figure 6.

Key observations from the diver surveys are summarized below:

- The subtidal habitat within the study area was characterized by soft sediment composed of silt (97.5%) with occasional cobble (1.0%), boulder (0.5%), and bedrock (1.0%) observed. Sparse shell hash was observed in 8.1% of transects with an average percent cover of approximately 4.9%.
- A nepheloid layer was observed at some areas of the study area. This layer is described as a layer of suspended sediment particles at the sediment-water interface.
- Wood waste was observed in 34 quadrats (34%). When observed, the average percent cover of wood waste was 54.1%. Spatially, the wood waste was concentrated on transects 61, 66, 68, and 69. Wood waste was generally sparse, patchy, or absent on the other transects.
- Diatomaceous mats were observed throughout the study area, in 76.8% of quadrats. Average percent cover when observed was approximately 54.6% and 41.9% of the study area was covered by diatoms.
- *Beggiatoa* mats were observed in 25.3% of quadrats, and where observed, average percent cover was 9.0%. *Beggiatoa* was almost exclusively observed in quadrats that contained diatom mats but rarely associated with quadrats that contained wood waste at the surface. Observations of *Beggiatoa* coverage in December 2018 were considerably less in areas previously observed to have substantial coverage in September 2016 (Figure 6), suggesting a seasonal trend of these species within the harbour. *Beggiatoa* generally form at the transition zone between oxygenated and anoxic environments (Ecology 2013) and the shift to fall weather (change in circulation and increase in storms) may increase the mixing of harbour surface waters, which could reduce the presence of *Beggiatoa*.
- Generally, vegetation was sparse within the study area and was observed in 14% of quadrats. Where present, vegetation consisted of unidentified red bladed and red filamentous algaes (average percent cover: 1% and 15% respectively), split kelp (*Saccharina groenlandica*, 25%), grass kelp (*Ulva intestinalis*, 5%), sea lettuce (*Ulva lactuca*, 20%), and unidentified brown algaes (7.75%).

- Invertebrates were observed occasionally within the study area, in approximately 26.3% of quadrats. The invertebrate species observed included acorn barnacles (*Balanus glandula*), Nuttal's cockle (*Clinocardium nuttallii*), graceful crabs (*Metacarcinus gracilis*), Dungeness crabs (*Metacarcinus magister*), red rock crabs (*Cancer magister*), hermit crabs (*Pagarus spp.*), unidentified Pandalid shrimp, turban snails (*Tegula spp.*), giant rock scallop (*Crassadoma gigantea*), giant plumose anemones (*Metridium farcimen*), and unidentified anemones. No vertebrate fish were observed during the field studies.

4.7 Surface Water Profiles

Table 4 presents the results of the surface water profiles from the dive transects. Parameters were generally similar throughout the water column with some lower readings of specific conductance and salinity at the surface (0.5-m depth). Dissolved oxygen generally showed a mild decreasing trend with depth at most locations.

5 Statistical Evaluation

Patterns among bioassay results, DGT porewater sulphide, and wood waste (percent cover, wood waste thickness) in Esquimalt Harbour were evaluated utilizing a multivariate statistical approach. Statistical evaluations included factor analysis for mixed data, principal components analysis, hierarchical clustering, and k-means clustering. A summary of the statistical methods, approach, and results are provided as Appendix E.

The results of the statistical evaluation indicate the following:

- No patterns were observed between bulk sulphide measured in the lab and porewater sulphide measured with DGT.
- No significant patterns were apparent using factor analysis for mixed data or hierarchical clustering.
- Principal components analysis and k-means clustering did demonstrate some evident relationships between wood thickness, porewater sulphide, and toxicity.
- K-means analysis indicate that the relationship between toxicity and wood thickness may be stronger than that between toxicity and porewater sulphide, though neither relationship is tightly correlated.

6 Potential Data Needs for Future Remedial Planning

Following additional study and completion of a pilot study in the wood waste remediation area, a Remedial Action Plan and Risk Management Plan will be developed for wood waste areas. Additional data collection may be beneficial to planning cleanup and restoration activities. The existing information provides a better understanding of the current condition of the Site, but other studies could provide insights into toxicity, surface sediment conditions, and seasonal trends.

6.1 Toxicity Testing

The larvae toxicity testing conducted in wood waste areas using standard testing procedures did not reproduce the high porewater sulphide concentrations observed in in-situ samples. This may have resulted from an insufficient equilibration period to replicate sulphide-producing conditions or an insufficient sample volume that replicates field conditions. The existing bioassay results may not have accurately characterized toxicity in these samples. The 48-hour bivalve larvae combined mortality and abnormality test was selected as part of this study as bivalve larvae tends to be one of the most sensitive organisms in the test; however, the following bioassay testing could be conducted to fully assess the toxicity of wood waste sediments:

- Acute 10-day amphipod mortality test (*Rhepoxynius abronius*, *Ampelisca abdita*, or *Eohaustorius estuarius*)
- Chronic 20-day juvenile survival and growth test (*Neanthes arenaceodentata*)
- Acute 48-hour bivalve larvae combined mortality and abnormality test (*Mytilus galloprovincialis or Dendraster excentricus*)

Similarly, testing methods could be modified to better define the relationship between wood waste conditions, sulphide concentration, and toxicity on benthic organisms. Modifications to the existing bioassay testing methods may include:

- Increased sediment sample volume to allow for a more representative sediment sample that incorporates larger wood waste fragments
- Longer incubation period before test initiation to allow for sulphide conditions to stabilize (in the bench scale treatability testing, measurable sulphides were not generated until weeks after setup [Anchor QEA 2019b]).

6.2 Surface Sediment Conditions

The wood waste pilot study is anticipated to be conducted in fiscal year 2019/2020, which should provide information on the constructability of placing sand and amended sand as well as the effectiveness of amended sand at controlling porewater sulphide concentrations. Following this pilot study, additional sediment testing will help inform future cleanup and restoration activities at the site. Depending on the success of the material placement, measurement of certain geotechnical parameters may be useful to inform the constructability of material placement in each WWMA. Similarly, specific sediment conditions, such as porewater sulphide, bulk sediment sulphides, and TOC, may be useful in assigning cleanup technologies to each area.

6.3 Seasonal Surface Water Trends

Surface water conditions may vary seasonally, which can affect porewater sulphide concentrations in parts of Esquimalt Harbour. Surface water column profiles measured in December 2018 could be repeated quarterly to assess the potential for seasonal trends. Prior to planning and designing a preferred cleanup remedy for the site, it is important to understand the potential for Esquimalt Harbour to naturally have low dissolved oxygen and oxidation reduction potential in the summer and fall, which may be more of a function of lack of surface water circulating and mixing and/or contribution of higher organic and possibly nutrient loads to surface water. This pattern could contribute to anoxic sediments and increases in porewater sulphide that may not necessarily only be the result of wood waste degradation. Surface water profiling should utilize a handheld YSI water quality SONDE (or similar field instrument) deployed from a vessel and lowered through the water column. Water quality measurements in the water column should include pH, conductivity, salinity, dissolved oxygen, temperature, oxidation reduction potential, and turbidity.

7 References

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Tables

Table 1
Surface Sediment Sample Summary

Station ID	Collection Date	Sample Type	Sampling Coordinates[1] Northing (metres)	Easting (metres)	Mudline Elevation (metres CD)	Attempts	Accepted Attempt	Primary Lithology (USCS Symbol)[2]	Wood Debris Abundance and Description[2,3]	Sample ID	Sample Type: DGT Porewater Sulphide	RMP Chemistry[4]	48-hour Larval Bioassay	Sample Interval (cm)
EHWW-01	10/1/2018	Surface Grab	5365639	467773	-2.26	1	1	ML	Trace, small bark fragments	EHWW-01-SG-000010	X		X	0–10
EHWW-02	10/1/2018	Surface Grab	5365637	468039	-0.27	3	3	SP-SM	None	EHWW-02-SG-000010	X			
EHWW-03	10/1/2018	Surface Grab	5365737	467823	-2.65	1	1	ML	Moderate fragments up to 10 cm	EHWW-03-SG-000010	X			
EHWW-04	10/2/2018	Surface Grab	5366268	467261	-7.40	1	1	ML	None	EHWW-04-SG-000010	X	X		
EHWW-05	10/5/2018	Surface Grab	5365876	467699	-6.99	4	4	ML	Substantial, large and small fragments	EHWW-05-SG-000010	X			
EHWW-06	10/1/2018	Surface Grab	5366042	467439	-8.27	1	1	ML	Moderate, large bark fragments	EHWW-06-SG-000010	X	X	X	
EHWW-07	10/1/2018	Surface Grab	5365868	467561	-8.39	1	1	ML	Moderate, large bark fragments	EHWW-07-SG-000010	X			
EHWW-08	10/1/2018	Surface Grab	5365736	467622	-5.66	1	1	ML	Moderate, fragments up to 10 cm	EHWW-08-SG-000010	X		X	
	12/17/2018	Diver Core	5365722	467625		1	1			EHWW-08-SC-000010	X			
EHWW-09	10/1/2018	Surface Grab	5365771	467504	-8.41	2	2	ML	Substantial, bark to 25 cm	EHWW-09-SG-000010	X	X		
EHWW-10	10/3/2018	Surface Grab	5365187	467662	-11.31	1	1	ML	None	EHWW-10-SG-000010	X	X		
EHWW-11	10/3/2018	Surface Grab	5365697	467420	-8.39	2	2	ML	Substantial, bark up to 15 cm	EHWW-11-SG-000010	X		X	
EHWW-12	10/4/2018	Surface Grab	5365476	467342	-10.71	1	1	ML	Trace, bark fragments	EHWW-12-SG-000010	X		X	
EHWW-13	10/3/2018	Surface Grab	5365607	467287	-10.80	1	1	ML	Occasional, bark up to 15 cm	EHWW-13-SG-000010	X		X	
EHWW-14	10/3/2018	Surface Grab	5365541	467164	-12.33	1	1	ML	Trace, bark up to 20 cm	EHWW-14-SG-000010	X	X		
EHWW-15	10/2/2018	Surface Grab	5366239	466861	-5.70	1	1	ML	Trace, fragments up to 3 cm	EHWW-15-SG-000010	X		X	
EHWW-16	10/2/2018	Surface Grab	5366357	466952	-5.70	1	1	ML	Moderate, fragments up to 10 cm	EHWW-16-SG-000010	X			
EHWW-17	10/2/2018	Surface Grab	5366292	467015	-6.20	1	1	ML	None	EHWW-17-SG-000010	X			
EHWW-18	10/2/2018	Surface Grab	5366429	467007	-4.92	1	1	ML	Small fragments and larger bark	EHWW-18-SG-000010	X	X		
EHWW-19	10/2/2018	Surface Grab	5365973	466901	-6.70	1	1	ML	Moderate	EHWW-19-SG-000010	X	X		
EHWW-20	10/2/2018	Surface Grab	5366086	467073	-5.90	1	1	ML	Occasional large bark, moderate small fragments	EHWW-20-SG-000010	X			
EHWW-21[5]	10/2/2018	Surface Grab	--	--	--	3	--	--	--	--	--	--	--	
EHWW-22	10/3/2018	Surface Grab	5365770	467198	-7.22	1	1	ML	None	EHWW-22-SG-000010	X		X	
EHWW-23	10/5/2018	Surface Grab	5366302	467813	-1.50	5	5	SP-SM	None	EHWW-23-SG-000010	X			
EHWW-24	10/1/2018	Surface Grab	5366053	467720	-5.67	2	2	ML	Moderate, bark fragments	EHWW-24-SG-000010	X			
	12/18/2018	Diver Core	5366050	467717		1	1			EHWW-24-SC-000010	X			
EHWW-25	10/5/2018	Surface Grab	5366157	466920	-5.66	1	1	ML	None	EHWW-25-SG-000010	X			
	12/19/2018	Diver Core	5366151	466904		1	1			EHWW-25-SC-000010	X			
EHWW-26	10/3/2018	Surface Grab	5365713	467287	-10.67	1	1	ML	Trace to occasional	EHWW-26-SG-000010	X			
EHWW-27	10/3/2018	Surface Grab	5365844	467380	-9.38	1	1	ML	Moderate, large bark fragments	EHWW-27-SG-000010	X			
	12/17/2018	Diver Core	5365823	467402		1	1			EHWW-27-SC-000010	X			
EHWW-28	10/4/2018	Surface Grab	5365968	467189	-9.12	2	2	ML	Occasional, large bark	EHWW-28-SG-000010	X			

Table 1
Surface Sediment Sample Summary

Station ID	Collection Date	Sample Type	Sampling Coordinates[1] Northing (metres)	Easting (metres)	Mudline Elevation (metres CD)	Attempts	Accepted Attempt	Primary Lithology (USCS Symbol)[2]	Wood Debris Abundance and Description[2,3]	Sample ID	Sample Type: DGT Porewater Sulphide	RMP Chemistry[4]	48-hour Larval Bioassay	Sample Interval (cm)
EHWW-29	10/4/2018	Surface Grab	5366040	467114	-8.09	1	1	ML	None	EHWW-29-SG-000010	X		X	0–10
EHWW-30	10/3/2018	Surface Grab	5365365	467632	-11.46	1	1	ML	Trace, bark fragments up to 5 cm	EHWW-30-SG-000010	X	X		
EHWW-31	10/2/2018	Surface Grab	5366463	466834	-4.50	1	1	ML	None	EHWW-31-SG-000010	X		X	
EHWW-32	10/4/2018	Surface Grab	5365191	467385	-11.51	1	1	ML	None	EHWW-32-SG-000010	X			
EHWW-33	10/3/2018	Surface Grab	5365321	467258	-11.55	1	1	ML	None	EHWW-33-SG-000010	X	X		
EHWW-34	10/4/2018	Surface Grab	5365516	467689	-3.07	1	1	GM	Trace	EHWW-34-SG-000010	X			
EHWW-35	10/4/2018	Surface Grab	5365445	467542	-8.68	2	2	ML	Occasional, bark fragments	EHWW-35-SG-000010	X			
EHWW-36	10/5/2018	Surface Grab	5365842	467880	-2.62	1	1	ML	Substantial, large bark fragments, decomposed fibres	EHWW-36-SG-000010	X			
EHWW-37	10/5/2018	Surface Grab	5365577	467969	0.05	1	1	SP-SM	None	EHWW-37-SG-000010	X			
EHWW-38	10/3/2018	Surface Grab	5365961	467494	-8.51	1	1	ML	Moderate, large bark fragments	EHWW-38-SG-000010	X			
EHWW-39	10/1/2018	Surface Grab	5366174	467644	-5.81	1	1	ML	Moderate, bark and wood fragments	EHWW-39-SG-000010	X	X	X	
	12/19/2018	Diver Core	5366194	467631		1	1			EHWW-39-SC-000010	X			
EHWW-40	10/5/2018	Surface Grab	5366136	467844	-1.01	1	1	Wood Debris	Substantial, decomposed organics, wood fragments and fibres	EHWW-40-SG-000010	X		X	
EHWW-41	10/4/2018	Surface Grab	5366216	467441	-7.56	1	1	ML	Occasional , wood fragments up to 5 cm	EHWW-41-SG-000010	X			
	12/19/2018	Diver Core	5366235	467424		1	1			EHWW-41-SC-000010 EHWW-41-SC-000010 (FD)	X			
EHWW-42	10/2/2018	Surface Grab	5366447	467156	-6.35	1	1	ML	None	EHWW-42-SG-000010	X	X	X	
EHWW-43	10/5/2018	Surface Grab	5366071	467582	-4.98	1	1	ML	Substantial, large fragments , decomposed fibres	EHWW-43-SG-000010	X			
	12/17/2018	Diver Core	5366089	467569		1	1			EHWW-43-SC-000010	X			
EHWW-44	10/4/2018	Surface Grab	5366164	467346	-7.68	1	1	ML	Occasional	EHWW-44-SG-000010	X	X	X	
EHWW-45	10/4/2018	Surface Grab	5366606	467026	-4.88	1	1	ML	Trace, fragments up to 10 cm	EHWW-45-SG-000010	X	X		
EHWW-46	10/4/2018	Surface Grab	5366514	466801	-3.83	1	1	ML	Trace	EHWW-46-SG-000010	X	X		
EHWW-47	10/4/2018	Surface Grab	5366645	466792	-3.61	1	1	ML	Moderate, large bark fragments	EHWW-47-SG-000010	X			
EHWW-48	10/2/2018	Surface Grab	5366348	466788	-3.70	1	1	ML	Occasional, large bark fragments up to 30 cm	EHWW-48-SG-000010 EHWW-148-SG-000010 (FD)	X	X		
	12/19/2018	Diver Core	5366498	466931		1	1			EHWW-49-SC-000010	X			
EHWW-49	10/4/2018	Surface Grab	5366489	466714	-3.37	1	1	ML	Trace, fragments	EHWW-49-SG-000010	X			
EHWW-50	10/2/2018	Surface Grab	5366574	466931	-4.55	1	1	ML	Occasional, large bark fragements	EHWW-50-SG-000010	X		X	
	12/18/2018	Diver Core	5366576	466928		1	1			EHWW-50-SC-000010	X			
EHWW-52	12/19/2018	Diver Core	5366710	466740	--	1	1	ML[6]	None[6]	EHWW-52-SC-000010	X			
EHWW-REF-17[7]	10/3/2018	Surface Grab	5364438	466983	-12.25	1	1	ML	None	EHWW-REF17-SG-000010	X		X	
EHWW-REF-18[7]	10/3/2018	Surface Grab	5364792	467013	-12.19	1	1	ML	None	EHWW-REF18-SG-000010	X		X	

Table 1
Surface Sediment Sample Summary

Notes
1. Horizontal datum: Universal Transverse Mercator Zone 10 Grid, North American Datum 83.
2. From surface grab field logs, unless noted otherwise.
3. Trace: 0% to 5%; Occasional: 5% to 10%; Moderate: 10% to 30%; Substantial: greater than 30%.
4. PCB Aroclors, PAHs, Metals, Dioxin/Furans, TS/TOC.
5. Station not collected after three attempts due to submerged rocky outcrops.
6. Observation from adjacent Dive Transect Survey location 59 at 200 metres.
7. In-harbour reference sediment location for bioassay testing.

CD: Chart Datum
cm: centimetre
DGT: diffusive gradients in thin films
FD: field duplicate
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RMP: Risk Management Plan
TOC: total organic carbon
TS: total solids

USCS: unified soil classification system
- CL: inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
- GM: silty gravels
- ML: inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
- SP-SM: poorly graded sand with silt

Table 2
Subsurface Sediment Sample Summary

Station ID	Sample Date	Sampling Coordinates[1] Easting (metres)	Northing (metres)	Estimated Mudline Elevation (metres CD)[2]	Attempts	Accepted Attempt	Penetration (metres)	Recovery (metres)	Recovery (pct)	Sample ID	Sample Interval (centimetres)	Primary Lithology (USCS Symbol)	Wood Debris Abundance	Sample Type: Surface RMP[3]	Leave Surface Chemistry[4]	Archive	Geotechnical[5]	Bench Scale Sediment Volume[6]
EHWW-03	12/17/2018	467818	5365734	-2.61	1	1	2.29	1.04	45%	EHWW-03-SC-000050	0–50	ML	Substantial	X				
										EHWW-03-SC-150200	150–200	ML	None		X		X	
										EHWW-03-SC-200250	200–250	ML to CL/ML	None			X		
					4 (DT45)[7]	2	1.52	0.40	26%	EHWW-03-SC-2	0–40	--[6]	--[6]					X
						3	1.52	0.73	48%	EHWW-03-SC-3	0–73	--[6]	--[6]					X
						4	1.52	0.70	46%	EHWW-03-SC-4	0–70	--[6]	--[6]					X
EHWW-16	12/18/2018	466949	5366367	-5.06	4	4	6.10	4.57	75%	EHWW-16-SC-152202 EHWW-116-SC-152202 (FD)	152–202	ML	None		X		X	
										EHWW-16-SC-202252	202–252	ML	None			X		
					3 (DT45)[7]	1	1.83	1.75	96%	EHWW-16-SC-1	0–76	--[6]	--[6]					X
						2	1.52	1.50	98%	EHWW-16-SC-2	0–69	--[6]	--[6]					X
						3	1.22	0.82	67%	EHWW-16-SC-3	0–70	--[6]	--[6]					X
EHWW-24	12/18/2018	467715	5366054	-5.8	1	1	3.05	2.74	90%	EHWW-24-SC-045095	45–95	ML	None		X			
										EHWW-24-SC-095145	95–145	ML	None			X		
EHWW-36	12/17/2018	467882	5365843	-2.54	1	1	3.96	3.66	92%	EHWW-36-SC-000050	0–50	ML	Trace	X				
										EHWW-36-SC-183233	183–233	ML	None		X			
										EHWW-36-SC-233-283	233–283	ML to CL/ML	None			X		
EHWW-38	12/17/2018	467497	5365953	-8.45	1	1	9.60	5.49	57%	EHWW-38-SC-000050	0–50	ML	Occasional	X			X	
										EHWW-38-SC-050100	50–100	ML	None		X		X	
										EHWW-38-SC-100150	100–150	ML	None			X		
EHWW-39	12/18/2018	467649	5366183	-5.53	2[8] 4 (DT45)[7]	1	1.52	1.31	86%	EHWW-39-SC-035085	35–85	ML	None		X			
										EHWW-39-SC-085135	85–135	ML	None			X		
						2	1.52	0.75	49%	EHWW-39-SC-1	0–75	--[6]	--[6]					X
						3	1.52	1.15	75%	EHWW-39-SC-2	0–70	--[6]	--[6]					X
						4	1.52	1.08	71%	EHWW-39-SC-3	0–69	--[6]	--[6]					X
EHWW-40	12/18/2018	467844	5366143	-1.14	1	1	3.35	2.90	86%	EHWW-40-SC-000050	0–50	ML	Substantial	X				
										EHWW-40-SC-060110	60–110	ML	None		X			
										EHWW-40-SC-110160	110–160	ML to CL/ML	None			X		

Table 2
Subsurface Sediment Sample Summary

Station ID	Sample Date	Sampling Coordinates[1]		Estimated Mudline Elevation (metres CD)[2]	Attempts	Accepted Attempt	Penetration (metres)	Recovery		Sample ID	Sample Interval (centimetres)	Primary Lithology (USCS Symbol)	Wood Debris Abundance	Sample Type				
		Easting (metres)	Northing (metres)					(metres)	(pct)					Surface RMP[3]	Leave Surface Chemistry[4]	Archive	Geotechnical[5]	Bench Scale Sediment Volume[6]
EHWW-44	12/19/2018	467424	5366130	-8.82	1	1	3.96	3.05	77%	EHWW-44-SC-017067	17–67	ML	None		X			
										EHWW-44-SC-067117	67–117	ML	None			X		
EHWW-53	12/19/2018	466781	5366538	-3.39	1	1	4.57	3.96	87%	EHWW-53-SC-000016	0–16	ML	Moderate	X				
										EHWW-53-SC-016066	16–66	ML	None		X			
										EHWW-53-SC-066116	66–116	ML	None			X		
EHWW-54	12/18/2018	466883	5366256	-4.8	1	1	3.66	2.59	71%	EHWW-54-SC-000050	0–50	ML	Moderate to Substantial	X				
										EHWW-54-SC-055105	55–105	ML	None		X			
										EHWW-54-SC-105155	105–155	ML	None			X		
EHWW-55	12/19/2018	467399	5365788	-9.26	1	1	5.18	2.44	47%	EHWW-55-SC-110160	110–160	ML	None		X			
										EHWW-55-SC-160210	160–210	ML	None			X		
					5 (DT45)[7]	1	1.52	0.19	12%	EHWW-55-SC-1	0–19	--[6]	--[6]					X
						3	1.52	0.13	9%	EHWW-55-SC-2	0–13	--[6]	--[6]					X
EHWW-56	12/17/2018	467952	5365692	-1.5	2	2	1.83	1.22	67%	EHWW-56-SC-000050	0–50	ML	None		X[9]			
										EHWW-56-SC-050100	50–100	ML	None			X		
EHWW-57	12/17/2018	467530	5365730	-6.16	3	3	1.22	0.61	50%	EHWW-57-SC-000050	0–50	ML	Substantial	X				
					3 (DT45)[7]	1	0.91	0.22	24%	EHWW-57-SC-1	0–22	--[6]	--[6]					X
						2	1.22	0.50	41%	EHWW-57-SC-2	0–50	--[6]	--[6]					X
						3	1.22	0.53	43%	EHWW-57-SC-3	0–53	--[6]	--[6]					X
EHWW-58	12/16/2018	467682	5365811	-6.8	2	2	5.18	1.68	32%	EHWW-58-SC-361411	361–411	Shell Hash to CL	None		X			
										EHWW-58-SC-411461	411–461	CL	None			X	X	
EHWW-59	12/19/2018	467242	5366018	-8.3	1	1	5.49	3.35	61%	EHWW-59-SC-038088	38–88	ML	None		X			
										EHWW-59-SC-088138	88–138	ML	None			X		
					3 (DT45)[7]	1	1.52	0.89	58%	EHWW-59-SC-1	0–64	--[6]	--[6]					X
						2	1.52	0.90	59%	EHWW-59-SC-2	0–67	--[6]	--[6]					X
						3	1.52	0.83	54%	EHWW-59-SC-3	0–67	--[6]	--[6]					X
EHWW-65	12/19/2018	466719	5366789	-2.36	3	3	7.01	4.11	59%	EHWW-65-SC-000050 EHWW-165-SC-000050 (FD)	0–50	ML	None	X				

Table 2
Subsurface Sediment Sample Summary

Notes
1. Horizontal datum North American Datum of 1983, Universal Transverse Mercator Zone 10 North.
2. Estimated mudline elevation was calculated as a function of measured water depth and observed tide height recorded by Fisheries and Oceans Canada for Station ID: 7120, Victoria, British Columbia.
3. PCB Aroclors, PAHs, Metals, Dioxin/Furans, TS/TOC.
4. PCB Aroclors, PAHs, Metals, Dioxin/Furans, TS/TOC, Bulk Sulfides, Ammonia, TVS, Grain Size.
5. Moisture content, atterberg limits.
6. Sediment volume collected for bench scale treatability testing. Core was packaged and transported to Anchor QEA's Geochemistry Laboratory for testing.
7. Cores collected for bench scale treatability testing were collected using the Geoprobe DT45 sampling system into rigid plastic liners.
8. Primary accepted core collected using Geoprobe DT45 system.
9. No wood debris was observed at this location, 0-0.5 m interval selected for Leave Surface Chemistry suite testing.

AL: Atterberg limits
CD: Chart Datum
D/F: dioxin/furan
FD: field duplicate
GS: grain size
MC: moisture content
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
pct: percent
SVOC: semivolatile organic compound
TOC: total organic carbon
TS: total solids
TVS: total volatile solids

USCS: unified soil classification system

CL: inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays

ML: inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity

Table 3
Dive Survey Summary Observations

Transect ID	Transect Survey Date	Distance Along Transect (m)	DGT Collected	Substrate Type (%)					Wood Waste			Other Coverage (% Cover)	
				Silt	Cobble	Boulder	Bedrock	Shell	Surface Coverage (%)	Depth (m)	Predominant Wood Waste Type	*Beggiatoa* spp.	Diatoms
59	12/17/2018	0	--	**100**	0	0	0	**5**	0	**--**	--	0	0
		25	--	**100**	0	0	0	**5**	0	**--**	--	0	0
		50	--	**100**	0	0	0	**5**	0	0	--	0	**10**
		75	--	**100**	0	0	0	**1**	0	**--**	--	0	0
		100	--	**100**	0	0	0	**1**	0	0	--	0	**60**
		125	--	**100**	0	0	0	**1**	0	**--**	--	0	**10**
		150	--	**100**	0	0	0	0	0	**--**	--	0	0
		175	X	**100**	0	0	0	**1**	0	**--**	--	0	**90**
		200	--	**100**	0	0	0	0	0	0	--	0	**100**
60	12/18/2018	0	X	**100**	0	0	0	0	0	**>0.1**	**--**	0	**50**
		25	--	**100**	0	0	0	0	0	**--**	--	0	**50**
		50	--	**100**	0	0	0	0	0	**>0.16**	**--**	0	**50**
		75	--	**100**	0	0	0	0	0	**--**	**--**	0	**50**
		100	--	**100**	0	0	0	0	0	**0.13**	**--**	0	**75**
		125	--	**100**	0	0	0	0	0	**--**	**--**	0	**75**
		150	--	**100**	0	0	0	0	0	**0.14**	**--**	0	**75**
		175	--	**100**	0	0	0	0	0	**--**	**--**	0	**75**
		200	--	**100**	0	0	0	0	0	**>0.2**	**--**	0	**50**
61	12/19/2018	0	X	**100**	0	0	0	0	**10**	**--**	bark, large wood fragments	0	0
		25	--	**100**	0	0	0	0	**20**	**--**	bark	0	**25**
		50	--	**100**	0	0	0	0	0	**0.23**	**--**	0	**50**
		75	--	**100**	0	0	0	0	0	**--**	**--**	0	**20**
		100	--	**100**	0	0	0	0	**10**	**0.07**	submerged log	0	**20**
		125	--	**100**	0	0	0	0	0	**--**	**--**	0	**10**
		150	--	**100**	0	0	0	0	0	**0.25**	**--**	0	**50**
		175	--	**100**	0	0	0	0	**10**	**--**	bark	0	**50**
		200	--	**100**	0	0	0	0	0	**0.24**	**--**	0	**50**

Table 3
Dive Survey Summary Observations

Transect ID	Transect Survey Date	Distance Along Transect (m)	DGT Collected	Substrate Type (%)					Wood Waste			Other Coverage (% Cover)	
				Silt	Cobble	Boulder	Bedrock	Shell	Surface Coverage (%)	Depth (m)	Predominant Wood Waste Type	*Beggiatoa* spp.	Diatoms
62	12/19/2018	0	--	100	0	0	0	0	0	0.16	--	0	0
		25	--	100	0	0	0	0	0	--	--	0	0
		50	--	100	0	0	0	0	0	>0.18	--	0	0
		75	--	100	0	0	0	0	0	--	--	0	0
		100	--	100	0	0	0	0	0	>0.23	--	0	10
		125	--	100	0	0	0	0	0	--	--	0	0
		150	--	100	0	0	0	0	0	>0.22	--	0	10
		175	--	100	0	0	0	0	0	--	--	0	10
		200	X	100	0	0	0	0	0	>0.26	--	5	50
64	12/19/2018	0	--	100	0	0	0	0	0	>0.15	--	0	80
		25	--	100	0	0	0	0	0	--	--	0	80
		50	--	100	0	0	0	0	0	0	--	0	80
		75	--	100	0	0	0	0	0	--	--	5	80
		100	X	100	0	0	0	0	0	0	--	5	50
		125	--	100	0	0	0	0	0	--	--	5	80
		150	--	100	0	0	0	0	0	>0.27	--	5	80
		175	--	100	0	0	0	0	0	--	--	5	50
		200	--	100	0	0	0	0	0	0	--	5	50
65	12/19/2018	0	--	100	0	0	0	20	0	0	--	0	20
		25		100	0	0	0	0	0	--	--	10	80
		50	--	100	0	0	0	0	0	0.20	--	5	50
		75	--	100	0	0	0	0	0	--	--	5	80
		100	X	100	0	0	0	0	0	0.21	--	5	80
		125	--	100	0	0	0	0	0	--	--	5	90
		150	--	100	0	0	0	0	0	>0.17	--	5	80
		175	--	100	0	0	0	0	0	--	--	0	90
		200	--	100	0	0	0	0	50	>0.2	bark, large wood fragments	0	50

Table 3
Dive Survey Summary Observations

Transcript ID	Transect Survey Date	Distance Along Transect (m)	DGT Collected	Substrate Type (%)					Wood Waste			Other Coverage (% Cover)	
				Silt	Cobble	Boulder	Bedrock	Shell	Surface Coverage (%)	Depth (m)	Predominant Wood Waste Type	*Beggiatoa* spp.	Diatoms
66	12/18/2018	0	X	**100**	0	0	0	0	0	**>0.05**	**--**	**10**	**80**
		25	--	**100**	0	0	0	0	**10**	**--**	bark	0	**50**
		50	--	**100**	0	0	0	0	**10**	**>0.02**	bark, 1 submerged log	0	**80**
		75	--	**50**	0	**50**	0	0	**80**	**--**	bark and small wood fragments	0	0
		100	--	**100**	0	0	0	0	**80**	**>0.02**	70% wood fibres and small wood fragments, 10% large wood fragments and bark	0	0
		125	--	**100**	0	0	0	0	**80**	**--**	60% small wood fragments, 20% bark and large wood fragments	0	0
		150	--	**100**	0	0	0	0	**80**	**>0.23**	60% small wood fragments, 20% bark and large wood fragments	0	0
		175	--	**100**	0	0	0	0	**80**	**--**	40% small wood fragments, 40% bark and large wood fragments	0	0
		200	--	**100**	0	0	0	0	**80**	**>0.38**	40% small wood fragments, 40% bark and large wood fragments	0	0
67	12/17/2018	0	X	**100**	0	0	0	0	0	**--**	**--**	0	**90**
		25	--	**100**	0	0	0	0	0	**--**	**--**	0	**95**
		50	--	**100**	0	0	0	0	0	**>0.05**	**--**	0	**95**
		75	--	**100**	0	0	0	0	**30**	**--**	bark and large wood fragments	**1**	**80**
		100	--	**100**	0	0	0	0	**50**	**>0.1**	log	**20**	**30**
		125	--	**100**	0	0	0	0	0	**--**	**--**	0	**100**
		150	--	**100**	0	0	0	0	**25**	**>0.07**	bark and large wood fragments	**1**	**85**
		175	--	**100**	0	0	0	0	0	**--**	**--**	**5**	**80**
		200	--	**100**	0	0	0	0	0	**>0.2**	**--**	**20**	**40**
68	12/18/2018	0	--	0	0	0	**100**	0	0	**--**	**--**	0	**20**
		25	--	**100**	0	0	0	0	**100**	**--**	bark	0	**10**
		50	--	**100**	0	0	0	0	**100**	**>0.13**	bark	0	**50**
		75	--	**100**	0	0	0	0	0	**--**	**--**	**50**	**50**
		100	--	**100**	0	0	0	0	**10**	**>0.28**	bark	0	**50**
		125	--	**100**	0	0	0	0	0	**--**	**--**	**30**	**30**
		150	--	**100**	0	0	0	0	0	**>0.04**	**--**	**10**	**30**
		175	--	**100**	0	0	0	0	**10**	**--**	bark	0	**20**
		200	--	0	**100**	0	0	0	0	**--**	**--**	0	**80**

Table 3
Dive Survey Summary Observations

Transect ID	Transect Survey Date	Distance Along Transect (m)	DGT Collected	Substrate Type (%)					Wood Waste			Other Coverage (% Cover)	
				Silt	Cobble	Boulder	Bedrock	Shell	Surface Coverage (%)	Depth (m)	Predominant Wood Waste Type	*Beggiatoa* spp.	Diatoms
69	12/17/2018	0	--	**100**	0	0	0	0	**30**	**>0.37**	bark	0	**60**
		25	X	**100**	0	0	0	0	**85**	**--**	bark	0	0
		50	--	**100**	0	0	0	0	**100**	**0.04**	bark	0	0
		75	--	**100**	0	0	0	0	**50**	**--**	bark	**1**	0
		100	--	**100**	0	0	0	0	**60**	**>0.09**	bark	0	**30**
		125	--	**100**	0	0	0	0	**60**	**--**	bark	0	0
		150	--	**100**	0	0	0	0	**100**	**>0.09**	bark	0	**30**
		175	--	**100**	0	0	0	0	**100**	**--**	bark	0	**50**
		200	--	**100**	0	0	0	0	**70**	**--**	bark	0	**60**
70	12/17/2018	0	--	**100**	0	0	0	0	**15**	**>0.13**	bark	0	0
		25	--	**100**	0	0	0	0	**100**	**--**	bark, submerged log	**5**	0
		50	--	**100**	0	0	0	0	**75**	**0.17**	**--**	0	0
		75	--	**100**	0	0	0	0	0	**--**	bark, submerged log	0	**50**
		100	--	**100**	0	0	0	0	0	**>0.05**	**--**	0	**50**
		125	--	**100**	0	0	0	0	**10**	**--**	bark	0	**30**
		150	--	**100**	0	0	0	0	0	**0.19**	**--**	**1**	**60**
		175	--	**100**	0	0	0	0	0	**--**	**--**	0	**40**
		200	X	**100**	0	0	0	0	**60**	**--**	bark	0	**40**

Table 3
Dive Survey Summary Observations

	Marine Vegetation (% cover)							Number of Species Observed							
Transect ID	Red Blade	Red Filamentous	Split Kelp	Succulent Seaweed	Grass Kelp	Sea Lettuce	Browns	Acorn Barnacle	Nuttal's Cockle	Graceful Rock Crab	Dungeness Crab	Hermit Crab	Turban Snail	Giant Plumose Anemone	Anemone Other
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	**25**	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	**2**	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3

Dive Survey Summary Observations

Transect ID	Marine Vegetation (% cover)							Number of Species Observed							
	Red Blade	Red Filamentous	Split Kelp	Succulent Seaweed	Grass Kelp	Sea Lettuce	Browns	Acorn Barnacle	Nuttal's Cockle	Graceful Rock Crab	Dungeness Crab	Hermit Crab	Turban Snail	Giant Plumose Anemone	Anemone Other
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	**10**	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3
Dive Survey Summary Observations

Transcect ID	Marine Vegetation (% cover)							Number of Species Observed							
Transect ID	Red Blade	Red Filamentous	Split Kelp	Succulent Seaweed	Grass Kelp	Sea Lettuce	Browns	Acorn Barnacle	Nuttal's Cockle	Graceful Rock Crab	Dungeness Crab	Hermit Crab	Turban Snail	Giant Plumose Anemone	Anemone Other
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	**10**	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	**20**	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0
	0	**5**	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	**40**	0	0	0	0	0	**10**	0	0	0	0	0	0	**4**
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	**10**	**10**	0	0	0	0	0	0	0

Table 3
Dive Survey Summary Observations

Transect ID	Marine Vegetation (% cover)							Number of Species Observed								
	Red Blade	Red Filamentous	Split Kelp	Succulent Seaweed	Grass Kelp	Sea Lettuce	Browns	Acorn Barnacle	Nuttal's Cockle	Graceful Rock Crab	Dungeness Crab	Hermit Crab	Turban Snail	Giant Plumose Anemone	Anemone Other
69	0	0	**5**	0	0	0	0	0	0	**1**	0	**1**	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	**1**	0	**1**	0
	0	0	0	0	0	0	0	**5**	0	0	0	0	0	0	0
	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0
	0	0	0	0	**5**	0	0	**1**	0	0	0	0	**1**	0	0
	0	0	**50**	0	0	0	0	**1**	0	0	0	0	0	0	0
	0	0	**20**	0	0	0	0	**1**	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	**5**	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0

Notes:

Non-zero results are in **BOLD**
--: results not reported or not applicable

ID: identification

m: metre

Table 4
Surface Water Profile Results

Transect ID	Date Sampled	Water Depth (m)	Sample Depth (m)	pH	Specific Conductance (µS/cm)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/L)	ORP (mV)	Turbidity (NTU)	Sulphides (mg/L)
59	12/17/2018	4.5	0.5	7.59	51,920	33.79	8.3	6.87	91.9	0	--
			1.5	7.59	52,878	34.50	8.4	6.90	92.7	0	--
			2.5	7.59	53,104	34.65	8.4	6.82	93.0	0	--
			3.5	7.57	53,209	34.75	8.5	6.46	92.8	0.2	--
60	12/18/2018	7.5	0.5	7.61	51,137	33.23	8.3	7.66	105.1	0	ND
			1.5	7.61	52,649	34.33	8.3	7.62	105.2	0	--
			2.5	7.49	52,773	34.42	8.4	7.49	105.4	0	--
			4.0	7.59	53,236	34.77	8.5	7.22	105.7	0	ND
			4.5	7.58	53,257	34.79	8.5	6.96	105.9	0	--
			5.5	7.57	53,324	34.83	8.6	6.90	105.9	0	--
			6.5	7.52	53,396	34.89	8.6	6.82	105.9	0	--
			7.2	7.60	53,441	34.92	8.6	7.00	105.3	0	ND
61	12/19/2018	6.8	0.5	7.65	43,240	27.57	7.9	8.78	118.9	0.7	ND
			1.5	7.60	52,054	33.90	8.4	7.92	121.6	0	--
			2.5	7.60	52,311	34.09	8.4	7.68	121.9	0	--
			3.5	7.58	52,554	34.27	8.5	7.22	122.0	0	ND
			4.5	7.60	52,747	34.41	8.5	7.28	121.7	0	--
			5.5	7.60	52,871	34.50	8.5	7.28	121.6	0	--
			6.5	7.58	52,971	34.57	8.5	7.04	121.4	0	--
			6.8	7.52	53,000	34.60	8.5	6.61	118.5	0.6	ND
62	12/19/2018	6.5	0.5	7.29	47,134	30.53	7.8	8.59	199.4	0.1	ND
			1.5	7.31	52,049	33.87	8.1	8.34	196.8	0	--
			2.5	7.27	52,051	33.90	8.4	7.75	195.7	0	--
			3.5	7.26	52,378	34.14	8.4	7.39	194.4	0	ND
			4.5	7.33	52,701	34.38	8.5	7.02	182.2	0	--
			5.5	7.33	52,817	34.46	8.5	7.00	181.1	0	--
			6.2	7.28	52,977	34.58	8.5	6.06	173.1	0	ND

Table 4
Surface Water Profile Results

Transect ID	Date Sampled	Water Depth (m)	Sample Depth (m)	pH	Specific Conductance (µS/cm)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/L)	ORP (mV)	Turbidity (NTU)	Sulphides (mg/L)
64	12/19/2018	9.0	0.5	7.63	46,978	30.23	8.1	8.36	113.0	0	ND
			1.5	7.63	52,527	34.22	8.2	8.14	113.2	0	--
			2.5	7.62	52,337	34.10	8.4	8.05	113.7	0	--
			3.5	7.60	52,542	34.26	8.5	7.84	114.4	0	--
			4.5	7.58	52,990	34.59	8.5	7.10	114.7	0	ND
			5.5	7.58	53,020	34.61	8.5	7.09	114.7	0	--
			6.5	7.58	53,119	34.68	8.5	7.09	114.6	0	--
			7.5	7.58	53,305	34.82	8.6	7.00	114.7	0	--
			8.5	7.57	53,352	34.86	8.6	6.93	114.6	0	--
			8.8	7.56	53,376	34.88	8.6	6.79	114.4	0.9	ND
65	12/19/2018	8.0	0.5	7.64	42,697	27.19	7.9	8.57	116.1	0.3	ND
			1.5	7.59	51,560	33.54	8.4	8.08	117.3	0	--
			2.5	7.56	52,152	33.97	8.4	7.79	118.3	0	--
			3.5	7.56	52,692	34.37	8.5	7.62	118.5	0	ND
			4.5	7.58	52,925	34.54	8.5	7.59	118.6	0	--
			5.5	7.59	53,141	34.70	8.5	7.45	118.1	0	--
			6.5	7.58	53,216	34.76	8.6	7.37	118.1	0	--
			7.5	7.53	53,295	34.82	8.6	6.70	118.0	0	ND
66	12/18/2018	6.7	0.5	7.69	47,004	30.25	8.1	8.65	99.6	0	ND
			1.5	7.68	50,884	33.04	8.2	8.44	100.1	0	--
			2.5	7.66	50,936	33.08	8.3	8.27	100.8	0	--
			3.5	7.63	51,554	33.53	8.3	7.92	101.5	0	ND
			4.5	7.58	52,472	34.20	8.4	7.04	102.1	0	--
			5.5	7.57	53,165	34.72	8.5	6.82	102.3	0	--
			6.5	7.56	53,385	34.88	8.6	6.57	102.1	0.2	ND

Table 4
Surface Water Profile Results

Transect ID	Date Sampled	Water Depth (m)	Sample Depth (m)	pH	Specific Conductance (µS/cm)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/L)	ORP (mV)	Turbidity (NTU)	Sulphides (mg/L)
67	12/17/2018	9.6	0.5	7.63	50,929	32.99	8.2	7.87	97.5	0	--
			1.5	7.61	52,860	34.42	8.4	7.41	97.9	0	--
			2.5	7.57	53,215	34.74	8.4	6.64	98.2	0	--
			3.5	7.61	53,277	34.79	8.5	7.01	97.8	0	--
			4.5	7.62	53,305	34.82	8.5	7.23	97.7	0	--
			5.5	7.63	53,310	34.82	8.5	7.32	97.6	0	--
			6.5	7.61	53,318	34.83	8.5	7.13	97.7	0	--
			7.5	7.59	53,336	34.84	8.6	6.89	97.9	0	--
			8.5	7.58	53,369	34.87	8.6	6.58	97.7	0	--
			9.0	7.57	53,388	34.89	8.6	6.32	97.1	0	--
68	12/18/2018	11.5	0.5	7.55	51,088	33.19	8.2	7.85	132.2	0	ND
			1.5	7.55	51,411	33.42	8.3	8.18	131.7	0	--
			2.5	7.54	51,879	33.77	8.3	7.31	131.6	0	--
			3.5	7.53	52,205	34.01	8.4	7.58	131.6	0	--
			4.5	7.51	52,558	34.27	8.4	7.00	131.0	0	--
			5.5	7.48	53,092	34.66	8.5	6.66	130.4	0	ND
			6.5	7.49	53,203	34.74	8.5	6.58	124.0	0	--
69	12/17/2018	6.4	0.5	7.61	50,145	33.28	8.2	7.72	102.6	0	--
			1.5	7.60	52,913	34.53	8.3	7.15	103.1	0	--
			2.5	7.58	53,099	34.67	8.4	7.01	103.4	0	--
			3.5	7.59	53,222	34.76	8.5	7.15	103.2	0	--
			4.5	7.60	53,278	34.80	8.5	7.30	103.0	0	--
			5.5	7.60	53,282	34.80	8.5	7.23	100.3	0	--
70	12/17/2018	11.0	0.5	7.38	50,575	35.81	8.1	8.25	211.6	0	--
			1.5	7.38	52,842	34.46	8.3	7.40	208.3	0	--
			2.5	7.38	53,061	34.64	8.4	6.94	204.2	0	--
			3.5	7.40	53,186	34.72	8.5	7.06	201.3	0	--
			4.5	7.43	53,267	34.79	8.5	7.39	196.6	0	--
			5.5	7.43	53,281	34.80	8.5	7.49	192.3	0	--
			6.5	7.43	53,281	34.80	8.5	7.39	188.8	0	--
			7.5	7.43	53,283	34.80	8.5	7.36	186.8	0	--
			8.5	7.43	53,288	34.81	8.5	7.35	186.1	0	--
			9.5	7.43	53,416	34.90	8.6	7.22	185.1	0	--
			10.8	7.44	53,454	34.96	8.6	7.24	181.9	0	--

Table 4
Surface Water Profile Results

Notes:
--: results not reported or not applicable
µS/cm: microsemens per centimetre
ID: identification
m: metre
mg/L: miligrams per litre
mV: milivolts
ND: non-detect
NTU: Nephelometric Turbidity Unit
ORP: oxidation-reduction potential
ppt: parts per thousand

Table 5
DGT Analytical Results Summary

Station ID	Sample ID	Collection Date	DGT Porewater Sulphide[1,2] (mg/L as H_2S)	Sample Depth (centimetres)
EHWW-01	EHWW-01-SG-000010	10/1/2018	**12.5**	0 to 10
EHWW-02	EHWW-02-SG-000010	10/2/2018	**1.59**	
EHWW-03	EHWW-03-SG-000010	10/1/2018	**> 51.6**	
EHWW-04	EHWW-04-SG-000010	10/2/2018	**> 51.6**	
EHWW-05	EHWW-05-SG-000010	10/5/2018	**25.0**	
EHWW-06	EHWW-06-SG-000010	10/1/2018	**33.7**	
EHWW-07	EHWW-07-SG-000010	10/1/2018	**25.3**	
EHWW-08	EHWW-08-SG-000010	10/1/2018	**19.1**	
	EHWW-08-SC-000010	12/17/2018	**15.3**	
EHWW-09	EHWW-09-SG-000010	10/1/2018	**19.5**	
EHWW-10	EHWW-10-SG-000010	10/4/2018	**0.418**	
EHWW-11	EHWW-11-SG-000010	10/3/2018	**32.5**	
	EHWW-111-SG-000010 (FD)	10/3/2018	**27.3**	
EHWW-12	EHWW-12-SG-000010	10/5/2018	**2.84**	
	EHWW-112-SG-000010 (FD)	10/4/2018	**3.06**	
EHWW-13	EHWW-13-SG-000010	10/4/2018	**0.937**	
EHWW-14	EHWW-14-SG-000010	10/4/2018	**2.02**	
EHWW-15	EHWW-15-SG-000010	10/2/2018	**> 51.6**	
EHWW-16	EHWW-16-SG-000010	10/2/2018	**> 51.6**	
EHWW-17	EHWW-17-SG-000010	10/2/2018	**> 51.6**	
EHWW-18	EHWW-18-SG-000010	10/2/2018	**20.7**	
EHWW-19	EHWW-19-SG-000010	10/2/2018	**> 51.6**	
EHWW-20	EHWW-20-SG-000010	10/2/2018	**26.5**	
EHWW-22	EHWW-22-SG-000010	10/3/2018	**19.0**	
EHWW-23	EHWW-23-SG-000010	10/6/2018	**0.614**	
EHWW-24	EHWW-24-SG-000010	10/1/2018	**> 51.6**	
	EHWW-24-SC-000010	12/18/2018	**105**	
EHWW-25	EHWW-25-SG-000010	10/5/2018	**> 51.6**	
	EHWW-25-SC-000010	12/19/2018	**53.8**	
EHWW-26	EHWW-26-SG-000010	10/3/2018	**23.4**	
EHWW-27	EHWW-27-SG-000010	10/3/2018	**28.3**	
	EHWW-127-SG-000010 (FD)	10/3/2018	**37.2**	
	EHWW-27-SC-000010	12/17/2018	**23.5**	
EHWW-28	EHWW-28-SG-000010	10/5/2018	**--R**	
EHWW-29	EHWW-29-SG-000010	10/4/2018	**47.3**	
EHWW-30	EHWW-30-SG-000010	10/4/2018	**1.74**	
EHWW-31	EHWW-31-SG-000010	10/2/2018	**> 51.6**	
	EHWW-131-SG-000010 (FD)	10/2/2018	**> 4.30**	
EHWW-32	EHWW-32-SG-000010	10/5/2018	**1.75**	
EHWW-33	EHWW-33-SG-000010	10/4/2018	**0.607**	
EHWW-34	EHWW-34-SG-000010	10/5/2018	**1.98**	
EHWW-35	EHWW-35-SG-000010	10/5/2018	**1.51**	
EHWW-36	EHWW-36-SG-000010	10/5/2018	**13.8**	
EHWW-37	EHWW-37-SG-000010	10/6/2018	**0.273**	
EHWW-38	EHWW-38-SG-000010	10/3/2018	**42.5**	
EHWW-39	EHWW-39-SG-000010	10/1/2018	**> 206**	
	EHWW-39-SC-000010	12/19/2018	**87.5**	
EHWW-40	EHWW-40-SG-000010	10/5/2018	**15.8**	
EHWW-41	EHWW-41-SG-000010	10/4/2018	**24.6**	
	EHWW-41-SC-000010	12/19/2018	**38.7**	
	EHWW-141-SC-000010 (FD)	12/19/2018	**49.8**	
EHWW-42	EHWW-42-SG-000010	10/2/2018	**17.7**	
EHWW-43	EHWW-43-SG-000010	10/5/2018	**29.4**	
	EHWW-43-SC-000010	12/17/2018	**43.6**	
EHWW-44	EHWW-44-SG-000010	10/4/2018	**20.0**	
EHWW-45	EHWW-45-SG-000010	10/4/2018	**> 51.6**	
EHWW-46	EHWW-46-SG-000010	10/4/2018	**> 51.6**	
EHWW-47	EHWW-47-SG-000010	10/4/2018	**> 51.6**	
EHWW-48	EHWW-48-SG-000010	10/2/2018	**> 51.6**	
	EHWW-48-SC-000010	12/19/2018	**43.8**	
EHWW-49	EHWW-49-SG-000010	10/4/2018	**> 51.6**	
EHWW-50	EHWW-50-SG-000010	10/2/2018	**31.5**	
	EHWW-50-SC-000010	12/18/2018	**17.1**	
EHWW-52	EHWW-52-SC-000010	12/19/2018	**7.79**	
EHWW-REF-17	EHWW-REF17-SG-000010	10/4/2018	**0.418**	
EHWW-REF-18	EHWW-REF18-SG-000010	10/4/2018	**0.335**	

Notes:

1: Greater than values indicate that the DGT membrane was saturated. Reported values are set to greater than the maximum point on the calibration curve applied to the DGT exposure duration.

DGT: diffusive gradients in thin films

FD: field duplicate sample

mg/L: milligrams per litre

R: Rejected

Table 6
Analytical Results Summary

		Location ID	EHWW-03	EHWW-03	EHWW-04	EHWW-06	EHWW-09
		Sample ID	EHWW-03-SC-000050	EHWW-03-SC-150200	EHWW-04-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010
		Sample Date	12/17/2018	12/17/2018	10/2/2018	10/1/2018	10/1/2018
		Depth	0 - 0.5 m	1.5 - 2 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	--	1 U	--	--	--
Phosphorus	SW6010C	--	**1240**	**579**	**1190**	**1260**	**1490**
Sulphide, bulk	CALCULATED[1]	--	**24100**	**5100**	--	--	--
Conventional Parameters (pct)							
Loss on ignition	D2974	--	--	**1.2**	--	--	--
Moisture (water) content	D2216	--	--	**23.4**	--	--	--
Total organic carbon	AGAT_INOR-181-6027	--	**13.6**	**0.58**	--	--	--
Total solids	SM2540G	--	**24**	**77**	--	--	--
Liquid limit	D4318	--	--	**31**	--	--	--
Plastic limit	D4318	--	--	**18**	--	--	--
Plasticity index	D4318	--	--	**13**	--	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	**7.2**	**8.5**	**7.6**	**7**	**7.1**
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	**47**	**44**	--	--	--
Metals (mg/kg)							
Aluminum	SW6010C	--	**11500**	**17600**	**14500**	**15700**	**17700**
Antimony	SW6020A	--	**0.5**	**0.4**	**0.2**	**0.4**	**0.4**
Arsenic	SW6020A	41.6	**7.5**	**6.3**	**12**	**18.4**	**25.4**
Barium	SW6020A	--	**35**	**70.1**	**45.5**	**53.2**	**57**
Beryllium	SW6020A	--	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**1.81**	**1.18**	**3.63**	**3.3**	**2.63**
Calcium	SW6010C	--	**29000**	**39200**	**7360**	**7540**	**8100**
Chromium	SW6020A	160	**31**	**35**	**28**	**37**	**37**
Cobalt	SW6020A	--	**5.4**	**10.2**	**4.8**	**6.6**	**6.4**
Copper	SW6020A	108	**56.8**	**33.8**	**41.9**	**66.3**	**73.8**
Iron	SW6010C	--	**24300**	**24900**	**22700**	**27400**	**30400**
Lead	SW6020A	112	**20.1**	**4.4**	**23.6**	**28.8**	**27.8**
Lithium	SW6020A	--	**13.5**	**24.2**	**19**	**21.2**	**22.8**

Table 6
Analytical Results Summary

		Location ID	EHWW-10	EHWW-14	EHWW-16	EHWW-16	EHWW-18
		Sample ID	EHWW-10-SG-000010	EHWW-14-SG-000010	EHWW-16-SC-152202	EHWW-116-SC-152202	EHWW-18-SG-000010
		Sample Date	10/3/2018	10/3/2018	12/18/2018	12/18/2018	10/2/2018
		Depth	0 - 0.1 m	0 - 0.1 m	1.52 - 2.02 m	1.52 - 2.02 m	0 - 0.1 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	--	--	1 U	**1**	--
Phosphorus	SW6010C	--	**1430**	**1030**	**748**	**751**	**1150**
Sulphide, bulk	CALCULATED[1]	--	--	--	**7000**	**9500**	--
Conventional Parameters (pct)							
Loss on ignition	D2974	--	--	--	**2.5**	**2.5**	--
Moisture (water) content	D2216	--	--	--	**43.6**	--	--
Total organic carbon	AGAT_INOR-181-6027	--	--	--	**1.17**	**1.11**	--
Total solids	SM2540G	--	--	--	**56**	**60**	--
Liquid limit	D4318	--	--	--	NP	--	--
Plastic limit	D4318	--	--	--	NP	--	--
Plasticity index	D4318	--	--	--	NP	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	**7.6**	**7.4**	**7.6**	**7.5**	**6.6**
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	--	--	**26**	--	--
Metals (mg/kg)							
Aluminum	SW6010C	--	**16800**	**16400**	**12500**	**13000**	**12800**
Antimony	SW6020A	--	**0.7**	**0.4**	**0.2**	**0.2**	**0.5**
Arsenic	SW6020A	41.6	**10.3**	**12.9**	**8.3**	**7.4**	**17.6**
Barium	SW6020A	--	**73.8**	**53.2**	**29.2**	**29.8**	**42.9**
Beryllium	SW6020A	--	**0.4**	**0.3**	**0.2**	**0.2**	**0.3**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**0.66**	**2.21**	**4.59**	**4.61**	**3.86**
Calcium	SW6010C	--	**8910**	**7010**	**17900**	**10900**	**7100**
Chromium	SW6020A	160	**30**	**30**	**25**	**24**	**31**
Cobalt	SW6020A	--	**6.2**	**5.6**	**4.9**	**4.8**	**5.6**
Copper	SW6020A	108	**66.7**	**46.7**	**17.7**	**18.3**	**54.6**
Iron	SW6010C	--	**29400**	**27600**	**17200**	**17800**	**22700**
Lead	SW6020A	112	**32.9**	**23.3**	**2.8**	**2.8**	**28.1**
Lithium	SW6020A	--	**24.8**	**22.5**	**14.3**	**14.7**	**18.3**

Table 6
Analytical Results Summary

		Location ID	EHWW-19	EHWW-24	EHWW-30	EHWW-33	EHWW-36
		Sample ID	EHWW-19-SG-000010	EHWW-24-SC-045095	EHWW-30-SG-000010	EHWW-33-SG-000010	EHWW-36-SC-000050
		Sample Date	10/2/2018	12/18/2018	10/3/2018	10/3/2018	12/17/2018
		Depth	0 - 0.1 m	0.45 - 0.95 m	0 - 0.1 m	0 - 0.1 m	0 - 0.5 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	--	1 U	--	--	--
Phosphorus	SW6010C	--	**1060**	**812**	**1190**	**1050**	**1180**
Sulphide, bulk	CALCULATED[1]	--	--	**9500**	--	--	--
Conventional Parameters (pct)							
Loss on ignition	D2974	--	--	**3.5**	--	--	--
Moisture (water) content	D2216	--	--	--	--	--	--
Total organic carbon	AGAT_INOR-181-6027	--	--	**1.18**	--	--	**13.5**
Total solids	SM2540G	--	--	**60**	--	--	**26**
Liquid limit	D4318	--	--	--	--	--	--
Plastic limit	D4318	--	--	--	--	--	--
Plasticity index	D4318	--	--	--	--	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	**7.5**	**7.8**	**7.6**	**7.5**	**6.9**
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	--	**8**	--	--	--
Metals (mg/kg)							
Aluminum	SW6010C	--	**13300**	**14300**	**16600**	**17100**	**15100**
Antimony	SW6020A	--	**0.5**	**0.2**	**0.5**	**0.5**	**0.8**
Arsenic	SW6020A	41.6	**14.5**	**8.4**	**15.5**	**14.9**	**19.6**
Barium	SW6020A	--	**42.9**	**34.4**	**67.5**	**57**	**45.4**
Beryllium	SW6020A	--	**0.3**	**0.3**	**0.3**	**0.4**	**0.3**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**3.74**	**3.88**	**0.92**	**1.48**	**3.4**
Calcium	SW6010C	--	**7770**	**9080**	**7910**	**7390**	**9110**
Chromium	SW6020A	160	**29**	**30**	**35**	**33**	**45**
Cobalt	SW6020A	--	**5.4**	**5.6**	**6.9**	**6.4**	**8.7**
Copper	SW6020A	108	**46.9**	**18.8**	**73.8**	**52.9**	**91.2**
Iron	SW6010C	--	**21700**	**19900**	**29900**	**28700**	**27400**
Lead	SW6020A	112	**22.3**	**3**	**31.7**	**24.8**	**40.3**
Lithium	SW6020A	--	**16.8**	**18**	**23.4**	**24.3**	**18.1**

Table 6
Analytical Results Summary

		Location ID	EHWW-36	EHWW-38	EHWW-38	EHWW-39	EHWW-39
		Sample ID	EHWW-36-SC-183233	EHWW-38-SC-000050	EHWW-38-SC-050100	EHWW-39-SG-000010	EHWW-39-SC-035085
		Sample Date	12/17/2018	12/17/2018	12/17/2018	10/1/2018	12/18/2018
		Depth	1.83 - 2.33 m	0 - 0.5 m	0.5 - 1 m	0 - 0.1 m	0.35 - 0.85 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	**2**	--	1 U	--	1 U
Phosphorus	SW6010C	--	**494**	**915**	**830**	**1370**	**825**
Sulphide, bulk	CALCULATED[1]	--	**4900**	**12900**	**7600**	--	**6700**
Conventional Parameters (pct)							
Loss on ignition	D2974	--	**1.5**	--	**3.6**	--	**3.2**
Moisture (water) content	D2216	--	--	**60.5**	**44.8**	--	--
Total organic carbon	AGAT_INOR-181-6027	--	**0.35**	**4.34**	**1.52**	--	**1.46**
Total solids	SM2540G	--	**72**	**37**	**55**	--	**60**
Liquid limit	D4318	--	--	NP	NP	--	--
Plastic limit	D4318	--	--	NP	NP	--	--
Plasticity index	D4318	--	--	NP	NP	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	**8.5**	**7.5**	**7.8**	**7.1**	**7.8**
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	**6**	**14**	**5**	--	**15**
Metals (mg/kg)							
Aluminum	SW6010C	--	**29100**	**16100**	**16200**	**15900**	**13400**
Antimony	SW6020A	--	**0.4**	**0.4**	**0.2**	**0.5**	**0.2**
Arsenic	SW6020A	41.6	**6.3**	**9.2**	**8.1**	**18.9**	**6.4**
Barium	SW6020A	--	**103**	**49.5**	**43.9**	**57.9**	**32.7**
Beryllium	SW6020A	--	**0.5**	**0.3**	**0.4**	**0.3**	**0.2**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**0.31**	**3.25**	**3.86**	**4.52**	**4.32**
Calcium	SW6010C	--	**13800**	**19300**	**10100**	**7640**	**16600**
Chromium	SW6020A	160	**49**	**38**	**33**	**41**	**29**
Cobalt	SW6020A	--	**18.3**	**6.1**	**5.7**	**7.2**	**5**
Copper	SW6020A	108	**59.6**	**46.6**	**19.5**	**86.2**	**18.7**
Iron	SW6010C	--	**39200**	**25200**	**21600**	**27600**	**17900**
Lead	SW6020A	112	**6.1**	**29.2**	**5.5**	**37.1**	**6.8**
Lithium	SW6020A	--	**30.9**	**22.4**	**21**	**23**	**16**

Table 6
Analytical Results Summary

		Location ID	EHWW-40	EHWW-40	EHWW-42	EHWW-44	EHWW-44
		Sample ID	EHWW-40-SC-000050	EHWW-40-SC-060110	EHWW-42-SG-000010	EHWW-44-SG-000010	EHWW-44-SC-017067
		Sample Date	12/18/2018	12/18/2018	10/2/2018	10/4/2018	12/19/2018
		Depth	0 - 0.5 m	0.6 - 1.1 m	0 - 0.1 m	0 - 0.1 m	0.17 - 0.67 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	--	1 U	--	--	**2**
Phosphorus	SW6010C	--	**1060**	**657**	**1310**	**898**	**823**
Sulphide, bulk	CALCULATED[1]	--	**23700**	**6700**	--	--	**8300**
Conventional Parameters (pct)							
Loss on ignition	D2974	--	--	**4.1**	--	--	**3.5**
Moisture (water) content	D2216	--	--	--	--	--	--
Total organic carbon	AGAT_INOR-181-6027	--	**13.4**	**1.1**	--	--	**1.49**
Total solids	SM2540G	--	**24**	**75**	--	--	**57**
Liquid limit	D4318	--	--	--	--	--	--
Plastic limit	D4318	--	--	--	--	--	--
Plasticity index	D4318	--	--	--	--	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	**6.8**	**7.8**	**7.4**	**7.3**	**7.5**
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	**80**	**55**	--	--	**5**
Metals (mg/kg)							
Aluminum	SW6010C	--	**10700**	**8370**	**15400**	**14200**	**16800**
Antimony	SW6020A	--	**0.6**	**0.2**	**0.2**	**0.3**	**0.2**
Arsenic	SW6020A	41.6	**6.8**	**9.1**	**12.5**	**12.9**	**9.4**
Barium	SW6020A	--	**28.2**	**20.3**	**47.4**	**43.2**	**42.8**
Beryllium	SW6020A	--	**0.2**	**0.1**	**0.3**	**0.3**	**0.3**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**3.43**	**1.47**	**4.23**	**2.73**	**3.73**
Calcium	SW6010C	--	**6510**	**35000**	**7920**	**7530**	**12900**
Chromium	SW6020A	160	**33**	**16**	**30**	**29**	**36**
Cobalt	SW6020A	--	**5**	**5**	**5**	**5.7**	**6.4**
Copper	SW6020A	108	**68.5**	**14**	**46.8**	**43.7**	**23.1**
Iron	SW6010C	--	**17700**	**13000**	**23600**	**23200**	**23100**
Lead	SW6020A	112	**33.4**	**4.4**	**26.1**	**20.3**	**5.3**
Lithium	SW6020A	--	**12.9**	**7.8**	**19.4**	**18.1**	**22.3**

Table 6
Analytical Results Summary

		Location ID	EHWW-45	EHWW-46	EHWW-48	EHWW-48	EHWW-53
		Sample ID	EHWW-45-SG-000010	EHWW-46-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-53-SC-000016
		Sample Date	10/4/2018	10/4/2018	10/2/2018	10/2/2018	12/19/2018
		Depth	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.16 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	--	--	--	--	--
Phosphorus	SW6010C	--	**1190**	**1060**	**1170**	**1190**	**999**
Sulphide, bulk	CALCULATED[1]	--	--	--	--	--	**8700**
Conventional Parameters (pct)							
Loss on ignition	D2974	--	--	--	--	--	--
Moisture (water) content	D2216	--	--	--	--	--	--
Total organic carbon	AGAT_INOR-181-6027	--	--	--	--	--	**3.32**
Total solids	SM2540G	--	--	--	--	--	**52**
Liquid limit	D4318	--	--	--	--	--	--
Plastic limit	D4318	--	--	--	--	--	--
Plasticity index	D4318	--	--	--	--	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	**7.4**	**7.3**	**7.3**	**7.3**	**7.8**
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	--	--	--	--	**37**
Metals (mg/kg)							
Aluminum	SW6010C	--	**14200**	**13400**	**16100**	**15100**	**12100**
Antimony	SW6020A	--	**0.2**	**0.2**	**0.3**	**0.3**	**0.5**
Arsenic	SW6020A	41.6	**13.6**	**14**	**14.9**	**18.4**	**11.4**
Barium	SW6020A	--	**39.9**	**35.5**	**43.1**	**40.9**	**48.2**
Beryllium	SW6020A	--	**0.2**	**0.2**	**0.3**	**0.3**	**0.2**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**4.1**	**4.01**	**4.4**	**4.35**	**4.92**
Calcium	SW6010C	--	**7800**	**7080**	**7550**	**7750**	**15400**
Chromium	SW6020A	160	**33**	**26**	**35**	**35**	**28**
Cobalt	SW6020A	--	**5.7**	**4.8**	**6.6**	**6.4**	**5.1**
Copper	SW6020A	108	**54.1**	**42.9**	**60.8**	**60.7**	**43.7**
Iron	SW6010C	--	**21400**	**19900**	**24700**	**24000**	**16600**
Lead	SW6020A	112	**24.2**	**20.4**	**25.4**	**24.1**	**84.8**
Lithium	SW6020A	--	**17.6**	**15.3**	**20.4**	**18.6**	**14.4**

Table 6
Analytical Results Summary

		Location ID	EHWW-53	EHWW-53	EHWW-54	EHWW-54	EHWW-54
		Sample ID	EHWW-53-SC-016066	EHWW-53-SC-066116	EHWW-54-SC-000050	EHWW-54-SC-055105	EHWW-54-SC-105155
		Sample Date	12/19/2018	12/19/2018	12/18/2018	12/18/2018	12/18/2018
		Depth	0.16 - 0.66 m	0.66 - 1.16 m	0 - 0.5 m	0.55 - 1.05 m	1.05 - 1.55 m
		Sample Type	N	N	N	N	N
Analytes	Method	CCME Marine PEL					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	1 U	--	--	1 U	--
Phosphorus	SW6010C	--	672	405	947	885	612
Sulphide, bulk	CALCULATED[1]	--	4700	--	6500	7900	--
Conventional Parameters (pct)							
Loss on ignition	D2974	--	1.3	--	--	2.8	--
Moisture (water) content	D2216	--	--	--	--	--	--
Total organic carbon	AGAT_INOR-181-6027	--	0.87	--	3.5	1.41	--
Total solids	SM2540G	--	75	82	48	59	58
Liquid limit	D4318	--	--	--	--	--	--
Plastic limit	D4318	--	--	--	--	--	--
Plasticity index	D4318	--	--	--	--	--	--
Conventional Parameters (standard units)							
pH	SM4500HB	--	8	8.1	7.6	7.9	7.5
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	54	--	14	18	--
Metals (mg/kg)							
Aluminum	SW6010C	--	8220	9120	13400	13700	17500
Antimony	SW6020A	--	0.1	0.1	0.2	0.2	0.2
Arsenic	SW6020A	41.6	4.7	5.7	6.9	8.5	8.3
Barium	SW6020A	--	20.8	16.6	35.3	31.4	31.4
Beryllium	SW6020A	--	0.1	0.1	0.3	0.3	0.3
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	5.02	1.76	4.44	5.67	3.45
Calcium	SW6010C	--	39400	16000	9220	20200	11700
Chromium	SW6020A	160	15	16	29	29	39
Cobalt	SW6020A	--	3.5	4.8	4.7	5.2	8.6
Copper	SW6020A	108	11.4	12.8	30	20.1	34.4
Iron	SW6010C	--	11300	13500	18400	18700	25700
Lead	SW6020A	112	1.9	1.4	18.1	3.2	3.6
Lithium	SW6020A	--	8.6	9.1	15.9	16.4	21.7

Table 6
Analytical Results Summary

		Location ID	EHWW-55	EHWW-56	EHWW-57	EHWW-58	EHWW-58
		Sample ID	EHWW-55-SC-110160	EHWW-56-SC-000050	EHWW-57-SC-000050	EHWW-58-SC-361411	EHWW-58-SC-411461
		Sample Date	12/19/2018	12/17/2018	12/17/2018	12/16/2018	12/16/2018
		Depth	1.1 - 1.6 m	0 - 0.5 m	0 - 0.5 m	3.61 - 4.11 m	4.11 - 4.61 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Conventional Parameters (mg/kg)							
Ammonia as nitrogen	SM4500NH3E	--	1 U	--	--	1 U	--
Phosphorus	SW6010C	--	**975**	**680**	**825**	**577**	--
Sulphide, bulk	CALCULATED[1]	--	**8500**	--	**47300**	**2000**	--
Conventional Parameters (pct)							
Loss on ignition	D2974	--	**4.5**	--	--	**1.6**	--
Moisture (water) content	D2216	--	--	--	--	--	**28.9**
Total organic carbon	AGAT_INOR-181-6027	--	**1.92**	**1.75**	**16.1**	**0.66**	--
Total solids	SM2540G	--	**61**	**65**	**21**	**75**	--
Liquid limit	D4318	--	--	--	--	--	**53**
Plastic limit	D4318	--	--	--	--	--	**27**
Plasticity index	D4318	--	--	--	--	--	**27**
Conventional Parameters (standard units)							
pH	SM4500HB	--	**7.9**	**8.2**	**7**	**8.5**	--
Grain Size (pct)							
Sand and gravel (>#200 sieve)	SSMA_55.4	--	**3**	**60**	**61**	**45**	--
Metals (mg/kg)							
Aluminum	SW6010C	--	**16800**	**7730**	**8030**	**22100**	--
Antimony	SW6020A	--	**0.2**	**0.2**	**0.7**	**0.3**	--
Arsenic	SW6020A	41.6	**6.2**	**7.4**	**12.9**	**5.7**	--
Barium	SW6020A	--	**57**	**19.6**	**28.5**	**61.3**	--
Beryllium	SW6020A	--	**0.3**	**0.1**	**0.2**	**0.4**	--
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	--
Cadmium	SW6020A	4.2	**2.96**	**1.25**	**1.49**	**0.93**	--
Calcium	SW6010C	--	**10400**	**35900**	**18500**	**71600**	--
Chromium	SW6020A	160	**33**	**16**	**47**	**42**	--
Cobalt	SW6020A	--	**5.8**	**4**	**4.3**	**12**	--
Copper	SW6020A	108	**24.4**	**22.3**	**52.9**	**43.2**	--
Iron	SW6010C	--	**23800**	**12800**	**43900**	**32200**	--
Lead	SW6020A	112	**17.5**	**5.5**	**15**	**4.2**	--
Lithium	SW6020A	--	**21.5**	**8.1**	**10.7**	**30.3**	--

Table 6
Analytical Results Summary

		Location ID	EHWW-59	EHWW-65	EHWW-65
		Sample ID	EHWW-59-SC-038088	EHWW-65-SC-000050	EHWW-165-SC-000050
		Sample Date	12/19/2018	12/19/2018	12/19/2018
		Depth	0.38 - 0.88 m	0 - 0.5 m	0 - 0.5 m
		Sample Type	N	N	FD
Analytes	**Method**	**CCME Marine PEL**			
Conventional Parameters (mg/kg)					
Ammonia as nitrogen	SM4500NH3E	--	1 U	--	--
Phosphorus	SW6010C	--	**903**	**617**	**731**
Sulphide, bulk	CALCULATED[1]	--	**7500**	**4600**	--
Conventional Parameters (pct)					
Loss on ignition	D2974	--	**4.8**	--	--
Moisture (water) content	D2216	--	--	--	--
Total organic carbon	AGAT_INOR-181-6027	--	**1.63**	**1.28**	**1.33**
Total solids	SM2540G	--	**55**	**70**	**70**
Liquid limit	D4318	--	--	--	--
Plastic limit	D4318	--	--	--	--
Plasticity index	D4318	--	--	--	--
Conventional Parameters (standard units)					
pH	SM4500HB	--	**7.8**	**8**	**8**
Grain Size (pct)					
Sand and gravel (>#200 sieve)	SSMA_55.4	--	**4**	**46**	--
Metals (mg/kg)					
Aluminum	SW6010C	--	**15700**	**8210**	**8600**
Antimony	SW6020A	--	**0.2**	**0.2**	**0.2**
Arsenic	SW6020A	41.6	**6.6**	**7.5**	**7**
Barium	SW6020A	--	**44.4**	**20.2**	**21.1**
Beryllium	SW6020A	--	**0.3**	**0.2**	**0.1**
Bismuth	SW6020A	--	0.5 U	0.5 U	0.5 U
Cadmium	SW6020A	4.2	**4.4**	**4.3**	**4.92**
Calcium	SW6010C	--	**12200**	**8160**	**7430**
Chromium	SW6020A	160	**32**	**18**	**18**
Cobalt	SW6020A	--	**5.4**	**3.8**	**4**
Copper	SW6020A	108	**19.3**	**20.7**	**21.7**
Iron	SW6010C	--	**21300**	**11900**	**12500**
Lead	SW6020A	112	**7.6**	**9.6**	**10.4**
Lithium	SW6020A	--	**20**	**9.4**	**10.5**

Table 6
Analytical Results Summary

		Location ID	EHWW-03	EHWW-03	EHWW-04	EHWW-06	EHWW-09
		Sample ID	EHWW-03-SC-000050	EHWW-03-SC-150200	EHWW-04-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010
		Sample Date	12/17/2018	12/17/2018	10/2/2018	10/1/2018	10/1/2018
		Depth	0 - 0.5 m	1.5 - 2 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Magnesium	SW6010C	--	**10100**	**8330**	**9400**	**12000**	**13400**
Manganese	SW6020A	--	**179**	**330**	**164**	**176**	**175**
Mercury	SW6020A	0.7	**0.31**	**0.04**	**0.38**	**0.39**	**0.33**
Molybdenum	SW6020A	--	**20.6**	**4.9**	**2.4**	**10.4**	**8.9**
Nickel	SW6020A	--	**21.8**	**29.5**	**17.5**	**24.5**	**24**
Potassium	SW6010C	--	**2720**	**3060**	**2770**	**3490**	**3930**
Selenium	SW6020A	--	**1.8**	**2.2**	**1.7**	**2.1**	**2.7**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**34400**	**6190**	**21200**	**33300**	**37500**
Strontium	SW6020A	--	**239**	**309**	**58**	**66**	**69**
Thallium	SW6020A	--	**0.3**	**0.3**	**0.4**	**0.4**	**0.4**
Tin	SW6020A	--	**5.6**	**0.5**	**4.5**	**5.1**	**4.9**
Titanium	SW6010C	--	**640**	**1270**	**1160**	**1070**	**1130**
Uranium (Uranium 238)	SW6020A	--	**6.5**	**1.7**	**1.2**	**3.9**	**3**
Vanadium	SW6020A	--	**57**	**63**	**42**	**59**	**57**
Zinc	SW6020A	271	**110**	**52**	**80**	**118**	**109**
Zirconium	SW6020A	--	**5.8**	**9.7**	**6.5**	**9.1**	**8**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	200 U	50 U	100 U	100 U	200 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	20 U	5 U	10 U	10 U	20 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	20 U	5 U	**20**	**30**	**30**
Acenaphthene	BCLM2015D-PAHS	88.9	20 U	5 U	10 U	10 U	20 U
Acenaphthylene	BCLM2015D-PAHS	128	20 U	5 U	10 U	10 U	20 U
Anthracene	BCLM2015D-PAHS	245	**50**	4 U	**26**	**38**	**40**
Benzo(a)anthracene	BCLM2015D-PAHS	693	**150**	30 U	**60**	**110**	**110**
Benzo(a)pyrene	BCLM2015D-PAHS	763	**100**	30 U	**70**	**130**	**130**
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	**260**	20 U	**110**	**200**	**220**
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	200 U	50 U	100 U	100 U	200 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	**80**	20 U	**50**	**90**	**90**
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	**120**	20 U	**50**	**110**	**110**

Table 6
Analytical Results Summary

		Location ID	EHWW-10	EHWW-14	EHWW-16	EHWW-16	EHWW-18
		Sample ID	EHWW-10-SG-000010	EHWW-14-SG-000010	EHWW-16-SC-152202	EHWW-116-SC-152202	EHWW-18-SG-000010
		Sample Date	10/3/2018	10/3/2018	12/18/2018	12/18/2018	10/2/2018
		Depth	0 - 0.1 m	0 - 0.1 m	1.52 - 2.02 m	1.52 - 2.02 m	0 - 0.1 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Magnesium	SW6010C	--	**10300**	**10400**	**5470**	**5590**	**10500**
Manganese	SW6020A	--	**188**	**178**	**178**	**178**	**163**
Mercury	SW6020A	0.7	**0.58**	**0.38**	**0.05**	**0.03**	**0.32**
Molybdenum	SW6020A	--	**2.1**	**3**	**3.2**	**3.3**	**19.7**
Nickel	SW6020A	--	**20.3**	**19.7**	**17**	**17.5**	**21.6**
Potassium	SW6010C	--	**2940**	**3040**	**1650**	**1720**	**2860**
Selenium	SW6020A	--	**1.1**	**1.5**	**2.8**	**3.9**	**2.6**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**15600**	**20500**	**6920**	**7350**	**29800**
Strontium	SW6020A	--	**61**	**54**	**113**	**71**	**76**
Thallium	SW6020A	--	**0.2**	**0.3**	**0.7**	**0.7**	**0.4**
Tin	SW6020A	--	**4.3**	**3.5**	**0.4**	**0.4**	**4.6**
Titanium	SW6010C	--	**1300**	**1290**	**1180**	**1220**	**915**
Uranium (Uranium 238)	SW6020A	--	**1.4**	**1.4**	**1.2**	**1.2**	**7.2**
Vanadium	SW6020A	--	**48**	**45**	**43**	**42**	**57**
Zinc	SW6020A	271	**86**	**83**	**58**	**48**	**103**
Zirconium	SW6020A	--	**8.2**	**8**	**7.3**	**7.5**	**8.6**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	100 U	100 U	50 U	**50**	100 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	10 U	10 U	5 U	5 U	10 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	**10**	**10**	**9**	**11**	**20**
Acenaphthene	BCLM2015D-PAHS	88.9	**10**	10 U	5 U	5 U	10 U
Acenaphthylene	BCLM2015D-PAHS	128	**10**	10 U	5 U	5 U	10 U
Anthracene	BCLM2015D-PAHS	245	**60**	**27**	4 U	4 U	**40**
Benzo(a)anthracene	BCLM2015D-PAHS	693	**180**	**70**	30 U	30 U	**60**
Benzo(a)pyrene	BCLM2015D-PAHS	763	**250**	**90**	30 U	30 U	**100**
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	**330**	**120**	20 U	20 U	**150**
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	100 U	100 U	50 U	50 U	100 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	**130**	**50**	20 U	20 U	**60**
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	**190**	**60**	20 U	20 U	**80**

Table 6
Analytical Results Summary

		Location ID	EHWW-19	EHWW-24	EHWW-30	EHWW-33	EHWW-36
		Sample ID	EHWW-19-SG-000010	EHWW-24-SC-045095	EHWW-30-SG-000010	EHWW-33-SG-000010	EHWW-36-SC-000050
		Sample Date	10/2/2018	12/18/2018	10/3/2018	10/3/2018	12/17/2018
		Depth	0 - 0.1 m	0.45 - 0.95 m	0 - 0.1 m	0 - 0.1 m	0 - 0.5 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Magnesium	SW6010C	--	**8690**	**6490**	**10800**	**10400**	**11300**
Manganese	SW6020A	--	**158**	**198**	**184**	**190**	**225**
Mercury	SW6020A	0.7	**0.39**	**0.04**	**0.58**	**0.42**	**0.43**
Molybdenum	SW6020A	--	**2.7**	**3.6**	**2.3**	**1.9**	**19.6**
Nickel	SW6020A	--	**19.1**	**19.6**	**22.8**	**21.7**	**32.6**
Potassium	SW6010C	--	**2400**	**2030**	**3150**	**3080**	**2790**
Selenium	SW6020A	--	**1.5**	**1.3**	**1.2**	**1.2**	**2.5**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**18600**	**7430**	**20000**	**18200**	**30800**
Strontium	SW6020A	--	**57**	**63**	**58**	**56**	**83**
Thallium	SW6020A	--	**0.5**	**0.5**	**0.2**	**0.3**	**0.5**
Tin	SW6020A	--	**3.4**	**0.6**	**4.6**	**3.5**	**28.9**
Titanium	SW6010C	--	**1130**	**1260**	**1250**	**1300**	**912**
Uranium (Uranium 238)	SW6020A	--	**1.3**	**1.6**	**1.3**	**1.2**	**6.2**
Vanadium	SW6020A	--	**44**	**49**	**52**	**49**	**76**
Zinc	SW6020A	271	**93**	**55**	**97**	**90**	**158**
Zirconium	SW6020A	--	**6.3**	**8.4**	**7.9**	**8.3**	**7.1**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	100 U	50 U	100 U	50 U	200 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	10 U	5 U	**10**	**5**	20 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	**20**	**11**	**10**	**13**	**20**
Acenaphthene	BCLM2015D-PAHS	88.9	10 U	5 U	**10**	**8**	**20**
Acenaphthylene	BCLM2015D-PAHS	128	**10**	5 U	**10**	**6**	**30**
Anthracene	BCLM2015D-PAHS	245	**43**	4 U	**64**	**30**	**110**
Benzo(a)anthracene	BCLM2015D-PAHS	693	**100**	30 U	**160**	**70**	**380**
Benzo(a)pyrene	BCLM2015D-PAHS	763	**120**	30 U	**200**	**90**	**310**
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	**190**	20 U	**230**	**130**	**640**
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	100 U	50 U	100 U	50 U	200 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	**80**	20 U	**100**	**50**	**230**
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	**100**	20 U	**130**	**60**	**360**

Table 6
Analytical Results Summary

		Location ID	EHWW-36	EHWW-38	EHWW-38	EHWW-39	EHWW-39
		Sample ID	EHWW-36-SC-183233	EHWW-38-SC-000050	EHWW-38-SC-050100	EHWW-39-SG-000010	EHWW-39-SC-035085
		Sample Date	12/17/2018	12/17/2018	12/17/2018	10/1/2018	12/18/2018
		Depth	1.83 - 2.33 m	0 - 0.5 m	0.5 - 1 m	0 - 0.1 m	0.35 - 0.85 m
		Sample Type	N	N	N	N	N
Analytes	Method	CCME Marine PEL					
Magnesium	SW6010C	--	**14900**	**9590**	**7240**	**11900**	**6160**
Manganese	SW6020A	--	**752**	**197**	**202**	**187**	**185**
Mercury	SW6020A	0.7	**0.06**	**0.54**	**0.08**	**0.47**	**0.09**
Molybdenum	SW6020A	--	**0.5**	**9.5**	**4.4**	**13.2**	**4.4**
Nickel	SW6020A	--	**48.1**	**26**	**20.7**	**28.1**	**17.3**
Potassium	SW6010C	--	**3490**	**2790**	**2290**	**3420**	**1830**
Selenium	SW6020A	--	**0.9**	**1.5**	**2.8**	**2.8**	**1.7**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**5530**	**20800**	**9090**	**30300**	**8420**
Strontium	SW6020A	--	**83**	**162**	**82**	**75**	**118**
Thallium	SW6020A	--	**0.1**	**0.4**	**0.4**	**0.5**	**0.5**
Tin	SW6020A	--	**0.6**	**6.5**	**1.7**	**8.8**	**1.3**
Titanium	SW6010C	--	**1800**	**1170**	**1300**	**1090**	**1090**
Uranium (Uranium 238)	SW6020A	--	**0.6**	**3.8**	**1.9**	**4.3**	**1.7**
Vanadium	SW6020A	--	**99**	**61**	**54**	**65**	**46**
Zinc	SW6020A	271	**88**	**90**	**65**	**149**	**54**
Zirconium	SW6020A	--	**11.1**	**9.6**	**9.8**	**8.8**	**7.3**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	50 U	100 U	**50**	100 U	50 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	**12**	10 U	5 U	10 U	5 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	**17**	10 U	**8**	**30**	**9**
Acenaphthene	BCLM2015D-PAHS	88.9	5 U	10 U	5 U	**10**	5 U
Acenaphthylene	BCLM2015D-PAHS	128	5 U	10 U	5 U	**10**	5 U
Anthracene	BCLM2015D-PAHS	245	4 U	**16**	4 U	**51**	4 U
Benzo(a)anthracene	BCLM2015D-PAHS	693	30 U	60 U	30 U	**100**	30 U
Benzo(a)pyrene	BCLM2015D-PAHS	763	30 U	60 U	30 U	**100**	30 U
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	20 U	**90**	20 U	**160**	20 U
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	50 U	100 U	50 U	100 U	50 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	20 U	40 U	20 U	**70**	20 U
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	20 U	**40**	20 U	**80**	20 U

Table 6
Analytical Results Summary

		Location ID	EHWW-40	EHWW-40	EHWW-42	EHWW-44	EHWW-44
		Sample ID	EHWW-40-SC-000050	EHWW-40-SC-060110	EHWW-42-SG-000010	EHWW-44-SG-000010	EHWW-44-SC-017067
		Sample Date	12/18/2018	12/18/2018	10/2/2018	10/4/2018	12/19/2018
		Depth	0 - 0.5 m	0.6 - 1.1 m	0 - 0.1 m	0 - 0.1 m	0.17 - 0.67 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Magnesium	SW6010C	--	**9090**	**3840**	**9730**	**9340**	**7480**
Manganese	SW6020A	--	**139**	**188**	**166**	**169**	**239**
Mercury	SW6020A	0.7	**0.41**	**0.08**	**0.39**	**0.29**	**0.07**
Molybdenum	SW6020A	--	**27**	**7.4**	**3**	**4.1**	**5.2**
Nickel	SW6020A	--	**22.7**	**11.5**	**19.2**	**19.4**	**23.5**
Potassium	SW6010C	--	**2340**	**853**	**2790**	**2610**	**2440**
Selenium	SW6020A	--	**2.1**	**2.9**	**1.8**	**1.6**	**4.2**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**31900**	**4130**	**20600**	**19600**	**8840**
Strontium	SW6020A	--	**69**	**251**	**57**	**56**	**101**
Thallium	SW6020A	--	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**
Tin	SW6020A	--	**8.9**	**1.5**	**4.5**	**3.3**	**0.7**
Titanium	SW6010C	--	**585**	**873**	**1200**	**1140**	**1380**
Uranium (Uranium 238)	SW6020A	--	**7.8**	**1.9**	**1.6**	**1.5**	**2.2**
Vanadium	SW6020A	--	**58**	**38**	**43**	**48**	**58**
Zinc	SW6020A	271	**162**	**31**	**90**	**81**	**63**
Zirconium	SW6020A	--	**5.2**	**4.9**	**6.2**	**7.2**	**10.3**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	200 U	50 U	100 U	100 U	50 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	20 U	5 U	10 U	10 U	5 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	**40**	5 U	**20**	**10**	5 U
Acenaphthene	BCLM2015D-PAHS	88.9	**60**	5 U	10 U	**10**	5 U
Acenaphthylene	BCLM2015D-PAHS	128	**30**	5 U	10 U	10 U	5 U
Anthracene	BCLM2015D-PAHS	245	**110**	4 U	**25**	**45**	4 U
Benzo(a)anthracene	BCLM2015D-PAHS	693	**420**	30 U	**60**	**90**	30 U
Benzo(a)pyrene	BCLM2015D-PAHS	763	**210**	30 U	**70**	**120**	30 U
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	**630**	20 U	**110**	**160**	20 U
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	200 U	50 U	100 U	100 U	50 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	**180**	20 U	**40**	**50**	20 U
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	**260**	20 U	**60**	**90**	20 U

Table 6
Analytical Results Summary

		Location ID	EHWW-45	EHWW-46	EHWW-48	EHWW-48	EHWW-53
		Sample ID	EHWW-45-SG-000010	EHWW-46-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-53-SC-000016
		Sample Date	10/4/2018	10/4/2018	10/2/2018	10/2/2018	12/19/2018
		Depth	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.16 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Magnesium	SW6010C	--	**9230**	**8840**	**10700**	**10700**	**6170**
Manganese	SW6020A	--	**149**	**139**	**179**	**173**	**156**
Mercury	SW6020A	0.7	**0.3**	**0.31**	**0.33**	**0.34**	**0.55**
Molybdenum	SW6020A	--	**3.1**	**4.4**	**6.7**	**6.3**	**7.9**
Nickel	SW6020A	--	**20.7**	**18**	**23.8**	**23.8**	**20.1**
Potassium	SW6010C	--	**2670**	**2540**	**3010**	**2940**	**1670**
Selenium	SW6020A	--	**1.6**	**1.9**	**2**	**2.1**	**1.3**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**21800**	**20900**	**25400**	**27000**	**11800**
Strontium	SW6020A	--	**57**	**52**	**59**	**60**	**103**
Thallium	SW6020A	--	**0.4**	**0.5**	**0.5**	**0.4**	**0.7**
Tin	SW6020A	--	**4**	**2.8**	**3.4**	**3.5**	**2.9**
Titanium	SW6010C	--	**1110**	**1010**	**1200**	**1160**	**891**
Uranium (Uranium 238)	SW6020A	--	**1.7**	**2.2**	**2.6**	**2.5**	**3.2**
Vanadium	SW6020A	--	**48**	**41**	**53**	**52**	**49**
Zinc	SW6020A	271	**107**	**90**	**121**	**119**	**98**
Zirconium	SW6020A	--	**5**	**4.4**	**6.1**	**5.9**	**5**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	100 U	100 U	100 U	100 U	50 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	10 U	10 U	10 U	10 U	5 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	**20**	**20**	**30**	**20**	**11**
Acenaphthene	BCLM2015D-PAHS	88.9	10 U	10 U	10 U	10 U	5 U
Acenaphthylene	BCLM2015D-PAHS	128	10 U	10 U	10 U	10 U	5 U
Anthracene	BCLM2015D-PAHS	245	**18**	**17**	**25**	**29**	**10**
Benzo(a)anthracene	BCLM2015D-PAHS	693	60 U	60 U	60 U	**90**	**30**
Benzo(a)pyrene	BCLM2015D-PAHS	763	60 U	60 U	**60**	**110**	**30**
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	**80**	**60**	**120**	**210**	**60**
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	100 U	100 U	100 U	100 U	50 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	40 U	40 U	**50**	**90**	**20**
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	**40**	40 U	**50**	**100**	**20**

Table 6
Analytical Results Summary

		Location ID	EHWW-53	EHWW-53	EHWW-54	EHWW-54	EHWW-54
		Sample ID	EHWW-53-SC-016066	EHWW-53-SC-066116	EHWW-54-SC-000050	EHWW-54-SC-055105	EHWW-54-SC-105155
		Sample Date	12/19/2018	12/19/2018	12/18/2018	12/18/2018	12/18/2018
		Depth	0.16 - 0.66 m	0.66 - 1.16 m	0 - 0.5 m	0.55 - 1.05 m	1.05 - 1.55 m
		Sample Type	N	N	N	N	N
Analytes	Method	CCME Marine PEL					
Magnesium	SW6010C	--	**3510**	**4470**	**6890**	**5500**	**7920**
Manganese	SW6020A	--	**131**	**170**	**156**	**193**	**250**
Mercury	SW6020A	0.7	**0.04**	**0.03**	**0.38**	**0.04**	**0.03**
Molybdenum	SW6020A	--	**5.8**	**2.2**	**7.5**	**3.5**	**4.2**
Nickel	SW6020A	--	**10.8**	**12.6**	**19.3**	**19.4**	**29.8**
Potassium	SW6010C	--	**942**	**837**	**1940**	**1820**	**2610**
Selenium	SW6020A	--	**2**	**0.4**	**1**	**2.4**	**1.2**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**4490**	**3210**	**12200**	**5720**	**4390**
Strontium	SW6020A	--	**278**	**97**	**60**	**113**	**71**
Thallium	SW6020A	--	**0.8**	**0.4**	**0.5**	**0.8**	**0.5**
Tin	SW6020A	--	**0.2**	**0.4**	**2.6**	**0.4**	**0.6**
Titanium	SW6010C	--	**828**	**1100**	**1110**	**1190**	**1340**
Uranium (Uranium 238)	SW6020A	--	**2.1**	**0.8**	**2.9**	**1.4**	**1.3**
Vanadium	SW6020A	--	**31**	**35**	**49**	**47**	**58**
Zinc	SW6020A	271	**33**	**26**	**70**	**53**	**59**
Zirconium	SW6020A	--	**4.7**	**5.9**	**6.5**	**7.8**	**9**
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	50 U	--	100 U	50 U	--
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	5 U	--	10 U	5 U	--
2-Methylnaphthalene	BCLM2015D-PAHS	201	5 U	--	10 U	5 U	--
Acenaphthene	BCLM2015D-PAHS	88.9	5 U	--	10 U	5 U	--
Acenaphthylene	BCLM2015D-PAHS	128	5 U	--	10 U	5 U	--
Anthracene	BCLM2015D-PAHS	245	4 U	--	8 U	4 U	--
Benzo(a)anthracene	BCLM2015D-PAHS	693	30 U	--	60 U	30 U	--
Benzo(a)pyrene	BCLM2015D-PAHS	763	30 U	--	60 U	30 U	--
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	20 U	--	40 U	20 U	--
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	50 U	--	100 U	50 U	--
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	20 U	--	40 U	20 U	--
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	20 U	--	40 U	20 U	--

Table 6
Analytical Results Summary

		Location ID	EHWW-55	EHWW-56	EHWW-57	EHWW-58	EHWW-58
		Sample ID	EHWW-55-SC-110160	EHWW-56-SC-000050	EHWW-57-SC-000050	EHWW-58-SC-361411	EHWW-58-SC-411461
		Sample Date	12/19/2018	12/17/2018	12/17/2018	12/16/2018	12/16/2018
		Depth	1.1 - 1.6 m	0 - 0.5 m	0 - 0.5 m	3.61 - 4.11 m	4.11 - 4.61 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Magnesium	SW6010C	--	**7620**	**3980**	**9530**	**11100**	--
Manganese	SW6020A	--	**214**	**130**	**385**	**383**	--
Mercury	SW6020A	0.7	**0.28**	**0.14**	**0.29**	**0.04**	--
Molybdenum	SW6020A	--	**3.4**	**3.8**	**28.6**	**2.7**	--
Nickel	SW6020A	--	**21.9**	**11.9**	**19.8**	**34**	--
Potassium	SW6010C	--	**2350**	**1060**	**2620**	**3000**	--
Selenium	SW6020A	--	**2.7**	**0.3**	**1.9**	**1.5**	--
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U	0.5 U	--
Sodium	SW6010C	--	**8620**	**6390**	**41700**	**6340**	--
Strontium	SW6020A	--	**97**	**271**	**193**	**595**	--
Thallium	SW6020A	--	**0.3**	**0.4**	**0.2**	**0.2**	--
Tin	SW6020A	--	**2.8**	**1.3**	**3.7**	**0.4**	--
Titanium	SW6010C	--	**1330**	**699**	**452**	**1300**	--
Uranium (Uranium 238)	SW6020A	--	**1.7**	**1.5**	**8.4**	**1.5**	--
Vanadium	SW6020A	--	**54**	**32**	**51**	**80**	--
Zinc	SW6020A	271	**72**	**37**	**142**	**64**	--
Zirconium	SW6020A	--	**10.5**	**3.7**	**5.3**	**7.8**	--
Semivolatile Organics (µg/kg)							
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	50 U	50 U	200 U	50 U	--
Polycyclic Aromatic Hydrocarbons (µg/kg)							
1-Methylnaphthalene	BCLM2015D-PAHS	--	5 U	5 U	20 U	5 U	--
2-Methylnaphthalene	BCLM2015D-PAHS	201	5 U	5 U	20 U	5 U	--
Acenaphthene	BCLM2015D-PAHS	88.9	5 U	5 U	20 U	5 U	--
Acenaphthylene	BCLM2015D-PAHS	128	5 U	5 U	20 U	5 U	--
Anthracene	BCLM2015D-PAHS	245	**10**	**4**	20 U	4 U	--
Benzo(a)anthracene	BCLM2015D-PAHS	693	**30**	30 U	100 U	30 U	--
Benzo(a)pyrene	BCLM2015D-PAHS	763	**30**	30 U	100 U	30 U	--
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	**50**	**30**	**100**	20 U	--
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	50 U	50 U	200 U	50 U	--
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	**30**	20 U	80 U	20 U	--
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	**20**	20 U	80 U	20 U	--

Table 6
Analytical Results Summary

		Location ID	EHWW-59	EHWW-65	EHWW-65
		Sample ID	EHWW-59-SC-038088	EHWW-65-SC-000050	EHWW-165-SC-000050
		Sample Date	12/19/2018	12/19/2018	12/19/2018
		Depth	0.38 - 0.88 m	0 - 0.5 m	0 - 0.5 m
		Sample Type	N	N	FD
Analytes	**Method**	**CCME Marine PEL**			
Magnesium	SW6010C	--	**7220**	**4090**	**4160**
Manganese	SW6020A	--	**190**	**133**	**142**
Mercury	SW6020A	0.7	**0.08**	**0.22**	**0.29**
Molybdenum	SW6020A	--	**3.7**	**2.7**	**2.6**
Nickel	SW6020A	--	**20.2**	**13.6**	**13.3**
Potassium	SW6010C	--	**2190**	**863**	**885**
Selenium	SW6020A	--	**3.5**	**1**	**0.8**
Silver	SW6020A	--	0.5 U	0.5 U	0.5 U
Sodium	SW6010C	--	**9120**	**5580**	**5250**
Strontium	SW6020A	--	**89**	**49**	**48**
Thallium	SW6020A	--	**0.4**	**0.7**	**0.8**
Tin	SW6020A	--	**0.7**	**1.4**	**1.6**
Titanium	SW6010C	--	**1300**	**859**	**943**
Uranium (Uranium 238)	SW6020A	--	**1.8**	**1.1**	**1**
Vanadium	SW6020A	--	**50**	**38**	**38**
Zinc	SW6020A	271	**61**	**56**	**58**
Zirconium	SW6020A	--	**9.3**	**4**	**4.3**
Semivolatile Organics (µg/kg)					
Benzo(b)pyridine (Quinoline)	BCLM2015D-PAHS	--	50 U	50 U	50 U
Polycyclic Aromatic Hydrocarbons (µg/kg)					
1-Methylnaphthalene	BCLM2015D-PAHS	--	5 U	5 U	5 U
2-Methylnaphthalene	BCLM2015D-PAHS	201	5 U	5 U	5 U
Acenaphthene	BCLM2015D-PAHS	88.9	5 U	**14**	5 U
Acenaphthylene	BCLM2015D-PAHS	128	5 U	5 U	5 U
Anthracene	BCLM2015D-PAHS	245	4 U	**38**	**4**
Benzo(a)anthracene	BCLM2015D-PAHS	693	30 U	**50**	30 U
Benzo(a)pyrene	BCLM2015D-PAHS	763	30 U	**50**	30 U
Benzo(b)fluoranthene	BCLM2015D-PAHS	--	20 U	**60**	**20**
Benzo(g,h,i)perylene	BCLM2015D-PAHS	--	50 U	50 U	50 U
Benzo(j)fluoranthene	BCLM2015D-PAHS	--	20 U	**30**	20 U
Benzo(k)fluoranthene	BCLM2015D-PAHS	--	20 U	**40**	20 U

Table 6
Analytical Results Summary

		Location ID	EHWW-03	EHWW-03	EHWW-04	EHWW-06	EHWW-09
		Sample ID	EHWW-03-SC-000050	EHWW-03-SC-150200	EHWW-04-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010
		Sample Date	12/17/2018	12/17/2018	10/2/2018	10/1/2018	10/1/2018
		Depth	0 - 0.5 m	1.5 - 2 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	200 U	50 U	100 U	100 U	200 U
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	20 U	5 U	10 U	10 U	20 U
Fluoranthene	BCLM2015D-PAHS	1494	**500**	10 U	**160**	**240**	**250**
Fluorene	BCLM2015D-PAHS	144	60 U	20 U	40 U	40 U	60 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	60 U	20 U	40 U	**40**	60 U
Naphthalene	BCLM2015D-PAHS	391	20 U	5 U	**10**	**10**	20 U
Phenanthrene	BCLM2015D-PAHS	544	**80**	20 U	**60**	**90**	**90**
Pyrene	BCLM2015D-PAHS	1398	**560**	10 U	**160**	**300**	**260**
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.8 U	0.3 U	0.5 U	0.7 U	0.4 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	3 U	0.4 U	2 U	1 U	2 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	4 U	0.4 U	3 U	4 U	3 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**7**	0.4 U	3 U	6 U	**2**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	4 U	0.4 U	3 U	4 U	3 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**74**	0.4 U	**25**	**14**	**38**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**410**	**1**	**181**	**140**	**299**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**5.5**	**0.4**	**6.1**	**2.8**	**11.3**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**12**	0.4 U	**45**	**12**	**36**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**61**	**0.7**	**29**	**30**	**42**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**182**	**0.9**	**76**	**51**	**119**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	**3**	0.4 U	0.5 U	0.5 U	0.8 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	**2**	0.3 U	**1**	0.7 U	0.8 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	1 U	0.3 U	**1**	0.7 U	0.6 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**5**	0.2 U	**1**	0.8 U	**2**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**3**	0.2 U	1 U	0.7 U	**1**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	4 U	0.3 U	1 U	1 U	2 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**4**	0.2 U	**2**	2 U	1 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**63**	**0.6**	**29**	**9.1**	**40**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	2 U	0.5 U	**2**	0.6 U	2 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	**27**	0.6 U	**18**	**6**	**28**
Total Tetra-Furans	E1613	--	**40**	**0.8**	**11.2**	**5**	**11.3**

Table 6
Analytical Results Summary

		Location ID	EHWW-10	EHWW-14	EHWW-16	EHWW-16	EHWW-18
		Sample ID	EHWW-10-SG-000010	EHWW-14-SG-000010	EHWW-16-SC-152202	EHWW-116-SC-152202	EHWW-18-SG-000010
		Sample Date	10/3/2018	10/3/2018	12/18/2018	12/18/2018	10/2/2018
		Depth	0 - 0.1 m	0 - 0.1 m	1.52 - 2.02 m	1.52 - 2.02 m	0 - 0.1 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	**200**	100 U	50 U	50 U	100 U
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	**20**	10 U	5 U	5 U	10 U
Fluoranthene	BCLM2015D-PAHS	1494	**340**	**150**	10 U	10 U	**110**
Fluorene	BCLM2015D-PAHS	144	40 U	40 U	20 U	20 U	40 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	**80**	40 U	20 U	20 U	40 U
Naphthalene	BCLM2015D-PAHS	391	**10**	10 U	5 U	5 U	10 U
Phenanthrene	BCLM2015D-PAHS	544	**150**	**60**	20 U	20 U	**40**
Pyrene	BCLM2015D-PAHS	1398	**320**	**160**	10 U	10 U	**190**
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.9 U	0.5 U	0.3 U	0.3 U	0.9 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	5 U	0.6 U	0.6 U	0.4 U	3 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**3**	2 U	0.5 U	0.2 U	2 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**4**	2 U	0.5 U	0.2 U	**7**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**3**	2 U	0.5 U	0.2 U	**3**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**57**	**14**	0.6 U	0.5 U	**70**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**463**	**104**	**3.1**	**1**	**432**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**5.4**	**1.5**	**0.5**	**0.4**	**28.3**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**17**	**13**	**3.2**	**0.9**	**78**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**29**	**18**	**1.9**	**1.7**	**120**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**116**	**46**	**4.1**	**2.4**	**168**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	2 U	0.4 U	0.4 U	0.4 U	**3**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	2 U	0.9 U	0.3 U	0.4 U	**1**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	3 U	0.8 U	0.4 U	0.7 U	**2.1**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	10 U	**17**	0.2 U	0.3 U	**3**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	10 U	**8**	0.2 U	0.3 U	**3**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	2 U	3 U	0.3 U	0.4 U	2 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	20 U	**5**	0.2 U	0.3 U	**2**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**20**	**423**	0.4 U	0.4 U	**73**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	2 U	**10**	0.9 U	0.5 U	3 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	**25**	**196**	0.7 U	0.8 U	**27**
Total Tetra-Furans	E1613	--	**14**	**2.9**	0.4 U	**0.7**	**31**

Table 6
Analytical Results Summary

		Location ID	EHWW-19	EHWW-24	EHWW-30	EHWW-33	EHWW-36
		Sample ID	EHWW-19-SG-000010	EHWW-24-SC-045095	EHWW-30-SG-000010	EHWW-33-SG-000010	EHWW-36-SC-000050
		Sample Date	10/2/2018	12/18/2018	10/3/2018	10/3/2018	12/17/2018
		Depth	0 - 0.1 m	0.45 - 0.95 m	0 - 0.1 m	0 - 0.1 m	0 - 0.5 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	**100**	50 U	**100**	**60**	**300**
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	10 U	5 U	**10**	**7**	**20**
Fluoranthene	BCLM2015D-PAHS	1494	**190**	10 U	**330**	**150**	**820**
Fluorene	BCLM2015D-PAHS	144	40 U	20 U	40 U	20 U	60 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	40 U	20 U	**60**	**30**	**110**
Naphthalene	BCLM2015D-PAHS	391	10 U	5 U	**10**	**7**	**60**
Phenanthrene	BCLM2015D-PAHS	544	**60**	20 U	**170**	**70**	**230**
Pyrene	BCLM2015D-PAHS	1398	**230**	10 U	**340**	**160**	**1810**
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.5 U	0.3 U	0.4 U	0.4 U	1 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	1 U	0.4 U	1 U	2 U	2 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	2 U	0.5 U	2 U	0.9 U	**3**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**3**	0.5 U	2 U	**2.1**	**13**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	2 U	0.5 U	2 U	**1**	5 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**31**	0.7 U	**42**	**25**	**191**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**249**	**1.1**	**314**	**192**	**948**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**5.5**	**0.6**	**3.3**	**4.2**	**14**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**16**	**0.9**	**10**	**10**	**25**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**35**	**1.5**	**29**	**35.4**	**120**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**93**	**1.2**	**146**	**71**	**405**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	**1.2**	0.4 U	0.6 U	0.6 U	**3**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	**0.9**	0.2 U	0.8 U	2 U	3 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	**1.5**	0.3 U	**1.1**	**1**	**4**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**2.9**	0.2 U	**1**	**1.2**	**8**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**1.8**	0.2 U	1 U	**1.3**	**5**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	1 U	0.3 U	2 U	0.9 U	8 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**2**	0.2 U	1 U	**1.2**	**6**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**79.3**	0.4 U	**11**	**19**	**134**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	**2**	0.5 U	2 U	3 U	**6**
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	**27**	0.5 U	**13**	**12.7**	**74**
Total Tetra-Furans	E1613	--	**12.7**	**0.6**	**9**	**10.6**	**75**

Table 6
Analytical Results Summary

		Location ID	EHWW-36	EHWW-38	EHWW-38	EHWW-39	EHWW-39
		Sample ID	EHWW-36-SC-183233	EHWW-38-SC-000050	EHWW-38-SC-050100	EHWW-39-SG-000010	EHWW-39-SC-035085
		Sample Date	12/17/2018	12/17/2018	12/17/2018	10/1/2018	12/18/2018
		Depth	1.83 - 2.33 m	0 - 0.5 m	0.5 - 1 m	0 - 0.1 m	0.35 - 0.85 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	50 U	100 U	50 U	100 U	50 U
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	5 U	10 U	5 U	**10**	5 U
Fluoranthene	BCLM2015D-PAHS	1494	10 U	**90**	10 U	**240**	10 U
Fluorene	BCLM2015D-PAHS	144	20 U	40 U	20 U	40 U	20 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	20 U	40 U	20 U	**40**	20 U
Naphthalene	BCLM2015D-PAHS	391	5 U	10 U	5 U	**20**	5 U
Phenanthrene	BCLM2015D-PAHS	544	**30**	**60**	20 U	**80**	20 U
Pyrene	BCLM2015D-PAHS	1398	10 U	**110**	10 U	**310**	10 U
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	**0.8**	0.3 U	0.6 U	0.3 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	0.4 U	**1**	0.7 U	**5**	0.6 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.3 U	3 U	0.3 U	**4**	0.7 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.3 U	**3**	0.3 U	**13**	0.6 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.3 U	3 U	0.3 U	**5**	0.7 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	0.5 U	**16**	0.7 U	**111**	**2.6**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**6**	**105**	**0.5**	**712**	**4**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	**2.6**	0.3 U	**68.5**	**0.7**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**0.4**	**6**	**3.1**	**137**	**2.8**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**1.2**	**11**	**2.4**	**189**	**3.2**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**1.4**	**45**	**2**	**322**	**5.9**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	0.4 U	**3**	0.4 U	**9.4**	0.6 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.2 U	**3**	0.2 U	**3**	**1**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.3 U	**2**	0.3 U	**5**	0.7 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.2 U	**3**	0.3 U	**6**	**4**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.2 U	**3**	0.3 U	**5**	**2**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.4 U	2 U	0.7 U	4 U	2 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.2 U	2 U	0.3 U	**3**	1 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	0.4 U	**25**	0.4 U	**71**	**63**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	0.5 U	3 U	0.5 U	**2**	2 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	0.6 U	0.6 U	2 U	**34**	**14**
Total Tetra-Furans	E1613	--	**0.4**	**21.9**	**0.6**	**106.7**	**5.5**

Table 6
Analytical Results Summary

		Location ID	EHWW-40	EHWW-40	EHWW-42	EHWW-44	EHWW-44
		Sample ID	EHWW-40-SC-000050	EHWW-40-SC-060110	EHWW-42-SG-000010	EHWW-44-SG-000010	EHWW-44-SC-017067
		Sample Date	12/18/2018	12/18/2018	10/2/2018	10/4/2018	12/19/2018
		Depth	0 - 0.5 m	0.6 - 1.1 m	0 - 0.1 m	0 - 0.1 m	0.17 - 0.67 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	**300**	50 U	100 U	100 U	50 U
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	20 U	5 U	10 U	**10**	5 U
Fluoranthene	BCLM2015D-PAHS	1494	**1030**	**10**	**140**	**170**	10 U
Fluorene	BCLM2015D-PAHS	144	60 U	20 U	40 U	40 U	20 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	**70**	20 U	40 U	**40**	20 U
Naphthalene	BCLM2015D-PAHS	391	**110**	5 U	10 U	**10**	5 U
Phenanthrene	BCLM2015D-PAHS	544	**400**	20 U	**60**	**50**	20 U
Pyrene	BCLM2015D-PAHS	1398	**1120**	**10**	**150**	**350**	10 U
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**7.2**	0.3 U	0.8 U	0.5 U	0.3 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**22**	0.4 U	**0.8**	**1.6**	0.4 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**29**	0.6 U	3 U	2 U	0.3 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**91**	0.6 U	**4**	**11**	0.3 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**61**	0.5 U	3 U	**3**	0.3 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**388**	**0.6**	**44**	**76**	0.8 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**1170**	**1.3**	**291**	**381**	**1.9**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**230**	**0.3**	**7.7**	**10.1**	**0.3**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**728**	0.4 U	**21.2**	**27.3**	**1.4**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**1320**	**1.4**	**50**	**120**	**2.1**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**1430**	**1.8**	**109**	**359**	**1.2**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	**23**	0.4 U	**2**	**2**	0.4 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	**13**	0.8 U	2 U	1 U	0.3 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	**24**	1 U	**2**	**2**	0.3 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**14**	0.3 U	**3**	**3**	0.3 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**14**	0.3 U	**2**	**1.8**	0.3 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	10 U	0.6 U	2 U	2 U	0.5 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**14**	0.7 U	**2**	**1.8**	0.3 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**95**	**2.9**	**53**	**53**	**0.6**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	10 U	0.5 U	3 U	4 U	0.7 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	**16**	0.5 U	**20**	**10**	0.5 U
Total Tetra-Furans	E1613	--	**387**	**2.2**	**22**	**19**	**0.4**

Table 6
Analytical Results Summary

		Location ID	EHWW-45	EHWW-46	EHWW-48	EHWW-48	EHWW-53
		Sample ID	EHWW-45-SG-000010	EHWW-46-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-53-SC-000016
		Sample Date	10/4/2018	10/4/2018	10/2/2018	10/2/2018	12/19/2018
		Depth	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.16 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	100 U	100 U	100 U	**100**	50 U
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	10 U	10 U	10 U	10 U	5 U
Fluoranthene	BCLM2015D-PAHS	1494	**110**	**100**	**110 J**	**530 J**	**50**
Fluorene	BCLM2015D-PAHS	144	40 U	40 U	40 U	40 U	20 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	40 U	40 U	40 U	40 U	**20**
Naphthalene	BCLM2015D-PAHS	391	10 U	10 U	10 U	10 U	5 U
Phenanthrene	BCLM2015D-PAHS	544	40 U	40 U	**40**	**80**	**30**
Pyrene	BCLM2015D-PAHS	1398	**120**	**100**	**130 J**	**450 J**	**80**
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	0.2 U	0.3 U	0.2 U	0.8 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	3 U	2 U	**0.9**	2 U	2 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	3 U	5 U	2 U	3 U	3 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	3 U	4 U	2 U	3 U	**4**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	3 U	5 U	2 U	3 U	3 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**98**	**19**	**11**	**22**	**41**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**1390**	**149**	**121**	**123**	**227**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**3.1**	**0.8**	**1.5**	**2.4**	**9.3**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**13**	**10**	**14.3**	**11**	**10**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**18**	**16**	**19**	**24**	**12**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**224**	**74**	**35 J**	**74 J**	**47**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	**1.2**	0.4 U	**1.1**	0.5 U	2 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.6 U	1 U	**1.2**	0.6 U	3 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.5 U	1 U	0.5 U	0.5 U	2 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**1.1**	1 U	0.8 U	2 U	**3**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.8 U	1 U	**0.8**	2 U	3 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	1 U	0.7 U	1 U	3 U	5 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	1 U	6 U	0.9 U	2 U	3 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**20**	**14.5**	**19**	**16**	**55**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	2 U	0.7 U	2 U	2 U	2 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	**33**	**10**	**12**	**10**	4 U
Total Tetra-Furans	E1613	--	**10.5**	**4.1**	**6.1**	**4.5**	**26**

Table 6
Analytical Results Summary

		Location ID	EHWW-53	EHWW-53	EHWW-54	EHWW-54	EHWW-54
		Sample ID	EHWW-53-SC-016066	EHWW-53-SC-066116	EHWW-54-SC-000050	EHWW-54-SC-055105	EHWW-54-SC-105155
		Sample Date	12/19/2018	12/19/2018	12/18/2018	12/18/2018	12/18/2018
		Depth	0.16 - 0.66 m	0.66 - 1.16 m	0 - 0.5 m	0.55 - 1.05 m	1.05 - 1.55 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	50 U	--	100 U	50 U	--
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	5 U	--	10 U	5 U	--
Fluoranthene	BCLM2015D-PAHS	1494	10 U	--	**50**	10 U	--
Fluorene	BCLM2015D-PAHS	144	20 U	--	40 U	20 U	--
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	20 U	--	40 U	20 U	--
Naphthalene	BCLM2015D-PAHS	391	5 U	--	10 U	5 U	--
Phenanthrene	BCLM2015D-PAHS	544	20 U	--	40 U	20 U	--
Pyrene	BCLM2015D-PAHS	1398	10 U	--	**60**	10 U	
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	--	0.4 U	0.3 U	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	0.4 U	--	0.9 U	0.4 U	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.5 U	--	0.9 U	1 U	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.5 U	--	**1.8**	0.9 U	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.5 U	--	0.9 U	0.9 U	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**0.7**	--	**14**	1 U	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**2**	--	**82**	**1.1**	--
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	--	**5.4**	0.3 U	--
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**1.6**	--	**11.3**	**1.1**	--
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**1.8**	--	**15.5**	**2**	--
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**2.3**	--	**14**	**4**	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	0.4 U	--	0.9 U	0.4 U	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.3 U	--	1 U	0.3 U	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.4 U	--	**1**	0.3 U	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.2 U	--	**3**	0.2 U	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.2 U	--	1 U	0.2 U	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.4 U	--	2 U	0.3 U	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	**0.3**	--	**2**	0.2 U	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	0.4 U	--	**62**	0.4 U	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	0.5 U	--	6 U	0.5 U	--
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	0.5 U	--	5 U	0.5 U	--
Total Tetra-Furans	E1613	--	**0.8**	--	**23.7**	0.4 U	--

Table 6
Analytical Results Summary

		Location ID	EHWW-55	EHWW-56	EHWW-57	EHWW-58	EHWW-58
		Sample ID	EHWW-55-SC-110160	EHWW-56-SC-000050	EHWW-57-SC-000050	EHWW-58-SC-361411	EHWW-58-SC-411461
		Sample Date	12/19/2018	12/17/2018	12/17/2018	12/16/2018	12/16/2018
		Depth	1.1 - 1.6 m	0 - 0.5 m	0 - 0.5 m	3.61 - 4.11 m	4.11 - 4.61 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Chrysene	BCLM2015D-PAHS	846	50 U	50 U	200 U	50 U	--
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	5 U	5 U	20 U	5 U	--
Fluoranthene	BCLM2015D-PAHS	1494	**60**	**40**	**290**	10 U	--
Fluorene	BCLM2015D-PAHS	144	20 U	20 U	80 U	20 U	--
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	**20**	20 U	80 U	20 U	--
Naphthalene	BCLM2015D-PAHS	391	5 U	5 U	20 U	5 U	--
Phenanthrene	BCLM2015D-PAHS	544	**40**	20 U	80 U	20 U	--
Pyrene	BCLM2015D-PAHS	1398	**60**	**40**	**220**	10 U	--
Dioxins/Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	0.2 U	1 U	0.3 U	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	0.6 U	0.6 U	**13**	0.7 U	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.7 U	0.8 U	6 U	0.3 U	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.7 U	**1.7**	5 U	0.3 U	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.7 U	0.7 U	5 U	0.3 U	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**1**	**22.1**	**43**	0.4 U	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**7.6**	**102**	**308**	0.6 U	--
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	**4.2**	**96**	0.3 U	--
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**1.8**	**6.6**	**114**	**1.4**	--
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**2.5**	**19.8**	**104**	**2.1**	--
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**4**	**48.8**	**790**	**2.5**	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	0.5 U	0.5 U	3 U	0.4 U	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	1 U	0.9 U	**49**	0.3 U	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.8 U	**0.9**	**30**	0.4 U	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.8 U	**1.1**	**42**	0.2 U	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.8 U	**0.8**	**10**	0.2 U	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	2 U	2 U	10 U	0.4 U	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.9 U	1 U	**15**	0.2 U	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**4.3**	**11.9**	**65**	0.4 U	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	1 U	0.8 U	**20**	0.5 U	--
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	0.8 U	**5**	10 U	1 U	--
Total Tetra-Furans	E1613	--	**1.6**	**7.6**	**111**	0.4 U	--

Table 6
Analytical Results Summary

		Location ID	EHWW-59	EHWW-65	EHWW-65
		Sample ID	EHWW-59-SC-038088	EHWW-65-SC-000050	EHWW-165-SC-000050
		Sample Date	12/19/2018	12/19/2018	12/19/2018
		Depth	0.38 - 0.88 m	0 - 0.5 m	0 - 0.5 m
		Sample Type	N	N	FD
Analytes	**Method**	**CCME Marine PEL**			
Chrysene	BCLM2015D-PAHS	846	50 U	50 U	50 U
Dibenzo(a,h)anthracene	BCLM2015D-PAHS	135	5 U	**7**	5 U
Fluoranthene	BCLM2015D-PAHS	1494	10 U	**140**	**20**
Fluorene	BCLM2015D-PAHS	144	20 U	20 U	20 U
Indeno(1,2,3-c,d)pyrene	BCLM2015D-PAHS	--	20 U	**30**	20 U
Naphthalene	BCLM2015D-PAHS	391	5 U	5 U	5 U
Phenanthrene	BCLM2015D-PAHS	544	20 U	**120**	20 U
Pyrene	BCLM2015D-PAHS	1398	10 U	**120**	**20**
Dioxins/Furans (ng/kg)					
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	0.3 U	0.3 U	0.4 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	0.4 U	0.5 U	0.6 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.5 U	1 U	1 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.5 U	1 U	**1**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	0.5 U	1 U	1 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	1 U	**10**	**10**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613	--	**5**	**61**	**79**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613	--	**0.6**	**0.8**	**0.5**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613	--	**1.1**	**0.8**	**2.2**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613	--	**2**	**8**	**3**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613	--	**4**	**25 J**	**14 J**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613	--	0.4 U	0.5 U	0.6 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.4 U	0.8 U	0.5 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613	--	0.3 U	0.7 U	**1**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.3 U	**1.3**	**1.3**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.3 U	**0.6**	0.4 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.6 U	0.8 U	0.6 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613	--	0.3 U	0.6 U	**0.9**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613	--	**0.8**	**12**	**17.5**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613	--	0.5 U	2 U	1 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613	--	0.5 U	1 U	0.9 U
Total Tetra-Furans	E1613	--	**1**	**8**	**7.2**

Table 6
Analytical Results Summary

		Location ID	EHWW-03	EHWW-03	EHWW-04	EHWW-06	EHWW-09
		Sample ID	EHWW-03-SC-000050	EHWW-03-SC-150200	EHWW-04-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010
		Sample Date	12/17/2018	12/17/2018	10/2/2018	10/1/2018	10/1/2018
		Depth	0 - 0.5 m	1.5 - 2 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**14**	**0.4**	**9**	**2.5**	**5.2**
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**72**	0.3 U	**21**	**7**	**26**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**127**	**0.9**	**56**	**18.8**	**78**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**5.6**	**0.6**	**3.3**	**2.5**	**3.1**
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	--	--	50 U	50 U	50 U
Aroclor 1221	SW8082	--	--	--	50 U	50 U	50 U
Aroclor 1232	SW8082	--	--	--	50 U	50 U	50 U
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1248	SW8082	--	--	--	50 U	50 U	50 U
Aroclor 1254	SW8082	709	50 U	50 U	50 U	50 U	50 U
Aroclor 1260	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1262	SW8082	--	--	--	50 U	50 U	50 U
Aroclor 1268	SW8082	--	--	--	50 U	50 U	50 U
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	50 U	50 U	50 U

Table 6
Analytical Results Summary

		Location ID	EHWW-10	EHWW-14	EHWW-16	EHWW-16	EHWW-18
		Sample ID	EHWW-10-SG-000010	EHWW-14-SG-000010	EHWW-16-SC-152202	EHWW-116-SC-152202	EHWW-18-SG-000010
		Sample Date	10/3/2018	10/3/2018	12/18/2018	12/18/2018	10/2/2018
		Depth	0 - 0.1 m	0 - 0.1 m	1.52 - 2.02 m	1.52 - 2.02 m	0 - 0.1 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**5**	**10**	0.4 U	**0.7**	**22**
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	20 U	**115**	0.3 U	**0.6**	**53**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**24**	**706**	0.9 U	**0.5**	**131**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**7.8**	**8.8**	**0.7**	**0.7**	**5.6**
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	50 U	50 U	--	--	50 U
Aroclor 1221	SW8082	--	50 U	50 U	--	--	50 U
Aroclor 1232	SW8082	--	50 U	50 U	--	--	50 U
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1248	SW8082	--	50 U	50 U	--	--	50 U
Aroclor 1254	SW8082	709	**80**	50 U	50 U	50 U	50 U
Aroclor 1260	SW8082	--	**50**	50 U	50 U	50 U	50 U
Aroclor 1262	SW8082	--	50 U	50 U	--	--	50 U
Aroclor 1268	SW8082	--	50 U	50 U	--	--	50 U
Total 7 PCB Aroclors (U = 1/2)	--	189	**255**	50 U	50 U	50 U	50 U

Table 6
Analytical Results Summary

		Location ID	EHWW-19	EHWW-24	EHWW-30	EHWW-33	EHWW-36
		Sample ID	EHWW-19-SG-000010	EHWW-24-SC-045095	EHWW-30-SG-000010	EHWW-33-SG-000010	EHWW-36-SC-000050
		Sample Date	10/2/2018	12/18/2018	10/3/2018	10/3/2018	12/17/2018
		Depth	0 - 0.1 m	0.45 - 0.95 m	0 - 0.1 m	0 - 0.1 m	0 - 0.5 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**10.2**	0.3 U	**6.4**	**6**	**43**
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**47**	0.3 U	**11**	**18**	**217**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**135**	0.5 U	**24**	**37**	**370**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**3.7**	**0.6**	**2.3**	**2.7**	**9.4**
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1221	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1232	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1248	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1254	SW8082	709	50 U	50 U	**150**	50 U	50 U
Aroclor 1260	SW8082	--	50 U	50 U	**70**	50 U	50 U
Aroclor 1262	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1268	SW8082	--	50 U	--	50 U	50 U	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	**345**	50 U	50 U

Table 6
Analytical Results Summary

		Location ID	EHWW-36	EHWW-38	EHWW-38	EHWW-39	EHWW-39
		Sample ID	EHWW-36-SC-183233	EHWW-38-SC-000050	EHWW-38-SC-050100	EHWW-39-SG-000010	EHWW-39-SC-035085
		Sample Date	12/17/2018	12/17/2018	12/17/2018	10/1/2018	12/18/2018
		Depth	1.83 - 2.33 m	0 - 0.5 m	0.5 - 1 m	0 - 0.1 m	0.35 - 0.85 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	0.3 U	**18**	0.3 U	**50**	**8**
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	0.4 U	**26**	0.7 U	**78**	**14**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	0.5 U	**46**	0.5 U	**134**	**93**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**0.6**	**5.0**	**0.8**	**13.1**	**2.3**
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	--	--	--	50 U	--
Aroclor 1221	SW8082	--	--	--	--	50 U	--
Aroclor 1232	SW8082	--	--	--	--	50 U	--
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1248	SW8082	--	--	--	--	50 U	--
Aroclor 1254	SW8082	709	50 U	50 U	50 U	50 U	50 U
Aroclor 1260	SW8082	--	50 U	50 U	50 U	**80**	50 U
Aroclor 1262	SW8082	--	--	--	--	50 U	--
Aroclor 1268	SW8082	--	--	--	--	50 U	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	50 U	**230**	50 U

Table 6
Analytical Results Summary

		Location ID	EHWW-40	EHWW-40	EHWW-42	EHWW-44	EHWW-44
		Sample ID	EHWW-40-SC-000050	EHWW-40-SC-060110	EHWW-42-SG-000010	EHWW-44-SG-000010	EHWW-44-SC-017067
		Sample Date	12/18/2018	12/18/2018	10/2/2018	10/4/2018	12/19/2018
		Depth	0 - 0.5 m	0.6 - 1.1 m	0 - 0.1 m	0 - 0.1 m	0.17 - 0.67 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**157**	1 U	**11**	**12**	0.3 U
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**223**	**1**	**37**	**39**	**0.7**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**158**	**4.2**	**91**	**91**	**1.4**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**65.2**	**0.9**	**4.6**	**5.0**	**0.6**
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	--	--	50 U	50 U	--
Aroclor 1221	SW8082	--	--	--	50 U	50 U	--
Aroclor 1232	SW8082	--	--	--	50 U	50 U	--
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1248	SW8082	--	--	--	50 U	50 U	--
Aroclor 1254	SW8082	709	50 U	50 U	50 U	50 U	50 U
Aroclor 1260	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1262	SW8082	--	--	--	50 U	50 U	--
Aroclor 1268	SW8082	--	--	--	50 U	50 U	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	50 U	50 U	50 U

Table 6
Analytical Results Summary

		Location ID	EHWW-45	EHWW-46	EHWW-48	EHWW-48	EHWW-53
		Sample ID	EHWW-45-SG-000010	EHWW-46-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-53-SC-000016
		Sample Date	10/4/2018	10/4/2018	10/2/2018	10/2/2018	12/19/2018
		Depth	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.1 m	0 - 0.16 m
		Sample Type	N	N	N	FD	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**4.5**	**2**	**2.6**	**2.7**	**16**
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**14**	**12**	**9**	**10**	**34**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**52**	**27.8**	**33**	**29**	**90**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**3.3**	**3.3**	**2.2**	**2.7**	**4.3**
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1221	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1232	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1248	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1254	SW8082	709	50 U	50 U	50 U	50 U	50 U
Aroclor 1260	SW8082	--	50 U	50 U	50 U	50 U	50 U
Aroclor 1262	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1268	SW8082	--	50 U	50 U	50 U	50 U	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	50 U	50 U	50 U

Table 6
Analytical Results Summary

		Location ID	EHWW-53	EHWW-53	EHWW-54	EHWW-54	EHWW-54
		Sample ID	EHWW-53-SC-016066	EHWW-53-SC-066116	EHWW-54-SC-000050	EHWW-54-SC-055105	EHWW-54-SC-105155
		Sample Date	12/19/2018	12/19/2018	12/18/2018	12/18/2018	12/18/2018
		Depth	0.16 - 0.66 m	0.66 - 1.16 m	0 - 0.5 m	0.55 - 1.05 m	1.05 - 1.55 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**0.5**	--	**11**	**0.5**	--
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**0.7**	--	**39**	0.3 U	--
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	0.5 U	--	**92**	0.5 U	--
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**0.7**	--	**2.8**	**0.8**	--
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	--	--	--	--	--
Aroclor 1221	SW8082	--	--	--	--	--	--
Aroclor 1232	SW8082	--	--	--	--	--	--
Aroclor 1242	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1248	SW8082	--	--	--	--	--	--
Aroclor 1254	SW8082	709	50 U	--	50 U	50 U	--
Aroclor 1260	SW8082	--	50 U	--	50 U	50 U	--
Aroclor 1262	SW8082	--	--	--	--	--	--
Aroclor 1268	SW8082	--	--	--	--	--	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	--	50 U	50 U	--

Table 6
Analytical Results Summary

		Location ID	EHWW-55	EHWW-56	EHWW-57	EHWW-58	EHWW-58
		Sample ID	EHWW-55-SC-110160	EHWW-56-SC-000050	EHWW-57-SC-000050	EHWW-58-SC-361411	EHWW-58-SC-411461
		Sample Date	12/19/2018	12/17/2018	12/17/2018	12/16/2018	12/16/2018
		Depth	1.1 - 1.6 m	0 - 0.5 m	0 - 0.5 m	3.61 - 4.11 m	4.11 - 4.61 m
		Sample Type	N	N	N	N	N
Analytes	**Method**	**CCME Marine PEL**					
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	1 U	**4.4**	**330**	**0.5**	--
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**4**	**19**	**437**	0.4 U	--
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**5**	**33.5**	**509**	**1**	--
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**1.1**	**1.6**	**40.7**	0.7 U	--
PCB Aroclors (µg/kg)							
Aroclor 1016	SW8082	--	--	--	--	--	--
Aroclor 1221	SW8082	--	--	--	--	--	--
Aroclor 1232	SW8082	--	--	--	--	--	--
Aroclor 1242	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1248	SW8082	--	--	--	--	--	--
Aroclor 1254	SW8082	709	50 U	50 U	50 U	50 U	--
Aroclor 1260	SW8082	--	50 U	50 U	50 U	50 U	--
Aroclor 1262	SW8082	--	--	--	--	--	--
Aroclor 1268	SW8082	--	--	--	--	--	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	50 U	50 U	--

Table 6
Analytical Results Summary

		Location ID	EHWW-59	EHWW-65	EHWW-65
		Sample ID	EHWW-59-SC-038088	EHWW-65-SC-000050	EHWW-165-SC-000050
		Sample Date	12/19/2018	12/19/2018	12/19/2018
		Depth	0.38 - 0.88 m	0 - 0.5 m	0 - 0.5 m
		Sample Type	N	N	FD
Analytes	**Method**	**CCME Marine PEL**			
Total Pentachlorodibenzofuran (PeCDF)	E1613	--	**1.5**	**2.9**	**3.7**
Total Hexachlorodibenzofuran (HxCDF)	E1613	--	**0.6**	**9.4**	**12.7**
Total Heptachlorodibenzofuran (HpCDF)	E1613	--	**1.1**	**20**	**28**
Total Dioxin/Furan TEQ 1998 (Fish) (U = 1/2)	--	21.5	**0.7**	**1.3**	**1.8**
PCB Aroclors (µg/kg)					
Aroclor 1016	SW8082	--	--	--	--
Aroclor 1221	SW8082	--	--	--	--
Aroclor 1232	SW8082	--	--	--	--
Aroclor 1242	SW8082	--	50 U	50 U	50 U
Aroclor 1248	SW8082	--	--	--	--
Aroclor 1254	SW8082	709	50 U	50 U	50 U
Aroclor 1260	SW8082	--	50 U	50 U	50 U
Aroclor 1262	SW8082	--	--	--	--
Aroclor 1268	SW8082	--	--	--	--
Total 7 PCB Aroclors (U = 1/2)	--	189	50 U	50 U	50 U

Table 6
Analytical Results Summary

Notes:

1. Sulphide was calculated by subtracting sulphate from total sulphur (method INOR-181-6027, INOR-181-6028, and ARD-181-18009).

Totals are calculated as the sum of all detected results and half of the reporting limit of nondetect results (U=1/2). If all results are not detected, the highest limit value is reported as the sum.

Dioxin/furan TEQ values were calculated with 1998 World Health Organization toxicity equivalency factor values for fish.

Total 7 PCB Aroclors is the sum of Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260.

U.S. Environmental Protection Agency Stage 2A data validation was completed by Anchor QEA.

Detected concentration is greater than CCME Marine PEL screening level

Bold: Detected result

--: results not reported or not applicable

µg/kg: micrograms per kilogram

µg/L: micrograms per litre

CCME: Canadian Council of Ministers of the Environment

FD: field duplicate sample

J: Estimated value

m: metre

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

N: normal environmental sample

ng/kg: nanograms per kilogram

NP: non-plastic

PCB: polychlorinated biphenyls

pct: percent

PEL: probable effects level

TEQ: Toxic Equivalents Quotient

U: Compound analyzed, but not detected above detection limit

Figures

Publish Date: 2019/02/13, 10:54 AM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\DataMemorandum\Fig1_SiteAndVicinityMap.mxd

ANCHOR QEA

Figure 1
Esquimalt Harbour Sites and Vicinity Map
Wood Waste Remediation Project Data Memorandum

LEGEND:

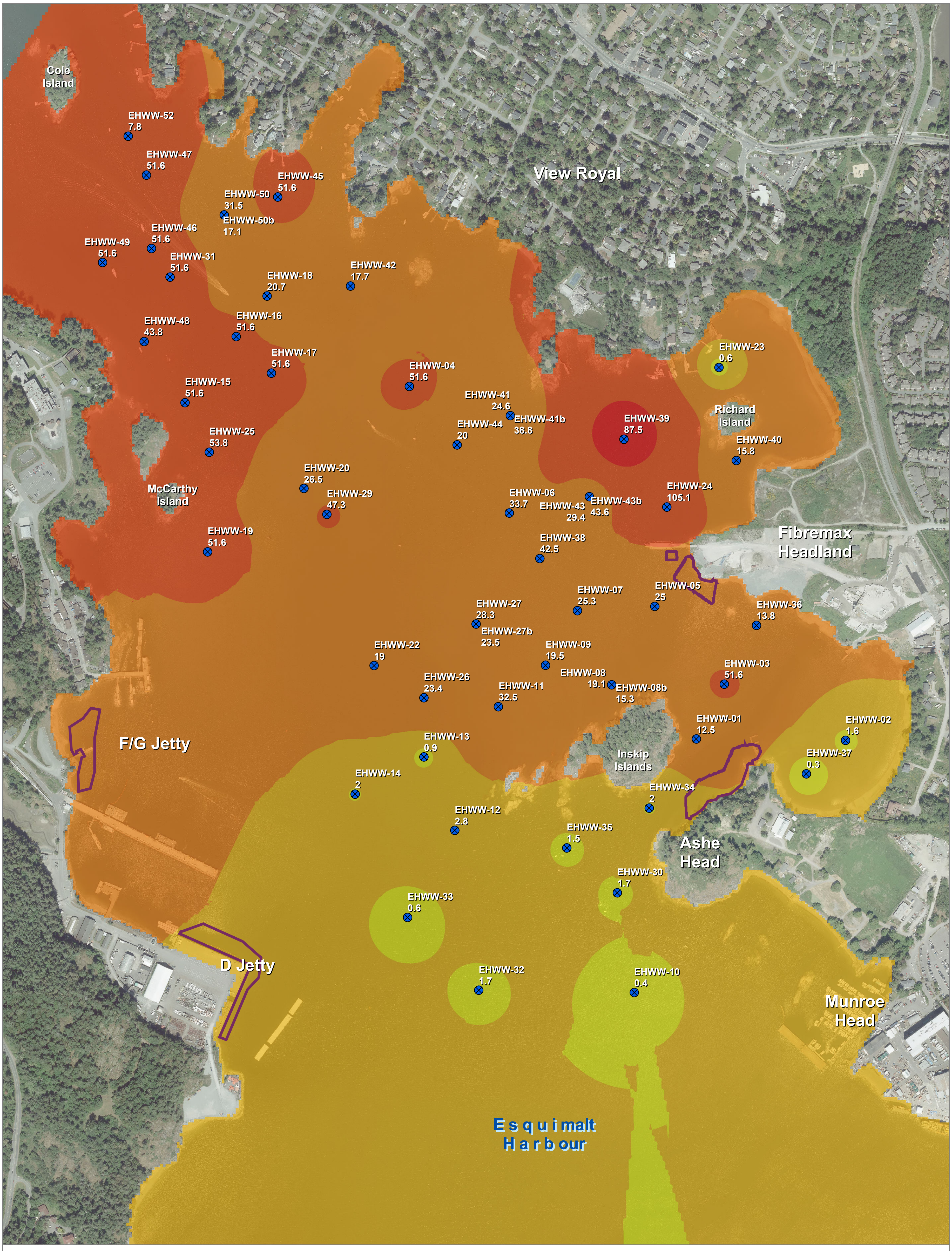
- DGT Sample Location
- Diver Observation Location
- December Dive Transect
- Sonic Boring
- Sonic Boring, Bench Scale
- Bathy Contours Chart Datum (1-metre interval)
- Completed Remediation Projects

0 200
Metres

Publish Date: 2019/02/25, 4:41 PM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\DataMemorandum\Fig2_WoodWasteAdditionalSampling.mxd

ANCHOR QEA

Figure 2
Sample and Survey Locations
Wood Waste Remediation Project Data Memorandum



LEGEND:

- DGT Sample Location
- Completed Remediation Projects

DGT Sulphide Interpolation

- 0.3 - 2.2
- 2.3 - 11.6
- 11.7 - 45.2
- 45.3 - 123
- 123.1 - 206.4

NOTES:

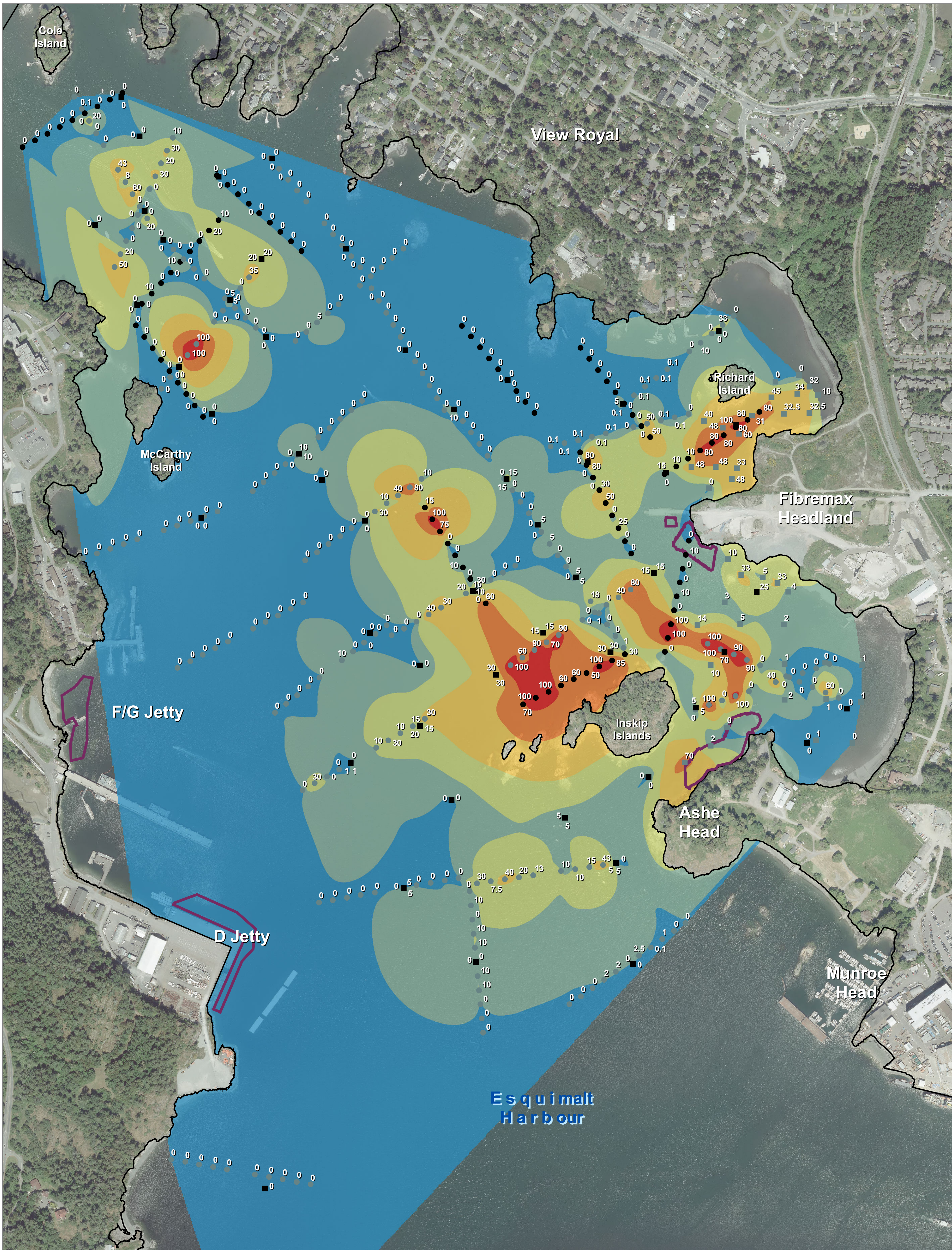
1. The sulphide interpolation was created using Inverse Distance Weighted methodology.
2. Locations with a "b" suffix are from December 2018. All other concentrations are from October 2018.

0 200
Metres

Publish Date: 2019/02/25, 4:59 PM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\DataMemorandum\Fig3_WoodWasteDGTPorewaterSulphide.mxd

ANCHOR QEA

Figure 3
DGT Porewater Sulphide Results
Wood Waste Remediation Project Data Memorandum



LEGEND:

- Anchor QEA Dive Survey
- Anchor QEA Grab Sample
- Hemmera Dive Survey
- SNC Grab/Core Sample
- Completed Remediation Projects

Wood Waste (% Cover)

- 0 - 1
- 1.1 - 10
- 10.1 - 25
- 25.1 - 50
- 50.1 - 75
- 75.1 - 100

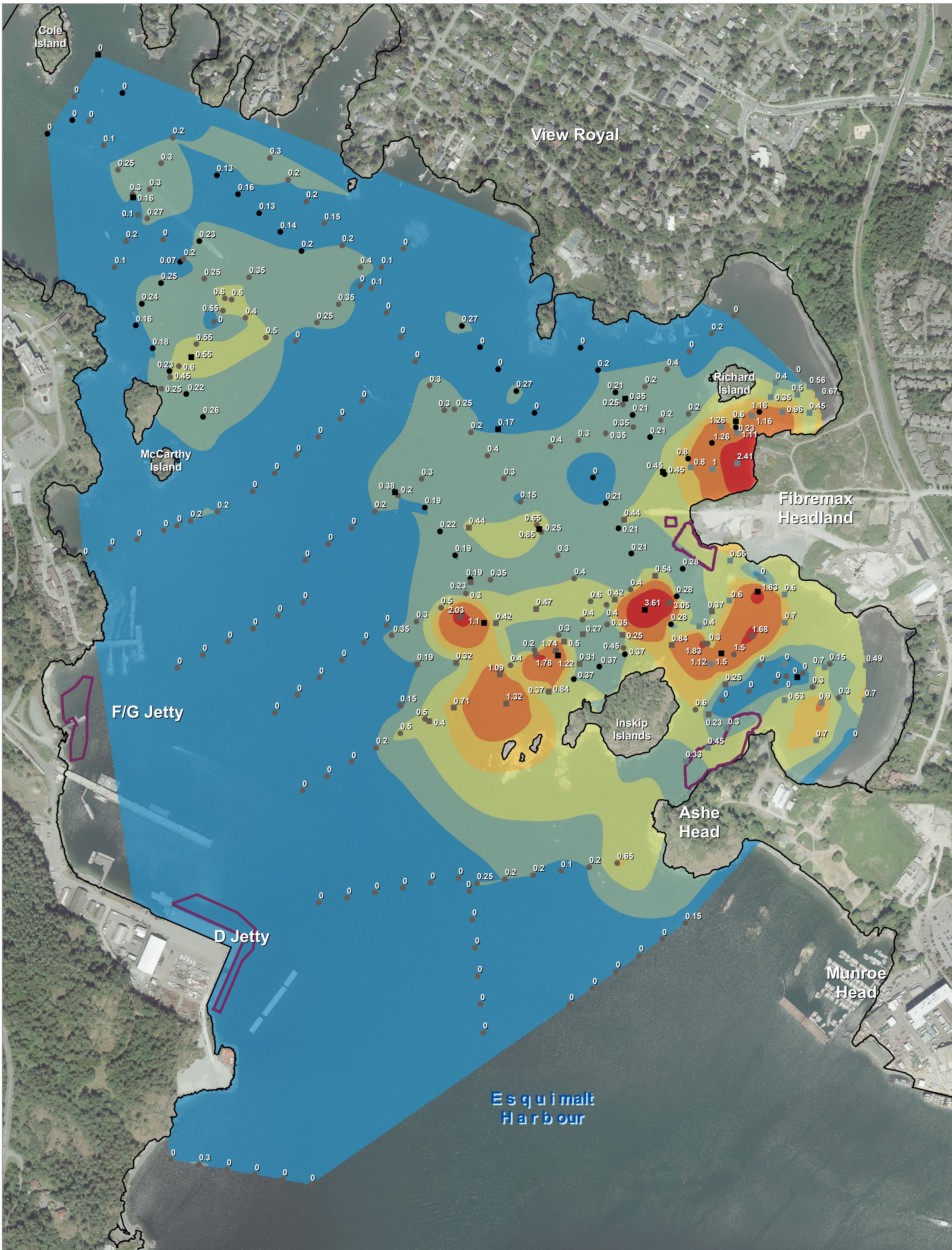
NOTE:
The wood waste percent cover was created using a Natural Neighbor interpolation method.

0 200
Metres

Publish Date: 2019/02/25, 5:15 PM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\DataMemorandum\WoodWaste_Interpolations.mxd

ANCHOR QEA

Figure 4
Wood Waste Percent Cover in Esquimalt Harbour
Wood Waste Remediation Project Data Memorandum



LEGEND:

- Anchor QEA Dive Survey
- Anchor QEA Boring Location
- Hemmera Boring Location
- Hemmera Dive Survey
- SNC Core Location
- Completed Remediation Projects

Wood Waste Thickness (metres)

- 0 - 0.2
- 0.21 - 0.4
- 0.41 - 0.6
- 0.61 - 0.8
- 0.81 - 1.5
- 1.51 - 3.55

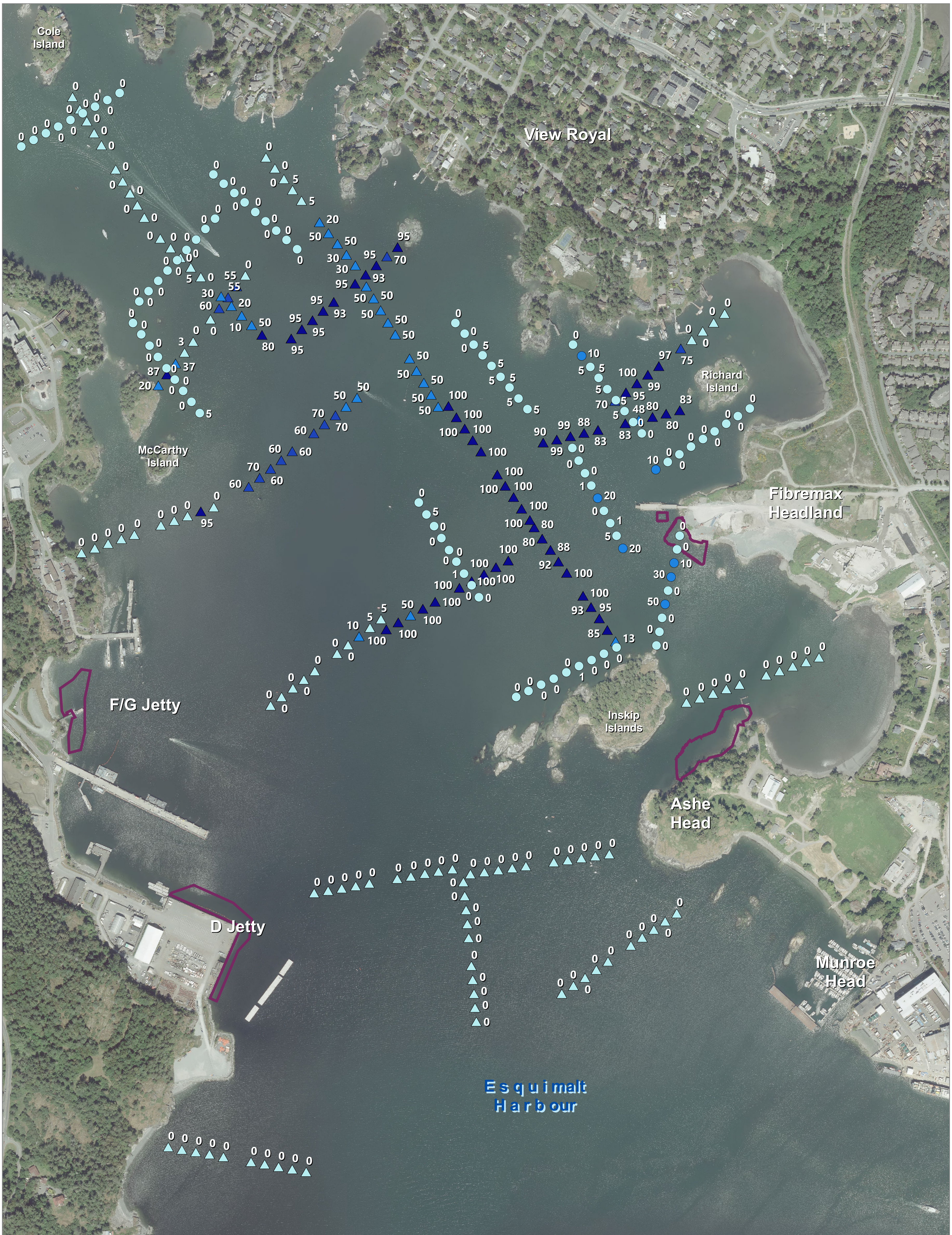
NOTE:
The wood waste thickness was created using a Natural Neighbor interpolation method.

0 200
Metres

Publish Date: 2019/02/25, 5:13 PM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\DataMemorandum\WoodWaste_Interpolations.mxd

ANCHOR QEA

Figure 5
Wood Waste Thickness in Esquimalt Harbour
Wood Waste Remediation Project Data Memorandum



LEGEND:

▲ Hemmera Observations (2016/2017)

● Anchor QEA Observations (2018)

Completed Remediation Projects

Beggiatoa Coverage (%)

- 0 - 5
- 6 - 25
- 26 - 50
- 51 - 75
- 76 - 100

0 200
Metres

Publish Date: 2019/02/25, 5:16 PM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\DataMemorandum\Fig6_WoodWaste_BeggiatoaCoverage.mxd

ANCHOR QEA

Figure 6
Beggiatoa Coverage in Esquimalt Harbour
Wood Waste Remediation Project Data Memorandum

Appendix A
Field Data

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-01
Job No: 170553-11.05	Date: 10/1/18
Field Staff: EM, JD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5365636.7
	Long. 467773.5

Water Height

DTM Depth Sounder: ____________

DTM Lead Line: 4.46

Tide Measurements

Time: 1412

Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -2.26 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1407	~~467773~~ EM 10/1 5365639	467773	Y	13	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SANDY SILT (ML) Moist, Soft, gray, 70% fines, 30% f-sand
trace biota (crab, worm), macroalgae, trace wood debris (small fragments, bark-like)
Slight H_2S-odor

~~EHWW-02~~ EHWW-01-SG-000010 @ 1415 - Bioassay

Sample Depth: 0-10 cm

Field Measurements: temperature: 11.5 °C; pH: ~~∅~~ std units; electrical conductivity/salinity: >10 ppt mS/cm; ppt
7.14 → taken from DGT bag beyond range

Sample Containers: 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-02
Job No: 170553-11.05 | Date: 10/1/18
Field Staff: EM, JD, MD (Hemmera) | Sample Method: Power Grab
Contractor: Coastline | Proposed Coordinates: Lat. 5365659.7
Long. 468041.3

Water Height
DTM Depth Sounder: ______
DTM Lead Line: #1 2.56, 2.47 #2/#3
Mudline Elevation (datum): calculated after sampling -0.27m

Tide Measurements
Time: 1242 #1
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: Difficulty grabbing, jaws not closed until grab retrieved

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1238	5365634	468042	N	—	jaws close insufficient recovery
2	1250	5365637	468038	N	-	insufficient material rec.
3	1300	5365637	468039	Y	10	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

POORLY GRADED SAND W/SILT, moist to wet, loose, gray, 90% f-sand, 10% fines, trace shell hash, slight H_2S odor, trace organics (sticks)

EHWW-02-SG-000010 @ 1305

Sample Depth: 0-10cm

Field Measurements: temperature: 11.9°C; pH: ~~6.6~~ std units; electrical conductivity/salinity: 78 mS/cm, ppt
EM 10/6
6.98 → taken from DGT bag

Sample Containers: 1 bioassay bag, 1 DGT

Analyses: DGT 24-hr & bioassay

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW -03
Job No: 170553-11.05
Date: 10/1/18
Field Staff: DM, JD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365740.0
Long. 467824.3

Water Height
DTM Depth Sounder:
DTM Lead Line: 4.85
Mudline Elevation (datum): calculated after sampling
Notes: ~-2.65m

Tide Measurements
Time: 1330
Height: ~~0.73~~ 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1326	5365737	467823	Y	24	jaws close wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, soft dark gray, 90% fines, 10% f-sand trace shell hash, moderate wood debris (fragments up to 10cm) moderate H_2S odor

EHWW-03-SG-000010 @ 1330

Sample Depth: 0-10cm

Field Measurements: temperature: 11.4 °C; pH: 7.06 std units; electrical conductivity/salinity: exceeds meter >10ppt mS/cm; ppt
* taken from DGT bag

Sample Containers: 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW - 04
Job No: 170553-11.05	Date: 10/2/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366266.9
	Long. 467264.0

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 9.7

Tide Measurements

Time: 1530

Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -7.4m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1530	5366268	467261	Y	30	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) 0-10cm wet, very soft, gray, 90% fines, 10% f-sand
10-30 cm moist, soft, gray, 90% fines, 10% f-sand
slight-moderate H_2S odor throughout, trace shells

EHWW-04-SG-000010 @ 1545

Sample Depth: 0-10cm

Field Measurements: temperature: 11.7°C; pH: Ø std units; electrical conductivity/salinity: >10 mS/cm ppt
COSG taken from DGT bag out of range

Sample Containers: 2x 16 oz, 1 bioassay bag, 2x DGT

Analyses:

1553
#924

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-05
Job No: 170553-11.05	Date: 10/4/18 / 10/5/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5365881.5
	Long. 467699.8

Water Height

DTM Depth Sounder:

DTM Lead Line: #1 8.93 / #2 9.0, #3 8.72, #4 8.79

Mudline Elevation (datum): calculated after sampling

Tide Measurements

Time: 1328

Height: 2.2

@1345 2.3

@1128 1.8

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -6.99m

Grab #	Time	Confirmed Coordinates (datum)		Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
		NAD 83 (N)	NAD 83 (E)			
1	1326	5365880	467699	N	—	jaws close only partially ~~overlying H2O~~ grab winnowed
2	1336	5365882	467700	N	-	Metal chain link in grab jaws / grab winnowed
3	1344	5365876	467703	N	-	jaws closed grab empty,
reattempt on 10/5 4	1128	5365876	467699	Y	15	jaws closed partially overlying H2O wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, very soft, dark gray, 90% fines, 10% f-sand (substantial wood debris (large & small fragments & fibers) Moderate to strong H2S odor

EM 10/4

~~EHWW-05-SG-000010~~ @ EHWW-05-SG-0000 @1150

Sample Depth: 0-10cm

EM 10/5

Field Measurements: temperature: 9.9 °C; pH: 6.7 std units; electrical conductivity/salinity: ~~9.0~~ mS/cm; ppt

710 out of range

Sample Containers: ~~2x DGT, 1 bioassay~~ 2x DGT + bioassay

EM 10/4

Analyses: 2x DGT,

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-06
Job No: 170553-11.05
Date: 10/1/18
Field Staff: EM, JD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5366039.7
Long. 467440.4

Water Height
DTM Depth Sounder:
DTM Lead Line: 10.47
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1440
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -8.27m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1440	5366042	467439	Y	28	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) moist to wet, very soft, gray 90% fines, 10% f-sand
Moderate wood fragments (large bark frags), slight-med H_2S odor
ghost shrimp,

EHWW-06-SG-000010 @ 1455

Sample Depth: 0-10cm
Field Measurements: temperature: 11.2°C; pH: 6.95 std units; electrical conductivity/salinity: mS/cm; ppt
taken from DGT bag
Sample Containers: 2x DGT, bioassay, 2x16 oz
Analyses: DGT sulphide, PAH, PCP, Metals, D/F,

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-07
Job No: 170553-11.05 | Date: 10/1/18
Field Staff: EM, JD, MD(Hemmera) | Sample Method: Power Grab
Contractor: Coastline | Proposed Coordinates: Lat. 5365864.9
Long. 467560.0

Water Height
DTM Depth Sounder: 10.39 m

DTM Lead Line:

Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1015
Pred. 2.0
Height:

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -8.39 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0914	5365868	467561	Y	15	jaws closed wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT(ML) wet, soft, gray, 90% fines, 10% m-sand, moderate wood debris, bark fragment (large) trace shell hash, ghost shrimp (alive) Mod. H_2S odor.

Sample Depth: 0-10 cm

Field Measurements: temperature: 51.8 F °C; pH 6.63 * EM 10/16 std units; electrical conductivity/salinity: over range mS/cm; ppt >10ppt
7.00 → taken from bat bag

Sample Containers: 1 bag.

Analyses: Bioassay Sample EHWW-07-SG-000010 @ 0940

3x DGT: 0.5, 2, 24 hr

* pH probe calibration malfunction, possibly bad data

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation — Station: EHWW-08
Job No: 170553-11.05 — Date: 10/1/18
Field Staff: EM, JD — Sample Method: POWER GRAB
Contractor: Coastline — Proposed Coordinates: Lat. 5365736.4
Long. 467619.6

Water Height
DTM Depth Sounder:
DTM Lead Line: 7.86

Tide Measurements
Time: 15:20
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -5.66m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1520	5365736	467622	Y	23	jaws cl

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

moist to wet, very soft gray
Moderate wood debris up to 10-cm 90% fine 10% SANDS
Slight H_2S odor, trace shell hash

Bioassay: EHWW-08-SG-000010 @1535

Sample Depth: 0-10cm

Field Measurements: temperature: 12°C; pH: Ø std units; electrical conductivity/salinity: 7.0ppt mS/cm; ppt
6.98 taken from DGT bag

Sample Containers: 2x DGT, 1x bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation — Station: EHWW-09
Job No: 170553-11.05 — Date: 10/1/18
Field Staff: EM, JD — Sample Method: POWER GRAB
Contractor: Coastline — Proposed Coordinates: Lat. 5365768.7
Long. 467505.5

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 10.7 / 10.7!

Tide Measurements
Time: 1600
Height: 2.3
2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: -8.41 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1600	5365767	467503	N	–	winnowed jaws open partially from wood
2	1610	5365771	467504	Y	11	Partial winnow but avoided this area wood in jaw

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, very soft, grey, 90% fines, 10% f-sand.
Substantial wood debris (bark to 10"), moderate H_2S odor

SAMPLE ID Bio/Chem: EHWW-09-SG-000010 @ 1610

Sample Depth: 0-10cm

Field Measurements: temperature: 11.7°C; pH: Ø std units; electrical conductivity/salinity: 710 mS/cm; ppt
7.03 taken from DGT bag — over range

Sample Containers: 2x 16 oz, 1 bioassay bag, 2x DGT

Analyses: PAH, PCB, D/F, metals, DGT sulphide

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-10
Job No: 170553-11.05
Date: 10/3/18
Field Staff: PM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365185.6
Long. 467652.9

Water Height

DTM Depth Sounder:

DTM Lead Line: 13.01

-11.31 m

Mudline Elevation (datum): calculated after sampling

Tide Measurements

Time: 0933

Height: 1.7

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: location under barge, closest could get is ~5 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0933	5365187	467662	Y	26	jaws close overlying H2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-5cm
SILT (ML) wet, soft, gray, 90% fines, 10% f-sand
5-26cm same as 0-5 but moist.
trace shell hash throughout, trace biota (worms), NO odor.

EHWW-10-X-B0016 @ 0950

Sample Depth: 0-10cm

Field Measurements: temperature: 10.4°C; pH: 7.15 std units; electrical conductivity/salinity: 710 mS/cm/ppt
out of range

Sample Containers: 1X bioassay, 2X 16oz, 1X DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: DTM, MD
Contractor: Coastline

Station: EHWW-11
Date: 10/3/18
Sample Method: Power Grab
Proposed Coordinates: Lat. 5365699.6
Long. 467424.2

Water Height
DTM Depth Sounder:
DTM Lead Line: #1 10.40 / #2 10.69
Mudline Elevation (datum): calculated after sampling
-8.39 m

Tide Measurements
Time: 1322
Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1322	5365699	467422	N	-	large plank in jaw grab 50% winnowed
2	1332	5365697	467420	Y	30	wood in jaws, but jaws closed

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, very soft, gray, 90% fines, 10% f-sand
Substantial wood debris, predom. bark frags up to 15cm
Moderate H_2S odor, occasional biota (clam), trace shell hash

EHWW-11-SG-000010 @ 1352

Sample Depth: 0-10cm

Field Measurements: temperature: 10.8°C; pH: 7.0 std units; electrical conductivity/salinity: 7.10 mS/cm ppt
over range

Sample Containers: 3x DGT (dip ~~24 hour~~ 2-hr DTM 10/3), 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-12
Job No: 170553-11.05	Date: 10/4/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5365473.8
	Long. 467340.4

Water Height

DTM Depth Sounder:

DTM Lead Line: 13.01

Tide Measurements

Time: 1358

Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -10.71 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1356	5365476	467342	Y	30	jaws close

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-15 cm SILT (ML) wet, very soft, gray, 92% fines, 8% f-sand
15-30 Same as 0-15 but moist, soft
1 live clam (bentnose) trace wood debris (bark fragments), trace shells
Slight H_2S odor.
EHWW-12-SG-000010 @ 1410

Sample Depth: 0-10 cm

Field Measurements: temperature: 10.5 °C; pH: 7.18 std units; electrical conductivity/salinity: 7.10 mS/cm; ppt
out of range.

Sample Containers: 4x DGT, dup both treatments, 1x bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-13
Job No: 170553-11.05
Date: 10/3/18
Field Staff: EM, MD
Sample Method: POWERGRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365608.6
Long. 467288.8

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 13.0

Tide Measurements
Time: 1228
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: -10.8m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1227	5365607	~~4678~~ EM 10/3 467287	Y	30	Jaws close overlying water

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-15cm SILT(ml) wet, very soft, gray, 90% fines, 10% f-sand
15-30cm SILT(ml) moist, soft, gray, 90% fines, 10% f-sand
Slight H_2S odor. Occasional wood fragments (predom bark up to 15cm)

EHWW-13-SG-00010 @1255

Sample Depth: 0-10cm

Field Measurements: temperature: 10.2°C; pH: 7.14 std units; electrical conductivity/salinity: 710 mS/cm/ppt
out of range

Sample Containers: 1x bioassay, 2x DG-1

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: EM, MD
Contractor: Coastline

Station: EHWW-14
Date: 10/3/18
Sample Method: POWER GRAB
Proposed Coordinates: Lat. 5365542.5
Long. 467165.1

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 14.43

Tide Measurements
Time: 1150
Height: 2.1

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: -12.33 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1150	5365541	467164	Y	30	Jaws closed overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) moist to wet, very soft, gray, 90% fines, 10% f-sand
slight H_2S odor, trace shell hash, trace wood debris (bark frag. up to 20 cm)
grades to moist soft w/depth.

EHWW-14-SG-000010 @1209
Sample Depth: 0-10 cm
Field Measurements: temperature: 10.4 °C; pH: 7.02 std units; electrical conductivity/salinity: >10 mS/cm; ppt
out of range
Sample Containers: 1x DGT (24 only), 2x 16oz, 1 bioassay
Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-15
Job No: 170553-11.05 | Date: 10/2/18
Field Staff: EM, MD | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366240.8
Long. 466861.8

Water Height
DTM Depth Sounder:

DTM Lead Line: 7.3

Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 0816
Height: 1.6

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -5.7m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0816	5366239	466861	Y	30	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) 0-10cm wet, very soft, gray, 90% fines 10% f-sand
10-30 cm moist, soft, gray, 90% fines, 10% f-sand
trace organics (wood fragments up to 3cm)
slight-moderate H_2S odor trace shell hash
Bio sample ID: EHWW-15-SG-000010 @ 0830

Sample Depth: 0-10cm

Field Measurements: temperature: 11.2 °C; pH: ∅ std units; electrical conductivity/salinity: >10ppt mS/cm; ppt
*6.87 taken from DGT bag out of range

Sample Containers: 2x DGT, 1 bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-16
Job No: 170553-11.05	Date: 10/2/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366357.3
	Long. 466954.3

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 7.4

Tide Measurements

Time: 0849

Height: 1.7

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -5.7m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0848	5366357	466952	Y	30	jaws close overlying water

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-8cm SILT(ML) wet, very soft, gray, 90% fines, 10% f-sand
8-30cm SANDY SILT (ML) moist, soft to med. dense, gray, 70% fines, 30% f-sand
moderate wood debris (small fragments, some bark frags, to 10 cm)
Moderate H_2S odor throughout, trace shell hash
Bioassay EHWW-16-SG-000010 @ 0900

Sample Depth: 0-10cm

Field Measurements: temperature: 11.1 °C; pH: Ø 6.93 - taken from DGT bag std units; electrical conductivity/salinity: 710ppt out of range mS/cm; ppt

Sample Containers: 2x DGT, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-17
Job No: 170553-11.05	Date: 10/2/18
Field Staff: BM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366290.5
	Long. 467015.0

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 8.0
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 0918
Height: 1.8

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -6.2 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0915	5366292	467015	Y	30	Jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10 cm wet, very soft, gray, SILT (ML), 90% fines, 10% f-sand, trace shell hash
10-30 cm moist, soft, gray, SILT (ML) 80% fines, 20% f-sand,
Slight H_2S odor throughout, no wood debris.

BIO sample ID: EHWW-17-SG-000010 @ 0930

Sample Depth: 0-10cm

Field Measurements: temperature: 11.4 °C; pH: [illegible] std units; electrical conductivity/salinity: >10ppt mS/cm; ppt
6.97 taken from DGT bag out of range

Sample Containers: 2x DGT, bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-18
Job No: 170553-11.05	Date: 10/2/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366428.2
	Long. 467006.3

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 6.92

Mudline Elevation (datum): calculated after sampling

Notes: -4.92

Tide Measurements

Time: 0957

Height: 2.0

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0950	5366429	467007	Y	29	jaws closed wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT(ML) wet, very soft, grayish brown, 90% fines 10% f-sand
moderate wood debris on surface & throughout grab, ~~fine~~
slight-mod. H_2S odor, 1 clam (alive, bentnose)
wood debris is mixed small fragments & larger bark fragments.
EHWW-18-SG-000010 @ 09 1005 - bio & chem

Sample Depth: 0-10cm

Field Measurements: temperature: 11.5 °C; pH: ∅ std units; electrical conductivity/salinity: >10ppt mS/cm; ppt
6.93 - taken from DGT bag out-range

Sample Containers: 2x16oz, 1 bioassay bag, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW - 19
Job No: 170553-11.05
Date: 10/12/18
Field Staff: EM, MD
Sample Method: Power Grab
Contractor: Coastline
Proposed Coordinates: Lat. 5365972.4
Long. 466904.5

Water Height
DTM Depth Sounder:
DTM Lead Line: 8.7

Tide Measurements
Time: 1038
Height: 2.0

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: =6.7 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1036	5365973	466901	Y	30	jaws close, some wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT(ML) wet, very soft, gray, 90% fines, 10% f-sand
10-30cm Same as 0-10cm but with moderate wood debris
trace coarse gravel subrounded & subangular
Slight-moderate H2S odor
Chem + bio sample ID: EHWW-19-SG-000010 @ 1055

Sample Depth: 0-10cm

Field Measurements: temperature: 11.2°C; pH: * std units; electrical conductivity/salinity: 70ppt mS/cm; ppt
*6.98 taken from DGT bag   out of range

Sample Containers: 2x 16oz, 1 bioassay bag, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-20
Job No: 170553-11.05 | Date: 10/2/18
Field Staff: EM, MD | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366086.1
Long. 467070.2

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 8.1

Tide Measurements
Time: 1141
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -5.9m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1140	~~5366426~~ EM 5366086	467073	Y	30	jaws partially closed

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT(ML) wet, very soft, gray, 90% fines, 10% f-sand. Occasional wood debris, large bark fragments.
10-30 cm SILT(ML) moist, soft, gray, 90% fines, 10% f-sand. Moderate wood debris small, mixed size fragments. Moderate H_2S odor throughout. 1 live clam (bentnose)
Bio sample ID: EHWW-20-SG-000010 @ 1155

Sample Depth: 0-10 cm

Field Measurements: temperature: 12 °C; pH: ~~0~~ 6.96 - taken from DGT bag std units; electrical conductivity/salinity: >10ppt mS/cm; ppt

Sample Containers: 2x DGT, 1 bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EH NW - 21
Job No: 170553-11.05
Date: 10/2/18
Field Staff: EM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5366352.7
Long. 467334.3

Water Height
DTM Depth Sounder: #2 ~6.4
DTM Lead Line: #1 8.1 #3 8.45
-6.25 m
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1313
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: After 3 attempts, no recovery, Station in rocky outcrop area will abandon location & return if time at end of Program

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1313	5366352	4 ~~8~~67335	N	—	no recovery
2	1325	5366354	467336	N	—	No recovery move ~5m NNW
3	1343	5366348	467322	N	—	move ~15m west, to get off seamount No recovery

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Sample Depth: 0-10cm
Field Measurements: temperature: °C; pH: std units; electrical conductivity/salinity: mS/cm; ppt

Sample Containers: 2x 16oz, chm

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-22
Job No: 170553-11.05
Date: 10/3/18
Field Staff: EM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365771.3
Long. 467197.7

Water Height
DTM Depth Sounder:
DTM Lead Line: 9.52

Tide Measurements
Time: 1647
Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling -7.22m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1446 ~~1646~~ EM 10/3	5365770	467198	Y	28	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT(ML) wet, very soft, gray, 90% fines, 10% f-sand
10-28cm same as 0-10cm but moist, soft
trace shell hash, trace subrounded gravel 4cm, moderate H_2S odor

EHWW-22-SG-00001D @1500

Sample Depth: 0-10cm

Field Measurements: temperature: 10.5°C; pH: 7.17 std units; electrical conductivity/salinity: 7 / 10 mS/cm; ppt
out of range

Sample Containers: 2x DGT, 1x bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-23
Job No: 170553-11.05	Date: 10/5/18
Field Staff: EM MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366304.9
	Long. 467811.7

Water Height
DTM Depth Sounder:
DTM Lead Line: #1 2.53, #1 2.57 #5 2.6 #3 2.61 #4 2.66

Tide Measurements
Time: 0815 Height: 0.9
0822 1.0
0837 1.0

Mudline Elevation (datum): calculated after sampling 0851 1.1

Notes: -1.5m

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0814	5366306	467814	N	~13	Jaws close, overlying H_2O, insufficient volume of grab has sed! only 1/2
2	0822	5366305	467813	N	~13	winnowed in middle added weight
3	0837	5366304	467813	N	~13	winnowed in middle
4	0851	5366306	467813	N	—	Nothing in grab
5	0857	5366302	467813	Y	14	overlying water jaws closed no winnow

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

POORLY GRADED SAND w/ SILT (SP-SM) Moist, loose, gray, 90% f-m sand, 10% fines, occasional shell hash.
Macroalgae in jaws, slight H_2S odor

EHWW-23-SG-000010 @ 0910

Sample Depth: 0-10cm

Field Measurements: temperature: 10.3°C; pH: 7.27 std units; electrical conductivity/salinity: >10 mS/cm; ppt
out of range

Sample Containers: 1x DGT, 1 bi[illegible]

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-24
Job No: 170553-11.05 | Date: 10/1/18
Field Staff: EM, JD, MD(Hemmera) | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366052.3
Long. 467721.4

Water Height
DTM Depth Sounder:
DTM Lead Line: #1 7.87m
#2 7.77m
Mudline Elevation (datum): calculated after sampling
-5.67m

Tide Measurements
Time: 1117
Height: 2.1m

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 ~~(N)~~ E	NAD 83 ~~(E)~~ N	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1117	467715	5366054	N	—	jaws partially open. Wood in jaws Winnowed
2	1132	467720	5366053	Y	15	jaws partially open

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) Wet, very soft, dark gray, 90% fines 10% m-Sand.
Moderate wood fragments (bark); shell hash (trace)
Mod-high H_2S odor

EHWW-24-SG-000010 @1132

Sample Depth: 0-10cm

Field Measurements: temperature: 11.4 °C; pH: ~~6.7~~ std units; electrical conductivity/salinity: 7/10ppt mS/cm; ppt
EM 10/6
6.94 - taken from DGT bag

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-25
Job No: 170553-11.05
Date: 10/5/18
Field Staff: EM
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5366157.4
Long. 466920.6

Water Height
DTM Depth Sounder:
DTM Lead Line: 6.46

Tide Measurements
Time: 0742
Height: 0.8

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: -5.66 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0742	5366157	466920	Y	30	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-15 cm SILT(ML) wet, very soft, gray; 90% fines, 10% f-sand
15-30 cm same as 0-15 but moist, soft
moderate H_2S odor throughout, no wood.

EHWW-25-SG-000010 @ 0755

Sample Depth: 0-10 cm

Field Measurements: temperature: 10 °C; pH: 6.9 std units; electrical conductivity/salinity: > 10 mS/cm; ppt out of range

Sample Containers: 2P DGT, 1P bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-26
Job No: 170553-11.05
Date: 10/3/18
Field Staff: OM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365714.3
Long. 467281.1

Water Height
DTM Depth Sounder:
DTM Lead Line: 12.97

Tide Measurements
Time: 1411
Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: -10.67m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1411	5365713	~~467187~~ OM 467287	Y	30	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab on surface (graceful grab)
0-10cm SILT(ML) wet, very soft, gray, 90% fines, 10% f-sand
10-30cm SILT(ML) moist, soft, gray, 90% fines, 10% f-sand
trace-occasional wood debris throughout, moderate H_2S odor, trace shell hash.
EHWW-26-SG-000010 @ 1428

Sample Depth: 0-10cm
Field Measurements: temperature: 10.4 °C; pH: 7.20 std units; electrical conductivity/salinity: 7/0 mS/cm; ppt
out of range

Sample Containers: 2x DGT, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: DM / MD
Contractor: Coastline

Station: EHWW-27
Date: 10/3/18
Sample Method: Power GRAB
Proposed Coordinates: Lat. 5365846.2
Long. 467379.8

Water Height
DTM Depth Sounder:
DTM Lead Line: 11.68

Tide Measurements
Time: 1524
Height: 2.3

Mudline Elevation (datum): calculated after sampling
Notes: -9.38 m

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1524	5365844	467380	Y	22	jaws closed, wood in jaws, overlying H_2O
						Old metal cable in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, very soft, gray, 100% fines, moderate H_2S odor
Moderate wood debris, predom large bark fragments
metal cable (non-utility) in grab, cable is braided metal
moderate H_2S odor.
EHWW-27-SG-00010 @ 1545

Sample Depth: 0-10 cm
Field Measurements: temperature: 10.3°C; pH: 7.2 std units; electrical conductivity/salinity: >10 mS/cm, ppt out of range

Sample Containers: 4x DGT, dup both 2hr & 24 hr, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWN - 28
Job No: 170553-11.05
Date: 10/4/18
Field Staff: EM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365969.1
Long. 467187.7

Water Height
DTM Depth Sounder:
DTM Lead Line: #1 11.10 / #2 11.12
Mudline Elevation (datum): calculated after sampling
Notes: -9.12

Tide Measurements
Time: 1137
Height: 2.0
@ 1148 2.0

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1136	5365970	467190	N	—	1/2 of grab winnowed large wood in jaw
2	1147	5365968	467189	Y	30	jaws closed wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT (ML) wet, v. soft, gray, 90% fines, 10% f-sand
10-30cm Same as 0-10 but moist, soft
occasional wood debris throughout, predom. large bark fragment
Slight - Moderate H_2S odor. Trace shells.
EHWW-28-SG-000010 @ 1200

Sample Depth: 0-10cm
Field Measurements: temperature: 11.5°C; pH: 6.98 std units; electrical conductivity/salinity: 710 mS/cm; ppt
out of range

Sample Containers: 1x bioassay, 2x PGA

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW -29
Job No: 170553-11.05 | Date: 10/4/18
Field Staff: EM, MD | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366037.6
Long. 467111.1

Water Height
DTM Depth Sounder:
DTM Lead Line: 1029
Mudline Elevation (datum): calculated after sampling -8.09m

Tide Measurements
Time: 1250
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1250	5366040	467114	Y	30	jaws closed overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-15cm wet, very soft, gray, 90% fines, 10% F-sand SILT (ML)
15-30cm same as 0-15 but moist, soft
Slight H_2S odor, 1 clam (live, bent nose)

EHWW-29-SC-000010 @ 1305

Sample Depth: 0-10cm

Field Measurements: temperature: ~~10~~ 11.7 °C; pH: 7.63 std units; electrical conductivity/salinity: >10 mS/cm; ppt out of range EM 10/4

Sample Containers: 1x bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: EM, MD
Contractor: Coastline

Station: EHWW-30
Date: 10/3/18
Sample Method: POWER GRAB
Proposed Coordinates: Lat. 5365362.9
Long. 467633.3

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 13.36

Tide Measurements
Time: 1022
Height: 1.9

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -11.46m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1022	5365365	467632	Y	29	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-5cm
SILT (ML) wet, very soft, gray, 90% fines, 10% f-sand
5-29cm Same as 0-5cm but moist, soft
slight H_2S odor, trace shell hash
Trace wood debris throughout, predom. bark fragments ~5cm max.
EHWW-30-SG-000010 @ 1035

Sample Depth: 0-10cm
Field Measurements: temperature: 10.4 °C; pH: 7.18 std units; electrical conductivity/salinity: 710 mS/cm; ppt
out of range

Sample Containers: 2x 16oz, 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-31
Job No: 170553-11.05	Date: 10/2/18
Field Staff: BM, MD	Sample Method: Power Grab
Contractor: Coastline	Proposed Coordinates: Lat. 5366463.2
	Long. 466832.0

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 6.7

Mudline Elevation (datum): calculated after sampling -4.5m

Tide Measurements

Time: ______

Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: No photos of grab taken

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1439	5366463	466834	Y	20	Jaws close overlying water small wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Large ghost shrimp at surface
~~mlf~~ SILT (ML) moist - wet, very soft, gray, 85% fines, 15% f-sand
1 live clam, bentnose, trace shells
moderate H_2S odor
EHWW-31-SG-000010

Sample Depth: 0-10cm

Field Measurements: temperature: 11.6 C; pH: ∅ std units; electrical conductivity/salinity: >10ppt mS/cm; ppt
6.84 - taken from DGT bag out of range

Sample Containers: 2x DGT, bioassay
DLP 2hr & 24 hour

Analyses:

#6 24

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW - 32
Job No: 170553-11.05
Date: 10/4/18
Field Staff: EM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365192.7
Long. 467386.4

Water Height
DTM Depth Sounder:
DTM Lead Line: 13.71
Mudline Elevation (datum): calculated after sampling
-11.51m

Tide Measurements
Time: 1600
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1558	5365191	467385	Y	30	Jaws close

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT(ml) wet, very soft, gray, 90% fines, 10% f sand.
trace worms, & shells.
10-30cm same as 0-10 but moist, soft
EM 10/4
No odor.
~~@ 540~~

Sample Depth: 0-10 EHWW-32-SG-003010 @ 1610
Field Measurements: temperature: 10.7 °C; pH: 7.09 std units; electrical conductivity/salinity: 710 mS/cm; ppt
Out of Range

Sample Containers: 1x DGT, 1 bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: FM, JD
Contractor: Coastline

Station: EHWW - 33
Date: 10/3/18
Sample Method: POWER GRAB
Proposed Coordinates: Lat. 5365323.2
Long. 467258.6

Water Height
DTM Depth Sounder:
DTM Lead Line: 13.55

Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1100
Height: 2.0

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -11.55m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1100	5365321	467258	Y	30	jaws close

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10 cm SILT (ML) wet, very soft, gray, 90% fines, 10% f-sand
10-30 cm same as 0-10 but moist, soft
trace shell hash throughout, slight H_2S odor

EHWW-33-SG-0.0010 @ 1120

Sample Depth: 0-10 cm
Field Measurements: temperature: 10.3 °C; pH: 7.29 std units; electrical conductivity/salinity: 710 mS/cm; ppt
out of range

Sample Containers: 2x DGT, 1x bioassay, 2x 16oz &

Analyses:

*Added extra DGT to 24 hour treatment to test saturation

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-34
Job No: 170553-11.05	Date: 10/4/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5365512.1
	Long. 467692.1

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 5.37

Mudline Elevation (datum): calculated after sampling

Tide Measurements

Time: ______

Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -3.07M

Grab #	Time	Confirmed Coordinates (datum)		Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
		NAD 83 (N)	NAD 83 (E)			
1	1524	5365516	467689	Y	20	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILTY GRAVEL W/ SAND (GM)
Moist to wet, medium dense, gray, 50% f-c gravel, 35% m-c sand, 15% fines
gravel is subrounded. Substantial shell hash.
trace wood debris. No odor.
Macroalgae @ surface, 2 fish. EHWW-34-SG-000010 @ 1540

Sample Depth: 0-10cm

Field Measurements: temperature: 12.1 °C; pH: 7.35 std units; electrical conductivity/salinity: >10 mS/cm; ppt
out of range

Sample Containers: 2+ DGT, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: EM, MD
Contractor: Coastline

Station: EHWW-35
Date: 10/4/18
Sample Method: POWER GRAB
Proposed Coordinates: Lat. 5365448.1
Long. 4675434

Water Height
DTM Depth Sounder:
DTM Lead Line: #1 10.51 #2 10.98
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1430
Height: 2.3
@1445 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -8.68 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1429	5365449	467544	N	–	winnowed surface seaweed in jaws
2	1443	5365445	467542	Y	19	~2 m south of target seaweed partial winnow but will avoid that area

might have been on rocky slope

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Macroalgae & worm tubes @ surface, red rock crab, prawn.
SILT(ML) moist to wet soft, dark grey, 80% fines, 20% f-sand
Substantial Anthropogenic fragments (black, hard, fissile, slight odor)
occasional wood debris (bark fragment)
EHWW-35-SG-000000 @1458

Sample Depth: 0-10 cm
Field Measurements: temperature: 11.4 °C; pH: 7.10 std units; electrical conductivity/salinity: >10 mS/cm/ppt
out of range

Sample Containers: 2X DOT, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: BM MA
Contractor: Coastline

Station: EHWW-36
Date: 10/5/18
Sample Method: Power Grab
Proposed Coordinates: Lat. 5365844.1
Long. 467881.2

Water Height
DTM Depth Sounder:
DTM Lead Line: 4.12

Tide Measurements
Time: 1025
Height: 1.5

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
-2.62m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1025	5365842	467880	Y	20	jaws closed, overlying water

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) moist to wet, soft, grayish brown, 90% fines, 10% f. sand, moderate - substantial wood debris, large bark fragments, decomposed fibers, moderate - strong H_2S odor, trace biota (polychaete, nereid?)
EHWW-36-SC-000010 @ 1040

Sample Depth: 0-10cm

Field Measurements: temperature: 10.4 °C; pH: 6.4 std units; electrical conductivity/salinity: 21.0 mS/cm, ppt
Out of range

Sample Containers: 2x 8oz, 1 bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-37
Job No: 170553-11.05 | Date: 10/5/18
Field Staff: DM, MD | Sample Method: Power Grab
Contractor: Coastline | Proposed Coordinates: Lat. 5365579.4
Long. 467968.6

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 1.65

Tide Measurements
Time: 1101
Height: 1.7

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
0.05 m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1100	5365577	467969	Y	15	Jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

POORLY GRADED SAND w/SILT (SP-SM) Moist, loose to medium dense, grey, 90% f-sand, 10% fines, occasional shell hash & biota (worms) slight H_2S odor trace organics (stick)
EHWW-37-SG-000010 @ 1110

Sample Depth: 0-10cm
Field Measurements: temperature: 10.2°C; pH: 7.16 std units; electrical conductivity/salinity: 8.0 mS/cm; ppt

Sample Containers: 1x DGT, 1x bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-38
Job No: 170553-11.05
Date: 10/3/18
Field Staff: EM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5365960.5
Long. 467492.9

Water Height
DTM Depth Sounder:
DTM Lead Line: 10.71

Tide Measurements
Time: 1608
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -8.51 M

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1607	5365961	467494	Y	30	jaws closed, wood in jaws overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT (ML) wet, very soft, gray, 90% fines, 10% f-sand
10-30cm Same as 0-10 but moist, soft
Moderate wood debris throughout, predom. large bark fragments
Moderate H_2S odor
EHWW-38-SG-00010 @ 1620

Sample Depth: 0-10 cm

Field Measurements: temperature: 11.6 °C; pH: 7.05 std units; electrical conductivity/salinity: >10 mS/cm ppt
Out of range

Sample Containers: 2x DGT, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-39
Job No: 170553-11.05
Date: 10/1/18
Field Staff: EM, JD, MD (Hemmera)
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5366171.4
Long. 467643.5

Water Height
DTM Depth Sounder:
DTM Lead Line: 7.9

Tide Measurements
Time: 1043
Height: 2.1

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
-5.81 m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1027	467644	5366174	~~N~~ Y	24	overlying water jaws mostly closed

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, soft, grey, 90% fines, 10% f-sand
moderate wood debris (bark & wood fragments). Mod. H_2S odor

Sample Depth: 0-10 cm
Field Measurements: temperature: 11.7 °C; pH: 6.6 std units; electrical conductivity/salinity: ~~[illegible]~~ mS/cm; ppt EM 10/6
& 6.99 taken from DGT bag 710 ppt
Sample Containers: 2x 16oz 1 bioassay bag
Analyses: SAMPLE ID: EHWW-39-SG-000010 @ 1040 bioassay + chem

3x DGT: 0.5, 2, 24 hr

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-40
Job No: 170553-11.05 | Date: 10/5/18
Field Staff: EM MD | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366137.0
Long. 467841.7

Water Height
DTM Depth Sounder:
DTM Lead Line: 2.31

Tide Measurements
Time: 0925
Height: 1.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
Notes: -1.01 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0925	5366136	467844	Y	28	jaws close overlying water metal wire fragment in jaw

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Decomposed organics (wood fragments & fibers)
moist, soft, brown/gray,
Graceful crab @ surface. Moderate-strong H2S odor
1 small live clam, trace shell hash,
EHWW-40-SG-000010 @ 0935

Sample Depth: 0-10cm

Field Measurements: temperature: 11.0 °C; pH: 7.04 std units; electrical conductivity/salinity: 710 mS/cm; ppt
Out of range

Sample Containers: 2 x DGT, 1 bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-41
Job No: 170553-11.05	Date: 10/4/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366216.8
	Long. 467445.4

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 9.46

Tide Measurements

Time: ______

Height: 1.9

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling

Notes: -7.56m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1058	5366216	467441	Y	30	jaws close overlying water

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

EM

0-15 SILT(ml) wet, very soft, gray, 90% fines, 10% sand, trace shells, trace organics (sticks); occasional wood debris (small wood fragments <5cm) moderate H_2S odor grades to moist with depth

EHWW-41-SG-0000 @ 1115

Sample Depth: 0-10cm

Field Measurements: temperature: 11.1 °C; pH: 7.06 std units; electrical conductivity/salinity: >10 mS/cm; ppt

out of range

Sample Containers: 1x bioassay bag, 2x DGT

Analyses:

Surface Sediment Collection Log

em 10/2

Job: EHRP Wood Debris Remediation	Station: EHWW - ~~21~~ 42
Job No: 170553-11.05	Date: 10/2/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366447.9
	Long. 467154.8

Water Height

DTM Depth Sounder: ______

DTM Lead Line: 8.55

Mudline Elevation (datum): calculated after sampling

Tide Measurements

Time: 1235

Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -6.35m

Photo was labelled station -21, will need to fix.

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1234	5366447	467156	Y	30	jaws close overlying water

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm

SILT (ML) wet, very soft, gray, 95% fines, 5% f-sand

10-30 cm; same as before but moist, soft

trace shell hash. Slight H_2S odor throughout.

10/2 EM

Chem + bio ID: ~~EHWW-21-SG-000010 @ 1245~~ EHWW-42-SG-000010 @ 1245

Sample Depth: 0-10cm

Field Measurements: temperature: 11.7 °C; pH: ~~X~~ std units; electrical conductivity/salinity: 7.10ppt mS/cm; ppt

*0.96: taken from DGT bag out of range

Sample Containers: 2x 16oz, 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-43
Job No: 170553-11.05	Date: 10/5/18
Field Staff: DM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366068.9
	Long. 467581.0

Water Height

DTM Depth Sounder: ________

DTM Lead Line: 6.38 m

Mudline Elevation (datum): calculated after sampling

Tide Measurements

Time: 0954

Height: 1.4

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -4.98 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	Confirmed Coordinates (datum) NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0954	5366071	467582	Y	15	Jaws close wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT w/ substantial wood debris wet, soft, gray, 90% fines
(ML) 10% f-sand substantial wood debris
both large fragments & also decomposed fibers
moderate H2S odor, [illegible] @ surface,
EHWW-49-SG-00010 @ 1000 potential [illegible] @ surface

Sample Depth: 0-10

Field Measurements: temperature: 10.1 °C; pH: 7.07 std units; electrical conductivity/salinity: >10 mS/cm; ppt
out of range

Sample Containers: 2x DGT, 1 bioassay bag

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-44
Job No: 170553-11.05
Date: 10/4/18
Field Staff: EM, MD
Sample Method: Power Grab
Contractor: Coastline
Proposed Coordinates: Lat. 5366163.6
Long. 467346.7

Water Height
DTM Depth Sounder:
DTM Lead Line: 8.68
Mudline Elevation (datum): calculated after sampling -7.68m

Tide Measurements
Time: 0801
Height: 1.0

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0800	5366164	467346	Y	36	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT (ML) wet, soft to very soft, gray, 90% fines, 10% f-sand
occasional wood debris, occasional shell hash.
Moderate H_2S odor

EHWW-44-SG-000010 @ 0815

Sample Depth: 0-10cm

Field Measurements: temperature: 9.5 °C; pH: 7.0 std units; electrical conductivity/salinity: 7.0 mS/cm, ppt
out of range

Sample Containers: 2x 16oz, 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: EM, MD
Contractor: Coastline

Station: EHWW-45
Date: 10/4/18
Sample Method: POWER GRAB
Proposed Coordinates: Lat. 5366605.3
Long. 467025.6

Water Height
DTM Depth Sounder:
DTM Lead Line: 6.08

Tide Measurements
Time: 0830
Height: 1.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
-4.88m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0837	5366606	467026	Y	30	Jaws close Overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-15cm SILT(ML) wet, very soft, gray, 90% fines, 10% fine sand
15-30cm same as 0-15 but moist, soft
trace wood debris throughout (small fragments <10cm) Moderate-high H_2S odor

EHWW-45-SG-000010 @ 0850

Sample Depth: 0-10cm

Field Measurements: temperature: 10.0 °C; pH: 6.85 std units; electrical conductivity/salinity: >10 mS/cm/ppt
Out of range

Sample Containers: 2x 16oz, 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW – 46
Job No: 170553-11.05 | Date: 10/4/18
Field Staff: EM, MD | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366511.7
Long. 466799.7

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 5.23
Mudline Elevation (datum): calculated after sampling
Notes: -3.83m

Tide Measurements
Time: 0915
Height: 1.4

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0914	5366514	466801	Y	30	jaws close

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT (ML) Wet, very soft, gray, 90% fines, 10% f-sand
10-30cm Same as 0-10cm but moist, soft
trace shells throughout, very trace wood debris
Moderate H_2S odor
EHWW-46-SG-000010 @ 0930

Sample Depth: 0-10cm
Field Measurements: temperature: 10.8 °C; pH: 6.78 std units; electrical conductivity/salinity: >10 mS/cm/ppt
out of range

Sample Containers: 2x 16oz, 1 bioassay bag, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: EHWW-47
Job No: 170553-11.05 | Date: 10/4/18
Field Staff: EM MB | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5366643.0
Long. 466791.0

Water Height
DTM Depth Sounder:
DTM Lead Line: 5.21
Mudline Elevation (datum): calculated after sampling -3.61 m

Tide Measurements
Time: 0957
Height: 1.6

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0955	5366645	466792	Y	28	jaws closed wood in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT (ML) wet, very soft, gray, 90% fines, 10% f-sand, trace shells,
10-28cm SILT (ML) moist, soft, gray, 90% fines, 10% f-sand, moderate
wood debris, predom. bark fragments (large)
moderate H_2S odor throughout.
EHWW-47-SG-000010 @ 1005

Sample Depth: 0-10 cm

Field Measurements: temperature: 11.0 °C; pH: 6.86 std units; electrical conductivity/salinity: 710 mS/cm/ ppt
out of range

Sample Containers: 1 bioassay bag, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-48
Job No: 170553-11.05
Date: 10/2/18
Field Staff: DM, MD
Sample Method: Power Grab
Contractor: Coastline
Proposed Coordinates: Lat. 5366348.8
Long. 466787.7

Water Height
DTM Depth Sounder:
DTM Lead Line: 5.9
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1403
Height: 2.2

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -3.7m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1401	~~5340~~ EM 10/2 5366348	466788	Y	30	jaws close, wood in jaws.

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT(ML) wet, very soft, gray, 90% fines, 10% f-sand, grades to soft, moist with depth. occasional wood fragments, large bark to ~30cm
Slight-moderate H_2S odor throughout

Chem + bio ID: EHWW-48-SG-000010 @ 1420 + dup (chem only): EHWW-148-SG-000010 @ 1425

Sample Depth: 0-10cm

Field Measurements: temperature: 11.5 °C; pH: 8 std units; electrical conductivity/salinity: >10ppt over range mS/cm; ppt

Sample Containers: 4x 16oz, 1 bioassay, 2x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Job No: 170553-11.05
Field Staff: EM, MD
Contractor: Coastline

Station: EHWIN-49
Date: 10/4/18
Sample Method: POWER GRAB
Proposed Coordinates: Lat. 5366486.9
Long. 466713.9

Water Height
DTM Depth Sounder:
DTM Lead Line: 5.07
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 1028
Height: 1.7

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -3.37m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1026	5366489	466714	Y	28	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

SILT(ML) occasional shells
0-10cm wet, very soft, gray, 90% fines, 10% f-sand, trace wood fragments
10-28cm moist, soft, gray, 90% fines, 10% f-sand, moderate shells & shell hash, 1 live clam (bent nose).
moderate H_2S odor throughout.
EHWIN-49-SG-000010 @ 1049

Sample Depth: 0-10cm

Field Measurements: temperature: 11.2°C; pH: 6.8 std units; electrical conductivity/salinity: >10 mS/cm/ppt
out of range

Sample Containers: 2x DGT, 1x bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation	Station: EHWW-50
Job No: 170553-11.05	Date: 10/2/18
Field Staff: EM, MD	Sample Method: POWER GRAB
Contractor: Coastline	Proposed Coordinates: Lat. 5366570.3
	Long. 466928.6

Water Height
DTM Depth Sounder:
DTM Lead Line: 6.85

Tide Measurements
Time: 1600
Height: 2.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
-4.55m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	1600	5366574 ~~5365574~~	466931	Y	30	jaws closed wood debris in jaw

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SILT(ML) wet, very soft gray, 90% fines, 10% f-sand
10-30cm SILT(ML) moist, soft, gray, 90% fines, 10% f-sand
Occasional wood debris throughout (predom. large bark fragments)

Sample Depth: EHWW-50-SG-000010 @

Field Measurements: temperature: 11.3°C; pH: ~~D~~ 6.97 - taken from DGT bag std units; electrical conductivity/salinity: >10 mS/cm/ ppt out of range

Sample Containers: 2 x DGT, 1 x bioassay

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation | Station: REF-17
Job No: 170553-11.05 | Date: 10/3/18
Field Staff: EM, MD | Sample Method: POWER GRAB
Contractor: Coastline | Proposed Coordinates: Lat. 5364440.451
Long. 466980.9602

Water Height
DTM Depth Sounder: ______
DTM Lead Line: 13.55

Tide Measurements
Time: 0810
Height: 1.3

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (datum): calculated after sampling
-12.25m

Notes:

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0809	5364438	466983	Y	26	jaws close seaweed in jaws

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-10cm SANDY SILT (ML) wet, soft, gray, 60% fines, 40% f-sand
10-26cm SILTY SAND (SM) moist, loose, gray, 60% f-sand, 40% fines
worms & trace shell hash throughout, no odor

EHWW-REF17-SG-000010 @ 0825

Sample Depth: 0-10cm

Field Measurements: temperature: 10.2 °C; pH: 7.2 std units; electrical conductivity/salinity: 710 mS/cm; ppt
Out of range

Sample Containers: 1x bioassay, 1x DGT

Analyses:

Surface Sediment Collection Log

Job: EHRP Wood Debris Remediation
Station: EHWW-REF18
Job No: 170553-11.05
Date: 10/3/18
Field Staff: BM, MD
Sample Method: POWER GRAB
Contractor: Coastline
Proposed Coordinates: Lat. 5364796.1
Long. 467012.79

Water Height
DTM Depth Sounder:
DTM Lead Line: 13.69
Mudline Elevation (datum): calculated after sampling

Tide Measurements
Time: 0845
Height: 1.5

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: -12.19 m

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	0845	5364792	467013	Y	25	jaws close overlying H_2O

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

0-5cm SILT(ML) wet, soft, gray 90% fines, 10% f-sand
5-25cm Same as before but moist,
trace shell hash throughout Occasional biota (worms)
No odor
EHWW-REF18-SG-000010 @ 0900

Sample Depth: 0-10cm

Field Measurements: temperature: 9.9°C; pH: 7.22 std units; electrical conductivity/salinity: >10 mS/cm ppt
out of range

Sample Containers: 1x DGT, 1x bioassay bag

Analyses:

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP Wood Debris **DATE:** 10/1/18

SITE LOCATION: **PERSONNEL:** EM, JD, MD(Henderson)

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F 5d .10 °C

[Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0715	Arrive @ CFSA, mob gear
08~~15~~	H&S meeting
0835	Depart CFSA, mob to Station 07
0915	Sample accepted at -07, 3 DGT deployments +bioassay
1010	mob to -39
1027	Accepted attempt #1, 3DGTs, + bioassay + chem 2x16oz
1105	Mob to -24, accept attempt 2
1205	mob back to CFSA, place parking permits on cars,
1230	Mob to -02, Mika off vessel temporarily for pers. reasons
1200	Accept #3 @ -02
1323	mob to -03, first attempt accepted
1400	Mob to -01, first attempt accepted
1435	mob to -06, first attempt accepted
1510	Mob to -08, first attempt accepted
1555	Mob to -09, second attempt accepted
1640	Mob back to CFSA
1700	mob gear off boat
	EM
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP wood waste **DATE:** 10/2

SITE LOCATION: **PERSONNEL:** EM, MD (Hemmera)

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM (circled) | HEAVY

SUNNY (circled) | CLOUDY (circled) | RAIN | ? — **TEMPERATURE:** °F . °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0730	Meet coastline @ CFSA, H&S meeting
0800	Depart CFSA, mob to -15
0815	first attempt -15 accepted
0845	Mob to -16, first attempt accepted
0915	Mob to -17, first attempt accepted
0940	mob to -18, first attempt accepted
1025	mob to -19, first attempt accepted.
1130	Mob to -20, first attempt accepted. removed some weight
	from grab to avoid over-penetration
1220	Mob to -~~21~~ 42* EM 10/2 first attempt accepted. *sample initially collected & named -21 but error was caught & fixed. all labeles updated
1255	Mob to -21, attempt 3x, bunted
	on location located on rocky reef area
1400	Mob to -48, attempt 1 accepted.
1435	Mob to -31, attempt 1 accepted
1522	mob to -04, attempt accepted
1555	Mob to ~~-51~~ -50, attempt 1 accepted.
1625	return to CFSA
	EM

Samples delivered to lab:

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP wood waste **DATE:** 10/3/18

SITE LOCATION: **PERSONNEL:** EM, MD (Hemmera)

WEATHER:	WIND FROM:	N	NE	E	SE	S	SW	W	NW	LIGHT	MEDIUM	HEAVY
		SUNNY		CLOUDY		RAIN			?	TEMPERATURE:	°F 45	°C

[Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0730	EM, MD on site, load gear
0800	H&S meeting
0805	Depart marina, head to in-harbour reference areas
	due to favorable wind conditions
0820	Accepted #1 @ REF-17 Sample ID EHWW-REF17-SG-000010
0834	Mob to REF-18, attempt 1 accepted @ 0835
0925	Mob to EHWW-10, attempt 1 accepted, location under barge
	took as close as possible ~5m off station
1015	Mob to EHWW-30, first attempt accepted
1035	Mob to EHWW-33, first attempt accepted
1130	mob to -14, first attempt accepted
1220	Mob to -13, first attempt accepted
1320	mob to -11, Second attempt accepted
1405	mob to -26, first attempt accepted
1445	Mob to -22, first attempt accepted
1515	mob to -27, first attempt accepted
1600	mob to -28, first attempt accepted
1635	return to CFSA, demob gear.
1700	Off Site
	EM
	tide station: Esquimalt Harbour
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems/Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP wood waste **DATE:** 10/4/18

SITE LOCATION: **PERSONNEL:** EM, MD (Hemmera)

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F 45. °C

[Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0730	EM/MD on site, meet Constline, mob gear
0745	H&S meeting, depart CFSA
0800	Mob to -44, first attempt accepted
0835	Mob to -45, first attempt accepted
0900	mob to -46, first attempt accepted
0945	Mob to -47, first attempt accepted
1020	mob to -49 first attempt accepted
1055	mob to -41, first attempt accepted,
1130	mob to -78, Second attempt accepted
1240	mob to -29 first attempt accepted
1340	Mob to -05, 3 failed attempts, will re-attempt at
	end of Program if time.
1355	mob to -12, attempt 1 accepted
1420	Mob to -35, attempt 2 accepted
1520	mob to -34, attempt 1 accepted
1620	return to CFSA to demob for day.
1645	leave CFSA, continue to process DGTS @ Rental
	EM
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME:	EHRP wood waste	**DATE:**	10/5/18
SITE LOCATION:	CFSA	**PERSONNEL:**	EM, MD

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW | LIGHT | MEDIUM | HEAVY
SUNNY | CLOUDY | RAIN | ? **TEMPERATURE:** °F 45 . °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	0720 EM M(Hemmerea) arrive on site, load gear
0730	H&S meeting, push off
0740	Mob to -25, first attempt accepted
0810	mob to -23, first 3 attempts rejected due to ...
	added ~200 lbs of extra weight to see if
0900	attempt #5 accepted.
0920	Mob to -40, 1st attempt accepted
0950	mob to -43, 1st attempt accepted
1020	mob to -36, 1st attempt accepted
1050	mob to -37, 1st attempt accepted
1120	reattempt @ -5 with added weight, attempt 4 accepted
1200	finish sampling, return to dock for demob.
1230	Depart CFSA
	EM
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Safety Briefing Form

ANCHOR QEA

Date: 10/1/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: EM
Health & Safety Officer: CT
Project Manager: DB

TOPICS COVERED:

- ☒ Emergency Procedures and Evacuation Route
- ☒ Directions to Hospital
- ☒ HASP Review and Location
- ☒ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☒ Fire Extinguisher Location
- ☒ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☒ Communication
- ☒ Site Security
- ☒ Vessel Safety Protocols
- ☒ Work Zones
- ☒ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☒ Lifting Techniques
- ☒ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☒ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☒ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: Rain, cloudy,

Daily Work Scope: Collect surface grabs

Site-specific Hazards: on-water work, potentially contaminated media power grab equip.

Safety Comments: Drink water! Have fun!

Make sure you're

Attendees

Printed Name	Signature
EVAN MALCZYK	[signature]
Deanna Wright	[signature]
Chelsea Wright	[signature]
Joy Dunay	[signature]
Mika Davis	[signature]
Tosa Wright	[signature]

End of Day Wellness Check

PLAYING IT SAFE

ANCHOR QEA

Daily Safety Briefing Form

Date: 10/2/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: EM　　**Health & Safety Officer:** CT　　**Project Manager:** DB

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
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- ☐ Lines of Authority
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- ☐ Site Security
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- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: mixed
windy

Daily Work Scope: Collect surface
grabs

Site-specific Hazards: On-water work
H_2S

Safety Comments:

Attendees

Printed Name	Signature
Josh Wright	[signature]
Deanna Wright	[signature]
Chelsea Wright	[signature]
Mika Davis	[signature]
	EM

End of Day Wellness Check

PLAYING IT SAFE

Daily Safety Briefing Form

ANCHOR QEA

Date: 10/3/18
Project No: **170553-11.05**
Project Name: **EHRP Wood Waste**

Person Conducting Meeting: EM **Health & Safety Officer:** DT **Project Manager:** DB

TOPICS COVERED:

- [x] Emergency Procedures and Evacuation Route
- [ ] Directions to Hospital
- [x] HASP Review and Location
- [ ] Safety Equipment Location
- [ ] Proper Safety Equipment Use
- [ ] Employee Right-to-Know/ SDS Location
- [ ] Fire Extinguisher Location
- [ ] Eye Wash Station Location
- [ ] Buddy System
- [ ] Self and Coworker Monitoring
- [x] Lines of Authority
- [x] Communication
- [ ] Site Security
- [x] Vessel Safety Protocols
- [x] Work Zones
- [x] Vehicle Safety and Driving/ Road Conditions
- [ ] Equipment Safety and Operation
- [ ] Proper Use of PPE
- [ ] Decontamination Procedures
- [ ] Near Miss Reporting Procedures
- [x] Lifting Techniques
- [x] Slips, Trips, and Falls
- [ ] Hazard Exposure Routes
- [x] Heat and Cold Stress
- [ ] Overhead and Underfoot Hazards
- [x] Chemical Hazards
- [ ] Flammable Hazards
- [ ] Biological Hazards
- [ ] Eating/Drinking/Smoking
- [ ] Reviewed Prior Lessons Learned
- [ ] Field Team Medical Conditions for Emergency Purposes (Confidential):
- [ ] Other:

Weather Conditions: Sun, calm

Daily Work Scope: Collect grabs

Site-specific Hazards: On-water work

Safety Comments:

Attendees

Printed Name	Signature
Evan Malczyk	[signature]
Hannah Wright	[signature]
Tom Wright	[signature]
Bonnie Andrews	[signature]
Mike Davis	[signature]

End of Day Wellness Check

PLAYING IT SAFE

ANCHOR QEA

Daily Safety Briefing Form

Date: 10/4/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: EM **Health & Safety Officer:** C **Project Manager:** BD

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☐ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: ~~Collect surface~~ EM 10/4

Daily Work Scope: Collect surface grabs

Site-specific Hazards: On-water work

Safety Comments: Stay warm! watch for slips!

Attendees

Printed Name	Signature
Evan Malczyk	
Tom Wright	[signature]
Bonnie Andrews	[signature]
Desmond Wright	[signature]
Mika Davis	[signature]
	EM

End of Day Wellness Check

PLAYING IT SAFE

Daily Safety Briefing Form

Date: 10/5/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: EM
Health & Safety Officer: CT
Project Manager: DD

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☐ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: Rain

Daily Work Scope: collect surface grabs

Site-specific Hazards: Slips, trips

Safety Comments:

Attendees

Printed Name	Signature
EVAN MALCZYK	[signature]
Tom Wright	[signature]
Mika Davis	[signature]
Deegan Wolf	[signature]
Bonnie Andrea	[signature]
	EM

End of Day Wellness Check

PLAYING IT SAFE

Page 1

hr.

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS	
07	0.5 hr	10/1/18 0934	10/1 1004	10/1 1005	EHWW-07-SG-00009DA @ 1005	very little visible color
07	2 hr	0937	10/1 ~~1139~~ 1137	10/1 1140	EHWW-07-SG-00009B @ 1140	
07	24 hr	0939	10/2 0939	10/2 0955	EHWW-07-SG-000010C @ 0955	No color
39	0.5	10/1/18 1037	10/1 1107	10/1 1107	EHWW-39-SG-000010A @ 1107	No vis color change
39	2	1039	10/1 1239	10/1 1238	EHWW-39-SG-000010B @ 1238	
39	24	1041	10/2 1041	10/2 1108	EHWW-39-SG-000010C @ 1108	
24	2	10/1/18 1141	10/1 1341	10/1 1356	EHWW-24-SG-000010A @ 1356	
24	24	1142	10/2 1142	10/2 1202	EHWW-24-SG-000010B @ 1202	
02	24	10/1/18 1306	10/2 1306	10/2 1338	EHWW-02-SG-000010A @ 1338	
03	2	10/1 1341	10/1 1541	10/1 1551	EHWW-03-SG-000010A @ 1551	
03	24	1342	10/2 1342	10/2 1352	EHWW-03-SG-00010B @ 1352	
01	2	10/1 1416	10/1 1616	10/1 1635	EHWW-01-SG-000010A @ 1635	
01	24	1418	10/2 1418	10/2 1429	EHWW-01-SG-000010B @ 1429	
06	2	10/1 1454	10/1 1654	10/1 1745	EHWW-06-SG-000010A @ 1745	
06	24	10/1 1455	10/2 1455	10/2 1524	EHWW-06-SG-000010B @ 1524	

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS
08	2	10/1 1534	10/1 1734	10/1 1749	EHWW-08-SG-000010A @ 1749
08	24	⊥ 1535	10/2 1535	10/2 1553	EHWW-08-SG-000010B @1553
09	2	10/1 1620	10/1 1820	10/1 1831	EHWW-09-SG-000010A @ 1831
09	24	⊥ 1621	10/2 1621	10/2 1630	EHWW-09-SG-000010B @1630
15	2	10/2 0827	10/2 ~~0827~~ 1027	10/2 1030	EHWW-15-SG-000010A @1030
15	24	⊥ 0828	10/3 0828	10/3 0906	EHWW-15-SG-000010B @0906
16	2	10/2 ~~[illegible]~~ 0859	10/2 1059	10/2 1105	EHWW-16-SG-000010A @ 1105
16	24	⊥ 0901	10/3 0901	10/3 0909	EHWW-16-SG-000010B @0909
17	2	10/2 0927	10/2 1126	10/2 1136	EHWW-17-SG-000010A @ 1136
17	24	⊥ 0927	10/3. 0927	10/3 ~~1630~~ 1012	EHWW-17-SG- @1012 -000010B ~~@1630~~
18	2	10/2 1004	10/2 1204	10/2 1205	EHWW-18-SG-000010A @ 1205
18	24	⊥ 1005	10/3 1005	10/3 1014	EHWW-18-SG-000010B @ 1014
19	2	10/2 1051	10/2 1251	10/2 1254	EHWW-19-SG-000010A @ 1254
19	24	⊥ 1053	10/3 1053	10/3 1151	EHWW-19-SG-000010B @ 1151
20	2	10/2 1151	10/2 1351	10/2 1355	EHWW-20-SG-000010A @ 1355
20	24	⊥ 1153	10/3. 1153	10/3 1215	EHWW-20-SG-000010B @ 1215

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS
42	2	10/2 1243	10/2 1443	10/2 1459	EHWW-42-SG-000010A @1459
42	24	1244	10/3 1244	10/3 1325	EHWW-42-SG-000010B @1325
48	2	10/2 1414	10/2 1614	10/2 1626	EHWW-48-SG-000010A @1622
48	24	1415	10/3 1415	10/3 1438	EHWW-48-SG-000010B @1438
31	2	10/2 14:54	10/2 16:54	10/2 1730	EHWW-31-SG-000010A @1730
31	24	14:57	10/3. 1457	10/3 1530 x2 DGTS	EHWW-31-SG-000010B @1530 DUP EHWW-131-SG-000010B @1530
04	2	10/2 1539	10/2 1739	10/2 1741	EHWW-04-SG-000010A @1741
04	24	1541	10/3 1541	10/3 1601	EHWW-04-SG-000010B @1601
50	2	10/2 1609	10/2 1809	10/2 1814	EHWW-50-SG 000010A @1814.
50	24	1610	10/3 1610	10/3 1629	EHWW-50-SG-000010B @1629
REF 17	24	10/3 0822	10/4 0822	10/4 0858	EHWW-REF17-SG-000010B @0858
REF 18	24	10/3 0858	10/4 0858	10/4 0900	EHWW-REF18-SG-000010B @0900
10	24	10/3 0948	10/4 0948	10/4 10:20	EHWW-10-SG-000010B @10:20
30	2	10/3 1033	10/3 1253	10/3 1252	EHWW-30-SG-000010A @1252
30	24	10/3 1035	10/4 1035	10/4 10:46	EHWW-30-SG-000010B @10:46
33	2	10/3 1117	10/3 1317	10/3 1322	EHWW-33-SG-000010A @1322
33	24	10/3 1119	10/4 1119	2 DGTS 10/4 11:26	EHWW-33-SG-000010B @11:26

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS
14	24	10/3/18 1206	10/4 1206	10/4 12:11	EHWW-14-SG-000010B @ 12:11
13	2	10/3 1246	10/3 1446	10/3 1451	EHWW-13-SG-000010A @1451
13	24	1250	10/4 1250	10/4 13:12	EHWW-13-SG-000010B @ 13:12
11	2	10/3 1348	10/3 1548	A 2DGTS. DUP. 10/3 1539	EHWW-11-SG-000010A EHWW-111-SG-000010A (FD) Both @1539
11	24	1350	10/4 1350	[redacted] 10/4 14:13	EHWW-11-SG-000010B @ 14:13
26	2	10/3 1424	10/3 1624	10/3 1628	EHWW-26-SG-000010A @1628
26	24	1426	10/4 1426	10/4 1505	EHWW-26-SG-000010B @ 1505
22	2	10/3 1457	10/3 1657	10/3 1721	EHWW-22-SG-000010A @1724
22	24	1500	10/4 1500	10/4 1511	EHWW-22-SG-000010B @ 1511
27	2	10/3 1542	10/3 1742	A 2 DGTS 10/3 1751	EHWW-27-SG-000010A EHWW-127-SG-000010A DUP. Both @1751
27	24	1544	10/4 1544	A 2DGTs 10/4 1551	EHWW-27-SG-000010B EHWW-127-SG-000010B DUP both @ 1551
38	2	10/3 1618	10/3 1818	10/3 1835	EHWW-38-SG-000010A @1835
38	24	1620	10/4 1620	10/4 16:22	EHWW-38-SG-000010B @ 16:22
44	2	10/4 0813	10/4 1013	10/4 10:24	EHWW-44-SG-000010A @ 10:24
44	24	0814	10/5 0814	10/5 0906	EHWW-44-SG-000010B @0906.

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS
45	2	10/4 0846	10/4 1046	10/4 10:50	EHWW-45-SG-000010A@10:50
45	24	0848	10/5 0848	10/5 0921	EHWW-45-SG-000010B@0921
46	2	10/4 0924	10/4 1126	10/4 11:33	EHWW-46-SG-000010A @ 11:33
46	24	0929	10/5 0929	10/5 0944.	EHWW-46-SG-000010B @ 0944
47	2	10/4 1002	10/4 1202	10/4 12:08	EHWW-47-SG-000010A @ 12:08
47	24	1004	10/5 1004	10/5. 10:18	EHWW-47-SG-000010B @ 10:18 stopped
49	2	10/4 1037	10/4 1237	10/4 12:46	EHWW-49-SG-000010A @ 12:46.
49	24	1037	10/5 1037	10/5 1111.	EHWW-49-SG-000010B@1111
41	2	10/4 1113	10/4 1313	10/4 13:15	EHWW-41-SG-000010A @ 13:15
41	24	1113	10/5 1113	10/5 1116	EHWW-41-SG-000010B @ 1116.
28	24	10/4 1200	10/5 1200	10/5 1205	EHWW-28-SG-000010B @1205.
29	2	10/4 1301	10/4 1501	10/4 1508	EHWW-29-SG-000010A @1508
29	24	1303	10/5 1303	10/5 1326	EHWW-29-SG-000010B@1326
12	2	10/4 1405	10/4 1605	2 DGTS 10/4 16:11	EHWW-12-SG-000010A EHWW-112-SG-000010A DUP both @ 16:11
12	24	1406	10/5 1406	2 DGTS 10/5 1411	EHWW-12-SG-000010B EHWW-112-SG-000010B both @ 1411

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS
35	2	10/4 1455	10/4 1655	10/4 1659	EHWW-35-SG-000010A @1659
35	24	1456	10/5 1456	10/5 1503	EHWW-35-SG-000010B @1503
34	2	10/4 1538	10/4 1738	10/4 1745	EHWW-34-SG-000010A @1745
34	24	1540	10/5 1540	10/5 1537	EHWW-34-SG-000010B @1537
32	24	10/4 1609	10/5. 1609	10/5 1700	EHWW-32-SG-000010B @1700.
25	2	10/5 753	10/5 953	10/5 1006.	EHWW-25-SG-000010A@1006.
25	24	753	10/6. 753	10/6 0753	EHWW-25-SG-000010B @0753
23	24	10/5 0909	10/6 0909 mo	10/6. 0935	EHWW-23-SG-000010B@ 0935.
~~23~~	~~24~~		~~10/6.~~	~~cm~~	
40	2	10/5 0937	10/5 1137	10/5 1155	EHWW-40-SG-000010A@1155
40	24	0937	10/6. 0937.	10/6 0950	EHWW-40-SG-000010B@0950
43	2	10/5 1002	10/5 1202	10/5 1202	EHWW-43-SG-000010A @1202
43	24	1003	10/6. 1003	10/6 1010	EHWW-43-SG-00001B@ 1010.
36	2	10/5 1035	10/5 1235	10/5 1256	EHWW-36-SG-000010A @1256
36	24	1036	10/6. 1036	10/6 1045	EHWW-36-SG-000010B@1045
37	24	10/5 1109	10/6 1109	10/6 1115	EHWW-37-SG-000010B @1115
~~37~~	~~24~~		~~10/6.~~ mo.		

SAMPLE LOCATION	DGT EXPOSURE DURATION	DGT DEPLOYED (DATE/TIME)	RETRIEVE ON (DATE/TIME)	DGT RETRIEVED (DATE/TIME)	COMMENTS
05	2	10/5 1148	10/5 1348	10/05 1352	ENW-05-SG-000010A@1352
05	24	1149	10/6 1149	10/6 1155	ENW-05-SG-000010B@1155

Chain of Custo[illegible]ecord and Laboratory Analysis Request

COC#

Date: 10/1/2018
Laboratory : **Nautilus**
Project Name: **EHRP Wood Debris Remediation**
Project Number: **170553-11.05**
Project Contact: **Cheronne Oreiro**
Phone Number: **206.971.2680**
Shipment Method: **Delivery**

AN QE

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Bioassay Archive	Comn
1	EHWW-01-SG-000010	10/1/18 1415	SE	1	X	
2	EHWW-02-SG-000010	1305	SE	1	X	
3	EHWW-03-SG-000010	1330	SE	1	X	
4	EHWW-06-SG-000010	1455	SE	1	X	
5	EHWW-07-SG-000010	0940	SE	1	X	
6	EHWW-08-SG-000010	1535	SE	1	X	
7	EHWW-09-SG-000010	1610	SE	1	X	
8	EHWW-24-SG-000010	1132	SE	1	X	
9	EHWW-39-SG-000010	1040	SE	1	X	
10			SE			
11			SE			
12			SE			
13			SE			
14			SE			

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: [signature] EVAN MALCZYK	Company: Anchor QEA LLC. 10/1/18 1913	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custo[illegible] [illegible]ecord and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/2/2018
Laboratory : Nautilus
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Bioassay Archive	Comments
1	EHWW-04-SG-000010	10/2/2018 1545	SE	1	X	
2	EHWW-15-SG-000010	0830	SE	1	X	
3	EHWW-16-SG-000010	0900	SE	1	X	
4	EHWW-17-SG-000010	0930	SE	1	X	
5	EHWW-18-SG-000010	1005	SE	1	X	
6	EHWW-19-SG-000010	1055	SE	1	X	
7	EHWW-20-SG-000010	1155	SE	1	X	
8	~~EHWW-21-SG-000010~~		SE			
9	EHWW-31-SG-000010	1500	SE	1	X	
10	EHWW-42-SG-000010	1245	SE	1	X	
11	EHWW-48-SG-000010	1420	SE	1	X	
12	EHWW-50-SG-000010	1610	SE	1	X	
13			SE			
14			SE			

Sediment and Field QC

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: EVAN MALCZYK
Company: Anchor QEA LLC.
Signature/Printed Name
10/2/2018 ~~0700~~ 1900 pm 10/2
Date/Time

Received By:
Company:
Signature/Printed Name
Date/Time

Relinquished By:
Company:
Signature/Printed Name
Date/Time

Received By:
Company:
Signature/Printed Name
Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page ______ of ______

COC#

ANCHOR QEA

...ain of Custo... ...ecord and Laboratory Analysis Request

Date: 10/3/18
Laboratory: Nautilus
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Bioassay Archive	Comments
1	EHWW-27-SG-000010	10/3/18 1545	SE	1	✓	
2	EHWW-22-SG-000010	1500	SE	1	✓	
3	EHWW-26-SG-000010	1428	SE	1	✓	
4	EHWW-11-SG-000010	1352	SE	1	✓	
5	EHWW-11-SG-000010	1255	SE	1	✓	
6	EHWW-14-SG-000010	1208	SE	1	✓	
7	EHWW-33-SG-000010	1120	SE	1	✓	
8	EHWW-30-SG-000010	1035	SE	1	✓	
9	EHWW-10-SG-000010	0950	SE	1	✓	
10	EHWW-REF17-SG-000010	0825	SE	1	✓	
11	EHWW-REF18-SG-000010	0900	SE	1	✓	
12	EHWW-13-SG-000010	1255	SE	1	✓	
13			SE			
14			SE			

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: EVAN MALCZYK Signature/Printed Name Company: Anchor QEA LLC. Date/Time: 10/3/2018 1930	Received By: Signature/Printed Name Company: Date/Time
Relinquished By: Signature/Printed Name Company: Date/Time	Received By: Signature/Printed Name Company: Date/Time

Page of

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Chain of Custo[…]ecord and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/2018
Laboratory : Nautilus
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Bioassay Archive	Comments
1	EHWW-44-SG-000010	10/4/18 0815	SE	1	✓	
2	EHWW-45-SG-000010	10/4/18 0850	SE	1	✓	
3	EHWW-46-SG-000010	10/4/18 0930	SE	1	✓	
4	EHWW-47-SG-000010	10/4/18 1005	SE	1	✓	
5	EHWW-49-SG-000010	10/4/18 1049	SE	1	✓	
6	EHWW-41-SG-000010	10/4/18 1115	SE	1	✓	
7	EHWW-28-SG-000010	10/4/18 1200	SE	1	✓	
8	EHWW-29-SG-000010	10/4/18 1305	SE	1	✓	
9	EHWW-12-SG-000010	10/4/18 1410	SE	1	✓	
10	EHWW-35-SG-000010	10/4/18 1458	SE	1	✓	
11	EHWW-34-SG-000010	10/4/18 1540	SE	1	✓	
12	EHWW-32-SG-000010	10/4/18 1610	SE	1	✓	
13	EHWW-25-SG-000010	10/5/18 0755	SE	1	✓	
14	EHWW-23-SG-000010	10/5/18 0910	SE	1	✓	

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
[signature] EVAN MALCZYK	Anchor QEA LLC. 10/5/18 1500	[signature] Mika Davis	Hemmera 10/5/18 1501
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
[signature]	Hemmera 10/6/18	[signature]	Nautilus Envs
Signature/Printed Name	Date/Time	Signature/Printed Name [signature]	Date/Time

Oct 6/18 @ 1355h

Distribution: *A copy will be made for the laboratory and client. The Project file will retain the original.*

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/18
Laboratory : Nautilus
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Bioassay Archive	Comments
1	EHWW-40-SG-000010	10/5/18 0935	SE	1	✓	
2	EHWW-43-SG-000010	10/5/18 1000	SE	1	✓	
3	EHWW-36-SG-000010	10/5/18 1040	SE	1	✓	
4	EHWW-37-SG-000010	10/5/18 1110	SE	1	✓	
5	EHWW-05-SG-000010	10/5/18 1150	SE	1	✓	
6			SE			
7			SE			
8			SE			
9			SE			
10			SE			
11			SE			
12			SE			
13			SE			
14			SE			

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company: Hemmera
Evan Maczka	10/5/18 1520	Mika Davis	10/5/18 1520
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company: Hemmera	Received By:	Company: Nautilus Env
	10/6/18.		
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

[illegible] 10/6/18 1355h

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/4/2018
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	PAHs	PCB Aroclors	Metals	Dioxin/Furans	Comments
1	EHWW-46-SG-000010	10/4/18 0930	SE	2	|	|	|	|	
2	EHWW-45-SG-000010	10/4/18 0850	SE	2					
3	EHWW-44-SG-000010	10/4/18 0815	SE	2					
4	EHWW-14-SG-000010	10/3/18 1208	SE	2					
5	EHWW-33-SG-000010	10/3/18 1120	SE	2					
6	EHWW-30-SG-000010	10/3/18 1035	SE	2					
7	EHWW-10-SG-000010	10/3/18 0950	SE	2					
8	EHWW-04-SG-000010	10/2/18 1545	SE	2					
9	EHWW-18-SG-000010	10/2/18 1005	SE	2					
10	EHWW-19-SG-000010	10/2/18 1055	SE	2					
11	EHWW-42-SG-000010	10/2/18 1245	SE	2					
12	EHWW-48-SG-000010	10/2/18 1420	SE	2					
13	EHWW-148-SG-000010	10/2/18 1425	SE	2					
14	EHWW-06-SG-000010	10/1/18 1455	SE	2					

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:
Please homogenize sample and subsample necessary volume to send out for PCB and D/F analysis

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Evan Malczyk	10/4/2018 2000		
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page ______ of ______

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/4/2018
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	PAHs	PCB Aroclors	Metals	Dioxin/Furans															Comments
1	EHWW-09-SG-000010	10/1/18 1610	SE	2	1	1	1	1															
2	EHWW-39-SG-000010	10/1/18 1040	SE	2	1	1	1	1															
3			SE																				
4			SE																				
5			SE																				
6			SE																				
7			SE																				
8			SE																				
9			SE																				
10			SE																				
11			SE																				
12			SE																				
13			SE																				
14			SE																				

Sediment and Field QC

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:
Please homogenize sample and subsample necessary volume to send out for PCB and D/F analysis

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page ______ of ______

Chain of Cust[illegible] Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/18
Laboratory: Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time		Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-07-SG-000010A	10/1/18	1005	SE	1		
2	EHWW-07-SG-000010B	10/1/18	1140	SE	1		
3	EHWW-07-SG-000010C	10/2/18	0955 ~~1407~~	SE	1		
4	EHWW-39-SG-000010A	10/1/18	1107	SE	1		
5	EHWW-39-SG-000010B	10/1/18	1238	SE	1		
6	EHWW-39-SG-000010C	10/2/18	1108	SE	1		
7	EHWW-24-SG-000010A	10/1/18	1356	SE	1		
8	EHWW-24-SG-000010B	10/2/18	1202	SE	1		
9	EHWW-~~82~~-SG-000010A	10/2/18	1338	SE	1		
10	EHWW-03-SG-000010A	10/1/18	1551	SE	1		
11	EHWW-03-SG-000010B	10/2/18	1352	SE	1		
12	EHWW-01-SG-000010A	10/1/18	1635	SE	1		
13	EHWW-01-SG-000010B	10/2/18	1429	SE	1		
14	EHWW-06-SG-000010A	10/1/18	1745	SE	1		

Sediment and Field QC

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
[signature] Evan Malczyk	10/5/18 1500	[signature] Mika Davis	10/5/18 1507
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company: HEMMERA	Received By:	Company:
[signature]	10/10/18 0930		
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

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Page 1 of 8

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/18
Laboratory : Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-06-SG-000010B	10/2/18 1524	SE	1		
2	EHWW-08-SG-000010A	10/1/18 1749	SE	1		
3	EHWW-08-SG-000010B	10/2/18 1553	SE	1		
4	EHWW-09-SG-000010A	10/1/18 1831	SE	1		
5	EHWW-09-SG-000010B	10/2/18 1630	SE	1		
6	EHWW-15-SG-000010A	10/2/18 1030	SE	1		
7	EHWW-15-SG-000010B	10/3/18 0906	SE	1		
8	EHWW-16-SG-000010A	10/2/18 1105	SE	1		
9	EHWW-16-SG-000010B	10/3/18 0909	SE	1		
10	EHWW-17-SG-000010A	10/2/18 1136	SE	1		
11	EHWW-17-SG-000010B	10/3/18 1012	SE	1		
12	EHWW-18-SG-000010A	10/2/18 1205	SE	1		
13	EHWW-18-SG-000010B	10/3/18 1014	SE	1		
14	EHWW-19-SG-000010A	10/2/18 1254	SE	1		

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
EVAN MALCZYK	10/5/18 1500	Mika Davis	10/5/18 1501
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company: HEMMERA	Received By:	Company:
	10/10/18 0930		
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date:
Laboratory : Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time		Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-19-SG-000010B	10/3/18	~~1014~~ 1151	SE	1	✓	
2	EHWW-20-SG-000010A	10/2/18	1358	SE	1	✓	
3	EHWW-20-SG-000010B	10/3/18	1215	SE	1	✓	
4	EHWW-42-SG-000010A	10/2/18	1459	SE	1	✓	
5	EHWW-42-SG-000010B	10/3/18	1325	SE	1	✓	
6	EHWW-48-SG-000010A	10/2/18	1622	SE	1	✓	
7	EHWW-48-SG-000010B	10/3/18	1438	SE	1	✓	
8	EHWW-31-SG-000010A	10/2/18	1730	SE	1	✓	
9	EHWW-31-SG-000010B	10/3/18	1530	SE	1	✓	
10	EHWW-131-SG-000010B	10/3/18	1530	SE	1	✓	
11	EHWW-04-SG-000010A	10/2/18	1741	SE	1	✓	
12	EHWW-04-SG-000010B	10/3/18	1601	SE	1	✓	
13	EHWW-50-SG-000010A	10/2/18	1814	SE	1	✓	
14	EHWW-50-SG-000010B	10/3/18	1629	SE	1	✓	

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Evan Malczyk	10/5/18 1500	Mika Davis	10/5/18 1507
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company: Henmera	Received By:	Company:
	10/10/18		
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date:
Laboratory : Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-REF17-SG-000010B	10/4/18 0858	SE	1		
2	EHWW-REF18-SG-000010B	10/4/18 0908	SE	1		
3	EHWW-10-SG-000010B	10/4/18 1020	SE	1		
4	EHWW-30-SG-000010A	10/3/18 1252	SE	1		
5	EHWW-30-SG-000010B	10/4/19 1046	SE	1		
6	EHWW-33-SG-000010A	10/3/18 1322	SE	1		
7	EHWW-33-SG-000010B	10/4/18 1126	SE	1		
8	EHWW-14-SG-000010B	10/4/18 1214	SE	1		
9	EHWW-13-SG-000010A	10/3/18 1451	SE	1		
10	EHWW-13-SG-000010B	10/4/18 1312	SE	1		
11	EHWW-11-SG-000010A	10/3/18 1539	SE	1		
12	EHWW-111-SG-000010A	10/3/18 1539	SE	1		
13	EHWW-11-SG-000010B	10/4/18 1413	SE	1		
14	EHWW-26-SG-000010A	10/3/18 1628	SE	1		

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
Evan Malczyk — EVAN MALCZYK (Signature/Printed Name)	Anchor QEA LLC. 10/5/18 1500 (Date/Time)	Mika Davis — Mika Davis (Signature/Printed Name)	10/5/18 1501 (Date/Time)
Mika Davis (Signature/Printed Name)	HEMMERA 10/10/18 0930 (Date/Time)	(Signature/Printed Name)	(Date/Time)

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/18
Laboratory: Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-26-SG-000010B	10/4/18 1505	SE	1	|	
2	EHWW-22-SG-000010A	10/3/18 1721	SE	1	|	
3	EHWW-22-SG-000010B	10/4/18 1511	SE	1	|	
4	EHWW-27-SG-000010A	10/3/18 1751	SE	1	|	
5	EHWW-127-SG-000010A	10/3/18 1751	SE	1	|	
6	EHWW-27-SG-000010B	10/4/18 1551	SE	1	|	
7	EHWW-127-SG-000010B	10/4/18 1551	SE	1	|	
8	EHWW-38-SG-000010A	10/3/18 1835	SE	1	|	
9	EHWW-38-SG-000010B	10/4/18 1627	SE	1	|	
10	EHWW-44-SG-000010A	10/4/18 1024	SE	1	|	
11	EHWW-44-SG-000010B	10/5/18 0906	SE	1	|	
12	EHWW-45-SG-000010A	10/4/18 1050	SE	1	|	
13	EHWW-45-SG-000010B	10/5/18 0921	SE	1	|	
14	EHWW-46-SG-000010A	10/4/18 1133	SE	1	|	

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name: [signature] Evan Malczyk	Anchor QEA LLC. Date/Time: 10/5/18 1500	Signature/Printed Name: [signature] Mika Davis	Date/Time: 10/5/18 1501
Signature/Printed Name: [signature]	Company: Hemmera Date/Time: 10/10/18 0930	Signature/Printed Name:	Date/Time:

Distribution: *A copy will be made for the laboratory and client. The Project file will retain the original.*

Chain of Custo[illegible] Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date:	10/5/18
Laboratory :	Anchor QEA Geochemistry Laboratory
Project Name:	EHRP Wood Debris Remediation
Project Number:	170553-11.05
Project Contact:	Evan Malczyk
Phone Number:	206.219.5891
Shipment Method:	Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-46-SG-000010B	10/5/18 0944	SE	1		
2	EHWW-47-SG-000010A	10/4/18 1208	SE	1		
3	EHWW-47-SG-000010B	10/5/18 1018	SE	1		
4	EHWW-49-SG-000010A	10/4/18 1246	SE	1		
5	EHWW-49-SG-000010B	10/5/18 1111	SE	1		
6	EHWW-41-SG-000010A	10/4/18 1315	SE	1		
7	EHWW-41-SG-000010B	10/5/18 1116	SE	1		
8	EHWW-28-SG-000010B	10/5/18 1205	SE	1		
9	EHWW-29-SG-000010A	10/4/18 1508	SE	1		
10	EHWW-29-SG-000010B	10/5/18 1326	SE	1		
11	EHWW-12-SG-000010A	10/4/18 1611	SE	1		
12	EHWW-112-SG-000010A	10/4/18 1611	SE	1		
13	EHWW-12-SG-000010B	10/4/18 1411	SE	1		
14	EHWW-112-SG-000010B	10/5/18 1411	SE	1		

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
EVAN MALCZYK	10/5/18 1500	Mika Davis	10/5/18 1501
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company: HEMMERA	Received By:	Company:
	10/10/18 0930		
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

Date: 10/5/18
Laboratory: Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-35-SG-000010A	10/4/18 1659	SE	1		
2	EHWW-35-SG-000010B	10/5/18 1503	SE	1		
3	EHWW-34-SG-000010 A	10/4/18 1745	SE	1		
4	EHWW-34-SG-000010 B	10/5/18 1537	SE	1		
5	EHWW-32-SG-000010B	10/5/18 1700	SE	1		
6	EHWW-25-SG-000010A	10/5/18 1006	SE	1		
7	EHWW-25-SG-000010 B	10/6/18 0753	SE	1		
8	EHWW-23-SG-000010B	10/6/18 0945	SE	1		
9	EHWW-40-SG-000010 A	10/5/18 1155	SE	1		
10	EHWW-40-SG-000010B	10/6/18 0950	SE	1		
11	EHWW-43-SG-000010A	10/5/18 1202	SE	1		
12	EHWW-43-SG-000010B	10/6/18 1010	SE	1		
13	EHWW-36-SG-000010A	10/5/18 1256	SE	1		
14	EHWW-36-SG-000010 B	10/6/18 1045	SE	1		

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: [signature] EVAN MALCZYK	Company: Anchor QEA LLC. 10/5/18 1500	Received By: [signature] Mika Davis	Company: 10/5/18 1501
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time
Relinquished By: [signature]	Company: Hemmera 10/10/18 0930	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/18
Laboratory : Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Comments
1	EHWW-37-SG-000010A	10/6/18 1115	SE	1	✓	
2	EHWW-05-SG-000010A	10/5/18 1352	SE	1	✓	
3	EHWW-05-SG-000010B	10/6/18 1155	SE	1	✓	
4			SE			
5			SE			
6			SE			
7			SE			
8			SE			
9			SE			
10			SE			
11			SE			
12			SE			
13			SE			
14			SE			

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
EVAN MALCZYK (Signature/Printed Name)	Anchor QEA LLC. 10/5/18 1500 (Date/Time)	Mika Davis (Signature/Printed Name)	10/5/18 1501 (Date/Time)
(Signature/Printed Name)	HEMMERA 10/10/18 0930 (Date/Time)	(Signature/Printed Name)	(Date/Time)

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-03	ELEVATION AND DATUM: -2.61 m CD	
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/17/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 14.5ft/4.42m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 814015	WATER DEPTH: 17.5ft/5.33m	WATER LEVEL: 2.72 m
LAT/NORTHING: 5365734.30	LONG/EASTING: 467918.13	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
1				0-150 cm: Moist - wet, soft, dark gray-brown, SILT WITH WOOD WASTE (ML),							EHWW-03-SC-000050 @1155
2				90% fines, 10% f-sand, substantial organic					10	90	
3				material (wood fragments, up to 4"), trace H_2S-like							EHWW-03-SC-150200 @1200
4				odor							
5				150-232 cm: Moist, soft, gray, SANDY SILT (ML),							
6				70% fines, 30% f-sand, substantial shell hash.					30	70	
7				232-442 cm: Moist, med-stiff, gray, medium plasticity, CLAYEY SILT							EHWW-03-SC-200250 @1210
8				(CL/ML), 100% fines							
9				@310 cm: Grades to gray w/brown mottling						100	
10				@360 cm: Grades to brown w/gray mottling							
11				@370 cm: one gravel (subrounded, 2 cm)							
12											
13											
14				end of core @14.5ft/4.42m							

Project No. 170553-11.05	45% recovery correction applied to 0-232 cm.	Page 1 of 1

SUBSURFACE BORING LOG

PROJECT: WWRP				
BORING LOCATION: EHWW-16		ELEVATION AND DATUM: ~5.06m CD		
DRILLING CONTRACTOR: Drillwell		DATE STARTED: 12/18/18		LOGGED BY: BW
DRILLING METHOD: Sonic		TOTAL DEPTH: 20ft / 6.10m		MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS		WATER DEPTH: 25ft / 7.62 m		WATER LEVEL: 2.55 m
LAT/NORTHING: 5366366.52		LONG/EASTING: 466948.88		
BOREHOLE DIAMETER: 4"		HAMMER TYPE/SYSTEM: N/A		

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
0–5				0-152cm: Interval extruded into bucket, SILT WITH WOOD WASTE (ML), graded to SILT (ML) unit described below at end of run, interface is @ 152cm							EHWW-16-SC-152202 @ 1445
5–8				152-262cm: Wet, soft, gray, SANDY SILT (ML), 70% fines, 30% f-sand, moderate shell hash, trace H_2S-like odor.					30	70	EHWW-16-SC-152-202 @ 1450
9–18				262-580 cm: Moist, very soft, gray, SILT (ML) 90% fines, 10% f-sand, trace to moderate shell hash, trace H_2S-like odor. @ 430cm: Grades to soft					10	90	EHWW-16-SC-202252 @ 1455
18–20				580-610 cm: Moist, soft, to medium stiff, gray, CLAYEY SILT (CL/ML), medium plasticity, 100% fines.						100	
				end of core @ 20ft / 6.10 m							

Depth marks: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Project No. 170553-11.05	0-5 ft push extruded into bucket, no recovery correction applied to core	Page 1 of 1

SUBSURFACE BORING LOG

PROJECT: WWRP	
BORING LOCATION: EHWW-24	ELEVATION AND DATUM: -5.80m CD
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/18/18 — LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 10ft/3.05m — MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 28ft/8.53m — WATER LEVEL: 2.73
LAT/NORTHING: 5366053.50	LONG/EASTING: 467714.59
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
0–2				0-45cm: moist, soft, dark gray-brown, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand, substantial (30-50%) organic material (wood waste, very fine wood particles), trace H_2S-like odor.					10	90	EHWW-24-SC-045095 @ 1200
2–6				45-182cm: moist, soft, gray, SILT (ML), 90% fines, 10% f-sand, moderate shell hash, trace H_2S-like odor. @125 cm: organic material (wood & bark fibers)					10	90	EHWW-24-SC-095145 @ 1215
6–10				182-305 cm: moist, medium stiff, gray, CLAYEY SILT (CL/ML), 100% fines, medium plasticity. @ 200 cm: Grades to brown.						100	
				end of core @ 10ft/3.05m							

Project No. 170553-11.05

90% recovery correction applied to entire core.

SUBSURFACE BORING LOG

PROJECT: WWRP	
BORING LOCATION: EHWW-36	ELEVATION AND DATUM: -2.54m CD
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/17/18 — LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 12ft/3.66m — MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 17ft/5.18m — WATER LEVEL: 264m
LAT/NORTHING: 5365843.50	LONG/EASTING: 467882.06
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A

DEPTH (feet)	Recovery	Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	SAMPLE ID OTHER REMARKS
0–2				0-40.5cm: wet, soft, brown-gray, SILT (ML), 90% fines, 10% f-sand, trace organic material (wood fibers)					10	90	EHWW-36-SC-000050 @ 1025
2–6				40.5-183 cm: Moist, soft, brown-gray, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand substantial (30-50%) organic material (wood fragments & fibers)					10	90	EHWW-36-SC-183233 @ 1035; EHWW-36-SC-233283 @ 1040
6–9				183-250cm: Moist, medium stiff, gray, SILT W/SAND & CLAY (ML), 70% silt, 20% clay, 10% f-sand. @240 cm: Pocket of organic material (wood fibers)					10	90	
9–11.5				250-350 cm: moist, soft to medium stiff, gray, CLAYEY SILT (CL/ML), 100% fines						100	
11.5–12				350-366 cm: Moist, dense, gray, CLAYEY SAND (SC), 70% f-m sand, 30% clay, trace gravel.				70		30	
				end of core @ 12ft/3.66m							

Project No. 170553-11.05

30% recovery correction applied to 0-5.8ft, no recovery correction applied to 5.8-12 ft.

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-38	ELEVATION AND DATUM: -8.4 SmCD	
DRILLING CONTRACTOR: Drill well	DATE STARTED: 12/17/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 31.5ft/9.60 m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140 15	WATER DEPTH: 33ft/10.06 m	WATER LEVEL: 1.61 m
LAT/NORTHING: 5365953.40	LONG/EASTING: 467496.52	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
2				0-85 cm: Moist to wet, soft, dark gray to brown, low plasticity, SILT (ML), 90% fines, 10% f-sand, occassional organic material (wood fragments and fibers), trace H_2S-like odor.					10	90	EHWW-38-SC-000050 @1630
6									5	95	EHWW-38-SC-050100 @ 1645 *uncorrected start depth, was collected from 85-135 cm
8				85-853 cm: Moist, soft, brown to gray, low plasticity, SILT (ML), 95% fines, 5% f-sand, trace shell hash, trace H_2S-like odor. @ 533 cm: Grades to gray @ 722 cm: Large piece of wood							
12											EHWW-38-SC-100150 @ 1650 *uncorrected start depth, was collected from 135-185 cm
16				853-960 cm: Moist, stiff, gray, medium plasticity, CLAYEY SILT (CL/ML), 100% fines							
28				end of core @ 31.5 ft. 9.60 m						100	

Project No. 170553-11.05	57% recovery correction applied to entire core	Page 1 of 1

SUBSURFACE BORING LOG

PROJECT: WWRP	
BORING LOCATION: EHWW - 39	ELEVATION AND DATUM: - 5.53m CD
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/18/18 — LOGGED BY: BW
DRILLING METHOD: Sonic / DT lexan core	TOTAL DEPTH: 5ft / 1.52 m — MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 27ft / 8.23m — WATER LEVEL: 2.70m
LAT/NORTHING: 5366182.73	LONG/EASTING: 467648.64
BOREHOLE DIAMETER: 3" (lexan core)	HAMMER TYPE/SYSTEM: N/A

DEPTH (feet)	SAMPLES Recovery	Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	SAMPLE ID OTHER REMARKS
1				0-35cm: Moist, soft, brown to dark gray, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand, moderate							EHWW-39-SC-035085 @ 1030
2				organic material (wood waste, wood fragments),							EHWW-39-SC-085135 @ 1040
3				moderate H_2S-like odor							
4				35-152 cm: Moist, soft, dark gray, SILT (ML), 90%							
5				fines, 10% f-sand, moderate shell hash, moderate H_2S-like odor							
				end of core @ 5ft / 1.52 m							

Project No. 170553-11.05

86% recovery correction applied to entire core

Page 1 of 1

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-40	ELEVATION AND DATUM: -1.14 m CD	
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/18/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 11ft / 3.35 m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 814015	WATER DEPTH: 11.5ft / 3.50 m	WATER LEVEL: 2.36m
LAT/NORTHING: 5366143.23	LONG/EASTING: 467843.64	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	SAMPLES: PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
1				0-60 cm: Moist, soft, brown-gray, SILT WITH WOOD WASTE (ML), 95% fines, 5% f-sand, substantial (30-50%) organic material (fine wood waste particles), trace H_2S-like odor				-	5	95	EHWW-40-SC-000050 @ 0850
2											
3									40	60	EHWW-40-SC-060110 @ 0845
4				60-127 cm: Moist, soft, gray, SANDY SILT (ML) 60% fines, 40% f-sand, substantial shell hash, trace H_2S-like odor							
5				@ 80 cm: substantial organic material (pine cones & sticks)							EHWW-40-SC-110160 @ 0900
6										100	
7											
8				127-290 cm: Moist, stiff, gray w/ brown mottling, low plasticity, CLAYEY SILT (CL/ML), 100% fines							
9											
10				@ 180 cm: Grades to brown.							
11											
				end of core @ 9.5ft / 2.90 m							

Project No.	no ~~recovery~~ recovery correction applied	Page 1 of ___

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-44	ELEVATION AND DATUM: -8.82 m CD	
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/19/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 13ft/3.96m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 38ft/11.58m	WATER LEVEL: 2.76 m
LAT/NORTHING: 5366129.75	LONG/EASTING: 467424.17	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES Recovery	Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	SAMPLE ID OTHER REMARKS
1				0-17 cm: Moist, soft, brownish gray, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand substantial organic material (wood fragments up to 1cm, fine wood fibers), moderate H_2S-like odor. @surface: Biota (live Macoma clam)					10	90	EHWW-44-SC-017067 @ 1300
2									5	95	EHWW-44-SC-067117 @ 1305
3											
4											
5				17-396 cm: Moist, soft, gray SILT (ML) 95% fines, 5% f-sand, moderate shell hash, moderate H_2S-like odor.							
6											
7											
8											
9											
10											
11											
12											
13											
				end of core @ 13 ft/3.96m							

Project No. 170553-11.05	1) Station moved ~250 ft due to barge blocking access. 2) 77% recovery correction applied to entire core.	Page 1 of 1

SUBSURFACE BORING LOG

PROJECT: WWRP	
BORING LOCATION: EHWW - 53	ELEVATION AND DATUM: -3.39 m CD
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/19/18 · LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 15ft / 4.57m · MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 20ft / 6.10m · WATER LEVEL: 2.71 m
LAT/NORTHING: 5366538.10	LONG/EASTING: 466780.64
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
0–3				0-16 cm: Moist, soft, brownish gray, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand, moderate organic material (fine wood particles, wood fibers), moderate H2S-like odor.					10	90	EHWW-53-SC-000016 @ 1415; EHWW-53-SC-016066 @ 1420
4–7				16-175 cm: Moist, soft, gray, SANDY SILT (ML), 75% fines, 25% f-sand, trace gravel (subrounded, up to 3 cm), substantial shell hash, trace H2S-like odor					25	75	EHWW-53-SC-066116 @ 1425
7–10				175-457 cm: Moist, medium stiff, gray, CLAYEY SILT (CL/ML), 100% fines, trace shell hash.						100	
14				End of core @ 15ft/4.57m							
15											

Project No. 170553-11.05

87% recovery correction applied to entire core

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW -54	ELEVATION AND DATUM: -4.80 m CD	
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/18/19	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 12ft/3.66m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 21ft/6.40m	WATER LEVEL: 1.60 m
LAT/NORTHING: 5366256.45	LONG/EASTING: 466883.42	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
				0-21cm: Moist, soft, dark gray-brown, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand, substantial organic material (fine wood fragments/particles, wood fragments) trace H_2S-like odor.					10	90	EHWW-54-SC-000050 @ 1630
1									10	90	
2											EHWW-54-SC-055105 @ 1635
3									10	90	
4				21-55cm: Moist, soft, gray, SILT (ML), 90% fines, 10% f-sand, moderate organic material (wood fragments), trace H_2S-like odor, moderate shell hash.							EHWW-54-SC-105155 @ 1640
5											
6											
7											
8				55-325 cm: Moist, soft, gray, SILT (ML), 90% fines 10% f-sand, moderate shell hash, trace H_2S-like odor.							
9											
10				325-366 cm: Moist, medium stiff, gray, medium plasticity, CLAYEY SILT (CL/ML)							
11										100	
12											
				end of core @ 12ft/3.66m							

Project No. 170553-11.05	71% recovery correction applied to entire core	Page 1 of 1

SUBSURFACE BORING LOG

PROJECT: WWRP	
BORING LOCATION: EHWW-55	ELEVATION AND DATUM: -9.26 m CD
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/19/18 — LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 17ft/5.18m — MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 38ft/11.58m — WATER LEVEL: 2.32m
LAT/NORTHING: 5365787.92	LONG/EASTING: 467399.34
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A

DEPTH (feet)	SAMPLES: Recovery	Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
0–8				0-110 cm: Moist, soft, brown, SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand, substantial (50-70%) organic material (wood fragments, up to 5 cm), moderate H_2S-like odor.					10	90	EHWW-55-SC-110160 @ 0850
									10	90	EHWW-55-SC-160210 @ 0855
8–17				110-518cm: Moist, soft, gray, SILT (ML), 90% fines, 10% f-sand, trace-moderate shell hash, moderate H_2S-like odor							
				end of core @ 17ft / 5.18m							

Project No. 170553-11.05

47% recovery correction applied to entire core

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW - S6	ELEVATION AND DATUM: -1.50 m CD	
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/17/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 6ft / 1.83m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 17ft / 3.96m	WATER LEVEL: 2.46m
LAT/NORTHING: 5365691.94	LONG/EASTING: 467951.73	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	SAMPLE ID OTHER REMARKS
1				0-45cm: moist, soft, gray, SANDY SILT (ML), 60% fines, 40% f-sand, moderate shell hash, trace H_2S-like odor.					40	60	EHWW-S6-SC-000050 @0905
2											
3				45-183 cm: moist, medium stiff to stiff, gray, low-medium plasticity, SILT WITH SAND (ML), 85% fines, 15% f-sand, trace shell hash					15	85	EHWW-S6-SC-050100 @0920
4											
5											
6											
				end of core @6.0ft/1.83m							

Project No. 170593-11.05

67% recovery correction applied to entire core.

Page 1 of 1

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-57	ELEVATION AND DATUM: ~ 6.16 m CD	
DRILLING CONTRACTOR: Drill well	DATE STARTED: 12/17/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 4ft / 1.22m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 27 ft / 8.23m	WATER LEVEL: 2.07m
LAT/NORTHING: 5365730.35	LONG/EASTING: 467529.61	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
				0-122 cm: Moist, soft, dark gray-brown SILT WITH WOOD WASTE (ML), 90% fines, 10% f-sand, substantial (30-50%) organic material (wood fragments up to 7 cm) moderate H_2S-like odor. @15 cm: increase in organic material					10	90	EHWW-57-SC-000050 @1445
1											
2											
3											
4											
				end of core @ 4.0ft / 1.22m							
				Note: Drillers indicate difficult drilling @ bottom, possible bedrock							

Project No. 170553-11.05	50% recovery correction applied to entire core	Page 1 of 1

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-58	ELEVATION AND DATUM: -6.80 m CD	
DRILLING CONTRACTOR: Drillwell	DATE STARTED: 12/16/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 17ft/5.18m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 814015	WATER DEPTH: 28ft/8.53 m	WATER LEVEL: 1.73 m
LAT/NORTHING: 5365811.18	LONG/EASTING: 467682.46	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	SAMPLE ID OTHER REMARKS
11				0-351cm: No recovery, material (wood & sand), lost from core tube on retrieval					90	10	EHWW-58-SC-361411 @ 1630
12				351-361 cm: Moist, loose, dark gray, POORLY GRADED SAND WITH SILT (SP SM), 90% f-sand, 10% fines, substantial organic material (wood fragments), moderate H_2S-like odor.							EHWW-58-SC-411461 @ 1635
13										100	
14											
15											
16				361-394cm: Moist, loose gray, SHELL HASH WITH SILTY SAND, 80% shell hash, 15% f-sand, 5% fines, trace H_2S-like odor							
17				394-518cm: Moist, stiff, brown w/gray mottling, medium-high plasticity, CLAY (CL), 100% fines							
				end of core @ 17ft/5.18m							

Project No. 170553-11.05	0-11.5ft, no recovery, no recovery correction applied to 11.5-17 ft.	Page 1 of 1

SUBSURFACE BORING LOG

PROJECT: WWRP	
BORING LOCATION: EHWW - 59	ELEVATION AND DATUM: - 8.30 m CD
DRILLING CONTRACTOR: Drill well	DATE STARTED: 12/19/18 — LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 18ft / 5.49m — MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 36ft / 10.97m — WATER LEVEL: 2.67m
LAT/NORTHING: 5366017.95	LONG/EASTING: 467242.41
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	SAMPLES: PID Reading (ppm)	DESCRIPTION	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines	SAMPLE ID OTHER REMARKS
				0-38cm: Moist, soft, brown to gray, SILT WITH WOOD WASTE (ML), 90% fines 10% f-sand, substantial organic material (wood fragments up to 3cm, fine wood fibers), moderate H_2S-like odor.					10	90	EHWW-59-SC-038088 @ 1045
2									10	90	
4				38-549cm: Moist, soft, gray, SILT (ML), 90% fines, 10% f-sand, moderate shell hash, moderate H_2S-like odor.						100	EHWW-59-SC-08838 @ 1050
6				@100cm: Grades to 100% fines, trace f-sand							
8											
10											
12											
14											
16											
18				end of core @ 18ft/5.49m							

Project No. 170553-11.05

61% recovery correction applied to entire core.

PROJECT: WWRP	SUBSURFACE BORING LOG	
BORING LOCATION: EHWW-65	ELEVATION AND DATUM: -2.36 m CD	
DRILLING CONTRACTOR: Drill well	DATE STARTED: 12/19/18	LOGGED BY: BW
DRILLING METHOD: Sonic	TOTAL DEPTH: 23ft/7.01m	MEASURING POINT:
DRILLING EQUIPMENT: Geoprobe 8140LS	WATER DEPTH: 17ft/5.18m	WATER LEVEL: 2.82m
LAT/NORTHING: 5366789.09	LONG/EASTING: 466718.84	
BOREHOLE DIAMETER: 4"	HAMMER TYPE/SYSTEM: N/A	

DEPTH (feet)	SAMPLES: Recovery	SAMPLES: Blows/ 6 inches	PID Reading (ppm)	DESCRIPTION	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	SAMPLE ID OTHER REMARKS
2				0-363 cm: Moist, soft, gray, SANDY SILT (ML), 70% fines, 30% f-sand, moderate shell hash, moderate H_2S-like odor.							EHWW-65-SC-000050 @ 1200
4											EHWW-165-SC-000050 @ 1205
6				@ 130-154 cm: substantial shell hash							
8				@ 160 cm: Organic material (one wood fragment, 7 cm)							
10				@ 210 cm: organic material (one stick, 7 cm).							
12											
14				363-701 cm: Moist, soft, gray, SILT (ML), 90% fines, 10% f-sand, trace shell hash, trace H_2S-like odor.							
16											
18											
20				end of core @ 23ft/7.01m							
22											
24											

Project No. 170553-11.05	59% recovery correction applied to entire core	Page 1 of 1

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHWW **DATE:** 12/16/18

SITE LOCATION: Esquimalt Harbour **PERSONNEL:**

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW | LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? | **TEMPERATURE:** °F 50 . 10 °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0830	EM/BW/EP onsite to mob, strong winds, on wind-hold.
1400	Mob back to CFSA to meet barge/drillers
1430	Depart CFSA, Mob to EHWW-58.
1520	on location, first attempt,
1550	Attempt 1 on board, no recovery. will reattempt
1605	Attempt 2 @ EHWW-58, ~5.5 of recovery on 17' push
	achieved 2-layer interval, sampled
1700	Mob back to CFSA
1715	Staff off-site.

Samples delivered to lab:

	NA

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature:

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP **DATE:** 12/17/18

SITE LOCATION: Esquimalt **PERSONNEL:** BW/EM, RT, Drillwell, mercury

WEATHER: overcast **WIND FROM:** N | NE | E | SE | S | SW | W | NW | LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? **TEMPERATURE:** °F 50 °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0715	AQ onsite, mob from CFSA to barge
0735	H&S meeting
0755	mob to EHWW-56
0815	on location, 0930 Attempt #1
0852	Attempt #2, bottom @ 24 ft
0950	Attempt #1 @ EHWW-36, accepted.
1100	Attempt #1 @ ~~EHWW 08~~ EM EHWW-03, 1st attempt
	accepted. will switch to DT 45 - to collect bench
DT #1	rejected, insufficient recovery in tube
DT #2	Accepted, #3 accepted, #4 accepted
1330	mob to -57 attempted for 30 min to get on station but
	issues with nearby rocky island, accepted location ~60 ft
	from target.
	1st attempt w/ 6" barrel to ~13 ft, no recovery
	2nd attempt w/ 4" barrel with catcher (bent).
	~8 ft push hit bedrock, ~2.5 ft recovered, wood debris, small plugs of
	sand/shell @ bottom
	#3 4 ft push ~2 ft recovered, bedrock ~4 ft
	accept #3, /surface interval only, no leave surface.
1600	1st attempt on -38 spuds fully extended.
	attempt with 4", no catcher, 37 ft water top barge
	accepted
1730	EM, BW, RT transit off barge to CFSA
Samples delivered to lab:	
	NA

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log - DT45 Cores

Esquimalt Harbour Remediation Project

Bench Core Collection Summary

PROJECT NAME:	EHRP Nav waste	**DATE:**	12/17
SITE LOCATION:	Esquimalt Harbour	**PERSONNEL:**	EM, BW, RT (Hemmera)

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — SUNNY | CLOUDY | RAIN | ? — LIGHT | MEDIUM | HEAVY — **TEMPERATURE:** °F 50 °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
	EHWW-03 " All pushed to 5ft
1140	1st attempt @ 1140
	~0.5ft of material in tube, coarse wood debris.
	(rejected)
	#2 ~40cm recovered on 5ft push (retained)
	#3 ~73cm recovered ~15cm wood debris ; retained
	#4 ~70cm recovered ~10-15cm wood w/ sand.
	HC-like odor, trace sheen in water that washed out
	of tube. retained
	EHWW-57
1540	#1 water depth 32.0ft @ 1540 push to 35 3ft push.
	~22cm recovery (retained) wood debris / fines
	#2 push to 35ft, water depth @ 31ft, 4ft push
	~50 cm recovery (retained) wood debris & fines
	#3 ~~water~~ push from 20-35 ft
	~53cm recovery, retained, wood debris & fines
	~~37ft water depth~~
Samples delivered to lab:	
	NA

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHWW **DATE:** 11/18/18

SITE LOCATION: Esquimalt Harbour **PERSONNEL:** DM/BW/RT

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F 50 . °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0730	mob gear & depart CFSA
0745	H&S meeting
0800	Mob to EHWW-40
0828	last bag of EHWW-40 collected
0915	Mob to EHWW-39, difficulty positioning barge in
	strong winds
0930	1st attempt -39 rejected. no recovery
0945	2nd attempt, no wood debris, switching to DT45 system
	to assess ability to retain any wood debris
1000	3rd attempt w/ DT45, accepted, processed as primary
1015	core
	took 5 additional accepted attempts @-39 for bench scale
1115	Depart -39, mob to -24
1136	Attempt 1 @-24, accepted
1240	mob to -44
1250	Cant stay at -44 due to wind (swinging barge)
	will go north to -16
1316	Attempt #1 @ -16 no recovery
	Attempt #2 rejected missing top 10 ft, 10-20ft SANDY SILT w/ shell hash
	Attempt #3 6" barrel, no retention,
	#4 6" barrel to 20ft, retained core
1445	Switch to DT system & collect cores.
	1st attempt, no recovery, attempts 2-4 recovered.
1600	Mob to -54, 1st attempt accepted
Samples delivered to lab:	@1645 mob to dock barge
	See COCs, sample drop @ Hemmera office for carrier
	pickup.

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: ______________

Daily Log

DT45 Bench Core Collection Summary

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP wood waste **DATE:** 12/18/18

SITE LOCATION: Esquimalt Harbour **PERSONNEL:** 1

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — SUNNY | CLOUDY | RAIN | ? — LIGHT | MEDIUM | HEAVY — **TEMPERATURE:** °F °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
	EHWW-39 All pushed to 5-ft
	Attempt #1, accepted, processed as primary core
	on the barge
1030	Attempt #2, accepted, EHWW-39-SC-1
	labeled as #1 for bench testing, 75cm recovery
1050	Attempt #3 accepted, EHWW-39-SC-2
	labeled as #2 for bench testing, 115cm total recovery
	cut down to ~70cm for packaging/transport.
1110	Attempt #4 accepted, EHWW-39-SC-3
	labelled as #3 for bench testing, 108cm total recovery
	Cut down to ~69cm for packaging/transport
	EHWW-16 All pushed to 5ft
1500	Attempt #1 accepted, EHWW-16-SC-1
	175cm recovery, cut down to ~76cm for packaging.
1527	Attempt #2 accepted, EHWW-16-SC-2
	150cm recovery, cut down to ~69cm for packaging.
1545	Attempt #3 accepted, EHWW-16-SC-3
	82cm recovery, cut down to ~70cm for packaging
Samples delivered to lab:	
	NA

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME:	EHRP WW	**DATE:**	~~12/18/18~~ 12/19/18
SITE LOCATION:	Esquimalt Harbor	**PERSONNEL:**	EM, BW, RT (Hemmera)

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW | LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? **TEMPERATURE:** °F 40 . °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	0730 depart from ~~barge~~ CFSA
800	H&S meeting
~8:15	on station -55
8:27	1st push @ station 55, accepted
	Switch to DT system, will try to collect cores to replace
	-03. first attempt rejected NO m recovered
	2nd attempt retained, short but have intact surface, want to
	retain coarse wood
	3rd attempt retained
	4/5th attempt rejected, moved on.
1000	mob to -59 1st attempt accepted
	DTUS cores 1-3 accepted
1045	collect water sample for bench testing
1115	mob to -65, divers blocking -53
	first two attempted pushes have no recovery,
1145	third attempt using catcher, accepted
1220	mob to -44, station near barge,
1245	1st push at 44, accepted
1500	finish sampling -44. EM off barge to deliver
	samples to courier. BW/RT demob equipment from
	barge.
1700	EM return to CFSA, load/demob gear from CFSA.
	Mercury transport will hold drums in yard in Vancouver
	during disposal characterization.
Samples delivered to lab:	AGAT
	See COC, samples dropped off @ Ace courier.

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

DT45 Bench Core Collection summary

Esquimalt Harbour Remediation Project

PROJECT NAME:

DATE: 12/19/18

SITE LOCATION:

PERSONNEL: EM, BW, RT (Hemmera)

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F . °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
	EHWW-55 All pushed to 5-ft
0900	#1, 19cm recovered, intact surface but won't retain deeper coarse wood. retained
0920	#2 A few Wood fragments retained, not retained
0940	#3 ~13cm recovered, mix of silt & wood, retained as #2 on COC
1000	#4 few bark fragments not retained
1020	#5 few bark fragments not retained
	Cores #1 & 2 (Shorties) submitted for bench testing.
	EHWW-59 All pushed to 5ft
1030	#1 retained, 89cm recovered, cut to ~64cm
1045	#2 retained, 90 cm recovered, cut to ~67cm
1100	#3 retained, 83 cm recovered, cut to ~67cm

Samples delivered to lab:

NA

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: [signature]

ANCHOR QEA

Daily Safety Briefing Form

Date: 12/6/18

Project No: 170553-11.05

Project Name: EHRP Wood Waste

Person Conducting Meeting: EM

Health & Safety Officer: CT

Project Manager: JD / DB

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☒ HASP Review and Location
- ☒ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☒ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☒ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☒ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☒ Proper Use of PPE
- ☒ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☒ Lifting Techniques
- ☒ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☒ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: overcast, slight drizzle

Daily Work Scope: Sonic boring

Site-specific Hazards: overhead crane hazard, no railing on barge, be alert to drilling team activities

Safety Comments:

Attendees

Printed Name	Signature
Braydon Aumen	[signature]
Nick Sampson	[signature]
Graham Frueh	[signature]
DYLAN MORRIS	[signature]
Dan Smith	[signature]
Benadette Wright	[signature]

End of Day Wellness Check

PLAYING IT SAFE

Daily Safety Briefing Form

Date: 12/17/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: EM
Health & Safety Officer: DT
Project Manager: DP

TOPICS COVERED:

- [x] Emergency Procedures and Evacuation Route
- [x] Directions to Hospital
- [x] HASP Review and Location
- [ ] Safety Equipment Location
- [ ] Proper Safety Equipment Use
- [ ] Employee Right-to-Know/ SDS Location
- [x] Fire Extinguisher Location
- [ ] Eye Wash Station Location
- [ ] Buddy System
- [ ] Self and Coworker Monitoring
- [ ] Lines of Authority
- [x] Communication
- [ ] Site Security
- [ ] Vessel Safety Protocols
- [x] Work Zones
- [x] Vehicle Safety and Driving/ Road Conditions
- [ ] Equipment Safety and Operation
- [ ] Proper Use of PPE
- [x] Decontamination Procedures
- [ ] Near Miss Reporting Procedures
- [x] Lifting Techniques
- [x] Slips, Trips, and Falls
- [ ] Hazard Exposure Routes
- [x] Heat and Cold Stress
- [ ] Overhead and Underfoot Hazards
- [x] Chemical Hazards
- [ ] Flammable Hazards
- [ ] Biological Hazards
- [x] Eating/Drinking/Smoking
- [ ] Reviewed Prior Lessons Learned
- [ ] Field Team Medical Conditions for Emergency Purposes (Confidential):
- [ ] Other:

Weather Conditions: calm mam rain/wind in pm

Daily Work Scope: Collect Sonic borings

Site-specific Hazards: On-water work H_2S odor

Safety Comments:

Attendees

Printed Name	Signature
Bob Thomas	[signature]
Braydon Aumen	[signature]
Nick Sampson	[signature]
Graham Friel	[signature]
DYLAN MORRIS	[signature]
Dan Smith	[signature]
Bernadette Wright	[signature]

End of Day Wellness Check

Daily Safety Briefing Form

ANCHOR QEA

Date: 12/18/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: DM **Health & Safety Officer:** DT **Project Manager:** DP

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☒ Communication
- ☐ Site Security
- ☒ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☒ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☒ Hazard Exposure Routes
- ☒ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☒ Other: Lightning

Weather Conditions: rain & wind

Daily Work Scope: collect sonic borings

Site-specific Hazards: on-water work potentially co

Safety Comments:

Attendees

Printed Name	Signature
DYLAN MORRIS	[signature]
Dan Smith	[signature]
Brayden Ammy	[signature]
Nick Sampson	[signature]
Graham Grail	[signature]
Ross Thomas	[signature]
Bernadett Ingit	[signature]

End of Day Wellness Check

PLAYING IT SAFE

Daily Safety Briefing Form em

ANCHOR QEA

Date: ~~12/18/18~~ 12/19/18
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: em
Health & Safety Officer: DT
Project Manager: DB

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☒ Directions to Hospital
- ☒ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☒ Communication
- ☐ Site Security
- ☒ Vessel Safety Protocols
- ☒ Work Zones
- ☒ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☒ Lifting Techniques
- ☒ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☒ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☒ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: wind & rain

Daily Work Scope: Collect barrage

Site-specific Hazards: on-water work potentially contaminated media

Safety Comments:

Attendees

Printed Name	Signature
Evan Malczyk	[signature]
Bernadette Wright	[signature]
Braxton Aumen	[signature]
Don Smith	[signature]
DYLAN Morris	[signature]
Graham Grill	[signature]
Nick Simpson	[signature]

End of Day Wellness Check

Rob Thomas	[signature]

PLAYING IT SAFE

Chain of C. ..dy Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/16/18
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Archive	Comments
1	EHWW-58-SC-361411	12/16/18 1630	SE	5	X	X	X	X	X	X	X	X	X					
2	EHWW-58-SC-411461	12/16/18 1635	SE	5										X	X		X	
3	~~EHWW-36-SC-000050~~	~~12/17/18 1025~~	SE															
4	EHWW-36-SC-183233	12/17/18 1035	SE	5	X	X	X	X	X	X	X	X	X					
5	EHWW-36-SC-233283	12/17/18 1040	SE	5													X	
6	EHWW-03-SC-000050	12/17/18 1155	SE	2						X			X					
7	EHWW-03-SC-150200	12/17/18 1200	SE	6	X	X	X	X	X	X	X	X	X	X	X			
8	EHWW-03-SC-200250	12/17/18 1210	SE	5													X	
9	EHWW-57-SC-000050	12/17/18 1445	SE	2						X			X					
10	EHWW-56-SC-000050	12/17/18 0925	SE	1									X					
11	EHWW-56-SC-050100	12/17/18 0920	SE	5	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~				X	Archive a
12	EHWW-38-SC-000050	12/17/18 1630	SE	3						X			X	X	X			
13	EHWW-38-SC-050100	12/17/18 1645	SE	6	X	X	X	X	X	X	X	X	X	X	X			
14	EHWW-38-SC-100150	12/17/18 1650	SE	5													X	

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name: [signature] Eli Patmont	Date/Time: 12/18/2018 18:06	Signature/Printed Name:	Date/Time:
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name:	Date/Time:	Signature/Printed Name:	Date/Time:

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of C[illegible]ody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/17/18
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	~~Bulk Sulphides~~	~~Ammonia~~	~~TVS~~	~~Grain Size~~	~~Moisture Content~~	~~Atterberg Limits~~	~~TCLP Metals~~						Comments
1	EHWW-36-SC-000050	12/17/18 1025	SE	4	X	X	X	X	X													
2	EHWW-03-SC-000050	12/17/18 1155	SE	4	X	X	X	X	X													
3	EHWW-57-SC-000050	12/17/18 1445	SE	4	X	X	X	X	X													
4	EHWW-56-SC-000050	12/17/18 0905	SE	4	X	X	X	X	X													
5	EHWW-38-SC-000050	12/17/18, 1630	SE	4	X	X	X	X	X													
6	EHWW-40-SC-000050	12/18/18 0850	SE	4	X	X	X	X	X													
7			SE																			
8			SE																			
9			SE																			
10			SE																			
11			SE																			
12			SE																			
13			SE																			
14			SE																			

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name: Eli Petmont	Date/Time: 12/18/2018 18:06	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of C[illegible]ody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/18/18
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne C[illegible]eiro
Phone Number: 206.971.2680
Shipment Method: Delivery

					Sediment and Field QC													
Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Archive	Comments
1	EHWW-~~SC~~ BW 40-SC-000050	12/18/18 0850	SE	2						X			X					
2	EHWW-40-SC-060110	12/18/18 0845	SE	5	X	X	X	X	X	X	X	X	X					
3	EHWW-40-SC-110160	12/18/18 0900	SE	5													X	
4	EHWW-39-SC-035085	12/18/18 1030	SE	5	X	X	X	X	X	X	X	X	X					
5	EHWW-39-SC-085135	12/18/18 1040	SE	5													X	
6	EHWW-24-SC-045095	12/18/18 1200	SE	5	X	X	X	X	X	X	X	X	X					
7	EHWW-24-SC-095145	12/18/18 1215	SE	5													X	
8	EHWW-16-SC-152202	12/18/18 1445	SE	6	X	X	X	X	X	X	X	X	X	X	X			
9	EHWW-116-SC-152202	12/18/18 1450	SE	4	X	X	X	X	X	X	X	X						
10	EHWW-16-SC-202252	12/18/18 1455	SE	5													X	
11			SE															
12			SE															
13			SE															
14			SE															

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name: [signature] Eli Patmont	Date/Time: 12/18/2018 18:06	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

RMP

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/19/18
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

					Sediment and Field QC												
Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Comments
1	EHWW-S4-SC-000050	12/18/18 1630	SE	4	X	X	X	X	X								
2	EHWW-6S-SC-000050	12/19/18 1200	SE	4	X	X	X	X	X								
3	EHWW-16S-SC-000050	12/19/18 1205	SE	4	X	X	X	X	X								
4	EHWW-S3-SC-000016	12/19/18 1415	SE	4	X	X	X	X	X								
5			SE														
6			SE														
7			SE														
8			SE														
9			SE														
10			SE														
11			SE														
12			SE														
13			SE														
14			SE														

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	12/19/18 1555	Received By:	Company:	
Signature/Printed Name		Date/Time	Signature/Printed Name		Date/Time
Relinquished By:	Company:		Received By:	Company:	
Signature/Printed Name		Date/Time	Signature/Printed Name		Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page ____ of ____

WOOD WASTE

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR OEA

Date: 12/19/18
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170563-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	DIFs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Archive	Freeze	Comments
1	EHWW-S4-SC-000050	12/19/18 1630	SE	2						X			X						
2	EHWW-S4-SC-055105	12/18/18 1635	SE	5	X	X	X	X	X	X	X	X	X						
3	EHWW-S4-SC-105155	12/18/18 1640	SE	5													X		
4	EHWW-S5-SC-110160	12/19/18 0850	SE	5	X	X	X	X	X	X	X	X	X						
5	EHWW-S5-SC-160210	12/19/18 0855	SE	5													X		
6	EHWW-S9-SC-038088	12/19/18 1045	SE	5	X	X	X	X	X	X	X	X	X						
7	EHWW-S9-SC-088138	12/19/18 1050	SE	5													X		
8	EHWW-65-SC-000050	12/19/18 1210	SE	2						X			X						
9	EHWW-44-SC-017067	12/19/18 1310	SE	5	X	X	X	X	X	X	X	X	X						
10	EHWW-44-SC-067117	12/19/18 1315	SE	5													X		
11	EHWW-S3-SC-000016	12/19/18 1415	SE	2						X			X						
12	EHWW-S3-SC-016066	12/19/18 1420	SE	5	X	X	X	X	X	X	X	X	X						
13	EHWW-S3-SC066116	12/19/18 1425	SE	5														X	
14	EHWW-IDW-SCD	12/19/18 1430	SE	3		X	X	X									X	X	

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time 12/19/18 1555	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

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Page ____ of ____

Chain of Custody Record and Laboratory Analysis Request COC#

ANCHOR QEA

Date: 12/19/18
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Comments
					Sediment and Field QC												
1	EHWW-IDW-WATER	12/19/18 1452	~~SE~~ water	1		X	X	X									HOLD
2			SE														
3			SE														
4			SE														
5			SE														
6			SE														
7			SE														
8			SE														
9			SE														
10			SE														
11			SE														
12			SE														
13			SE														
14			SE														

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time: 12/19/18 1555	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/19/2018
Laboratory : Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Waste
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Bench Scale Testing (core tube)	Bench Scale Testing (water)	Comments
1	EHWW-52-SC-000010-30min	12/19/2018	DGT	1	X			Collection time: 12:59
2	EHWW-39-SC-000010-30min	12/19/18 15:01	↓	↓	X			
3	EHWW-52-SC-000010-2hr	12/19/18 14:36			X			
4	EHWW-41-SC-000010-30min	12/19/18 16:43			X			
5	EHWW-48-SC-000010-30min	12/19/18 12:46			X			
6	EHWW-08-SC-000010-30min	12/17/18 11:46			X			
7	EHWW-27-SC-000010-30min	12/17/18 10:42			X			
8	EHWW-25-SC-000010-2hr	12/19/2018 12:08			X			
9	EHWW-25-SC-000010-30min	12/19/18 10:34			X			
10	EHWW-43-SC-000010-30min	12/17/18 14:35			X			
11	EHWW-50-SC-000010-30min	12/18/18 13:00			X			
12	EHWW-48-SC-000010-2hr	12/19/18 14:26			X			
13	EHWW-24-SC-000010-30min	12/18/18 15:27			X			
14	EHWW-39-SC-000010-2hr	12/19/18 16:36	↓	↓	X			

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments: Rec ON Ice

Relinquished By:	Company:	Received By:	Company:
Evan Malczyk	Anchor QEA LLC.	J. Bow	Anchor QEA LLC
Signature/Printed Name	Date/Time: 12/20/18 1810	Signature/Printed Name	Date/Time: 12/20/18 1810

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page 1 of 2

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/19/2018
Laboratory: Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Waste
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Bench Scale Testing (core tube)	Bench Scale Testing (water)	Comments
1	EHWW-43-SC-000010-30min	12/17/18 16:10	DGT	1	X			
2	EHWW-08-SC-000010-2hr	12/17/18 14:15	↓	1	X			
3	EHWW-24-SC-000010-2hr	12/18/18 16:55		1	X			
4	EHWW-141-SC-000010-30min	12/19/18 16:41		1	X			
5	EHWW-141-SC-000010-2hr	12/19/18 18:07		1	X			
6	EHWW-41-SC-000010-2hr	12/19/18 18:08		1	X			
7								
8								
9								
10								
11								
12								
13								
14								

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments: Rec. ON ICE J.G.

Relinquished By: EVAN MALCZYK	Company: Anchor QEA LLC.	Received By: J.GOIN	Company: Anchor QEA LLC
Signature/Printed Name	Date/Time 12/20/18 1810	Signature/Printed Name	Date/Time 12/20/18 1810
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Cu[illegible]y Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/20/2018
Laboratory : Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Waste
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Bench Scale Testing (core tube)	Bench Scale Testing (water)	Comments
1	EHWW-03-SC-2	12/7/18 1200	SE	1		X		
2	EHWW-03-SC-3	1220	SE	1		X		
3	EHWW-03-SC-4	1240	SE	1		X		
4	EHWW-57-SC-1	12/7/18 1540	SE	1		X		
5	EHWW-57-SC-2	1600	SE	1		X		
6	EHWW-57-SC-3	1620	SE	1		X		
7	EHWW-39-SC-1	12/18/18 1030	SE	1		X		
8	EHWW-39-SC-2	1050	SE	1		X		
9	EHWW-39-SC-3	1110	SE	1		X		
10	EHWW-16-SC-1	12/18/18 1500	SE	1		X		
11	EHWW-16-SC-2	1527	SE	1		X		
12	EHWW-16-SC-3	1545	SE	1		X		
13	EHWW-55-SC-1	12/19/18 0900	SE	1		X		
14	EHWW-55-SC-2	12/19/18 0940	SE	1		X		

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments: Rec ON ICE [illegible]

Relinquished By:	Company:	Received By:	Company:
EVAN MALCZYK [signature]	Anchor QEA LLC.	J. GOSN [signature]	Anchor QEA LLC
Signature/Printed Name	Date/Time: 12/20/18 1610	Signature/Printed Name	Date/Time: 12/20/18 1810

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

Date: 12/20/18
Laboratory: Anchor QEA Geochemistry Laboratory
Project Name: EHRP Wood Waste
Project Number: 170553-11.05
Project Contact: Evan Malczyk
Phone Number: 206.219.5891
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	DGT - Porewater Sulfide	Bench Scale Testing (core tube)	Bench Scale Testing (water)	Comments
1	EHWW-59-SC-1	12/19/18 1030	SE	1		X		
2	EHWW-59-SC-2	1045	SE	1		X		
3	EHWW-59-SC-3	1100	SE	1		X		
4	EHWW-SITEWATER	12/19/18 1030	SW	4			X	
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments: Rec ON Ice

Relinquished By:	Company:	Received By:	Company:
EVAN MALCZYK	Anchor QEA LLC.	J. GOAN	Anchor QEA LLC
Signature/Printed Name	Date/Time: 12/19/18 1810	Signature/Printed Name	Date/Time: 12/20/18 1810

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T59
Job No. 170553-11.05	Distance Along Transect: 0 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 0	Water Depth: 4.5m
% Recovery: 0%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				No Recovery			

Diver Core Collection and Processing Log

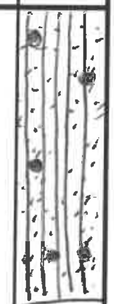
Job: WWRP	Transect/Sample ID: T59
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 4	Water Depth: 4.5 m
% Recovery: 4%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		70	30	0-4cm SILTY SAND (SM), moist, soft, dark brown 5% shell fragments, slight H_2S-like odor			
5							
10							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/17/2018
Drive Length (cm): 100
Recovery (cm): 11
% Recovery: 11%
Notes:

Transect/Sample ID: ~~59~~ EP 2/07/19 T59
Distance Along Transect: 100m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 9.5m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		60	40	0-11cm SILTY SAND (SM), soft, wet, dark brown, 5% shell fragments, slight H_2S-like odor, trace biota (worm).			
				Bottom of core @ 11cm			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T59
Job No. 170553-11.05	Distance Along Transect: 150 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100 cm	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 0 cm	Water Depth: 4.5 m
% Recovery: 0%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				No Recovery			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T59
Job No. 170553-11.05	Distance Along Transect: 200 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 25	Water Depth: 4.5 m
% Recovery: 25%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
10, 20, 30		30	70	0-25cm SILT w/ SAND (ML), moist, soft, dark brown, 5% shell fragments, slight H_2S-like odor			

Diver Core Collection and Processing Log

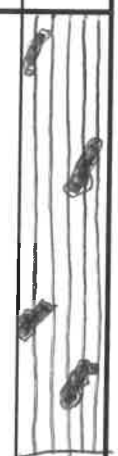
Job: WWRP	Transect/Sample ID: T60
Job No. 170553-11.05	Distance Along Transect: 0m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 10	Water Depth: 7.5 m
% Recovery: 13%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-10cm SANDY SILT (ML), wet, soft, dark brown, 5% bark, slight H_2S-like odor		~~EHWW-50~~ * EHVW-50-SC-000010 *: DGT sample collected from a separate core at the same location	
5							
10				Bottom of core @ 10cm			

Diver Core Collection and Processing Log

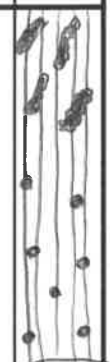
Job: WWRP
Job No. 170553-11.05
Date: 12/18/2018
Drive Length (cm): 80 cm
Recovery (cm): 16 cm
% Recovery: 20%
Notes:

Transect/Sample ID: T60
Distance Along Transect: 50 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 7.5 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0–5		5	95	0-10cm SANDY SILT (ML), wet, soft, dark brown, 5% wood fragments, slight H_2S-like odor			
10				10-16cm grades to 10% wood fragments			
15							
20				Bottom of core @ 16cm			

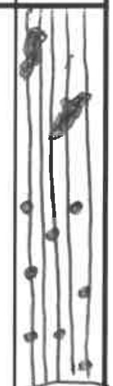
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T60
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80 cm	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 26 cm	Water Depth: 7.5 m
% Recovery: 33%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-13 cm SANDY SILT (ML), moist, soft, dark brown, 15% wood fragments (1 inch) 5% bark, trace biota (worm), slight H_2S-like odor			
10							
20		5	95	13-26 cm SANDY SILT (ML), moist, soft, dark brown, 15% shell fragments, slight H_2S-like odor			
30				Bottom of core @ 26cm			
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T60
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 28	Water Depth: 7.5 m
% Recovery: 35%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-14 cm SANDY SILT (ML), wet, soft, dark brown, 5% wood fragments, slight H_2S-like odor			
10							
			100	14-28 cm SILT (ML), moist, soft, dark brown, 15% shell fragments, slight H_2S-like odor.			
20							
30				Bottom of core @ 28 cm			
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T60
Job No. 170553-11.05	Distance Along Transect: 200 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 20	Water Depth: 7.5
% Recovery: 25%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0–20		10	90	0-10cm SANDY SILT (ML), wet, soft, dark brown, 5% wood fragments (0.5 inches), 5% shell fragments, slight H_2S-like odor 10-20cm grades to moist			
10, 20, 30, 40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T61
Job No. 170553-11.05	Distance Along Transect: 0 m
Date: 12/14/2018	Core Logged By: ERP
Drive Length (cm): 80 cm	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 0	Water Depth: 6.5 m
% Recovery: 0%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				No Recovery		*EHWW-48-SC-00006 *: DGT sample collected from a separate core at the same location	

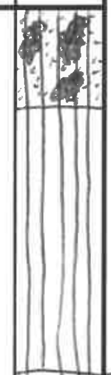
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T61
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80 cm	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 30 cm	Water Depth: 6.5 m
% Recovery: 38%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		5	95	0-23 cm SANDY SILT (ML), moist, soft, dark brown, 20% bark and wood fragments, moderate H_2S-like odor			
10							
20		5	95	23-30 cm SANDY SILT (ML), moist, soft, dark brown, 20% shell fragments			
30				Bottom of core @ 30 cm			
40							

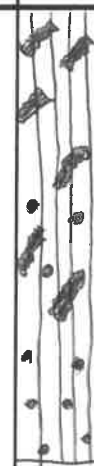
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T6
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 26	Water Depth: 6.5 m
% Recovery: 33%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		20	80	0-7 cm SILT w/SAND (ML), moist, soft, olive brown, 5% wood (sticks), 20% wood fragments, moderate H_2S-like odor			
10							
20		10	90	7-26 cm SANDY CLAYEY SILT (ML), moist, olive gray, moderate H_2S-like odor.			
30				Bottom of core @ 26cm			
40							

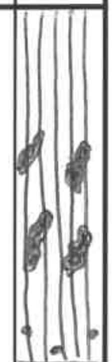
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T61
Job No. 170553-11.05	Distance Along Transect: 150 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 33	Water Depth: 6.5 m
% Recovery: 41%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-15cm SANDY SILT (ML), moist, soft, dark brown, 15% bark and wood fragments, moderate H_2S-like odor			
10				15-25cm grades to 5% shell fragments and 5% wood fragments			
20				25-33cm ~~SANDY SI~~ 2/18/2019 EP grades to 10% shell fragments, no wood, and trace H_2S-like odor			
30							
40				Bottom of core @ 33cm			

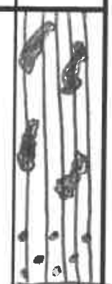
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T61
Job No. 170553-11.05	Distance Along Transect: 200 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 26	Water Depth: 6.5
% Recovery: 33%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-10cm SILT(ML), wet, soft, dark brown, trace H_2S-like odor			
10				10-24cm SILT(ML), moist, soft, dark brown, 10% wood fragments, trace H_2S-like odor			
20				24-26cm grades to 15% shell fragments and no wood			
30				Bottom of core @ 26cm			
40							

Diver Core Collection and Processing Log

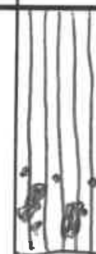
Job: WWRP	Transect/Sample ID: T62
Job No. 170553-11.05	Distance Along Transect: 0m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 20	Water Depth: 6.5m
% Recovery: 25%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-16cm SILT(ML), moist, soft, dark brown 6% bark, moderate H_2S-like odor			
10				16-20cm grades to 15% shell fragments and no wood			
20				Bottom of core @ 20cm			
30							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/19/2018
Drive Length (cm): 80
Recovery (cm): 18
% Recovery: 23%
Notes:

Transect/Sample ID: T62
Distance Along Transect: 50 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 6.5 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-13cm SILT (ML), moist, soft, dark brown moderate H_2S-like odor			
10				13-18 grades to 5% bark and 5% shell fragments			
20				Bottom of core @ 18cm			
30							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T62
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 23	Water Depth: 6.5 m
% Recovery: 29%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0–10			100	0-18cm CLAYEY SILT (ML), moist, soft, dark brown, 5% wood fragments, moderate H_2S-like odor			
10–20				18-23cm grades to 5% shell fragments			
20–30				Bottom of core @ 23cm			
30							

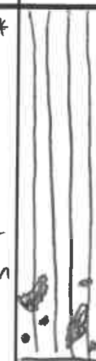
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T62
Job No. 170553-11.05	Distance Along Transect: 150 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 22	Water Depth: 6.5 m
% Recovery: 28%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-9cm CLAYEY SILT (ML), wet, soft, dark brown, 5% wood fragments, slight H_2S-like odor.			
10				9-22cm grades to moist and 5% shell fragments			
20							
				Bottom of core @ 22cm			
30							

Diver Core Collection and Processing Log

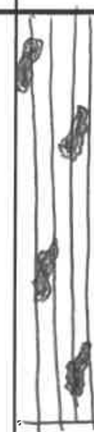
Job: WWRP	Transect/Sample ID: T62
Job No. 170553-11.05	Distance Along Transect: 200 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 26	Water Depth: 6.5 m
% Recovery: 33%	Contractor: Hemmera
Notes: Core brought up upside down	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0			100	0-20cm CLAYEY SILT (ML), moist, soft, dark brown, moderate H_2S-like odor		EHWW-2S-SC-000010*	
10						*: DGT sample collected from a separate core at the same location	
20				20-26cm grades to 5% wood fragments and 5% shell fragments			
30				Bottom of core @ 26 cm			
40							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/19/2018
Drive Length (cm): 80cm
Recovery (cm): 15cm
% Recovery: 19%
Notes:

Transect/Sample ID: T64
Distance Along Transect: 0 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 9.0 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		5	95	0-15cm SANDY SILT, f-sand, wet, very soft, dark brown, 5% wood fragments, slight H_2S-like odor.			
5							
10							
15							
				Bottom of core @ 15cm			
20							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T64
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 24	Water Depth: 9.0 m
% Recovery: 30%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
10		5	95	0-17cm SANDY SILT, f sand, moist, soft, dark brown, moderate H_2S-like odor			
20			100	17-24cm ~~SANDY S~~ SILT(ML), moist, soft, grayish brown, moderate H_2S-like odor (2/17/19 EP)			
30				Bottom of core @ 24cm			
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T64
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 31	Water Depth: 9.0 m
% Recovery: 39%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-21cm SILT(ML), moist, soft, dark brown, moderate H_2S-like odor		EHWW-41-SC-000010*	
10						*:DGT sample collected from a separate core at the same location	
20				21-29cm CLAYEY SILT(ML), soft, moist, dark brown, moderate H_2S-like odor			
				29-31cm grades to shell hash			
30				Bottom of core @ 31 cm			
40							
50							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/19/2018
Drive Length (cm): 80 cm
Recovery (cm): 27 cm
% Recovery: 34%
Notes:

Transect/Sample ID: T64
Distance Along Transect: 150 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 9.0 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor) 2/17/19 EP	Recovered Length (cm)	Sample	Summary Sketch
			100	0-~~25~~ 10 cm SILT (ML), moist, soft, dark Gray, moderate H_2S-like odor			
10				10-25 cm grades to 5% wood fragments			
20				25-27 grades to CLAYEY SILT (ML)			
30							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/19/2018
Drive Length (cm): 80cm
Recovery (cm): 27cm
% Recovery: 34%
Notes:

Transect/Sample ID: T64
Distance Along Transect: 200 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 9.0m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-10cm CLAYEY SILT (ML), wet, soft, dark brown, moderate H_2S-like odor			
10				10-27cm CLAYEY SILT (ML), moist, soft, dark brown, ~~moderate~~ 2/17/19 EP 20% shell fragments, moderate H_2S-like odor			
20							
30				Bottom of core @ 27cm			
40							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/19/2018
Drive Length (cm): 80
Recovery (cm): 19
% Recovery: 24%
Notes:

Transect/Sample ID: T65
Distance Along Transect: 0 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 7.8 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-16cm SANDY SILT (ML), f-sand, wet, very soft, dark brown, 15% shell fragments			
10				16-19cm grades to shell hash			
20				Bottom of core @ 19cm			
30							

Diver Core Collection and Processing Log

Job: WWRP

Job No. 170553-11.05

Date: 12/19/2018

Drive Length (cm): 80

Recovery (cm): 24

% Recovery: 30%

Notes:

Transect/Sample ID: T65

Distance Along Transect: 50 m

Core Logged By: ERP

Diameter of Core (in): 1 7/8 / 2.0

Water Depth: 7.8 m

Contractor: Hemmera

Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-20cm SILT(ML), moist, soft, dark brown 15% wood fragments, slight H_2S-like odor			
10							
			100	20-24cm SILT(ML), moist, soft, dark brown, 10% shell fragments, moderate ~~H~~ H_2S-like odor			
20							
30				Bottom of core @ 24cm			
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T65
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 27	Water Depth: 7.8 m
% Recovery: 34%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0			100	0-21cm CLAYEY SILT(ML), moist, soft, dark brown, 5% wood fragments, moderate H_2S-like odor		EHWW-39-SC-00010*	
10						*: DGT sample collected from a separate core at the same location	
20				21-27cm grades to 10% shell fragments and no wood			
30				Bottom of core @ 27cm			
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T65
Job No. 170553-11.05	Distance Along Transect: 150 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 17	Water Depth: 7.8 m
% Recovery: 21%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-15cm CLAYEY SILT (ML), moist, soft, dark brown, 5% wood fragments, moderate H_2S-like odor			
10				15-17cm grades to 40% bark and wood fragments (bark up to 1 inch)			
20				Bottom of core @ 17cm			
30							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T65
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 20	Water Depth: 7.8 m
% Recovery: 25%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-3cm SILT(ML), wet, soft, dark brown, 15% wood fragments, 15% shell fragments moderate H_2S-like odor			
10			100	3-20cm SILT(ML), moist, soft, dark brown 30% wood fragments, 30% shell fragments, strong H_2S-like odor			
20				Bottom of core @ 20cm			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T66
Job No. 170553-11.05	Distance Along Transect: 0 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 5	Water Depth: 5.0 m
% Recovery: 6%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-5cm SILT(ML), wet, very soft, olive gray, 5% wood fragments, slight H_2S-like odor		EHWW-24-SC-000010*	
				Bottom		*: DGT sample collected from a separate core at the same location	

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T66
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 2	Water Depth: 5.0 m
% Recovery: 3%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-2cm SANDY SILT (ML), wet, very soft, dark brown, 30% wood fragments and bark, moderate H_2S-like odor			
5				Bottom of core @ 2cm			
10							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T66
Job No. 170553-11.05	Distance Along Transect: 100m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 2	Water Depth: 5.0m
% Recovery: 3%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor) 2/18/2019 EP	Recovered Length (cm)	Sample	Summary Sketch
			100	0-2cm SILT (ML), wet, ~~soft~~, very soft, dark brown, >50% wood fragments, H_2S-like odor slight			
5							
				Bottom of core @ 2cm			
10							
15							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T66
Job No. 170553-11.05	Distance Along Transect: 150 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 23	Water Depth: 5.0 m
% Recovery: 29%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
			100	0-3cm SILT (ML), wet, soft, dark brown, 50% wood fragments, moderate H_2S-like odor			
10				3-23 cm grades to moist			
20							
				Bottom of core @ 23cm			
30							
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T66
Job No. 170553-11.05	Distance Along Transect: 200 m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 38cm	Water Depth: 5.0m
% Recovery: 48%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		5	95	0-13cm SANDY SILT (ML), wet, soft, dark brown, > 50% wood fragments, moderate H_2S-like odor			
10				13-38cm grades to moist			
20							
30							
40							
50							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T67
Job No. 170553-11.05	Distance Along Transect: 0 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 0	Water Depth: 9.6 m
% Recovery: 0 %	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				No Recovery		EHWW-43-SC-00006* *: DGT sample collected from a separate core at the same location	

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T67
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 5	Water Depth: 9.6 m
% Recovery: 6%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-5cm SANDY SILT (ML), wet, soft, dark brown, 5% wood fragments, slight H_2S-like odor			
5				Bottom of core @ 5cm			
10							
15							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T67
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 10	Water Depth: 9.6
% Recovery: 13%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0–10		10	90	0-10cm SANDY SILT (ML), soft, wet, dark brown, 40% wood fragments, moderate H_2S-like odor			
10				Bottom of core @ 10cm			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T67
Job No. 170553-11.05	Distance Along Transect: 150 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 80 cm	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 7 cm	Water Depth: 9.6 m
% Recovery: 9%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	**Classification and Remarks** (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor) 2/18/19 EP	Recovered Length (cm)	Sample	Summary Sketch
0		10	90	0-7 cm SANDY SILT, ~~wet~~ (ML), wet, very soft, dark brown, 5% wood fragments, slight H_2S-like odor			
5							
				Bottom of core @ 7 cm			
10							
15							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T67
Job No. 170553-11.05	Distance Along Transect: 200m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 80	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 20	Water Depth: 9.6m
% Recovery: 25%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
0–20		10	90	0-20cm SANDY SILT (ML), wet very soft, olive gray, 10% wood fragments, slight H_2S-like odor.			
20				Bottom of core @ 20cm			
25							
30							

Diver Core Collection and Processing Log

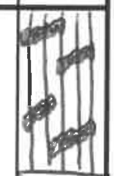
Job: WWRP	Transect/Sample ID: T68
Job No. 170553-11.05	Distance Along Transect: 0 m
Date: 12/19/2018	Core Logged By: ERP
Drive Length (cm): 0	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 0	Water Depth: 11.5 m
% Recovery: 0%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				Not collected			

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/18/2018
Drive Length (cm): 100
Recovery (cm): 13
% Recovery: 13%
Notes:

Transect/Sample ID: T68
Distance Along Transect: 50m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 11.5 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
10		10	90	0-13cm SANDY SILT(ML), wet, very soft, dark brown, 5% wood pieces (sticks), 10% wood fragments, slight H_2S-like odor			
20				Bottom of core @ 13cm			

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/18/2018
Drive Length (cm): 100
Recovery (cm): 28
% Recovery: 28%
Notes:

Transect/Sample ID: T68
Distance Along Transect: 100 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 11.5 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-10cm SANDY SILT (ML), wet, very soft, dark brown, 15% wood fibres, 5% wood fragments, strong H_2S-like odor			
10				10-28cm grades to moist and soft			
20							
30				Bottom of core @ 28cm			
40							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/18/2018
Drive Length (cm): 100cm
Recovery (cm): 4cm
% Recovery: 4%
Notes:

Transect/Sample ID: T68
Distance Along Transect: 150m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 11.5 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor) 2/18/19 EP	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-4cm ~~SILT~~ SANDY SILT (ML), wet, very soft, dark brown, large bark chunk, 2/18/19 EP moderate H_2S-like odor			
5							
10							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T68
Job No. 170553-11.05	Distance Along Transect: 200m
Date: 12/18/2018	Core Logged By: ERP
Drive Length (cm): 0	Diameter of Core (in): 7/8 / 2.0
Recovery (cm): 0	Water Depth: 11.5m
% Recovery: 0%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				2/18/2019 EP ~~Di~~ Not Collected			

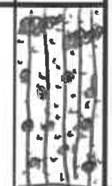
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T69
Job No. 170553-11.05	Distance Along Transect: 0 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 37	Water Depth: 6.0 m
% Recovery: 37%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		5	95	0-5cm SANDY SILT (ML), wet, soft, dark brown 5% wood fragments, moderate H_2S-like odor			
10				5-30cm grades to moist			
20							
30				30-37cm grades to 5% shell fragments			
40				Bottom of core @ 37cm			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T69
Job No. 170553-11.05	Distance Along Transect: 50m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 14	Water Depth: 6.0m
% Recovery: 14%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		50	50	0-4cm SILT w/SAND(ML), wet, soft, dark brown, 15% wood fragments, moderate H_2S-like odor			
10		50	50	4-14cm SILT w/SAND(ML), moist, soft, dark brown, 15% shell fragments			
20				Bottom of core @14cm			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T69
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 9	Water Depth: 6.0 m
% Recovery: 9%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
5		10	90	0-9 cm SANDY SILT, wet, soft, dark brown, 30% wood fragments, slight H_2S-like odor			
10				Bottom of core @ 9 cm			

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/17/2018
Drive Length (cm): 100
Recovery (cm): 9
% Recovery: 9%
Notes:

Transect/Sample ID: T69
Distance Along Transect: 150m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 6.0m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-9cm SANDY SILT (ML), wet, soft, dark brown, 5% wood fragments, slight H_2S-like odor			
5							
10				Bottom of core @ 9cm			

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/17/2018
Drive Length (cm): 100cm
Recovery (cm): 0cm
% Recovery: 0%
Notes:

Transect/Sample ID: T69
Distance Along Transect: 200 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 6.0m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				No Recovery			

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T70
Job No. 170553-11.05	Distance Along Transect: 0m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 13	Water Depth: 11.0m
% Recovery: 13%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
10		30	70	0-13cm SILT w/ SAND (ML), wet, soft, dark brown, 10% wood fragments, moderate H_2S-like odor.			
20				Bottom of core @ 13cm			

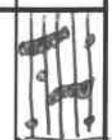
Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T70
Job No. 170553-11.05	Distance Along Transect: 50 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 22	Water Depth: 11.0 m
% Recovery: 22%	Contractor: Hemmera
Notes: Bottom pluged w/ wood	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
		10	90	0-17cm SANDY SILT (ML) wet, soft, dark brown, 5% wood fragments, moderate H_2S-like odor			
10							
			100	17-22cm SILT (ML) wet, soft, olive brown, moderate H_2S-like odor			
20							
30							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T70
Job No. 170553-11.05	Distance Along Transect: 100 m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 5	Water Depth: 11.0 m
% Recovery: 5%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				0-5cm SANDY SILT (ML), wet, very soft, dark brown, 5% wood fragments, 5% shell fragments, slight H_2S-like odor			
5				Bottom of core @ 5cm			
10							
15							

Diver Core Collection and Processing Log

Job: WWRP
Job No. 170553-11.05
Date: 12/17/2018
Drive Length (cm): 100
Recovery (cm): 34
% Recovery: 34%
Notes:

Transect/Sample ID: T70
Distance Along Transect: 150 m
Core Logged By: ERP
Diameter of Core (in): 1 7/8 / 2.0
Water Depth: 11.0 m
Contractor: Hemmera
Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor) 2/18/19 EP	Recovered Length (cm)	Sample	Summary Sketch
		5	95	0-19cm SANDY SILT, ~~w~~ (ML), wet, very soft, dark brown, 5% wood fragments, moderate H_2S-like odor			
10							
20			100	19-34cm SILT (ML), moist, soft, olive gray, moderate H_2S-like odor			
30							
				Bottom of core @ 34cm			
40							

Diver Core Collection and Processing Log

Job: WWRP	Transect/Sample ID: T70
Job No. 170553-11.05	Distance Along Transect: 200m
Date: 12/17/2018	Core Logged By: ERP
Drive Length (cm): 100	Diameter of Core (in): 1 7/8 / 2.0
Recovery (cm): 0	Water Depth: 11.0 m
% Recovery: 0%	Contractor: Hemmera
Notes:	Field Staff: Eli Patmont, Mika Davis

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch
				No Recovery		EHWW-27-SC-000010* *: DGT sample collected from a separate core at the same location	

SURFACE WATER PROFILE LOG

Job: Esquimalt Harbour Wood Waste		**Station/Transect ID:** Transect 59	
Job No.: # 170553-11.05		**Date/Time:** 1510 12/17/2018	
Field Staff: EP/MD		**Field Staff:** —	
Lat/Northing: NA	**Long/Easting:** NA	**Water Depth (m)** 4.5m	

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.59	51920	33.79	8.3	6.87	91.9	0			
1.5	7.59	52878	34.50	8.4	6.90	92.7	0			
2.5	7.59	53104	34.65	8.4	6.82	93.0	0			
3.5	7.57	53209	34.75	8.5	6.46	92.8	0.2			

EP

Notes:

SURFACE WATER PROFILE LOG

Job: EHRP WW Station/Transect ID: T60
Job No.: 170553-11-05 Date/Time: 11:16 12/18/18
Field Staff: EP/MD Field Staff: —
Lat/Northing: NA Long/Easting: NA Water Depth (m) ~~7.0m~~ 7.5m

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.61	51137	33.23	8.3	7.66	105.1	0	0		Sulf collected
1.5	7.61	52649	34.33	8.3	7.62	105.2	0			
2.5	7.49	52773	34.42	8.4	7.49	105.4	0			
4.0	7.59	53236	34.77	8.5	7.22	105.7	0	0		Sulf collected
4.5	7.58	53257	34.79	8.5	6.96	105.9	0			
5.5	7.57	53324	34.83	8.6	6.90	105.9	0			
6.5	7.57	53396	34.89	8.6	6.87	105.9	0			
7.2	7.60	53441	34.92	8.6	7.00	105.3	0	0		Sulf collected, particulates

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHRP WW

Station/Transect ID: T61

Job No.: 170553-11.05

Date/Time: 1140 12/19/2018

Field Staff: EP/MD

Field Staff: —

Lat/Northing: NA

Long/Easting: NA

Water Depth (m) ~~0m~~ 6.5m

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.65	43240	27.57	7.9	8.78	118.9	0.7	0		Sulf collected
1.5	7.60	52054	33.90	8.4	7.92	121.6	0			
2.5	7.60	52311	34.09	8.4	7.68	121.9	0			
3.5	7.58	52554	34.27	8.5	7.22	122.0	0	0		Sulf collected
4.5	7.60	52747	34.41	8.5	7.28	121.7	0			
5.5	7.60	52871	34.50	8.5	7.28	121.6	0			
6.5	7.58	52971	34.57	8.5	7.04	121.4	0			
6.8	7.52	53000	34.60	8.5	6.61	118.5	0.6	0		Sulf collected

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHRP WW		Station/Transect ID: T62
Job No.: 170553-11.05		Date/Time: 0920 12/19/2018
Field Staff: EP/MD		Field Staff: —
Lat/Northing: NA	Long/Easting: NA	Water Depth (m) 6.5

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.29	47134	30.53	7.8	8.59	199.4	0.1	0		Sulf collected
1.5	7.31	52049	33.87	8.1	8.34	196.8	0			
2.5	7.27	52051	33.90	8.4	7.75	195.7	0			
3.5	7.26	52378	34.14	8.4	7.39	194.4	0	0		Sulf collected
4.5	7.33	52701	34.38	8.5	7.02	182.2	0			
5.5	7.33	52817	34.46	8.5	7.00	181.1	0			
~~6.5~~ 6.2	7.28	52977	34.58	8.5	6.06	~~173~~	0	0		Sulf ORP: 173.1

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHRP WW						Station/Transect ID: T64				
Job No.: 170553-11.05						Date/Time: 12/19/2018 1530				
Field Staff: EP/MD						Field Staff: —				
Lat/Northing: NA			Long/Easting: NA			Water Depth (m) 9.0				
WATER QUALITY DATA										
Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.63	46978	30.23	8.1	8.36	113.0	0	0		Sulf Collected
1.5	7.63	52527	34.22	8.2	8.14	113.2	0			
2.5	7.62	52337	34.10	8.4	8.05	113.7	0			
3.5	7.60	52542	34.26	8.5	7.84	114.4	0			
4.5	7.58	52990	34.59	8.5	7.10	114.7	0	0		Sulf Collected
5.5	7.58	53020	34.61	8.5	7.09	114.7	0			
6.5	7.58	53119	34.68	8.5	7.09	114.6	0			
7.5	7.58	53305	34.82	8.6	7.00	114.7	0			
8.5	7.57	53352	34.86	8.6	6.93	114.6	0			
8.8	7.56	53376	34.88	8.6	6.79	114.4	0.9	0		Sulf Collected

Notes:

SURFACE WATER PROFILE LOG

Job: EHRP WW **Station/Transect ID:** T65

Job No.: 170553-11.05 **Date/Time:** 12/14/2018

Field Staff: EP/MD **Field Staff:** —

Lat/Northing: NA **Long/Easting:** NA **Water Depth (m)** 8 m

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.64	42697	27.19	7.9	8.57	116.1	0.3	0	0	Sulf Collected
1.5	7.59	51560	33.54	8.4	8.08	117.3	0			
2.5	7.56	52151	33.97	8.4	7.79	118.3	0			
3.5	7.56	52692	34.37	8.5	7.62	118.5	0	0		Sulf Collected
4.5	7.58	52925	34.54	8.5	7.59	118.6	0			
5.5	7.59	53141	34.70	8.5	7.45	118.1	0			
6.5	7.58	53216	34.76	8.6	7.37	118.1	0			
7.5	7.53	53295	34.82	8.6	6.70	118.0	0	0		Sulf Collected

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHPP WW		**Station/Transect ID:** T66
Job No.: 170553-11.05		**Date/Time:** 1500 12/18/2018
Field Staff: EP/MD		**Field Staff:** —
Lat/Northing: NA	**Long/Easting:** NA	**Water Depth (m)** 6.7 m

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.69	47004	30.25	8.1	8.65	99.6	0	0		Sulf
1.5	7.68	50884	33.04	8.2	8.44	100.1	0			
2.5	7.66	50936	33.08	8.3	8.27	100.8	0			
3.5	7.63	51554	33.53	8.3	7.92	101.5	0	0		Sulf
4.5	7.58	52472	34.20	8.4	7.04	102.1	0			
5.5	7.57	53165	34.72	8.5	6.82	102.3	0			
6.5	7.56	53385	34.88	8.6	6.57	102.1	0.2	0		Sulf

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHWW		**Station/Transect ID:** T67
Job No.: 170553-11.05		**Date/Time:** 12/17/2018 1310
Field Staff: EP/MD		**Field Staff:** —
Lat/Northing: NA	**Long/Easting:** NA	**Water Depth (m)** 9.6m

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.63	50929	33.99	8.2	7.87	97.5	0			
1.5	7.61	52860	34.42	8.4	7.41	97.9	0			
2.5	7.57	53215	34.74	8.4	~~6.9~~ 6.64	98.2	0			
3.5	7.61	53277	34.79	8.5	7.01	97.8	0			
4.5	7.62	53305	34.82	8.5	7.23	97.7	0			
5.5	7.63	53310	34.82	8.5	7.32	97.6	0			
6.5	7.61	53318	34.83	8.5	~~7.3~~	97.7	0			DO: 7.13 mg/L
7.5	7.59	53336	34.84	8.6	6.89	97.9	0			~~DO~~
8.5	7.58	53369	34.87	8.6	~~6.64~~	97.7	0			DO: 6.58
9.0	7.57	53388	34.89	8.6	6.32	97.1	0			
~~9.5~~	~~7.57~~	~~53388~~	~~34.89~~	~~8.6~~	~~6.27~~	~~91.8~~	~~0~~			
9.5										Did not have time, divers came up.

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHRP WW
Job No.: 170553-11.05
Field Staff: ED/MD
Lat/Northing: NA
Long/Easting: NA
Station/Transect ID: T68
Date/Time: 09:12 12/18/18
Field Staff:
Water Depth (m) 11.5m

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.55	51088	~~34.1~~ 33.14	8.2	7.85	132.2		0		Sulf collected
1.5	7.55	51411	33.42	8.3	8.18	131.7				
2.5	7.54	51879	33.77	8.3	7.31	131.6				
3.5	7.53	52205	34.01	8.4	~~7.53~~	131.6				DO: 7.58
4.5	7.51	52658	34.27	8.4	7.00	131.0				
5.5	7.48	53092	34.66	8.5	6.66	130.4		0		Sulf collected
6.5	7.49	53203	34.74	8.5	6.58	~~130~~ 129.0				Ended data collection
7.5	-	-	-	-	-	-				because high wind
8.5	-	-	-	-	-	-				was sending YSI
9.5	-	-	-	-	-	-				too close to prop
10.5	-	-	-	-	-	-				
11.5	-	-	-	-	-	-				No bottom sulf

Notes:

SURFACE WATER PROFILE LOG

Job: EHWW		**Station/Transect ID:** T69	
Job No.: ~~12/17/2018~~ 170553-11.05		**Date/Time:** 12/17/2018 11:24	
Field Staff: EP/MD/		**Field Staff:** —	
Lat/Northing: NA	**Long/Easting:** NA	**Water Depth (m)** 6.4m	

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.61	50145	33.28	8.2	7.72	102.6	~~0.~~ 0			
1.5	7.60	52913	34.53	8.3	7.15	103.1	0			
2.5	7.58	53099	34.67	8.4	7.01	103.4	0			
3.5	7.59	53222	34.76	8.5	~~6.97~~	103.2	0			DO: 7.15
4.5	7.60	53278	34.80	8.5	7.30	103.0	0			
5.5	7.60	53282	34.80	8.5	7.23	100.3	0			
6.0										Unable to get, divers came up.

ERP

Notes:

SURFACE WATER PROFILE LOG

Job: EHWW	Station/Transect ID: ~~70~~ T70
Job No.: 170553-11.05	Date/Time: 12/17/2018
Field Staff: EP/MD	Field Staff: —
Lat/Northing: NA Long/Easting: NA	Water Depth (m) 11.0

WATER QUALITY DATA

Depth (m)	pH	Sp. Cond. (mS/cm)	Salinity (ppt)	Temp (°C)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Sulfide (mg/L)	(Other)	Comments
0.5	7.38	50575	32.81	8.1	8.25	211.6	~~0.70~~ 0			
1.5	7.38	502	34.46	8.3	7.40	208.3	0			SpC 52842
2.5	7.38	53061	34.64	8.4	6.94	204.2	0			
3.5	7.40	53186	34.72	8.5	7.06	201.3	0			
4.5	7.43	53267	34.79	8.5	7.39	196.6	0			
5.5	7.43	53281	34.80	8.5	7.49	192.3	0			
6.5	7.43	53291	34.80	8.5	7.39	188.8	0			
7.5	7.43	53293	34.80	8.5	7.36	186.8	0			
8.5	7.43	53288	34.81	8.5	7.35	186.1	0			
9.5	7.43	53416	34.90	8.6	7.22	185.1	0			
10.8	7.44	53454	34.96	8.6	7.24	181.9	0			
		~~53456~~	~~34.93~~	~~8.6~~	~~7.25~~	~~167.5~~	~~0~~			

ERP

Notes:

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP WW **DATE:** 12/17/2018

SITE LOCATION: ES Esquimalt Harbour **PERSONNEL:** EP/MD/TA/JW/MT

WEATHER: **WIND FROM:** N | NE | E | SE (circled) | S | SW | W | NW — LIGHT | MEDIUM (circled) | HEAVY

SUNNY | CLOUDY (circled) | RAIN | ? — **TEMPERATURE:** °F 50 . °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0715	AQ and Hemera on site
0730	H&S meeting with AQ & Hemerra
0750	Divers gearing up
0815	Leaving dock for barge
0834	Mobilize to transect 70 (EHWW-27)
0842	Marking start of transect 70. Moving towards end.
0846	Marking end of transect 70. Returning to start to deploy divers.
0900	Divers in the water.
0952	Divers out of water.
1010	DGT EHWW-27 into sediment. Only enough sed for 30 min
1042	DGT pulled: pH: 7.03, sal: >10 ppt, temp: 9.1°C
1105	Mobilize to transect 69 (EHWW08)
~~1010~~ 1110	Transect set. DGT will be pulled from 25m (0.5h & 24 DGT)
1115	Divers in the water — DGT parameters: EHWW08
1200	Divers out of the water — pH: 7.18 sal: >10
~~12~~ 1240	Mobilize to transect 67 (EHWW-43) — temp: 8.8°C
1245	Setting transect
1300	Divers in the water - switched to black ~~A~~ PVC cores because
~~1349~~	of poor recovery w/ lexan DGT Param pH: 7.37, temp: 7.49 sal: >10 ppt
1349	Divers out of water.
1442	Mobilize to transect 59 (EHWW-51 and EHWW-52)
1452	Setting transect
1504	Divers in the water - switched back to lexan
1510	Collecting SW params
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHWW **DATE:** 12/17/2018

SITE LOCATION: Esquimalt Harbour **PERSONNEL:** EP/MD/TA/JW/MT

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
1541	Divers back in boat. Did not collect DGT @ 175m. Bottom
	seds were hard at about 30cm, poor recovery.
1550	Not enough sed for DGT
~~1557~~	~~Using diver core from 200m run to gather 175m DGT~~
1610	Mobilize back to Marina
1630	AQ & Hemerra off site

ERP

Samples delivered to lab:

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature:

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRPWW **DATE:** 17/08/2018

SITE LOCATION: Esquimalt Harbour **PERSONNEL:** EP/MD/TA/SW/MT

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY

SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F °C [Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
0745	AQ on site - Cal check: all param good (pH, cond, & turb)
0750	H&S meeting - One diver unable to dive until congestion clears
0825	On water for the day - mobilize to barge to pick up jars for sulfides
0835	Mobilize to transect 68 (No DGT)
0841	Setting transect
0912	Diver in the water - video was recorded in reverse (200m to 0m)
0942	Diver up to grab cores - said 0m & 200m dive cores are will be on bed rock/cobble will only collect 50, 100, & 150m
1031	Only able to go to 7.5m - actual depth 11.5m - because YSI flagging too much.
1100	Mobilize to transect 60 (EHWW-50) DGT param: pH: 7.11 temp 8.1°C sal: 7.0
1103	Setting transect
1116	Diver in the water - switched to PVC cores
1220	Diver out of the water
1303	Mobilize to transect 66 (EHWW-40) DGT param: pH: 7.15 temp: 8.0°C sal: 7.0
1318	Setting transect
1346	Diver in the water
1523	Diver out ~~of~~ of the water - Diver ~~was~~ saw significant "fresh wood" unlike any other transect.
1550	Mobilize to barge
1600	Mobilize to CFSA to process final diver cores
1610	Off water
1650	Off site
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

EHWW50 start: 12:28
13:00

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP WW **DATE:** 12/19/2018

SITE LOCATION: Esquimalt Harbour **PERSONNEL:** EP/MD/TA/K/MT

WEATHER: **WIND FROM:** N | NE | E | SE | S | SW | W | NW — LIGHT | MEDIUM | HEAVY
SUNNY | CLOUDY | RAIN | ? — **TEMPERATURE:** °F 50 . °C
[Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	Boat: Reservoir Dog; Divers: Hemmera
0745	On site - Cal check (DO recal'd: all other params good)
0800	H&S meeting
0810	Mobilize to barge to deliver and pick up supplies
0820	Mobilize to transect 62 (EHWW-25)
0901	Setting transect DGT Param: pH: 7.07 temp: 8.7°C
0910	Divers in the water sal: >10ppt
0951	Divers out of water - wrong date on white board reads 12/18/18
1100	Mobilize to transect 61 (EHWW 48)
1110	Setting transect - this dive will not have video, GoPro not charging
1130	Divers in the water DGT Param: pH: 7.13, temp 9.4°C, sal >10ppt
1225	Divers out of the water
1230	Bouncing to EHWW52 for DGT sample
~~1240~~ 1235	Diver in water for bounce DGT Param: pH: 7.09, temp: 8.9°C
1245	Diver out of water Sal: >10ppt
1250	Mobilize to CFSA for new Go Pro
1257	Mobilize to transect 61 to pull
1305	Pulling transect @ T61
1310	Mobilize to transect 65 ~~(EHW~~ (EHWW39) DGT Param
1330	Setting transect pH: 7.11, temp: 9.0°C
~~1340~~ 1341	Divers in the water sal: >10ppt
1422	Divers out of the water
1450	Mobilize to transect 64 ~~(EHWW~~ (EHWW41) DGT Param
1520	Divers in the water pH: 7.16, temp: 9.0°C
1545	Diver out of the water sal: >10ppt
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: [signature]

Daily Log

Esquimalt Harbour Remediation Project

PROJECT NAME: EHRP WW **DATE:** 12/19/2018

SITE LOCATION: Esquimalt Harbour **PERSONNEL:** EP/MD/TA/K /MT

WEATHER:	WIND FROM:	N	NE	E	SE	S	SW	W	NW	LIGHT	MEDIUM	HEAVY
		SUNNY		CLOUDY		RAIN			?	TEMPERATURE: °F 50		°C

[Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
1550	Mobilize to barge to drop off equipment
~~1600~~ 1600	Mobilize to CFSA to finish processing cores
1610	Off water
~~1645~~ 1710	Off site
	ERP
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan Safety infractions, Important comments/instructions to contractors

Signature: [signature]

DGT parameters: pH: 7.16 temp: 9.0°C sal: 7.10 ppt

ANCHOR QEA

Daily Safety Briefing Form

Date: 12/17/2018
Project No: 170553-11.05
Project Name: EHRP Wood Waste

Person Conducting Meeting: Mika Davis
Health & Safety Officer: Chris Torell
Project Manager: Dan Berlin

TOPICS COVERED:

- [x] Emergency Procedures and Evacuation Route
- [x] Directions to Hospital
- [ ] HASP Review and Location
- [x] Safety Equipment Location
- [x] Proper Safety Equipment Use
- [ ] Employee Right-to-Know/ SDS Location
- [x] Fire Extinguisher Location
- [ ] Eye Wash Station Location
- [ ] Buddy System
- [x] Self and Coworker Monitoring
- [ ] Lines of Authority
- [x] Communication
- [ ] Site Security
- [x] Vessel Safety Protocols
- [x] Work Zones
- [ ] Vehicle Safety and Driving/ Road Conditions
- [ ] Equipment Safety and Operation
- [x] Proper Use of PPE
- [ ] Decontamination Procedures
- [ ] Near Miss Reporting Procedures
- [ ] Lifting Techniques
- [x] Slips, Trips, and Falls
- [ ] Hazard Exposure Routes
- [ ] Heat and Cold Stress
- [ ] Overhead and Underfoot Hazards
- [ ] Chemical Hazards
- [ ] Flammable Hazards
- [ ] Biological Hazards
- [ ] Eating/Drinking/Smoking
- [ ] Reviewed Prior Lessons Learned
- [ ] Field Team Medical Conditions for Emergency Purposes (Confidential):
- [ ] Other:

Weather Conditions: 50°F, cloudy

Daily Work Scope: Diver transects, DGT, & Surface water quality

Site-specific Hazards: Slips, trips, & falls; Cold stress

Safety Comments:

Attendees

Printed Name	Signature
Eli Patmont	[signature]

End of Day Wellness Check

PLAYING IT SAFE

Daily Safety Briefing Form

ANCHOR QEA

Date: 12/18/2018

Project No: 170553-11.05

Project Name: EHRP Wood Waste

Person Conducting Meeting: Mika Davis

Health & Safety Officer: Chris Torell

Project Manager: Dan Berlin

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☒ Safety Equipment Location
- ☒ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☒ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☒ Vessel Safety Protocols
- ☒ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☒ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: 45°F, rainy

Daily Work Scope: Diver transects, diver cores, DGTs, & water column

Site-specific Hazards: Cold stress,

Safety Comments:

Attendees

Printed Name	Signature
Eli Dutmont	[signature]
Mike Tonnese	[signature]
Joe Wonkse	[signature]
Mika Davis	[signature]
Tim Alo	[signature]

End of Day Wellness Check

PLAYING IT SAFE

ANCHOR QEA

Daily Safety Briefing Form

Date: 12/19/2018

Project No: 170553-11.05

Project Name: EHRP Wood Waste

Person Conducting Meeting: Mika Davis

Health & Safety Officer: Chris Torell

Project Manager: Dan Berlin

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☒ Proper Safety Equipment Use
- ☒ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☒ Buddy System
- ☒ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☒ Communication
- ☐ Site Security
- ☒ Vessel Safety Protocols
- ☒ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential):
- ☐ Other:

Weather Conditions: 50°F, rainy.

Daily Work Scope: Diver transects, DGTs, water profiling

Site-specific Hazards: slips, trips, falls; cold stress

Safety Comments:

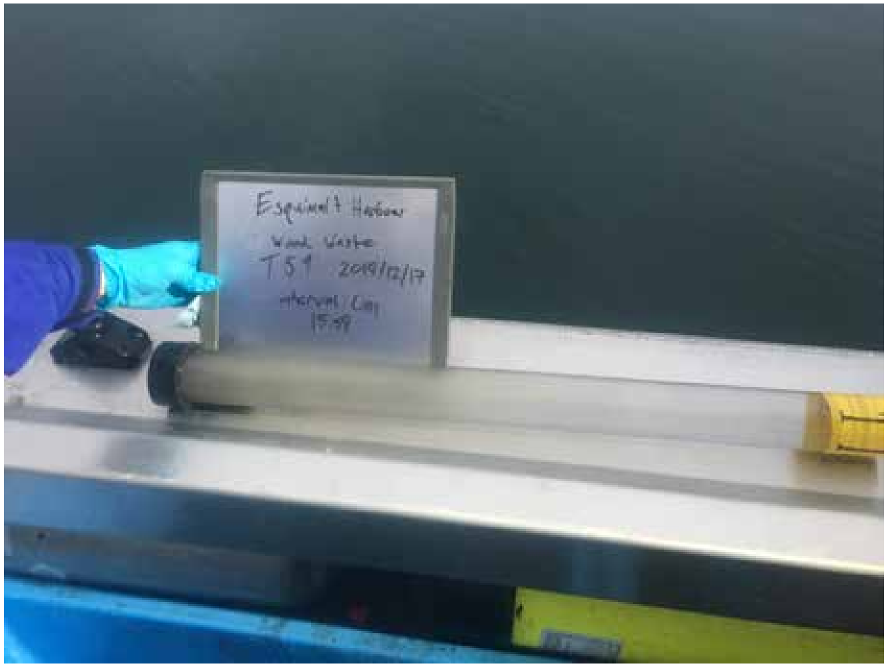
Attendees

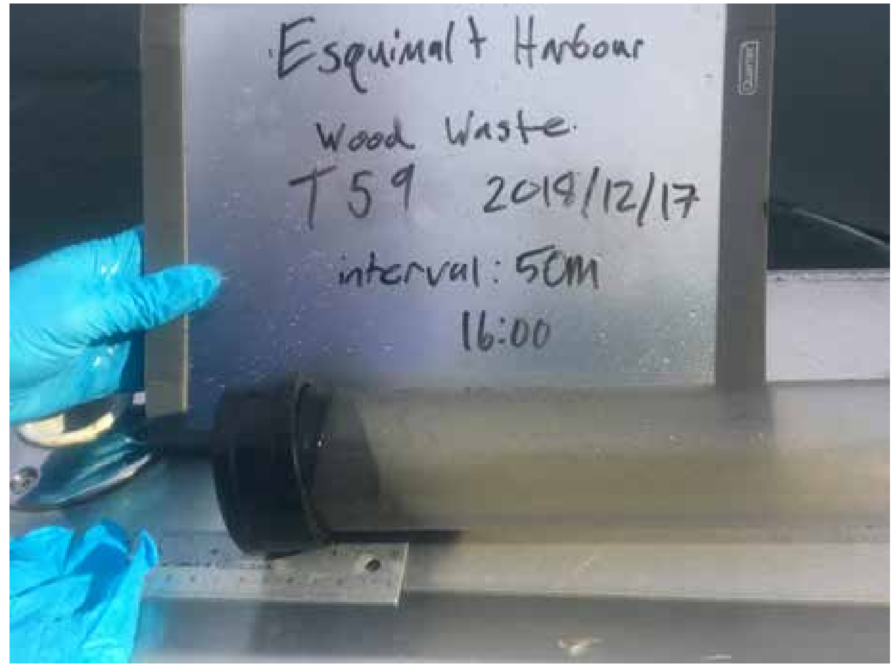
Printed Name	Signature
Eli Patmont	[signature]
Korey Fletcher	[signature]
M[illegible]	[signature]
Mika Davis	[signature]
Tim Abercrombie	[signature]

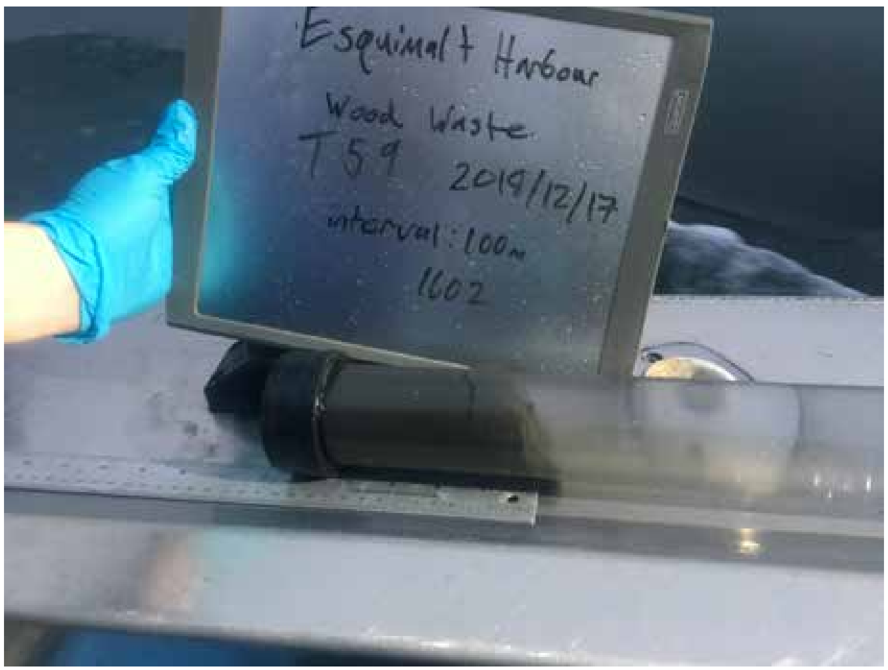
End of Day Wellness Check

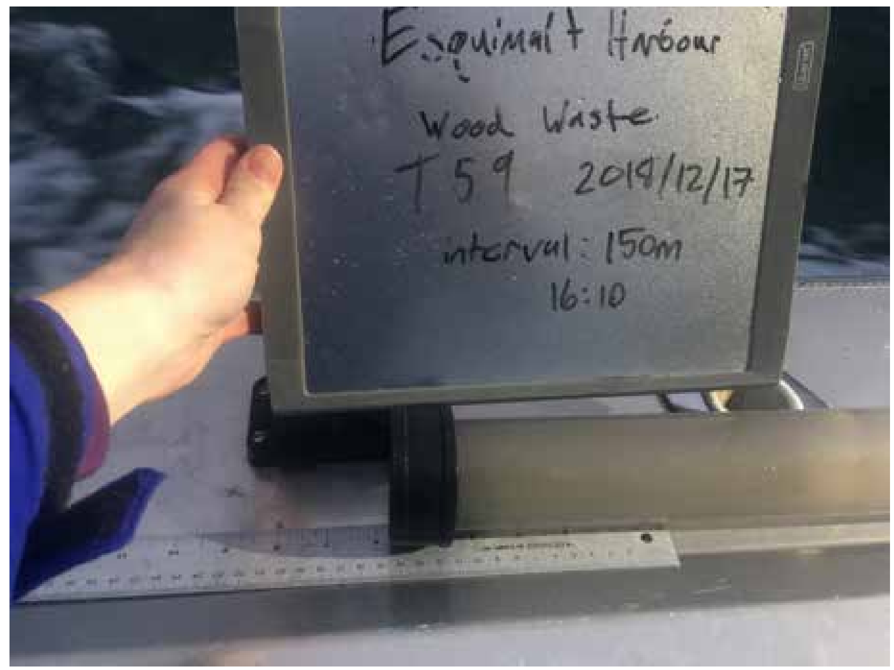
PLAYING IT SAFE

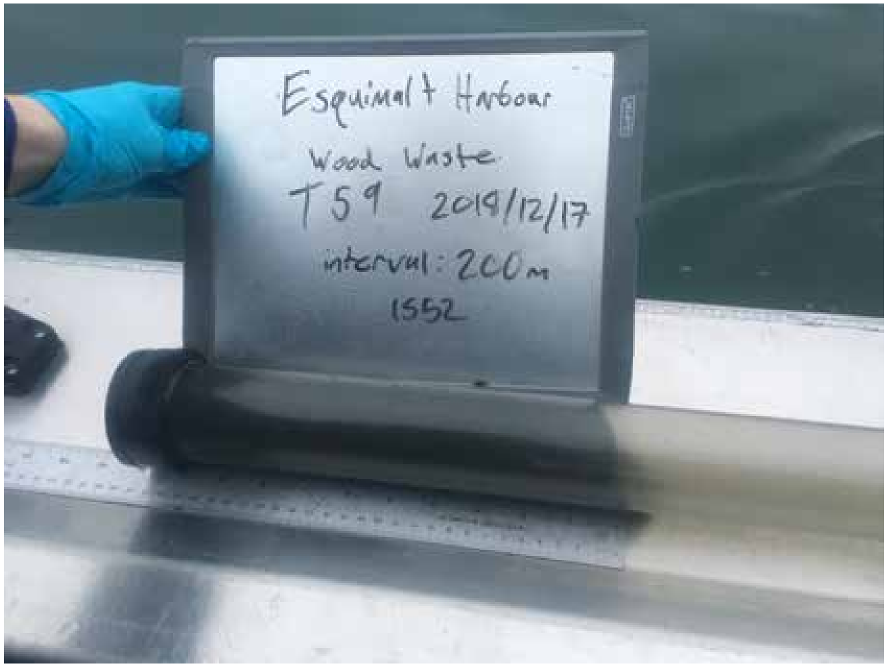
Diver Core Photographs

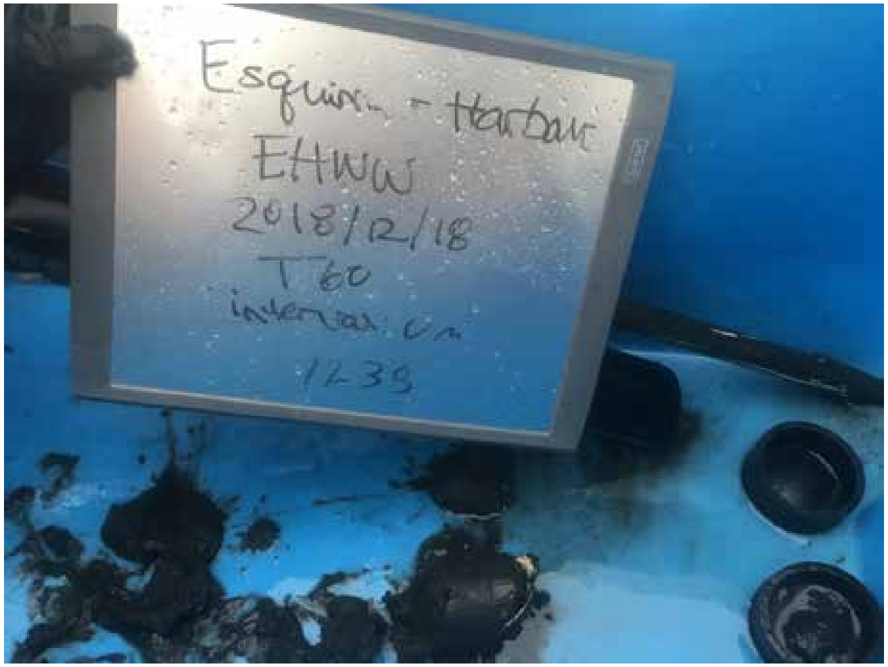

Esquimalt Harbour
Wood Waste
T59 2019/12/17
15:58


Esquimalt Harbour
Wood Waste
T59 2019/12/17
interval: 50m
16:00

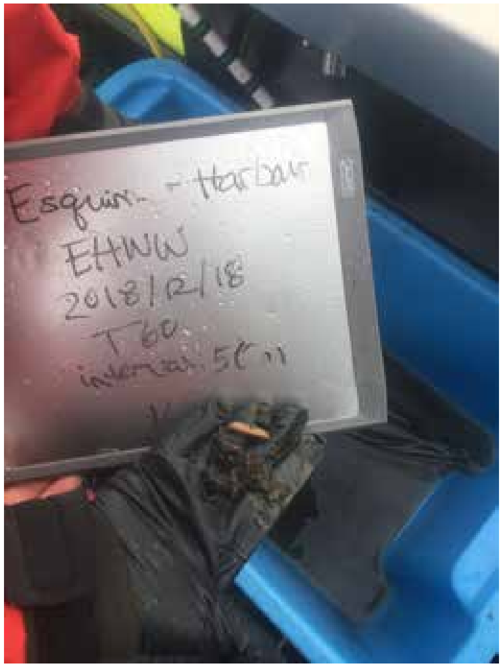

Esquimalt Harbour
Wood Waste
T59 2019/12/17
interval: 100m
1602


Esquimalt Harbour
Wood Waste
T59 2019/12/17
interval: 150m
16:10


Esquimalt Harbour
Wood Waste
T59 2019/12/17
interval: 200m
1552


Esquim - Harbour
EHWW
2018/12/18
T60
interval: 0cm
1239

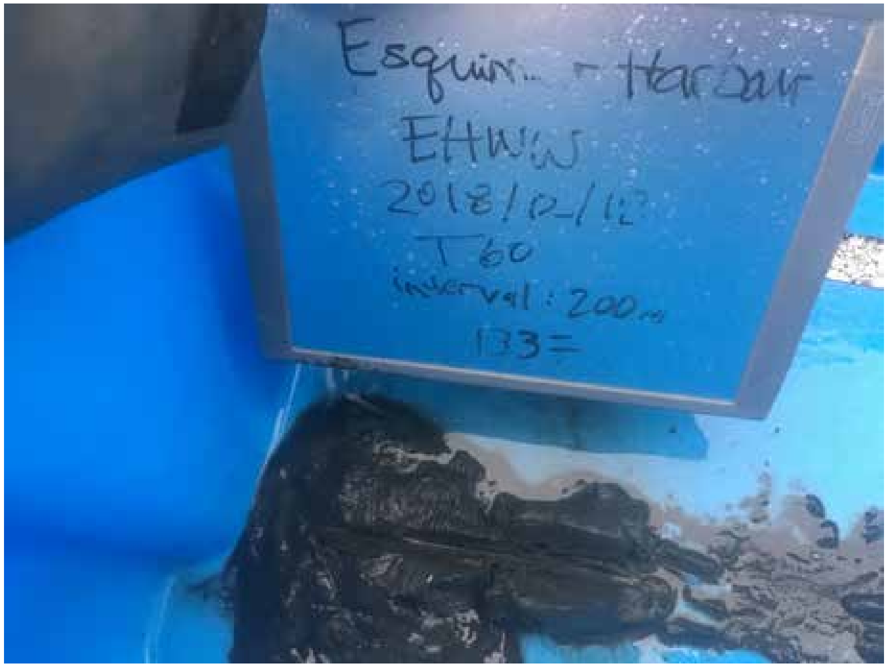

Esquim - Harbour
EHWW
2018/12/18
T60
interval: 5cm
1250

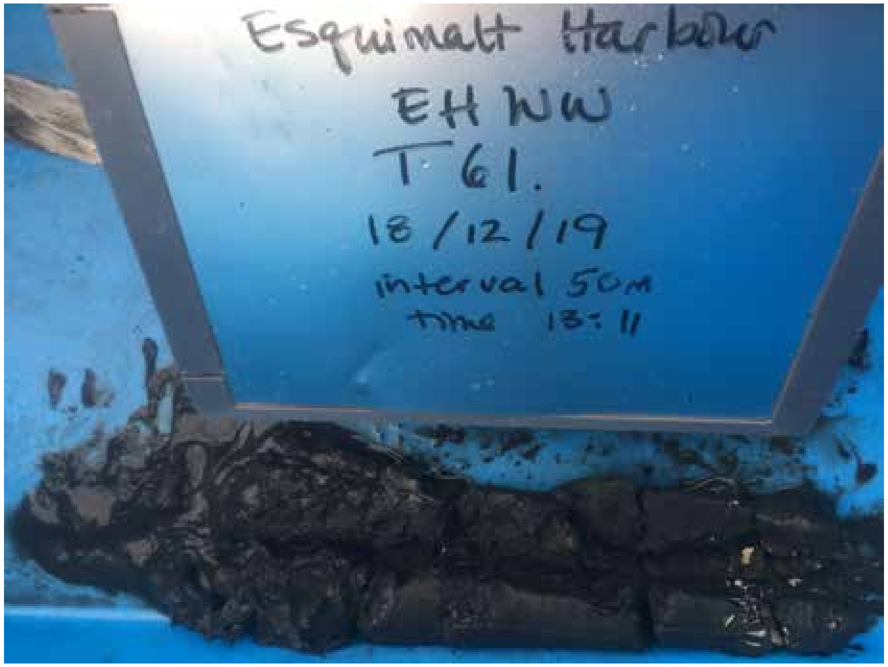

Esquim - Harbour
EHWW
2018/12/18
T60
interval: 5cm


Esquim - Harbour
EHWW
2018/12/18
T60
interval: 10cm
1310


Esquim - Harbour
EHWW
2018/12/18
T60
interval: 100m
1310


Esquim - Harbour
EHWW
2018/12/18
T60
interval: 150m


Esquim - Harbour
EHWW
T60
interval: 200m

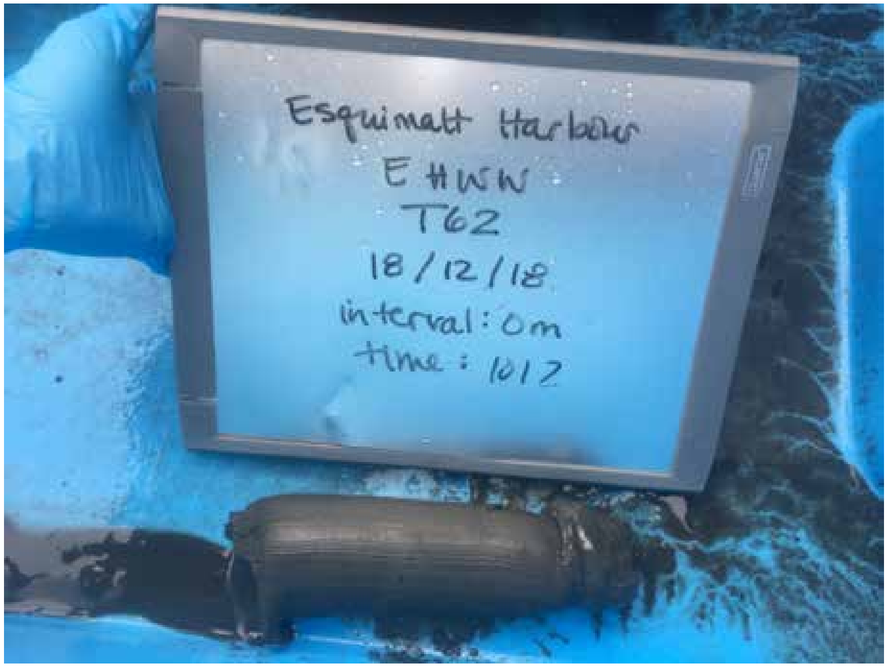

Esquimalt Harbour
EH NW
T 61.
18/12/19
interval 50m
time 13:11

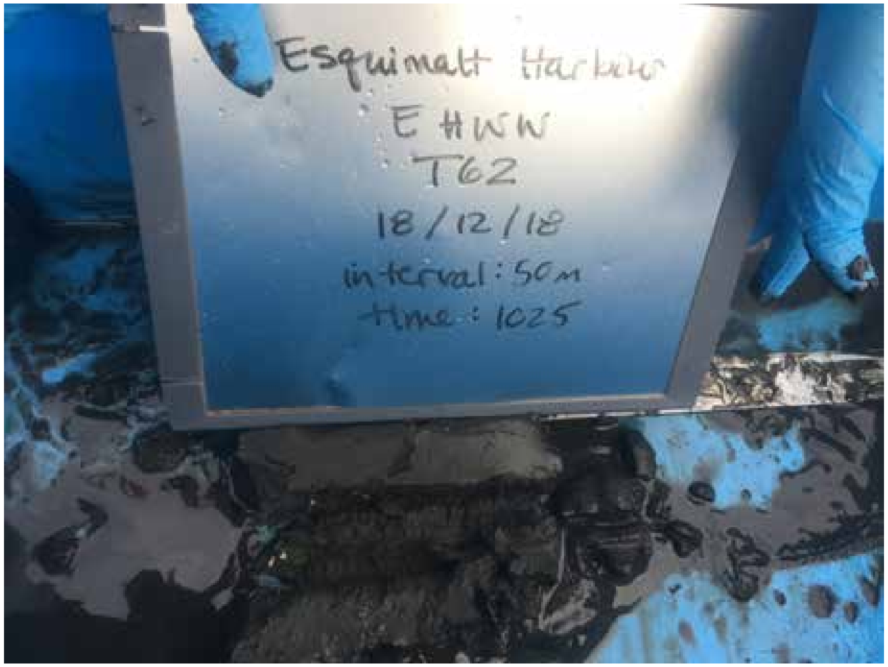

Esquimalt Harbour
EH NW
T 61.
18/12/19
interval 100m
time 1321
2 cm

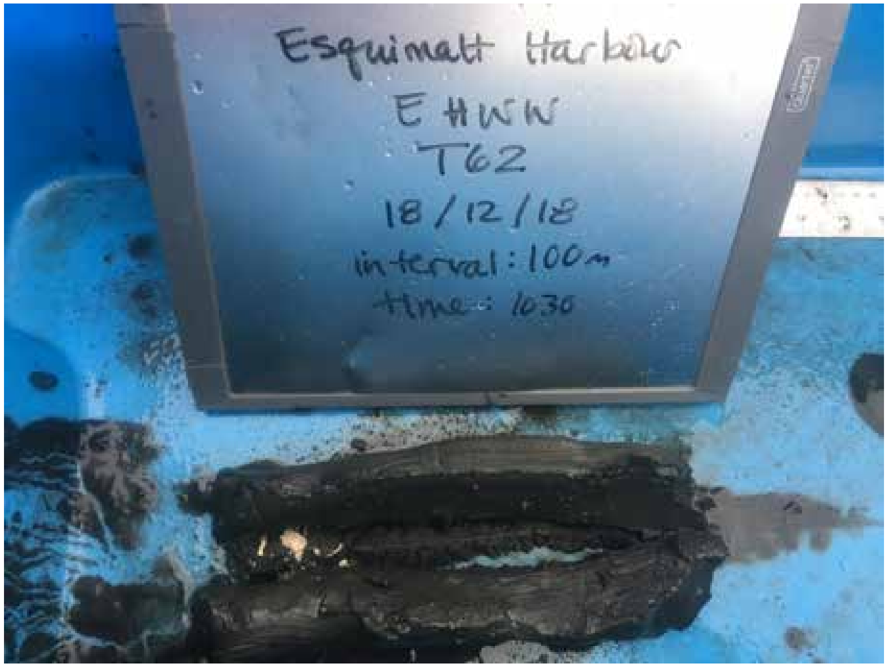

Esquimalt Harbour
EH NW
T 61.
18/12/19
interval 150
time 1328
2 cm


Esquimalt Harbour
EH NW
T 61
18/12/19
interval 200m
13:39


Esquimalt Harbour
EH NW
T 61
18/12/19
interval 200m
13:39

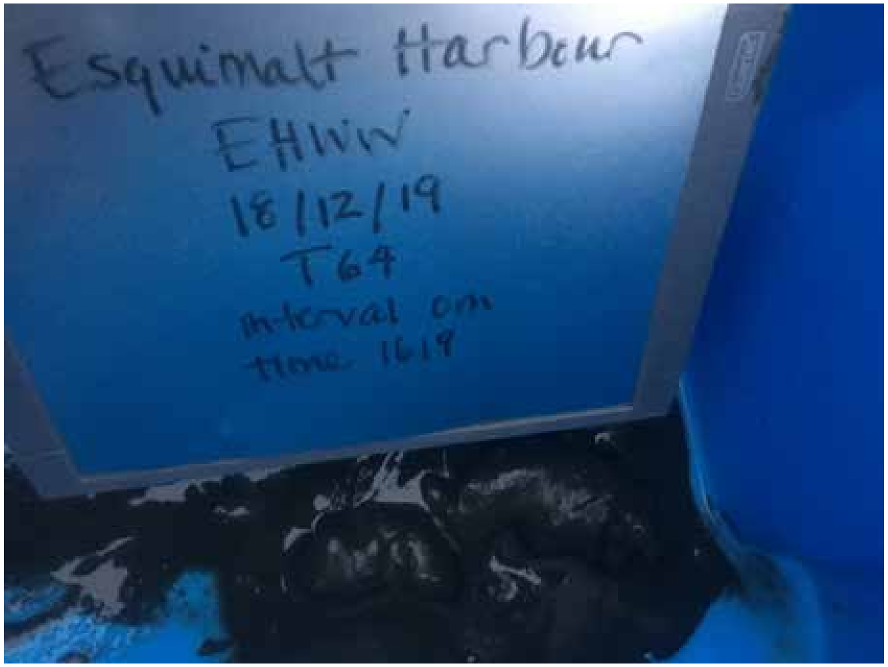

Esquimalt Harbour
EHWW
T62
18/12/18
interval: 0m
time: 1012

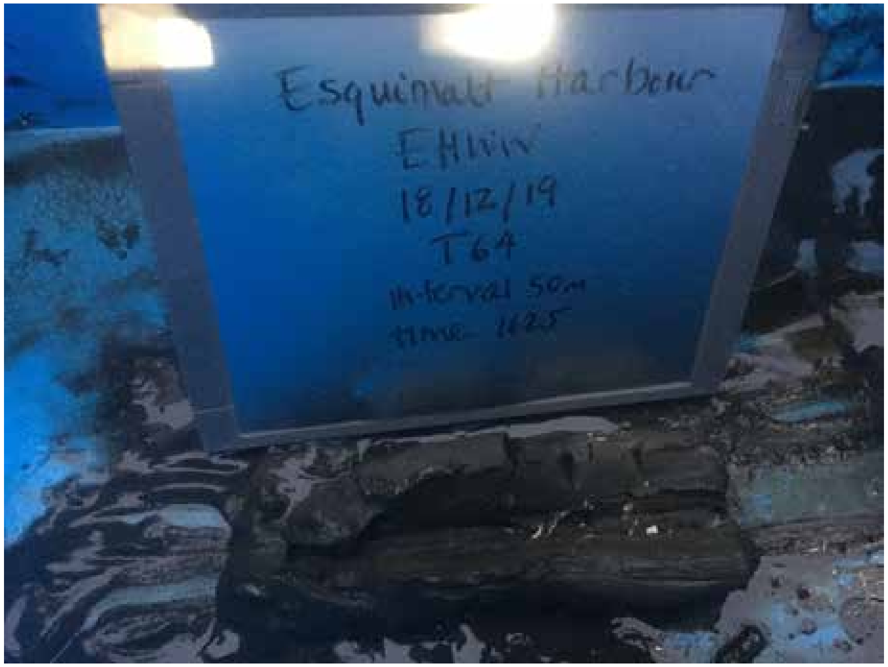

Esquimalt Harbour
EHWW
T62
18/12/18
interval: 50m
time: 1025


Esquimalt Harbour
EHWW
T62
18/12/18
interval: 100m
time: 1030

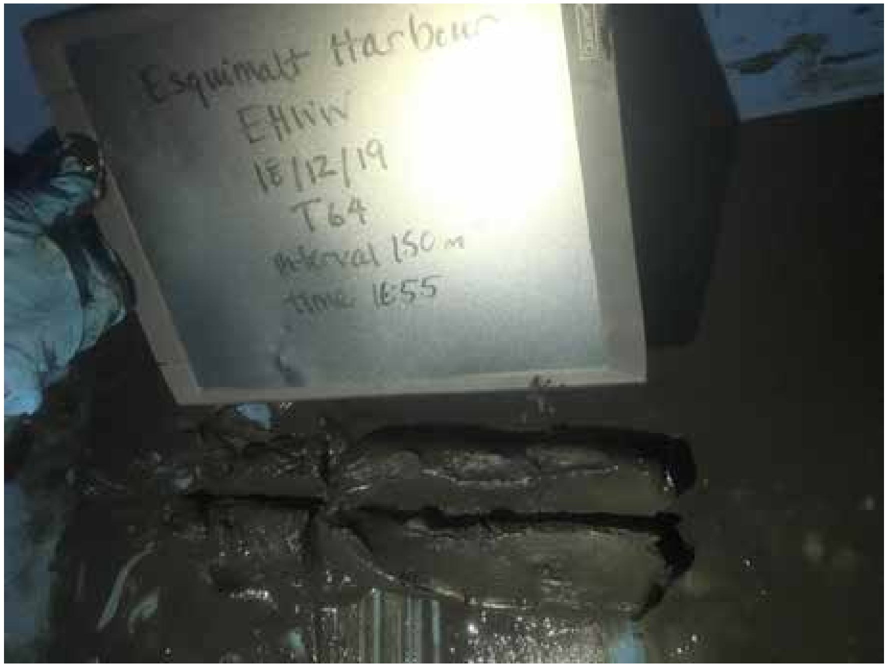

Esquimalt Harbour
EHWW
T62
18/12/18
interval: 150m
time: 1045

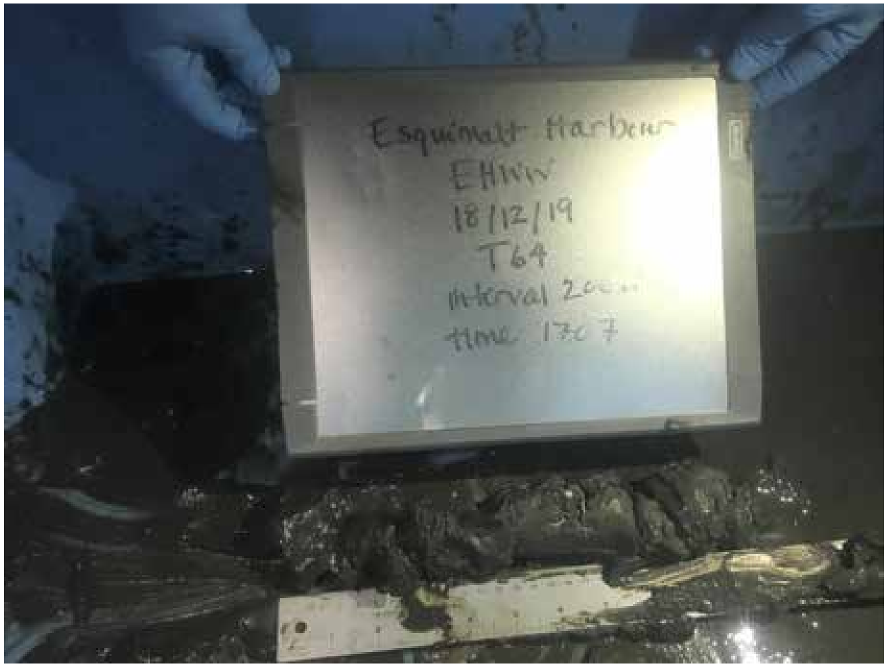

Esquimalt Harbour
E HWW
T62
18/12/18
interval: 200m
time: 1104


Esquimalt Harbour
EHWW
18/12/19
T64
interval 0m
time 1619

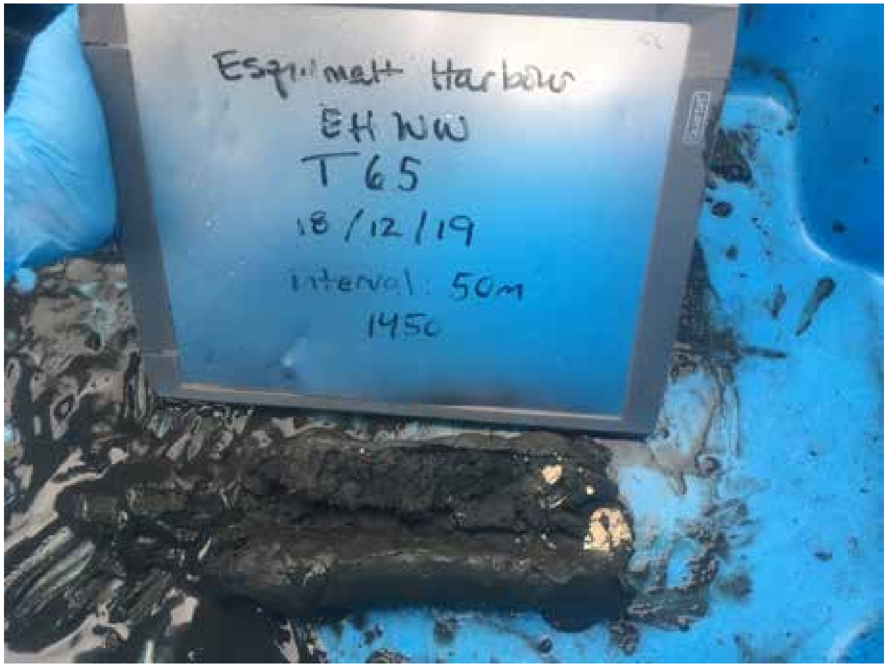

Esquimalt Harbour
EHWW
18/12/19
T64
interval 50m
time 1625

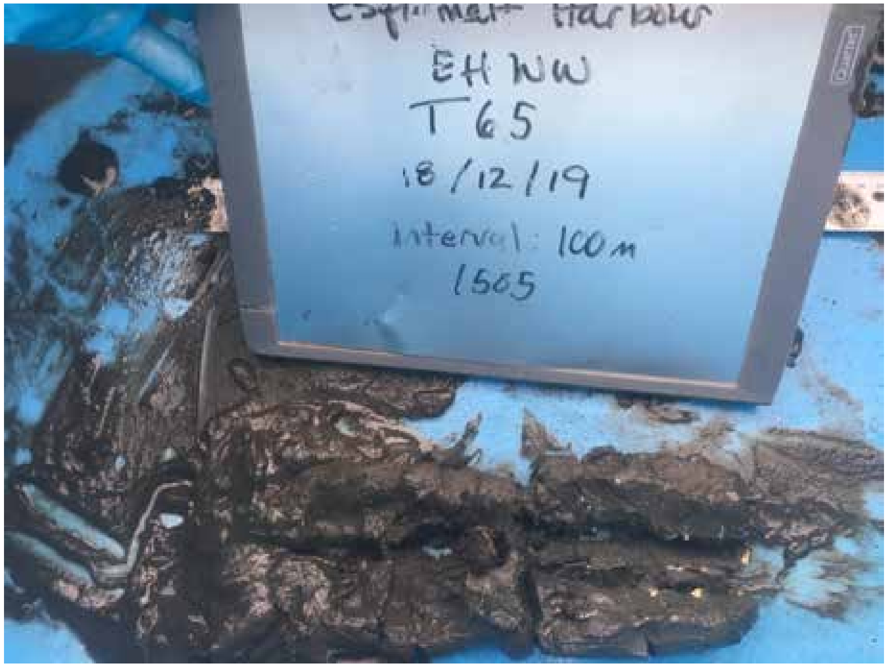

18/12/19
T64
interval 100m


Esquimalt Harbour
EHWW
18/12/19
T64
interval 150m
time 1655

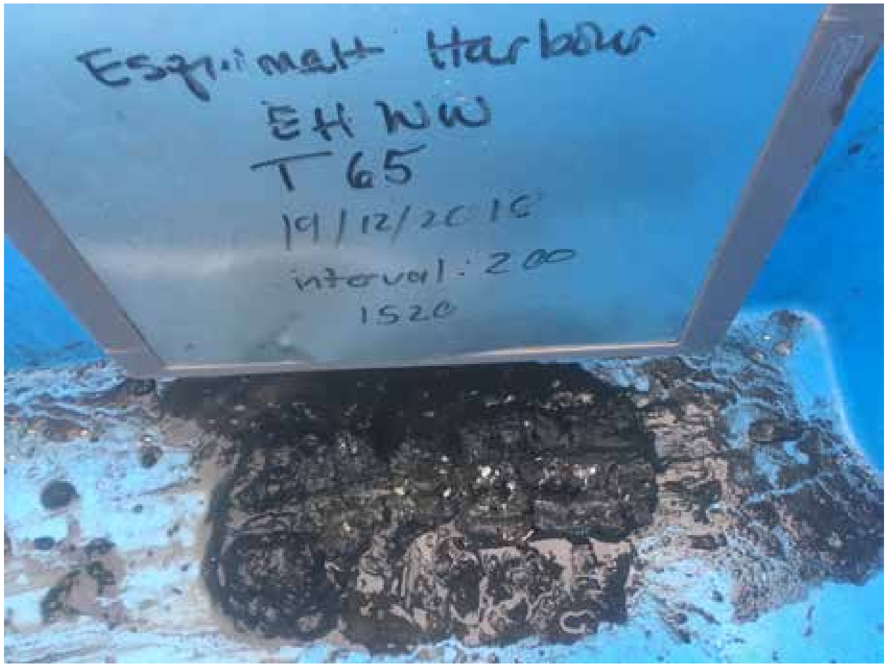

Esquimalt Harbour
EHWW
18/12/19
T64
interval
time

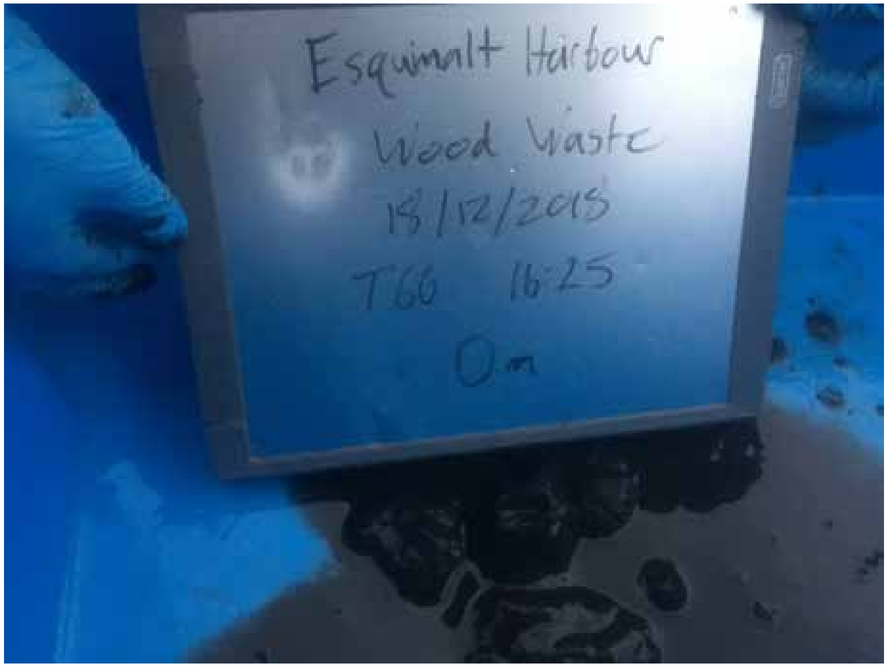

Esquimalt Harbour
EH WW
T65
18/12/19
interval 0m
1440

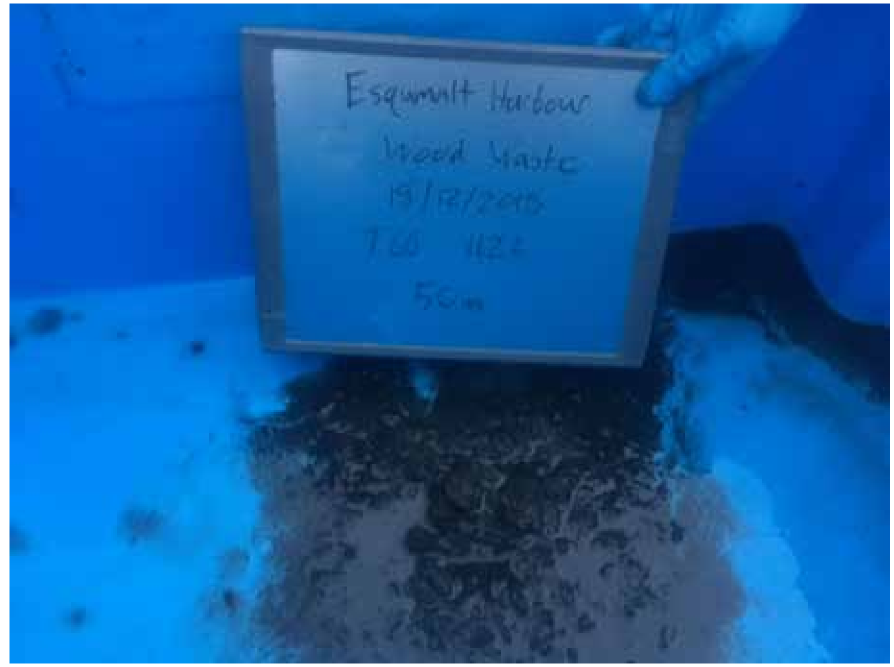

Esquimalt Harbour
EH WW
T65
18/12/19
interval: 50m
1450

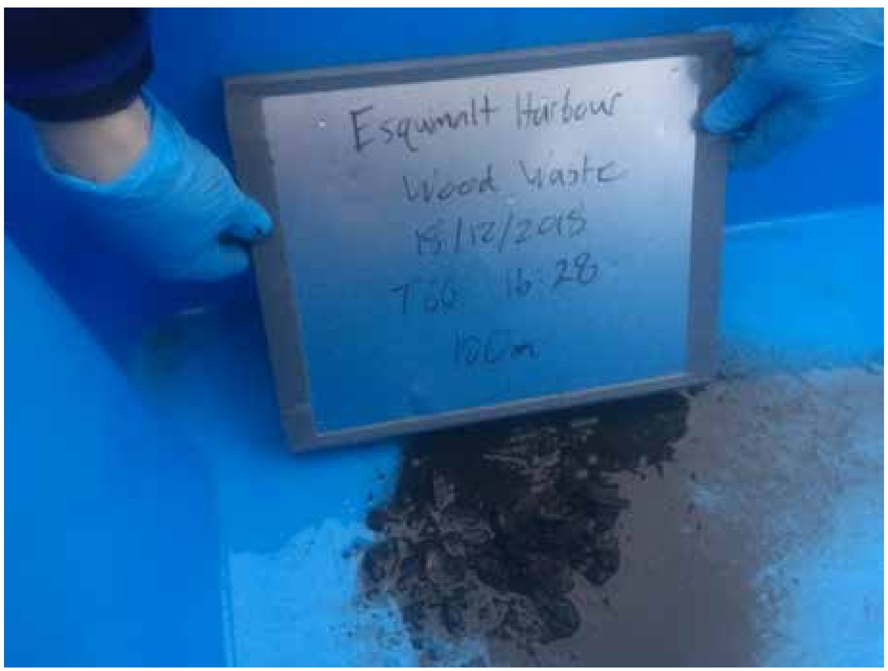

EH WW
T65
18/12/19
interval: 100m
1505


Esquimalt Harbour
EH WW
T65
18/12/19
interval: 150m
1505

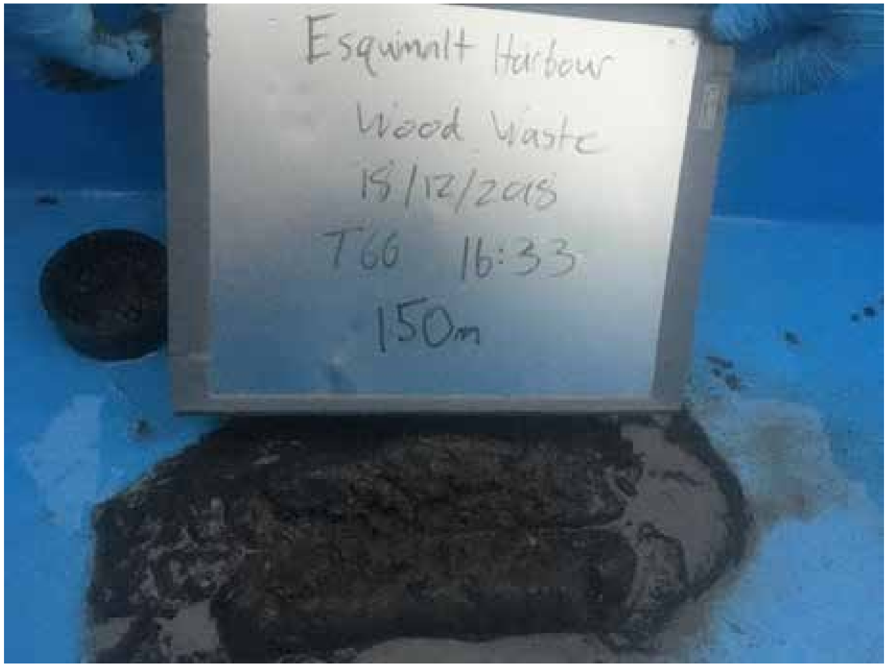

Esquimalt Harbour
EH WW
T65
19/12/2018
interval: 200
1520


Esquimalt Harbour
Wood Waste
18/12/2018
T66 16:25
0m


Esquimalt Harbour
Wood Waste
50m


Esquimalt Harbour
Wood Waste
18/12/2018
T66 16:28
100m


Esquimalt Harbour
Wood Waste
18/12/2018
T66 16:33
150m

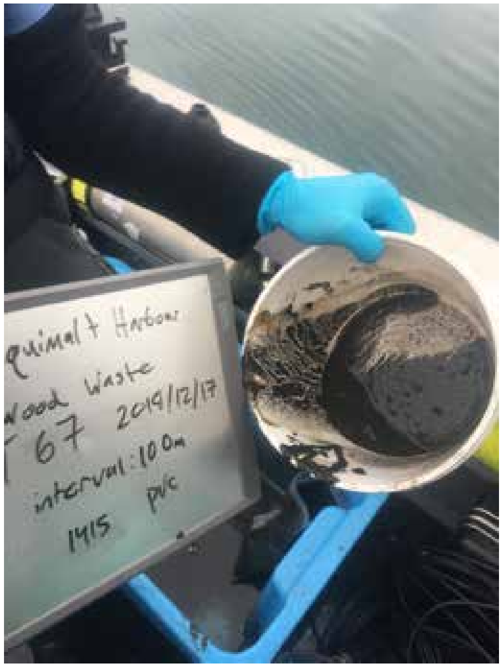

Esquimalt Harbour
Wood Waste
18/12/2018
T66 16:33
150m

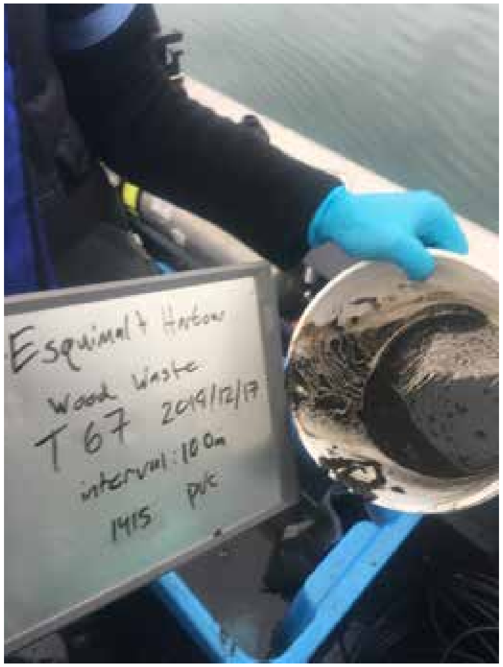

Esquimalt Harbour
Wood Waste
18/12/2018
T66 1639
200m

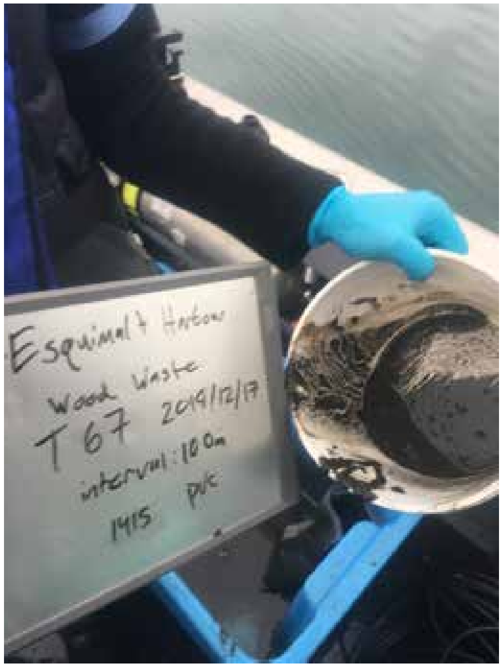

Wood Waste
18/12/2018
T66 1639
200m

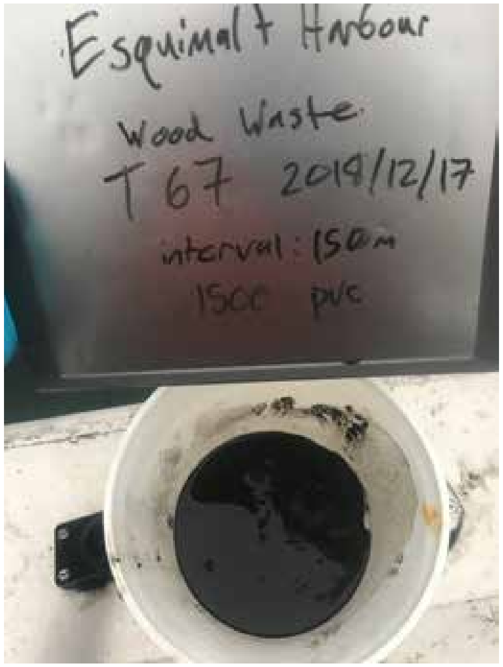

Esquimalt Harbour
Wood Waste
18/12/2018
T66 1639


T66 1639

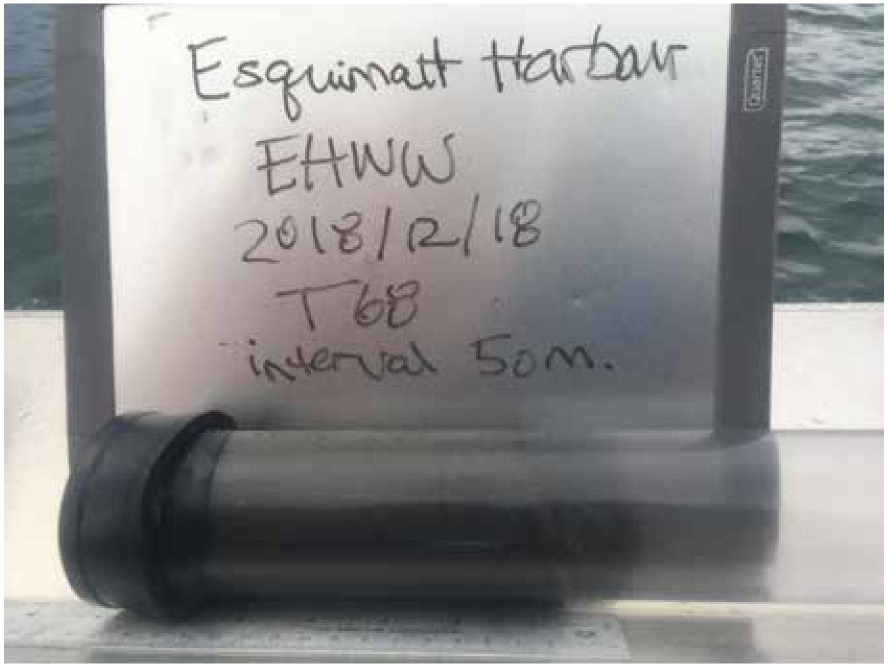

quimalt Harbour
Wood Waste
T67 2019/12/17
interval: 10.0m
1415 p/c

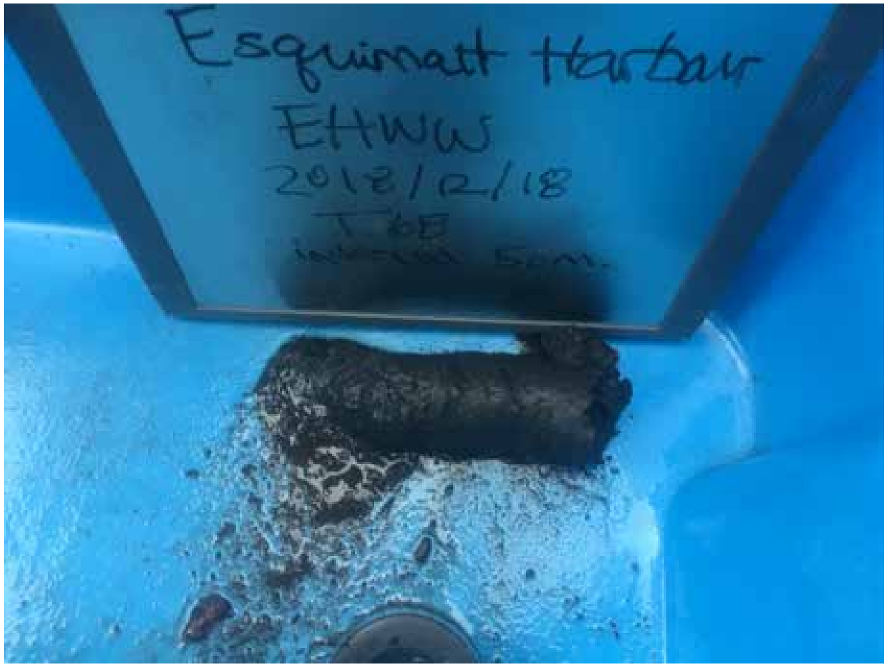

Esquimalt Harbour
Wood Waste
T67 2019/12/17
interval: 10.0m
1415 p/c


Esquimalt Harbour
Wood Waste
T67 2019/12/17
interval: 10.0m
1415 p/c


Esquimalt Harbour
Wood Waste
T67 2019/12/17
interval: 15.0m
1500 p/c

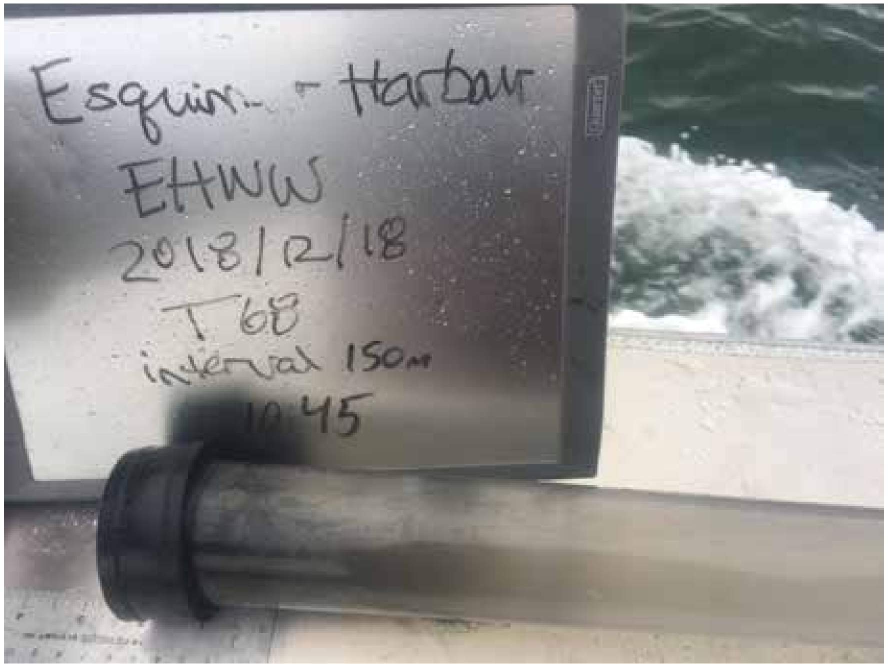

Esquimalt Harbour
Wood Waste
T67 2018/12/17
interval: 2.00m
1430 p/c


Esquimalt Harbour
EHWW
2018/12/18
T68
interval 50m.

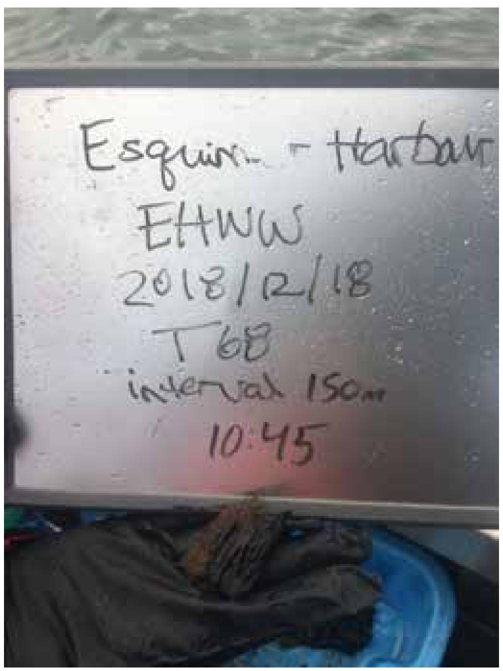

Esquimalt Harbour
EHWW
2018/12/18

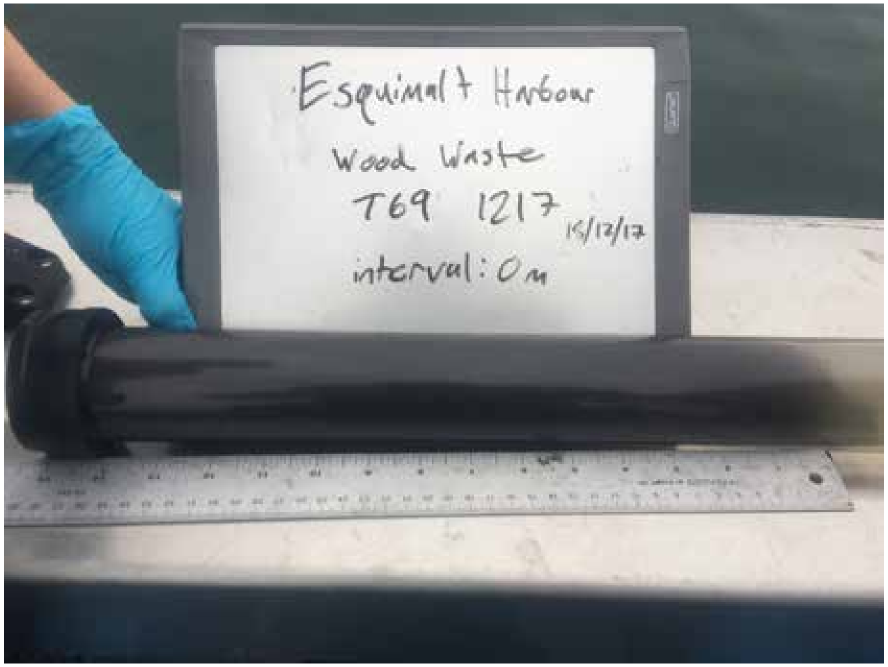

Esquimalt Harbour
EHWW
2018/12/18
T68
interval 100m
11:43 am

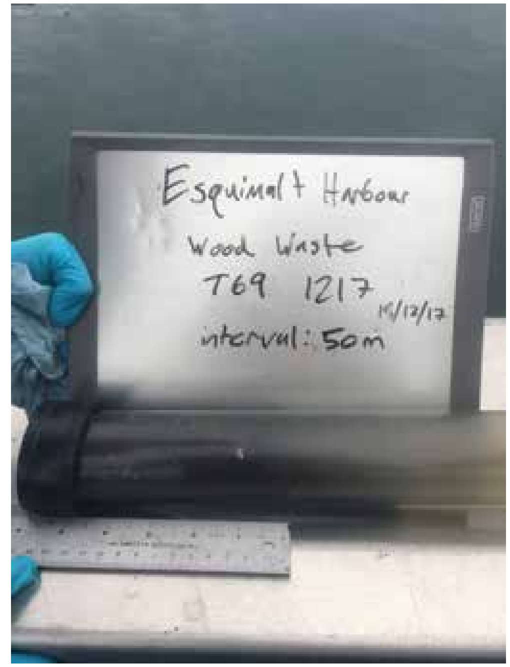

Esquimalt Harbour
EHWW
2018/12/18

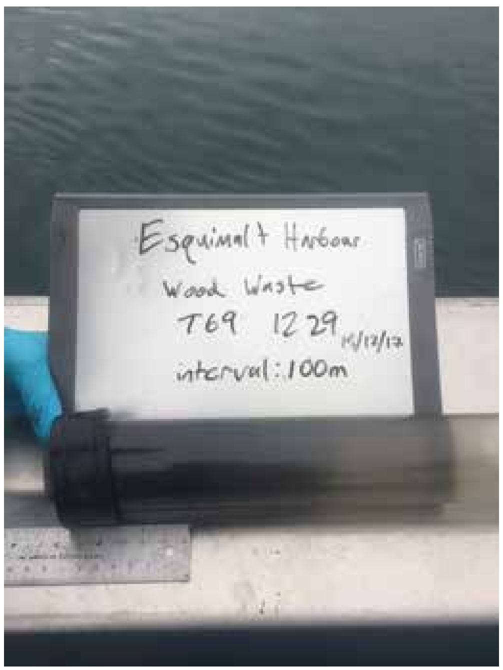

Esquim - Harbour
EHWW
2018/12/18
T68
interval 150m
10:45

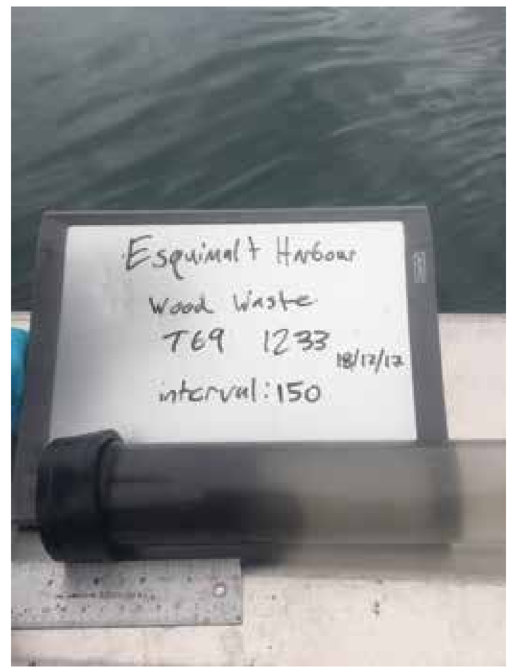

Esquim - Harbour
EHWW
2018/12/18
T68
interval 150m
10:45

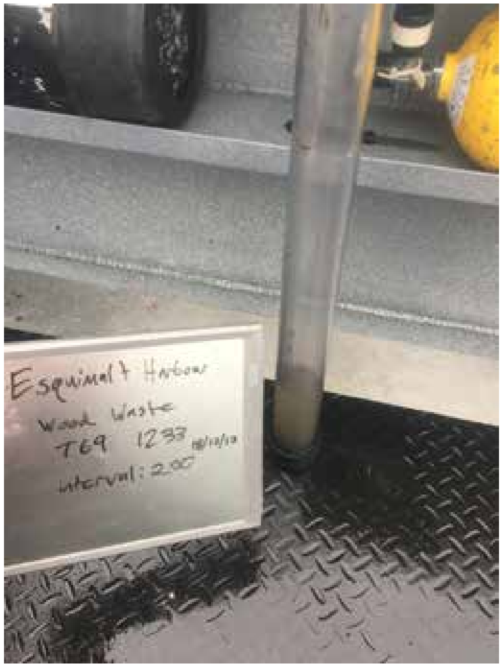

Esquim - Harbour
EHWW
2018/12/18
T68
interval 150m
10:45

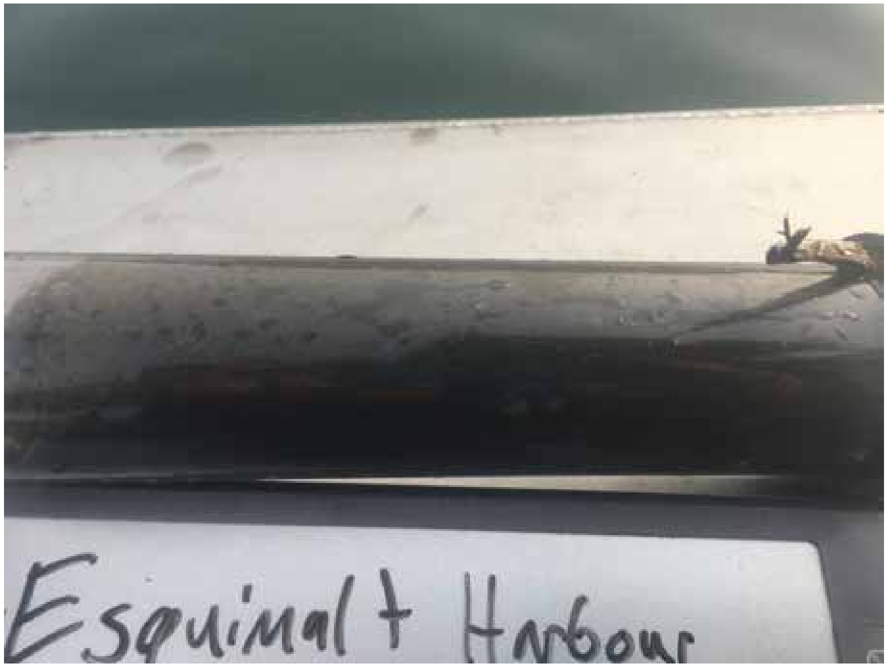

Esquimalt Harbour
Wood Waste
T69 1217
15/12/17
interval: 0m

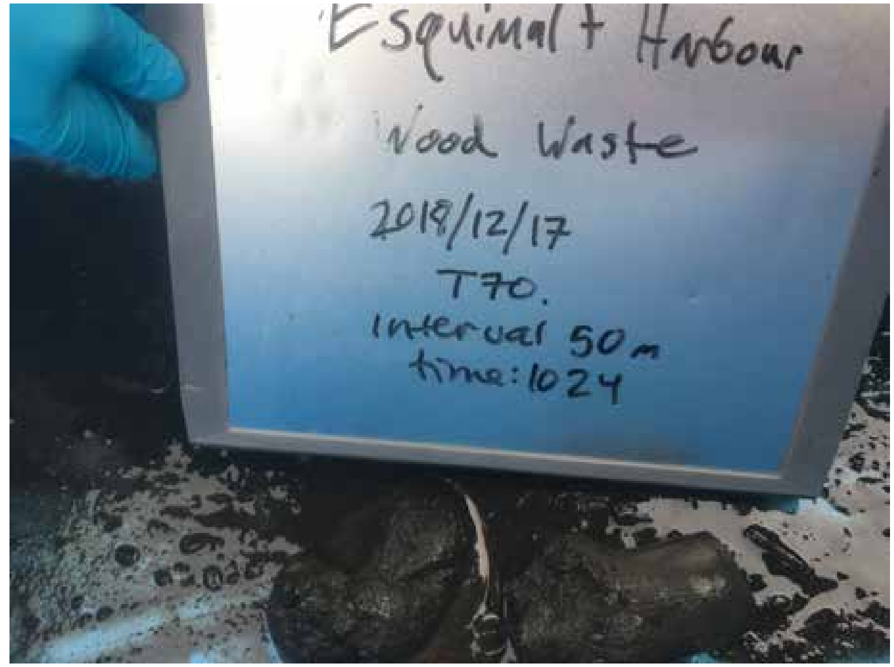

Esquimalt Harbour
Wood Waste
T69 1217
15/12/17
interval: 50m

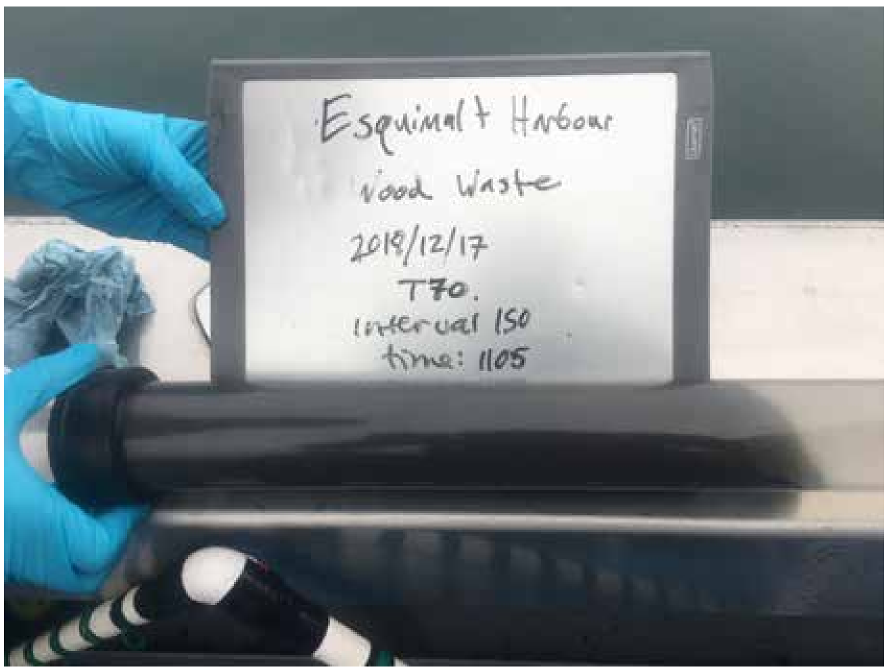

Esquimalt Harbour
Wood Waste
T69 1229
15/12/17
interval: 100m

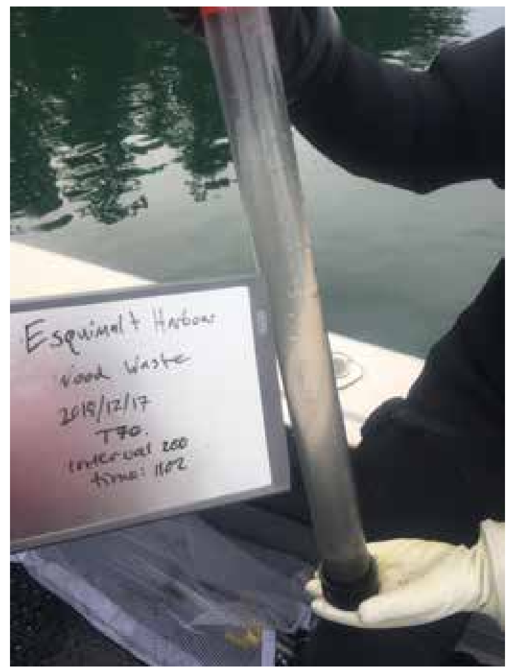

Esquimalt Harbour
Wood Waste
T69 1233
18/12/17
interval: 150


Esquimalt Harbour
Wood Waste
T69 1233
interval: 2.00


Esquimalt Harbour


Esquimalt Harbour
Wood Waste
2018/12/17
T70.
interval 50 m
time: 1024


Esquimalt Harbour
Wood Waste
2018/12/17
T70.
interval 150
time: 1105


Esquimalt Harbour
Wood Waste
2018/12/17
T70.
interval 200

Sonic Boring Photographs


2018/12/17

2018/12/17

2018/12/17

2018/12/17


12/17/18 1123
0-14.5
2018/12/17


12/17/18 1123
0-14.5
2018/12/17


12/17/18 1123
0-14.5
2018/12/17


12/17/18 1123
0-14.5
2018/12/17

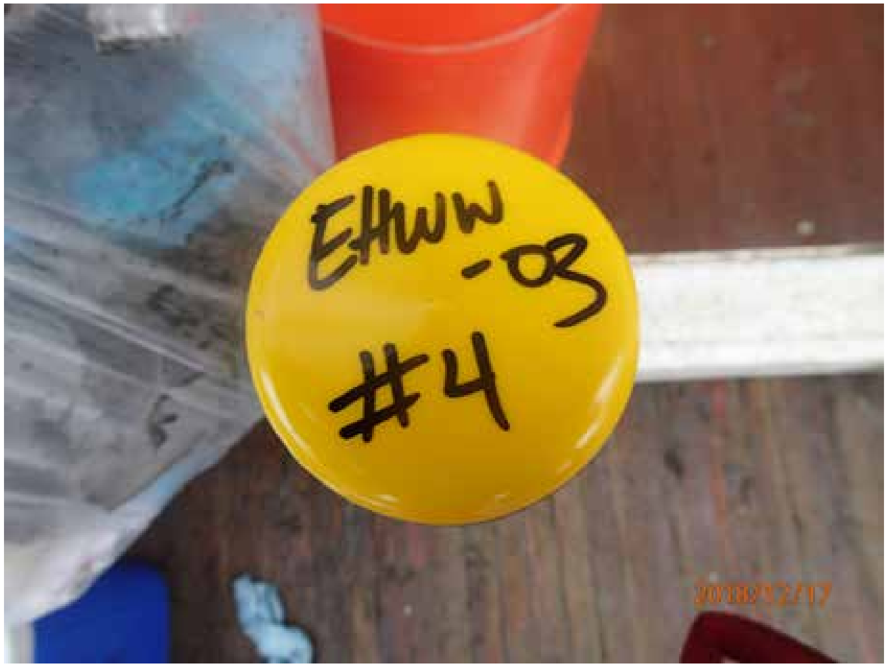

2018/12/17


EHWW
-03
#1
2018/12/17


2018/12/17


EHWW-03
TOP
#3
2018/12/17


2018/12/17

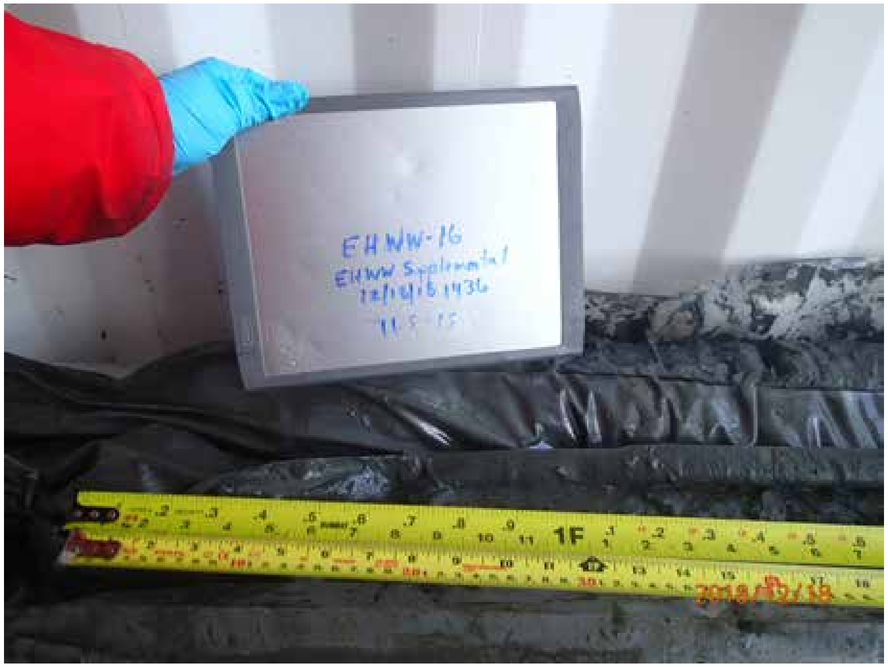

EHWW
-03
#4


EHWW-16
EHWW Supplemental
12/18/18 1436
2018/12/18

EHWW-16
EHWW Supplemental
12/18/18 1436
2018/12/18

EHWW-16
EHWW Supplemental
12/18/18 1436
2018/12/18

EHWW-16
EHWW Supplemental
12/18/18 1436
2018/12/18


EHWW-16
12/18/18 1436
2018/12/18


EHWW-16
12/18/18 1436
2018/12/18


EHWW-16
12/18/18 1436
2018/12/18


EHWW-16
12/18/18 1436
2018/12/18


EHWW-16
EHWW Supplemental
12/12/18 1436
15-20
2018/12/18


EHWW-24
EHWW Supplemental
12/18/18 11:48
0-5 ft
2018/12/18

EHWW-24
EHWW Supplemental
12/18/18 11:48
0-5 ft
2018/12/18

EHWW-24
EHWW Supplemental
12/18/18 11:48
0-5 ft
2018/12/18

EHWW-24
EHWW Supplemental
12/18/18 11:48
5-10 ft
2018/12/18


EHWW-24
EHWW Supplemental
12/18/18 11:48
5-10 ft
2018/12/18


EHWW-24
EHWW Supplemental
12/18/18 11:48
5-10 ft


EHWW-24
EHWW Supplemental
12/18/18 11:48
5-10 ft


10/17/18 0950
0-12 ft
2018/12/17


2018/12/17


10/17/18 0950
0-12 ft
2018/12/17


10/17/18 0950
0-12 ft
2018/12/17


2018/12/17


2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17

EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17

EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17

EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17

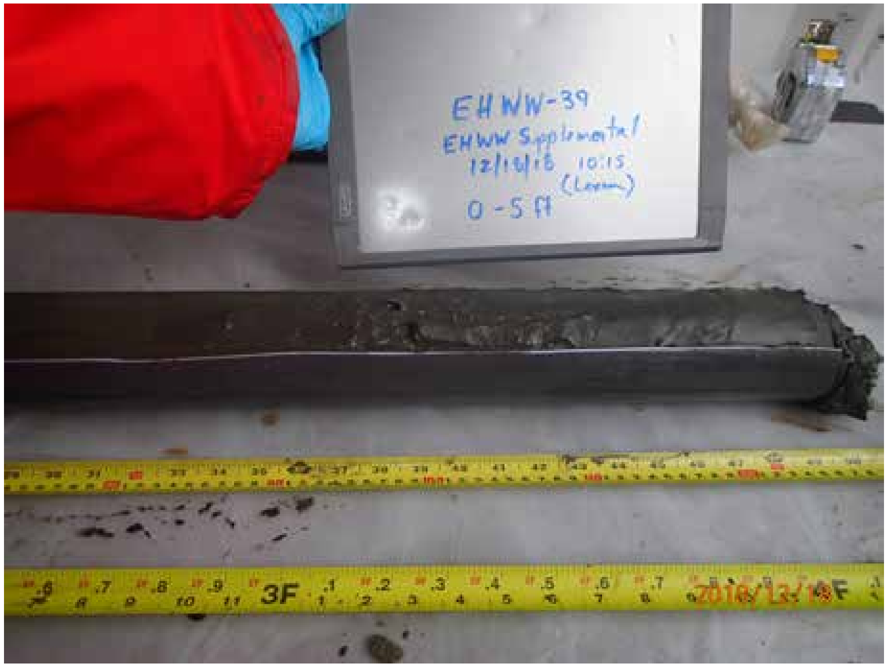

EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-38
EHWW Supplemental
12/17/18 16:24
0-31.5ft
2018/12/17


EHWW-39
EHWW Supplemental
12/18/18 10:15
(Leon)
0-5 ft
2018/12/18


EHWW-39
EHWW Supplemental
12/18/18 10:15
(Leon)
0-5 ft
2018/12/18


EHWW-39
EHWW Supplemental
12/18/18 10:15
(Leon)
0-5 ft
2018/12/18


EHWW-40
EHWW Supplemental
12/18/18 0830
0-5ft
2018/12/18


EHWW-40
EHWW Supplemental
12/18/18 0830
0-5ft
2018/12/18


EHWW-40
EHWW Supplemental
12/18/18 0830
0-5ft
2018/12/18


EHWW-40
EHWW Supplemental
12/18/18 0830
5-9 ft
2018/12/18


EHWW-40
EHWW Supplemental
12/18/18 0830
5-9 ft
2018/12/18


EHWW-40
EHWW Supplemental
12/18/18 0830
5-9 ft
2018/12/18


EHWW-44
EHWW Supplemental
12/19/18 1250
0-5 ft
2018/12/19


EHWW-44
EHWW Supplemental
12/19/18 1250
0-5 ft
2018/12/19


EHWW-44
EHWW Supplemental
12/19/18 1250
0-5 ft
2018/12/19


EHWW-44
EHWW Supplemental
12/19/18 1250
0-5 ft
2018/12/19


EHWW-44
EHWW Supplemental
12/19/18 1250
5-10 ft
2018/12/19


EHWW-44
EHWW Supplemental
12/19/18 1250
5-10 ft
2018/12/19


EHWW-44
EHWW Supplemental
12/19/18 1250
5-10 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
0-3 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
0-3 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
3-8 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
3-8 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
3-8 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
8-13 ft


EHWW-S3
EHWW Supplemental
12/19/18 1346
8-13 ft
2018/12/19


EHWW-S3
EHWW Supplemental
12/19/18 1346
8-13 ft
2018/12/19


EHWW-54
EHWW Supplemental
12/18/18 1627
0-3.5'
2018/12/18


EHWW-54
EHWW Supplemental
12/18/18 1627
0-3.5'
2018/12/18


EHWW-54
EHWW Supplemental
12/18/18 1627
3.5-8.5'
2018/12/18


EHWW-54
EHWW Supplemental
12/18/18 1627
3.5-8.5'
2018/12/18


EHWW-54
EHWW Supplemental
12/18/18 1627
3.5-8.5'
2018/12/18


EHWW-54
EHWW Supplemental
12/18/18 1627
3.5-8.5'


EHWW-SS
EHWW Supplemental
12/19/18 0842
0 - 3 ft
2018/12/19

EHWW-SS
EHWW Supplemental
12/19/18 0842
0 - 3 ft
2018/12/19

EHWW-SS
EHWW Supplemental
12/19/18 0842
3 - 8 ft
2018/12/19

EHWW-SS
EHWW Supplemental
12/19/18 0842
3 - 8 ft
2018/12/19


EHWW-55
2018/12/19


EHWW
-55 #1
TOP
2018/12/19


2018/12/19


4F
2018/12/19


EHWW-SS
EHWW Supplemental
12/19/18
DT attempt #1
2018/12/19


2018/12/19


2018/12/19


4F .1 .2 .3 .4 .5 .6 .7 .8
1 2 3 4 5 6 7 8 9 10
2018/12/19


2018/12/19

SS
#4
reject
2018/12/19

2018/12/19


EHWW-56
EHRP WW Sco
12/17/18 0840
0-12 ft
2018/12/17


EHWW-56
EHRP WW Sco
12/17/18 0840
0-12 ft
2018/12/17


EHWW-56
EHRP WW Sco
12/17/18 0840
0-12 ft
2018/12/17


EHWW-56
0-6 ft
Attempt #2
2018/12/17


12/17/18 0855
0-6 ft
Attempt #2
2018/12/17

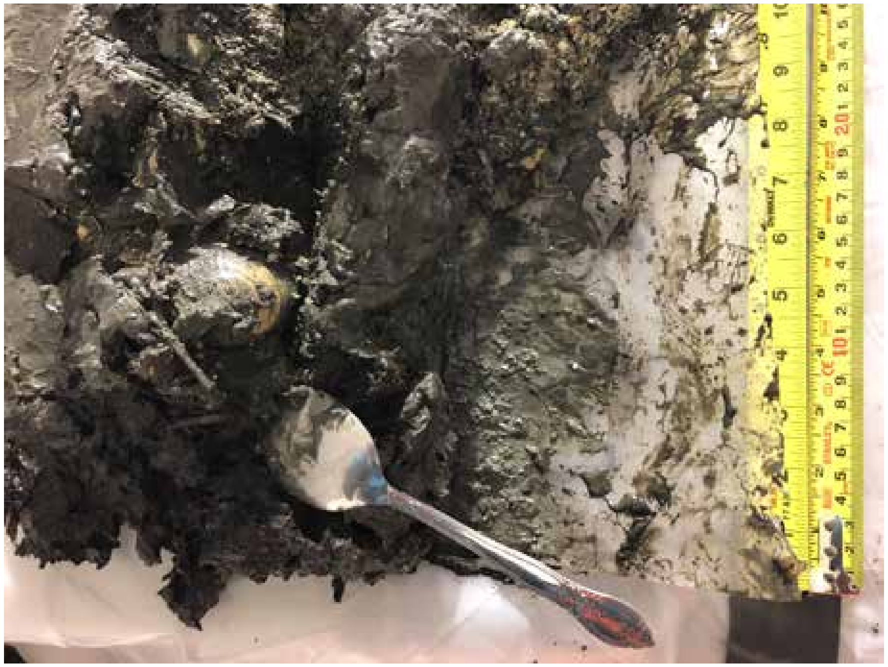

12/17/18 0855
0-6 ft
Attempt #2
2018/12/17


EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft
1F
2F

EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft
1F
2F
3F

EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft
3F
4F

EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft
4F
5F

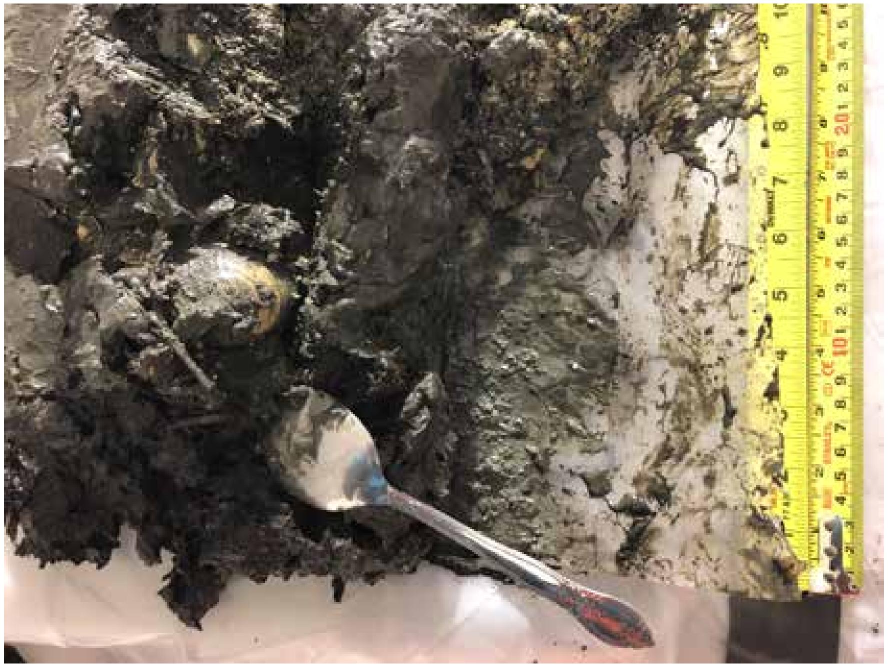



EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft


EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft


EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft


EHWW-58
EHRP WW Supp
12/16/18 1605
0-17 ft




EHWW-65
EHWW Supplemental
12/19/18 1158
0-3 ft
2018/12/19


EHWW-65
EHWW Supplemental
12/19/18 1158
8-13 ft
2018/12/19


EHWW-65
EHWW Supplemental
12/19/18 1158
8-13 ft
2018/12/19


EHWW-65
EHWW Supplemental
12/19/18 1158
0-3 ft
2018/12/19


EHWW-65
EHWW Supplemental
12/19/18 1158
0-3 ft
2018/12/19


EHWW-65
EHWW Supplemental
12/19/18 1158
3-8 ft
2018/12/19


EHWW-65
EHWW Supplemental
12/19/18 1158
3-8 ft
2018/12/19

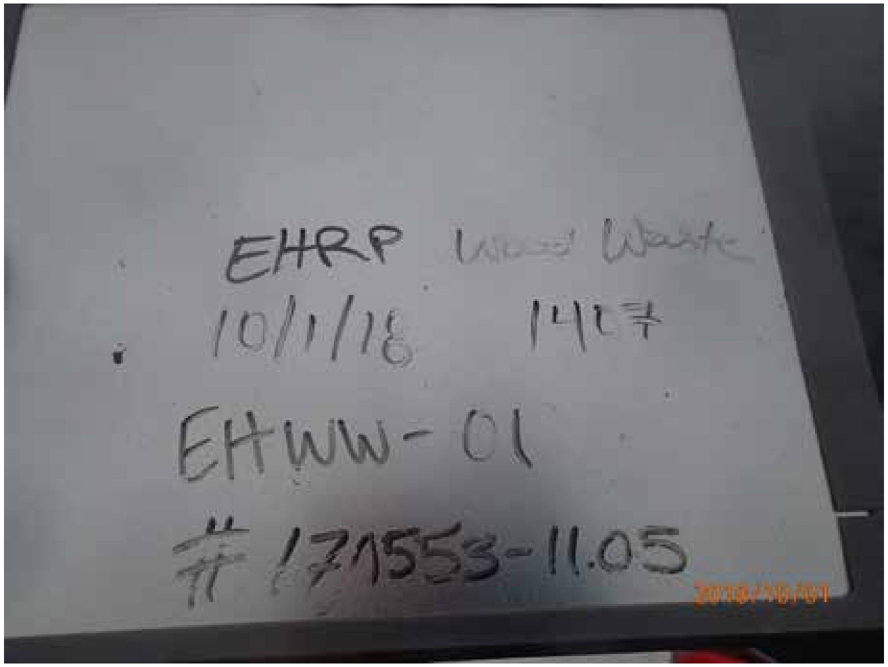

EHWW-65
EHWW Supplemental
12/19/18 1158
3-8 ft
2018/12/19


EHWW-6S
EHWW Supplemental
12/19/18 1158
3-8 ft
2018/12/19


EHWW-6S
EHWW Supplemental
12/19/18 1158
8-13 ft
2018/12/19

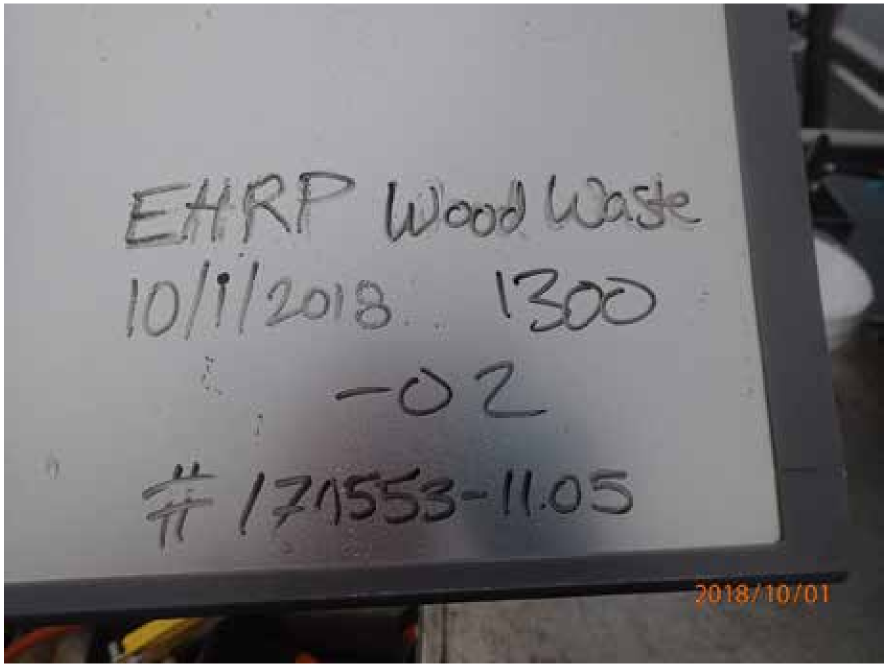

EHWW-6S
EHWW Supplemental
12/19/18 1158
8-13 ft
2018/12/19

Surface Grab Photographs


EHRP Wood Waste
10/1/18 1427
EHWW-01
#171553-11.05

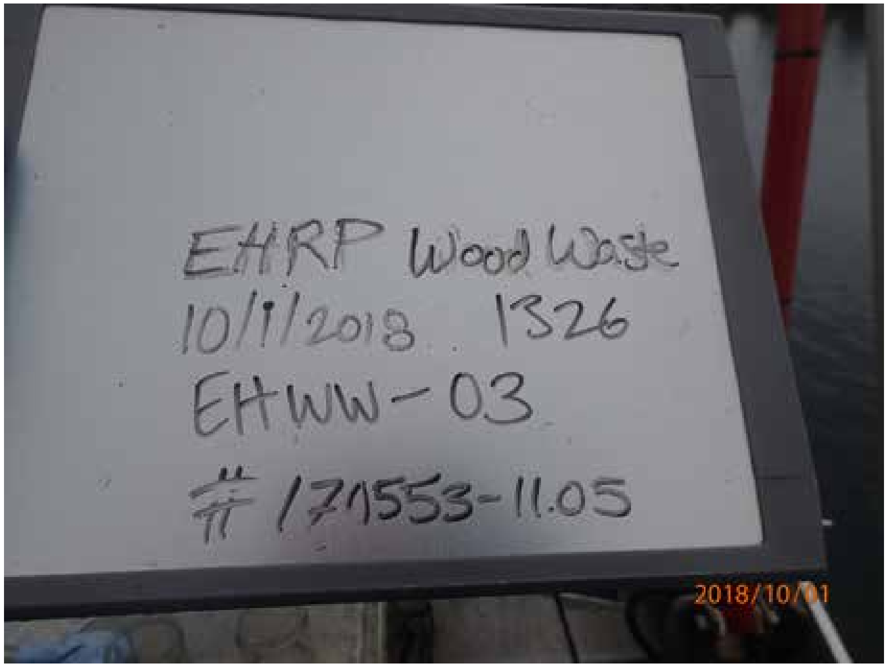

2018/10/01


2018/10/01


EHRP Wood Waste
10/1/2018 1300
-02
#171553-11.05
2018/10/01

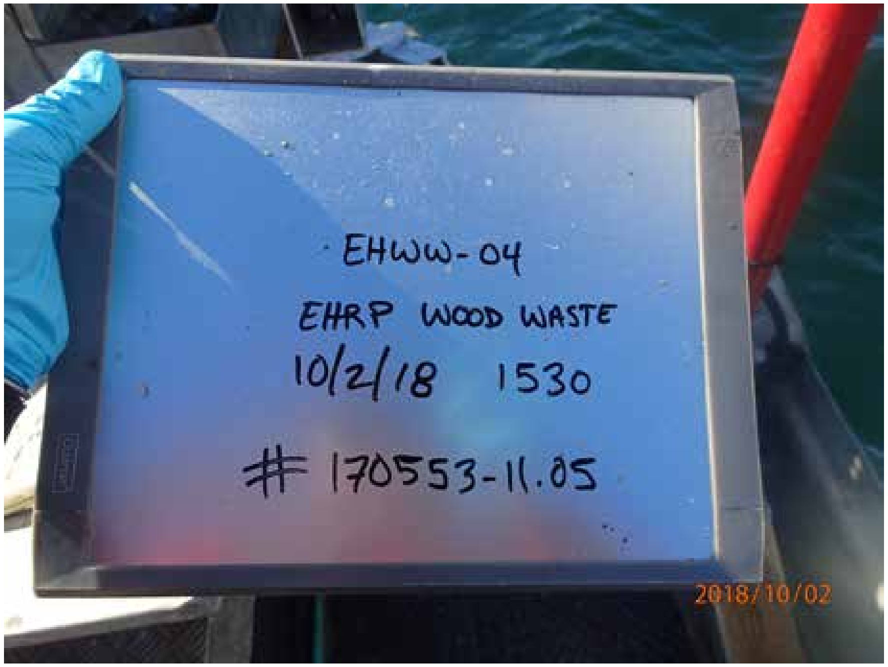

2018/10/01


2018/10/01


EHRP Wood Waste
10/1/2018 1326
EHWW-03
#171553-11.05
2018/10/01

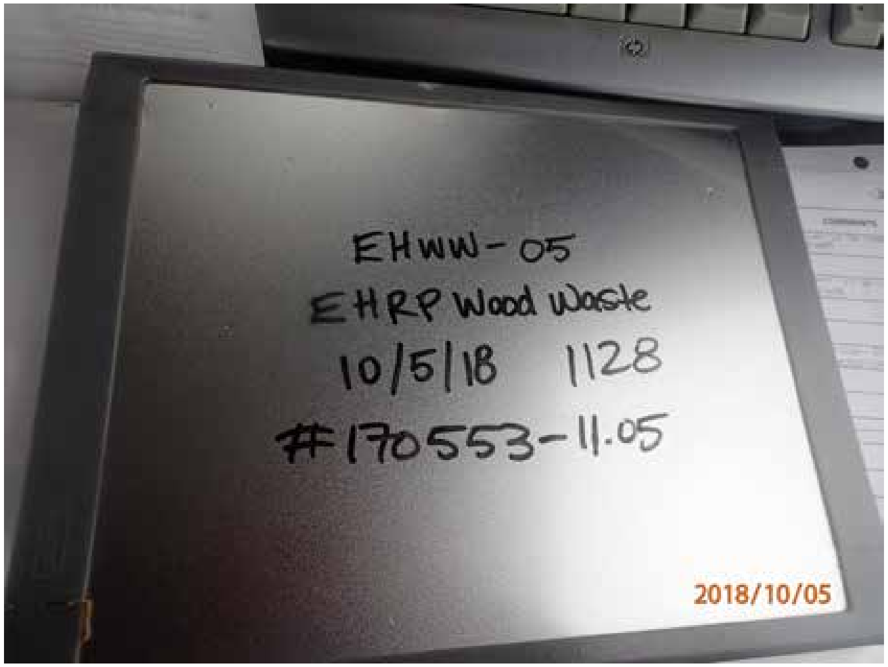

2018/10/01


2018/10/01


EHWW-04
EHRP WOOD WASTE
10/2/18 1530
170553-11.05
2018/10/02


2018/10/02


2018/10/02


EHWW-05
EHRP Wood Waste
10/5/18 1128
#170553-11.05
2018/10/05

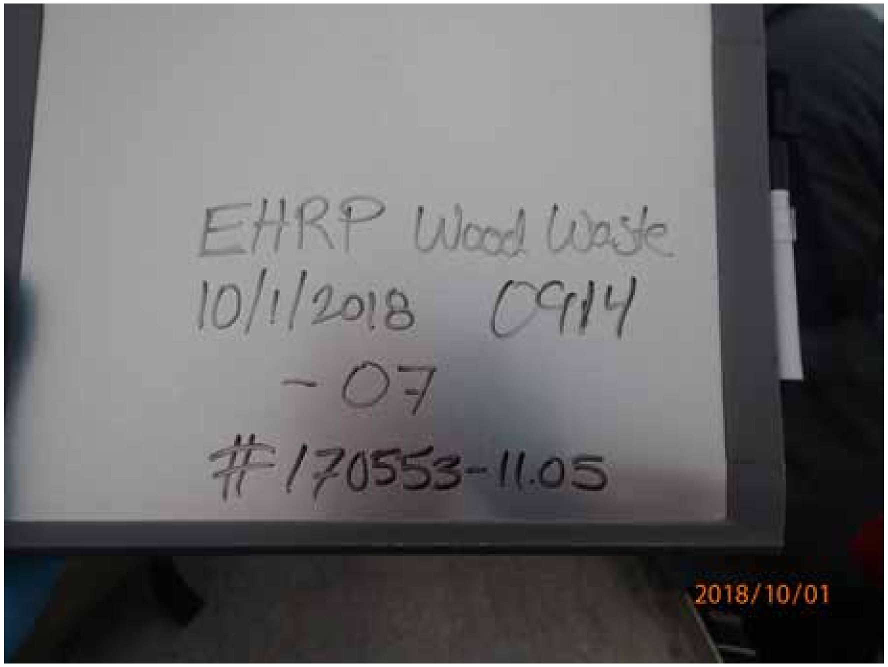

2018/10/05


2018/10/05


EHRF Wood Waste
10/1/18 1450
EHWW-06
#170553-11.05
2018/10/01


2018/10/01

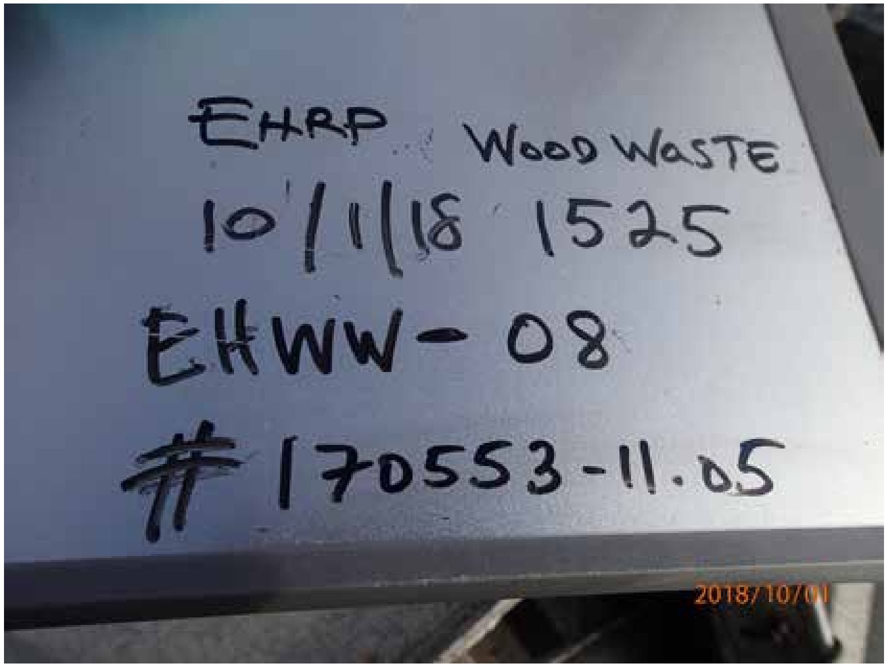

2018/10/01


EHRP Wood Waste
10/1/2018 0914
-07
#170553-11.05
2018/10/01


2018/10/01


2018/10/01


2018/10/01


EHRP WOOD WASTE
10/1/18 1525
EHWW-08
#170553-11.05
2018/10/01


2018/10/01


2018/10/01

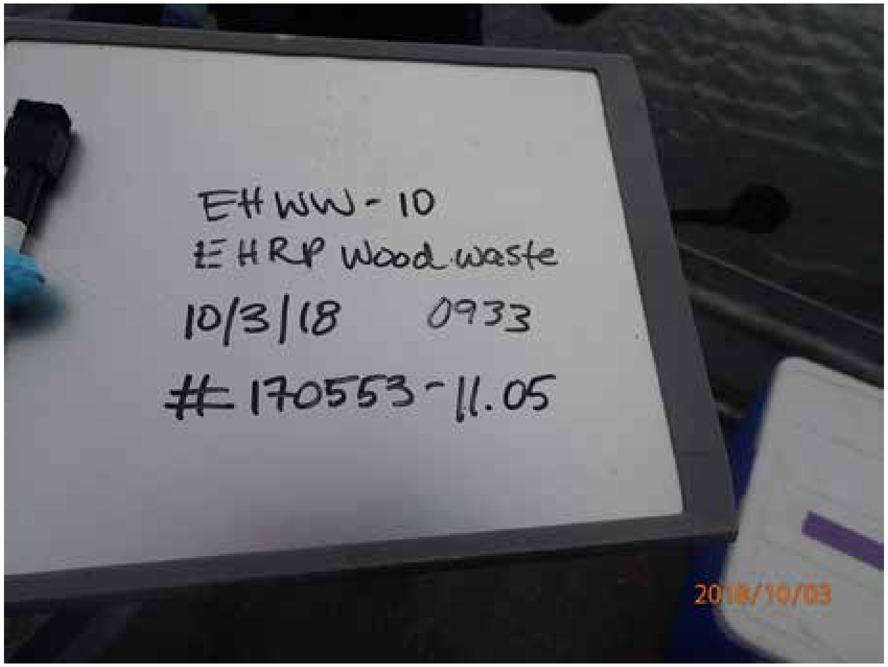

2018/10/01


EHRP WOOD WASTE
10/1/18 1610
EHWW-09
170553-11.05
2018/10/01


2018/10/01

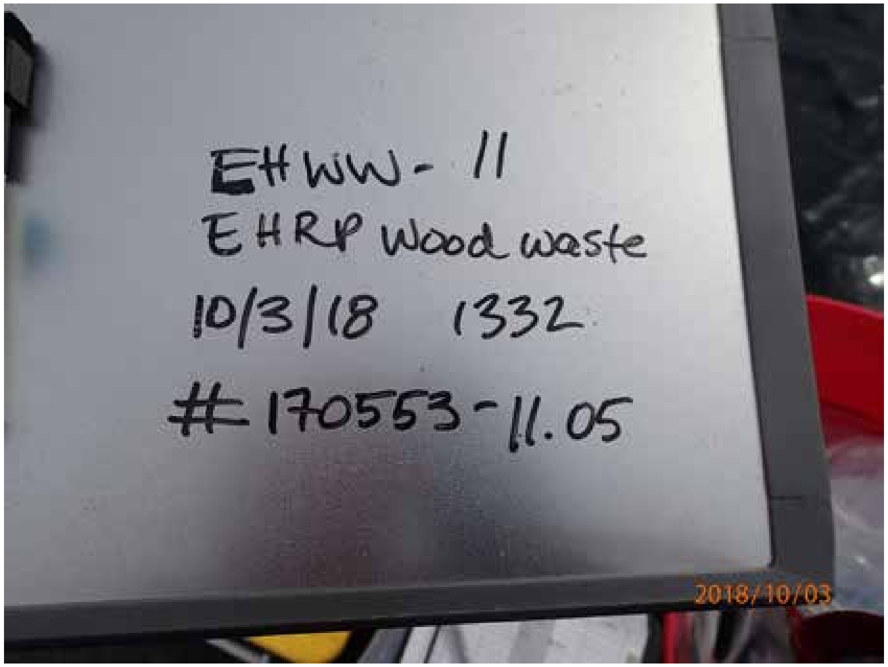

2018/10/01


2018/10/01


EHWW-10
EHRP Wood waste
10/3/18 0933
#170553-11.05
2018/10/03


2018/10/03


2018/10/03


EHWW- 11
EHRP Wood waste
10/3/18 1332
170553-11.05
2018/10/03

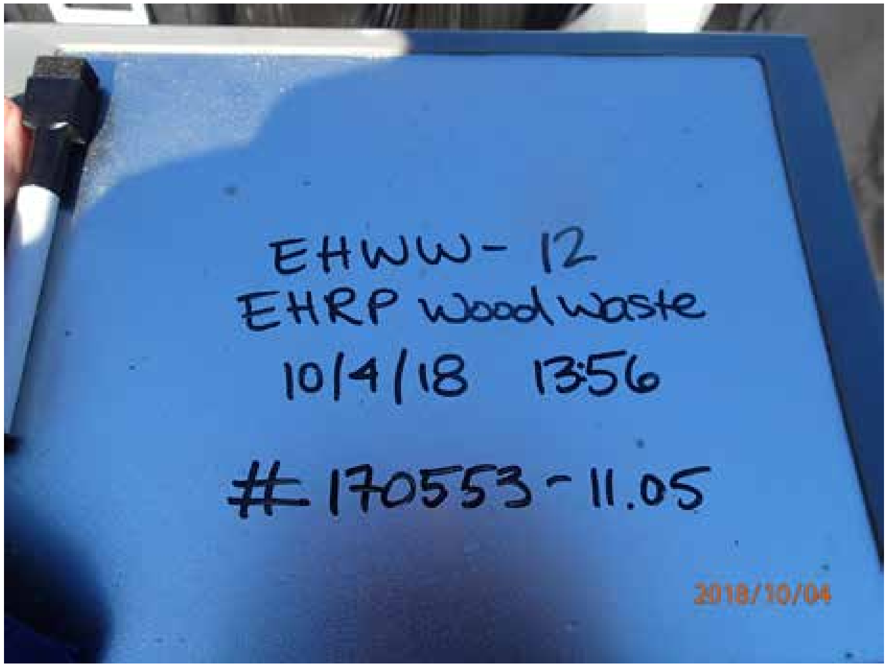

2018/10/03


2018/10/03


2018/10/03


2018/10/03

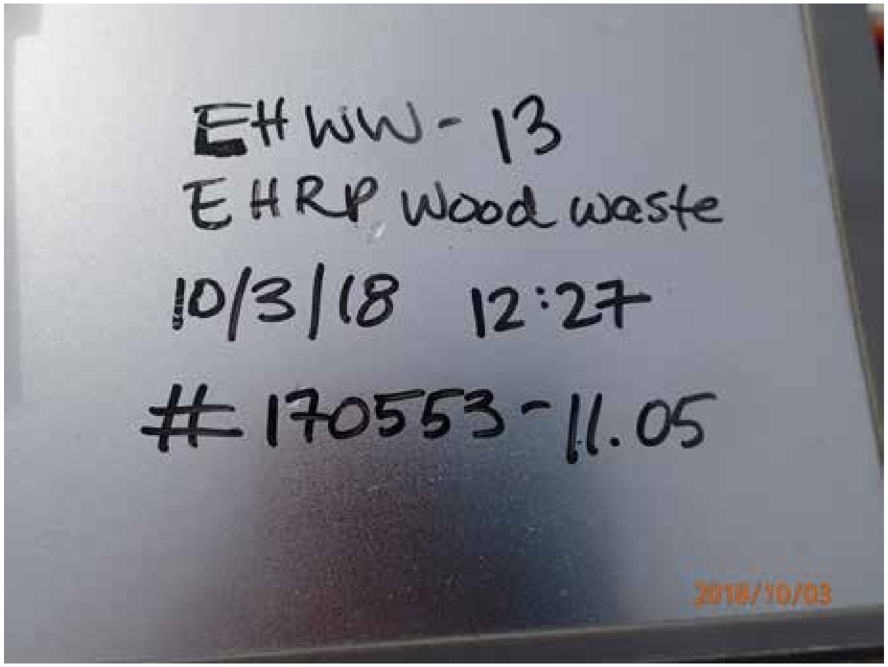

2018/10/03


EHWW- 12
EHRP Wood Waste
10/4/18 13:56
#170553-11.05
2018/10/04


2018/10/04


2018/10/04

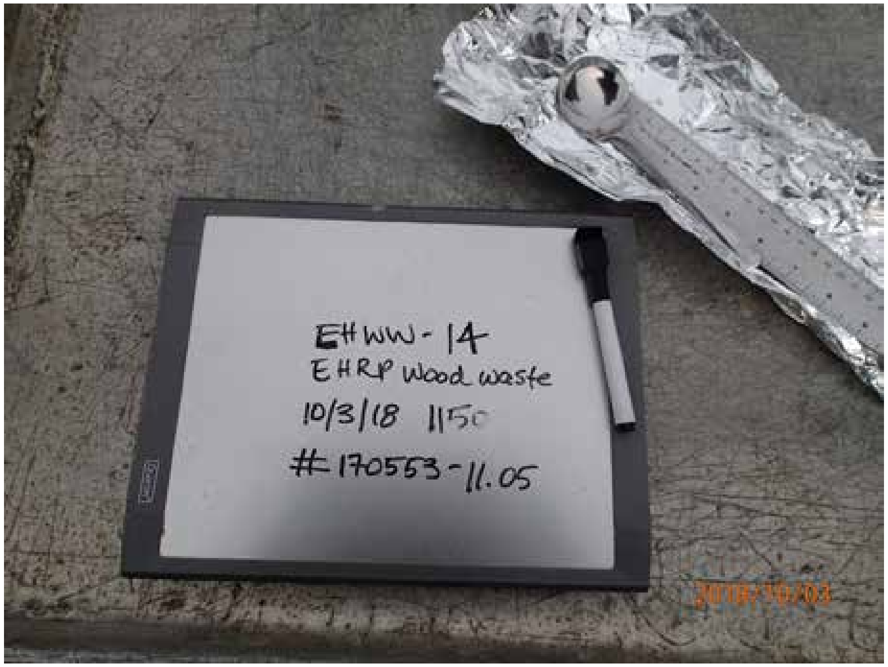

2018/10/04


EHWW-13
EHRP Wood waste
10/3/18 12:27
#170553-11.05
2018/10/03


2018/10/03

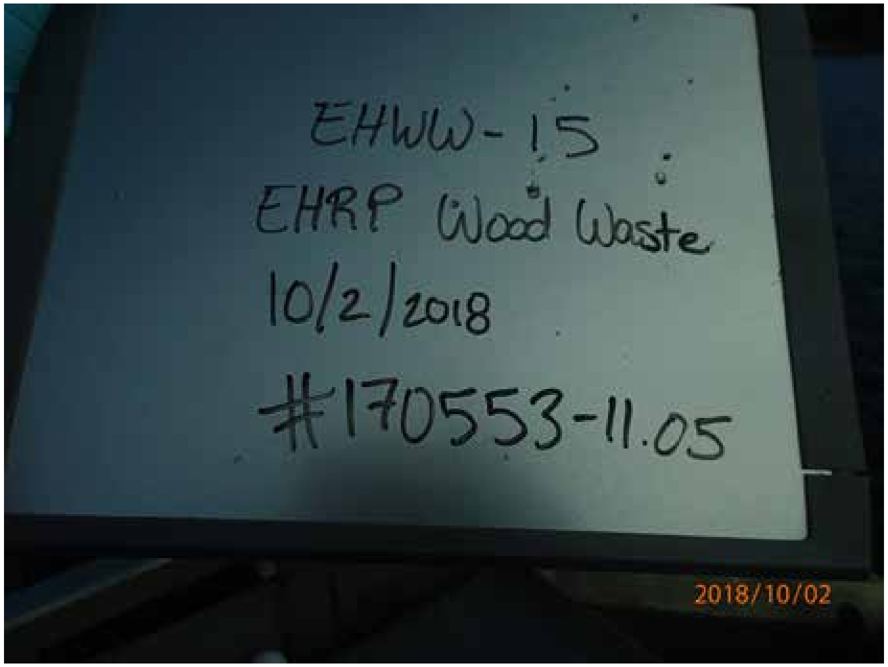

2018/10/03


2018/10/03


EHWW-14
EHRP Wood waste
10/3/18 1150
#170553-11.05
2018/10/03


2018/10/03

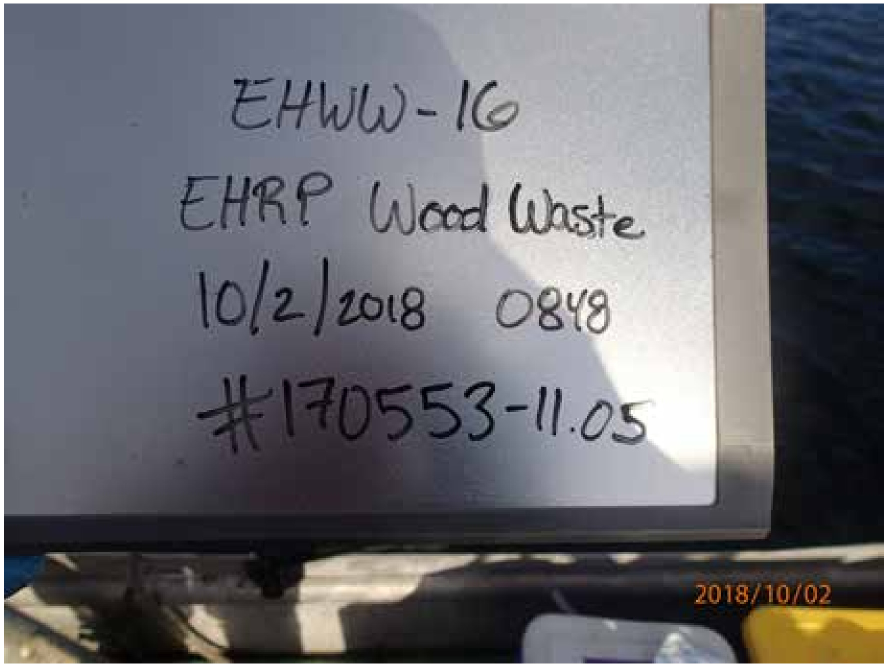

2018/10/03


EHWW-15
EHRP Wood Waste
10/2/2018
#170553-11.05
2018/10/02

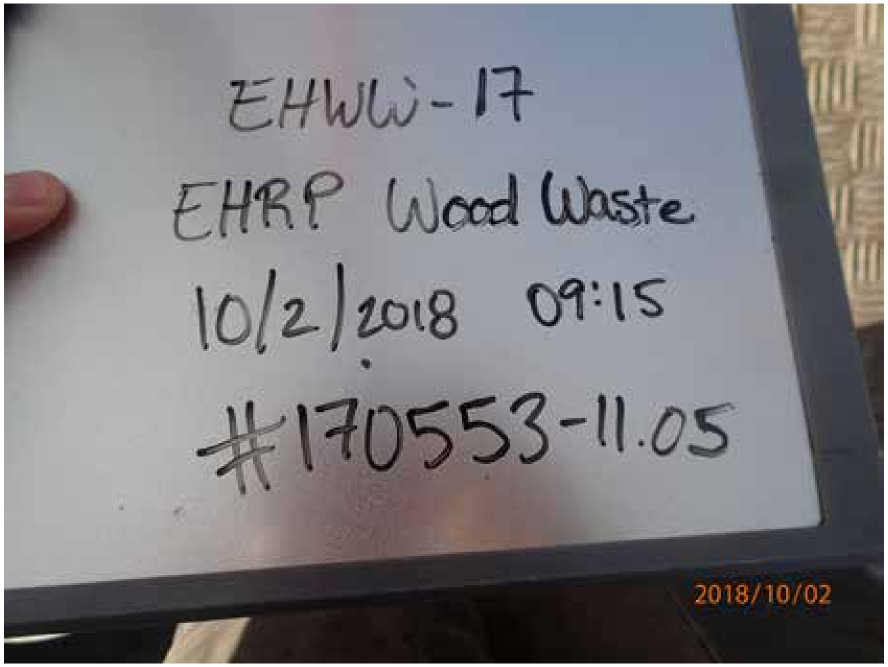

2018/10/02


2018/10/02


2018/10/02

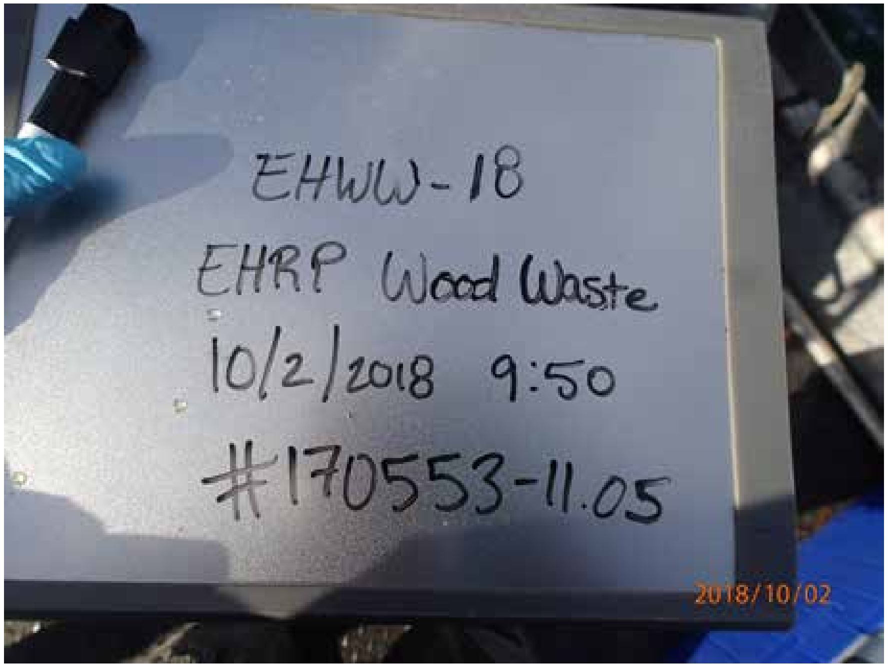

EHWW-16
EHRP Wood Waste
10/2/2018 0848
#170553-11.05
2018/10/02


2018/10/02


EHWW-17
EHRP Wood Waste
10/2/2018 09:15
#170553-11.05
2018/10/02


2018/10/02


2018/10/02

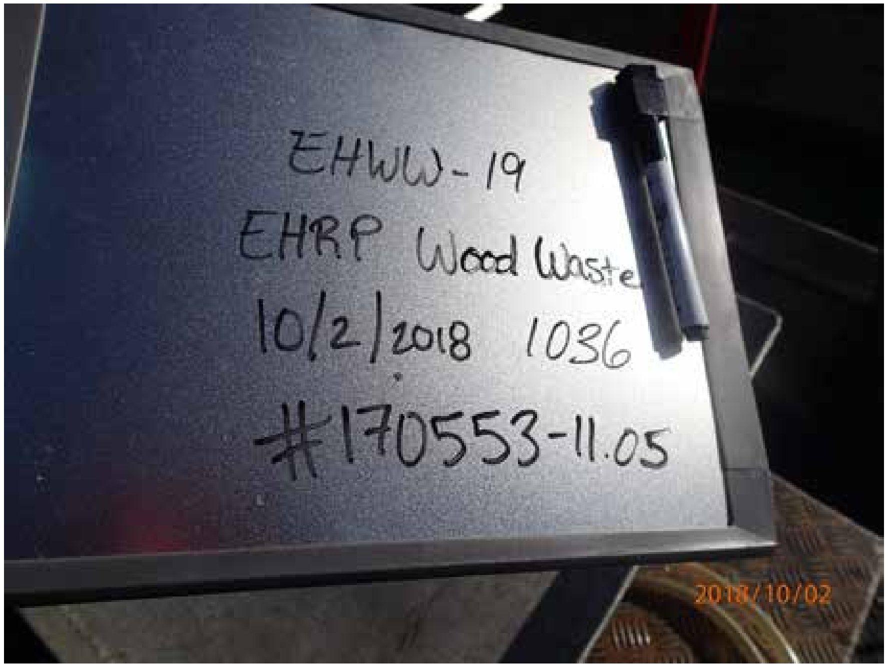

EHWW-18
EHRP Wood Waste
10/2/2018 9:50
#170553-11.05
2018/10/02


2018/10/02


2018/10/02

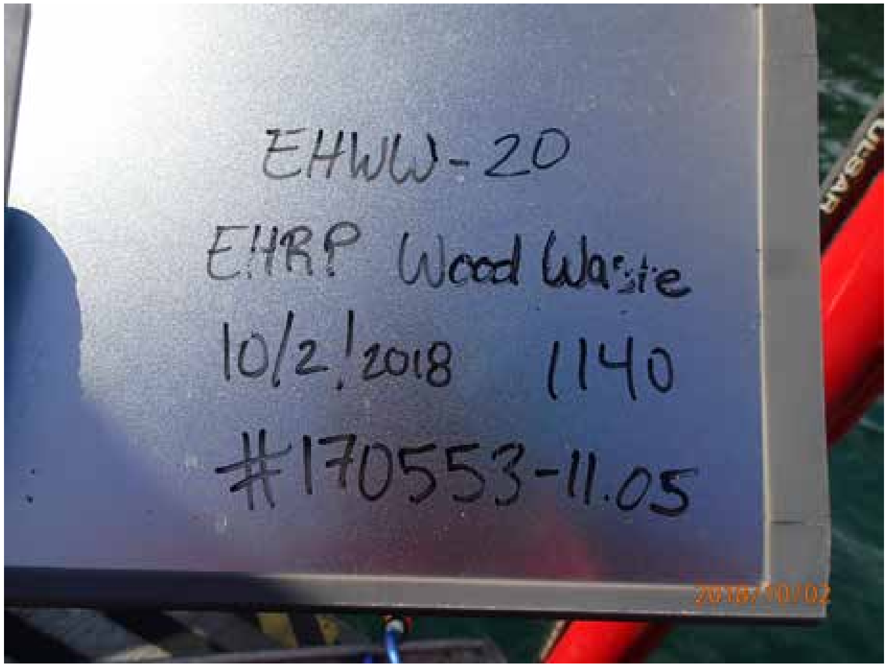

2018/10/02


2018/10/02


EHWW-19
EHRP Wood Waste
10/2/2018 1036
#170553-11.05
2018/10/02


2018/10/02


2018/10/02


EHWW-20
EHRP Wood Waste
10/2/2018 1140
#170553-11.05
2018/10/02


2018/10/02

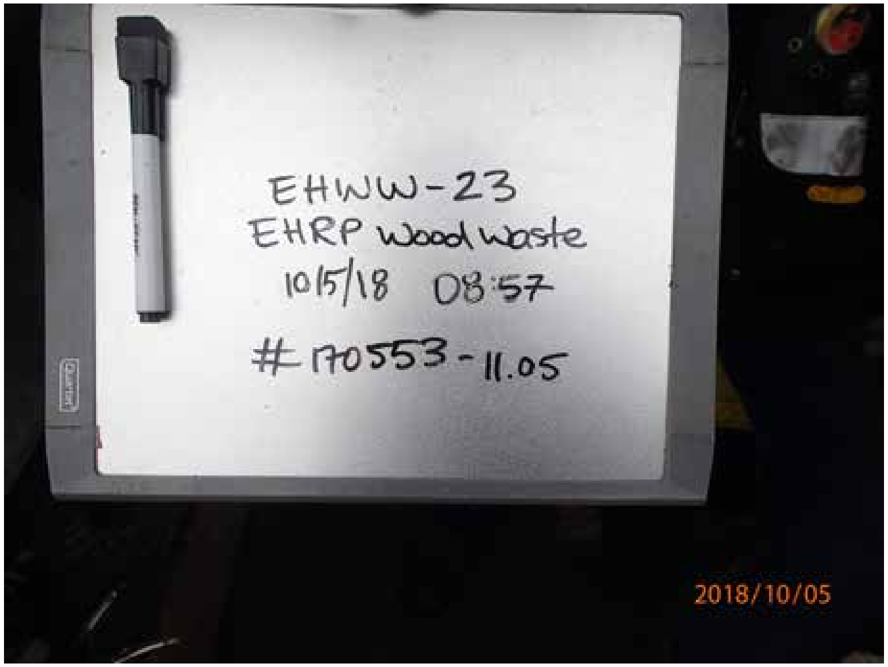

2018/10/02


2018/10/02


EHWW-22
EHRP Wood waste
10/3/18 1446
#170553-11.05
2018/10/03

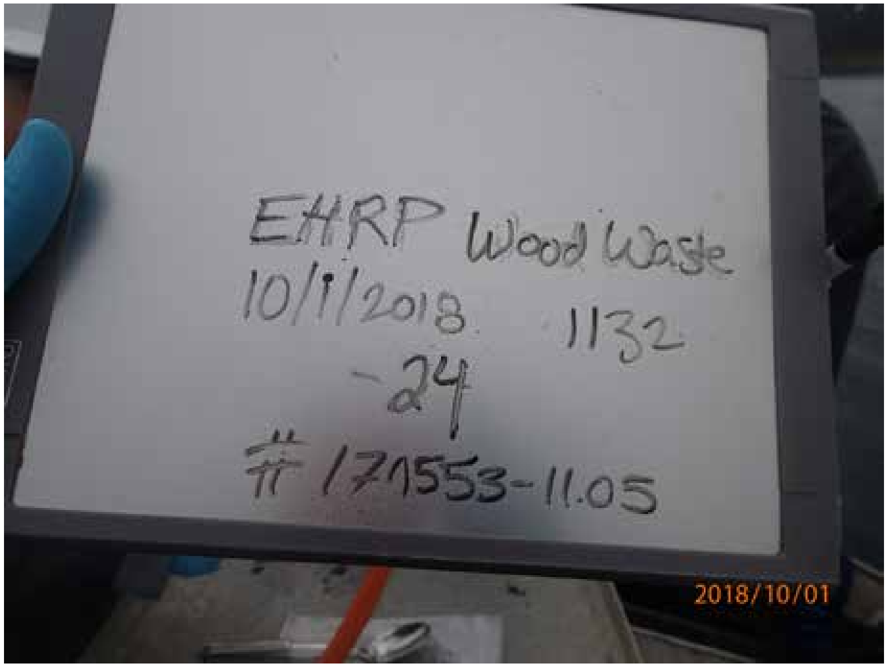

2018/10/03


2018/10/03


EHWW-23
EHRP Wood Waste
10/5/18 08:57
#170553-11.05
2018/10/05


2018/10/05

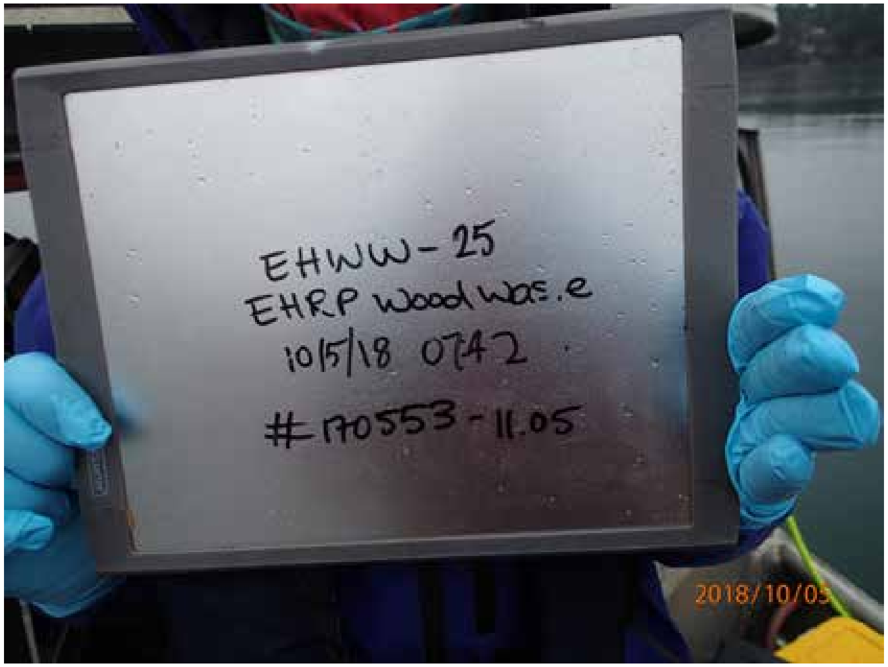

2018/10/05


EHRP Wood Waste
10/1/2018 1132
-24
#171553-11.05
2018/10/01


2018/10/01

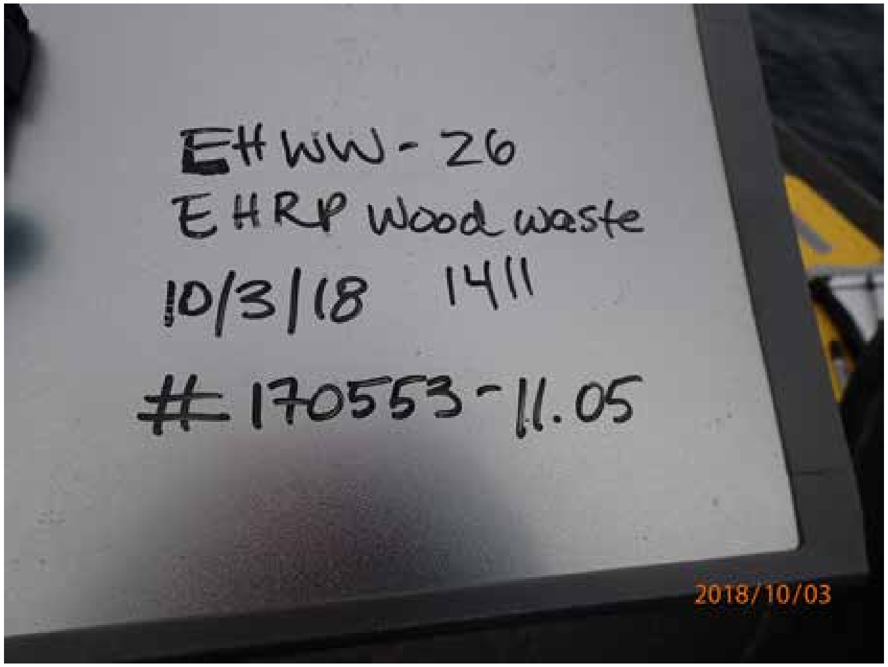

2018/10/01


2018/10/01

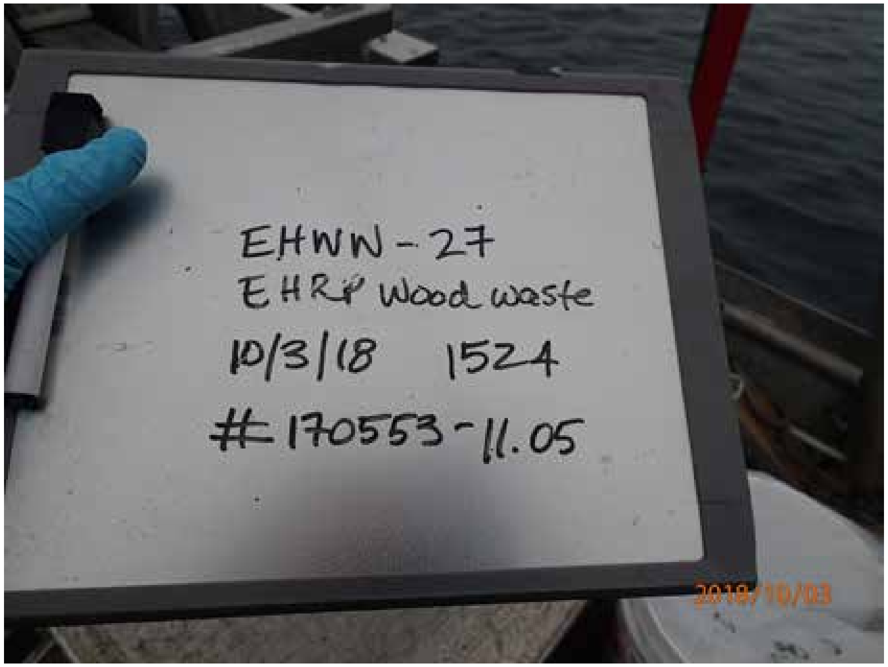
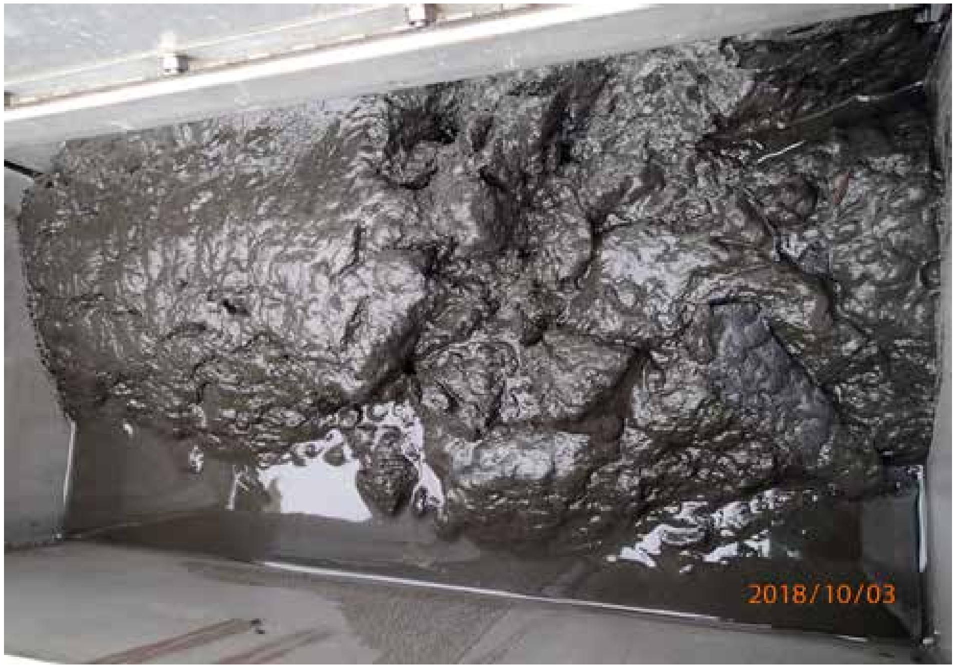

EHWW-25
EHRP Wood Waste
10/5/18 0742
#170553-11.05
2018/10/05


2018/10/05


2018/10/05


EHWW-26
EHRP Wood waste
10/3/18 1411
#170553-11.05
2018/10/03


2018/10/03


EHWW-27
EHRP Wood waste
10/3/18 1524
170553-11.05
2018/10/03

2018/10/03

2018/10/03

2018/10/03

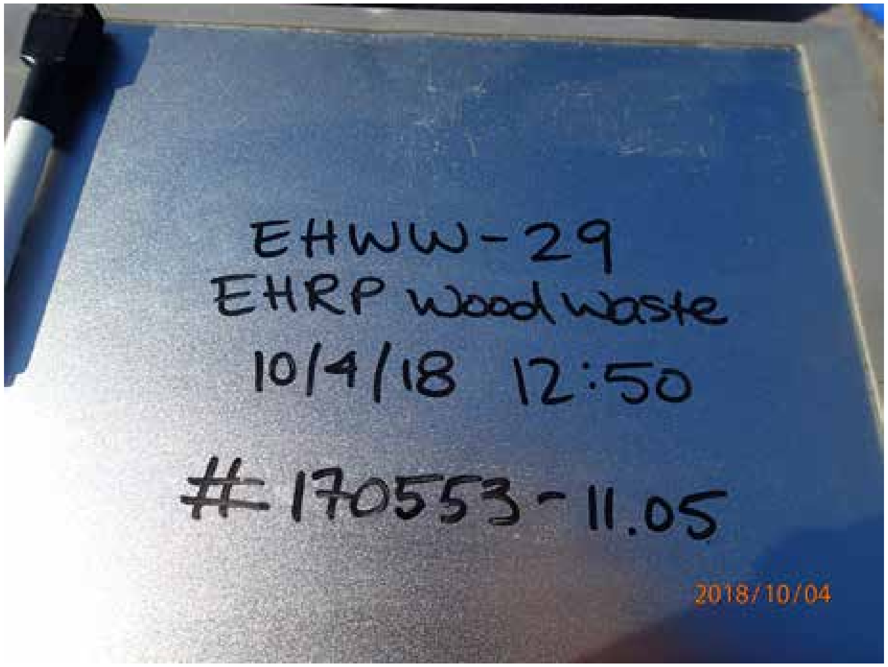

2018/10/03


2018/10/03


EHWW-28
EHRP Wood waste
10/4/18 11:47
170553-11.05
2018/10/04


2018/10/04


2018/10/04

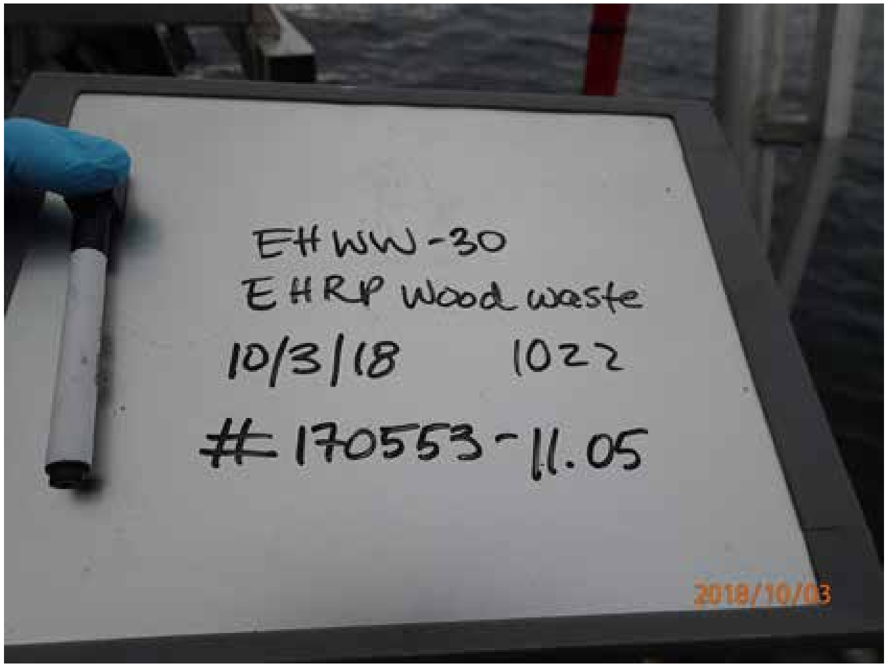

EHWW-29
EHRP Wood Waste
10/4/18 12:50
#170553-11.05
2018/10/04

2018/10/04

2018/10/04

2018/10/04


2018/10/04


EHWW-30
EHRP Wood waste
10/3/18 1022
170553-11.05
2018/10/03

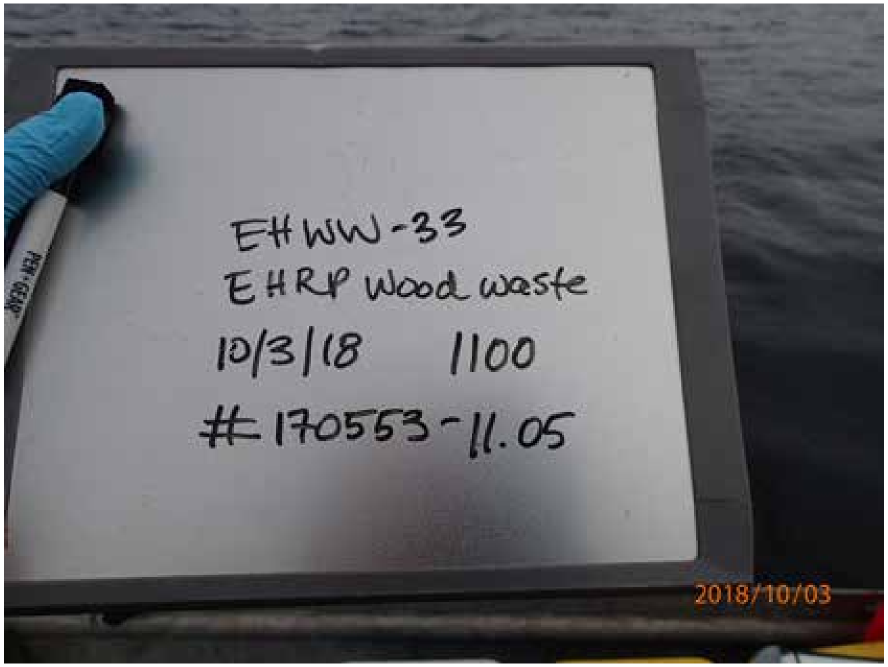

2018/10/03


2018/10/03


EHWW-32
EHRP Wood Was.e
10/4/18 15:58
#170553-11.05
2018/10/04

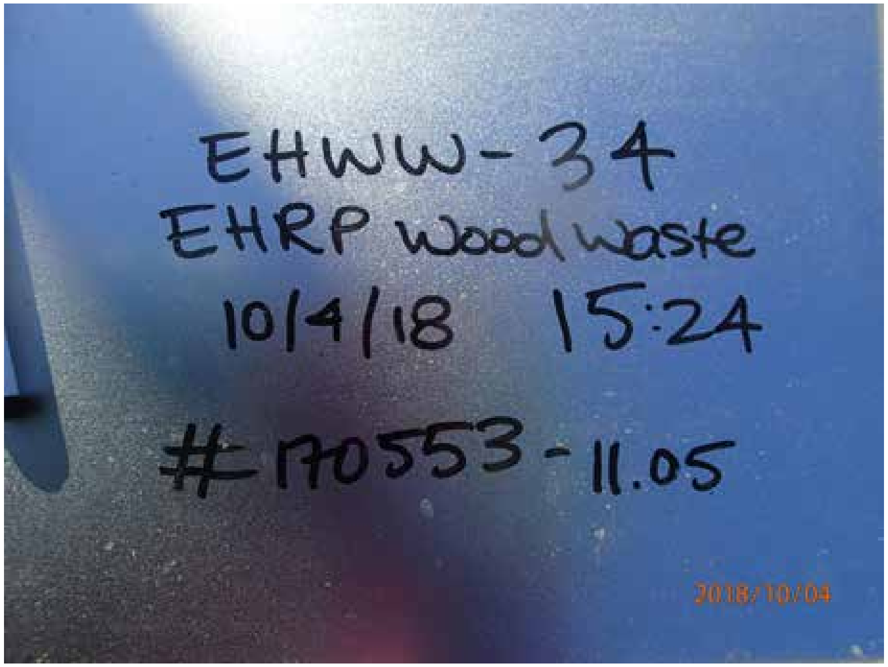

2018/10/04

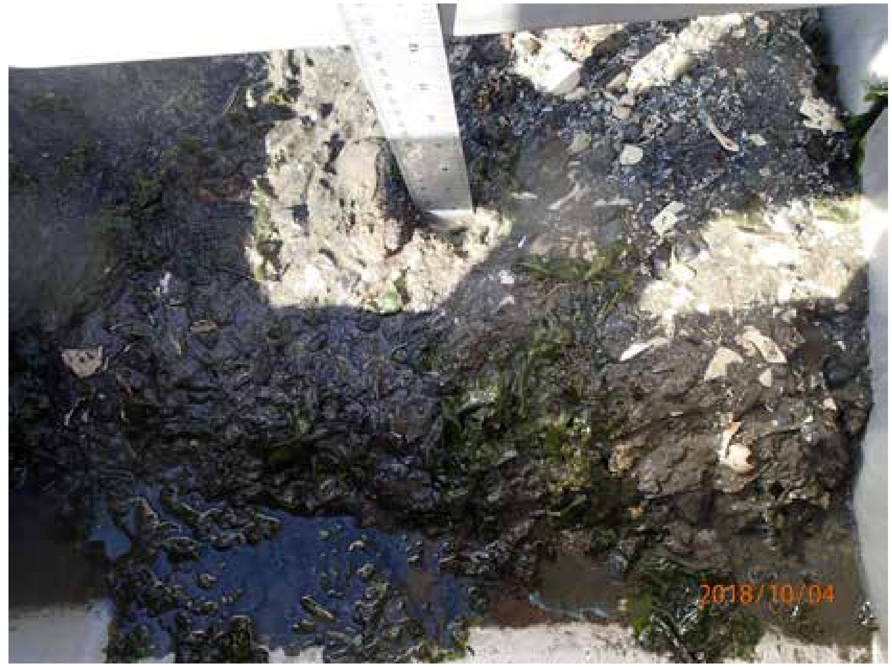

2018/10/04


EHWW-33
EHRP Wood waste
10/3/18 1100
#170553-11.05
2018/10/03


2018/10/03


2018/10/03

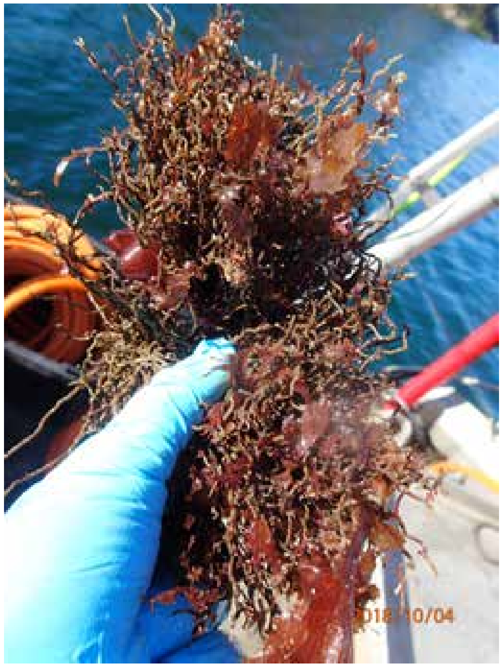

EHWW-34
EHRP Wood Waste
10/4/18 15:24
#170553-11.05
2018/10/04


2018/10/04


2018/10/04


EHWW-35
EHRP Wood waste
10/4/18 14:43
#170553-11.05
2018/10/04

2018/10/04

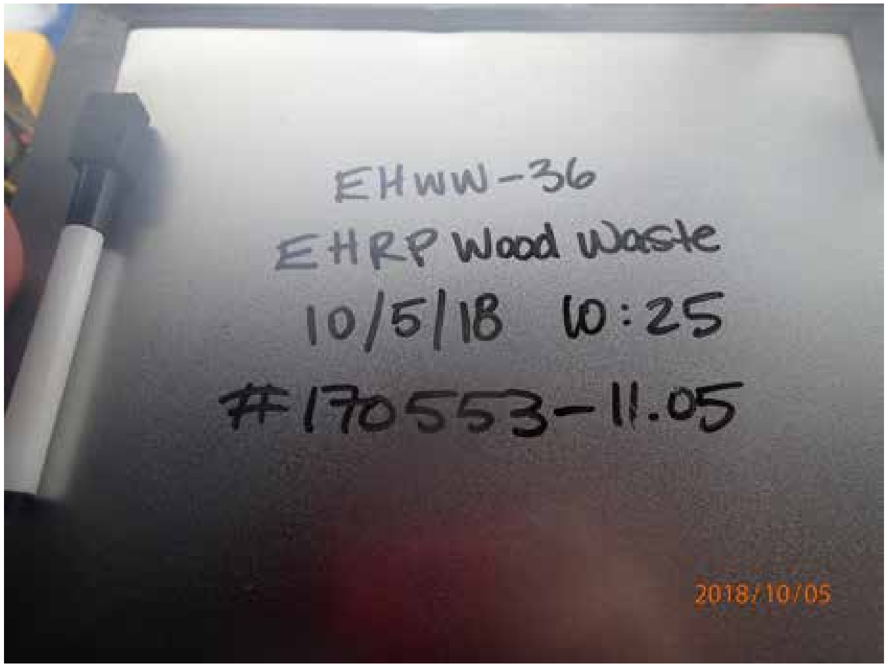
2018/10/04



2018/10/04

2018/10/04

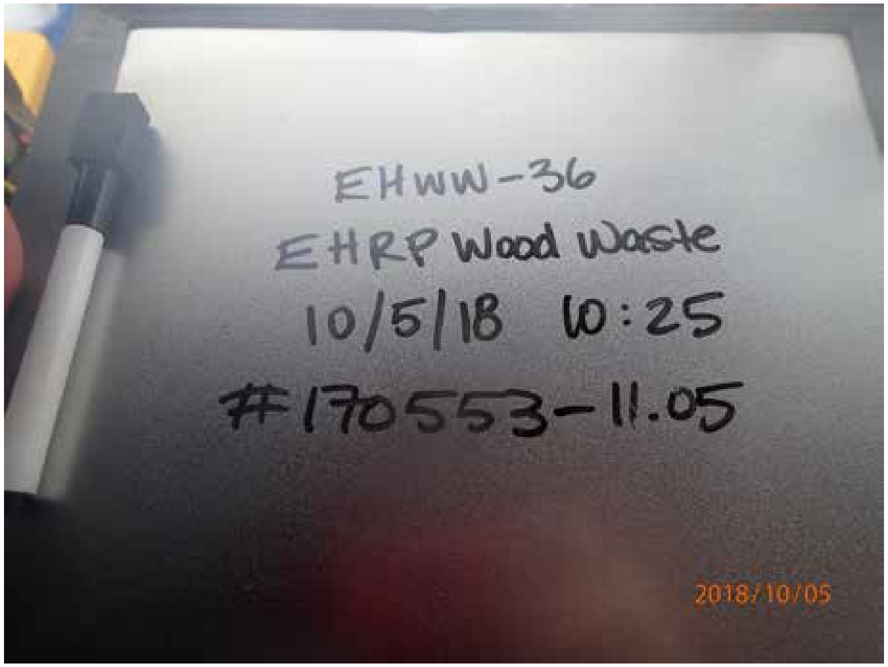
2018/10/04

2018/10/04


EHWW-36
EHRP Wood Waste
10/5/18 10:25
#170553-11.05
2018/10/05

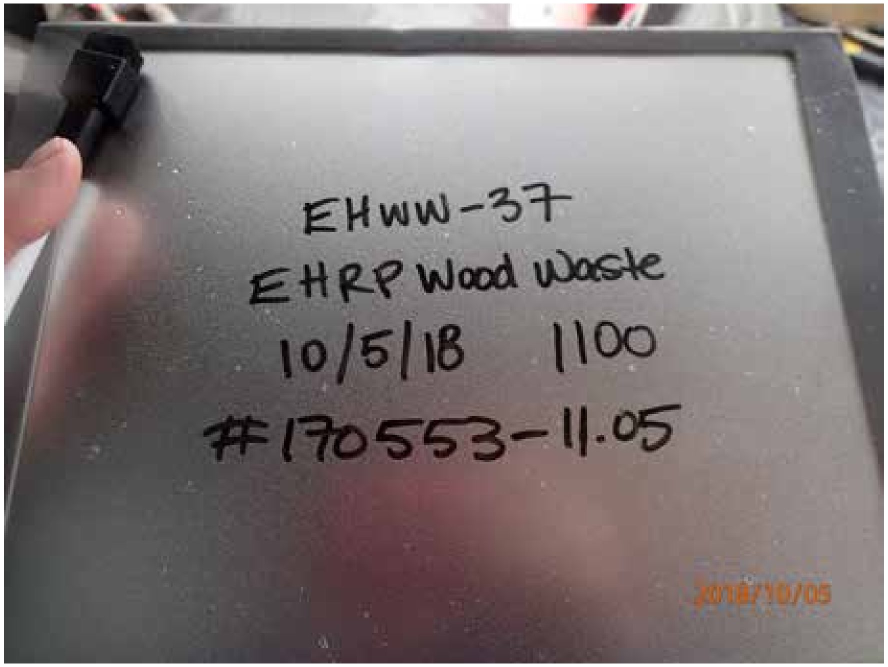

2018/10/05


2018/10/05


EHWW-36
EHRP Wood Waste
10/5/18 10:25
#170553-11.05
2018/10/05

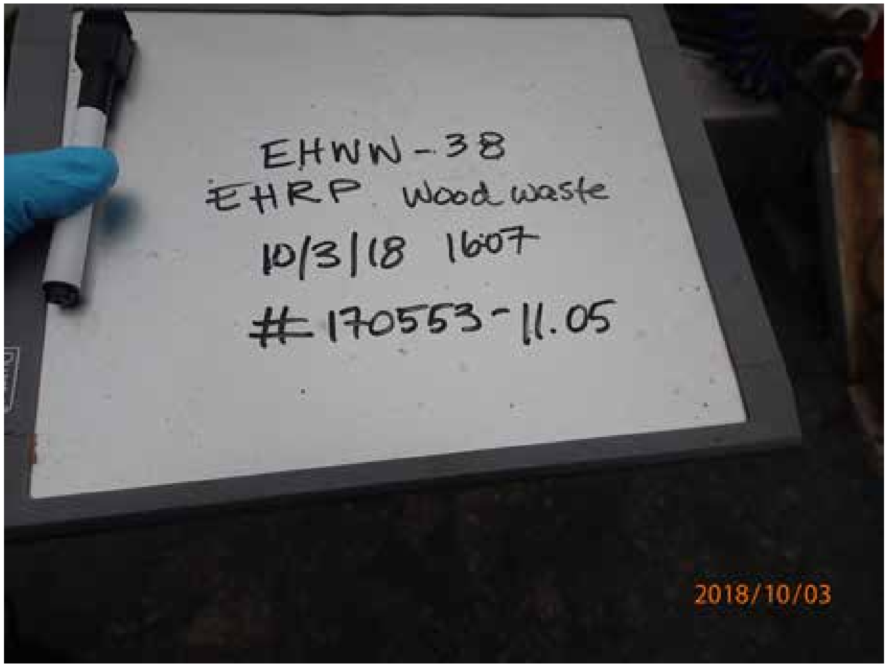

2018/10/05


2018/10/05


EHWW-37
EHRP Wood Waste
10/5/18 1100
#170553-11.05
2018/10/05

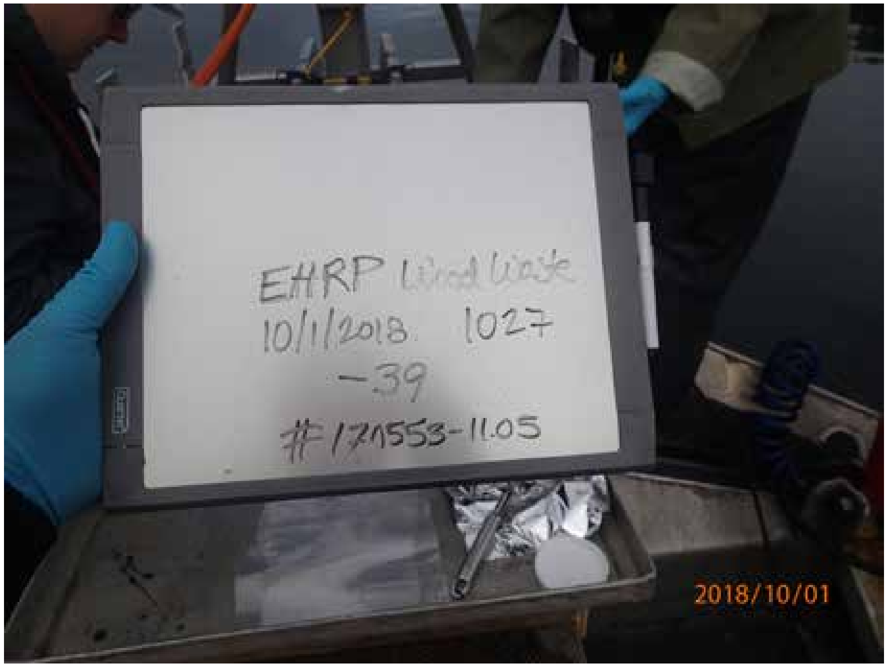

2018/10/05

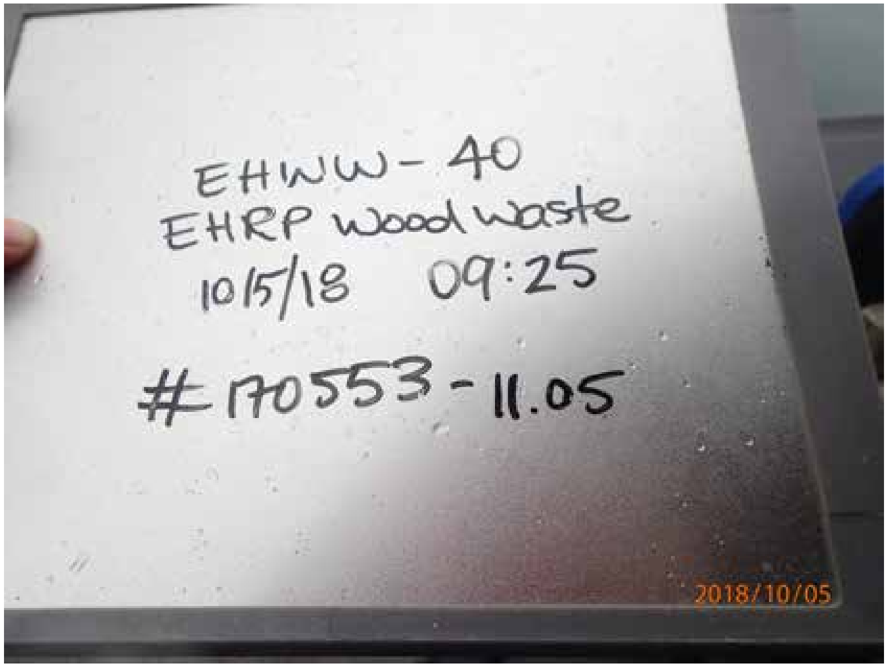

2018/10/05


EHWW-38
EHRP Wood waste
10/3/18 1607
#170553-11.05
2018/10/03


2018/10/03

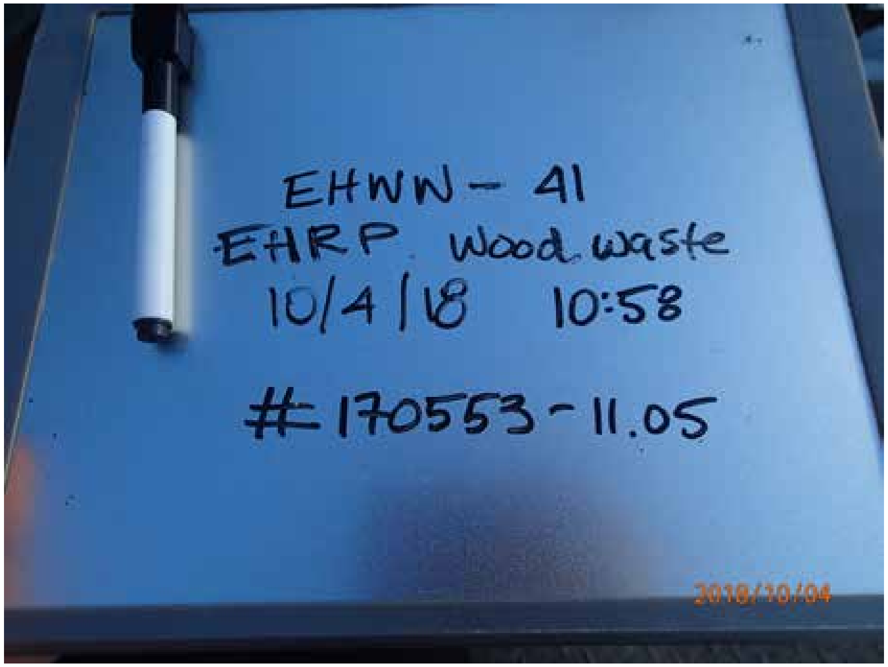

2018/10/03


EHRP Wood Waste
10/1/2018 1027
-39
#171553-11.05
2018/10/01


EHWW-40
EHRP Wood waste
10/5/18 09:25
#170553-11.05
2018/10/05


2018/10/05


2018/10/05


EHWW-41
EHRP Wood waste
10/4/18 10:58
#170553-11.05
2018/10/04

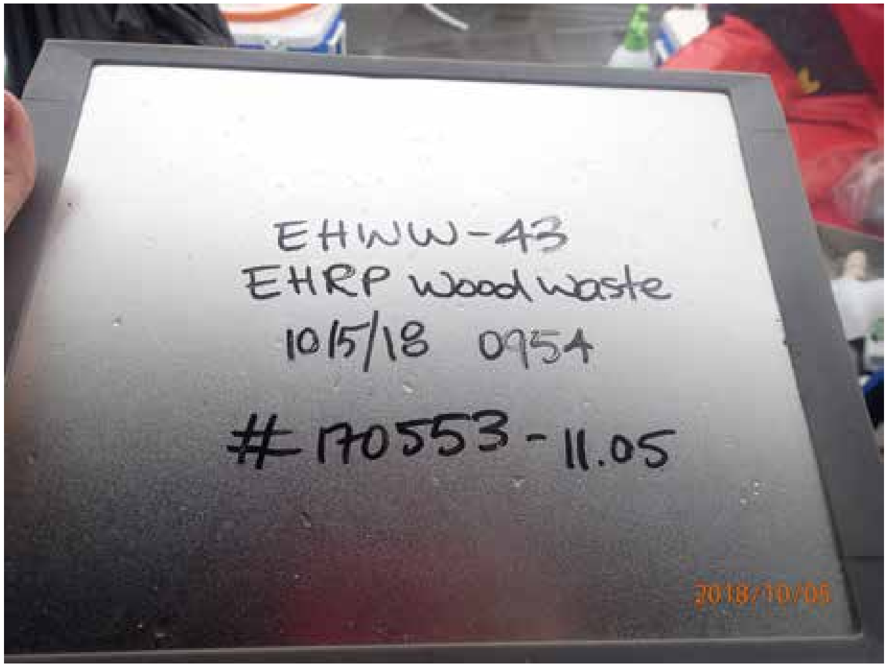

2018/10/04


2018/10/04


EHWW- 42
EHRP WOOD WASTE
10/2/2018 12:34
#170553-11.05
2018/10/02

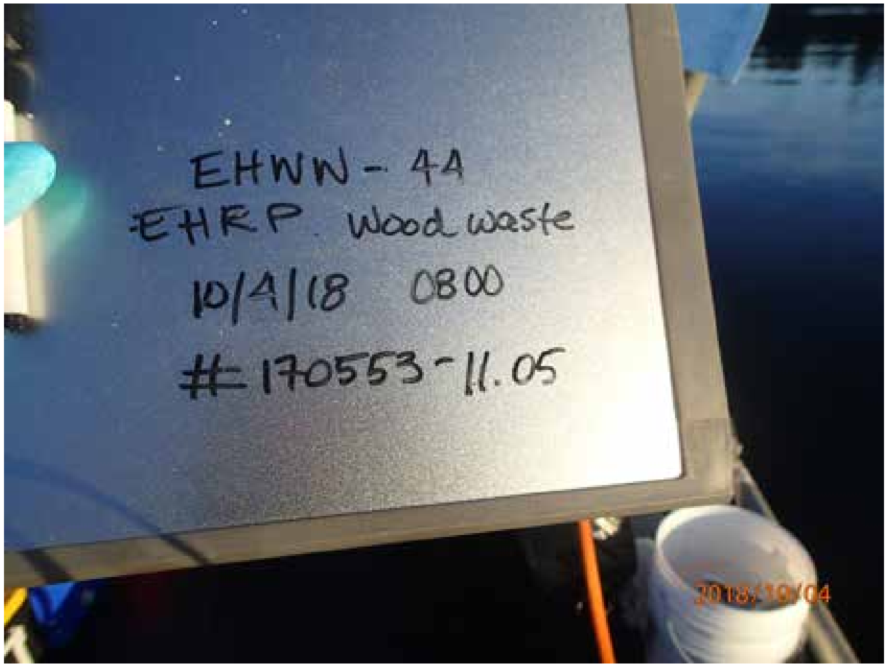

2018/10/02


2018/10/02


EHWW-43
EHRP Wood waste
10/5/18 0954
#170553-11.05
2018/10/05


2018/10/05

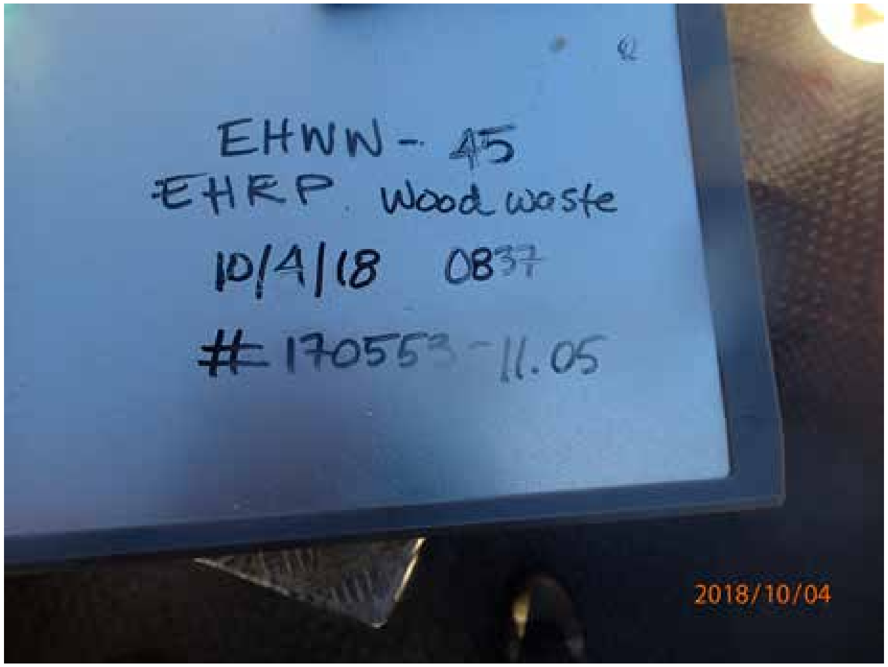

2018/10/05


EHWW-44
EHRP Wood waste
10/4/18 0800
#170553-11.05
2018/10/04


2018/10/04

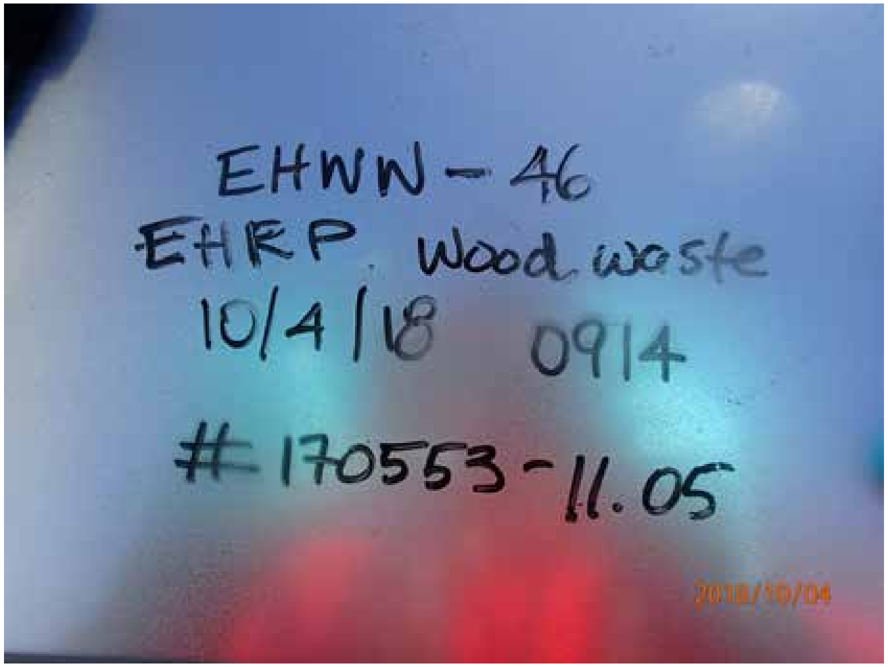

2018/10/04


2018/10/04


EHWN-45
EHRP Wood waste
10/4/18 0837
#170553-11.05
2018/10/04


2018/10/04

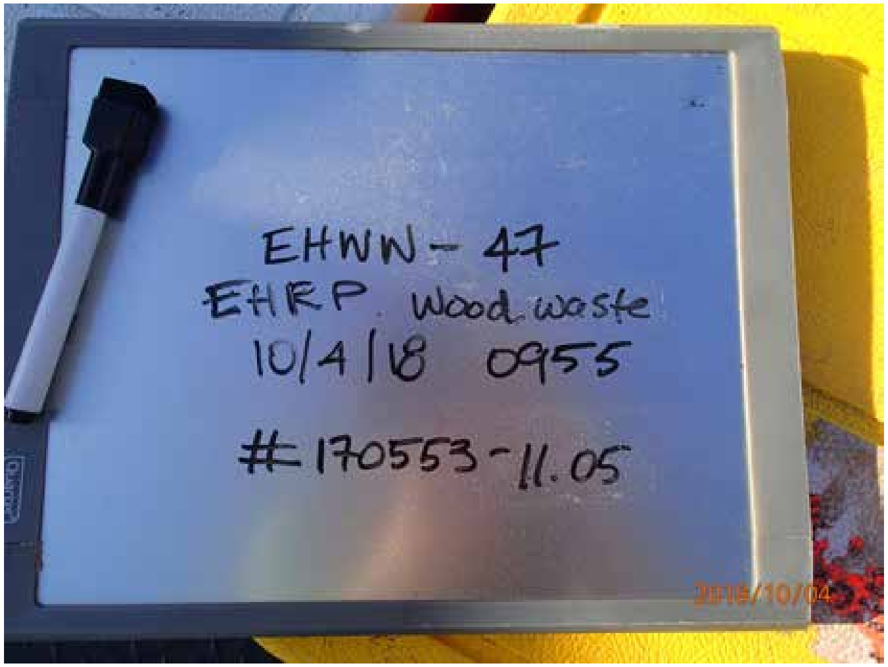

2018/10/04


EHWW-46
EHRP Wood waste
10/4/18 0914
#170553-11.05
2018/10/04


2018/10/04

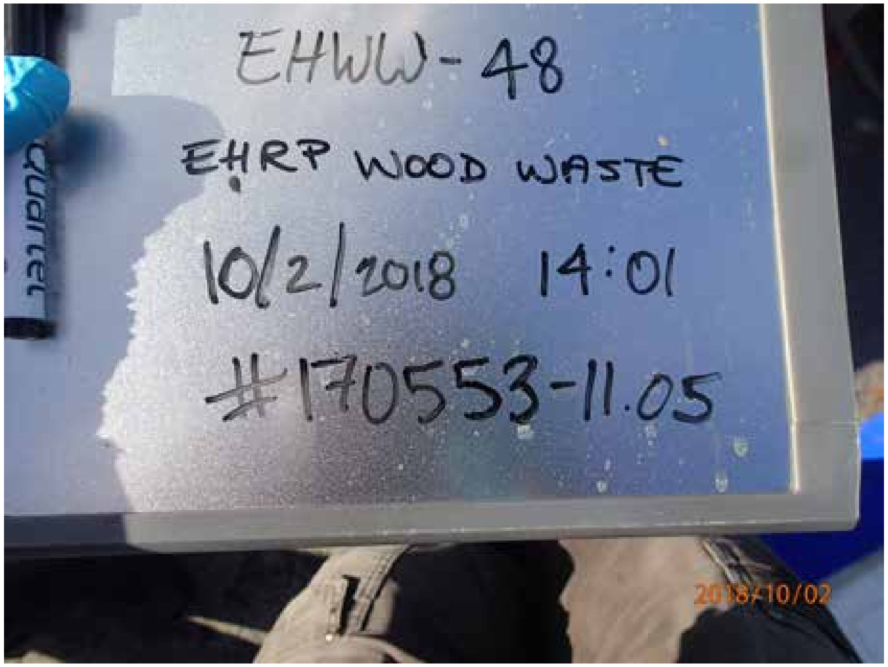

2018/10/04


2018/10/04


EHWW-47
EHRP Wood waste
10/4/18 0955
#170553-11.05
2018/10/04


2018/10/04

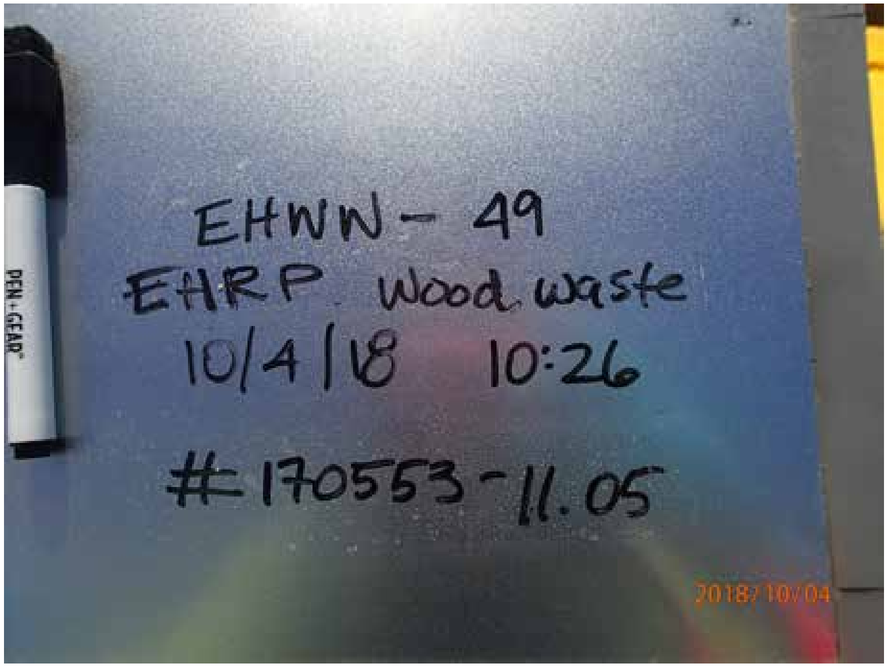

2018/10/04


EHWW-48
EHRP WOOD WASTE
10/2/2018 14:01
#170553-11.05
2018/10/02


2018/10/02


2018/10/02

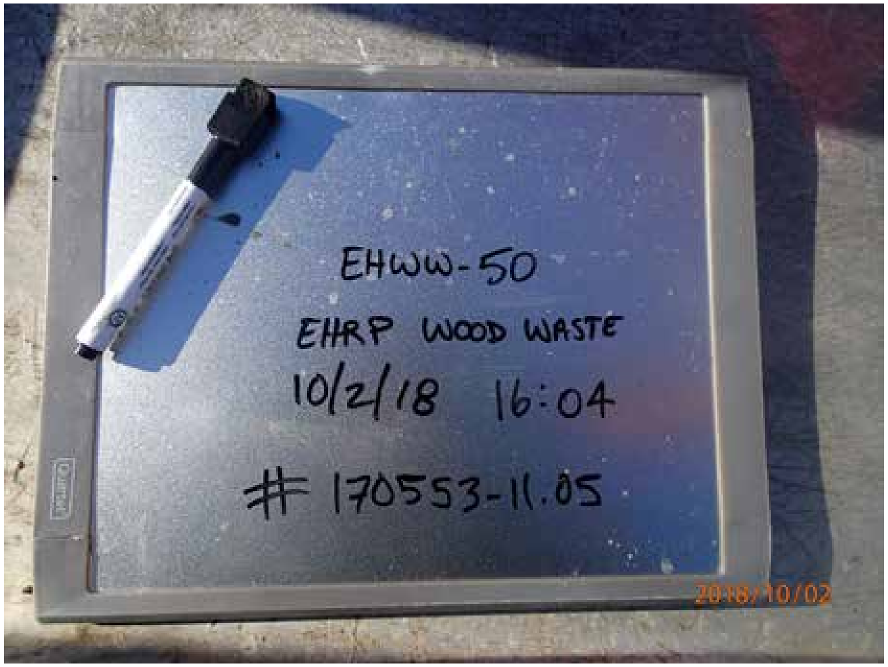

2018/10/02


EHWN- 49
EHRP Wood waste
10/4/18 10:26
#170553-11.05
2018/10/04


2018/10/04

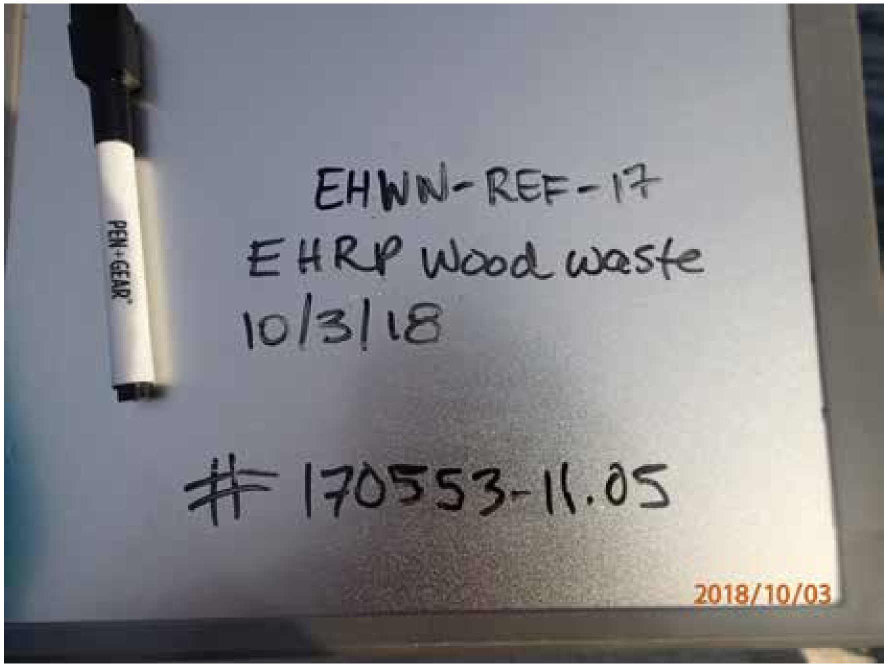

2018/10/04


2018/10/04


EHWW-50
EHRP WOOD WASTE
10/2/18 16:04
170553-11.05
2018/10/02


2018/10/02


2018/10/02


EHWW-REF-17
EHRP Wood waste
10/3/18
170553-11.05
2018/10/03


2018/10/03

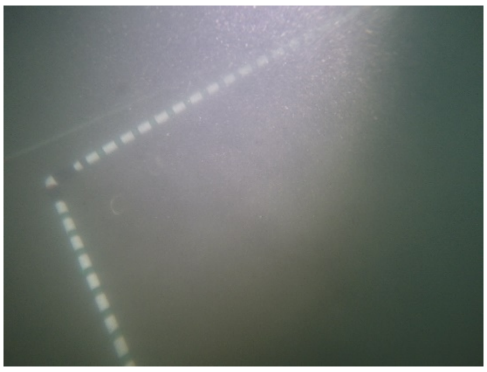
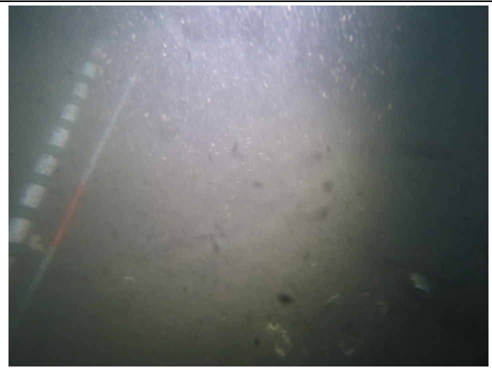
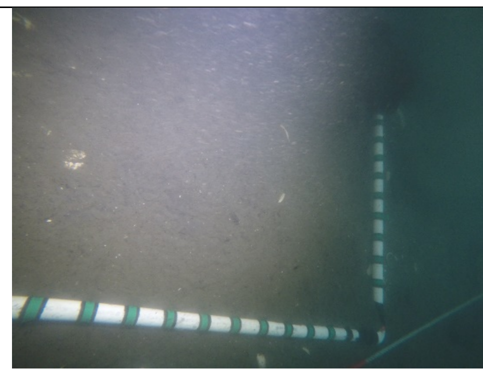
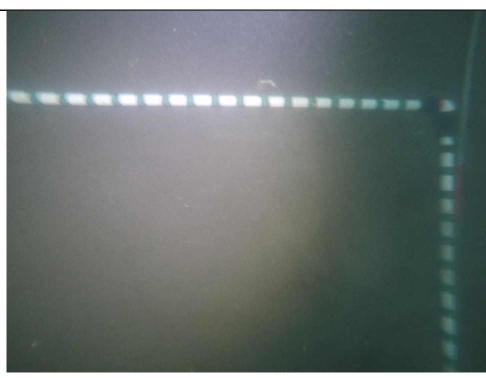
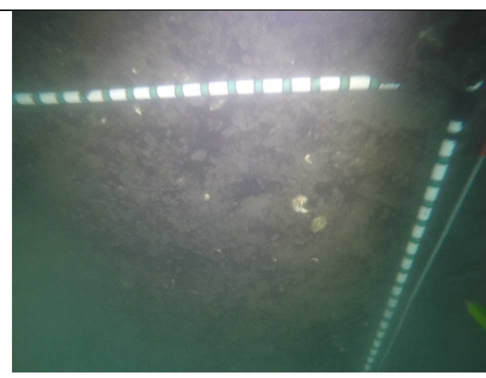
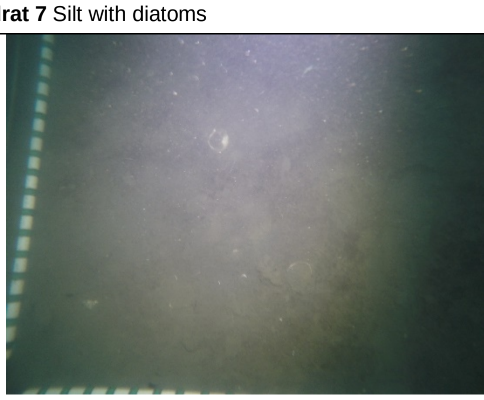

2018/10/03

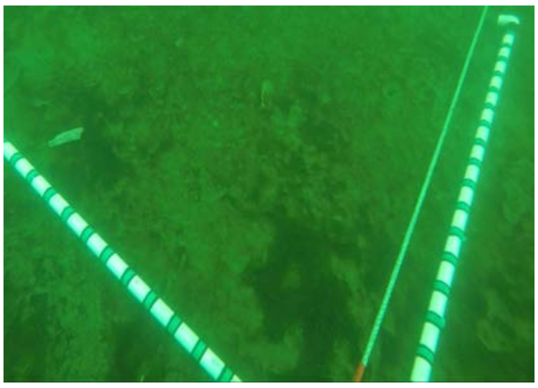
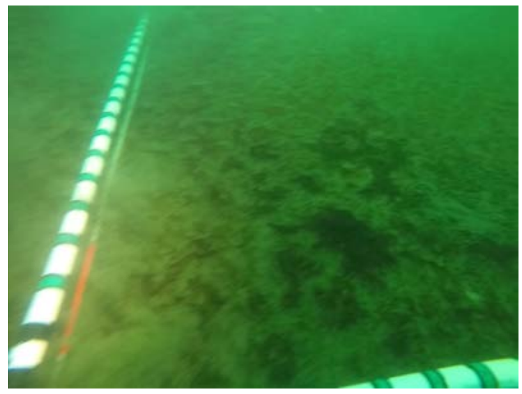
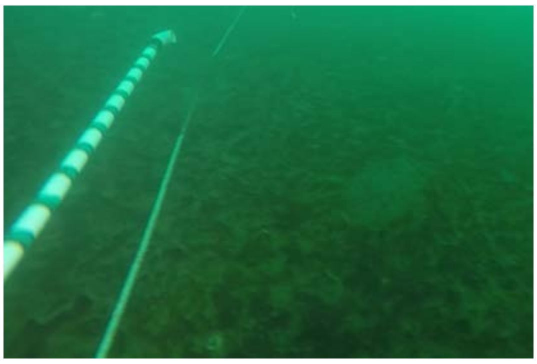
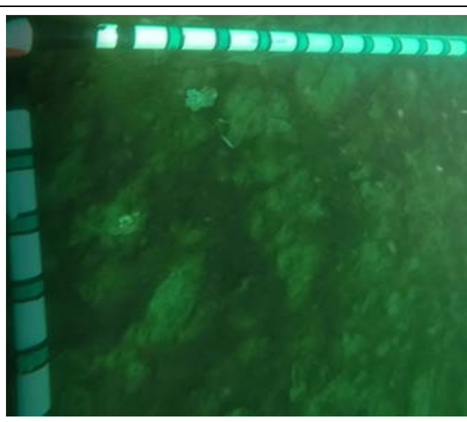
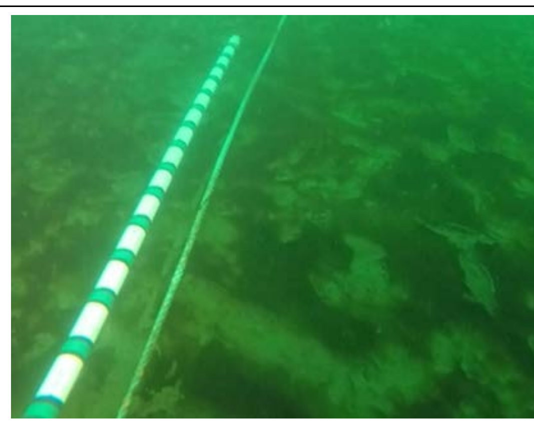
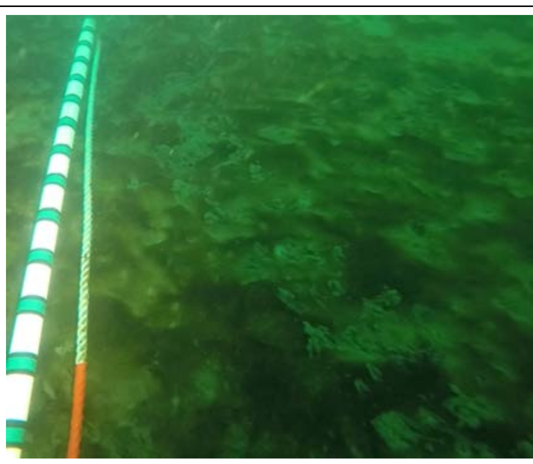
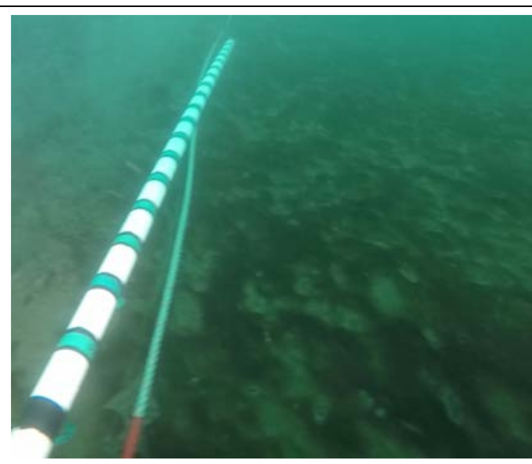
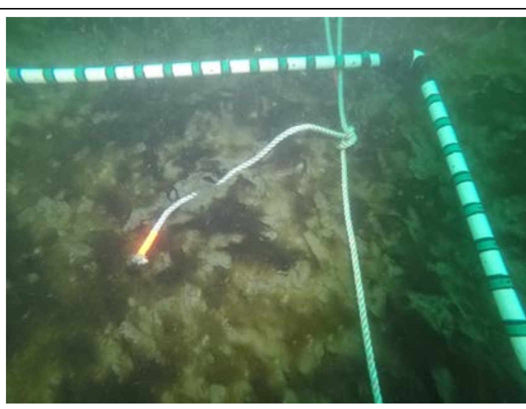
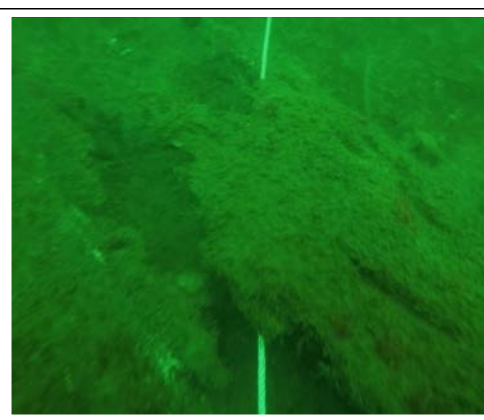

EHWN-REF-18
EHRP Wood waste
10/3/18 0845
170553-11.05
2018/10/03

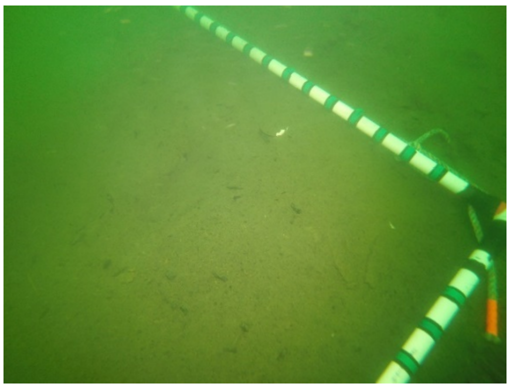

2018/10/03


2018/10/03

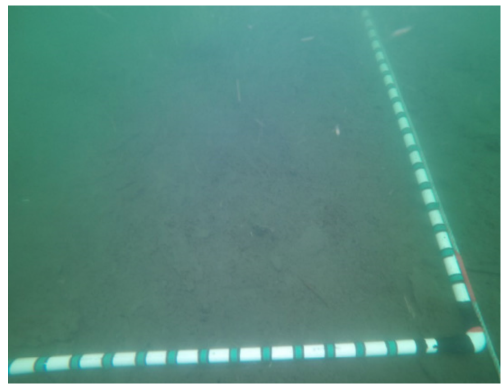
Diver Survey Photographs

 **Quadrat 1** Silt with trace shell	 **Quadrat 2** Silt with trace shell
Quadrat 3 No photo	**Quadrat 4** No photo
Quadrat 5 No photo	 **Quadrat 6** Silt with trace shell and minor diatom
 **Quadrat 7** Silt with diatoms	 **Quadrat 8** Silt with trace shell and 90% diatom
 **Quadrat 9** Silt with diatoms	
Transect 59; December 17 2018; 09:03 – 09:52	

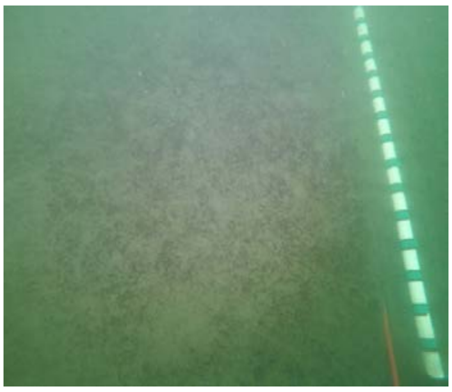
 **Quadrat 1** Silt with diatoms	 **Quadrat 2** Silt with diatoms
 **Quadrat 3** Silt with diatoms	 **Quadrat 4** Silt with diatoms
 **Quadrat 5** Silt with diatoms	 **Quadrat 6** Silt with diatoms
 **Quadrat 7** Silt with diatoms	 **Quadrat 8** Silt with diatoms
 **Quadrat 9** Silt with diatoms	 **Incidental** View of cut log between Q1 and Q2, closer to Q1
Transect 60; December 18 2018; 11:16 – 12:20	



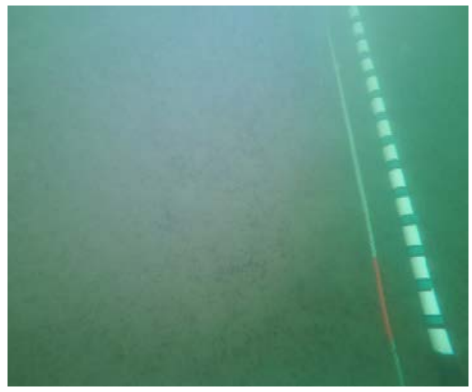
Quadrat 1 Silt with some bark/larger wood fragments



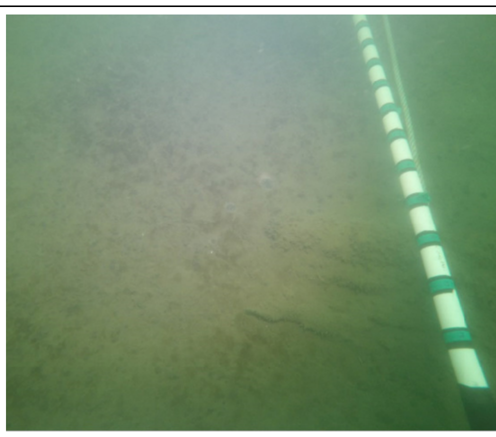
Quadrat 2 Silt with bark



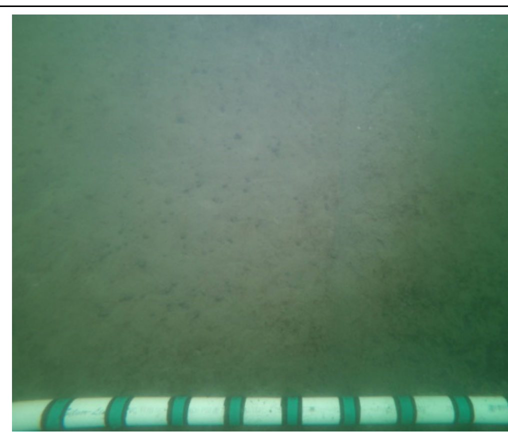
Quadrat 3 Silt with diatoms



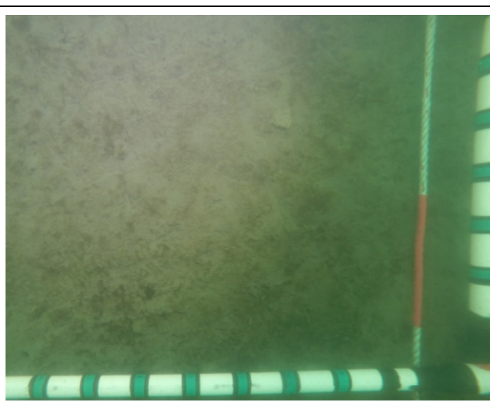
Quadrat 4 Silt with diatoms



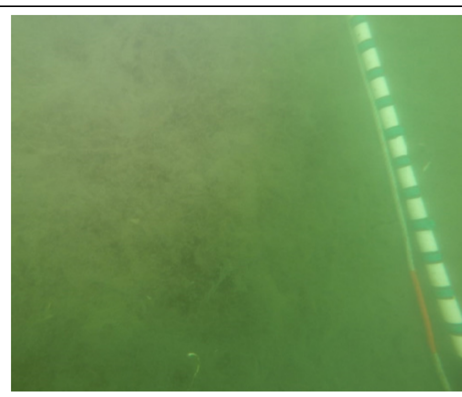
Quadrat 5 Silt with bark/submerged log



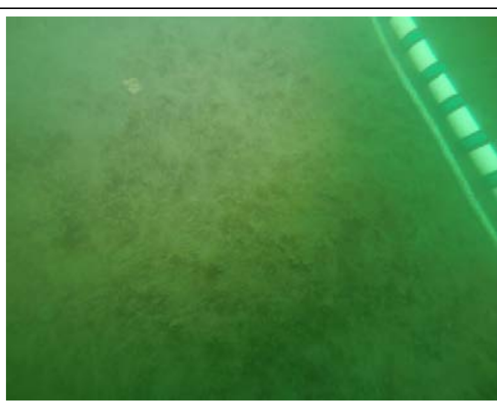
Quadrat 6 Bare with trace diatoms



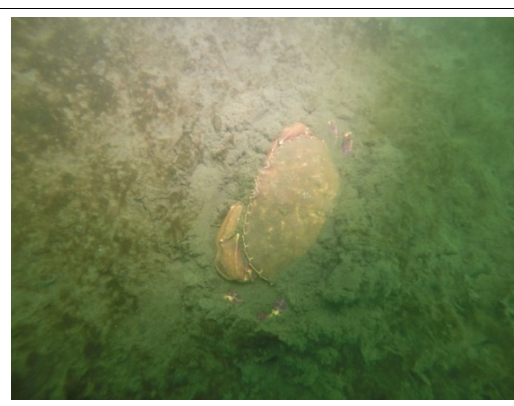
Quadrat 7 Silt with trace diatoms



Quadrat 8 Silt with bark and trace diatoms



Quadrat 9 Silt with diatoms



Incidental Graceful crab (*Metacarcinus gracilis*) in silt substrate with Diatomaceous mat

Transect 61; December 19 2018; 11:31 – 12:25

Quadrat 1 Bare silt

Quadrat 2 Bare silt

Quadrat 3 Bare silt

Quadrat 4 Bare silt

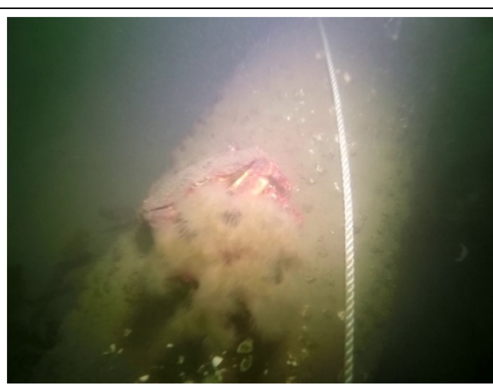
Quadrat 5 Silt with trace diatoms

Quadrat 6 Bare silt

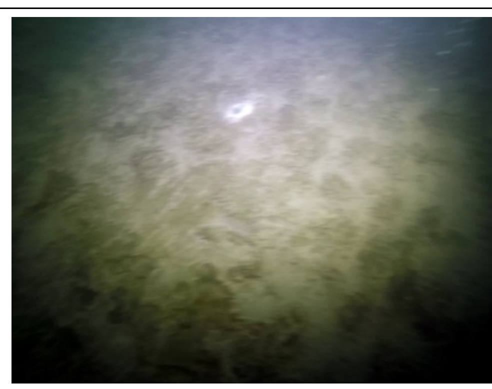
Quadrat 7 Silt with diatoms

Quadrat 8 No Photo

Quadrat 9 No Photo



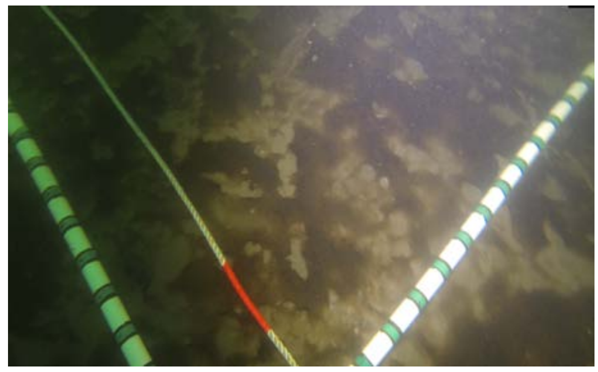
Incidental Graceful crab and giant plumose anemone (*Metridium farcimen*) observed log between Q3 and Q4



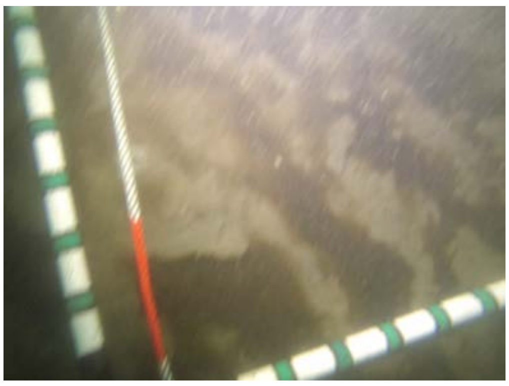
Incidental Small amount of *Beggiatoa* spp. observed among patchy diatomaceous mat.

Transect 62; December 19 2018; 09:10 – 09:51

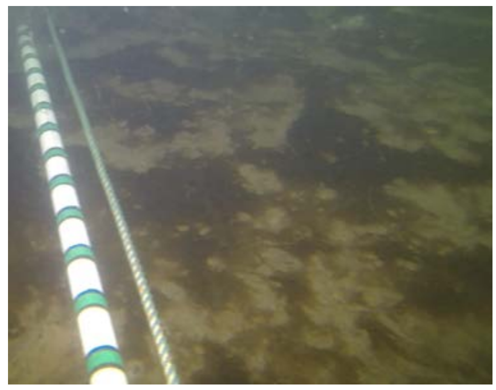
Quadrat 1 Silt with diatoms



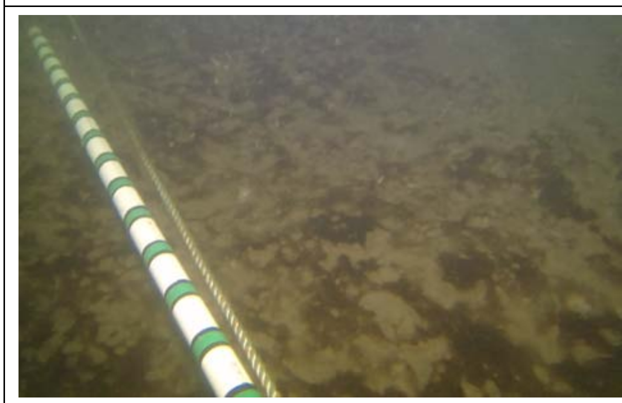
Quadrat 2 Silt with diatoms



Quadrat 3 Silt with diatoms

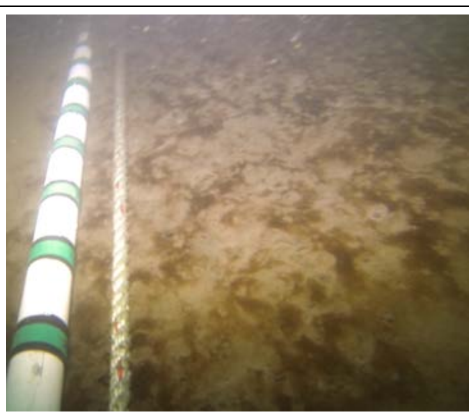


Quadrat 4 Silt with diatoms and trace *Beggiatoa spp.*

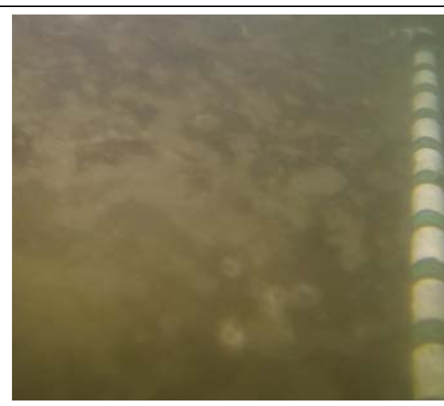


Quadrat 5 Silt with diatoms and trace *Beggiatoa spp.*

Quadrat 6 Silt with diatoms and trace *Beggiatoa spp.*



Quadrat 7 Silt with diatoms and trace *Beggiatoa spp.*



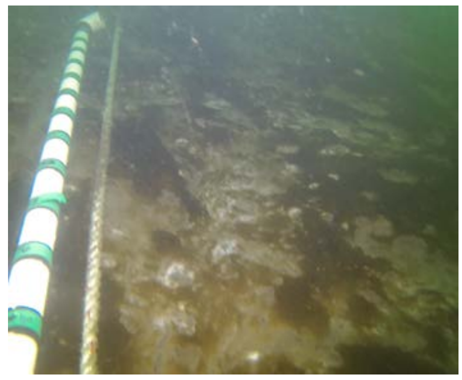
Quadrat 8 Silt with diatoms

Quadrat 9 No Photo

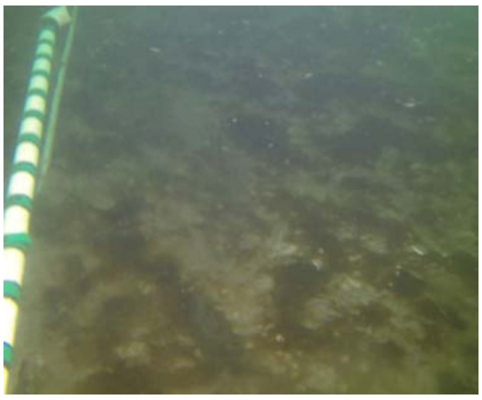
Incidental Log between Q6 and Q7

Transect 64; December 19 2018; 15:17 – 15:54

Quadrat 1 No Photo

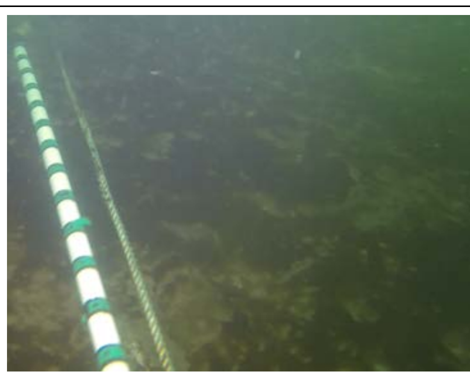


Quadrat 2 Silt with diatoms and *Beggiatoa spp.*



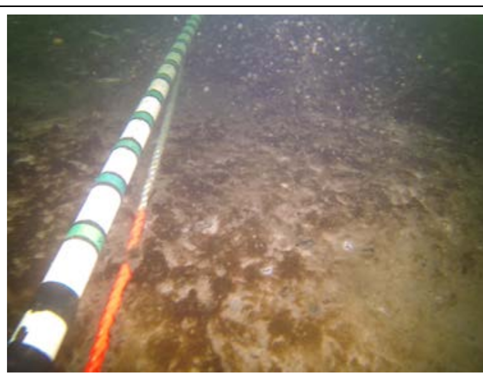
Quadrat 3 Silt with diatoms and trace *Beggiatoa spp.*

Quadrat 4 Silt with diatoms and trace *Beggiatoa spp.*

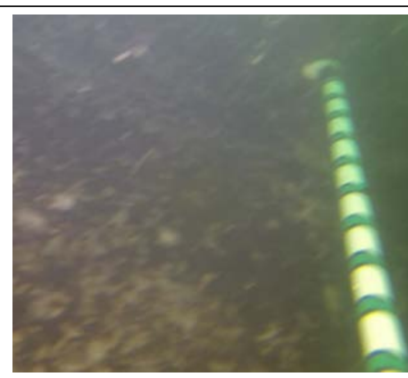


Quadrat 5 Silt with diatoms and trace *Beggiatoa spp.*

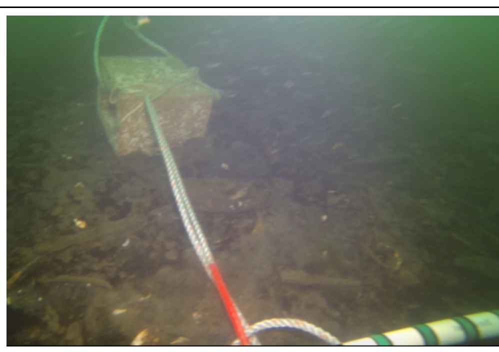
Quadrat 6 Silt with diatoms and trace *Beggiatoa spp.* near submerged log



Quadrat 7 Silt with diatoms and trace *Beggiatoa spp.*

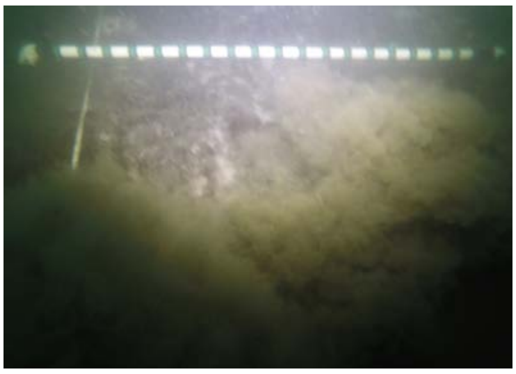


Quadrat 8 Silt with diatoms



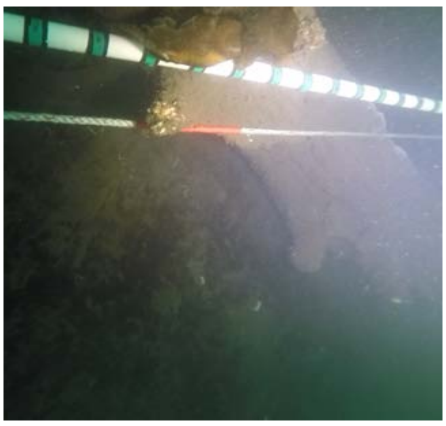
Quadrat 9 Silt with bark/larger wood fragments and diatoms

Transect 65; December 19 2018; 13:41 – 14:22



Quadrat 1 Silt with diatoms and *Beggiatoa spp.*

Quadrat 2 Silt with diatoms and trace bark



Quadrat 3 Silt with bark and submerged log

Quadrat 4 Silt and boulder with bark and small wood fragments

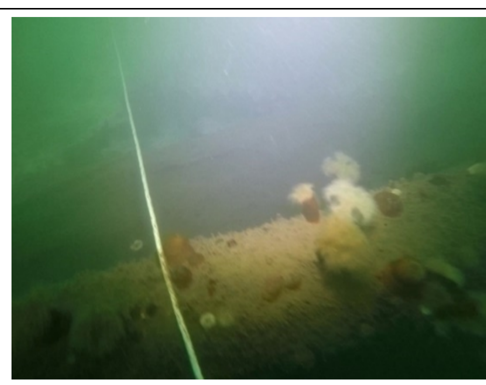
Quadrat 5 Silt with small wood fragments and bark and trace *Beggiatoa spp*

Quadrat 6 Silt with fine wood fragments and bark/larger wood fragments

Quadrat 7 Small wood fragments with bark/ large wood fragments

Quadrat 8 small wood fragments with larger wood fragments and scattered shell debris

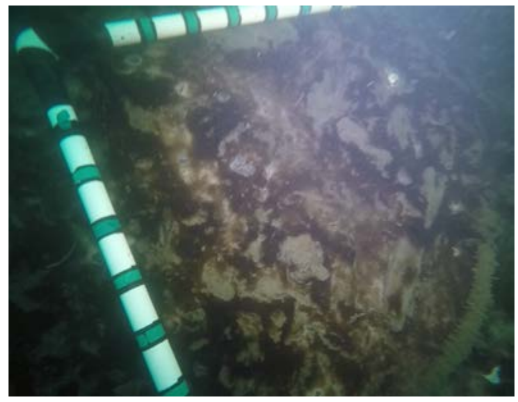
Quadrat 9 Silt with fine wood fragments and bark/larger wood fragments



Incidental Giant plumose and several unidentified anemones colonizing large log.

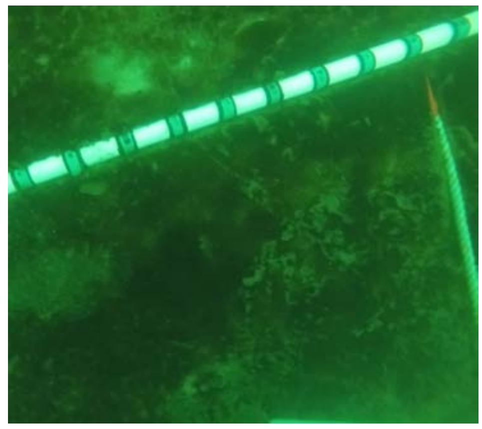
Transect 66; December 18 2018; 13:48 – 15:26

Quadrat 1 No Photo

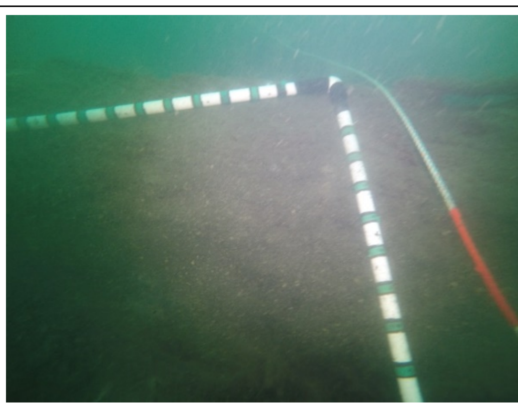


Quadrat 2 Silt with diatoms

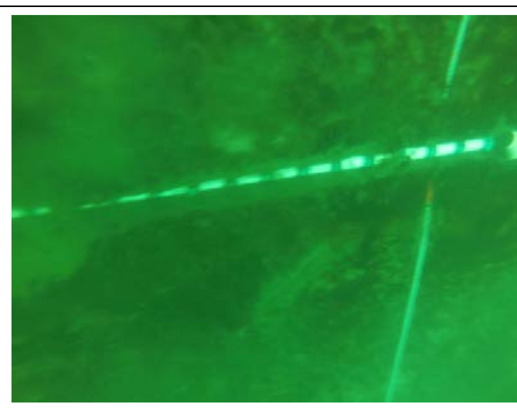
Quadrat 3 Silt with diatoms



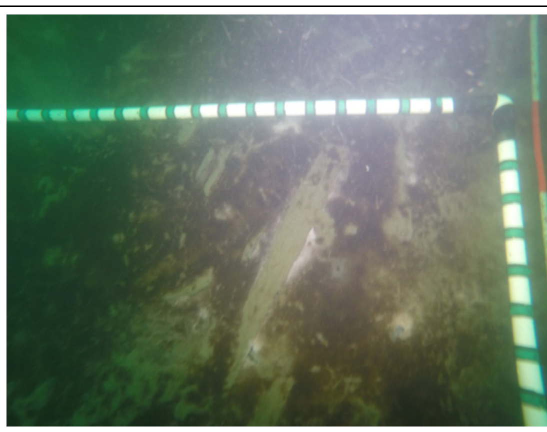
Quadrat 4 Silt with diatoms and bark/large wood fragments



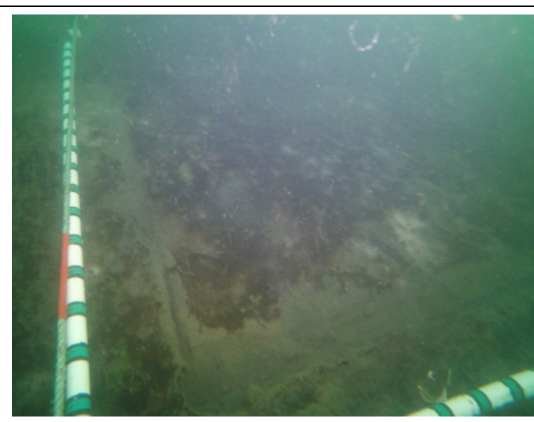
Quadrat 5 Silt with submerged log diatoms and *Beggiatoa spp.*



Quadrat 6 Silt with diatoms



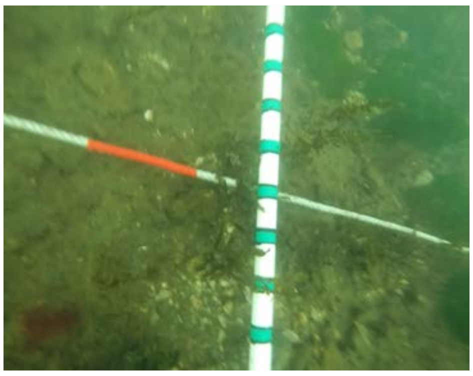
Quadrat 7 Silt with bark/larger wood fragments, diatoms, and trace *Beggiatoa spp.*



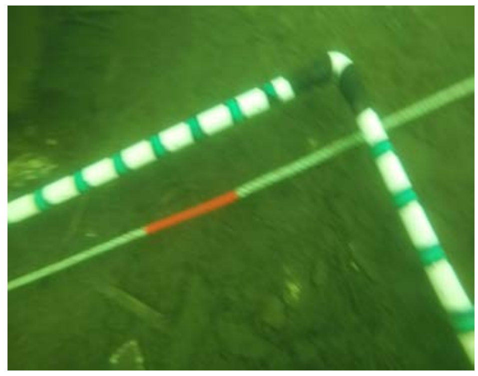
Quadrat 8 Silt with diatoms and trace *Beggiatoa spp.*

Quadrat 9 No Photo

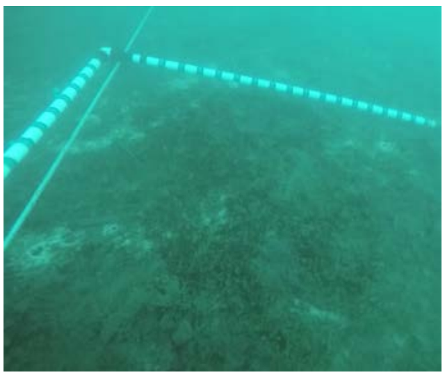
Transect 67; December 17 2018; 13:01 – 13:46



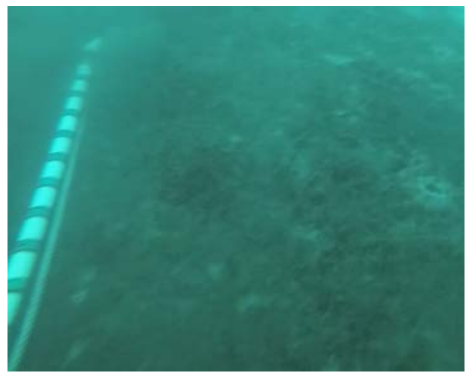
Quadrat 1 Cobble with diatoms, acorn barnacles, *Sargassum muticum*



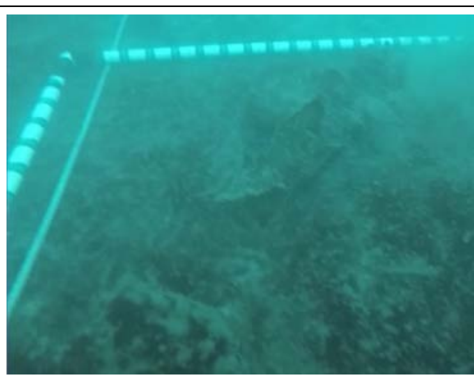
Quadrat 2 Silt with Bark and diatoms



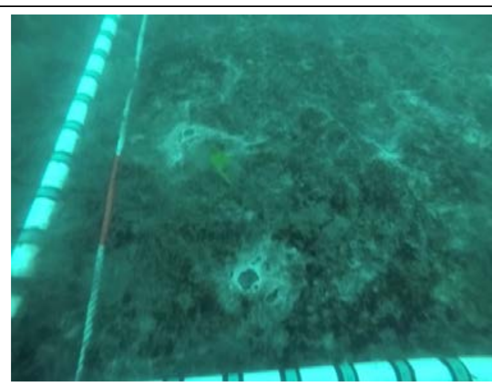
Quadrat 3 Silt with diatoms and trace *Beggiatoa spp.*



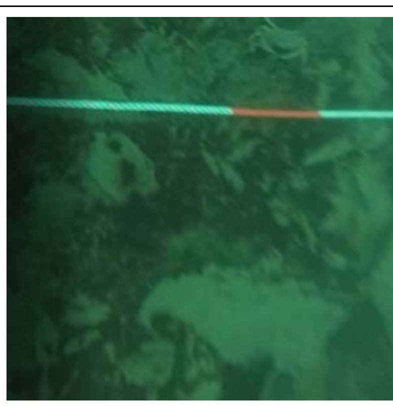
Quadrat 4 Silt with diatoms and *Beggiatoa* spp.



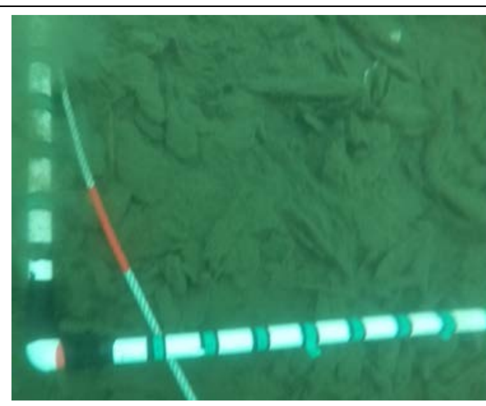
Quadrat 5 Silt with bark and diatoms



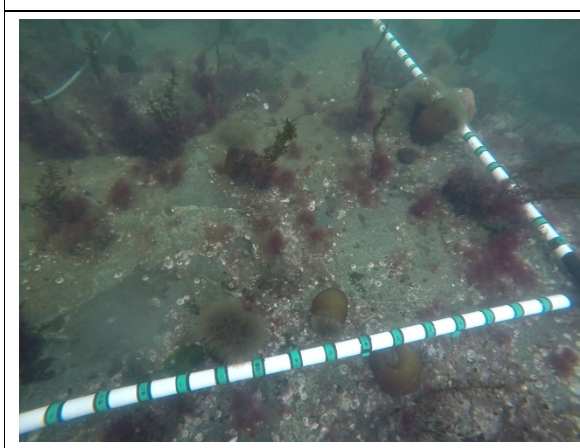
Quadrat 6 Silt with diatoms and *Beggiatoa spp.*



Quadrat 7 Silt with bark and diatoms



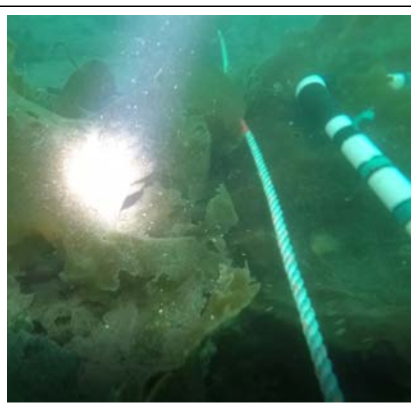
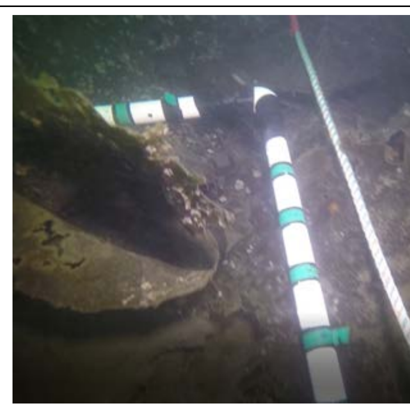
Quadrat 8 Silt with bark

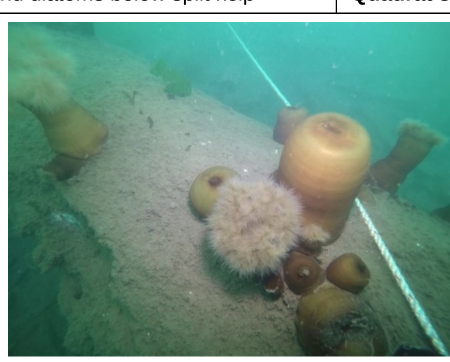


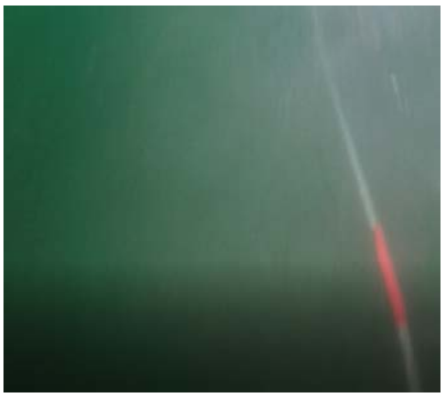
Quadrat 9 Bedrock with diatoms, red filamentous algae, *Sargassum muticum*, and brown anemones

Incidental Logs between Q2 and Q3

Transect 68; December 18 2018; 09:12 – 10:06

Quadrat 1 No photo	 **Quadrat 2** Silt with Bark and diatoms
 **Quadrat 3** Silt with bark	 **Quadrat 4** silt with bark
 **Quadrat 5** Silt with bark	 **Quadrat 6** Silt with bark
 **Quadrat 7** Silt with bark and diatoms below split kelp	 **Quadrat 8** Silt with bark and diatoms below split kelp

Quadrat 9 No Photo	 **Incidental** Log between Q3 and Q4 *M. farcimen* colonizing large log.	 **Incidental** Large boulders between Q4 and Q5 colonized by anemones, rock scallops, understory kelps, and coralline algae
Transect 69; December 17 2018; 11:17 – 12:00		



Quadrat 1 Silt with bark

Quadrat 2 silt with bark and submerged log and trace *Beggiatoa spp.*

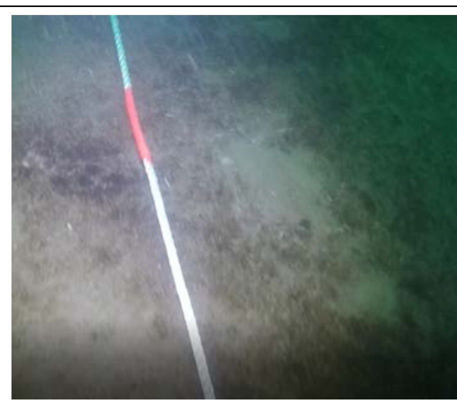
Quadrat 3 Silt with trace bark

Quadrat 4 Silt with bark and submerged log and diatoms

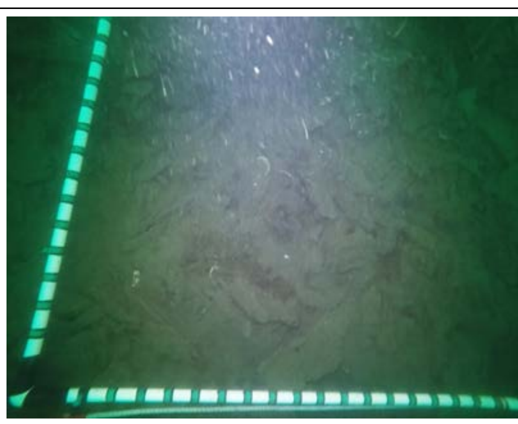
Quadrat 5 Silt with diatoms

Quadrat 6 No Photo

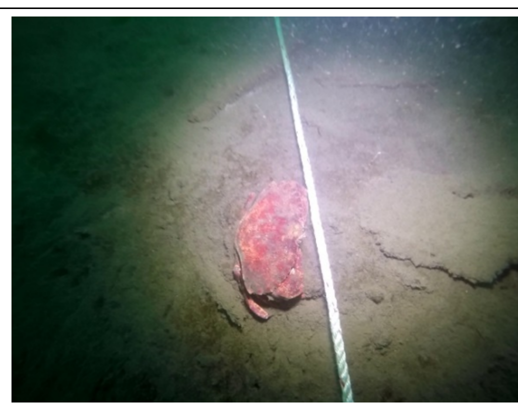
Quadrat 7 Silt with diatoms and trace *Beggiatoa spp.*



Quadrat 8 Silt with diatoms



Quadrat 9 Silt with bark and diatoms



Incidental Red rock crab (*Cancer magister*) observed on bark/large wood fragment overlaying silt

Transect 70; Dec 17 2018; 09:03 – 09:52

Appendix B
Laboratory Reports

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
219-800 BURRARD ST
VANCOUVER, BC V6Z 0B9
604-671-1831

ATTENTION TO: Cheronne Oreiro

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

AGAT WORK ORDER: 18V394408

SOIL ANALYSIS REVIEWED BY: Andrew Garrard, B.Sc., General Manager

TRACE ORGANICS REVIEWED BY: Andrew Garrard, B.Sc., General Manager

ULTRA TRACE REVIEWED BY: Philippe Morneau, chimiste

DATE REPORTED: Oct 16, 2018

PAGES (INCLUDING COVER): 35

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES
VERSION 1: Sample receipt temperature 1°C.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

Unit 120, 8600 Glenlyon Parkway
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TEL (778)452-4000
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

Parameter	Unit	G / S	RDL	EHWW-46-SG-000010	EHWW-45-SG-000010	EHWW-44-SG-000010	EHWW-14-SG-000010	EHWW-33-SG-000010	EHWW-30-SG-000010	EHWW-10-SG-000010	EHWW-04-SG-000010
SAMPLE TYPE:				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
DATE SAMPLED:				2018-10-04	2018-10-04	2018-10-04	2018-10-03	2018-10-03	2018-10-03	2018-10-03	2018-10-02
				9606459	9606460	9606461	9606462	9606463	9606464	9606465	9606466
Aluminum	µg/g		10	13400	14200	14200	16400	17100	16600	16800	14500
Antimony	µg/g		0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.7	0.2
Arsenic	µg/g		0.1	14.0	13.6	12.9	12.9	14.9	15.5	10.3	12.0
Barium	µg/g		0.5	35.5	39.9	43.2	53.2	57.0	67.5	73.8	45.5
Beryllium	µg/g		0.1	0.2	0.2	0.3	0.3	0.4	0.3	0.4	0.3
Bismuth	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	µg/g		0.01	4.01	4.10	2.73	2.21	1.48	0.92	0.66	3.63
Calcium	µg/g		10	7080	7800	7530	7010	7390	7910	8910	7360
Chromium	µg/g		1	26	33	29	30	33	35	30	28
Cobalt	µg/g		0.1	4.8	5.7	5.7	5.6	6.4	6.9	6.2	4.8
Copper	µg/g		0.2	42.9	54.1	43.7	46.7	52.9	73.8	66.7	41.9
Iron	µg/g		10	19900	21400	23200	27600	28700	29900	29400	22700
Lead	µg/g		0.1	20.4	24.2	20.3	23.3	24.8	31.7	32.9	23.6
Lithium	µg/g		0.5	15.3	17.6	18.1	22.5	24.3	23.4	24.8	19.0
Magnesium	µg/g		10	8840	9230	9340	10400	10400	10800	10300	9400
Manganese	µg/g		1	139	149	169	178	190	184	188	164
Mercury	µg/g		0.01	0.31	0.30	0.29	0.38	0.42	0.58	0.58	0.38
Molybdenum	µg/g		0.2	4.4	3.1	4.1	3.0	1.9	2.3	2.1	2.4
Nickel	µg/g		0.5	18.0	20.7	19.4	19.7	21.7	22.8	20.3	17.5
Phosphorus	µg/g		5	1060	1190	898	1030	1050	1190	1430	1190
Potassium	µg/g		5	2540	2670	2610	3040	3080	3150	2940	2770
Selenium	µg/g		0.1	1.9	1.6	1.6	1.5	1.2	1.2	1.1	1.7
Silver	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	µg/g		5	20900	21800	19600	20500	18200	20000	15600	21200
Strontium	µg/g		1	52	57	56	54	56	58	61	58
Thallium	µg/g		0.1	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.4
Tin	µg/g		0.2	2.8	4.0	3.3	3.5	3.5	4.6	4.3	4.5
Titanium	µg/g		1	1010	1110	1140	1290	1300	1250	1300	1160
Uranium	µg/g		0.2	2.2	1.7	1.5	1.4	1.2	1.3	1.4	1.2

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

Parameter	Unit	G / S	RDL	EHWW-46-SG-000010	EHWW-45-SG-000010	EHWW-44-SG-000010	EHWW-14-SG-000010	EHWW-33-SG-000010	EHWW-30-SG-000010	EHWW-10-SG-000010	EHWW-04-SG-000010
SAMPLE TYPE:				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
DATE SAMPLED:				2018-10-04	2018-10-04	2018-10-04	2018-10-03	2018-10-03	2018-10-03	2018-10-03	2018-10-02
				9606459	9606460	9606461	9606462	9606463	9606464	9606465	9606466
Vanadium	µg/g		1	41	48	48	45	49	52	48	42
Zinc	µg/g		1	90	107	81	83	90	97	86	80
Zirconium	µg/g		0.1	4.4	5.0	7.2	8.0	8.3	7.9	8.2	6.5
pH 1:2	pH units		0.1	7.3	7.4	7.3	7.4	7.5	7.6	7.6	7.6

Certified By:

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-18-SG-000010	EHWW-19-SG-000010	EHWW-42-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010	EHWW-39-SG-000010
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-01	2018-10-01	2018-10-01
Parameter	Unit	G / S	RDL	9606467	9606468	9606469	9606470	9606471	9606472	9606473	9606474
Aluminum	µg/g		10	12800	13300	15400	16100	15100	15700	17700	15900
Antimony	µg/g		0.1	0.5	0.5	0.2	0.3	0.3	0.4	0.4	0.5
Arsenic	µg/g		0.1	17.6	14.5	12.5	14.9	18.4	18.4	25.4	18.9
Barium	µg/g		0.5	42.9	42.9	47.4	43.1	40.9	53.2	57.0	57.9
Beryllium	µg/g		0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Bismuth	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	µg/g		0.01	3.86	3.74	4.23	4.40	4.35	3.30	2.63	4.52
Calcium	µg/g		10	7100	7770	7920	7550	7750	7540	8100	7640
Chromium	µg/g		1	31	29	30	35	35	37	37	41
Cobalt	µg/g		0.1	5.6	5.4	5.0	6.6	6.4	6.6	6.4	7.2
Copper	µg/g		0.2	54.6	46.9	46.8	60.8	60.7	66.3	73.8	86.2
Iron	µg/g		10	22700	21700	23600	24700	24000	27400	30400	27600
Lead	µg/g		0.1	28.1	22.3	26.1	25.4	24.1	28.8	27.8	37.1
Lithium	µg/g		0.5	18.3	16.8	19.4	20.4	18.6	21.2	22.8	23.0
Magnesium	µg/g		10	10500	8690	9730	10700	10700	12000	13400	11900
Manganese	µg/g		1	163	158	166	179	173	176	175	187
Mercury	µg/g		0.01	0.32	0.39	0.39	0.33	0.34	0.39	0.33	0.47
Molybdenum	µg/g		0.2	19.7	2.7	3.0	6.7	6.3	10.4	8.9	13.2
Nickel	µg/g		0.5	21.6	19.1	19.2	23.8	23.8	24.5	24.0	28.1
Phosphorus	µg/g		5	1150	1060	1310	1170	1190	1260	1490	1370
Potassium	µg/g		5	2860	2400	2790	3010	2940	3490	3930	3420
Selenium	µg/g		0.1	2.6	1.5	1.8	2.0	2.1	2.1	2.7	2.8
Silver	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	µg/g		5	29800	18600	20600	25400	27000	33300	37500	30300
Strontium	µg/g		1	76	57	57	59	60	66	69	75
Thallium	µg/g		0.1	0.4	0.5	0.4	0.5	0.4	0.4	0.4	0.5
Tin	µg/g		0.2	4.6	3.4	4.5	3.4	3.5	5.1	4.9	8.8
Titanium	µg/g		1	915	1130	1200	1200	1160	1070	1130	1090
Uranium	µg/g		0.2	7.2	1.3	1.6	2.6	2.5	3.9	3.0	4.3

Certified By:

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TEL (778)452-4000
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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-18-SG-000010	EHWW-19-SG-000010	EHWW-42-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010	EHWW-39-SG-000010
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-01	2018-10-01	2018-10-01
Parameter	Unit	G / S	RDL	9606467	9606468	9606469	9606470	9606471	9606472	9606473	9606474
Vanadium	µg/g		1	57	44	43	53	52	59	57	65
Zinc	µg/g		1	103	93	90	121	119	118	109	149
Zirconium	µg/g		0.1	8.6	6.3	6.2	6.1	5.9	9.1	8.0	8.8
pH 1:2	pH units		0.1	6.6	7.5	7.4	7.3	7.3	7.0	7.1	7.1

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9606459-9606474 Results are based on the dry weight of the sample

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
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http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-46-SG-000010	EHWW-45-SG-000010	EHWW-44-SG-000010	EHWW-14-SG-000010		EHWW-33-SG-000010		EHWW-30-SG-000010
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-10-04	2018-10-04	2018-10-04	2018-10-03		2018-10-03		2018-10-03
Parameter	Unit	G / S	RDL	9606459	9606460	9606461	9606462	RDL	9606463	RDL	9606464
Naphthalene	µg/g		0.01	<0.01	<0.01	0.01	<0.01	0.005	0.007	0.01	0.01
2-Methylnaphthalene	µg/g		0.01	0.02	0.02	0.01	0.01	0.005	0.013	0.01	0.01
1-Methylnaphthalene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	0.005	0.005	0.01	0.01
Acenaphthylene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	0.005	0.006	0.01	0.01
Acenaphthene	µg/g		0.01	<0.01	<0.01	0.01	<0.01	0.005	0.008	0.01	0.01
Fluorene	µg/g		0.04	<0.04	<0.04	<0.04	<0.04	0.02	<0.02	0.04	<0.04
Phenanthrene	µg/g		0.04	<0.04	<0.04	0.05	0.06	0.02	0.07	0.04	0.17
Anthracene	µg/g		0.008	0.017	0.018	0.045	0.027	0.004	0.030	0.008	0.064
Fluoranthene	µg/g		0.02	0.10	0.11	0.17	0.15	0.01	0.15	0.02	0.33
Pyrene	µg/g		0.02	0.10	0.12	0.35	0.16	0.01	0.16	0.02	0.34
Benzo(a)anthracene	µg/g		0.06	<0.06	<0.06	0.09	0.07	0.03	0.07	0.06	0.16
Chrysene	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	0.05	0.06	0.1	0.1
Benzo(b)fluoranthene	µg/g		0.04	0.06	0.08	0.16	0.12	0.02	0.13	0.04	0.23
Benzo(j)fluoranthene	µg/g		0.04	<0.04	<0.04	0.05	0.05	0.02	0.05	0.04	0.10
Benzo(k)fluoranthene	µg/g		0.04	<0.04	0.04	0.09	0.06	0.02	0.06	0.04	0.13
Benzo(a)pyrene	µg/g		0.06	<0.06	<0.06	0.12	0.09	0.03	0.09	0.06	0.20
Indeno(1,2,3-c,d)pyrene	µg/g		0.04	<0.04	<0.04	0.04	<0.04	0.02	0.03	0.04	0.06
Dibenzo(a,h)anthracene	µg/g		0.01	<0.01	<0.01	0.01	<0.01	0.005	0.007	0.01	0.01
Benzo(g,h,i)perylene	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	0.05	<0.05	0.1	<0.1
Quinoline	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	0.05	<0.05	0.1	<0.1
IACR CCME (Soil)	µg/g		1	<1	1	2	2	0.6	2.0	1	4
B[a]P TPE (Soil)	µg/g		0.1	<0.1	<0.1	0.1	0.1	0.05	0.13	0.1	0.2
Benzo(b+j)fluoranthene	µg/g		0.05	0.06	0.08	0.21	0.17	0.05	0.18	0.05	0.33
Surrogate	Unit	Acceptable Limits									
Naphthalene - d8	%	50-130		88	86	90	78		79		81
2-Fluorobiphenyl	%	50-130		94	88	94	81		83		85
P-Terphenyl - d14	%	60-130		96	91	98	83		87		87

Certified By:

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-10-SG-000010	EHWW-04-SG-000010	EHWW-18-SG-000010	EHWW-19-SG-000010	EHWW-42-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-06-SG-000010
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-10-03	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-01
Parameter	Unit	G / S	RDL	9606465	9606466	9606467	9606468	9606469	9606470	9606471	9606472
Naphthalene	µg/g		0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
2-Methylnaphthalene	µg/g		0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.03
1-Methylnaphthalene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	µg/g		0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	µg/g		0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	µg/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenanthrene	µg/g		0.04	0.15	0.06	0.04	0.06	0.06	0.04	0.08	0.09
Anthracene	µg/g		0.008	0.060	0.026	0.040	0.043	0.025	0.025	0.029	0.038
Fluoranthene	µg/g		0.02	0.34	0.16	0.11	0.19	0.14	0.11	0.53	0.24
Pyrene	µg/g		0.02	0.32	0.16	0.19	0.23	0.15	0.13	0.45	0.30
Benzo(a)anthracene	µg/g		0.06	0.18	0.06	0.06	0.10	0.06	<0.06	0.09	0.11
Chrysene	µg/g		0.1	0.2	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1
Benzo(b)fluoranthene	µg/g		0.04	0.33	0.11	0.15	0.19	0.11	0.12	0.21	0.20
Benzo(j)fluoranthene	µg/g		0.04	0.13	0.05	0.06	0.08	0.04	0.05	0.09	0.09
Benzo(k)fluoranthene	µg/g		0.04	0.19	0.05	0.08	0.10	0.06	0.05	0.10	0.11
Benzo(a)pyrene	µg/g		0.06	0.25	0.07	0.10	0.12	0.07	0.06	0.11	0.13
Indeno(1,2,3-c,d)pyrene	µg/g		0.04	0.08	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.04
Dibenzo(a,h)anthracene	µg/g		0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Quinoline	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
IACR CCME (Soil)	µg/g		1	5	1	2	3	1	1	3	3
B[a]P TPE (Soil)	µg/g		0.1	0.3	0.1	0.1	0.1	0.1	<0.1	0.1	0.1
Benzo(b+j)fluoranthene	µg/g		0.05	0.46	0.16	0.21	0.27	0.15	0.17	0.30	0.29
Surrogate	Unit	Acceptable Limits									
Naphthalene - d8	%	50-130		80	84	79	86	80	80	82	83
2-Fluorobiphenyl	%	50-130		84	88	84	90	84	84	85	87
P-Terphenyl - d14	%	60-130		89	88	86	93	87	88	89	93

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-09-SG-000010		EHWW-39-SG-000010
			SAMPLE TYPE:	Sediment		Sediment
			DATE SAMPLED:	2018-10-01		2018-10-01
Parameter	Unit	G / S	RDL	9606473	RDL	9606474
Naphthalene	µg/g		0.02	<0.02	0.01	0.02
2-Methylnaphthalene	µg/g		0.02	0.03	0.01	0.03
1-Methylnaphthalene	µg/g		0.02	<0.02	0.01	<0.01
Acenaphthylene	µg/g		0.02	<0.02	0.01	0.01
Acenaphthene	µg/g		0.02	<0.02	0.01	0.01
Fluorene	µg/g		0.06	<0.06	0.04	<0.04
Phenanthrene	µg/g		0.06	0.09	0.04	0.08
Anthracene	µg/g		0.01	0.04	0.008	0.051
Fluoranthene	µg/g		0.03	0.25	0.02	0.24
Pyrene	µg/g		0.03	0.26	0.02	0.31
Benzo(a)anthracene	µg/g		0.09	0.11	0.06	0.10
Chrysene	µg/g		0.2	<0.2	0.1	<0.1
Benzo(b)fluoranthene	µg/g		0.06	0.22	0.04	0.16
Benzo(j)fluoranthene	µg/g		0.06	0.09	0.04	0.07
Benzo(k)fluoranthene	µg/g		0.06	0.11	0.04	0.08
Benzo(a)pyrene	µg/g		0.09	0.13	0.06	0.10
Indeno(1,2,3-c,d)pyrene	µg/g		0.06	<0.06	0.04	0.04
Dibenzo(a,h)anthracene	µg/g		0.02	<0.02	0.01	0.01
Benzo(g,h,i)perylene	µg/g		0.2	<0.2	0.1	<0.1
Quinoline	µg/g		0.2	<0.2	0.1	<0.1
IACR CCME (Soil)	µg/g		2	3	1	2
B[a]P TPE (Soil)	µg/g		0.2	<0.2	0.1	0.1
Benzo(b+j)fluoranthene	µg/g		0.05	0.31	0.05	0.23
Surrogate	Unit	Acceptable Limits				
Naphthalene - d8	%	50-130		102		82
2-Fluorobiphenyl	%	50-130		106		83
P-Terphenyl - d14	%	60-130		104		87

Certified By:

Results relate only to the items tested and to all the items tested

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

Comments:	RDL - Reported Detection Limit; G / S - Guideline / Standard
9606459-9606462	Results are based on dry weight of sample. PAH detection limits increased due to high sample moisture content.
9606463	Results are based on dry weight of sample.
9606464-9606474	Results are based on dry weight of sample. PAH detection limits increased due to high sample moisture content.

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Polychlorinated Biphenyls Analysis [by extended Aroclor list] in Soil

DATE RECEIVED: 2018-10-06
DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-46-SG-000010	EHWW-45-SG-000010	EHWW-44-SG-000010	EHWW-14-SG-000010	EHWW-33-SG-000010	EHWW-30-SG-000010	EHWW-10-SG-000010	EHWW-04-SG-000010
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-10-04	2018-10-04	2018-10-04	2018-10-03	2018-10-03	2018-10-03	2018-10-03	2018-10-02
Parameter	Unit	G / S	RDL	9606459	9606460	9606461	9606462	9606463	9606464	9606465	9606466
Aroclor 1016	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1221	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1232	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1248	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.15	0.08	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	0.05	<0.05
Aroclor 1262	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1268	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.22	0.13	<0.05
Surrogate	Unit	Acceptable Limits									
Decachlorobiphenyl	%	50-150		115	120	125	125	125	125	130	135

Certified By:

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Polychlorinated Biphenyls Analysis [by extended Aroclor list] in Soil

DATE RECEIVED: 2018-10-06
DATE REPORTED: 2018-10-16

Parameter	Unit	G / S	RDL	EHWW-18-SG-000010	EHWW-19-SG-000010	EHWW-42-SG-000010	EHWW-48-SG-000010	EHWW-148-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010	EHWW-39-SG-000010
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-02	2018-10-01	2018-10-01	2018-10-01
				9606467	9606468	9606469	9606470	9606471	9606472	9606473	9606474
Aroclor 1016	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1221	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1232	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1248	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08
Aroclor 1262	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1268	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08
Surrogate	Unit	Acceptable Limits									
Decachlorobiphenyl	%	50-150		125	130	140	140	140	130	125	125

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
9606459-9606474 Analysis multiple peak pattern method by GC/ECD.
Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

		SAMPLE DESCRIPTION:		EHWW-46-SG-000010		EHWW-45-SG-000010		EHWW-44-SG-000010		EHWW-14-SG-000010
		SAMPLE TYPE:		Sediment		Sediment		Sediment		Sediment
		DATE SAMPLED:		2018-10-04		2018-10-04		2018-10-04		2018-10-03
Parameter	Unit	G / S	RDL	9606459	RDL	9606460	RDL	9606461	RDL	9606462
2,3,7,8-Tetra CDD	ng/kg		0.2	<0.2	0.3	<0.3	0.5	<0.5	0.5	<0.5
1,2,3,7,8-Penta CDD	ng/kg		2	<2	3	<3	0.8	1.6	0.6	<0.6
1,2,3,4,7,8-Hexa CDD	ng/kg		5	<5	3	<3	2	<2	2	<2
1,2,3,6,7,8-Hexa CDD	ng/kg		4	<4	3	<3	2	11	2	<2
1,2,3,7,8,9-Hexa CDD	ng/kg		5	<5	3	<3	2	3	2	<2
1,2,3,4,6,7,8-Hepta CDD	ng/kg		3	19	3	98	3	76	2	14
Octa CDD	ng/kg		6	149	10	1390	6	381	6	104
2,3,7,8-Tetra CDF	ng/kg		0.4	<0.4	0.7	1.2	1	2	0.4	<0.4
1,2,3,7,8-Penta CDF	ng/kg		1	<1	0.6	<0.6	1	<1	0.9	<0.9
2,3,4,7,8-Penta CDF	ng/kg		1	<1	0.5	<0.5	1	2	0.8	<0.8
1,2,3,4,7,8-Hexa CDF	ng/kg		1	<1	0.8	1.1	0.9	3.0	2	17
1,2,3,6,7,8-Hexa CDF	ng/kg		1	<1	0.8	<0.8	0.8	1.8	2	8
2,3,4,6,7,8-Hexa CDF	ng/kg		6	<6	1	<1	0.9	1.8	2	5
1,2,3,7,8,9-Hexa CDF	ng/kg		0.7	<0.7	1	<1	2	<2	3	<3
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.5	14.5	1	20	2	53	4	423
1,2,3,4,7,8,9-Hepta CDF	ng/kg		0.7	<0.7	2	<2	4	<4	5	10
Octa CDF	ng/kg		4	10	2	33	2	10	7	196
Total Tetrachlorodibenzodioxins	ng/kg		0.2	0.8	0.3	3.1	0.5	10.1	0.5	1.5
Total Pentachlorodibenzodioxins	ng/kg		2	10	3	13	0.8	27.3	0.6	13.0
Total Hexachlorodibenzodioxins	ng/kg		5	16	3	18	2	120	2	18
Total Heptachlorodibenzodioxins	ng/kg		3	74	3	224	3	359	2	46
Total PCDDs	ng/kg		6	250	10	1650	6	898	6	183
Total Tetrachlorodibenzofurans	ng/kg		0.4	4.1	0.7	10.5	1	19	0.4	2.9
Total Pentachlorodibenzofurans	ng/kg		1	2	0.6	4.5	1	12	0.9	10.0
Total Hexachlorodibenzofurans	ng/kg		6	12	1	14	2	39	3	115
Total Heptachlorodibenzofurans	ng/kg		0.7	27.8	2	52	4	91	5	706
Total PCDFs	ng/kg		6	55.2	2	114	4	171	7	1030
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		1.60		0

Certified By:

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06
DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-46-SG-000010		EHWW-45-SG-000010		EHWW-44-SG-000010		EHWW-14-SG-000010
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-10-04		2018-10-04		2018-10-04		2018-10-03
Parameter	Unit	G / S	RDL	9606459	RDL	9606460	RDL	9606461	RDL	9606462
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		1.06		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0		0.340		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.194		0.984		0.761		0.138
Octa CDD (TEF 0.0003)	TEQ			0.0447		0.417		0.114		0.0313
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0.121		0.223		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0		0		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0		0		0.523		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0.111		0.299		1.73
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0.175		0.803
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0.177		0.475
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.145		0.199		0.531		4.23
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0.103
Octa CDF (TEF 0.0003)	TEQ			0.00294		0.00980		0.00305		0.0587
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.386		1.84		5.82		7.57

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

Unit 120, 8600 Glenlyon Parkway
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

Surrogate	Unit	Acceptable Limits	EHWW-46-SG-000010	EHWW-45-SG-000010	EHWW-44-SG-000010	EHWW-14-SG-000010
		SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment
		DATE SAMPLED:	2018-10-04	2018-10-04	2018-10-04	2018-10-03
			9606459	9606460	9606461	9606462
13C-2378-TCDF	%	30-140	93	88	78	57
13C-12378-PeCDF	%	30-140	80	91	79	53
13C-23478-PeCDF	%	30-140	88	91	82	52
13C-123478-HxCDF	%	30-140	59	67	65	57
13C-123678-HxCDF	%	30-140	118	77	75	59
13C-234678-HxCDF	%	30-140	42	75	72	56
13C-123789-HxCDF	%	30-140	93	76	63	55
13C-1234678-HpCDF	%	30-140	72	58	48	42
13C-1234789-HpCDF	%	30-140	74	52	32	43
13C-2378-TCDD	%	30-140	121	118	107	73
13C-12378-PeCDD	%	30-140	90	107	97	59
13C-123478-HxCDD	%	30-140	88	73	76	57
13C-123678-HxCDD	%	30-140	101	97	91	65
13C-1234678-HpCDD	%	30-140	78	55	57	46
13C-OCDD	%	30-140	52	37	37	31

Certified By:

Results relate only to the items tested and to all the items tested

Unit 120, 8600 Glenlyon Parkway
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

		SAMPLE DESCRIPTION:		EHWW-33-SG-000010		EHWW-30-SG-000010		EHWW-10-SG-000010		EHWW-04-SG-000010
		SAMPLE TYPE:		Sediment		Sediment		Sediment		Sediment
		DATE SAMPLED:		2018-10-03		2018-10-03		2018-10-03		2018-10-02
Parameter	Unit	G / S	RDL	9606463	RDL	9606464	RDL	9606465	RDL	9606466
2,3,7,8-Tetra CDD	ng/kg		0.4	<0.4	0.4	<0.4	0.9	<0.9	0.5	<0.5
1,2,3,7,8-Penta CDD	ng/kg		2	<2	1	<1	5	<5	2	<2
1,2,3,4,7,8-Hexa CDD	ng/kg		0.9	<0.9	2	<2	2	3	3	<3
1,2,3,6,7,8-Hexa CDD	ng/kg		0.9	2.1	2	<2	2	4	3	<3
1,2,3,7,8,9-Hexa CDD	ng/kg		1	1	2	<2	2	3	3	<3
1,2,3,4,6,7,8-Hepta CDD	ng/kg		1	25	2	42	3	57	3	25
Octa CDD	ng/kg		2	192	4	314	8	463	5	181
2,3,7,8-Tetra CDF	ng/kg		0.6	<0.6	0.6	<0.6	2	<2	0.5	<0.5
1,2,3,7,8-Penta CDF	ng/kg		2	<2	0.8	<0.8	2	<2	0.9	1.0
2,3,4,7,8-Penta CDF	ng/kg		0.6	1.0	0.7	1.1	3	<3	1	1
1,2,3,4,7,8-Hexa CDF	ng/kg		0.7	1.2	1	1	10	<10	1	1
1,2,3,6,7,8-Hexa CDF	ng/kg		0.7	1.3	1	<1	10	<10	1	<1
2,3,4,6,7,8-Hexa CDF	ng/kg		0.7	1.2	1	<1	20	<20	1	2
1,2,3,7,8,9-Hexa CDF	ng/kg		0.9	<0.9	2	<2	2	<2	1	<1
1,2,3,4,6,7,8-Hepta CDF	ng/kg		2	19	2	11	1	20	1	29
1,2,3,4,7,8,9-Hepta CDF	ng/kg		3	<3	2	<2	2	<2	2	2
Octa CDF	ng/kg		0.9	12.7	2	13	3	25	1	18
Total Tetrachlorodibenzodioxins	ng/kg		0.4	4.2	0.4	3.3	0.9	5.4	0.5	6.1
Total Pentachlorodibenzodioxins	ng/kg		2	10	1	10	5	17	2	45
Total Hexachlorodibenzodioxins	ng/kg		0.9	35.4	2	29	2	29	3	29
Total Heptachlorodibenzodioxins	ng/kg		1	71	2	146	3	116	3	76
Total PCDDs	ng/kg		2	313	4	502	8	630	5	337
Total Tetrachlorodibenzofurans	ng/kg		0.6	10.6	0.6	9.0	2	14	0.5	11.2
Total Pentachlorodibenzofurans	ng/kg		2	6	0.8	6.4	3	5	1	9
Total Hexachlorodibenzofurans	ng/kg		0.9	18.0	2	11	20	<20	1	21
Total Heptachlorodibenzofurans	ng/kg		3	37	2	24	2	24	2	56
Total PCDFs	ng/kg		3	85	2	63	20	68	2	116
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		0		0

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

Parameter	Unit	G / S	RDL	EHWW-33-SG-000010	RDL	EHWW-30-SG-000010	RDL	EHWW-10-SG-000010	RDL	EHWW-04-SG-000010
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-10-03		2018-10-03		2018-10-03		2018-10-02
				9606463		9606464		9606465		9606466
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0.343		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0.212		0		0.288		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0.101		0		0.570		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.252		0.416		0.139		0.250
Octa CDD (TEF 0.0003)	TEQ			0.0576		0.0943		0		0.0542
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0		0		0.0287
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0.305		0.323		0		0.349
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0.119		0.113		0		0.145
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.126		0		0		0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.116		0		0		0.154
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.192		0.106		0.202		0.291
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0.0181
Octa CDF (TEF 0.0003)	TEQ			0.00380		0.00375		0.00755		0.00553
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			1.48		1.06		1.93		1.30

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

Surrogate	Unit	Acceptable Limits	EHWW-33-SG-000010	EHWW-30-SG-000010	EHWW-10-SG-000010	EHWW-04-SG-000010
		SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment
		DATE SAMPLED:	2018-10-03	2018-10-03	2018-10-03	2018-10-02
			9606463	9606464	9606465	9606466
13C-2378-TCDF	%	30-140	82	86	90	82
13C-12378-PeCDF	%	30-140	83	82	84	74
13C-23478-PeCDF	%	30-140	71	85	70	59
13C-123478-HxCDF	%	30-140	72	67	48	70
13C-123678-HxCDF	%	30-140	77	70	55	75
13C-234678-HxCDF	%	30-140	78	69	52	75
13C-123789-HxCDF	%	30-140	82	65	79	77
13C-1234678-HpCDF	%	30-140	55	55	60	56
13C-1234789-HpCDF	%	30-140	62	53	68	63
13C-2378-TCDD	%	30-140	116	115	121	114
13C-12378-PeCDD	%	30-140	81	96	90	73
13C-123478-HxCDD	%	30-140	80	71	71	76
13C-123678-HxCDD	%	30-140	85	78	74	85
13C-1234678-HpCDD	%	30-140	67	58	66	67
13C-OCDD	%	30-140	47	34	45	42

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SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-18-SG-000010		EHWW-19-SG-000010		EHWW-42-SG-000010		EHWW-48-SG-000010
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-10-02		2018-10-02		2018-10-02		2018-10-02
Parameter	Unit	G / S	RDL	9606467	RDL	9606468	RDL	9606469	RDL	9606470
2,3,7,8-Tetra CDD	ng/kg		0.9	<0.9	0.5	<0.5	0.8	<0.8	0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		3	<3	1	<1	0.8	0.8	0.5	0.9
1,2,3,4,7,8-Hexa CDD	ng/kg		2	<2	2	<2	3	<3	2	<2
1,2,3,6,7,8-Hexa CDD	ng/kg		2	7	2	3	3	4	2	<2
1,2,3,7,8,9-Hexa CDD	ng/kg		2	3	2	<2	3	<3	2	<2
1,2,3,4,6,7,8-Hepta CDD	ng/kg		3	70	2	31	2	44	3	11
Octa CDD	ng/kg		5	432	3	249	9	291	3	121
2,3,7,8-Tetra CDF	ng/kg		1	3	0.6	1.2	1	2	0.4	1.1
1,2,3,7,8-Penta CDF	ng/kg		1	1	0.6	0.9	2	<2	0.6	1.2
2,3,4,7,8-Penta CDF	ng/kg		0.9	2.1	0.5	1.5	1	2	0.5	<0.5
1,2,3,4,7,8-Hexa CDF	ng/kg		2	3	0.8	2.9	1	3	0.8	<0.8
1,2,3,6,7,8-Hexa CDF	ng/kg		1	3	0.8	1.8	1	2	0.8	0.8
2,3,4,6,7,8-Hexa CDF	ng/kg		1	2	1	2	1	2	0.9	<0.9
1,2,3,7,8,9-Hexa CDF	ng/kg		2	<2	1	<1	2	<2	1	<1
1,2,3,4,6,7,8-Hepta CDF	ng/kg		2	73	0.8	79.3	2	53	1	19
1,2,3,4,7,8,9-Hepta CDF	ng/kg		3	<3	1	2	3	<3	2	<2
Octa CDF	ng/kg		2	27	4	27	2	20	1	12
Total Tetrachlorodibenzodioxins	ng/kg		0.9	28.3	0.5	5.5	0.8	7.7	0.3	1.5
Total Pentachlorodibenzodioxins	ng/kg		3	78	1	16	0.8	21.2	0.5	14.3
Total Hexachlorodibenzodioxins	ng/kg		2	120	2	35	3	50	2	19
Total Heptachlorodibenzodioxins	ng/kg		3	168	2	93	2	109	3	35
Total PCDDs	ng/kg		5	826	3	399	9	478	3	191
Total Tetrachlorodibenzofurans	ng/kg		1	31	0.6	12.7	1	22	0.4	6.1
Total Pentachlorodibenzofurans	ng/kg		1	22	0.6	10.2	2	11	0.6	2.6
Total Hexachlorodibenzofurans	ng/kg		2	53	1	47	2	37	1	9
Total Heptachlorodibenzofurans	ng/kg		3	131	1	135	3	91	2	33
Total PCDFs	ng/kg		3	265	4	232	3	181	2	63
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		0.833		0.913

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA | ATTENTION TO: Cheronne Oreiro

SAMPLING SITE: | SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06 | DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-18-SG-000010		EHWW-19-SG-000010		EHWW-42-SG-000010		EHWW-48-SG-000010
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-10-02		2018-10-02		2018-10-02		2018-10-02
Parameter	Unit	G / S	RDL	9606467	RDL	9606468	RDL	9606469	RDL	9606470
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0.745		0.286		0.436		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0.283		0		0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.702		0.309		0.437		0.112
Octa CDD (TEF 0.0003)	TEQ			0.130		0.0746		0.0874		0.0362
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0.268		0.124		0.167		0.110
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0.0327		0.0272		0		0.0347
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0.632		0.456		0.462		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0.292		0.286		0.349		0
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.282		0.178		0.210		0.0786
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.241		0.193		0.187		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.731		0.793		0.531		0.195
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0.0155		0		0
Octa CDF (TEF 0.0003)	TEQ			0.00814		0.00807		0.00590		0.00353
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			4.35		2.75		3.71		1.48

Certified By:

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

		SAMPLE DESCRIPTION:	EHWW-18-SG-000010	EHWW-19-SG-000010	EHWW-42-SG-000010	EHWW-48-SG-000010
		SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment
		DATE SAMPLED:	2018-10-02	2018-10-02	2018-10-02	2018-10-02
Surrogate	Unit	Acceptable Limits	9606467	9606468	9606469	9606470
13C-2378-TCDF	%	30-140	89	102	72	89
13C-12378-PeCDF	%	30-140	86	92	76	84
13C-23478-PeCDF	%	30-140	88	99	78	88
13C-123478-HxCDF	%	30-140	75	84	75	65
13C-123678-HxCDF	%	30-140	79	87	79	70
13C-234678-HxCDF	%	30-140	78	82	77	69
13C-123789-HxCDF	%	30-140	84	87	79	81
13C-1234678-HpCDF	%	30-140	59	66	61	56
13C-1234789-HpCDF	%	30-140	61	64	68	55
13C-2378-TCDD	%	30-140	119	136	98	119
13C-12378-PeCDD	%	30-140	97	115	85	97
13C-123478-HxCDD	%	30-140	82	88	75	83
13C-123678-HxCDD	%	30-140	97	106	89	97
13C-1234678-HpCDD	%	30-140	65	69	70	61
13C-OCDD	%	30-140	44	45	46	37

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

		SAMPLE DESCRIPTION:		EHWW-148-SG-000010		EHWW-06-SG-000010		EHWW-09-SG-000010		EHWW-39-SG-000010
		SAMPLE TYPE:		Sediment		Sediment		Sediment		Sediment
		DATE SAMPLED:		2018-10-02		2018-10-01		2018-10-01		2018-10-01
Parameter	Unit	G / S	RDL	9606471	RDL	9606472	RDL	9606473	RDL	9606474
2,3,7,8-Tetra CDD	ng/kg		0.2	<0.2	0.7	<0.7	0.4	<0.4	0.6	<0.6
1,2,3,7,8-Penta CDD	ng/kg		2	<2	1	<1	2	<2	1	5
1,2,3,4,7,8-Hexa CDD	ng/kg		3	<3	4	<4	3	<3	2	4
1,2,3,6,7,8-Hexa CDD	ng/kg		3	<3	6	<6	2	2	2	13
1,2,3,7,8,9-Hexa CDD	ng/kg		3	<3	4	<4	3	<3	2	5
1,2,3,4,6,7,8-Hepta CDD	ng/kg		5	22	2	14	3	38	3	111
Octa CDD	ng/kg		4	123	3	140	19	299	40	712
2,3,7,8-Tetra CDF	ng/kg		0.5	<0.5	0.5	<0.5	0.8	<0.8	0.8	9.4
1,2,3,7,8-Penta CDF	ng/kg		0.6	<0.6	0.7	<0.7	0.8	<0.8	2	3
2,3,4,7,8-Penta CDF	ng/kg		0.5	<0.5	0.7	<0.7	0.6	<0.6	2	5
1,2,3,4,7,8-Hexa CDF	ng/kg		2	<2	0.8	<0.8	1	2	2	6
1,2,3,6,7,8-Hexa CDF	ng/kg		2	<2	0.7	<0.7	1	1	2	5
2,3,4,6,7,8-Hexa CDF	ng/kg		2	<2	2	<2	1	<1	3	3
1,2,3,7,8,9-Hexa CDF	ng/kg		3	<3	1	<1	2	<2	4	<4
1,2,3,4,6,7,8-Hepta CDF	ng/kg		1	16	0.4	9.1	1	40	1	71
1,2,3,4,7,8,9-Hepta CDF	ng/kg		2	<2	0.6	<0.6	2	<2	2	2
Octa CDF	ng/kg		3	10	1	6	2	28	2	34
Total Tetrachlorodibenzodioxins	ng/kg		0.2	2.4	0.7	2.8	0.4	11.3	0.6	68.5
Total Pentachlorodibenzodioxins	ng/kg		2	11	1	12	2	36	1	137
Total Hexachlorodibenzodioxins	ng/kg		3	24	6	30	3	42	2	189
Total Heptachlorodibenzodioxins	ng/kg		5	74	2	51	3	119	3	322
Total PCDDs	ng/kg		5	235	6	236	19	508	40	1430
Total Tetrachlorodibenzofurans	ng/kg		0.5	4.5	0.5	5.0	0.8	11.3	0.8	106.7
Total Pentachlorodibenzofurans	ng/kg		0.6	2.7	0.7	2.5	0.8	5.2	2	50
Total Hexachlorodibenzofurans	ng/kg		3	10	2	7	2	26	4	78
Total Heptachlorodibenzofurans	ng/kg		2	29	0.6	18.8	2	78	2	134
Total PCDFs	ng/kg		3	56	2	39	2	148	4	402
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		0		4.84

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

			SAMPLE DESCRIPTION:	EHWW-148-SG-000010		EHWW-06-SG-000010		EHWW-09-SG-000010		EHWW-39-SG-000010
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-10-02		2018-10-01		2018-10-01		2018-10-01
Parameter	Unit	G / S	RDL	9606471	RDL	9606472	RDL	9606473	RDL	9606474
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0.364
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0.247		1.28
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0.508
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.219		0.135		0.376		1.11
Octa CDD (TEF 0.0003)	TEQ			0.0370		0.0419		0.0898		0.214
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0		0		0.938
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0		0		0.0971
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0		0		0		1.53
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0.152		0.552
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0.144		0.458
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0.317
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.163		0.0913		0.404		0.705
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0.0200
Octa CDF (TEF 0.0003)	TEQ			0.00311		0.00176		0.00842		0.0102
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.422		0.270		1.42		12.9

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Certificate of Analysis

AGAT WORK ORDER: 18V394408

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-10-06

DATE REPORTED: 2018-10-16

		SAMPLE DESCRIPTION:	EHWW-148-SG-000010	EHWW-06-SG-000010	EHWW-09-SG-000010	EHWW-39-SG-000010
		SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment
		DATE SAMPLED:	2018-10-02	2018-10-01	2018-10-01	2018-10-01
Surrogate	Unit	Acceptable Limits	9606471	9606472	9606473	9606474
13C-2378-TCDF	%	30-140	65	87	80	94
13C-12378-PeCDF	%	30-140	64	82	74	93
13C-23478-PeCDF	%	30-140	68	79	85	91
13C-123478-HxCDF	%	30-140	65	72	66	72
13C-123678-HxCDF	%	30-140	68	102	69	76
13C-234678-HxCDF	%	30-140	71	57	68	73
13C-123789-HxCDF	%	30-140	66	91	73	74
13C-1234678-HpCDF	%	30-140	53	75	56	59
13C-1234789-HpCDF	%	30-140	51	73	55	59
13C-2378-TCDD	%	30-140	88	113	108	127
13C-12378-PeCDD	%	30-140	71	100	99	105
13C-123478-HxCDD	%	30-140	70	74	71	74
13C-123678-HxCDD	%	30-140	82	56	91	89
13C-1234678-HpCDD	%	30-140	56	78	58	69
13C-OCDD	%	30-140	38	48	37	45

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9606459-9606474 The results were corrected based on the surrogate percent recoveries.

Analysis performed at AGAT Montreal (unless marked by *)

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date: Oct 16, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works Metals in Soil															
Aluminum	9606459		13400	13300	0.7%	< 10	104%	70%	130%	95%	90%	110%			
Antimony	9606460		0.2	0.2	NA	< 0.1	95%	70%	130%	97%	90%	110%			
Arsenic	9606460		13.6	14.3	5.0%	< 0.1	117%	70%	130%	94%	90%	110%			
Barium	9606460		39.9	37.7	5.7%	< 0.5	88%	70%	130%	93%	90%	110%			
Beryllium	9606460		0.2	0.2	NA	< 0.1	85%	70%	130%	94%	90%	110%			
Bismuth	9606460		<0.5	<0.5	NA	< 0.5				102%	90%	110%			
Cadmium	9606460		4.10	3.86	6.0%	< 0.01	101%	70%	130%	98%	90%	110%			
Calcium	9606459		7080	7090	0.1%	< 10	122%	70%	130%	103%	90%	110%			
Chromium	9606460		33	28	16.4%	< 1	106%	70%	130%	95%	90%	110%			
Cobalt	9606460		5.7	4.7	19.2%	< 0.1	103%	70%	130%	98%	90%	110%			
Copper	9606460		54.1	44.7	19.0%	< 0.2	100%	70%	130%	90%	90%	110%			
Iron	9606459		19900	19600	1.5%	< 10	106%	70%	130%	100%	90%	110%			
Lead	9606460		24.2	23.3	3.8%	< 0.1	92%	70%	130%	91%	90%	110%			
Lithium	9606460		17.6	16.2	8.3%	< 0.5				106%	90%	110%			
Magnesium	9606459		8840	8650	2.2%	< 10	119%	70%	130%	104%	90%	110%			
Manganese	9606460		149	140	6.2%	< 1	85%	70%	130%	97%	90%	110%			
Mercury	9606460		0.30	0.31	3.3%	< 0.01	85%	70%	130%	107%	90%	110%			
Molybdenum	9606460		3.1	3.1	0.0%	< 0.2	82%	70%	130%	95%	90%	110%			
Nickel	9606460		20.7	17.2	18.5%	< 0.5	104%	70%	130%	99%	90%	110%			
Phosphorus	9606459		1060	1110	4.6%	< 5	82%	70%	130%	99%	90%	110%			
Potassium	9606459		2540	2530	0.4%	< 5	113%	70%	130%	104%	90%	110%			
Selenium	9606460		1.6	1.6	0.0%	< 0.1				99%	90%	110%			
Silver	9606460		<0.5	<0.5	NA	< 0.5	104%	70%	130%	93%	90%	110%			
Sodium	9606459		20900	20700	1.0%	< 5	117%	70%	130%	92%	90%	110%			
Strontium	9606460		57	52	9.2%	< 1	106%	70%	130%	94%	90%	110%			
Thallium	9606460		0.4	0.4	NA	< 0.1	100%	70%	130%	99%	90%	110%			
Tin	9606460		4.0	3.9	2.5%	< 0.2	91%	70%	130%	101%	90%	110%			
Titanium	9606459		1010	1010	0.0%	< 1				98%	90%	110%			
Uranium	9606460		1.7	1.6	6.1%	< 0.2	95%	70%	130%	102%	90%	110%			
Vanadium	9606460		48	40	18.2%	< 1	109%	70%	130%	100%	90%	110%			
Zinc	9606460		107	91	16.2%	< 1	102%	70%	130%	92%	90%	110%			
Zirconium	9606460		5.0	4.7	6.2%	< 0.1				102%	90%	110%			
pH 1:2	9606459		7.3	7.4	1.4%		99%	90%	110%	99%	95%	105%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

SAMPLING SITE:

AGAT WORK ORDER: 18V394408

ATTENTION TO: Cheronne Oreiro

SAMPLED BY:

Trace Organics Analysis

RPT Date: Oct 16, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works PAH in Soil Low Level															
Naphthalene	69952	9606474	0.023	0.022	NA	< 0.005	103%	80%	120%				98%	50%	130%
2-Methylnaphthalene	69952	9606474	0.036	0.041	13.0%	< 0.005	100%	80%	120%				96%	50%	130%
1-Methylnaphthalene	69952	9606474	0.008	0.008	NA	< 0.005	102%	80%	120%				100%	50%	130%
Acenaphthylene	69952	9606474	0.013	0.016	NA	< 0.005	102%	80%	120%				89%	50%	130%
Acenaphthene	69952	9606474	0.013	0.013	NA	< 0.005	101%	80%	120%				103%	50%	130%
Fluorene	69952	9606474	<0.02	<0.02	NA	< 0.02	102%	80%	120%				99%	50%	130%
Phenanthrene	69952	9606474	0.08	0.09	NA	< 0.02	101%	80%	120%				95%	60%	130%
Anthracene	69952	9606474	0.051	0.052	1.9%	< 0.004	101%	80%	120%				107%	60%	130%
Fluoranthene	69952	9606474	0.24	0.26	8.0%	< 0.01	104%	80%	120%				102%	60%	130%
Pyrene	69952	9606474	0.31	0.33	6.2%	< 0.01	104%	80%	120%				105%	60%	130%
Benzo(a)anthracene	69952	9606474	0.10	0.12	NA	< 0.03	101%	80%	120%				100%	60%	130%
Chrysene	69952	9606474	0.09	0.10	NA	< 0.05	100%	80%	120%				111%	60%	130%
Benzo(b)fluoranthene	69952	9606474	0.16	0.18	11.8%	< 0.02	100%	80%	120%				100%	60%	130%
Benzo(j)fluoranthene	69952	9606474	0.07	0.07	NA	< 0.02	103%	80%	120%				123%	60%	130%
Benzo(k)fluoranthene	69952	9606474	0.08	0.10	NA	< 0.02	101%	80%	120%				89%	60%	130%
Benzo(a)pyrene	69952	9606474	0.10	0.12	NA	< 0.03	101%	80%	120%				101%	60%	130%
Indeno(1,2,3-c,d)pyrene	69952	9606474	0.04	0.06	NA	< 0.02	99%	80%	120%				61%	60%	130%
Dibenzo(a,h)anthracene	69952	9606474	0.013	0.014	NA	< 0.005	100%	80%	120%				62%	60%	130%
Benzo(g,h,i)perylene	69952	9606474	0.05	0.07	NA	< 0.05	98%	80%	120%				66%	60%	130%
Quinoline	69952	9606474	0.07	0.09	NA	< 0.05	101%	80%	120%				97%	50%	130%
Naphthalene - d8	69952	9606474	82	87	5.9%		103%	80%	120%				83%	50%	130%
2-Fluorobiphenyl	69952	9606474	83	91	9.2%		101%	80%	120%				85%	50%	130%
P-Terphenyl - d14	69952	9606474	87	97	10.9%		106%	80%	120%				86%	60%	130%

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Polychlorinated Biphenyls Analysis [by extended Aroclor list] in Soil	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
Aroclor 1242	134	9606461	<0.05	<0.05	NA	< 0.05	100%	70%	130%	79%	70%	130%	80%	50%	150%
Aroclor 1254	134	9606461	<0.05	<0.05	NA	< 0.05	107%	70%	130%	80%	70%	130%	82%	50%	150%
Aroclor 1260	134	9606461	<0.05	<0.05	NA	< 0.05	112%	70%	130%	79%	70%	130%	80%	50%	150%
Total Polychlorinated Biphenyls	134	9606461	<0.05	<0.05	NA	< 0.05	106%	70%	130%	79%	70%	130%	81%	50%	150%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
SAMPLING SITE:
AGAT WORK ORDER: 18V394408
ATTENTION TO: Cheronne Oreiro
SAMPLED BY:

Ultra Trace Analysis

RPT Date: Oct 16, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Dioxins and Furans (Soil, WHO 2005)															
2,3,7,8-Tetra CDD	1	9583920	0.9	1.0	NA	< 0.1	94%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8-Penta CDD	1	9583920	22.8	23	0.0%	< 0.3	108%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,7,8-Hexa CDD	1	9583920	45	46	0.0%	< 0.3	103%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,6,7,8-Hexa CDD	1	9583920	117	113	0.0%	< 0.3	107%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8,9-Hexa CDD	1	9583920	95	94	0.0%	< 0.3	115%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,6,7,8-Hepta CDD	1	9583920	3150	3140	0.0%	< 0.4	107%	40%	130%	NA	40%	130%	NA	40%	130%
Octa CDD	1	9583920	22400	22000	0.0%	< 0.2	107%	40%	130%	NA	40%	130%	NA	40%	130%
2,3,7,8-Tetra CDF	1	9583920	0.6	0.6	NA	< 0.1	113%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8-Penta CDF	1	9583920	2.7	3	0.0%	< 0.1	108%	40%	130%	NA	40%	130%	NA	40%	130%
2,3,4,7,8-Penta CDF	1	9583920	2.8	3	0.0%	< 0.1	111%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,7,8-Hexa CDF	1	9583920	37	36	0.0%	< 0.1	111%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,6,7,8-Hexa CDF	1	9583920	17	17	0.0%	< 0.1	118%	40%	130%	NA	40%	130%	NA	40%	130%
2,3,4,6,7,8-Hexa CDF	1	9583920	34	34	0.0%	< 0.1	111%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8,9-Hexa CDF	1	9583920	< 2	< 7	NA	< 0.1	106%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,6,7,8-Hepta CDF	1	9583920	949	948	0.0%	< 0.1	109%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,7,8,9-Hepta CDF	1	9583920	63	63	0.0%	< 0.1	115%	40%	130%	NA	40%	130%	NA	40%	130%
Octa CDF	1	9583920	3960	4020	0.0%	< 0.1	108%	40%	130%	NA	40%	130%	NA	40%	130%

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Aluminum	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Antimony	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Arsenic	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Barium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Beryllium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Bismuth	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cadmium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Calcium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Chromium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cobalt	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Copper	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Iron	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Lead	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Lithium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Magnesium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Manganese	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Mercury	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Molybdenum	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Nickel	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Phosphorus	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Potassium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Selenium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Silver	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Sodium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Strontium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Thallium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Tin	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS

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Method Summary

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AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Titanium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Uranium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Vanadium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zinc	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zirconium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
pH 1:2	INOR-181-6031	BC MOE Lab Manual B (pH, Electrometric, Soil)	PH METER

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA — AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation — ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: — SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
1-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluorene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Phenanthrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Chrysene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(b)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(j)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(k)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Indeno(1,2,3-c,d)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Dibenzo(a,h)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(g,h,i)perylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Quinoline	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
IACR CCME (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
B[a]P TPE (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Naphthalene - d8	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Fluorobiphenyl	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
P-Terphenyl - d14	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
Aroclor 1016	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1221	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1232	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1242	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1248	TO-0410	EPA SW-846 8082	GC/ECD

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
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SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Aroclor 1254	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1260	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1262	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1268	TO-0410	EPA SW-846 8082	GC/ECD
Total Polychlorinated Biphenyls	TO-0410	EPA SW-846 8082	GC/ECD
Decachlorobiphenyl	TO-0410	EPA SW-846 8082	GC/ECD

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA | AGAT WORK ORDER: 18V394408
PROJECT: 170553-11.05 EHRP Wood Debris Remediation | ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: | SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Ultra Trace Analysis			
2,3,7,8-Tetra CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD	HR-151-5400	EPA 1613	HRMS
Octa CDD	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF	HR-151-5400	EPA 1613	HRMS
Octa CDF	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total PCDDs	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total PCDFs	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDD (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF (TEF 0.03)	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF (TEF 0.3)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	HR_151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDF (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
Total PCDDs and PCDFs (TEQ)	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDF	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-23478-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDF	HR-151-5400	EPA 1613	HRMS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
SAMPLING SITE:

AGAT WORK ORDER: 18V394408
ATTENTION TO: Cheronne Oreiro
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
13C-123678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-234678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-123789-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-1234789-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDD	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDD	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-123678-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDD	HR-151-5400	EPA 1613	HRMS
13C-OCDD	HR-151-5400	EPA 1613	HRMS

Chain of Custody Record and Laboratory Analysis Request

COC# 18V394408

ANCHOR QEA

Date: 10/4/2018
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	PAHs	PCB Aroclors	Metals	Dioxin/Furans	Comments
1	EHWW-46-SG-000010	10/4/18 0930	SE	2	/	/	/	/	9606459
2	EHWW-45-SG-000010	10/4/18 0850	SE	2	|	|	|	|	460
3	EHWW-44-SG-000010	10/4/18 0815	SE	2	|	|	|	|	461
4	EHWW-14-SG-000010	10/3/18 1208	SE	2	|	|	|	|	462
5	EHWW-33-SG-000010	10/3/18 1120	SE	2	|	|	|	|	463
6	EHWW-30-SG-000010	10/3/18 1035	SE	2	|	|	|	|	464
7	EHWW-10-SG-000010	10/3/18 0950	SE	2	|	|	|	|	465
8	EHWW-04-SG-000010	10/2/18 1545	SE	2	|	|	|	|	466
9	EHWW-18-SG-000010	10/2/18 1005	SE	2	|	|	|	|	467
10	EHWW-19-SG-000010	10/2/18 1055	SE	2	|	|	|	|	468
11	EHWW-42-SG-000010	10/2/18 1245	SE	2	|	|	|	|	469
12	EHWW-48-SG-000010	10/2/18 1420	SE	2	|	|	|	|	470
13	EHWW-148-SG-000010	10/2/18 1425	SE	2	|	|	|	|	471
14	EHWW-06-SG-000010	10/1/18 1455	SE	2	|	|	|	|	472

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Please homogenize sample and subsample necessary volume to send out for PCB and D/F analysis

Relinquished By:	Company:	Received By:	Company:
Evan Malczyk	Anchor QEA LLC.	S. Napier	
Signature/Printed Name	Date/Time: 10/4/2018 2000	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

V116395

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC# 18V394408

ANCHOR QEA

Date: 10/4/2019
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

OCT 3 • 9:05

					Sediment and Field QC				
Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	PAHs	PCB Aroclors	Metals	Dioxin/Furans	Comments
1	EHWW-09-SG-000010	10/1/18 1610	SE	2	1	1	1	1	9606473
2	EHWW-39-SG-000010	10/1/18 1040	SE	2	1	1	1	1	↓ 474
3			SE						
4			SE						
5			SE						
6			SE						
7			SE						
8			SE						
9			SE						
10			SE						
11			SE						
12			SE						
13			SE						
14			SE						

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:
Please homogenize sample and subsample necessary volume to send out for PCB and D/F analysis

Relinquished By:	Company: Anchor QEA LLC.	Received By: S. Napier	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

V116396

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page 2 of 2

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 18V394408

RECEIVING BASICS:

Received From: Ace-Victoria Waybill #: ______

SAMPLE QUANTITIES:

Coolers: 2 Containers: 32

TIME SENSITIVE ISSUES:

Earliest Date Sampled: 01-OCT-18 ALREADY EXCEEDED? Yes No

NON-CONFORMANCES:

3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) *use jars when available

(1) 1 + 0 + 0 = 0 °C (2) 2 + 2 + 2 = 2 °C (3) ___ + ___ + ___ = ___ °C (4) ___ + ___ + ___ = ___ °C

Was ice or ice pack present: Yes No 1°C

Integrity Issues:

Account Project Manager: ______ have they been notified of the above issues: Yes No

Whom spoken to: ______ Date and Time: ______

ADDITIONAL NOTES:

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
219-800 BURRARD ST
VANCOUVER, BC V6Z 0B9
604-671-1831

ATTENTION TO: Cheronne Oreiro

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

AGAT WORK ORDER: 18V422808

SOIL ANALYSIS REVIEWED BY: Dana Solari, Lab Reporter

TRACE ORGANICS REVIEWED BY: Dana Solari, Lab Reporter

ULTRA TRACE REVIEWED BY: Anastasia Kazakova, chimiste

DATE REPORTED: Feb 21, 2019

PAGES (INCLUDING COVER): 31

VERSION*: 4

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES

VERSION 4: Sample receipt temperature 3°C.

Version 4 is issued to report corrected RPD's for Dioxins and Furans. Version 4 is a replacement to all previous versions.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-36-SC-000050	EHWW-03-SC-000050	EHWW-57-SC-000050	EHWW-56-SC-000050	EHWW-38-SC-000050	EHWW-40-SC-000050	EHWW-54-SC-000050	EHWW-65-SC-000050
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801856	9801861	9801862	9801863	9801864	9801865	9801866	9801867
Aluminum	µg/g		10	15100	11500	8030	7730	16100	10700	13400	8210
Antimony	µg/g		0.1	0.8	0.5	0.7	0.2	0.4	0.6	0.2	0.2
Arsenic	µg/g		0.1	19.6	7.5	12.9	7.4	9.2	6.8	6.9	7.5
Barium	µg/g		0.5	45.4	35.0	28.5	19.6	49.5	28.2	35.3	20.2
Beryllium	µg/g		0.1	0.3	0.2	0.2	0.1	0.3	0.2	0.3	0.2
Bismuth	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	µg/g		0.01	3.40	1.81	1.49	1.25	3.25	3.43	4.44	4.30
Calcium	µg/g		10	9110	29000	18500	35900	19300	6510	9220	8160
Chromium	µg/g		1	45	31	47	16	38	33	29	18
Cobalt	µg/g		0.1	8.7	5.4	4.3	4.0	6.1	5.0	4.7	3.8
Copper	µg/g		0.2	91.2	56.8	52.9	22.3	46.6	68.5	30.0	20.7
Iron	µg/g		10	27400	24300	43900	12800	25200	17700	18400	11900
Lead	µg/g		0.1	40.3	20.1	15.0	5.5	29.2	33.4	18.1	9.6
Lithium	µg/g		0.5	18.1	13.5	10.7	8.1	22.4	12.9	15.9	9.4
Magnesium	µg/g		10	11300	10100	9530	3980	9590	9090	6890	4090
Manganese	µg/g		1	225	179	385	130	197	139	156	133
Mercury	µg/g		0.01	0.43	0.31	0.29	0.14	0.54	0.41	0.38	0.22
Molybdenum	µg/g		0.2	19.6	20.6	28.6	3.8	9.5	27.0	7.5	2.7
Nickel	µg/g		0.5	32.6	21.8	19.8	11.9	26.0	22.7	19.3	13.6
Phosphorus	µg/g		5	1180	1240	825	680	915	1060	947	617
Potassium	µg/g		5	2790	2720	2620	1060	2790	2340	1940	863
Selenium	µg/g		0.1	2.5	1.8	1.9	0.3	1.5	2.1	1.0	1.0
Silver	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	µg/g		5	30800	34400	41700	6390	20800	31900	12200	5580
Strontium	µg/g		1	83	239	193	271	162	69	60	49
Thallium	µg/g		0.1	0.5	0.3	0.2	0.4	0.4	0.5	0.5	0.7
Tin	µg/g		0.2	28.9	5.6	3.7	1.3	6.5	8.9	2.6	1.4
Titanium	µg/g		1	912	640	452	699	1170	585	1110	859
Uranium	µg/g		0.2	6.2	6.5	8.4	1.5	3.8	7.8	2.9	1.1

Certified By: D. Solani

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Certificate of Analysis

AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-36-SC-000050	EHWW-03-SC-000050	EHWW-57-SC-000050	EHWW-56-SC-000050	EHWW-38-SC-000050	EHWW-40-SC-000050	EHWW-54-SC-000050	EHWW-65-SC-000050
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801856	9801861	9801862	9801863	9801864	9801865	9801866	9801867
Vanadium	µg/g		1	76	57	51	32	61	58	49	38
Zinc	µg/g		1	158	110	142	37	90	162	70	56
Zirconium	µg/g		0.1	7.1	5.8	5.3	3.7	9.6	5.2	6.5	4.0
pH 1:2	pH units		0.1	6.9	7.2	7.0	8.2	7.5	6.8	7.6	8.0

Certified By: D. Solani

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Burnaby, British Columbia
CANADA V5J 0B6
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Certificate of Analysis

AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

Parameter	Unit	G / S	RDL	EHWW-165-SC-000050	EHWW-53-SC-000016
SAMPLE TYPE:				Soil	Soil
DATE SAMPLED:				2018-12-19	2018-12-19
				9801868	9801869
Aluminum	µg/g		10	8600	12100
Antimony	µg/g		0.1	0.2	0.5
Arsenic	µg/g		0.1	7.0	11.4
Barium	µg/g		0.5	21.1	48.2
Beryllium	µg/g		0.1	0.1	0.2
Bismuth	µg/g		0.5	<0.5	<0.5
Cadmium	µg/g		0.01	4.92	4.92
Calcium	µg/g		10	7430	15400
Chromium	µg/g		1	18	28
Cobalt	µg/g		0.1	4.0	5.1
Copper	µg/g		0.2	21.7	43.7
Iron	µg/g		10	12500	16600
Lead	µg/g		0.1	10.4	84.8
Lithium	µg/g		0.5	10.5	14.4
Magnesium	µg/g		10	4160	6170
Manganese	µg/g		1	142	156
Mercury	µg/g		0.01	0.29	0.55
Molybdenum	µg/g		0.2	2.6	7.9
Nickel	µg/g		0.5	13.3	20.1
Phosphorus	µg/g		5	731	999
Potassium	µg/g		5	885	1670
Selenium	µg/g		0.1	0.8	1.3
Silver	µg/g		0.5	<0.5	<0.5
Sodium	µg/g		5	5250	11800
Strontium	µg/g		1	48	103
Thallium	µg/g		0.1	0.8	0.7
Tin	µg/g		0.2	1.6	2.9
Titanium	µg/g		1	943	891
Uranium	µg/g		0.2	1.0	3.2

Certified By: D. Solani

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AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-165-SC-000050	EHWW-53-SC-000016
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801868	9801869
Vanadium	µg/g		1	38	49
Zinc	µg/g		1	58	98
Zirconium	µg/g		0.1	4.3	5.0
pH 1:2	pH units		0.1	8.0	7.8

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801856-9801869 Results are based on the dry weight of the sample

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Organic Carbon in Soil (%)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-36-SC-000050	EHWW-03-SC-000050	EHWW-57-SC-000050	EHWW-56-SC-000050	EHWW-38-SC-000050	EHWW-40-SC-000050	EHWW-54-SC-000050	EHWW-65-SC-000050
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801856	9801861	9801862	9801863	9801864	9801865	9801866	9801867
Organic Carbon-Total	%		0.02	13.5	13.6	16.1	1.75	4.34	13.4	3.50	1.28

			SAMPLE DESCRIPTION:	EHWW-165-SC-000050	EHWW-53-SC-000016
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801868	9801869
Organic Carbon-Total	%		0.02	1.33	3.32

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Solids in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

Parameter	Unit	G / S	RDL	EHWW-36-SC-000050	EHWW-03-SC-000050	EHWW-57-SC-000050	EHWW-56-SC-000050	EHWW-38-SC-000050	EHWW-40-SC-000050	EHWW-54-SC-000050	EHWW-65-SC-000050
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-19	2018-12-19
				9801856	9801861	9801862	9801863	9801864	9801865	9801866	9801867
Total Solids	%			26	24	21	65	37	24	48	70

Parameter	Unit	G / S	RDL	EHWW-165-SC-000050	EHWW-53-SC-000016
SAMPLE TYPE:				Soil	Soil
DATE SAMPLED:				2018-12-19	2018-12-19
				9801868	9801869
Total Solids	%			70	52

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

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Certificate of Analysis

AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-36-SC-000050	EHWW-03-SC-000050		EHWW-57-SC-000050		EHWW-56-SC-000050		EHWW-38-SC-000050
			SAMPLE TYPE:	Soil	Soil		Soil		Soil		Soil
			DATE SAMPLED:	2018-12-17	2018-12-17		2018-12-17		2018-12-17		2018-12-17
Parameter	Unit	G / S	RDL	9801856	9801861	RDL	9801862	RDL	9801863	RDL	9801864
Naphthalene	µg/g		0.02	0.06	<0.02	0.02	<0.02	0.005	<0.005	0.01	<0.01
2-Methylnaphthalene	µg/g		0.02	0.02	<0.02	0.02	<0.02	0.005	<0.005	0.01	<0.01
1-Methylnaphthalene	µg/g		0.02	<0.02	<0.02	0.02	<0.02	0.005	<0.005	0.01	<0.01
Acenaphthylene	µg/g		0.02	0.03	<0.02	0.02	<0.02	0.005	<0.005	0.01	<0.01
Acenaphthene	µg/g		0.02	0.02	<0.02	0.02	<0.02	0.005	<0.005	0.01	<0.01
Fluorene	µg/g		0.06	<0.06	<0.06	0.08	<0.08	0.02	<0.02	0.04	<0.04
Phenanthrene	µg/g		0.06	0.23	0.08	0.08	<0.08	0.02	<0.02	0.04	0.06
Anthracene	µg/g		0.01	0.11	0.05	0.02	<0.02	0.004	0.004	0.008	0.016
Fluoranthene	µg/g		0.03	0.82	0.50	0.04	0.29	0.01	0.04	0.02	0.09
Pyrene	µg/g		0.03	1.81	0.56	0.04	0.22	0.01	0.04	0.02	0.11
Benzo(a)anthracene	µg/g		0.09	0.38	0.15	0.1	<0.1	0.03	<0.03	0.06	<0.06
Chrysene	µg/g		0.2	0.3	<0.2	0.2	<0.2	0.05	<0.05	0.1	<0.1
Benzo(b)fluoranthene	µg/g		0.06	0.64	0.26	0.08	0.10	0.02	0.03	0.04	0.09
Benzo(j)fluoranthene	µg/g		0.06	0.23	0.08	0.08	<0.08	0.02	<0.02	0.04	<0.04
Benzo(k)fluoranthene	µg/g		0.06	0.36	0.12	0.08	<0.08	0.02	<0.02	0.04	0.04
Benzo(a)pyrene	µg/g		0.09	0.31	0.10	0.1	<0.1	0.03	<0.03	0.06	<0.06
Indeno(1,2,3-c,d)pyrene	µg/g		0.06	0.11	<0.06	0.08	<0.08	0.02	<0.02	0.04	<0.04
Dibenzo(a,h)anthracene	µg/g		0.02	0.02	<0.02	0.02	<0.02	0.005	<0.005	0.01	<0.01
Benzo(g,h,i)perylene	µg/g		0.2	<0.2	<0.2	0.2	<0.2	0.05	<0.05	0.1	<0.1
Quinoline	µg/g		0.2	<0.2	<0.2	0.2	<0.2	0.05	<0.05	0.1	<0.1
IACR CCME (Soil)	µg/g		2	10	3	2	<2	0.6	<0.6	1	1
B[a]P TPE (Soil)	µg/g		0.2	0.5	<0.2	0.2	<0.2	0.05	<0.05	0.1	<0.1
Benzo(b+j)fluoranthene	µg/g		0.05	0.87	0.34	0.05	0.10	0.05	<0.05	0.05	0.09
Surrogate	Unit	Acceptable Limits									
Naphthalene - d8	%	50-130		90	91		82		89		81
2-Fluorobiphenyl	%	50-130		94	97		93		98		95
P-Terphenyl - d14	%	60-130		100	106		116		106		92

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-40-SC-000050		EHWW-54-SC-000050		EHWW-65-SC-000050	EHWW-165-SC-000050	EHWW-53-SC-000016
			SAMPLE TYPE:	Soil		Soil		Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18		2018-12-19		2018-12-19	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801865	RDL	9801866	RDL	9801867	9801868	9801869
Naphthalene	µg/g		0.02	0.11	0.01	<0.01	0.005	<0.005	<0.005	<0.005
2-Methylnaphthalene	µg/g		0.02	0.04	0.01	<0.01	0.005	<0.005	<0.005	0.011
1-Methylnaphthalene	µg/g		0.02	<0.02	0.01	<0.01	0.005	<0.005	<0.005	<0.005
Acenaphthylene	µg/g		0.02	0.03	0.01	<0.01	0.005	<0.005	<0.005	<0.005
Acenaphthene	µg/g		0.02	0.06	0.01	<0.01	0.005	0.014	<0.005	<0.005
Fluorene	µg/g		0.06	<0.06	0.04	<0.04	0.02	<0.02	<0.02	<0.02
Phenanthrene	µg/g		0.06	0.40	0.04	<0.04	0.02	0.12	<0.02	0.03
Anthracene	µg/g		0.01	0.11	0.008	<0.008	0.004	0.038	0.004	0.010
Fluoranthene	µg/g		0.03	1.03	0.02	0.05	0.01	0.14	0.02	0.05
Pyrene	µg/g		0.03	1.12	0.02	0.06	0.01	0.12	0.02	0.08
Benzo(a)anthracene	µg/g		0.09	0.42	0.06	<0.06	0.03	0.05	<0.03	0.03
Chrysene	µg/g		0.2	0.3	0.1	<0.1	0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.06	0.63	0.04	<0.04	0.02	0.06	0.02	0.06
Benzo(j)fluoranthene	µg/g		0.06	0.18	0.04	<0.04	0.02	0.03	<0.02	0.02
Benzo(k)fluoranthene	µg/g		0.06	0.26	0.04	<0.04	0.02	0.04	<0.02	0.02
Benzo(a)pyrene	µg/g		0.09	0.21	0.06	<0.06	0.03	0.05	<0.03	0.03
Indeno(1,2,3-c,d)pyrene	µg/g		0.06	0.07	0.04	<0.04	0.02	0.03	<0.02	0.02
Dibenzo(a,h)anthracene	µg/g		0.02	<0.02	0.01	<0.01	0.005	0.007	<0.005	<0.005
Benzo(g,h,i)perylene	µg/g		0.2	<0.2	0.1	<0.1	0.05	<0.05	<0.05	<0.05
Quinoline	µg/g		0.2	<0.2	0.1	<0.1	0.05	<0.05	<0.05	<0.05
IACR CCME (Soil)	µg/g		2	8	1	<1	0.6	1.1	<0.6	0.8
B[a]P TPE (Soil)	µg/g		0.2	0.3	0.1	<0.1	0.05	0.07	<0.05	<0.05
Benzo(b+j)fluoranthene	µg/g		0.05	0.81	0.05	<0.05	0.05	0.09	<0.05	0.08
Surrogate	Unit	Acceptable Limits								
Naphthalene - d8	%	50-130		96		89		61	90	88
2-Fluorobiphenyl	%	50-130		98		92		64	97	90
P-Terphenyl - d14	%	60-130		105		93		60	100	96

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801856-9801862 Results are based on dry weight of sample.
PAH detection limits increased due to high sample moisture content.

9801863 Results are based on dry weight of sample.

9801864-9801866 Results are based on dry weight of sample.
PAH detection limits increased due to high sample moisture content.

9801867-9801869 Results are based on dry weight of sample.

Analysis performed at AGAT Vancouver (unless marked by *)

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Polychlorinated Biphenyls Analysis - Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-36-SC-000050	EHWW-03-SC-000050	EHWW-57-SC-000050	EHWW-56-SC-000050	EHWW-38-SC-000050	EHWW-40-SC-000050	EHWW-54-SC-000050	EHWW-65-SC-000050
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801856	9801861	9801862	9801863	9801864	9801865	9801866	9801867
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits									
Decachlorobiphenyl	%	50-150		105	86.6	95.7	90.8	86	97	84	96.5

			SAMPLE DESCRIPTION:	EHWW-165-SC-000050	EHWW-53-SC-000016
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9801868	9801869
Aroclor 1242	mg/kg		0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits			
Decachlorobiphenyl	%	50-150		90.5	94.9

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801856-9801869 Results are based on the dry weight of the sample.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20
DATE REPORTED: 2019-02-21

Parameter	Unit	G / S	RDL	EHWW-36-SC-000050	RDL	EHWW-03-SC-000050	RDL	EHWW-57-SC-000050	RDL	EHWW-56-SC-000050
SAMPLE TYPE:				Soil		Soil		Soil		Soil
DATE SAMPLED:				2018-12-17		2018-12-17		2018-12-17		2018-12-17
				9801856		9801861		9801862		9801863
2,3,7,8-Tetra CDD	ng/kg		1	<1	0.8	<0.8	1	<1	0.2	<0.2
1,2,3,7,8-Penta CDD	ng/kg		2	<2	3	<3	5	13	0.6	<0.6
1,2,3,4,7,8-Hexa CDD	ng/kg		1	3	4	<4	6	<6	0.8	<0.8
1,2,3,6,7,8-Hexa CDD	ng/kg		5	13	4	7	5	<5	0.7	1.7
1,2,3,7,8,9-Hexa CDD	ng/kg		5	<5	4	<4	5	<5	0.7	<0.7
1,2,3,4,6,7,8-Hepta CDD	ng/kg		5	191	2	74	6	43	0.8	22.1
Octa CDD	ng/kg		10	948	7	410	50	308	7	102
2,3,7,8-Tetra CDF	ng/kg		2	3	1	3	3	<3	0.5	<0.5
1,2,3,7,8-Penta CDF	ng/kg		3	<3	1	2	6	49	0.9	<0.9
2,3,4,7,8-Penta CDF	ng/kg		3	4	1	<1	5	30	0.7	0.9
1,2,3,4,7,8-Hexa CDF	ng/kg		4	8	2	5	6	42	0.8	1.1
1,2,3,6,7,8-Hexa CDF	ng/kg		5	5	2	3	5	10	0.7	0.8
2,3,4,6,7,8-Hexa CDF	ng/kg		6	6	3	4	7	15	1	<1
1,2,3,7,8,9-Hexa CDF	ng/kg		8	<8	4	<4	10	<10	2	<2
1,2,3,4,6,7,8-Hepta CDF	ng/kg		3	134	2	63	6	65	0.8	11.9
1,2,3,4,7,8,9-Hepta CDF	ng/kg		3	6	2	<2	6	20	0.8	<0.8
Octa CDF	ng/kg		3	74	5	27	10	<10	1	5
Total Tetrachlorodibenzodioxins	ng/kg		1	14	0.8	5.5	1	96	0.2	4.2
Total Pentachlorodibenzodioxins	ng/kg		2	25	3	12	5	114	0.6	6.6
Total Hexachlorodibenzodioxins	ng/kg		5	120	4	61	6	104	0.8	19.8
Total Heptachlorodibenzodioxins	ng/kg		5	405	2	182	6	790	0.8	48.8
Total PCDDs	ng/kg		10	1510	7	671	50	1410	7	182
Total Tetrachlorodibenzofurans	ng/kg		2	75	1	40	3	111	0.5	7.6
Total Pentachlorodibenzofurans	ng/kg		3	43	2	14	6	330	0.9	4.4
Total Hexachlorodibenzofurans	ng/kg		8	217	4	72	10	437	2	19
Total Heptachlorodibenzofurans	ng/kg		3	370	2	127	6	509	0.8	33.5
Total PCDFs	ng/kg		8	780	5	280	10	1390	2	69
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		13.5		0

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AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

Unit 120, 8600 Glenlyon Parkway
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-36-SC-000050		EHWW-03-SC-000050		EHWW-57-SC-000050		EHWW-56-SC-000050
			SAMPLE TYPE:	Soil		Soil		Soil		Soil
			DATE SAMPLED:	2018-12-17		2018-12-17		2018-12-17		2018-12-17
Parameter	Unit	G / S	RDL	9801856	RDL	9801861	RDL	9801862	RDL	9801863
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0.308		0		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			1.27		0.667		0		0.169
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			1.91		0.735		0.428		0.221
Octa CDD (TEF 0.0003)	TEQ			0.284		0.123		0.0924		0.0307
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0.329		0.327		0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0.0503		1.48		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			1.30		0		8.88		0.274
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0.751		0.487		4.19		0.109
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.536		0.307		1.02		0.0785
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.623		0.407		1.51		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			1.34		0.633		0.654		0.119
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0.0617		0		0.201		0
Octa CDF (TEF 0.0003)	TEQ			0.0223		0.00818		0		0.00144
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			8.74		3.75		31.9		1.00

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SAMPLING SITE:

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Dioxins and Furans (Soil, WHO 2005)

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Surrogate	Unit	Acceptable Limits	EHWW-36-SC-000050	EHWW-03-SC-000050	EHWW-57-SC-000050	EHWW-56-SC-000050
		SAMPLE TYPE:	Soil	Soil	Soil	Soil
		DATE SAMPLED:	2018-12-17	2018-12-17	2018-12-17	2018-12-17
			9801856	9801861	9801862	9801863
13C-2378-TCDF	%	30-140	77	75	44	79
13C-12378-PeCDF	%	30-140	76	74	39	74
13C-23478-PeCDF	%	30-140	77	76	36	79
13C-123478-HxCDF	%	30-140	75	71	48	72
13C-123678-HxCDF	%	30-140	72	68	105	72
13C-234678-HxCDF	%	30-140	73	70	58	74
13C-123789-HxCDF	%	30-140	70	70	32	67
13C-1234678-HpCDF	%	30-140	66	65	66	67
13C-1234789-HpCDF	%	30-140	72	68	30	72
13C-2378-TCDD	%	30-140	90	86	40	95
13C-12378-PeCDD	%	30-140	87	83	38	91
13C-123478-HxCDD	%	30-140	57	60	94	61
13C-123678-HxCDD	%	30-140	60	60	76	64
13C-1234678-HpCDD	%	30-140	63	59	52	64
13C-OCDD	%	30-140	41	39	33	38

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Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

Parameter	Unit	G / S	RDL	9801864	RDL	9801865	RDL	9801866	RDL	9801867
			SAMPLE DESCRIPTION:	EHWW-38-SC-000050		EHWW-40-SC-000050		EHWW-54-SC-000050		EHWW-65-SC-000050
			SAMPLE TYPE:	Soil		Soil		Soil		Soil
			DATE SAMPLED:	2018-12-17		2018-12-18		2018-12-19		2018-12-19
2,3,7,8-Tetra CDD	ng/kg		0.7	0.8	0.6	7.2	0.4	<0.4	0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		1	1	5	22	0.9	<0.9	0.5	<0.5
1,2,3,4,7,8-Hexa CDD	ng/kg		3	<3	8	29	0.9	<0.9	1	<1
1,2,3,6,7,8-Hexa CDD	ng/kg		3	3	6	91	0.9	1.8	1	<1
1,2,3,7,8,9-Hexa CDD	ng/kg		3	<3	7	61	0.9	<0.9	1	<1
1,2,3,4,6,7,8-Hepta CDD	ng/kg		3	16	10	388	2	14	2	10
Octa CDD	ng/kg		2	105	40	1170	7	82	3	61
2,3,7,8-Tetra CDF	ng/kg		0.8	3.0	6	23	0.9	<0.9	0.5	<0.5
1,2,3,7,8-Penta CDF	ng/kg		1	3	7	13	1	<1	0.8	<0.8
2,3,4,7,8-Penta CDF	ng/kg		1	2	7	24	1	1	0.7	<0.7
1,2,3,4,7,8-Hexa CDF	ng/kg		1	3	5	14	1	3	0.6	1.3
1,2,3,6,7,8-Hexa CDF	ng/kg		1	3	5	14	1	<1	0.6	0.6
2,3,4,6,7,8-Hexa CDF	ng/kg		2	<2	6	14	1	2	0.6	<0.6
1,2,3,7,8,9-Hexa CDF	ng/kg		2	<2	10	<10	2	<2	0.8	<0.8
1,2,3,4,6,7,8-Hepta CDF	ng/kg		2	25	10	95	4	62	1	12
1,2,3,4,7,8,9-Hepta CDF	ng/kg		3	<3	10	<10	6	<6	2	<2
Octa CDF	ng/kg		0.6	<0.6	6	16	5	<5	1	<1
Total Tetrachlorodibenzodioxins	ng/kg		0.7	2.6	0.6	230	0.4	5.4	0.3	0.8
Total Pentachlorodibenzodioxins	ng/kg		1	6	5	728	0.9	11.3	0.5	0.8
Total Hexachlorodibenzodioxins	ng/kg		3	11	8	1320	0.9	15.5	1	8
Total Heptachlorodibenzodioxins	ng/kg		3	45	10	1430	2	14	2	25
Total PCDDs	ng/kg		3	170	40	4880	7	128	3	96
Total Tetrachlorodibenzofurans	ng/kg		0.8	21.9	6	387	0.9	23.7	0.5	8.0
Total Pentachlorodibenzofurans	ng/kg		1	18	7	157	1	11	0.8	2.9
Total Hexachlorodibenzofurans	ng/kg		2	26	10	223	2	39	0.8	9.4
Total Heptachlorodibenzofurans	ng/kg		3	46	10	158	6	92	2	20
Total PCDFs	ng/kg		3	112	10	940	6	165	2	40
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0.826		7.25		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			1.25		22.2		0		0

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Certificate of Analysis

AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

			SAMPLE DESCRIPTION:	EHWW-38-SC-000050		EHWW-40-SC-000050		EHWW-54-SC-000050		EHWW-65-SC-000050
			SAMPLE TYPE:	Soil		Soil		Soil		Soil
			DATE SAMPLED:	2018-12-17		2018-12-18		2018-12-19		2018-12-19
Parameter	Unit	G / S	RDL	9801864	RDL	9801865	RDL	9801866	RDL	9801867
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		2.92		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0.306		9.15		0.180		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		6.11		0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.162		3.88		0.136		0.103
Octa CDD (TEF 0.0003)	TEQ			0.0315		0.351		0.0245		0.0182
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0.305		2.28		0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0.0776		0.397		0		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0.602		7.30		0.415		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0.313		1.36		0.340		0.127
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.259		1.37		0		0.0615
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		1.42		0.203		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.252		0.951		0.621		0.115
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0
Octa CDF (TEF 0.0003)	TEQ			0		0.00481		0		0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			4.38		66.9		1.92		0.424

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ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

Surrogate	Unit	Acceptable Limits	EHWW-38-SC-000050	EHWW-40-SC-000050	EHWW-54-SC-000050	EHWW-65-SC-000050
		SAMPLE TYPE:	Soil	Soil	Soil	Soil
		DATE SAMPLED:	2018-12-17	2018-12-18	2018-12-19	2018-12-19
			9801864	9801865	9801866	9801867
13C-2378-TCDF	%	30-140	85	58	74	67
13C-12378-PeCDF	%	30-140	81	63	71	66
13C-23478-PeCDF	%	30-140	90	58	76	71
13C-123478-HxCDF	%	30-140	74	47	72	66
13C-123678-HxCDF	%	30-140	75	47	75	66
13C-234678-HxCDF	%	30-140	78	45	76	69
13C-123789-HxCDF	%	30-140	73	30	72	65
13C-1234678-HpCDF	%	30-140	73	60	69	60
13C-1234789-HpCDF	%	30-140	76	36	72	63
13C-2378-TCDD	%	30-140	98	67	85	76
13C-12378-PeCDD	%	30-140	100	64	81	78
13C-123478-HxCDD	%	30-140	65	42	71	66
13C-123678-HxCDD	%	30-140	67	47	73	67
13C-1234678-HpCDD	%	30-140	67	36	65	55
13C-OCDD	%	30-140	39	44	46	38

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SAMPLING SITE: | SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20 | DATE REPORTED: 2019-02-21

Parameter	Unit	G / S	RDL	EHWW-165-SC-000050	RDL	EHWW-53-SC-000016
		SAMPLE TYPE:		Soil		Soil
		DATE SAMPLED:		2018-12-19		2018-12-19
				9801868		9801869
2,3,7,8-Tetra CDD	ng/kg		0.4	<0.4	0.8	<0.8
1,2,3,7,8-Penta CDD	ng/kg		0.6	<0.6	2	<2
1,2,3,4,7,8-Hexa CDD	ng/kg		1	<1	3	<3
1,2,3,6,7,8-Hexa CDD	ng/kg		1	1	3	4
1,2,3,7,8,9-Hexa CDD	ng/kg		1	<1	3	<3
1,2,3,4,6,7,8-Hepta CDD	ng/kg		2	10	8	41
Octa CDD	ng/kg		3	79	10	227
2,3,7,8-Tetra CDF	ng/kg		0.6	<0.6	2	<2
1,2,3,7,8-Penta CDF	ng/kg		0.5	<0.5	3	<3
2,3,4,7,8-Penta CDF	ng/kg		0.5	1.0	2	<2
1,2,3,4,7,8-Hexa CDF	ng/kg		0.4	1.3	3	3
1,2,3,6,7,8-Hexa CDF	ng/kg		0.4	<0.4	3	<3
2,3,4,6,7,8-Hexa CDF	ng/kg		0.4	0.9	3	<3
1,2,3,7,8,9-Hexa CDF	ng/kg		0.6	<0.6	5	<5
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.9	17.5	2	55
1,2,3,4,7,8,9-Hepta CDF	ng/kg		1	<1	2	<2
Octa CDF	ng/kg		0.9	<0.9	4	<4
Total Tetrachlorodibenzodioxins	ng/kg		0.4	0.5	0.8	9.3
Total Pentachlorodibenzodioxins	ng/kg		0.6	2.2	2	10
Total Hexachlorodibenzodioxins	ng/kg		1	3	3	12
Total Heptachlorodibenzodioxins	ng/kg		2	14	8	47
Total PCDDs	ng/kg		3	99	10	306
Total Tetrachlorodibenzofurans	ng/kg		0.6	7.2	2	26
Total Pentachlorodibenzofurans	ng/kg		0.5	3.7	3	16
Total Hexachlorodibenzofurans	ng/kg		0.6	12.7	5	34
Total Heptachlorodibenzofurans	ng/kg		1	28	2	90
Total PCDFs	ng/kg		1	52	5	165
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0

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Parameter	Unit	G / S	RDL	9801868	RDL	9801869
SAMPLE DESCRIPTION:				EHWW-165-SC-000050		EHWW-53-SC-000016
SAMPLE TYPE:				Soil		Soil
DATE SAMPLED:				2018-12-19		2018-12-19
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0.145		0.353
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.0998		0.410
Octa CDD (TEF 0.0003)	TEQ			0.0237		0.0682
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0.306		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0.131		0.331
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.0925		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.175		0.552
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0
Octa CDF (TEF 0.0003)	TEQ			0		0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.972		1.71

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PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-21

Surrogate	Unit	Acceptable Limits	9801868	9801869
		SAMPLE DESCRIPTION:	EHWW-165-SC-000050	EHWW-53-SC-000016
		SAMPLE TYPE:	Soil	Soil
		DATE SAMPLED:	2018-12-19	2018-12-19
13C-2378-TCDF	%	30-140	68	86
13C-12378-PeCDF	%	30-140	68	75
13C-23478-PeCDF	%	30-140	70	83
13C-123478-HxCDF	%	30-140	72	77
13C-123678-HxCDF	%	30-140	75	73
13C-234678-HxCDF	%	30-140	78	78
13C-123789-HxCDF	%	30-140	70	70
13C-1234678-HpCDF	%	30-140	66	58
13C-1234789-HpCDF	%	30-140	65	61
13C-2378-TCDD	%	30-140	79	95
13C-12378-PeCDD	%	30-140	75	87
13C-123478-HxCDD	%	30-140	70	76
13C-123678-HxCDD	%	30-140	71	76
13C-1234678-HpCDD	%	30-140	58	49
13C-OCDD	%	30-140	33	31

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801856-9801869 The results were corrected based on the surrogate percent recoveries.

Analysis performed at AGAT Montreal (unless marked by *)

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AGAT Laboratories

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA | AGAT WORK ORDER: 18V422808
PROJECT: 170553-11.05 EHRP Wood Debris Remediation | ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: | SAMPLED BY:

Soil Analysis

RPT Date: Feb 21, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works Metals in Soil															
Aluminum	9801867		8210	9010	9.3%	< 10	113%	70%	130%	103%	90%	110%			
Antimony	9801867		0.4	0.4	NA	< 0.1	120%	70%	130%	101%	90%	110%			
Arsenic	9801864		9.2	10.2	10.7%	< 0.1	100%	70%	130%	102%	90%	110%			
Barium	9801864		49.5	48.8	1.5%	< 0.5	101%	70%	130%	98%	90%	110%			
Beryllium	9801864		0.3	0.3	NA	< 0.1	106%	70%	130%	104%	90%	110%			
Bismuth	9801864		<0.5	<0.5	NA	< 0.5				105%	90%	110%			
Cadmium	9801864		3.25	3.13	4.0%	< 0.01	106%	70%	130%	101%	90%	110%			
Calcium	9801867		8160	7150	13.2%	< 10	124%	70%	130%	95%	90%	110%			
Chromium	9801864		38	38	0.3%	< 1	125%	70%	130%	108%	90%	110%			
Cobalt	9801864		6.1	6.1	0.7%	< 0.1	112%	70%	130%	101%	90%	110%			
Copper	9801864		46.6	46.5	0.3%	< 0.2	118%	70%	130%	107%	90%	110%			
Iron	9801867		11900	12300	2.9%	< 10	108%	70%	130%	105%	90%	110%			
Lead	9801864		29.2	24.8	16.4%	< 0.1	90%	70%	130%	93%	90%	110%			
Lithium	9801864		22.4	21.5	4.1%	< 0.5				95%	90%	110%			
Magnesium	9801867		4090	4220	3.2%	< 10	114%	70%	130%	103%	90%	110%			
Manganese	9801864		197	190	3.2%	< 1	101%	70%	130%	95%	90%	110%			
Mercury	9801864		0.54	0.49	8.9%	< 0.01	115%	70%	130%	105%	90%	110%			
Molybdenum	9801864		9.5	9.7	1.8%	< 0.2	107%	70%	130%	103%	90%	110%			
Nickel	9801864		26.0	25.0	3.7%	< 0.5	126%	70%	130%	110%	90%	110%			
Phosphorus	9801867		617	690	11.2%	< 5	82%	70%	130%	97%	90%	110%			
Potassium	9801867		863	981	12.8%	< 5	128%	70%	130%	102%	90%	110%			
Selenium	9801864		1.5	1.4	11.6%	< 0.1				97%	90%	110%			
Silver	9801864		<0.5	<0.5	NA	< 0.5	125%	70%	130%	102%	90%	110%			
Sodium	9801867		5580	5350	4.1%	< 5	130%	70%	130%	110%	90%	110%			
Strontium	9801864		162	166	2.1%	< 1	117%	70%	130%	102%	90%	110%			
Thallium	9801864		0.4	0.4	NA	< 0.1	130%	70%	130%	105%	90%	110%			
Tin	9801864		6.5	6.1	6.9%	< 0.2	108%	70%	130%	109%	90%	110%			
Titanium	9801867		859	935	8.5%	< 1				97%	90%	110%			
Uranium	9801864		3.8	3.8	0.9%	< 0.2	106%	70%	130%	104%	90%	110%			
Vanadium	9801864		61	60	1.6%	< 1	123%	70%	130%	105%	90%	110%			
Zinc	9801864		90	83	7.4%	< 1	112%	70%	130%	101%	90%	110%			
Zirconium	9801864		9.6	9.5	1.2%	< 0.1				96%	90%	110%			
pH 1:2	9801867		8.0	8.0	0.4%		98%	90%	110%	99%	95%	105%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

AGAT WORK ORDER: 18V422808

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Feb 21, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works PAH in Soil Low Level															
Naphthalene	70408	9801856	0.067	0.049	31.0%	< 0.005	103%	80%	120%				90%	50%	130%
2-Methylnaphthalene	70408	9801856	0.023	0.022	NA	< 0.005	105%	80%	120%				91%	50%	130%
1-Methylnaphthalene	70408	9801856	0.009	0.005	NA	< 0.005	105%	80%	120%				98%	50%	130%
Acenaphthylene	70408	9801856	0.038	0.031	20.3%	< 0.005	100%	80%	120%				89%	50%	130%
Acenaphthene	70408	9801856	0.028	0.027	3.6%	< 0.005	105%	80%	120%				99%	50%	130%
Fluorene	70408	9801856	0.03	0.02	NA	< 0.02	100%	80%	120%				95%	50%	130%
Phenanthrene	70408	9801856	0.23	0.32	32.7%	< 0.02	100%	80%	120%				78%	60%	130%
Anthracene	70408	9801856	0.110	0.096	13.6%	< 0.004	102%	80%	120%				112%	60%	130%
Fluoranthene	70408	9801856	0.82	1.01	20.8%	< 0.01	102%	80%	120%				98%	60%	130%
Pyrene	70408	9801856	1.81	2.52	32.8%	< 0.01	99%	80%	120%				108%	60%	130%
Benzo(a)anthracene	70408	9801856	0.38	0.24	45.2%	< 0.03	101%	80%	120%				86%	60%	130%
Chrysene	70408	9801856	0.32	0.22	NA	< 0.05	101%	80%	120%				105%	60%	130%
Benzo(b)fluoranthene	70408	9801856	0.64	0.47	30.6%	< 0.02	101%	80%	120%				78%	60%	130%
Benzo(j)fluoranthene	70408	9801856	0.23	0.16	35.9%	< 0.02	101%	80%	120%				83%	60%	130%
Benzo(k)fluoranthene	70408	9801856	0.36	0.24	40.0%	< 0.02	99%	80%	120%				79%	60%	130%
Benzo(a)pyrene	70408	9801856	0.31	0.19	48.0%	< 0.03	101%	80%	120%				108%	60%	130%
Indeno(1,2,3-c,d)pyrene	70408	9801856	0.11	0.08	NA	< 0.02	101%	80%	120%				103%	60%	130%
Dibenzo(a,h)anthracene	70408	9801856	0.029	0.019	NA	< 0.005	103%	80%	120%				106%	60%	130%
Benzo(g,h,i)perylene	70408	9801856	0.13	0.09	NA	< 0.05	99%	80%	120%				101%	60%	130%
Quinoline	70408	9801856	0.07	0.06	NA	< 0.05	89%	80%	120%				112%	50%	130%
Naphthalene - d8	70408	9801856	90	81	10.5%		104%	80%	120%				90%	50%	130%
2-Fluorobiphenyl	70408	9801856	94	93	1.1%		101%	80%	120%				94%	50%	130%
P-Terphenyl - d14	70408	9801856	100	100	0.0%		101%	80%	120%				97%	60%	130%

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Polychlorinated Biphenyls Analysis - Soil	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
Aroclor 1242	173	9801887	<0.05	<0.05	NA	< 0.05	114%	70%	130%	124%	70%	130%	118%	50%	150%
Aroclor 1254	173	9801887	<0.05	<0.05	NA	< 0.05	101%	70%	130%	104%	70%	130%	98%	50%	150%
Aroclor 1260	173	9801887	<0.05	<0.05	NA	< 0.05	107%	70%	130%	101%	70%	130%	103%	50%	150%
Total Polychlorinated Biphenyls	173	9801887	<0.05	<0.05	NA	< 0.05	107%	70%	130%	110%	70%	130%	106%	50%	150%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422808
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Ultra Trace Analysis

RPT Date: Feb 21, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Dioxins and Furans (Soil, WHO 2005)															
2,3,7,8-Tetra CDD	1	9744700	< 0.4	< 0.3	NA	< 0.1	84%	40%	130%	NA	40%	130%	81%	40%	130%
1,2,3,7,8-Penta CDD	1	9744700	< 1	< 0.6	NA	< 0.4	90%	40%	130%	NA	40%	130%	87%	40%	130%
1,2,3,4,7,8-Hexa CDD	1	9744700	< 1	< 0.9	NA	< 0.2	93%	40%	130%	NA	40%	130%	89%	40%	130%
1,2,3,6,7,8-Hexa CDD	1	9744700	2	1.6	NA	< 0.2	100%	40%	130%	NA	40%	130%	95%	40%	130%
1,2,3,7,8,9-Hexa CDD	1	9744700	1	1.7	NA	< 0.2	92%	40%	130%	NA	40%	130%	88%	40%	130%
1,2,3,4,6,7,8-Hepta CDD	1	9744700	11.2	10.4	7.4%	< 0.3	89%	40%	130%	NA	40%	130%	94%	40%	130%
Octa CDD	1	9744700	76	85	11.2%	< 0.1	106%	40%	130%	NA	40%	130%	121%	40%	130%
2,3,7,8-Tetra CDF	1	9744700	5.1	5.6	9.3%	< 0.2	100%	40%	130%	NA	40%	130%	99%	40%	130%
1,2,3,7,8-Penta CDF	1	9744700	2	2	0.0%	< 0.1	117%	40%	130%	NA	40%	130%	115%	40%	130%
2,3,4,7,8-Penta CDF	1	9744700	2.6	2.6	0.0%	< 0.3	111%	40%	130%	NA	40%	130%	113%	40%	130%
1,2,3,4,7,8-Hexa CDF	1	9744700	6.7	7	4.4%	< 0.2	109%	40%	130%	NA	40%	130%	108%	40%	130%
1,2,3,6,7,8-Hexa CDF	1	9744700	2.7	3	10.5%	< 0.2	106%	40%	130%	NA	40%	130%	115%	40%	130%
2,3,4,6,7,8-Hexa CDF	1	9744700	2.8	3	6.9%	< 0.2	111%	40%	130%	NA	40%	130%	115%	40%	130%
1,2,3,7,8,9-Hexa CDF	1	9744700	< 0.9	< 2	NA	< 0.2	101%	40%	130%	NA	40%	130%	107%	40%	130%
1,2,3,4,6,7,8-Hepta CDF	1	9744700	12.2	12.3	0.8%	< 0.3	111%	40%	130%	NA	40%	130%	108%	40%	130%
1,2,3,4,7,8,9-Hepta CDF	1	9744700	2.0	1.9	5.1%	< 0.3	108%	40%	130%	NA	40%	130%	105%	40%	130%
Octa CDF	1	9744700	< 1	< 1	NA	< 0.1	78%	40%	130%	NA	40%	130%	117%	40%	130%

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA | AGAT WORK ORDER: 18V422808
PROJECT: 170553-11.05 EHRP Wood Debris Remediation | ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: | SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Aluminum	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Antimony	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Arsenic	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Barium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Beryllium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Bismuth	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cadmium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Calcium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Chromium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cobalt	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Copper	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Iron	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Lead	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Lithium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Magnesium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Manganese	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Mercury	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Molybdenum	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Nickel	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Phosphorus	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Potassium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Selenium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Silver	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Sodium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Strontium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Thallium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Tin	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Titanium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Uranium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Vanadium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zinc	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zirconium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
pH 1:2	INOR-181-6031	BC MOE Lab Manual B (pH, Electrometric, Soil)	PH METER

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
1-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluorene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Phenanthrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Chrysene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(b)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(j)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(k)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Indeno(1,2,3-c,d)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Dibenzo(a,h)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(g,h,i)perylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Quinoline	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
IACR CCME (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
B[a]P TPE (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Naphthalene - d8	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Fluorobiphenyl	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
P-Terphenyl - d14	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
Aroclor 1242	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1254	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1260	TO-0410	EPA SW-846 8082	GC/ECD
Total Polychlorinated Biphenyls	TO-0410	EPA SW-846 8082	GC/ECD
Decachlorobiphenyl	TO-0410	EPA SW-846 8082	GC/ECD

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Ultra Trace Analysis			
2,3,7,8-Tetra CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD	HR-151-5400	EPA 1613	HRMS
Octa CDD	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF	HR-151-5400	EPA 1613	HRMS
Octa CDF	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total PCDDs	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total PCDFs	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDD (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF (TEF 0.03)	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF (TEF 0.3)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	HR_151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDF (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
Total PCDDs and PCDFs (TEQ)	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDF	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-23478-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDF	HR-151-5400	EPA 1613	HRMS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422808
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
13C-123678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-234678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-123789-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-1234789-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDD	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDD	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-123678-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDD	HR-151-5400	EPA 1613	HRMS
13C-OCDD	HR-151-5400	EPA 1613	HRMS

RMP

Chain of Custody Record and Laboratory Analysis Request

WO. 18V422808

COC#

ANCHOR QEA

Date: 12/17/18
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

2°C

DEC 20 09:15

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	~~Bulk Sulphides~~	~~Ammonia~~	~~TVS~~	~~Grain Size~~	~~Moisture Content~~	~~Atterberg Limits~~	~~TCLP Metals~~						Comments (AGAT Sample I.D.)
1	EHWW-36-SC-000050	12/17/18 1025	SE	4	X	X	X	X	X													9801856
2	EHWW-03-SC-000050	12/17/18 1155	SE	4	X	X	X	X	X													61
3	EHWW-57-SC-000050	12/17/18 1445	SE	4	X	X	X	X	X													62
4	EHWW-56-SC-000050	12/17/18 0905	SE	4	X	X	X	X	X													63
5	EHWW-38-SC-000050	12/17/18 1630	SE	4	X	X	X	X	X													64
6	EHWW-40-SC-000050	12/18/18 0850	SE	4	X	X	X	X	X													65
7			SE																			
8			SE																			
9			SE																			
10			SE																			
11			SE																			
12			SE																			
13			SE																			
14			SE																			

Sediment and Field QC

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name: Eli Portmont	Date/Time: 12/18/2018 18:06	Signature/Printed Name: Rebecca [illegible]	Date/Time:

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the origin

1 of ____

V117088

RMP

WO 18V422808 4°

Chain of C... dy Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 12/19/18
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

DEC 20 AM 9:14

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals						AGAT Sample I.D. Comments
					Sediment and Field QC																	
1	EHWW-S4-SC-000050	12/18/18 1630	SE	4	X	X	X	X	X													9801866
2	EHWW-6S-SC-000050	12/19/18 1200	SE	4	X	X	X	X	X													67
3	EHWW-16S-SC-000050	12/19/18 1205	SE	4	X	X	X	X	X													68
4	EHWW-S3-SC-000016	12/19/18 1415	SE	4	X	X	X	X	X													69
5			SE																			
6			SE																			
7			SE																			
8			SE																			
9			SE																			
10			SE																			
11			SE																			
12			SE																			
13			SE																			
14			SE																			

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time 12/19/18 1555	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original. of ____

V117089

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 18V422808

RECEIVING BASICS:
Received From: ACE IEI - [illegible] Waybill #: ______

SAMPLE QUANTITIES:
Coolers: 8 Containers: 40

TIME SENSITIVE ISSUES:
Earliest Date Sampled: 12-17-2018 ALREADY EXCEEDED? Yes No

NON-CONFORMANCES:
3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) ***use jars when available**

(1) 0 + 0 + 3 = 1 °C (2) 1 + 0 + 0 = 1 °C (3) 0 + 0 + 4 = 2 °C (4) 0 + 0 + 0 = 0 °C

Was ice or ice pack present: Yes No

Integrity Issues: (5) 4+4+3=4 ; (6) 2+3+3=3 ; (7) 4+5+4=4 ; (8) 4+2+0=2

Account Project Manager: ______ have they been notified of the above issues: Yes No

Whom spoken to: ______ Date and Time: ______

ADDITIONAL NOTES:

Document #: SR-186-9504.001
Revision Date: July 9, 2014

Page 1 of 1

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
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http://www.agatlabs.com

CLIENT NAME:	PUBLIC WORKS AND GOVERNMENT SERVICES CANADA 219-800 BURRARD ST VANCOUVER, BC V6Z 0B9 604-671-1831
ATTENTION TO:	Cheronne Oreiro
PROJECT:	170553-11.05 EHRP Wood Debris Remediation
AGAT WORK ORDER:	18V422820
SOIL ANALYSIS REVIEWED BY:	Dana Solari, Lab Reporter
TRACE ORGANICS REVIEWED BY:	Dana Solari, Lab Reporter
ULTRA TRACE REVIEWED BY:	Philippe Morneau, chimiste
DATE REPORTED:	Jan 11, 2019
PAGES (INCLUDING COVER):	39
VERSION*:	4

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES

VERSION 4: Sample receipt temperature 3°C.

Version 4 is issued to report complete results. Version 4 is an amendment to all previous versions.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Moisture Content Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Parameter	Unit	G / S	RDL		
			SAMPLE DESCRIPTION:	EHWW-58-SC-411461	EHWW-38-SC-000050
			SAMPLE TYPE:	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17
				9801889	9801932
Moisture	%		0.5	28.9	60.5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

AGAT Laboratories
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Particle Size by Sieve

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Parameter	Unit	G / S	RDL	9801887	9801891	9801896	9801899	9801925	9801928	9801932	9801935
SAMPLE DESCRIPTION:				EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-000050	EHWW-03-SC-150200	EHWW-57-SC-000050	EHWW-56-SC-000050	EHWW-38-SC-000050	EHWW-38-SC-050100
SAMPLE TYPE:				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
DATE SAMPLED:				2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17	2018-12-17
Sieve Analysis - 75 microns	%		1	45	6	47	44	61	60	14	5
Sieve Texture				Fine	Fine	Fine	Fine	Coarse	Coarse	Fine	Fine

Parameter	Unit	G / S	RDL	9801944	9801945	9801948	9801952	9801956
SAMPLE DESCRIPTION:				EHWW-40-SC-000050	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
SAMPLE TYPE:				Sediment	Sediment	Sediment	Sediment	Sediment
DATE SAMPLED:				2018-12-18	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Sieve Analysis - 75 microns	%		1	80	55	15	8	26
Sieve Texture				Coarse	Coarse	Fine	Fine	Fine

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801887-9801956 Value reported is amount of sample retained on a 75 micron sieve after wash with water and represents proportion by weight particles larger than indicated sieve size.

Analysis performed at AGAT Edmonton (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
Aluminum	µg/g		10	22100	29100	17600	16200	8370	13400	14300	12500
Antimony	µg/g		0.1	0.3	0.4	0.4	0.2	0.2	0.2	0.2	0.2
Arsenic	µg/g		0.1	5.7	6.3	6.3	8.1	9.1	6.4	8.4	8.3
Barium	µg/g		0.5	61.3	103	70.1	43.9	20.3	32.7	34.4	29.2
Beryllium	µg/g		0.1	0.4	0.5	0.3	0.4	0.1	0.2	0.3	0.2
Bismuth	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	µg/g		0.01	0.93	0.31	1.18	3.86	1.47	4.32	3.88	4.59
Calcium	µg/g		10	71600	13800	39200	10100	35000	16600	9080	17900
Chromium	µg/g		1	42	49	35	33	16	29	30	25
Cobalt	µg/g		0.1	12.0	18.3	10.2	5.7	5.0	5.0	5.6	4.9
Copper	µg/g		0.2	43.2	59.6	33.8	19.5	14.0	18.7	18.8	17.7
Iron	µg/g		10	32200	39200	24900	21600	13000	17900	19900	17200
Lead	µg/g		0.1	4.2	6.1	4.4	5.5	4.4	6.8	3.0	2.8
Lithium	µg/g		0.5	30.3	30.9	24.2	21.0	7.8	16.0	18.0	14.3
Magnesium	µg/g		10	11100	14900	8330	7240	3840	6160	6490	5470
Manganese	µg/g		1	383	752	330	202	188	185	198	178
Mercury	µg/g		0.01	0.04	0.06	0.04	0.08	0.08	0.09	0.04	0.05
Molybdenum	µg/g		0.2	2.7	0.5	4.9	4.4	7.4	4.4	3.6	3.2
Nickel	µg/g		0.5	34.0	48.1	29.5	20.7	11.5	17.3	19.6	17.0
Phosphorus	µg/g		5	577	494	579	830	657	825	812	748
Potassium	µg/g		5	3000	3490	3060	2290	853	1830	2030	1650
Selenium	µg/g		0.1	1.5	0.9	2.2	2.8	2.9	1.7	1.3	2.8
Silver	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	µg/g		5	6340	5530	6190	9090	4130	8420	7430	6920
Strontium	µg/g		1	595	83	309	82	251	118	63	113
Thallium	µg/g		0.1	0.2	0.1	0.3	0.4	0.4	0.5	0.5	0.7
Tin	µg/g		0.2	0.4	0.6	0.5	1.7	1.5	1.3	0.6	0.4
Titanium	µg/g		1	1300	1800	1270	1300	873	1090	1260	1180
Uranium	µg/g		0.2	1.5	0.6	1.7	1.9	1.9	1.7	1.6	1.2

Certified By: D. Solani

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
Vanadium	µg/g		1	80	99	63	54	38	46	49	43
Zinc	µg/g		1	64	88	52	65	31	54	55	58
Zirconium	µg/g		0.1	7.8	11.1	9.7	9.8	4.9	7.3	8.4	7.3
pH 1:2	pH units		0.1	8.5	8.5	8.5	7.8	7.8	7.8	7.8	7.6

Certified By: D. Solani

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
Aluminum	µg/g		10	13000
Antimony	µg/g		0.1	0.2
Arsenic	µg/g		0.1	7.4
Barium	µg/g		0.5	29.8
Beryllium	µg/g		0.1	0.2
Bismuth	µg/g		0.5	<0.5
Cadmium	µg/g		0.01	4.61
Calcium	µg/g		10	10900
Chromium	µg/g		1	24
Cobalt	µg/g		0.1	4.8
Copper	µg/g		0.2	18.3
Iron	µg/g		10	17800
Lead	µg/g		0.1	2.8
Lithium	µg/g		0.5	14.7
Magnesium	µg/g		10	5590
Manganese	µg/g		1	178
Mercury	µg/g		0.01	0.03
Molybdenum	µg/g		0.2	3.3
Nickel	µg/g		0.5	17.5
Phosphorus	µg/g		5	751
Potassium	µg/g		5	1720
Selenium	µg/g		0.1	3.9
Silver	µg/g		0.5	<0.5
Sodium	µg/g		5	7350
Strontium	µg/g		1	71
Thallium	µg/g		0.1	0.7
Tin	µg/g		0.2	0.4
Titanium	µg/g		1	1220
Uranium	µg/g		0.2	1.2

Certified By: D. Solani

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
Vanadium	μg/g		1	42
Zinc	μg/g		1	48
Zirconium	μg/g		0.1	7.5
pH 1:2	pH units		0.1	7.5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801887-9802033 Results are based on the dry weight of the sample

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

AGAT Laboratories
Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
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TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Soil Analysis - Ammonia

DATE RECEIVED: 2018-12-20
DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
Ammonia, Soluble	mg/L		1	<1	2	<1	1	<1	1	<1	<1
Ammonia-N, Total Soluble (Soil)	mg/kg		1	<1	2	<1	<1	<1	<1	<1	<1

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
Ammonia, Soluble	mg/L		1	2
Ammonia-N, Total Soluble (Soil)	mg/kg		1	1

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
Analysis performed at AGAT Edmonton (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - Atterberg Limits

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Parameter	Unit	G / S	RDL	EHWW-58-SC-411461	EHWW-03-SC-150200	EHWW-38-SC-000050	EHWW-38-SC-050100	EHWW-16-SC-152202
SAMPLE DESCRIPTION:				EHWW-58-SC-411461	EHWW-03-SC-150200	EHWW-38-SC-000050	EHWW-38-SC-050100	EHWW-16-SC-152202
SAMPLE TYPE:				Sediment	Sediment	Sediment	Sediment	Sediment
DATE SAMPLED:				2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18
				9801889	9801899	9801932	9801935	9801956
Liquid Limit			1	53	31	NR	NR	NR
Plastic Limit			1	27	18	NR	NR	NR
Plasticity Index				27	13	NR	NR	NR

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801889-9801899 Plasticity Index is a calculated parameter. The calculated value is the difference between the liquid limit and the plastic limit.

9801932-9801956 Plasticity Index is a calculated parameter. The calculated value is the difference between the liquid limit and the plastic limit.
Not reportable due to nature of the sample (oily matrix).

Analysis performed at AGAT Edmonton (unless marked by *)

Certified By: D. Solani

Certificate of Analysis

AGAT Laboratories

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Sulphide in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233		EHWW-03-SC-000050		EHWW-03-SC-150200		EHWW-57-SC-000050
			SAMPLE TYPE:	Sediment	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17		2018-12-17		2018-12-17		2018-12-17
Parameter	Unit	G / S	RDL	9801887	9801891	RDL	9801896	RDL	9801899	RDL	9801925
Sulphur - Total	%		0.01	0.24	0.52	0.01	2.65	0.01	0.55	0.01	5.15
Sulphate Sulphur	%		0.01	0.04	0.03	0.02	0.24	0.01	0.04	0.05	0.42
Sulphide (Calculation)	%		0.01	0.20	0.49	0.01	2.41	0.01	0.51	0.01	4.73

			SAMPLE DESCRIPTION:	EHWW-38-SC-000050	EHWW-38-SC-050100		EHWW-40-SC-000050		EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095
			SAMPLE TYPE:	Sediment	Sediment		Sediment		Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-17	2018-12-17		2018-12-18		2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801932	9801935	RDL	9801944	RDL	9801945	9801948	9801952
Sulphur - Total	%		0.01	1.41	0.82	0.01	2.57	0.01	0.72	0.73	1.00
Sulphate Sulphur	%		0.01	0.12	0.06	0.02	0.20	0.01	0.05	0.06	0.05
Sulphide (Calculation)	%		0.01	1.29	0.76	0.01	2.37	0.01	0.67	0.67	0.95

			SAMPLE DESCRIPTION:	EHWW-16-SC-152202	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment	Sediment
			DATE SAMPLED:	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801956	9802033
Sulphur - Total	%		0.01	0.76	1.01
Sulphate Sulphur	%		0.01	0.06	0.06
Sulphide (Calculation)	%		0.01	0.70	0.95

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solomi

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Certificate of Analysis

AGAT WORK ORDER: 18V422820
PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

TVS in Soil

DATE RECEIVED: 2018-12-20
DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
LOI	%		0.5	1.6	1.5	1.2	3.6	4.1	3.2	3.5	2.5

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
LOI	%		0.5	2.5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Organic Carbon in Soil (%)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
Organic Carbon-Total	%		0.02	0.66	0.35	0.58	1.52	1.10	1.46	1.18	1.17

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
Organic Carbon-Total	%		0.02	1.11

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Solids and Moisture Content in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Parameter	Unit	G / S	RDL	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-17	2018-12-17	2018-12-18
				9801899	9801935	9801956
Moisture	%		0.5	23.4	44.8	43.6
Total Solids	%			77	55	56

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Solids in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Parameter	Unit	G / S	RDL	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-116-SC-152202
SAMPLE TYPE:				Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
DATE SAMPLED:				2018-12-16	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
				9801887	9801891	9801945	9801948	9801952	9802033
Total Solids	%			75	72	75	60	60	60

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
Naphthalene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Methylnaphthalene	µg/g		0.005	<0.005	0.017	<0.005	0.008	<0.005	0.009	0.011	0.009
1-Methylnaphthalene	µg/g		0.005	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthylene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluorene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	µg/g		0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	µg/g		0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoranthene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Pyrene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	µg/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chrysene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(j)fluoranthene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	µg/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-c,d)pyrene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibenzo(a,h)anthracene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Benzo(g,h,i)perylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Quinoline	µg/g		0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05
IACR CCME (Soil)	µg/g		0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
B[a]P TPE (Soil)	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits									
Naphthalene - d8	%	50-130		84	90	90	89	85	83	85	92
2-Fluorobiphenyl	%	50-130		87	83	90	92	86	88	89	92
P-Terphenyl - d14	%	60-130		80	81	80	78	75	81	78	84

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
Naphthalene	µg/g		0.005	<0.005
2-Methylnaphthalene	µg/g		0.005	0.011
1-Methylnaphthalene	µg/g		0.005	<0.005
Acenaphthylene	µg/g		0.005	<0.005
Acenaphthene	µg/g		0.005	<0.005
Fluorene	µg/g		0.02	<0.02
Phenanthrene	µg/g		0.02	<0.02
Anthracene	µg/g		0.004	<0.004
Fluoranthene	µg/g		0.01	<0.01
Pyrene	µg/g		0.01	<0.01
Benzo(a)anthracene	µg/g		0.03	<0.03
Chrysene	µg/g		0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.02	<0.02
Benzo(j)fluoranthene	µg/g		0.02	<0.02
Benzo(k)fluoranthene	µg/g		0.02	<0.02
Benzo(a)pyrene	µg/g		0.03	<0.03
Indeno(1,2,3-c,d)pyrene	µg/g		0.02	<0.02
Dibenzo(a,h)anthracene	µg/g		0.005	<0.005
Benzo(g,h,i)perylene	µg/g		0.05	<0.05
Quinoline	µg/g		0.05	0.05
IACR CCME (Soil)	µg/g		0.6	<0.6
B[a]P TPE (Soil)	µg/g		0.05	<0.05
Benzo(b+j)fluoranthene	µg/g		0.05	<0.05
Surrogate	Unit	Acceptable Limits		
Naphthalene - d8	%	50-130		79
2-Fluorobiphenyl	%	50-130		87
P-Terphenyl - d14	%	60-130		85

Certified By: D. Solani

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801887-9802033 Results are based on dry weight of sample.

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Polychlorinated Biphenyls Analysis - Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17	2018-12-18	2018-12-18	2018-12-18	2018-12-18
Parameter	Unit	G / S	RDL	9801887	9801891	9801899	9801935	9801945	9801948	9801952	9801956
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits									
Decachlorobiphenyl	%	50-150		79.8	75.2	78.1	86.7	83.2	84.5	89.2	84.1

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
Aroclor 1242	mg/kg		0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05
Surrogate	Unit	Acceptable Limits		
Decachlorobiphenyl	%	50-150		84.5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801887-9802033 Results are based on the dry weight of the sample.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By: D. Solani

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Parameter	Unit	G / S	RDL	9801887	RDL	9801891	RDL	9801899	RDL	9801935
			SAMPLE DESCRIPTION:	EHWW-58-SC-361411		EHWW-36-SC-183233		EHWW-03-SC-150200		EHWW-38-SC-050100
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-12-16		2018-12-17		2018-12-17		2018-12-17
2,3,7,8-Tetra CDD	ng/kg		0.3	<0.3	0.3	<0.3	0.3	<0.3	0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		0.7	<0.7	0.4	<0.4	0.4	<0.4	0.7	<0.7
1,2,3,4,7,8-Hexa CDD	ng/kg		0.3	<0.3	0.3	<0.3	0.4	<0.4	0.3	<0.3
1,2,3,6,7,8-Hexa CDD	ng/kg		0.3	<0.3	0.3	<0.3	0.4	<0.4	0.3	<0.3
1,2,3,7,8,9-Hexa CDD	ng/kg		0.3	<0.3	0.3	<0.3	0.4	<0.4	0.3	<0.3
1,2,3,4,6,7,8-Hepta CDD	ng/kg		0.4	<0.4	0.5	<0.5	0.4	<0.4	0.7	<0.7
Octa CDD	ng/kg		0.6	<0.6	3	6	1	1	0.4	0.5
2,3,7,8-Tetra CDF	ng/kg		0.4	<0.4	0.4	<0.4	0.4	<0.4	0.4	<0.4
1,2,3,7,8-Penta CDF	ng/kg		0.3	<0.3	0.2	<0.2	0.3	<0.3	0.2	<0.2
2,3,4,7,8-Penta CDF	ng/kg		0.4	<0.4	0.3	<0.3	0.3	<0.3	0.3	<0.3
1,2,3,4,7,8-Hexa CDF	ng/kg		0.2	<0.2	0.2	<0.2	0.2	<0.2	0.3	<0.3
1,2,3,6,7,8-Hexa CDF	ng/kg		0.2	<0.2	0.2	<0.2	0.2	<0.2	0.3	<0.3
2,3,4,6,7,8-Hexa CDF	ng/kg		0.2	<0.2	0.2	<0.2	0.2	<0.2	0.3	<0.3
1,2,3,7,8,9-Hexa CDF	ng/kg		0.4	<0.4	0.4	<0.4	0.3	<0.3	0.7	<0.7
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.4	<0.4	0.4	<0.4	0.4	0.6	0.4	<0.4
1,2,3,4,7,8,9-Hepta CDF	ng/kg		0.5	<0.5	0.5	<0.5	0.5	<0.5	0.5	<0.5
Octa CDF	ng/kg		1	<1	0.6	<0.6	0.6	<0.6	2	<2
Total Tetrachlorodibenzodioxins	ng/kg		0.3	<0.3	0.3	<0.3	0.3	0.4	0.3	<0.3
Total Pentachlorodibenzodioxins	ng/kg		0.7	1.4	0.4	0.4	0.4	<0.4	0.7	3.1
Total Hexachlorodibenzodioxins	ng/kg		0.3	2.1	0.3	1.2	0.4	0.7	0.3	2.4
Total Heptachlorodibenzodioxins	ng/kg		0.4	2.5	0.5	1.4	0.4	0.9	0.7	2.0
Total PCDDs	ng/kg		0.7	6.7	3	9	1	4	0.7	8.3
Total Tetrachlorodibenzofurans	ng/kg		0.4	<0.4	0.4	0.4	0.4	0.8	0.4	0.6
Total Pentachlorodibenzofurans	ng/kg		0.4	0.5	0.3	<0.3	0.3	0.4	0.3	<0.3
Total Hexachlorodibenzofurans	ng/kg		0.4	<0.4	0.4	<0.4	0.3	<0.3	0.7	<0.7
Total Heptachlorodibenzofurans	ng/kg		0.5	1.0	0.5	<0.5	0.5	0.9	0.5	<0.5
Total PCDFs	ng/kg		1	2	0.6	1.2	0.6	2.5	2	<2
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		0		0

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-58-SC-361411		EHWW-36-SC-183233		EHWW-03-SC-150200		EHWW-38-SC-050100
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-12-16		2018-12-17		2018-12-17		2018-12-17
Parameter	Unit	G / S	RDL	9801887	RDL	9801891	RDL	9801899	RDL	9801935
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0		0		0		0
Octa CDD (TEF 0.0003)	TEQ			0		0.00175		0.000345		0.000164
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0		0		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0		0		0		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0		0		0.00646		0
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0
Octa CDF (TEF 0.0003)	TEQ			0		0		0		0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0		0.00175		0.00680		0.000164

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

		SAMPLE DESCRIPTION:	EHWW-58-SC-361411	EHWW-36-SC-183233	EHWW-03-SC-150200	EHWW-38-SC-050100
		SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment
		DATE SAMPLED:	2018-12-16	2018-12-17	2018-12-17	2018-12-17
Surrogate	Unit	Acceptable Limits	9801887	9801891	9801899	9801935
13C-2378-TCDF	%	30-140	58	54	48	49
13C-12378-PeCDF	%	30-140	50	47	41	47
13C-23478-PeCDF	%	30-140	37	56	45	54
13C-123478-HxCDF	%	30-140	61	74	52	62
13C-123678-HxCDF	%	30-140	61	80	64	68
13C-234678-HxCDF	%	30-140	64	76	61	69
13C-123789-HxCDF	%	30-140	54	63	45	51
13C-1234678-HpCDF	%	30-140	51	59	47	58
13C-1234789-HpCDF	%	30-140	45	50	36	44
13C-2378-TCDD	%	30-140	68	65	55	57
13C-12378-PeCDD	%	30-140	60	59	48	56
13C-123478-HxCDD	%	30-140	61	74	54	65
13C-123678-HxCDD	%	30-140	65	78	70	76
13C-1234678-HpCDD	%	30-140	47	53	39	48
13C-OCDD	%	30-140	30	34	32	37

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AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

		SAMPLE DESCRIPTION:		EHWW-40-SC-060110		EHWW-39-SC-035085		EHWW-24-SC-045095		EHWW-16-SC-152202
		SAMPLE TYPE:		Sediment		Sediment		Sediment		Sediment
		DATE SAMPLED:		2018-12-18		2018-12-18		2018-12-18		2018-12-18
Parameter	Unit	G / S	RDL	9801945	RDL	9801948	RDL	9801952	RDL	9801956
2,3,7,8-Tetra CDD	ng/kg		0.3	<0.3	0.3	<0.3	0.3	<0.3	0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		0.4	<0.4	0.6	<0.6	0.4	<0.4	0.6	<0.6
1,2,3,4,7,8-Hexa CDD	ng/kg		0.6	<0.6	0.7	<0.7	0.5	<0.5	0.5	<0.5
1,2,3,6,7,8-Hexa CDD	ng/kg		0.6	<0.6	0.6	<0.6	0.5	<0.5	0.5	<0.5
1,2,3,7,8,9-Hexa CDD	ng/kg		0.5	<0.5	0.7	<0.7	0.5	<0.5	0.5	<0.5
1,2,3,4,6,7,8-Hepta CDD	ng/kg		0.5	0.6	0.5	2.6	0.7	<0.7	0.6	<0.6
Octa CDD	ng/kg		0.9	1.3	2	4	0.9	1.1	0.7	3.1
2,3,7,8-Tetra CDF	ng/kg		0.4	<0.4	0.6	<0.6	0.4	<0.4	0.4	<0.4
1,2,3,7,8-Penta CDF	ng/kg		0.8	<0.8	0.9	1.0	0.2	<0.2	0.3	<0.3
2,3,4,7,8-Penta CDF	ng/kg		1	<1	0.7	<0.7	0.3	<0.3	0.4	<0.4
1,2,3,4,7,8-Hexa CDF	ng/kg		0.3	<0.3	1	4	0.2	<0.2	0.2	<0.2
1,2,3,6,7,8-Hexa CDF	ng/kg		0.3	<0.3	1	2	0.2	<0.2	0.2	<0.2
2,3,4,6,7,8-Hexa CDF	ng/kg		0.7	<0.7	1	<1	0.2	<0.2	0.2	<0.2
1,2,3,7,8,9-Hexa CDF	ng/kg		0.6	<0.6	2	<2	0.3	<0.3	0.3	<0.3
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.4	2.9	1	63	0.4	<0.4	0.4	<0.4
1,2,3,4,7,8,9-Hepta CDF	ng/kg		0.5	<0.5	2	<2	0.5	<0.5	0.9	<0.9
Octa CDF	ng/kg		0.5	<0.5	2	14	0.5	<0.5	0.7	<0.7
Total Tetrachlorodibenzodioxins	ng/kg		0.3	0.3	0.3	0.7	0.3	0.6	0.3	0.5
Total Pentachlorodibenzodioxins	ng/kg		0.4	<0.4	0.6	2.8	0.4	0.9	0.6	3.2
Total Hexachlorodibenzodioxins	ng/kg		0.6	1.4	0.7	3.2	0.5	1.5	0.5	1.9
Total Heptachlorodibenzodioxins	ng/kg		0.5	1.8	0.5	5.9	0.7	1.2	0.6	4.1
Total PCDDs	ng/kg		0.9	5.2	2	17	0.9	5.3	0.7	12.8
Total Tetrachlorodibenzofurans	ng/kg		0.4	2.2	0.6	5.5	0.4	0.6	0.4	<0.4
Total Pentachlorodibenzofurans	ng/kg		1	<1	0.9	8.0	0.3	<0.3	0.4	<0.4
Total Hexachlorodibenzofurans	ng/kg		0.7	1.0	2	14	0.3	<0.3	0.3	<0.3
Total Heptachlorodibenzofurans	ng/kg		0.5	4.2	2	93	0.5	<0.5	0.9	<0.9
Total PCDFs	ng/kg		1	7	2	135	0.5	1.1	0.9	1.0
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		0		0

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-40-SC-060110		EHWW-39-SC-035085		EHWW-24-SC-045095		EHWW-16-SC-152202
			SAMPLE TYPE:	Sediment		Sediment		Sediment		Sediment
			DATE SAMPLED:	2018-12-18		2018-12-18		2018-12-18		2018-12-18
Parameter	Unit	G / S	RDL	9801945	RDL	9801948	RDL	9801952	RDL	9801956
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.00584		0.0259		0		0
Octa CDD (TEF 0.0003)	TEQ			0.000376		0.00132		0.000343		0.000923
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0.0311		0		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0		0		0		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0.421		0		0
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0.158		0		0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0.0292		0.625		0		0
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0
Octa CDF (TEF 0.0003)	TEQ			0		0.00418		0		0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.0354		1.27		0.000343		0.000923

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Surrogate	Unit	Acceptable Limits				
		SAMPLE DESCRIPTION:	EHWW-40-SC-060110	EHWW-39-SC-035085	EHWW-24-SC-045095	EHWW-16-SC-152202
		SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment
		DATE SAMPLED:	2018-12-18	2018-12-18	2018-12-18	2018-12-18
			9801945	9801948	9801952	9801956
13C-2378-TCDF	%	30-140	57	58	56	46
13C-12378-PeCDF	%	30-140	49	49	48	45
13C-23478-PeCDF	%	30-140	59	55	56	52
13C-123478-HxCDF	%	30-140	52	60	65	56
13C-123678-HxCDF	%	30-140	54	62	73	59
13C-234678-HxCDF	%	30-140	41	66	73	64
13C-123789-HxCDF	%	30-140	48	54	56	47
13C-1234678-HpCDF	%	30-140	50	54	53	49
13C-1234789-HpCDF	%	30-140	47	47	45	40
13C-2378-TCDD	%	30-140	68	70	65	57
13C-12378-PeCDD	%	30-140	64	56	58	56
13C-123478-HxCDD	%	30-140	59	62	69	59
13C-123678-HxCDD	%	30-140	66	72	84	63
13C-1234678-HpCDD	%	30-140	47	49	47	44
13C-OCDD	%	30-140	32	34	33	33

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DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
2,3,7,8-Tetra CDD	ng/kg		0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		0.4	<0.4
1,2,3,4,7,8-Hexa CDD	ng/kg		0.2	<0.2
1,2,3,6,7,8-Hexa CDD	ng/kg		0.2	<0.2
1,2,3,7,8,9-Hexa CDD	ng/kg		0.2	<0.2
1,2,3,4,6,7,8-Hepta CDD	ng/kg		0.5	<0.5
Octa CDD	ng/kg		0.5	1.0
2,3,7,8-Tetra CDF	ng/kg		0.4	<0.4
1,2,3,7,8-Penta CDF	ng/kg		0.4	<0.4
2,3,4,7,8-Penta CDF	ng/kg		0.7	<0.7
1,2,3,4,7,8-Hexa CDF	ng/kg		0.3	<0.3
1,2,3,6,7,8-Hexa CDF	ng/kg		0.3	<0.3
2,3,4,6,7,8-Hexa CDF	ng/kg		0.3	<0.3
1,2,3,7,8,9-Hexa CDF	ng/kg		0.4	<0.4
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.4	<0.4
1,2,3,4,7,8,9-Hepta CDF	ng/kg		0.5	<0.5
Octa CDF	ng/kg		0.8	<0.8
Total Tetrachlorodibenzodioxins	ng/kg		0.3	0.4
Total Pentachlorodibenzodioxins	ng/kg		0.4	0.9
Total Hexachlorodibenzodioxins	ng/kg		0.2	1.7
Total Heptachlorodibenzodioxins	ng/kg		0.5	2.4
Total PCDDs	ng/kg		0.5	6.4
Total Tetrachlorodibenzofurans	ng/kg		0.4	0.7
Total Pentachlorodibenzofurans	ng/kg		0.7	0.7
Total Hexachlorodibenzofurans	ng/kg		0.4	0.6
Total Heptachlorodibenzofurans	ng/kg		0.5	0.5
Total PCDFs	ng/kg		0.8	2.5
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

			SAMPLE DESCRIPTION:	EHWW-116-SC-152202
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2018-12-18
Parameter	Unit	G / S	RDL	9802033
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0
Octa CDD (TEF 0.0003)	TEQ			0.000294
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0
Octa CDF (TEF 0.0003)	TEQ			0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.000294

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-11

Surrogate	Unit	Acceptable Limits	9802033
		SAMPLE DESCRIPTION:	EHWW-116-SC-152202
		SAMPLE TYPE:	Sediment
		DATE SAMPLED:	2018-12-18
13C-2378-TCDF	%	30-140	57
13C-12378-PeCDF	%	30-140	49
13C-23478-PeCDF	%	30-140	40
13C-123478-HxCDF	%	30-140	64
13C-123678-HxCDF	%	30-140	63
13C-234678-HxCDF	%	30-140	65
13C-123789-HxCDF	%	30-140	55
13C-1234678-HpCDF	%	30-140	56
13C-1234789-HpCDF	%	30-140	46
13C-2378-TCDD	%	30-140	68
13C-12378-PeCDD	%	30-140	58
13C-123478-HxCDD	%	30-140	67
13C-123678-HxCDD	%	30-140	67
13C-1234678-HpCDD	%	30-140	51
13C-OCDD	%	30-140	33

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9801887-9802033 The results were corrected based on the surrogate percent recoveries.

Analysis performed at AGAT Montreal (unless marked by *)

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
SAMPLING SITE:

AGAT WORK ORDER: 18V422820
ATTENTION TO: Cheronne Oreiro
SAMPLED BY:

Soil Analysis

RPT Date: Jan 11, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works Metals in Soil															
Aluminum	9801891		29100	29300	0.6%	< 10	110%	70%	130%	110%	90%	110%			
Antimony	9801891		0.4	0.4	NA	< 0.1	122%	70%	130%	102%	90%	110%			
Arsenic	9801891		6.3	8.1	25.2%	< 0.1	123%	70%	130%	95%	90%	110%			
Barium	9801891		103	102	0.9%	< 0.5	117%	70%	130%	108%	90%	110%			
Beryllium	9801891		0.5	0.5	1.9%	< 0.1	103%	70%	130%	105%	90%	110%			
Bismuth	9801891		<0.5	<0.5	NA	< 0.5				100%	90%	110%			
Cadmium	9801891		0.31	0.29	8.1%	< 0.01	115%	70%	130%	107%	90%	110%			
Calcium	9801891		13800	11800	16.0%	< 10	117%	70%	130%	96%	90%	110%			
Chromium	9801891		49	49	0.5%	< 1	111%	70%	130%	96%	90%	110%			
Cobalt	9801891		18.3	17.8	2.9%	< 0.1	107%	70%	130%	92%	90%	110%			
Copper	9801891		59.6	56.9	4.5%	< 0.2	104%	70%	130%	92%	90%	110%			
Iron	9801891		39200	38700	1.2%	< 10	104%	70%	130%	95%	90%	110%			
Lead	9801891		6.1	6.0	1.1%	< 0.1	99%	70%	130%	102%	90%	110%			
Lithium	9801891		30.9	31.0	0.4%	< 0.5				99%	90%	110%			
Magnesium	9801891		14900	14700	1.6%	< 10	108%	70%	130%	107%	90%	110%			
Manganese	9801891		752	749	0.4%	< 1	111%	70%	130%	107%	90%	110%			
Mercury	9801891		0.06	0.05	22.9%	< 0.01	99%	70%	130%	101%	90%	110%			
Molybdenum	9801891		0.5	0.5	NA	< 0.2	112%	70%	130%	104%	90%	110%			
Nickel	9801891		48.1	47.0	2.1%	< 0.5	111%	70%	130%	103%	90%	110%			
Phosphorus	9801891		494	527	6.3%	< 5	85%	70%	130%	92%	90%	110%			
Potassium	9801891		3490	3560	2.1%	< 5	124%	70%	130%	98%	90%	110%			
Selenium	9801891		0.9	<0.1	NA	< 0.1				100%	90%	110%			
Silver	9801891		<0.5	<0.5	NA	< 0.5	126%	70%	130%	105%	90%	110%			
Sodium	9801891		5530	5740	3.7%	< 5	129%	70%	130%	93%	90%	110%			
Strontium	9801891		83	72	14.5%	< 1	130%	70%	130%	96%	90%	110%			
Thallium	9801891		0.1	0.1	NA	< 0.1	116%	70%	130%	107%	90%	110%			
Tin	9801891		0.6	0.6	NA	< 0.2	107%	70%	130%	99%	90%	110%			
Titanium	9801891		1800	1840	2.1%	< 1				92%	90%	110%			
Uranium	9801891		0.6	0.5	NA	< 0.2	101%	70%	130%	101%	90%	110%			
Vanadium	9801891		99	98	1.6%	< 1	116%	70%	130%	97%	90%	110%			
Zinc	9801891		88	85	4.1%	< 1	111%	70%	130%	91%	90%	110%			
Zirconium	9801891		11.1	11.2	0.3%	< 0.1				103%	90%	110%			
pH 1:2	9801891		8.5	8.5	0.4%		98%	90%	110%	100%	95%	105%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

TVS in Soil															
LOI	9801887		1.6	1.7	NA	< 0.5									

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
SAMPLING SITE:

AGAT WORK ORDER: 18V422820
ATTENTION TO: Cheronne Oreiro
SAMPLED BY:

Soil Analysis (Continued)

RPT Date: Jan 11, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Sulphide in Soil															
Sulphur - Total	9802488		0.95	0.91	3.8%	< 0.01	98%	80%	120%						
Sulphate Sulphur	9801887		0.04	0.04	NA	< 0.01	107%	80%	110%	107%	85%	115%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
Particle Size by Sieve															
Sieve Analysis - 75 microns	361	9801928	60	60	1.2%	< 1	96%	80%	120%	NA			NA		
Soil Analysis - Atterberg Limits															
Liquid Limit	361	9804663	59	59	0.0%	< 1	98%	80%	120%						
Plastic Limit	361	9804663	37	29	24.2%	< 1	105%	80%	120%						
Soil Analysis - Ammonia															
Saturation Percentage	361	9802498	47	47	0.0%	< 1	94%	80%	120%						
Electrical Conductivity (Sat. Paste)	361	9802498	20.4	19.4	5.1%	< 0.05	95%	90%	110%						
Ammonia, Soluble	1904	9802498	<1	<1	NA	< 1	106%	80%	120%	101%	80%	120%	93%	80%	120%

Certified By: D. Solani

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SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Jan 11, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works PAH in Soil Low Level															
Naphthalene	70402	9795723	0.041	0.024	NA	< 0.005	101%	80%	120%				96%	50%	130%
2-Methylnaphthalene	70402	9795723	0.098	0.069	34.7%	< 0.005	99%	80%	120%				94%	50%	130%
1-Methylnaphthalene	70402	9795723	0.083	0.052	45.9%	< 0.005	99%	80%	120%				101%	50%	130%
Acenaphthylene	70402	9795723	<0.005	<0.005	NA	< 0.005	100%	80%	120%				97%	50%	130%
Acenaphthene	70402	9795723	<0.005	<0.005	NA	< 0.005	98%	80%	120%				107%	50%	130%
Fluorene	70402	9795723	0.02	<0.02	NA	< 0.02	101%	80%	120%				94%	50%	130%
Phenanthrene	70402	9795723	0.06	0.04	NA	< 0.02	98%	80%	120%				94%	60%	130%
Anthracene	70402	9795723	<0.004	<0.004	NA	< 0.004	100%	80%	120%				97%	60%	130%
Fluoranthene	70402	9795723	<0.01	<0.01	NA	< 0.01	98%	80%	120%				101%	60%	130%
Pyrene	70402	9795723	0.01	0.01	NA	< 0.01	102%	80%	120%				98%	60%	130%
Benzo(a)anthracene	70402	9795723	<0.03	<0.03	NA	< 0.03	100%	80%	120%				98%	60%	130%
Chrysene	70402	9795723	<0.05	<0.05	NA	< 0.05	99%	80%	120%				101%	60%	130%
Benzo(b)fluoranthene	70402	9795723	0.02	0.02	NA	< 0.02	103%	80%	120%				89%	60%	130%
Benzo(j)fluoranthene	70402	9795723	<0.02	<0.02	NA	< 0.02	93%	80%	120%				104%	60%	130%
Benzo(k)fluoranthene	70402	9795723	<0.02	<0.02	NA	< 0.02	105%	80%	120%				102%	60%	130%
Benzo(a)pyrene	70402	9795723	<0.03	<0.03	NA	< 0.03	98%	80%	120%				85%	60%	130%
Indeno(1,2,3-c,d)pyrene	70402	9795723	<0.02	<0.02	NA	< 0.02	100%	80%	120%				76%	60%	130%
Dibenzo(a,h)anthracene	70402	9795723	<0.005	<0.005	NA	< 0.005	106%	80%	120%				78%	60%	130%
Benzo(g,h,i)perylene	70402	9795723	<0.05	<0.05	NA	< 0.05	100%	80%	120%				69%	60%	130%
Quinoline	70402	9795723	<0.05	<0.05	NA	< 0.05	101%	80%	120%				109%	50%	130%
Naphthalene - d8	70402	9795723	91	86	5.6%		98%	80%	120%				94%	50%	130%
2-Fluorobiphenyl	70402	9795723	89	83	7.0%		98%	80%	120%				92%	50%	130%
P-Terphenyl - d14	70402	9795723	93	88	5.5%		100%	80%	120%				99%	60%	130%

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Polychlorinated Biphenyls Analysis - Soil	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
Aroclor 1242	173	9801887	<0.05	<0.05	NA	< 0.05	114%	70%	130%	124%	70%	130%	118%	50%	150%
Aroclor 1254	173	9801887	<0.05	<0.05	NA	< 0.05	101%	70%	130%	104%	70%	130%	98%	50%	150%
Aroclor 1260	173	9801887	<0.05	<0.05	NA	< 0.05	107%	70%	130%	101%	70%	130%	103%	50%	150%
Total Polychlorinated Biphenyls	173	9801887	<0.05	<0.05	NA	< 0.05	107%	70%	130%	110%	70%	130%	106%	50%	150%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422820
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Ultra Trace Analysis

RPT Date: Jan 11, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Dioxins and Furans (Soil, WHO 2005)															
2,3,7,8-Tetra CDD	1	9801899	< 0.3	< 0.3	NA	< 0.3	84%	40%	130%	NA	40%	130%	84%	40%	130%
1,2,3,7,8-Penta CDD	1	9801899	< 0.4	< 0.4	NA	< 0.4	89%	40%	130%	NA	40%	130%	98%	40%	130%
1,2,3,4,7,8-Hexa CDD	1	9801899	< 0.4	< 0.3	NA	< 0.2	97%	40%	130%	NA	40%	130%	97%	40%	130%
1,2,3,6,7,8-Hexa CDD	1	9801899	< 0.4	< 0.3	NA	< 0.2	95%	40%	130%	NA	40%	130%	95%	40%	130%
1,2,3,7,8,9-Hexa CDD	1	9801899	< 0.4	< 0.3	NA	< 0.2	101%	40%	130%	NA	40%	130%	101%	40%	130%
1,2,3,4,6,7,8-Hepta CDD	1	9801899	< 0.4	< 0.8	NA	< 0.4	93%	40%	130%	NA	40%	130%	93%	40%	130%
Octa CDD	1	9801899	1	1	0.0%	< 0.3	105%	40%	130%	NA	40%	130%	112%	40%	130%
2,3,7,8-Tetra CDF	1	9801899	< 0.4	< 0.4	NA	< 0.4	97%	40%	130%	NA	40%	130%	97%	40%	130%
1,2,3,7,8-Penta CDF	1	9801899	< 0.3	< 0.7	NA	< 0.2	99%	40%	130%	NA	40%	130%	112%	40%	130%
2,3,4,7,8-Penta CDF	1	9801899	< 0.3	< 0.5	NA	< 0.3	102%	40%	130%	NA	40%	130%	101%	40%	130%
1,2,3,4,7,8-Hexa CDF	1	9801899	< 0.2	< 0.6	NA	< 0.2	115%	40%	130%	NA	40%	130%	110%	40%	130%
1,2,3,6,7,8-Hexa CDF	1	9801899	< 0.2	< 0.5	NA	< 0.2	107%	40%	130%	NA	40%	130%	116%	40%	130%
2,3,4,6,7,8-Hexa CDF	1	9801899	< 0.2	< 0.5	NA	< 0.2	110%	40%	130%	NA	40%	130%	112%	40%	130%
1,2,3,7,8,9-Hexa CDF	1	9801899	< 0.3	< 0.6	NA	< 0.3	99%	40%	130%	NA	40%	130%	110%	40%	130%
1,2,3,4,6,7,8-Hepta CDF	1	9801899	0.6	0.7	15.4%	< 0.4	97%	40%	130%	NA	40%	130%	108%	40%	130%
1,2,3,4,7,8,9-Hepta CDF	1	9801899	< 0.5	< 0.4	NA	< 0.5	104%	40%	130%	NA	40%	130%	111%	40%	130%
Octa CDF	1	9801899	< 0.6	< 0.8	NA	< 0.5	97%	40%	130%	NA	40%	130%	84%	40%	130%

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AGAT Laboratories

Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA — AGAT WORK ORDER: 18V422820
PROJECT: 170553-11.05 EHRP Wood Debris Remediation — ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: — SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Moisture	INOR-181-6030	SSMA Chapter 70 (2nd Ed)	GRAVIMETRIC
Sieve Analysis - 75 microns	INOR-171-6009	KROETSCH 2007; SHEPPARD 2007	SIEVE
Aluminum	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Antimony	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Arsenic	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Barium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Beryllium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Bismuth	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cadmium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Calcium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Chromium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cobalt	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Copper	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Iron	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Lead	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Lithium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Magnesium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Manganese	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Mercury	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Molybdenum	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Nickel	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Phosphorus	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Potassium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Selenium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Silver	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Sodium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Strontium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Thallium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

AGAT WORK ORDER: 18V422820

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Tin	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Titanium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Uranium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Vanadium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zinc	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zirconium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
pH 1:2	INOR-181-6031	BC MOE Lab Manual B (pH, Electrometric, Soil)	PH METER
Ammonia, Soluble	Inor-171-6211	Carter & Gregorich 2007; SM 4500E	AQ-2 DISCRETE ANALYZER
Liquid Limit	INOR-171-6218	ASA 9 - 31-3	LIQUID LIMIT DEVICE
Plastic Limit	INOR-171-6218	ASA 9 - 31-3	N/A
Plasticity Index	INOR-171-6218	ASTM D4318-00	N/A
Sulphur - Total	INOR-181-6027	Modified from ASTM E1915-11	COMBUSTION
Sulphate Sulphur	ARD-181-18009; INOR-181-6028	MEND Report 1.20.1 (09); mod from SM 4500-SO4 E	SPECTROPHOTOMETER
LOI	INOR-181-6030	ASTM D2974-07a	GRAVIMETRIC

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
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http://www.agatlabs.com

Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422820
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
1-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluorene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Phenanthrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Chrysene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(b)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(j)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(k)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Indeno(1,2,3-c,d)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Dibenzo(a,h)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(g,h,i)perylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Quinoline	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
IACR CCME (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
B[a]P TPE (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Naphthalene - d8	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Fluorobiphenyl	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
P-Terphenyl - d14	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
Aroclor 1242	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1254	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1260	TO-0410	EPA SW-846 8082	GC/ECD
Total Polychlorinated Biphenyls	TO-0410	EPA SW-846 8082	GC/ECD
Decachlorobiphenyl	TO-0410	EPA SW-846 8082	GC/ECD

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422820
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Ultra Trace Analysis			
2,3,7,8-Tetra CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD	HR-151-5400	EPA 1613	HRMS
Octa CDD	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF	HR-151-5400	EPA 1613	HRMS
Octa CDF	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total PCDDs	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total PCDFs	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDD (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF (TEF 0.03)	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF (TEF 0.3)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	HR_151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDF (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
Total PCDDs and PCDFs (TEQ)	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDF	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-23478-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDF	HR-151-5400	EPA 1613	HRMS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422820
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
13C-123678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-234678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-123789-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-1234789-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDD	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDD	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-123678-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDD	HR-151-5400	EPA 1613	HRMS
13C-OCDD	HR-151-5400	EPA 1613	HRMS

Wood waste

Chain of C... dy Record and Laboratory Analysis Request COC#

ANCHOR QEA

18U42282

1°C

DEC 20 AM 8:15

Date: 12/16/18
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

	Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Archive	Comments
880	1	EHWW-58-SC-361411	12/16/18 1630	SE	5	X	X	X	X	X	X	X	X	X					
884	2	EHWW-58-SC-411461	12/16/18 1635	SE	5										X	X		X	
	3	~~EHWW-36-SC-000050~~	~~12/17/18 1025~~	SE															
891	4	EHWW-36-SC-183233	12/17/18 1035	SE	5	X	X	X	X	X	X	X	X	X					
893	5	EHWW-36-SC-233283	12/17/18 1040	SE	5													X	
896	6	EHWW-03-SC-000050	12/17/18 1155	SE	2						X			X					
899	7	EHWW-03-SC-150200	12/17/18 1200	SE	6	X	X	X	X	X	X	X	X	X	X	X			
921	8	EHWW-03-SC-200250	12/17/18 1210	SE	5													X	
925	9	EHWW-57-SC-000050	12/17/18 1445	SE	2						X			X					
928	10	EHWW-56-SC-000050	12/17/18 0925	SE	1									X					
929	11	EHWW-56-SC-050100	12/17/18 0920	SE	5	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~				X	Archive only
932	12	EHWW-38-SC-000050	12/17/18 1630	SE	3						X			X	X	X			
935	13	EHWW-38-SC-050100	12/17/18 1645	SE	6	X	X	X	X	X	X	X	X	X	X	X			
937	14	EHWW-38-SC-100150	12/17/18 1650	SE	5													X	

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name: Eli Patmont	Date/Time: 12/18/2018 18:06	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	

V117205

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

WOOD WASTE

Chain of C... dy Record and Laboratory Analysis Request

COC#

ANCHOR QEA

18U4228Z0

1°C

DEC 20 AM 9:15

Date: 12/18/18
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

	Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Archive						Comments
944	1	EHWW-~~SC~~ 40-SC-000050	12/18/18 0850	SE	2						X			X										
945	2	EHWW-40-SC-060110	12/18/18 0845	SE	5	X	X	X	X	X	X	X	X	X										
946	3	EHWW-40-SC-[illegible]10160	12/18/18 0900	SE	5													X						
948	4	EHWW-39-SC-035085	12/18/18 1030	SE	5	X	X	X	X	X	X	X	X	X										
950	5	EHWW-39-SC-08135	12/18/18 1040	SE	5													X						
952	6	EHWW-24-SC-045095	12/18/18 1200	SE	5	X	X	X	X	X	X	X	X	X										
953	7	EHWW-24-SC-095145	12/18/18 1215	SE	5													X						
956	8	EHWW-16-SC-152202	12/18/18 1445	SE	6	X	X	X	X	X	X	X	X	X	X	X								
2033	9	EHWW-116-SC-152202	12/18/18 1450	SE	4	X	X	X	X	X	X	X	X											
2034	10	EHWW-16-SC-202252	12/18/18 1455	SE	5													X						
	11			SE																				
	12			SE																				
	13			SE																				
	14			SE																				

Sediment and Field QC

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name: Eli Portmann	Date/Time: 12/18/2018 18:06	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	

V117204

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 18V422820

RECEIVING BASICS:

Received From: ACE EZ   Waybill #: ______

SAMPLE QUANTITIES:

Coolers: 8   Containers: 102

TIME SENSITIVE ISSUES:

Earliest Date Sampled: Dec 16, 2018   ALREADY EXCEEDED? Yes **No**

NON-CONFORMANCES:

3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) *use jars when available

(1) 0 + 0 + 3 = 1 °C (2) 1 + 0 + 0 = 1 °C (3) 0 + 0 + 4 = 2 °C (4) 0 + 0 + 0 = 0 °C

Was ice or ice pack present: **Yes** No

Integrity Issues: (5) 4 + 4 + 3 = 4 ; (6) 2 + 3 + 3 = 3 ; (7) 4 + 5 + 4 = 4 ; (8) 4 + 2 + 0 = 2

Account Project Manager: ______ have they been notified of the above issues: Yes No

Whom spoken to: ______ Date and Time: ______

ADDITIONAL NOTES:

Document #: SR-186-9504.001
Revision Date: July 9, 2014

Page 1 of 1

Unit 120, 8600 Glenlyon Parkway
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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
219-800 BURRARD ST
VANCOUVER, BC V6Z 0B9
604-671-1831

ATTENTION TO: Cheronne Oreiro

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

AGAT WORK ORDER: 18V422891

SOIL ANALYSIS REVIEWED BY: Dana Solari, Lab Reporter

TRACE ORGANICS REVIEWED BY: Dana Solari, Lab Reporter

ULTRA TRACE REVIEWED BY: Philippe Morneau, chimiste

DATE REPORTED: Feb 12, 2019

PAGES (INCLUDING COVER): 33

VERSION*: 5

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES
VERSION 5: Sample receipt temperature 3°C.

Version 5 is issued to report additional analysis of Metals and TS as requested by Cheronne Oreiro. Version 5 is an amendment to all other Versions.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Particle Size by Sieve

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL								
SAMPLE DESCRIPTION:				EHWW-54-SC-000050	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-65-SC-000050	EHWW-44-SC-017067	EHWW-53-SC-000016	EHWW-53-SC-016066
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2018-12-18	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
				9802297	9802304	9802457	9802459	9802468	9802472	9802488	9802498
Sieve Analysis - 75 microns	%		1	14	18	3	4	46	5	37	54
Sieve Texture				Fine	Fine	Fine	Fine	Fine	Fine	Fine	Coarse

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802297-9802498 Value reported is amount of sample retained on a 75 micron sieve after wash with water and represents proportion by weight particles larger than indicated sieve size.

Analysis performed at AGAT Edmonton (unless marked by *)

Certified By: D. Solani

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-54-SC-055105	EHWW-54-SC-105155	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066	EHWW-53-SC-066116	EHWW-IDW-SED
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9802304	9802456	9802457	9802459	9802472	9802498	9802502	9802505
Aluminum	µg/g		10	13700	17500	16800	15700	16800	8220	9120	16100
Antimony	µg/g		0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2
Arsenic	µg/g		0.1	8.5	8.3	6.2	6.6	9.4	4.7	5.7	7.1
Barium	µg/g		0.5	31.4	31.4	57.0	44.4	42.8	20.8	16.6	38.1
Beryllium	µg/g		0.1	0.3	0.3	0.3	0.3	0.3	0.1	0.1	0.3
Bismuth	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	µg/g		0.01	5.67	3.45	2.96	4.40	3.73	5.02	1.76	1.14
Calcium	µg/g		10	20200	11700	10400	12200	12900	39400	16000	8950
Chromium	µg/g		1	29	39	33	32	36	15	16	33
Cobalt	µg/g		0.1	5.2	8.6	5.8	5.4	6.4	3.5	4.8	8.9
Copper	µg/g		0.2	20.1	34.4	24.4	19.3	23.1	11.4	12.8	27.9
Iron	µg/g		10	18700	25700	23800	21300	23100	11300	13500	23900
Lead	µg/g		0.1	3.2	3.6	17.5	7.6	5.3	1.9	1.4	4.7
Lithium	µg/g		0.5	16.4	21.7	21.5	20.0	22.3	8.6	9.1	18.9
Magnesium	µg/g		10	5500	7920	7620	7220	7480	3510	4470	7550
Manganese	µg/g		1	193	250	214	190	239	131	170	301
Mercury	µg/g		0.01	0.04	0.03	0.28	0.08	0.07	0.04	0.03	0.07
Molybdenum	µg/g		0.2	3.5	4.2	3.4	3.7	5.2	5.8	2.2	2.4
Nickel	µg/g		0.5	19.4	29.8	21.9	20.2	23.5	10.8	12.6	24.7
Phosphorus	µg/g		5	885	612	975	903	823	672	405	560
Potassium	µg/g		5	1820	2610	2350	2190	2440	942	837	2090
Selenium	µg/g		0.1	2.4	1.2	2.7	3.5	4.2	2.0	0.4	0.8
Silver	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	µg/g		5	5720	4390	8620	9120	8840	4490	3210	5720
Strontium	µg/g		1	113	71	97	89	101	278	97	57
Thallium	µg/g		0.1	0.8	0.5	0.3	0.4	0.4	0.8	0.4	0.2
Tin	µg/g		0.2	0.4	0.6	2.8	0.7	0.7	0.2	0.4	0.7
Titanium	µg/g		1	1190	1340	1330	1300	1380	828	1100	1380
Uranium	µg/g		0.2	1.4	1.3	1.7	1.8	2.2	2.1	0.8	1.1

Certified By: D. Solari

Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works Metals in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL	EHWW-54-SC-055105	EHWW-54-SC-105155	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066	EHWW-53-SC-066116	EHWW-IDW-SED
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2018-12-18	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
				9802304	9802456	9802457	9802459	9802472	9802498	9802502	9802505
Vanadium	µg/g		1	47	58	54	50	58	31	35	64
Zinc	µg/g		1	53	59	72	61	63	33	26	54
Zirconium	µg/g		0.1	7.8	9.0	10.5	9.3	10.3	4.7	5.9	8.6
pH 1:2	pH units		0.1	7.9	7.5	7.9	7.8	7.5	8.0	8.1	7.8

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802304-9802505 Results are based on the dry weight of the sample

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - Ammonia

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9802304	9802457	9802459	9802472	9802498
Ammonia, Soluble	mg/L		1	<1	<1	1	2	<1
Ammonia-N, Total Soluble (Soil)	mg/kg		1	<1	<1	<1	2	<1

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Edmonton (unless marked by *)

Certified By: D. Solomi

Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Soluble Chloride

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-IDW-SED
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802505
Chloride, Soluble	mg/L		200	11600
Saturation Percentage	%		0.5	57.5
Chloride, Soluble (mg/kg)	mg/kg		2	6670

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Sulphide in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL	9802297	9802304	9802457	9802459	9802468	9802472	9802488	9802498
			SAMPLE DESCRIPTION:	EHWW-54-SC-000050	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-65-SC-000050	EHWW-44-SC-017067	EHWW-53-SC-000016	EHWW-53-SC-016066
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
Sulphur - Total	%		0.01	0.71	0.84	0.92	0.83	0.53	0.91	0.95	0.52
Sulphate Sulphur	%		0.01	0.06	0.05	0.07	0.08	0.07	0.08	0.08	0.05
Sulphide (Calculation)	%		0.01	0.65	0.79	0.85	0.75	0.46	0.83	0.87	0.47

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Soloni

Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

TCLP Leachate Metals

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL	EHWW-IDW-SED
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2018-12-19
				9802505
Antimony - TCLP Leachate	mg/L		0.01	<0.01
Arsenic - TCLP Leachate	mg/L		0.02	<0.02
Barium - TCLP Leachate	mg/L		0.5	<0.5
Beryllium - TCLP Leachate	mg/L		0.02	<0.02
Boron - TCLP Leachate	mg/L		0.5	<0.5
Cadmium - TCLP Leachate	mg/L		0.01	<0.01
Chromium - TCLP Leachate	mg/L		0.01	<0.01
Cobalt - TCLP Leachate	mg/L		0.05	<0.05
Copper - TCLP Leachate	mg/L		0.05	<0.05
Iron - TCLP Leachate	mg/L		1	<1
Lead - TCLP Leachate	mg/L		0.01	0.03
Mercury - TCLP Leachate	mg/L		0.01	<0.01
Nickel - TCLP Leachate	mg/L		0.05	<0.05
Selenium - TCLP Leachate	mg/L		0.05	<0.05
Silver - TCLP Leachate	mg/L		0.01	<0.01
Thallium - TCLP Leachate	mg/L		0.01	<0.01
Uranium - TCLP Leachate	mg/L		0.01	<0.01
Vanadium - TCLP Leachate	mg/L		0.05	<0.05
Zinc - TCLP Leachate	mg/L		0.1	<0.1
Zirconium - TCLP Leachate	mg/L		0.01	<0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802505 Analysis based on "as received"

Analysis performed at AGAT Vancouver (unless marked by *)

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

TVS in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL	9802304	9802457	9802459	9802472	9802498
SAMPLE DESCRIPTION:				EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19
LOI	%		0.5	2.8	4.5	4.8	3.5	1.3

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Organic Carbon in Soil (%)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9802304	9802457	9802459	9802472	9802498
Organic Carbon-Total	%		0.02	1.41	1.92	1.63	1.49	0.87

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Total Solids in Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-54-SC-055105	EHWW-54-SC-105155	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066	EHWW-53-SC-066116
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9802304	9802456	9802457	9802459	9802472	9802498	9802502
Total Solids	%			59	58	61	55	57	75	82

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066	EHWW-IDW-SED
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
				9802304	9802457	9802459	9802472	9802498	9802505
Naphthalene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Methylnaphthalene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1-Methylnaphthalene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthylene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluorene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	µg/g		0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
Anthracene	µg/g		0.004	<0.004	0.010	<0.004	<0.004	<0.004	<0.004
Fluoranthene	µg/g		0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
Pyrene	µg/g		0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	µg/g		0.03	<0.03	0.03	<0.03	<0.03	<0.03	<0.03
Chrysene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.02	<0.02	0.05	<0.02	<0.02	<0.02	<0.02
Benzo(j)fluoranthene	µg/g		0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	µg/g		0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	µg/g		0.03	<0.03	0.03	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-c,d)pyrene	µg/g		0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
Dibenzo(a,h)anthracene	µg/g		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Benzo(g,h,i)perylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Quinoline	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
IACR CCME (Soil)	µg/g		0.6	<0.6	0.8	<0.6	<0.6	<0.6	<0.6
B[a]P TPE (Soil)	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	µg/g		0.05	<0.05	0.08	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits							
Naphthalene - d8	%	50-130		92	85	98	93	87	86
2-Fluorobiphenyl	%	50-130		98	91	103	101	91	89
P-Terphenyl - d14	%	60-130		97	95	102	104	90	79

Certified By: D. Solomi

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Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Soil Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802304-9802505 Results are based on dry weight of sample.

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Polychlorinated Biphenyls Analysis - Soil

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067	EHWW-53-SC-016066	EHWW-IDW-SED
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-18	2018-12-19	2018-12-19	2018-12-19	2018-12-19	2018-12-19
Parameter	Unit	G / S	RDL	9802304	9802457	9802459	9802472	9802498	9802505
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits							
Decachlorobiphenyl	%	50-150		65.1	79.8	83	79.2	81.2	87.4

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802304-9802505 Results are based on the dry weight of the sample.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By: D. Solani

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Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

		SAMPLE DESCRIPTION:		EHWW-54-SC-055105		EHWW-55-SC-110160		EHWW-59-SC-038088		EHWW-44-SC-017067
		SAMPLE TYPE:		Soil		Soil		Soil		Soil
		DATE SAMPLED:		2018-12-18		2018-12-19		2018-12-19		2018-12-19
Parameter	Unit	G / S	RDL	9802304	RDL	9802457	RDL	9802459	RDL	9802472
2,3,7,8-Tetra CDD	ng/kg		0.3	<0.3	0.3	<0.3	0.3	<0.3	0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		0.4	<0.4	0.6	<0.6	0.4	<0.4	0.4	<0.4
1,2,3,4,7,8-Hexa CDD	ng/kg		1	<1	0.7	<0.7	0.5	<0.5	0.3	<0.3
1,2,3,6,7,8-Hexa CDD	ng/kg		0.9	<0.9	0.7	<0.7	0.5	<0.5	0.3	<0.3
1,2,3,7,8,9-Hexa CDD	ng/kg		0.9	<0.9	0.7	<0.7	0.5	<0.5	0.3	<0.3
1,2,3,4,6,7,8-Hepta CDD	ng/kg		1	<1	1	1	1	<1	0.8	<0.8
Octa CDD	ng/kg		0.3	1.1	0.9	7.6	2	5	0.8	1.9
2,3,7,8-Tetra CDF	ng/kg		0.4	<0.4	0.5	<0.5	0.4	<0.4	0.4	<0.4
1,2,3,7,8-Penta CDF	ng/kg		0.3	<0.3	1	<1	0.4	<0.4	0.3	<0.3
2,3,4,7,8-Penta CDF	ng/kg		0.3	<0.3	0.8	<0.8	0.3	<0.3	0.3	<0.3
1,2,3,4,7,8-Hexa CDF	ng/kg		0.2	<0.2	0.8	<0.8	0.3	<0.3	0.3	<0.3
1,2,3,6,7,8-Hexa CDF	ng/kg		0.2	<0.2	0.8	<0.8	0.3	<0.3	0.3	<0.3
2,3,4,6,7,8-Hexa CDF	ng/kg		0.2	<0.2	0.9	<0.9	0.3	<0.3	0.3	<0.3
1,2,3,7,8,9-Hexa CDF	ng/kg		0.3	<0.3	2	<2	0.6	<0.6	0.5	<0.5
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.4	<0.4	0.5	4.3	0.4	0.8	0.4	0.6
1,2,3,4,7,8,9-Hepta CDF	ng/kg		0.5	<0.5	1	<1	0.5	<0.5	0.7	<0.7
Octa CDF	ng/kg		0.5	<0.5	0.8	<0.8	0.5	<0.5	0.5	<0.5
Total Tetrachlorodibenzodioxins	ng/kg		0.3	<0.3	0.3	<0.3	0.3	0.6	0.3	0.3
Total Pentachlorodibenzodioxins	ng/kg		0.4	1.1	0.6	1.8	0.4	1.1	0.4	1.4
Total Hexachlorodibenzodioxins	ng/kg		1	2	0.7	2.5	0.5	2.0	0.3	2.1
Total Heptachlorodibenzodioxins	ng/kg		1	4	1	4	1	4	0.8	1.2
Total PCDDs	ng/kg		1	8	1	16	2	12	0.8	7.1
Total Tetrachlorodibenzofurans	ng/kg		0.4	<0.4	0.5	1.6	0.4	1.0	0.4	0.4
Total Pentachlorodibenzofurans	ng/kg		0.3	0.5	1	<1	0.4	1.5	0.3	<0.3
Total Hexachlorodibenzofurans	ng/kg		0.3	<0.3	2	4	0.6	0.6	0.5	0.7
Total Heptachlorodibenzofurans	ng/kg		0.5	<0.5	1	5	0.5	1.1	0.7	1.4
Total PCDFs	ng/kg		0.5	1.0	2	12	0.6	4.3	0.7	2.6
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0		0		0		0

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20
DATE REPORTED: 2019-02-12

Parameter	Unit	G / S	RDL	9802304	RDL	9802457	RDL	9802459	RDL	9802472
			SAMPLE DESCRIPTION:	EHWW-54-SC-055105		EHWW-55-SC-110160		EHWW-59-SC-038088		EHWW-44-SC-017067
			SAMPLE TYPE:	Soil		Soil		Soil		Soil
			DATE SAMPLED:	2018-12-18		2018-12-19		2018-12-19		2018-12-19
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0		0.0101		0		0
Octa CDD (TEF 0.0003)	TEQ			0.000324		0.00227		0.00136		0.000579
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0		0		0		0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0		0		0		0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0		0		0		0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0		0.0428		0.00816		0.00583
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0		0		0		0
Octa CDF (TEF 0.0003)	TEQ			0		0		0		0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.000324		0.0552		0.00952		0.00641

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Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

Surrogate	Unit	Acceptable Limits	EHWW-54-SC-055105	EHWW-55-SC-110160	EHWW-59-SC-038088	EHWW-44-SC-017067
		SAMPLE TYPE:	Soil	Soil	Soil	Soil
		DATE SAMPLED:	2018-12-18	2018-12-19	2018-12-19	2018-12-19
			9802304	9802457	9802459	9802472
13C-2378-TCDF	%	30-140	56	60	44	39
13C-12378-PeCDF	%	30-140	47	49	42	36
13C-23478-PeCDF	%	30-140	61	59	47	41
13C-123478-HxCDF	%	30-140	64	71	66	59
13C-123678-HxCDF	%	30-140	72	81	75	63
13C-234678-HxCDF	%	30-140	69	75	75	70
13C-123789-HxCDF	%	30-140	53	58	55	52
13C-1234678-HpCDF	%	30-140	57	57	65	55
13C-1234789-HpCDF	%	30-140	46	49	48	42
13C-2378-TCDD	%	30-140	67	68	54	46
13C-12378-PeCDD	%	30-140	65	63	51	44
13C-123478-HxCDD	%	30-140	63	70	68	64
13C-123678-HxCDD	%	30-140	76	85	79	75
13C-1234678-HpCDD	%	30-140	50	55	54	50
13C-OCDD	%	30-140	37	34	38	35

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ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-53-SC-016066
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802498
2,3,7,8-Tetra CDD	ng/kg		0.3	<0.3
1,2,3,7,8-Penta CDD	ng/kg		0.4	<0.4
1,2,3,4,7,8-Hexa CDD	ng/kg		0.5	<0.5
1,2,3,6,7,8-Hexa CDD	ng/kg		0.5	<0.5
1,2,3,7,8,9-Hexa CDD	ng/kg		0.5	<0.5
1,2,3,4,6,7,8-Hepta CDD	ng/kg		0.5	0.7
Octa CDD	ng/kg		0.7	2.0
2,3,7,8-Tetra CDF	ng/kg		0.4	<0.4
1,2,3,7,8-Penta CDF	ng/kg		0.3	<0.3
2,3,4,7,8-Penta CDF	ng/kg		0.4	<0.4
1,2,3,4,7,8-Hexa CDF	ng/kg		0.2	<0.2
1,2,3,6,7,8-Hexa CDF	ng/kg		0.2	<0.2
2,3,4,6,7,8-Hexa CDF	ng/kg		0.2	0.3
1,2,3,7,8,9-Hexa CDF	ng/kg		0.4	<0.4
1,2,3,4,6,7,8-Hepta CDF	ng/kg		0.4	<0.4
1,2,3,4,7,8,9-Hepta CDF	ng/kg		0.5	<0.5
Octa CDF	ng/kg		0.5	<0.5
Total Tetrachlorodibenzodioxins	ng/kg		0.3	<0.3
Total Pentachlorodibenzodioxins	ng/kg		0.4	1.6
Total Hexachlorodibenzodioxins	ng/kg		0.5	1.8
Total Heptachlorodibenzodioxins	ng/kg		0.5	2.3
Total PCDDs	ng/kg		0.7	7.9
Total Tetrachlorodibenzofurans	ng/kg		0.4	0.8
Total Pentachlorodibenzofurans	ng/kg		0.4	0.5
Total Hexachlorodibenzofurans	ng/kg		0.4	0.7
Total Heptachlorodibenzofurans	ng/kg		0.5	<0.5
Total PCDFs	ng/kg		0.5	2.4
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			0

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Certificate of Analysis

AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

			SAMPLE DESCRIPTION:	EHWW-53-SC-016066
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802498
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			0
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			0
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			0.00714
Octa CDD (TEF 0.0003)	TEQ			0.000585
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			0
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			0
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			0
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			0.0305
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			0
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0
Octa CDF (TEF 0.0003)	TEQ			0
Total PCDDs and PCDFs (TEQ)	ng/kg TEQ			0.0383

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ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Soil, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-02-12

		SAMPLE DESCRIPTION:	EHWW-53-SC-016066
		SAMPLE TYPE:	Soil
		DATE SAMPLED:	2018-12-19
Surrogate	Unit	Acceptable Limits	9802498
13C-2378-TCDF	%	30-140	54
13C-12378-PeCDF	%	30-140	45
13C-23478-PeCDF	%	30-140	54
13C-123478-HxCDF	%	30-140	64
13C-123678-HxCDF	%	30-140	69
13C-234678-HxCDF	%	30-140	78
13C-123789-HxCDF	%	30-140	62
13C-1234678-HpCDF	%	30-140	58
13C-1234789-HpCDF	%	30-140	52
13C-2378-TCDD	%	30-140	64
13C-12378-PeCDD	%	30-140	59
13C-123478-HxCDD	%	30-140	73
13C-123678-HxCDD	%	30-140	81
13C-1234678-HpCDD	%	30-140	55
13C-OCDD	%	30-140	33

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802304-9802498 The results were corrected based on the surrogate percent recoveries.

Analysis performed at AGAT Montreal (unless marked by *)

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422891
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date: Feb 12, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Sulphide in Soil															
Sulphur - Total	9802488		0.95	0.91	3.8%	< 0.01	98%	80%	120%						
Sulphate Sulphur	9802588		0.02	0.02	NA	< 0.01	110%	80%	110%	107%	85%	115%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
Public Works Metals in Soil															
Aluminum	9801891		29100	29300	0.6%	< 10	110%	70%	130%	110%	90%	110%			
Antimony	9801891		0.4	0.4	NA	< 0.1	122%	70%	130%	102%	90%	110%			
Arsenic	9801891		6.3	8.1	25.2%	< 0.1	123%	70%	130%	95%	90%	110%			
Barium	9801891		103	102	0.9%	< 0.5	117%	70%	130%	108%	90%	110%			
Beryllium	9801891		0.5	0.5	1.9%	< 0.1	103%	70%	130%	105%	90%	110%			
Bismuth	9801891		<0.5	<0.5	NA	< 0.5				100%	90%	110%			
Cadmium	9801891		0.31	0.29	8.1%	< 0.01	115%	70%	130%	107%	90%	110%			
Calcium	9801891		13800	11800	16.0%	< 10	117%	70%	130%	96%	90%	110%			
Chromium	9801891		49	49	0.5%	< 1	111%	70%	130%	96%	90%	110%			
Cobalt	9801891		18.3	17.8	2.9%	< 0.1	107%	70%	130%	92%	90%	110%			
Copper	9801891		59.6	56.9	4.5%	< 0.2	104%	70%	130%	92%	90%	110%			
Iron	9801891		39200	38700	1.2%	< 10	104%	70%	130%	95%	90%	110%			
Lead	9801891		6.1	6.0	1.1%	< 0.1	99%	70%	130%	102%	90%	110%			
Lithium	9801891		30.9	31.0	0.4%	< 0.5				99%	90%	110%			
Magnesium	9801891		14900	14700	1.6%	< 10	108%	70%	130%	107%	90%	110%			
Manganese	9801891		752	749	0.4%	< 1	111%	70%	130%	107%	90%	110%			
Mercury	9801891		0.06	0.05	22.9%	< 0.01	99%	70%	130%	101%	90%	110%			
Molybdenum	9801891		0.5	0.5	NA	< 0.2	112%	70%	130%	104%	90%	110%			
Nickel	9801891		48.1	47.0	2.1%	< 0.5	111%	70%	130%	103%	90%	110%			
Phosphorus	9801891		494	527	6.3%	< 5	85%	70%	130%	92%	90%	110%			
Potassium	9801891		3490	3560	2.1%	< 5	124%	70%	130%	98%	90%	110%			
Selenium	9801891		0.9	<0.1	NA	< 0.1				100%	90%	110%			
Silver	9801891		<0.5	<0.5	NA	< 0.5	126%	70%	130%	105%	90%	110%			
Sodium	9802505		5720	5760	0.6%	< 5	129%	70%	130%	93%	90%	110%			
Strontium	9801891		83	72	14.5%	< 1	130%	70%	130%	96%	90%	110%			
Thallium	9801891		0.1	0.1	NA	< 0.1	116%	70%	130%	107%	90%	110%			
Tin	9801891		0.6	0.6	NA	< 0.2	107%	70%	130%	99%	90%	110%			
Titanium	9801891		1800	1840	2.1%	< 1				92%	90%	110%			
Uranium	9801891		0.6	0.5	NA	< 0.2	101%	70%	130%	101%	90%	110%			
Vanadium	9801891		99	98	1.6%	< 1	116%	70%	130%	97%	90%	110%			
Zinc	9801891		88	85	4.1%	< 1	111%	70%	130%	91%	90%	110%			
Zirconium	9801891		11.1	11.2	0.3%	< 0.1				103%	90%	110%			
pH 1:2	9801891		8.5	8.5	0.4%		98%	90%	110%	100%	95%	105%			

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422891
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Soil Analysis (Continued)

RPT Date: Feb 12, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
TVS in Soil															
LOI	9802304		2.8	2.8	0.0%	< 0.5									

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
TCLP Leachate Metals															
Antimony - TCLP Leachate	9802505		2.71	2.58	5.1%	< 0.01				101%	90%	110%	127%	70%	130%
Arsenic - TCLP Leachate	9802505		1.94	1.81	6.9%	< 0.02	84%	50%	150%	105%	90%	110%	97%	70%	130%
Barium - TCLP Leachate	9802505		1.2	1.1	NA	< 0.5	83%	50%	150%	94%	90%	110%	108%	70%	130%
Beryllium - TCLP Leachate	9802505		1.14	1.13	1.1%	< 0.02				98%	90%	110%	111%	70%	130%
Boron - TCLP Leachate	9802505		1.4	1.4	NA	< 0.5				100%	90%	110%	94%	70%	130%
Cadmium - TCLP Leachate	9802505		1.06	1.04	2.2%	< 0.01	83%	50%	150%	98%	90%	110%	101%	70%	130%
Chromium - TCLP Leachate	9802505		0.96	1.02	6.7%	< 0.01	112%	50%	150%	105%	90%	110%	91%	70%	130%
Copper - TCLP Leachate	9802505		0.96	1.08	11.6%	< 0.05	57%	50%	150%	98%	90%	110%	88%	70%	130%
Iron - TCLP Leachate	9802505		2	2	NA	< 1				104%	90%	110%	105%	70%	130%
Lead - TCLP Leachate	9802505		2.08	2.01	3.2%	< 0.01	71%	50%	150%	91%	90%	110%	98%	70%	130%
Mercury - TCLP Leachate	9802505		1.94	1.90	2.1%	< 0.01	73%	50%	150%	99%	90%	110%	95%	70%	130%
Nickel - TCLP Leachate	9802505		0.96	1.12	15.0%	< 0.05				102%	90%	110%	89%	70%	130%
Selenium - TCLP Leachate	9802505		1.03	1.03	0.2%	< 0.05	80%	50%	150%	110%	90%	110%	109%	70%	130%
Silver - TCLP Leachate	9802505		0.29	0.28	1.6%	< 0.01	140%	50%	150%	99%	90%	110%	110%	70%	130%
Thallium - TCLP Leachate	9802505		5.73	5.60	2.3%	< 0.01				102%	90%	110%	111%	70%	130%
Uranium - TCLP Leachate	9802505		1.70	1.77	4.0%	< 0.01				102%	90%	110%			
Vanadium - TCLP Leachate	9802505		1.04	1.15	10.3%	< 0.05				108%	90%	110%	95%	70%	130%
Zinc - TCLP Leachate	9802505		1.2	1.1	4.9%	< 0.1	85%	50%	150%	94%	90%	110%	87%	70%	130%
Zirconium - TCLP Leachate	9802505		<0.01	<0.01	NA	< 0.01				105%	90%	110%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Lower	Upper	Recovery	Lower	Upper	Recovery	Lower	Upper
Particle Size by Sieve															
Sieve Analysis - 75 microns	362	9805275	14	14	0.0%	< 1	96%	80%	120%	NA			NA		
Soil Analysis - Ammonia															
Saturation Percentage	9802498	9802498	47	47	0.0%	< 1	94%	80%	120%						
Electrical Conductivity (Sat. Paste)	9802498	9802498	20.4	19.4	5.1%	< 0.05	95%	90%	110%						
Ammonia, Soluble	1904	9802498	<1	<1	NA	< 1	106%	80%	120%	101%	80%	120%	93%	80%	120%
Soluble Chloride															
Chloride, Soluble	9852319	IH20182	1770	1810	2.2%	< 2	90%	80%	120%	100%	85%	115%			
Saturation Percentage	9859855	IH20182	43.5	43.6	0.2%	< 0.5	99%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422891
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Soil Analysis (Continued)

RPT Date: Feb 12, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works Metals in Soil															
Aluminum	9802456		17500	17600	0.6%	< 10	108%	70%	130%	102%	90%	110%			
Antimony	9802456		0.2	0.2	NA	< 0.1	118%	70%	130%	104%	90%	110%			
Arsenic	9802456		8.3	8.8	5.7%	< 0.1	102%	70%	130%	108%	90%	110%			
Barium	9802456		31.4	32.9	4.5%	< 0.5	105%	70%	130%	102%	90%	110%			
Beryllium	9802456		0.3	0.3	NA	< 0.1	100%	70%	130%	102%	90%	110%			
Bismuth	9802456		<0.5	<0.5	NA	< 0.5				105%	90%	110%			
Cadmium	9802456		3.45	3.52	1.9%	< 0.01	127%	70%	130%	106%	90%	110%			
Calcium	9802456		11700	12500	7.4%	< 10	110%	70%	130%	91%	90%	110%			
Chromium	9802456		39	37	2.9%	< 1	105%	70%	130%	105%	90%	110%			
Cobalt	9802456		8.6	8.6	0.1%	< 0.1	108%	70%	130%	107%	90%	110%			
Copper	9802456		34.4	33.6	2.3%	< 0.2	105%	70%	130%	108%	90%	110%			
Iron	9802456		25700	25800	0.5%	< 10	104%	70%	130%	91%	90%	110%			
Lead	9802456		3.6	3.6	0.8%	< 0.1	94%	70%	130%	98%	90%	110%			
Magnesium	9802456		7920	7990	1.0%	< 10	109%	70%	130%	109%	90%	110%			
Manganese	9802456		250	255	2.0%	< 1	101%	70%	130%	106%	90%	110%			
Mercury	9802456		0.03	0.04	NA	< 0.01	89%	70%	130%	100%	90%	110%			
Molybdenum	9802456		4.2	4.3	2.7%	< 0.2	106%	70%	130%	103%	90%	110%			
Nickel	9802456		29.8	29.2	2.2%	< 0.5	110%	70%	130%	107%	90%	110%			
Phosphorus	9802456		612	635	3.6%	< 5	79%	70%	130%	103%	90%	110%			
Potassium	9802456		2610	2590	0.6%	< 5	112%	70%	130%	99%	90%	110%			
Selenium	9802456		1.2	1.4	18.6%	< 0.1				107%	90%	110%			
Lithium	9802456		21.7	21.9	1.2%	< 0.5				104%	90%	110%			
Silver	9802456		<0.5	<0.5	NA	< 0.5	127%	70%	130%	100%	90%	110%			
Sodium	9802456		4390	4480	1.9%	< 5	121%	70%	130%	99%	90%	110%			
Strontium	9802456		71	77	7.6%	< 1	118%	70%	130%	104%	90%	110%			
Thallium	9802456		0.5	0.5	0.0%	< 0.1	103%	70%	130%	98%	90%	110%			
Tin	9802456		0.6	0.6	NA	< 0.2	117%	70%	130%	101%	90%	110%			
Titanium	9802456		1340	1410	4.8%	< 1	114%	70%	130%	96%	90%	110%			
Uranium	9802456		1.3	1.3	0.8%	< 0.2	106%	70%	130%	104%	90%	110%			
Vanadium	9802456		58	58	0.9%	< 1	106%	70%	130%	105%	90%	110%			
Zinc	9802456		59	60	0.6%	< 1	106%	70%	130%	110%	90%	110%			
Zirconium	9802456		9.0	9.2	1.9%	< 0.1				104%	90%	110%			
pH 1:2	9881353		7.3	7.2	0.6%		100%	90%	110%	101%	95%	105%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Certified By: D. Solomi

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AGAT WORK ORDER: 18V422891

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

ATTENTION TO: Cheronne Oreiro

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Trace Organics Analysis

RPT Date: Feb 12, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works PAH in Soil Low Level															
Naphthalene	70408	9801856	0.067	0.049	31.0%	< 0.005	103%	80%	120%				90%	50%	130%
2-Methylnaphthalene	70408	9801856	0.023	0.022	NA	< 0.005	105%	80%	120%				91%	50%	130%
1-Methylnaphthalene	70408	9801856	0.009	0.005	NA	< 0.005	105%	80%	120%				98%	50%	130%
Acenaphthylene	70408	9801856	0.038	0.031	20.3%	< 0.005	100%	80%	120%				89%	50%	130%
Acenaphthene	70408	9801856	0.028	0.027	3.6%	< 0.005	105%	80%	120%				99%	50%	130%
Fluorene	70408	9801856	0.03	0.02	NA	< 0.02	100%	80%	120%				95%	50%	130%
Phenanthrene	70408	9801856	0.23	0.32	32.7%	< 0.02	100%	80%	120%				78%	60%	130%
Anthracene	70408	9801856	0.110	0.096	13.6%	< 0.004	102%	80%	120%				112%	60%	130%
Fluoranthene	70408	9801856	0.82	1.01	20.8%	< 0.01	102%	80%	120%				98%	60%	130%
Pyrene	70408	9801856	1.81	2.52	32.8%	< 0.01	99%	80%	120%				108%	60%	130%
Benzo(a)anthracene	70408	9801856	0.38	0.24	45.2%	< 0.03	101%	80%	120%				86%	60%	130%
Chrysene	70408	9801856	0.32	0.22	NA	< 0.05	101%	80%	120%				105%	60%	130%
Benzo(b)fluoranthene	70408	9801856	0.64	0.47	30.6%	< 0.02	101%	80%	120%				78%	60%	130%
Benzo(j)fluoranthene	70408	9801856	0.23	0.16	35.9%	< 0.02	101%	80%	120%				83%	60%	130%
Benzo(k)fluoranthene	70408	9801856	0.36	0.24	40.0%	< 0.02	99%	80%	120%				79%	60%	130%
Benzo(a)pyrene	70408	9801856	0.31	0.19	48.0%	< 0.03	101%	80%	120%				108%	60%	130%
Indeno(1,2,3-c,d)pyrene	70408	9801856	0.11	0.08	NA	< 0.02	101%	80%	120%				103%	60%	130%
Dibenzo(a,h)anthracene	70408	9801856	0.029	0.019	NA	< 0.005	103%	80%	120%				106%	60%	130%
Benzo(g,h,i)perylene	70408	9801856	0.13	0.09	NA	< 0.05	99%	80%	120%				101%	60%	130%
Quinoline	70408	9801856	0.07	0.06	NA	< 0.05	89%	80%	120%				112%	50%	130%
Naphthalene - d8	70408	9801856	90	81	10.5%		104%	80%	120%				90%	50%	130%
2-Fluorobiphenyl	70408	9801856	94	93	1.1%		101%	80%	120%				94%	50%	130%
P-Terphenyl - d14	70408	9801856	100	100	0.0%		101%	80%	120%				97%	60%	130%

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Polychlorinated Biphenyls Analysis - Soil															
Aroclor 1242	173	9801887	<0.05	<0.05	NA	< 0.05	114%	70%	130%	124%	70%	130%	118%	50%	150%
Aroclor 1254	173	9801887	<0.05	<0.05	NA	< 0.05	101%	70%	130%	104%	70%	130%	98%	50%	150%
Aroclor 1260	173	9801887	<0.05	<0.05	NA	< 0.05	107%	70%	130%	101%	70%	130%	103%	50%	150%
Total Polychlorinated Biphenyls	173	9801887	<0.05	<0.05	NA	< 0.05	107%	70%	130%	110%	70%	130%	106%	50%	150%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

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Ultra Trace Analysis

RPT Date: Feb 12, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Dioxins and Furans (Soil, WHO 2005)															
2,3,7,8-Tetra CDD	1	9801899	< 0.3	< 0.3	NA	< 0.3	84%	40%	130%	NA	40%	130%	84%	40%	130%
1,2,3,7,8-Penta CDD	1	9801899	< 0.4	< 0.4	NA	< 0.4	89%	40%	130%	NA	40%	130%	98%	40%	130%
1,2,3,4,7,8-Hexa CDD	1	9801899	< 0.4	< 0.3	NA	< 0.2	97%	40%	130%	NA	40%	130%	97%	40%	130%
1,2,3,6,7,8-Hexa CDD	1	9801899	< 0.4	< 0.3	NA	< 0.2	95%	40%	130%	NA	40%	130%	95%	40%	130%
1,2,3,7,8,9-Hexa CDD	1	9801899	< 0.4	< 0.3	NA	< 0.2	101%	40%	130%	NA	40%	130%	101%	40%	130%
1,2,3,4,6,7,8-Hepta CDD	1	9801899	< 0.4	< 0.8	NA	< 0.4	93%	40%	130%	NA	40%	130%	93%	40%	130%
Octa CDD	1	9801899	1	1	0.0%	< 0.3	105%	40%	130%	NA	40%	130%	112%	40%	130%
2,3,7,8-Tetra CDF	1	9801899	< 0.4	< 0.4	NA	< 0.4	97%	40%	130%	NA	40%	130%	97%	40%	130%
1,2,3,7,8-Penta CDF	1	9801899	< 0.3	< 0.7	NA	< 0.2	99%	40%	130%	NA	40%	130%	112%	40%	130%
2,3,4,7,8-Penta CDF	1	9801899	< 0.3	< 0.5	NA	< 0.3	102%	40%	130%	NA	40%	130%	101%	40%	130%
1,2,3,4,7,8-Hexa CDF	1	9801899	< 0.2	< 0.6	NA	< 0.2	115%	40%	130%	NA	40%	130%	110%	40%	130%
1,2,3,6,7,8-Hexa CDF	1	9801899	< 0.2	< 0.5	NA	< 0.2	107%	40%	130%	NA	40%	130%	116%	40%	130%
2,3,4,6,7,8-Hexa CDF	1	9801899	< 0.2	< 0.5	NA	< 0.2	110%	40%	130%	NA	40%	130%	112%	40%	130%
1,2,3,7,8,9-Hexa CDF	1	9801899	< 0.3	< 0.6	NA	< 0.3	99%	40%	130%	NA	40%	130%	110%	40%	130%
1,2,3,4,6,7,8-Hepta CDF	1	9801899	0.6	0.7	15.4%	< 0.4	97%	40%	130%	NA	40%	130%	108%	40%	130%
1,2,3,4,7,8,9-Hepta CDF	1	9801899	< 0.5	< 0.4	NA	< 0.5	104%	40%	130%	NA	40%	130%	111%	40%	130%
Octa CDF	1	9801899	< 0.6	< 0.8	NA	< 0.5	97%	40%	130%	NA	40%	130%	84%	40%	130%

Certified By:

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Method Summary

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sieve Analysis - 75 microns	INOR-171-6009	KROETSCH 2007; SHEPPARD 2007	SIEVE
Aluminum	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Antimony	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Arsenic	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Barium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Beryllium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Bismuth	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cadmium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Calcium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Chromium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cobalt	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Copper	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Iron	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Lead	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Lithium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Magnesium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Manganese	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Mercury	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Molybdenum	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Nickel	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Phosphorus	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Potassium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Selenium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Silver	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Sodium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Strontium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Thallium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Tin	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Titanium	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Uranium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Vanadium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zinc	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zirconium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
pH 1:2	INOR-181-6031	BC MOE Lab Manual B (pH, Electrometric, Soil)	PH METER
Ammonia, Soluble	Inor-171-6211	Carter & Gregorich 2007; SM 4500E	AQ-2 DISCRETE ANALYZER
Chloride, Soluble	LAB-181-4022, INOR-181-6023	BC MOE Lab Manual Section B	COLORIMETER
Saturation Percentage	LAB-181-4022	BC MOE Lab Manual Section B	GRAVIMETRIC
Sulphur - Total	INOR-181-6027	Modified from ASTM E1915-11	COMBUSTION
Sulphate Sulphur	ARD-181-18009; INOR-181-6028	MEND Report 1.20.1 (09); mod from SM 4500-SO4 E	SPECTROPHOTOMETER
Antimony - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Arsenic - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Barium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Beryllium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Boron - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Cadmium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Chromium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Cobalt - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Copper - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Iron - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Lead - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Mercury - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP/MS
Nickel - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Selenium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Silver - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Thallium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Uranium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Vanadium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Zinc - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Zirconium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
LOI	INOR-181-6030	ASTM D2974-07a	GRAVIMETRIC

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
1-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluorene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Phenanthrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Chrysene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(b)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(j)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(k)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Indeno(1,2,3-c,d)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Dibenzo(a,h)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(g,h,i)perylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Quinoline	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
IACR CCME (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
B[a]P TPE (Soil)	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Naphthalene - d8	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Fluorobiphenyl	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
P-Terphenyl - d14	ORG-180-5102	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
Aroclor 1242	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1254	TO-0410	EPA SW-846 8082	GC/ECD
Aroclor 1260	TO-0410	EPA SW-846 8082	GC/ECD
Total Polychlorinated Biphenyls	TO-0410	EPA SW-846 8082	GC/ECD
Decachlorobiphenyl	TO-0410	EPA SW-846 8082	GC/ECD

Unit 120, 8600 Glenlyon Parkway
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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422891
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Ultra Trace Analysis			
2,3,7,8-Tetra CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD	HR-151-5400	EPA 1613	HRMS
Octa CDD	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF	HR-151-5400	EPA 1613	HRMS
Octa CDF	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total PCDDs	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total PCDFs	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDD (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF (TEF 0.03)	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF (TEF 0.3)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	HR_151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDF (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
Total PCDDs and PCDFs (TEQ)	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDF	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-23478-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDF	HR-151-5400	EPA 1613	HRMS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422891
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
13C-123678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-234678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-123789-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-1234789-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDD	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDD	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-123678-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDD	HR-151-5400	EPA 1613	HRMS
13C-OCDD	HR-151-5400	EPA 1613	HRMS

WOOD WASTE

Chain of Custody Record and Laboratory Analysis Request

COC# 18V422891 4°C

ANCHOR QEA

DEC 20 AM 9:14

Date: 12/19/18
Laboratory: AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

	Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Archive	TCLP				Comments
1802297	1	EHWW-S4-SC-000050	12/18/18 1630	SE	2						X			X									
304	2	EHWW-S4-SC-055105	12/18/18 1635	SE	5	X	X	X	X	X	X	X	X	X									
456	3	EHWW-S4-SC-105155	12/18/18 1640	SE	5													X					
457	4	EHWW-S5-SC-110160	12/19/18 0850	SE	5	X	X	X	X	X	X	X	X	X									
458	5	EHWW-S5-SC-160210	12/19/18 0855	SE	5													X					
459	6	EHWW-S9-SC-038088	12/19/18 1045	SE	5	X	X	X	X	X	X	X	X	X									
467	7	EHWW-S9-SC-088138	12/19/18 1050	SE	5													X					
468	8	EHWW-65-SC-000050	12/19/18 1200	SE	2						X			X									
472	9	EHWW-44-SC-017067	12/19/18 1310	SE	5	X	X	X	X	X	X	X	X	X									
475	10	EHWW-44-SC-067117	12/19/18 1315	SE	5													X					
488	11	EHWW-S3-SC-000016	12/19/18 1415	SE	2						X			X									
498	12	EHWW-S3-SC-016066	12/19/18 1420	SE	5	X	X	X	X	X	X	X	X	X									
502	13	EHWW-S3-SC 066116	12/19/18 1425	SE	5													X					
505	14	EHWW-IDW-SED	12/19/18 1430	SE	3		X	X	X								X	X					

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time 12/19/18 1555	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By: [signature]	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

V117282

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 18V422891

RECEIVING BASICS:

Received From: ACE #3 Waybill #: ______

SAMPLE QUANTITIES:

Coolers: 8 Containers: 58

TIME SENSITIVE ISSUES:

Earliest Date Sampled: Dec 18, 2018 ALREADY EXCEEDED? Yes No (circled: No)

NON-CONFORMANCES:

3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) *use jars when available

(1) 0 + 0 + 3 = 1 °C (2) 1 + 0 + 0 = 1 °C (3) 0 + 0 + 4 = 2 °C (4) 0 + 0 + 0 = 0 °C

Was ice or ice pack present: Yes No (circled: Yes)

Integrity Issues: (5) 4 + 4 + 3 = 4 ; (6) 2 + 3 + 3 = 3 ; (7) 4 + 5 + 4 = 4 ; (8) 4 + 2 + 0 = 2

Account Project Manager: ______ have they been notified of the above issues: Yes No

Whom spoken to: ______ Date and Time: ______

ADDITIONAL NOTES:

Unit 120, 8600 Glenlyon Parkway
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FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
219-800 BURRARD ST
VANCOUVER, BC V6Z 0B9
604-671-1831

ATTENTION TO: Cheronne Oreiro

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

AGAT WORK ORDER: 18V422993

SOIL ANALYSIS REVIEWED BY: Dana Solari, Lab Reporter

TRACE ORGANICS REVIEWED BY: Alison Sekera, Trace Organics Supervisor

ULTRA TRACE REVIEWED BY: Anastasia Kazakova, chimiste

DATE REPORTED: Jan 15, 2019

PAGES (INCLUDING COVER): 17

VERSION*: 3

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES
VERSION 3: Sample receipt temperature 3°C.

Version 3 is issued to report complete results. Version 3 is an amendment to all previous versions.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V422993

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

TCLP Leachate Metals

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-15

			SAMPLE DESCRIPTION:	EHWW-1DW-WATER
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802785
Antimony - TCLP Leachate	mg/L		0.01	<0.01
Arsenic - TCLP Leachate	mg/L		0.02	0.04
Barium - TCLP Leachate	mg/L		0.5	<0.5
Beryllium - TCLP Leachate	mg/L		0.02	<0.02
Boron - TCLP Leachate	mg/L		0.5	2.1
Cadmium - TCLP Leachate	mg/L		0.01	0.05
Chromium - TCLP Leachate	mg/L		0.01	<0.01
Cobalt - TCLP Leachate	mg/L		0.05	<0.05
Copper - TCLP Leachate	mg/L		0.05	0.06
Iron - TCLP Leachate	mg/L		1	8
Lead - TCLP Leachate	mg/L		0.01	0.04
Mercury - TCLP Leachate	mg/L		0.01	<0.01
Nickel - TCLP Leachate	mg/L		0.05	<0.05
Selenium - TCLP Leachate	mg/L		0.05	0.05
Silver - TCLP Leachate	mg/L		0.01	<0.01
Thallium - TCLP Leachate	mg/L		0.01	<0.01
Uranium - TCLP Leachate	mg/L		0.01	<0.01
Vanadium - TCLP Leachate	mg/L		0.05	<0.05
Zinc - TCLP Leachate	mg/L		0.1	0.2
Zirconium - TCLP Leachate	mg/L		0.01	<0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802785 Analysis based on "as received"

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

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Certificate of Analysis

AGAT WORK ORDER: 18V422993
PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Polychlorinated Biphenyls Analysis in Water

DATE RECEIVED: 2018-12-20
DATE REPORTED: 2019-01-15

			SAMPLE DESCRIPTION:	EHWW-1DW-WATER
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802785
Aroclor 1242	µg/L		0.009	<0.009
Aroclor 1254	µg/L		0.009	<0.009
Aroclor 1260	µg/L		0.009	<0.009
Total Polychlorinated Biphenyls	µg/L		0.009	<0.009
Surrogate	Unit	Acceptable Limits		
Decachlorobiphenyl	%	50-150		97

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
9802785 Analysis multiple peak pattern method by GC/ECD.
Analysis performed at AGAT Calgary (unless marked by *)

Certified By: Alison Sekera

Certificate of Analysis

AGAT WORK ORDER: 18V422993

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Water Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-15

			SAMPLE DESCRIPTION:	EHWW-1DW-WATER
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802785
Naphthalene	µg/L		0.05	0.47
Quinoline	µg/L		0.05	<0.05
Acenaphthylene	µg/L		0.02	0.09
Acenaphthene	µg/L		0.02	0.29
Fluorene	µg/L		0.02	0.72
Phenanthrene	µg/L		0.04	5.07
Anthracene	µg/L		0.01	0.22
Acridine	µg/L		0.05	<0.05
Fluoranthene	µg/L		0.02	2.22
Pyrene	µg/L		0.02	1.93
Benzo(a)anthracene	µg/L		0.01	0.58
Chrysene	µg/L		0.01	0.58
Benzo(b)fluoranthene	µg/L		0.01	0.97
Benzo(j)fluoranthene	µg/L		0.01	0.19
Benzo(k)fluoranthene	µg/L		0.01	0.47
Benzo(a)pyrene	µg/L		0.01	0.32
Indeno(1,2,3-c,d)pyrene	µg/L		0.01	0.32
Dibenzo(a,h)anthracene	µg/L		0.01	<0.01
Benzo(g,h,i)perylene	µg/L		0.01	0.47
1-Methylnaphthalene	µg/L		0.05	0.34
2-Methylnaphthalene	µg/L		0.05	0.80
Benzo(b+j)fluoranthene	µg/L		0.01	1.16
Surrogate	Unit	Acceptable Limits		
Naphthalene - d8	%	50-130		68
2-Fluorobiphenyl	%	50-130		85
P-Terphenyl - d14	%	60-130		89

Certified By: Alison Sekera

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Public Works PAH in Water Low Level

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-15

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802785 Sample container inappropriate as per analysis requirements.

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: Alison Sekera

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FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Water, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-15

Parameter	Unit	G / S	RDL	EHWW-1DW-WATER
			SAMPLE DESCRIPTION:	EHWW-1DW-WATER
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2018-12-19
				9802785
2,3,7,8-Tetra CDD	pg/L		2	<2
1,2,3,7,8-Penta CDD	pg/L		3	6
1,2,3,4,7,8-Hexa CDD	pg/L		2	6
1,2,3,6,7,8-Hexa CDD	pg/L		2	54
1,2,3,7,8,9-Hexa CDD	pg/L		2	14
1,2,3,4,6,7,8-Hepta CDD	pg/L		3	730
Octa CDD	pg/L		5	4820
2,3,7,8-Tetra CDF	pg/L		1	25
1,2,3,7,8-Penta CDF	pg/L		1	<1
2,3,4,7,8-Penta CDF	pg/L		0.9	17
1,2,3,4,7,8-Hexa CDF	pg/L		1	33
1,2,3,6,7,8-Hexa CDF	pg/L		1	22
2,3,4,6,7,8-Hexa CDF	pg/L		1	22
1,2,3,7,8,9-Hexa CDF	pg/L		2	<2
1,2,3,4,6,7,8-Hepta CDF	pg/L		2	519
1,2,3,4,7,8,9-Hepta CDF	pg/L		2	<2
Octa CDF	pg/L		4	131
Total Tetrachlorodibenzodioxins	pg/L		2	48
Total Pentachlorodibenzodioxins	pg/L		3	88
Total Hexachlorodibenzodioxins	pg/L		2	134
Total Heptachlorodibenzodioxins	pg/L		3	1920
Total PCDDs	pg/L		5	7010
Total Tetrachlorodibenzofurans	pg/L		1	262
Total Pentachlorodibenzofurans	pg/L		1	125
Total Hexachlorodibenzofurans	pg/L		2	319
Total Heptachlorodibenzofurans	pg/L		2	1070
Total PCDFs	pg/L		4	1910
2,3,7,8-Tetra CDD (TEF 1.0)	TEQ			0
1,2,3,7,8-Penta CDD (TEF 1.0)	TEQ			6.38

Certified By:

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CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Water, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-15

			SAMPLE DESCRIPTION:	EHWW-1DW-WATER
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2018-12-19
Parameter	Unit	G / S	RDL	9802785
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	TEQ			0.600
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	TEQ			5.35
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	TEQ			1.39
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	TEQ			7.30
Octa CDD (TEF 0.0003)	TEQ			1.44
2,3,7,8-Tetra CDF (TEF 0.1)	TEQ			2.53
1,2,3,7,8-Penta CDF (TEF 0.03)	TEQ			0
2,3,4,7,8-Penta CDF (TEF 0.3)	TEQ			5.06
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	TEQ			3.33
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	TEQ			2.20
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	TEQ			2.18
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	TEQ			0
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	TEQ			5.19
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	TEQ			0
Octa CDF (TEF 0.0003)	TEQ			0.0392
Total PCDDs and PCDFs (TEQ)	pg/L TEQ			43.0

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18V422993

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Dioxins and Furans (Water, WHO 2005)

DATE RECEIVED: 2018-12-20

DATE REPORTED: 2019-01-15

		SAMPLE DESCRIPTION:	EHWW-1DW-WATER
		SAMPLE TYPE:	Water
		DATE SAMPLED:	2018-12-19
Surrogate	Unit	Acceptable Limits	9802785
13C-2378-TCDF	%	30-140	41
13C-12378-PeCDF	%	30-140	32
13C-23478-PeCDF	%	30-140	39
13C-123478-HxCDF	%	30-140	66
13C-123678-HxCDF	%	30-140	72
13C-234678-HxCDF	%	30-140	70
13C-123789-HxCDF	%	30-140	63
13C-1234678-HpCDF	%	30-140	52
13C-1234789-HpCDF	%	30-140	57
13C-2378-TCDD	%	30-140	48
13C-12378-PeCDD	%	30-140	37
13C-123478-HxCDD	%	30-140	53
13C-123678-HxCDD	%	30-140	66
13C-1234678-HpCDD	%	30-140	51
13C-OCDD	%	30-140	30

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9802785 The results were corrected based on the surrogate percent recoveries.

Analysis performed at AGAT Montreal (unless marked by *)

Certified By:

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

AGAT WORK ORDER: 18V422993

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jan 15, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
TCLP Leachate Metals															
Antimony - TCLP Leachate	9802505		2.71	2.58	5.1%	< 0.01				101%	90%	110%	127%	70%	130%
Arsenic - TCLP Leachate	9802505		1.94	1.81	6.9%	< 0.02	84%	50%	150%	105%	90%	110%	97%	70%	130%
Barium - TCLP Leachate	9802505		1.2	1.1	NA	< 0.5	83%	50%	150%	94%	90%	110%	108%	70%	130%
Beryllium - TCLP Leachate	9802505		1.14	1.13	1.1%	< 0.02				98%	90%	110%	111%	70%	130%
Boron - TCLP Leachate	9802505		1.4	1.4	NA	< 0.5				100%	90%	110%	94%	70%	130%
Cadmium - TCLP Leachate	9802505		1.06	1.04	2.2%	< 0.01	90%	50%	150%	98%	90%	110%	101%	70%	130%
Chromium - TCLP Leachate	9802505		0.96	1.02	6.7%	< 0.01	112%	50%	150%	105%	90%	110%	91%	70%	130%
Copper - TCLP Leachate	9802505		0.96	1.08	11.6%	< 0.05	57%	50%	150%	98%	90%	110%	88%	70%	130%
Iron - TCLP Leachate	9802505		2	2	NA	< 1				104%	90%	110%	105%	70%	130%
Lead - TCLP Leachate	9802505		2.08	2.01	3.2%	< 0.01	71%	50%	150%	91%	90%	110%	98%	70%	130%
Mercury - TCLP Leachate	9802505		1.94	1.90	2.1%	< 0.01	73%	50%	150%	99%	90%	110%	95%	70%	130%
Nickel - TCLP Leachate	9802505		0.96	1.12	15.0%	< 0.05				102%	90%	110%	89%	70%	130%
Selenium - TCLP Leachate	9802505		1.03	1.03	0.2%	< 0.05	96%	50%	150%	110%	90%	110%	109%	70%	130%
Silver - TCLP Leachate	9802505		0.29	0.28	1.6%	< 0.01	140%	50%	150%	99%	90%	110%	110%	70%	130%
Thallium - TCLP Leachate	9802505		5.73	5.60	2.3%	< 0.01				102%	90%	110%	111%	70%	130%
Uranium - TCLP Leachate	9802505		1.70	1.77	4.0%	< 0.01				102%	90%	110%			
Vanadium - TCLP Leachate	9802505		1.04	1.15	10.3%	< 0.05				108%	90%	110%	95%	70%	130%
Zinc - TCLP Leachate	9802505		1.2	1.1	4.9%	< 0.1	85%	50%	150%	94%	90%	110%	87%	70%	130%
Zirconium - TCLP Leachate	9802505		<0.01	<0.01	NA	< 0.01				105%	90%	110%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Certified By: D. Solani

AGAT Laboratories

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

AGAT WORK ORDER: 18V422993

PROJECT: 170553-11.05 EHRP Wood Debris Remediation

ATTENTION TO: Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Jan 15, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Public Works PAH in Water Low Level															
Naphthalene	70406	W-MS1	0.33	0.36	8.7%	< 0.05	103%	80%	120%				69%	50%	130%
Quinoline	70406	W-MS1	0.48	0.58	18.9%	< 0.05	89%	80%	120%				97%	50%	130%
Acenaphthylene	70406	W-MS1	0.42	0.42	0.0%	< 0.02	100%	80%	120%				84%	50%	130%
Acenaphthene	70406	W-MS1	0.45	0.47	4.3%	< 0.02	105%	80%	120%				90%	50%	130%
Fluorene	70406	W-MS1	0.49	0.49	0.0%	< 0.02	100%	80%	120%				100%	50%	130%
Phenanthrene	70406	W-MS1	0.35	0.32	9.0%	< 0.04	100%	80%	120%				71%	60%	130%
Anthracene	70406	W-MS1	0.49	0.49	0.0%	< 0.01	102%	80%	120%				99%	60%	130%
Acridine	70406	W-MS1	0.42	0.44	4.7%	< 0.05	97%	80%	120%				84%	50%	130%
Fluoranthene	70406	W-MS1	0.42	0.42	0.0%	< 0.02	102%	80%	120%				85%	60%	130%
Pyrene	70406	W-MS1	0.48	0.44	8.7%	< 0.02	99%	80%	120%				98%	60%	130%
Benzo(a)anthracene	70406	W-MS1	0.37	0.37	0.0%	< 0.01	101%	80%	120%				76%	60%	130%
Chrysene	70406	W-MS1	0.49	0.48	2.1%	< 0.01	101%	80%	120%				98%	60%	130%
Benzo(b)fluoranthene	70406	W-MS1	0.36	0.35	2.8%	< 0.01	101%	80%	120%				72%	60%	130%
Benzo(j)fluoranthene	70406	W-MS1	0.38	0.42	10.0%	< 0.01	101%	80%	120%				78%	60%	130%
Benzo(k)fluoranthene	70406	W-MS1	0.32	0.31	3.2%	< 0.01	99%	80%	120%				65%	60%	130%
Benzo(a)pyrene	70406	W-MS1	0.48	0.51	6.1%	< 0.01	101%	80%	120%				98%	60%	130%
Indeno(1,2,3-c,d)pyrene	70406	W-MS1	0.45	0.49	8.5%	< 0.01	101%	80%	120%				91%	60%	130%
Dibenzo(a,h)anthracene	70406	W-MS1	0.46	0.49	6.3%	< 0.01	103%	80%	120%				93%	60%	130%
Benzo(g,h,i)perylene	70406	W-MS1	0.45	0.45	0.0%	< 0.01	99%	80%	120%				91%	60%	130%
1-Methylnaphthalene	70406	W-MS1	0.39	0.43	9.8%	< 0.05	105%	80%	120%				78%	50%	130%
2-Methylnaphthalene	70406	W-MS1	0.34	0.36	5.7%	< 0.05	105%	80%	120%				68%	50%	130%
Naphthalene - d8	70406	W-MS1	84	95	12.3%		104%	80%	120%				84%	50%	130%
2-Fluorobiphenyl	70406	W-MS1	88	102	14.7%		101%	80%	120%				89%	50%	130%
P-Terphenyl - d14	70406	W-MS1	81	81	0.0%		101%	80%	120%				81%	60%	130%

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Certified By: Alison Sekera

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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422993
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Ultra Trace Analysis

RPT Date: Jan 15, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Dioxins and Furans (Water, WHO 2005)															
2,3,7,8-Tetra CDD	1	NA	NA	NA	0.0%	< 1	83%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8-Penta CDD	1	NA	NA	NA	0.0%	< 2	92%	70%	130%	NA	70%	130%	NA	70%	130%
1,2,3,4,7,8-Hexa CDD	1	NA	NA	NA	0.0%	< 2	100%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,6,7,8-Hexa CDD	1	NA	NA	NA	0.0%	< 2	91%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8,9-Hexa CDD	1	NA	NA	NA	0.0%	< 2	102%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,6,7,8-Hepta CDD	1	NA	NA	NA	0.0%	< 2	99%	40%	130%	NA	40%	130%	NA	40%	130%
Octa CDD	1	NA	NA	NA	0.0%	< 3	104%	40%	130%	NA	40%	130%	NA	40%	130%
2,3,7,8-Tetra CDF	1	NA	NA	NA	0.0%	< 0.7	98%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8-Penta CDF	1	NA	NA	NA	0.0%	< 0.5	116%	40%	130%	NA	40%	130%	NA	40%	130%
2,3,4,7,8-Penta CDF	1	NA	NA	NA	0.0%	< 0.4	117%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,7,8-Hexa CDF	1	NA	NA	NA	0.0%	< 0.8	112%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,6,7,8-Hexa CDF	1	NA	NA	NA	0.0%	< 0.8	117%	40%	130%	NA	40%	130%	NA	40%	130%
2,3,4,6,7,8-Hexa CDF	1	NA	NA	NA	0.0%	< 0.9	117%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,7,8,9-Hexa CDF	1	NA	NA	NA	0.0%	< 2	107%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,6,7,8-Hepta CDF	1	NA	NA	NA	0.0%	< 0.5	113%	40%	130%	NA	40%	130%	NA	40%	130%
1,2,3,4,7,8,9-Hepta CDF	1	NA	NA	NA	0.0%	< 1	113%	40%	130%	NA	40%	130%	NA	40%	130%
Octa CDF	1	NA	NA	NA	0.0%	< 0.9	76%	40%	130%	NA	40%	130%	NA	40%	130%

Certified By:

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA   AGAT WORK ORDER: 18V422993
PROJECT: 170553-11.05 EHRP Wood Debris Remediation   ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Arsenic - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Barium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Beryllium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Boron - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Cadmium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Chromium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Cobalt - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Copper - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Iron - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Lead - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Mercury - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP/MS
Nickel - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Selenium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Silver - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Thallium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Uranium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Vanadium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Zinc - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Zirconium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA   AGAT WORK ORDER: 18V422993
PROJECT: 170553-11.05 EHRP Wood Debris Remediation   ATTENTION TO: Cheronne Oreiro
SAMPLING SITE: SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Aroclor 1242	TO-0400	EPA SW-846 8082	GC/ECD
Aroclor 1254	TO-0400	EPA SW-846 8082	GC/ECD
Aroclor 1260	TO-0400	EPA SW-846 8082	GC/ECD
Total Polychlorinated Biphenyls	TO-0400	EPA SW-846 8082	GC/ECD
Decachlorobiphenyl	TO-0400	EPA SW-846 8082	GC/ECD
Naphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Quinoline	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthylene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluorene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Phenanthrene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Anthracene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acridine	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluoranthene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Pyrene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)anthracene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Chrysene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(b)fluoranthene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(j)fluoranthene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(k)fluoranthene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)pyrene	ORG-180-5133	Modified from BC MOE Lab Manual Section D	GC/MS
Indeno(1,2,3-c,d)pyrene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Dibenzo(a,h)anthracene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(g,h,i)perylene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
1-Methylnaphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Methylnaphthalene	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Naphthalene - d8			GC/MS
2-Fluorobiphenyl	ORG-180-5133	Modified form BCMOE Lab Manual Section D (PAH)	GC/MS
P-Terphenyl - d14	ORG-180-5133	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS

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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422993
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Ultra Trace Analysis			
2,3,7,8-Tetra CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD	HR-151-5400	EPA 1613	HRMS
Octa CDD	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF	HR-151-5400	EPA 1613	HRMS
Octa CDF	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzodioxins	HR-151-5400	EPA 1613	HRMS
Total PCDDs	HR-151-5400	EPA 1613	HRMS
Total Tetrachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Pentachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Hexachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total Heptachlorodibenzofurans	HR-151-5400	EPA 1613	HRMS
Total PCDFs	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDD (TEF 1.0)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDD (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDD (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDD (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
2,3,7,8-Tetra CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8-Penta CDF (TEF 0.03)	HR-151-5400	EPA 1613	HRMS
2,3,4,7,8-Penta CDF (TEF 0.3)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8-Hexa CDF (TEF 0.1)	HR_151-5400	EPA 1613	HRMS
1,2,3,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
2,3,4,6,7,8-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,7,8,9-Hexa CDF (TEF 0.1)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,6,7,8-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
1,2,3,4,7,8,9-Hepta CDF (TEF 0.01)	HR-151-5400	EPA 1613	HRMS
Octa CDF (TEF 0.0003)	HR-151-5400	EPA 1613	HRMS
Total PCDDs and PCDFs (TEQ)	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDF	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-23478-PeCDF	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDF	HR-151-5400	EPA 1613	HRMS

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
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http://www.agatlabs.com

Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V422993
PROJECT: 170553-11.05 EHRP Wood Debris Remediation
ATTENTION TO: Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
13C-123678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-234678-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-123789-HxCDF	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-1234789-HpCDF	HR-151-5400	EPA 1613	HRMS
13C-2378-TCDD	HR-151-5400	EPA 1613	HRMS
13C-12378-PeCDD	HR-151-5400	EPA 1613	HRMS
13C-123478-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-123678-HxCDD	HR-151-5400	EPA 1613	HRMS
13C-1234678-HpCDD	HR-151-5400	EPA 1613	HRMS
13C-OCDD	HR-151-5400	EPA 1613	HRMS

4°C

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

18V 422993

DEC 20 ~ 9:14

Date: 12/19/18
Laboratory : AGAT
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

	Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	TS/TOC	Metals	PAHs	Total PCB Aroclors	D/Fs	Bulk Sulphides	Ammonia	TVS	Grain Size	Moisture Content	Atterberg Limits	TCLP Metals	Comments
						Sediment and Field QC												
982785	1	EHWW - IDW-WATER	12/19/18 1452	water ~~SE~~	1		X	X	X									HOLD
	2			SE														
	3			SE														
	4			SE														
	5			SE														
	6			SE														
	7			SE														
	8			SE														
	9			SE														
	10			SE														
	11			SE														
	12			SE														
	13			SE														
	14			SE														

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time 12/19/18 1555	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	V117208

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original. Page ____ of ____

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 18V422993

RECEIVING BASICS:

Received From: ACE # 4 Waybill #: ____

SAMPLE QUANTITIES:

Coolers: 8 Containers: 1

TIME SENSITIVE ISSUES:

Earliest Date Sampled: Dec 19, 2018 ALREADY EXCEEDED? Yes No

NON-CONFORMANCES:

3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) ***use jars when available**

(1) 0 + 0 + 3 = 1 °C (2) 1 + 0 + 1 = 0 °C (3) 0 + 0 + 4 = 2 °C (4) 0 + 0 + 0 = 0 °C

Was ice or ice pack present: Yes No (5) 4 + 4 + 3 = 4; (6) 2 + 3 + 3 = 3; (7) 4 + 5 + 4 = 4

Integrity Issues: (8) - 4 + 2 + 0 = 2.

PAH and Dioxins and Furan submitted using incorrect containers.

Account Project Manager: ____ have they been notified of the above issues: Yes No

Whom spoken to: ____ Date and Time: ____

ADDITIONAL NOTES:

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
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http://www.agatlabs.com

CLIENT NAME:	PUBLIC WORKS AND GOVERNMENT SERVICES CANADA 219-800 BURRARD ST VANCOUVER, BC V6Z 0B9 604-671-1831
ATTENTION TO:	Evan Malczyk/Cheronne Oreiro
PROJECT:	
AGAT WORK ORDER:	18V423749
SOIL ANALYSIS REVIEWED BY:	Dana Solari, Lab Reporter
DATE REPORTED:	Dec 31, 2018
PAGES (INCLUDING COVER):	6
VERSION*:	1

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES
VERSION 1: Sample receipt temperature 6°C.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18V423749

PROJECT:

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ATTENTION TO: Evan Malczyk/Cheronne Oreiro

SAMPLING SITE:

SAMPLED BY:

TCLP Leachate Metals

DATE RECEIVED: 2018-12-21

DATE REPORTED: 2018-12-31

			SAMPLE DESCRIPTION:	SA01 Disposal Bin Soil Sample	SA02 Disposal Bin Soil Sample	SA03 Disposal Bin Soil Sample
			SAMPLE TYPE:	Soil	Soil	Soil
			DATE SAMPLED:	2018-12-20	2018-12-20	2018-12-20
Parameter	Unit	G / S	RDL	9809296	9809297	9809298
Antimony - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01
Arsenic - TCLP Leachate	mg/L		0.02	<0.02	<0.02	<0.02
Barium - TCLP Leachate	mg/L		0.5	<0.5	<0.5	<0.5
Beryllium - TCLP Leachate	mg/L		0.02	<0.02	<0.02	<0.02
Boron - TCLP Leachate	mg/L		0.5	<0.5	<0.5	<0.5
Cadmium - TCLP Leachate	mg/L		0.01	0.01	<0.01	<0.01
Chromium - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01
Cobalt - TCLP Leachate	mg/L		0.05	<0.05	<0.05	<0.05
Copper - TCLP Leachate	mg/L		0.05	0.06	0.05	0.08
Iron - TCLP Leachate	mg/L		1	5	5	5
Lead - TCLP Leachate	mg/L		0.01	0.03	0.02	0.03
Mercury - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01
Nickel - TCLP Leachate	mg/L		0.05	<0.05	<0.05	<0.05
Selenium - TCLP Leachate	mg/L		0.05	<0.05	<0.05	<0.05
Silver - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01
Thallium - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01
Uranium - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01
Vanadium - TCLP Leachate	mg/L		0.05	<0.05	<0.05	<0.05
Zinc - TCLP Leachate	mg/L		0.1	<0.1	<0.1	<0.1
Zirconium - TCLP Leachate	mg/L		0.01	<0.01	<0.01	<0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9809296-9809298 Analysis based on "as received"

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

AGAT Laboratories

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
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Quality Assurance

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V423749
PROJECT:
ATTENTION TO: Evan Malczyk/Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date: Dec 31, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
TCLP Leachate Metals															
Antimony - TCLP Leachate	9802505		2.71	2.58	5.1%	< 0.01				101%	90%	110%	127%	70%	130%
Arsenic - TCLP Leachate	9802505		1.94	1.81	6.9%	< 0.02	84%	50%	150%	105%	90%	110%	97%	70%	130%
Barium - TCLP Leachate	9802505		1.2	1.1	NA	< 0.5	83%	50%	150%	94%	90%	110%	108%	70%	130%
Beryllium - TCLP Leachate	9802505		1.14	1.13	1.1%	< 0.02				98%	90%	110%	111%	70%	130%
Boron - TCLP Leachate	9802505		1.4	1.4	NA	< 0.5				100%	90%	110%	94%	70%	130%
Cadmium - TCLP Leachate	9802505		1.06	1.04	2.2%	< 0.01	83%	50%	150%	98%	90%	110%	101%	70%	130%
Chromium - TCLP Leachate	9802505		0.96	1.02	6.7%	< 0.01	112%	50%	150%	105%	90%	110%	91%	70%	130%
Copper - TCLP Leachate	9802505		0.96	1.08	11.6%	< 0.05	57%	50%	150%	98%	90%	110%	88%	70%	130%
Iron - TCLP Leachate	9802505		2	2	NA	< 1				104%	90%	110%	105%	70%	130%
Lead - TCLP Leachate	9802505		2.08	2.01	3.2%	< 0.01	71%	50%	150%	91%	90%	110%	98%	70%	130%
Mercury - TCLP Leachate	9802505		1.94	1.90	1.6%	< 0.01	73%	50%	150%	99%	90%	110%	95%	70%	130%
Nickel - TCLP Leachate	9802505		0.96	1.12	15.0%	< 0.05				102%	90%	110%	89%	70%	130%
Selenium - TCLP Leachate	9802505		1.03	1.03	0.2%	< 0.05	80%	50%	150%	110%	90%	110%	109%	70%	130%
Silver - TCLP Leachate	9802505		0.29	0.28	1.6%	< 0.01	140%	50%	150%	99%	90%	110%	110%	70%	130%
Thallium - TCLP Leachate	9802505		5.73	5.60	2.3%	< 0.01				102%	90%	110%	111%	70%	130%
Uranium - TCLP Leachate	9802505		<0.01	<0.01	NA	< 0.01				102%	90%	110%			
Vanadium - TCLP Leachate	9802505		1.04	1.15	10.3%	< 0.05				108%	90%	110%	95%	70%	130%
Zinc - TCLP Leachate	9802505		1.2	1.1	4.9%	< 0.1	85%	50%	150%	94%	90%	110%	87%	70%	130%
Zirconium - TCLP Leachate	9802505		<0.01	<0.01	NA	< 0.01				105%	90%	110%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Certified By: D. Solani

AGAT Laboratories
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Method Summary

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
AGAT WORK ORDER: 18V423749
PROJECT:
ATTENTION TO: Evan Malczyk/Cheronne Oreiro
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Arsenic - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Barium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Beryllium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Boron - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Cadmium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Chromium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Cobalt - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Copper - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Iron - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Lead - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Mercury - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP/MS
Nickel - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Selenium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Silver - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Thallium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Uranium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Vanadium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Zinc - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS
Zirconium - TCLP Leachate	MET-181-6102, LAB-181-4001	EPA 1311 and EPA 6020A	ICP-MS

120 - 8600 Glenlyon Parkway
Burnaby, BC
V5J 0B6
P: 778.452.4000 • F: 778.452.4074

AGAT Laboratories

Chain of Custody Record

Laboratory Use Only

Arrival Temperature: 6°C

AGAT Job Number: 18V423749

Notes: DEC 21 AM11:48

Report Information

Company: Anchor QEA / Klohn Crippen Berger

Contact: Evan Malczyk, Cheronne Oreiro

Address: 720 Olive Way, Suite 1900 Seattle, WA

Phone: 206.219.5891 Fax:

LSD:

Client Project #: TA 700425061

Report Information

1. Name:
Email:
2. Name:
Email:

Report Format

☐ Single Sample per page

☐ Multiple Samples per page

☐ Excel Format Included

Turnaround Time Required (TAT)

Regular TAT ☐ 5 to 7 working days

Rush TAT ☐ Day 2 - 100% ☐ Day 3 - 50% ☐ Day 4 - 25%

Date Required:

PLEASE CONTACT LABORATORY IF RUSH REQUIRED SAMPLE SUBMISSION CUT OFF FOR EFFECTIVE DATE BY 3 PM

Invoice To

Same as above Yes ☑ / No ☐

Company:

Contact:

Address:

Phone: Fax:

PO/AFE#:

Requirements *(Please Check)*

☐ **BC CSR Soil**
☐ AL
☐ IL
☐ PL
☐ CL
☐ RL-LD ☐ RL-HD
☐ WL-N ☐ WL-R

☐ **BC CSR - Water**
☐ DW
☐ AW
☐ IW
☐ LW

Schedule 3.3 *(Please Specify)*

CCME *(Please Specify)*

Other *(Please Specify)*

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	SAMPLE MATRIX (AGAT Sample I.D.)	DATE/TIME SAMPLED	COMMENTS - SITE SAMPLE INFO. SAMPLE CONTAINMENT	NUMBER OF CONTAINERS	PRESERVED (Y/N)	HAZARDOUS (Y/N)	Hold for: ☐ 60 DAYS
SA01	Disposal Bin Soil Sample	9809296	2018-12-20 14:00	Archive for testing	1			
SA02	"	97	" 14:30	direction from	1			
SA03	"	98	" 15:00	Anchor QEA	1			

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
[signature]	2018-12-21	Ann [signature]	

Page ____ of ____

Nº: 029275

Document #: DIV-186-1500.004

Date Revised: January 26, 2018

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 18V427749

RECEIVING BASICS:

Received From: Client   Waybill #: ____________

SAMPLE QUANTITIES:

Coolers: 1   Containers: 3

TIME SENSITIVE ISSUES:

Earliest Date Sampled: 2018-12-20   ALREADY EXCEEDED? Yes No

NON-CONFORMANCES:

3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) ***use jars when available**

(1) 6 + 6 + 6 = 6 °C (2) ___+___+___=____°C (3) ___+___+___=____°C (4) ___+___+___=____°C

Was ice or ice pack present: Yes No

Integrity Issues:

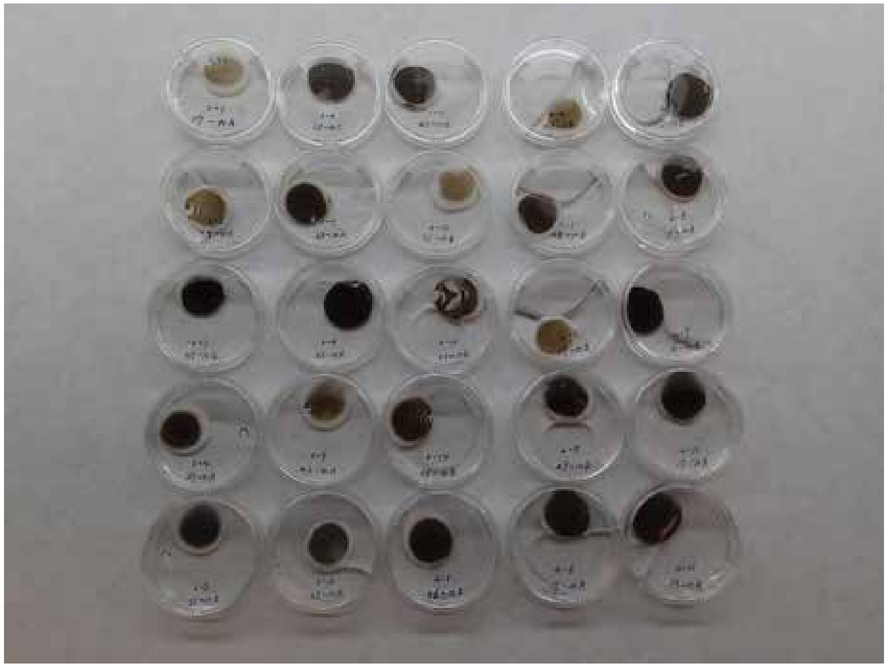
Account Project Manager: ____________ have they been notified of the above issues: Yes No

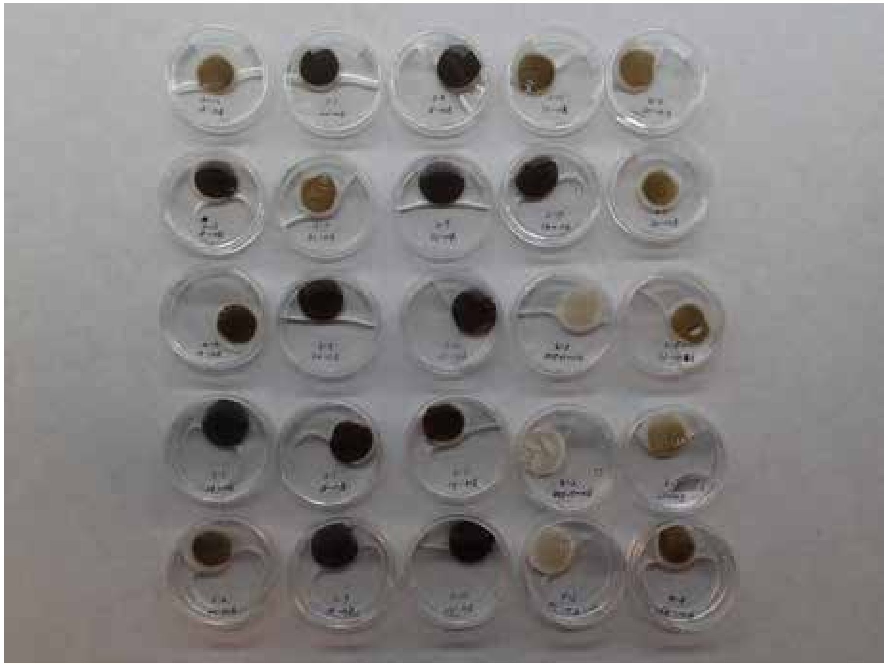
Whom spoken to: ____________ Date and Time: ____________

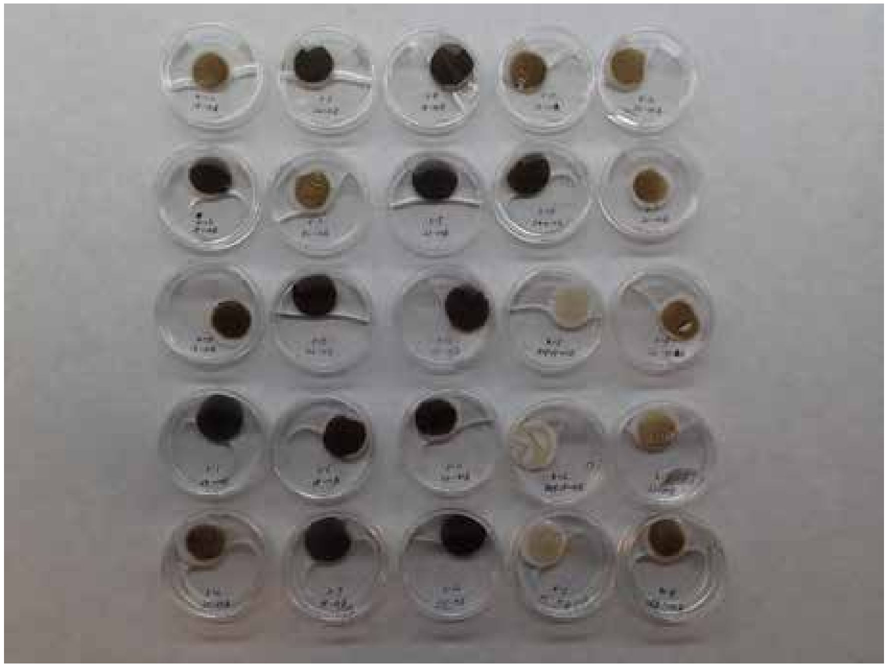
ADDITIONAL NOTES:

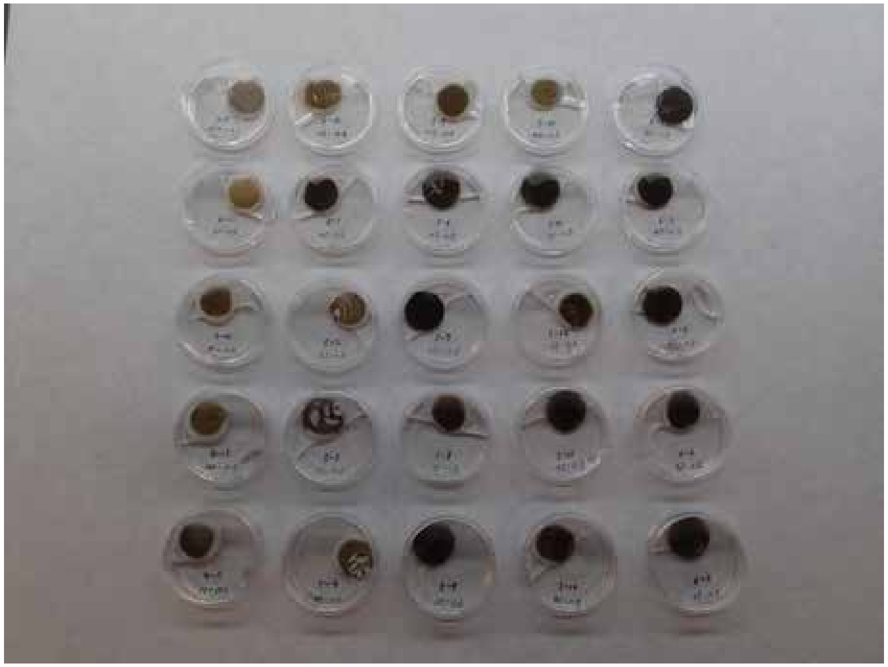
Document #: SR-186-9504.001
Revision Date: July 9, 2014

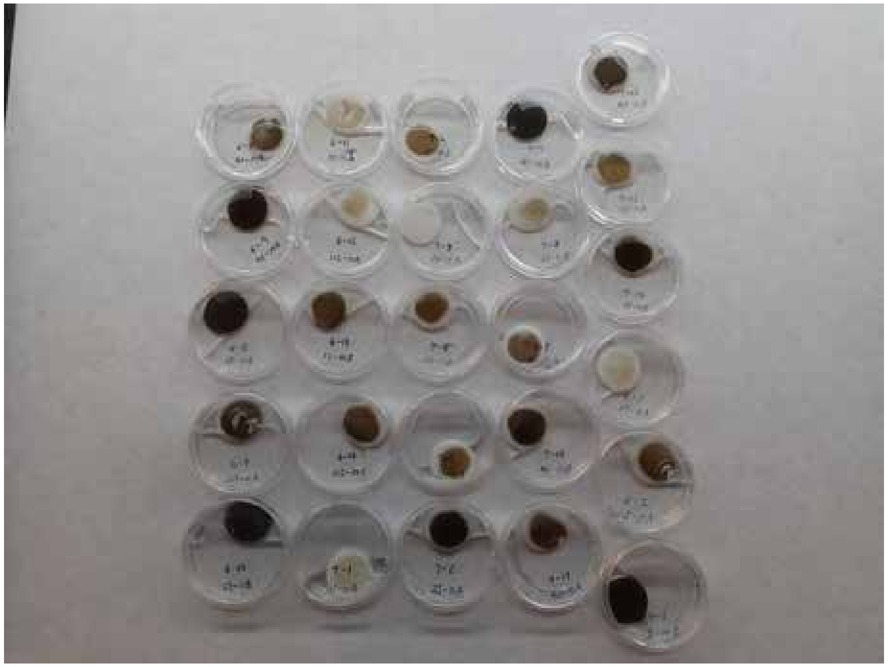
Page 1 of 1

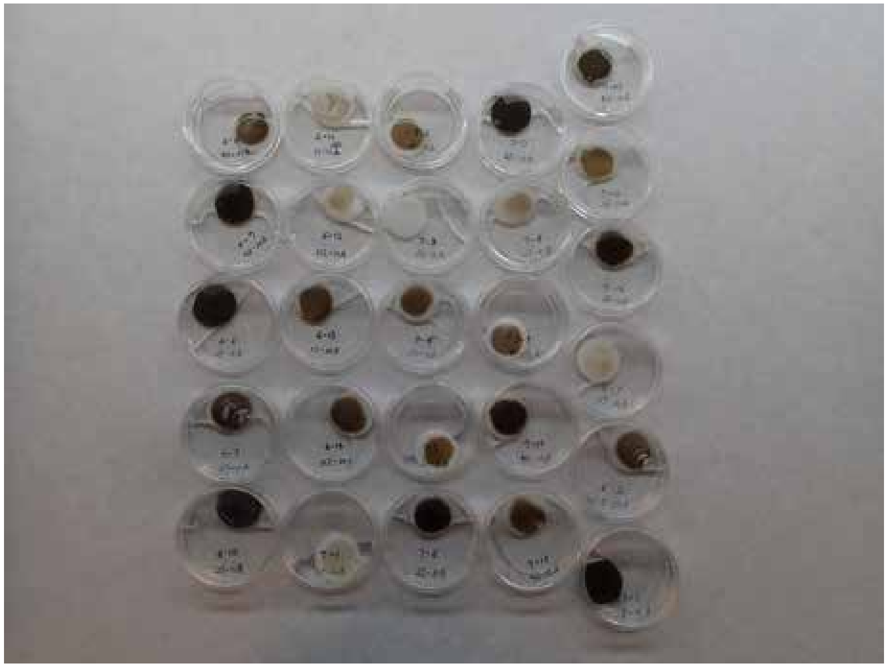


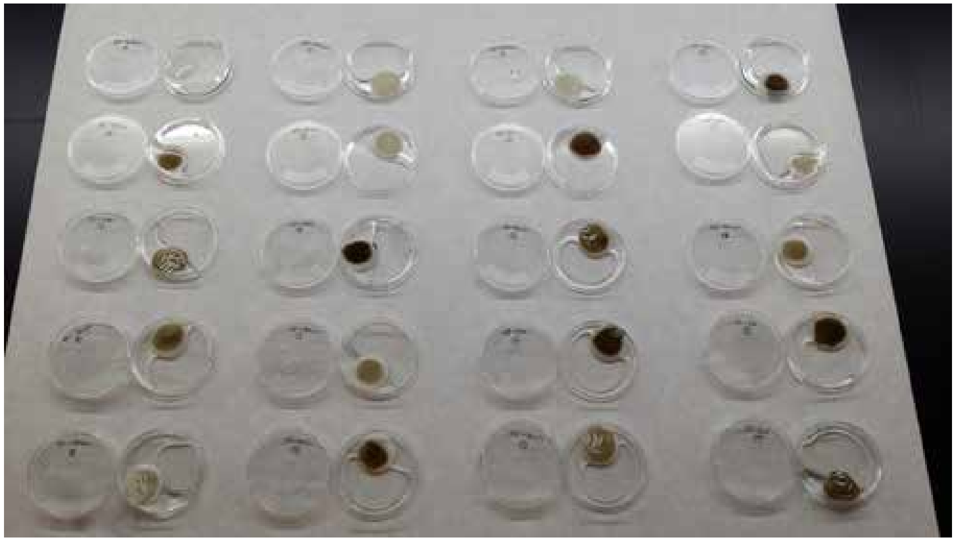


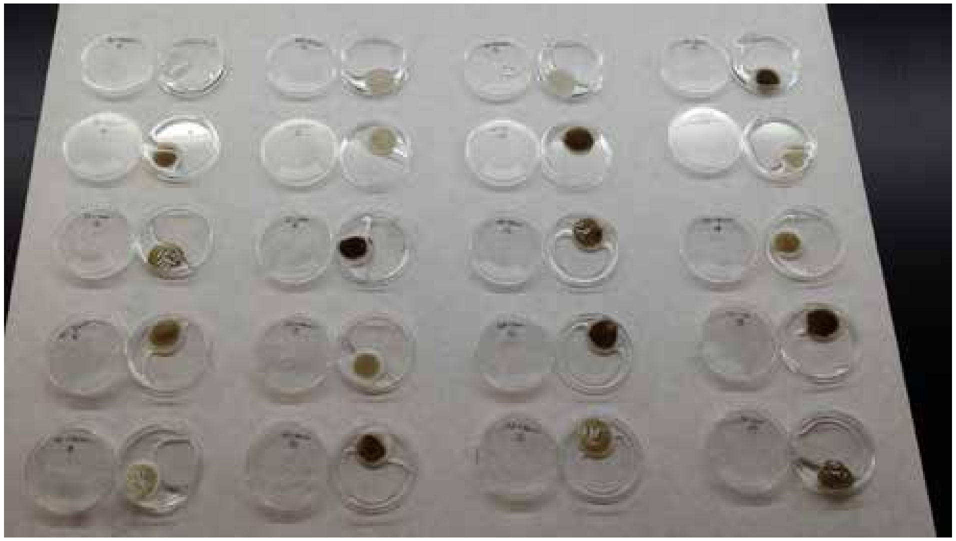












Appendix C
Data Validation Reports

720 Olive Way, Suite 1900
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Data Validation Report – EPA Stage 2A

January 31, 2019

Project: Wood Waste Remediation Project

Project Number: 170553-11.05

This report summarizes the review of analytical results for 15 sediment samples and one field duplicate collected on October 1, 2, 3, and 4, 2018. The samples were collected by Anchor QEA and submitted to AGAT Laboratories (AGAT) in Burnaby, British Columbia, Canada. The samples were analyzed for the following parameters:

- Polycyclic aromatic hydrocarbons (PAHs) by laboratory standard operating procedure ORG-180-5102, section D.
- Polychlorinated biphenyl Aroclors (PCBs) by U.S. Environmental Protection Agency (USEPA) method 8082
- Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCD/F) by USEPA method 1613
- Metals by USEPA methods 6010C and 6020A
- pH by laboratory standard operating procedure INOR-181-6031 which is equivalent to standard method 4500-HB

AGAT sample data group number 18V394408 was reviewed in this report. Sample IDs, matrices, and analyses are presented in Table 1.

Table 1
Sample IDs, Matrices, and Analyses

Sample ID	Lab Sample ID	Matrix	Analyses
EHWW-04-SG-000010	9606466	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-06-SG-000010	9606472	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-09-SG-000010	9606473	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-10-SG-000010	9606465	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-14-SG-000010	9606462	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-148-SG-000010	9606471	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-18-SG-000010	9606467	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-19-SG-000010	9606468	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-30-SG-000010	9606464	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-33-SG-000010	9606463	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-39-SG-000010	9606474	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-42-SG-000010	9606469	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-44-SG-000010	9606461	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-45-SG-000010	9606460	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-46-SG-000010	9606459	Sediment	PAHs, PCBs, metals, PCD/F, pH
EHWW-48-SG-000010	9606470	Sediment	PAHs, PCBs, metals, PCD/F, pH

Data Validation and Qualifications

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control (QC) guidelines outlined in the analytical procedures. Laboratory results were reviewed using the laboratory control limits and the following guidelines:

- Esquimalt Harbour Remediation Project, Sampling and Analysis Plan Wood Debris Remediation and Habitat Restoration Support (SAP; Anchor QEA, 2018)
- USEPA 1986 (SW-846, Third Edition), Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review (USEPA 2016)
- USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2017a)
- USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA 2017b)

Unless noted in this report, laboratory results for the samples listed above were within QC criteria.

Field Documentation

Field documentation was checked for completeness and accuracy. The chain-of-custody forms were signed by AGAT at the time of sample receipt. Samples were received within the correct temperature range and in good condition.

Holding Times and Sample Preservation

Samples were appropriately preserved and analyzed within holding times.

Laboratory Method Blanks

Laboratory method blanks were analyzed at the required frequencies. All method blanks were free of target analytes.

Field Quality Control

Field Duplicates

One field duplicate was collected in association with this sample set. Detected results are summarized in Table 2.

Table 2
Field Duplicate Summary

Analyte	EHWW-48-SG-000010	EHWW-148-SG-000010	RPD
Fluoranthene	0.11 µg/g	0.53 µg/g	131.3%
Pyrene	0.13 µg/g	0.45 µg/g	110.3%
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	12 ng/kg	10 ng/kg	18.2%
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	121 ng/kg	123 ng/kg	1.6%
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	19 ng/kg	16 ng/kg	17.1%
Total Heptachlorodibenzofuran (HpCDF)	33 ng/kg	29 ng/kg	12.9%
Total Heptachlorodibenzo-p-dioxin (HpCDD)	35 ng/kg	74 ng/kg	71.6%
Total Hexachlorodibenzofuran (HxCDF)	9 ng/kg	10 ng/kg	10.5%
Total Hexachlorodibenzo-p-dioxin (HxCDD)	19 ng/kg	24 ng/kg	23.3%
Total Pentachlorodibenzo-p-dioxin (PeCDD)	14.3 ng/kg	11 ng/kg	26.1%
Total Tetrachlorodibenzo-p-dioxin (TCDD)	1.5 ng/kg	2.4 ng/kg	46.2%
Total Tetra-Furans	6.1 ng/kg	4.5 ng/kg	30.2%
pH	7.3 unitless	7.3 unitless	0.0%
Aluminum	16100 µg/g	15100 µg/g	6.4%
Calcium	7550 µg/g	7750 µg/g	2.6%
Iron	24700 µg/g	24000 µg/g	2.9%
Magnesium	10700 µg/g	10700 µg/g	0.0%
Phosphorus	1170 µg/g	1190 µg/g	1.7%
Potassium	3010 µg/g	2940 µg/g	2.4%
Sodium	25400 µg/g	27000 µg/g	6.1%
Titanium	1200 µg/g	1160 µg/g	3.4%
Arsenic	14.9 µg/g	18.4 µg/g	21.0%
Barium	43.1 µg/g	40.9 µg/g	5.2%
Cadmium	4.4 µg/g	4.35 µg/g	1.1%
Chromium	35 µg/g	35 µg/g	0.0%
Cobalt	6.6 µg/g	6.4 µg/g	3.1%
Copper	60.8 µg/g	60.7 µg/g	0.2%
Lead	25.4 µg/g	24.1 µg/g	5.3%
Lithium	20.4 µg/g	18.6 µg/g	9.2%
Manganese	179 µg/g	173 µg/g	3.4%
Mercury	0.33 µg/g	0.34 µg/g	3.0%
Molybdenum	6.7 µg/g	6.3 µg/g	6.2%
Nickel	23.8 µg/g	23.8 µg/g	0.0%
Selenium	2 µg/g	2.1 µg/g	4.9%
Strontium	59 µg/g	60 µg/g	1.7%
Tin	3.4 µg/g	3.5 µg/g	2.9%
Uranium (Uranium 238)	2.6 µg/g	2.5 µg/g	3.9%
Vanadium	53 µg/g	52 µg/g	1.9%
Zinc	121 µg/g	119 µg/g	1.7%
Zirconium	6.1 µg/g	5.9 µg/g	3.3%

Notes:
µg/g: microgram per gram
ng/kg: nanogram per kilogram

Result values less than five times the reporting limit (RL) may have exaggerated relative percent difference (RPD) values; therefore, the values were not evaluated. All RPD values were within control limits with the exceptions of the fluoranthene, pyrene, and total HpCDD RPD values. Both parent and duplicate results for these analytes were qualified “J” to indicate estimated values. Table 3 summarizes qualified results.

Surrogate Recoveries

Surrogate recoveries were within the laboratory control limits.

Laboratory Control Samples

Laboratory control samples (LCS) were analyzed at the required frequencies or certified reference materials were analyzed in place of LCSs. All LCS recoveries were within laboratory-required control limits.

Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike (MS) and matrix spike duplicate (MSD) samples were analyzed at the required frequency and resulted in recoveries and/or RPD values within laboratory-required control limits.

Laboratory Duplicates

Laboratory duplicates were analyzed at the required frequency. Result values less than five times the RL may have exaggerated RPD values; therefore, the values were not evaluated. All duplicate RPD values were within laboratory control limits.

Certified Reference Material

Certified reference materials (CRMs) were analyzed and reported as QC standards. CRM results were reported as percent recoveries so could not be evaluated based on true values and confidence intervals. CRMs were instead evaluated against laboratory control limits. CRM analyses resulted in recoveries within laboratory control limits.

Reporting Limits

Reporting limits were acceptable as reported. All values were reported using the laboratory reporting limits. Values were reported as undiluted or when diluted, the reporting limit reflects the dilution factor.

Overall Assessment

As was determined by this evaluation, the laboratory followed the specified analytical methods and all requested sample analyses were completed. Accuracy was acceptable as demonstrated by the surrogate, LCS, MS/MSD, and CRM recovery values. Precision was acceptable as demonstrated by the MS/MSD and laboratory and field duplicate RPD values, with exceptions noted above. Most data are acceptable as reported, all other data are acceptable as qualified. Table 3 summarizes the qualifiers applied to the sample results reviewed in this report.

Data Qualifier Definitions

J Indicates an estimated value.

Table 3
Data Qualification Summary

Sample ID	Parameter	Analyte	Reported Result	Qualified Result	Reason
EHWW-48-SG-000010	PAHs	Fluoranthene	0.11 µg/g	0.11J µg/g	Field duplicate RPD above control limit
		Pyrene	0.13 µg/g	0.13J µg/g	
	PDC/F	Total Heptachlorodibenzo-p-dioxin (HpCDD)	35 ng/kg	35J ng/kg	
EHWW-148-SG-000010	PAHs	Benzo(b)fluoranthene	0.21 µg/g	0.21J µg/g	Field duplicate RPD above control limit
		Fluoranthene	0.53 µg/g	0.53J µg/g	
		Pyrene	0.45 µg/g	0.45J µg/g	
	PDC/F	Total Heptachlorodibenzo-p-dioxin (HpCDD)	74 ng/kg	74J ng/kg	

Notes:
µg/g: microgram per gram
ng/kg: nanogram per kilogram

References

Anchor QEA, 2018. Sampling and Analysis Plan, Wood Debris Remediation and Habitat Restoration Support, Esquimalt Harbour Remediation Project. September 2018.

USEPA. 1986. Test methods for Evaluating Solid Waste: Physical/Chemical Methods. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-530/SW-846.

USEPA. 2016. USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 542-B-16-001. April 2016.

USEPA. 2017a. National Functional Guidelines for Superfund Organic Methods Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-002. January 2017.

USEPA 2017b. National Functional Guidelines for Inorganic Superfund Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-001. January 2017.

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ANCHOR QEA

Data Validation Report – EPA Stage 2A

February 6, 2019

Project: Wood Waste Remediation Project

Project Number: 170553-11.05

This report summarizes the review of analytical results for nine sediment samples and one field duplicate collected on December 17, 18, and 19, 2018. The samples were collected by Anchor QEA and submitted to AGAT Laboratories (AGAT) in Burnaby, British Columbia, Canada. The samples were analyzed for the following parameters:

- Polycyclic aromatic hydrocarbons (PAHs) by laboratory standard operating procedure (SOP) ORG-180-5102, section D.
- Polychlorinated biphenyl Aroclors (PCBs) by U.S. Environmental Protection Agency (USEPA) method 8082
- Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCD/F) by USEPA method 1613
- Metals by USEPA methods 6010C and 6020A
- pH by laboratory SOP INOR-181-6031 which is equivalent to standard method (SM) 4500-HB
- Total organic carbon (TOC) by laboratory SOP INOR-181-6027
- Total solids (TS) by laboratory SOP INOR 181-6024.002 which is equivalent to SM2540G

AGAT sample data group (SDG) number 18V422808 was reviewed in this report. Sample IDs, matrices, and analyses are presented in Table 1.

Table 1
Sample IDs, Matrices, and Analyses

Sample ID	Lab Sample ID	Matrix	Analyses
EHWW-03-SC-000050	9801861	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-165-SC-000050	9801868	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-36-SC-000050	9801856	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-38-SC-000050	9801864	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-40-SC-000050	9801865	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-53-SC-000016	9801869	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-54-SC-000050	9801866	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-56-SC-000050	9801863	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-57-SC-000050	9801862	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH
EHWW-65-SC-000050	9801867	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH

Data Validation and Qualifications

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control (QA/QC) guidelines outlined in the analytical procedures. Laboratory results were reviewed using the laboratory control limits and the following guidelines:

- Esquimalt Harbour Remediation Project, Sampling and Analysis Plan Wood Debris Remediation and Habitat Restoration Support (SAP; Anchor QEA, 2018)
- USEPA 1986 (SW-846, Third Edition), Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review (USEPA 2016)
- USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2017a)
- USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA 2017b)

Unless noted in this report, laboratory results for the samples listed above were within QC criteria.

Field Documentation

Field documentation was checked for completeness and accuracy. The chain-of-custody forms were signed by AGAT at the time of sample receipt. Samples were received within the correct temperature range and in good condition.

Holding Times and Sample Preservation

Samples were appropriately preserved and analyzed within holding times.

Laboratory Method Blanks

Laboratory method blanks were analyzed at the required frequencies. All method blanks were free of target analytes.

Field Quality Control

Field Duplicates

One field duplicate was collected in association with this sample set. Detected results are summarized in Table 2.

Table 2
Field Duplicate Summary

Analyte	EHWW-65-SC-000050	EHWW-165-SC-000050	RPD
Total organic carbon	1.28 %	1.33 %	3.8%
Total Solids	70 %	70 %	0.0%
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	61 ng/kg	79 ng/kg	25.7%
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	12 ng/kg	17.5 ng/kg	37.3%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	10 ng/kg	10 ng/kg	0.0%
Total Heptachlorodibenzofuran (HpCDF)	20 ng/kg	28 ng/kg	33.3%
Total Heptachlorodibenzo-p-dioxin (HpCDD)	25 ng/kg	14 ng/kg	56.4%
Total Hexachlorodibenzofuran (HxCDF)	9.4 ng/kg	12.7 ng/kg	29.9%
Total Tetra-Furans	8 ng/kg	7.2 ng/kg	10.5%
pH	8 SU	8 SU	0.0%
Aluminum	8210 µg/g	8600 µg/g	4.6%
Calcium	8160 µg/g	7430 µg/g	9.4%
Iron	11900 µg/g	12500 µg/g	4.9%
Magnesium	4090 µg/g	4160 µg/g	1.7%
Phosphorus	617 µg/g	731 µg/g	16.9%
Potassium	863 µg/g	885 µg/g	2.5%
Sodium	5580 µg/g	5250 µg/g	6.1%
Titanium	859 µg/g	943 µg/g	9.3%
Arsenic	7.5 µg/g	7 µg/g	6.9%
Barium	20.2 µg/g	21.1 µg/g	4.4%
Cadmium	4.3 µg/g	4.92 µg/g	13.4%
Chromium	18 µg/g	18 µg/g	0.0%
Cobalt	3.8 µg/g	4 µg/g	5.1%
Copper	20.7 µg/g	21.7 µg/g	4.7%
Lead	9.6 µg/g	10.4 µg/g	8.0%
Lithium	9.4 µg/g	10.5 µg/g	11.1%
Manganese	133 µg/g	142 µg/g	6.5%
Mercury	0.22 µg/g	0.29 µg/g	27.5%
Molybdenum	2.7 µg/g	2.6 µg/g	3.8%
Nickel	13.6 µg/g	13.3 µg/g	2.2%
Selenium	1 µg/g	0.8 µg/g	22.2%
Strontium	49 µg/g	48 µg/g	2.1%
Thallium	0.7 µg/g	0.8 µg/g	13.3%
Tin	1.4 µg/g	1.6 µg/g	13.3%
Uranium (Uranium 238)	1.1 µg/g	1 µg/g	9.5%
Vanadium	38 µg/g	38 µg/g	0.0%
Zinc	56 µg/g	58 µg/g	3.5%
Zirconium	4 µg/g	4.3 µg/g	7.2%

Notes:
µg/g: microgram per gram
ng/kg: nanogram per gram
RPD: relative percent difference

Result values less than five times the reporting limit (RL) may have exaggerated relative percent difference (RPD) values; therefore, the values were not evaluated. All RPD values were within control limits with the exception of the total HpCDD RPD value. Both parent and duplicate results for this analyte were qualified “J” to indicate estimated values. Table 3 summarizes qualified results.

Surrogate Recoveries

Surrogate recoveries were within the laboratory control limits.

Laboratory Control Samples

Laboratory control samples (LCS) were analyzed at the required frequencies or certified reference materials were analyzed in place of LCSs. All LCS recoveries were within laboratory-required control limits.

Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike (MS) and matrix spike duplicate (MSD) samples were analyzed at the required frequency and resulted in recoveries and/or RPD values within laboratory-required control limits.

Laboratory Duplicates

Laboratory duplicates were analyzed at the required frequency. Result values less than five times the RL may have exaggerated RPD values; therefore, the values were not evaluated. All duplicate RPD values were within laboratory control limits.

Certified Reference Material

Certified reference materials (CRMs) were analyzed and reported as quality control (QC) standards. CRM results were reported as percent recoveries so could not be evaluated based on true values and confidence intervals. CRMs were instead evaluated against laboratory control limits. CRM analyses resulted in recoveries within laboratory control limits.

Reporting Limits

Reporting limits were acceptable as reported. All values were reported using the laboratory reporting limits. Values were reported as undiluted or when diluted, the reporting limit reflects the dilution factor.

Overall Assessment

As was determined by this evaluation, the laboratory followed the specified analytical methods and all requested sample analyses were completed. Accuracy was acceptable as demonstrated by the surrogate, LCS, MS/MSD, and CRM recovery values. Precision was acceptable as demonstrated by the

MS/MSD and laboratory and field duplicate RPD values, with exceptions noted above. Most data are acceptable as reported, all other data are acceptable as qualified. Table 3 summarizes the qualifiers applied to the sample results reviewed in this report.

Data Qualifier Definitions

J Indicates an estimated value.

Table 3
Data Qualification Summary

Sample ID	Parameter	Analyte	Reported Result	Qualified Result	Reason
EHWW-65-SC-000050	PCD/F	Total Heptachlorodibenzo-p-dioxin (HpCDD)	25 ng/kg	25J ng/kg	Field duplicate RPD above control limit
EHWW-165-SC-000050	PCD/F	Total Heptachlorodibenzo-p-dioxin (HpCDD)	14 ng/kg	14J ng/kg	Field duplicate RPD above control limit

Notes:
ng/kg: nanogram per kilogram
RPD: relative percent difference

References

Anchor QEA, 2018. Sampling and Analysis Plan, Wood Debris Remediation and Habitat Restoration Support, Esquimalt Harbour Remediation Project. September 2018.

USEPA. 1986. Test methods for Evaluating Solid Waste: Physical/Chemical Methods. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-530/SW-846.

USEPA. 2016. USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 542-B-16-001. April 2016.

USEPA. 2017a. National Functional Guidelines for Superfund Organic Methods Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-002. January 2017.

USEPA 2017b. National Functional Guidelines for Inorganic Superfund Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-001. January 2017.

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ANCHOR QEA

Data Validation Report – EPA Stage 2A

February 7, 2019

Project: Wood Waste Remediation Project

Project Number: 170553-11.05

This report summarizes the review of analytical results for fourteen sediment samples and one field duplicate sample collected on December 16, 17, and 18, 2018. The samples were collected by Anchor QEA and submitted to AGAT Laboratories (AGAT) in Burnaby, British Columbia, Canada. The samples were analyzed for the following parameters:

- Polycyclic aromatic hydrocarbons (PAHs) by laboratory standard operating procedure (SOP) ORG-180-5102, section D.
- Polychlorinated biphenyl Aroclors (PCBs) by U.S. Environmental Protection Agency (USEPA) method 8082
- Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCD/F) by USEPA method 1613
- Metals by USEPA methods 6010C and 6020A
- pH by laboratory SOP INOR-181-6031 which is equivalent to standard method (SM) 4500-HB
- Total organic carbon (TOC) by laboratory SOP INOR-181-6027
- Total solids (TS) by laboratory SOP INOR 181-6024.002 which is equivalent to SM2540G
- Ammonia (NH3) by Standard Method (SM) 4500-NH3E
- Moisture by laboratory SOP INOR-181-6030
- Grain size by laboratory SOP INOR-171-6009
- Atterberg limits by ASTM International method D4318-00
- Sulphide (S2) calculated using methods ASTM International method E1915-11-modified, and SM 4500-SO4E-modified
- Total volatile solids (TVS) by ASTM International method D2974-07a

AGAT sample data group (SDG) number 18V4422820 was reviewed in this report. Sample IDs, matrices, and analyses are presented in Table 1.

Table 1
Sample IDs, Matrices, and Analyses

Sample ID	Lab Sample ID	Matrix	Analyses
EHWW-58-SC-361411	9801887	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size
EHWW-58-SC-411461	9801889	Sediment	Moisture, Atterberg limits
EHWW-36-SC-183233	9801891	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size
EHWW-03-SC-000050	9801896	Sediment	S2, grain size
EHWW-03-SC-150200	9801899	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size, moisture, Atterberg limits

Sample ID	Lab Sample ID	Matrix	Analyses
EHWW-57-SC-000050	9801925	Sediment	S2, grain size
EHWW-56-SC-000050	9801928	Sediment	Grain size
EHWW-38-SC-000050	9801932	Sediment	S2, grain size, moisture, Atterberg limits
EHWW-38-SC-050100	9801935	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size, moisture, Atterberg limits
EHWW-40-SC-000050	9801944	Sediment	S2, grain size
EHWW-40-SC-060110	9801945	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size
EHWW-39-SC-035085	9801948	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size
EHWW-24-SC-045095	9801952	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size
EHWW-16-SC-152202	9801956	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS, grain size, moisture, Atterberg limits
EHWW-116-SC-152202	9802033	Sediment	PAHs, PCBs, metals, PCD/F, TOC, TS, pH, S2, NH3, TVS

Data Validation and Qualifications

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control (QA/QC) guidelines outlined in the analytical procedures. Laboratory results were reviewed using the laboratory control limits and the following guidelines:

- Esquimalt Harbour Remediation Project, Sampling and Analysis Plan Wood Debris Remediation and Habitat Restoration Support (SAP; Anchor QEA, 2018)
- USEPA 1986 (SW-846, Third Edition), Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review (USEPA 2016)
- USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2017a)
- USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA 2017b)

Unless noted in this report, laboratory results for the samples listed above were within QC criteria.

Field Documentation

Field documentation was checked for completeness and accuracy. The chain-of-custody forms were signed by AGAT at the time of sample receipt. Samples were received within the correct temperature range and in good condition.

Holding Times and Sample Preservation

Samples were appropriately preserved and analyzed within holding times.

Laboratory Method Blanks

Laboratory method blanks were analyzed at the required frequencies. All method blanks were free of target analytes.

Field Quality Control

Field Duplicates

One field duplicate was collected in association with this sample set. Detected results are summarized in Table 2.

Table 2
Field Duplicate Summary

Analyte	EHWW-16-SC-152202	EHWW-116-SC-152202	RPD
Sulfphide	0.7 %	0.95 %	30.3%
Total organic carbon	1.17 %	1.11 %	5.3%
Total Solids	56 %	60 %	6.9%
Loss on ignition	2.5 %	2.5 %	0.0%
pH	7.6	7.5	1.3%
Aluminum	12500 µg/g	13000 µg/g	3.9%
Calcium	17900 µg/g	10900 µg/g	48.6%
Iron	17200 µg/g	17800 µg/g	3.4%
Magnesium	5470 µg/g	5590 µg/g	2.2%
Phosphorus	748 µg/g	751 µg/g	0.4%
Potassium	1650 µg/g	1720 µg/g	4.2%
Sodium	6920 µg/g	7350 µg/g	6.0%
Titanium	1180 µg/g	1220 µg/g	3.3%
Arsenic	8.3 µg/g	7.4 µg/g	11.5%
Barium	29.2 µg/g	29.8 µg/g	2.0%
Cadmium	4.59 µg/g	4.61 µg/g	0.4%
Chromium	25 µg/g	24 µg/g	4.1%
Cobalt	4.9 µg/g	4.8 µg/g	2.1%
Copper	17.7 µg/g	18.3 µg/g	3.3%
Lead	2.8 µg/g	2.8 µg/g	0.0%
Lithium	14.3 µg/g	14.7 µg/g	2.8%
Manganese	178 µg/g	178 µg/g	0.0%
Molybdenum	3.2 µg/g	3.3 µg/g	3.1%
Nickel	17 µg/g	17.5 µg/g	2.9%
Selenium	2.8 µg/g	3.9 µg/g	32.8%
Strontium	113 µg/g	71 µg/g	45.7%
Thallium	0.7 µg/g	0.7 µg/g	0.0%
Uranium (Uranium 238)	1.2 ug/g	1.2 µg/g	0.0%
Vanadium	43 µg/g	42 µg/g	2.4%
Zinc	58 µg/g	48 µg/g	18.9%
Zirconium	7.3 µg/g	7.5 µg/g	2.7%

Notes:
µg/g: microgram per gram
ng/kg: nanogram per gram
mg/L: milligram per liter
mg/kg: microgram per kilogram

Result values less than five times the reporting limit (RL) may have exaggerated relative percent difference (RPD) values; therefore, the values were not evaluated. All RPD values were within control limits and no date were qualified.

Surrogate Recoveries

Surrogate recoveries were within the laboratory control limits.

Laboratory Control Samples

Laboratory control samples (LCS) were analyzed at the required frequencies or certified reference materials were analyzed in place of LCSs. All LCS recoveries were within laboratory-required control limits.

Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike (MS) and matrix spike duplicate (MSD) samples were analyzed at the required frequency and resulted in recoveries and/or RPD values within laboratory-required control limits.

Laboratory Duplicates

Laboratory duplicates were analyzed at the required frequency. Result values less than five times the RL may have exaggerated RPD values; therefore, the values were not evaluated. All duplicate RPD values were within laboratory control limits.

Certified Reference Material

Certified reference materials (CRMs) were analyzed and reported as quality control (QC) standards. CRM results were reported as percent recoveries so could not be evaluated based on true values and confidence intervals. CRMs were instead evaluated against laboratory control limits. CRM analyses resulted in recoveries within laboratory control limits.

Reporting Limits

Reporting limits were acceptable as reported. All values were reported using the laboratory reporting limits. Values were reported as undiluted or when diluted, the reporting limit reflects the dilution factor.

Overall Assessment

As was determined by this evaluation, the laboratory followed the specified analytical methods and all requested sample analyses were completed. Accuracy was acceptable as demonstrated by the surrogate, LCS, MS/MSD, and CRM recovery values. Precision was acceptable as demonstrated by the MS/MSD and laboratory and field duplicate RPD values. All data are acceptable as reported.

References

Anchor QEA, 2018. Sampling and Analysis Plan, Wood Debris Remediation and Habitat Restoration Support, Esquimalt Harbour Remediation Project. September 2018.

USEPA. 1986. Test methods for Evaluating Solid Waste: Physical/Chemical Methods. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-530/SW-846.

USEPA. 2016. USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 542-B-16-001. April 2016.

USEPA. 2017a. National Functional Guidelines for Superfund Organic Methods Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-002. January 2017.

USEPA 2017b. National Functional Guidelines for Inorganic Superfund Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-001. January 2017.

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Data Validation Report – EPA Stage 2A

February 9, 2019

Project: Esquimalt Harbour Woodwaste

Project Number: 170553-11.05

This report summarizes the review of analytical results for eight sediment samples collected on December 18 and 19, 2019. The samples were collected by Anchor QEA and submitted to AGAT Laboratories (AGAT) in Burnaby, British Columbia, Canada. The samples were analyzed for the following parameters:

- Polycyclic aromatic hydrocarbons (PAHs) by laboratory standard operating procedure (SOP) ORG-180-5102, section D.
- Polychlorinated biphenyl Aroclors (PCBs) by U.S. Environmental Protection Agency (USEPA) method 8082
- Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCD/F) by USEPA method 1613
- Metals by USEPA methods 6010C and 6020A
- pH by laboratory SOP INOR-181-6031 which is equivalent to standard method (SM) 4500-HB
- Total organic carbon (TOC) by laboratory SOP INOR-181-6027
- Total solids (TS) by laboratory SOP INOR 181-6024.002 which is equivalent to SM2540G
- Ammonia (NH3) by Standard Method (SM) 4500-NH3E
- Grain size by laboratory SOP INOR-171-6009
- Sulphide (S2) calculated using methods ASTM International method E1915-11-modified, and SM 4500-SO4E-modified
- Total volatile solids (TVS) by ASTM International method D2974-07a

AGAT sample data group (SDG) number 18V422891 was reviewed in this report. Sample IDs, matrices, and analyses are presented in Table 1.

Table 1
Sample IDs, Matrices, and Analyses

Sample ID	Lab Sample ID	Matrix	Analyses
EHWW-54-SC-000050	9802297	Sediment	S2, grain size
EHWW-54-SC-055105	9802304	Sediment	PAH, PCB, PCD/F, metals, pH, TOC, TS, TVS, S2, NH3, grain size
EHWW-55-SC-110160	9802457	Sediment	PAH, PCB, PCD/F, metals, pH, TOC, TS, TVS, S2, NH3, grain size
EHWW-59-SC-038088	9802459	Sediment	PAH, PCB, PCD/F, metals, pH, TOC, TS, TVS, S2, NH3, grain size
EHWW-65-SC-000050	9802468	Sediment	S2, grain size

Sample ID	Lab Sample ID	Matrix	Analyses
EHWW-44-SC-017067	9802472	Sediment	PAH, PCB, PCD/F, metals, pH, TOC, TS, TVS, S2, NH3, grain size
EHWW-53-SC-000016	9802488	Sediment	S2, grain size
EHWW-53-SC-016066	9802498	Sediment	PAH, PCB, PCD/F, metals, pH, TOC, TS, TVS, S2, NH3, grain size
EHWW-53-SC-066166	9802502	Sediment	Metals, TS
EHWW-54-SC-105155	9802456	Sediment	Metals TS

Data Validation and Qualifications

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control (QA/QC) guidelines outlined in the analytical procedures. Laboratory results were reviewed using the laboratory control limits and the following guidelines:

- Esquimalt Harbour Remediation Project, Sampling and Analysis Plan Wood Debris Remediation and Habitat Restoration Support (SAP; Anchor QEA, 2018)
- USEPA 1986 (SW-846, Third Edition), Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review (USEPA 2016)
- USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2017a)
- USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA 2017b)

Unless noted in this report, laboratory results for the samples listed above were within QC criteria.

Field Documentation

Field documentation was checked for completeness and accuracy. The chain-of-custody forms were signed by AGAT at the time of sample receipt. Samples were received within the correct temperature range and in good condition.

Holding Times and Sample Preservation

Samples were appropriately preserved and analyzed within holding times.

Laboratory Method Blanks

Laboratory method blanks were analyzed at the required frequencies. All method blanks were free of target analytes.

Field Quality Control

No field quality control samples were collected in association with this sample set.

Surrogate Recoveries

Surrogate recoveries were within the laboratory control limits.

Laboratory Control Samples

Laboratory control samples (LCS) were analyzed at the required frequencies or certified reference materials were analyzed in place of LCSs. All LCS recoveries were within laboratory-required control limits.

Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike (MS) and matrix spike duplicate (MSD) samples were analyzed at the required frequency and resulted in recoveries and/or RPD values within laboratory-required control limits.

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Laboratory duplicates were analyzed at the required frequency. Result values less than five times the RL may have exaggerated RPD values; therefore, the values were not evaluated. All duplicate RPD values were within laboratory control limits.

Certified Reference Material

Certified reference materials (CRMs) were analyzed and reported as quality control (QC) standards. CRM results were reported as percent recoveries so could not be evaluated based on true values and confidence intervals. CRMs were instead evaluated against laboratory control limits. CRM analyses resulted in recoveries within laboratory control limits.

Reporting Limits

Reporting limits were acceptable as reported. All values were reported using the laboratory reporting limits. Values were reported as undiluted or when diluted, the reporting limit reflects the dilution factor.

Overall Assessment

As was determined by this evaluation, the laboratory followed the specified analytical methods and all requested sample analyses were completed. Accuracy was acceptable as demonstrated by the surrogate, LCS, MS/MSD, and CRM recovery values. Precision was acceptable as demonstrated by the MS/MSD and laboratory and field duplicate RPD values. All data are acceptable as reported.

References

Anchor QEA, 2018. Sampling and Analysis Plan, Wood Debris Remediation and Habitat Restoration Support, Esquimalt Harbour Remediation Project. September 2018.

USEPA. 1986. Test methods for Evaluating Solid Waste: Physical/Chemical Methods. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-530/SW-846.

USEPA. 2016. USEPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 542-B-16-001. April 2016.

USEPA. 2017a. National Functional Guidelines for Superfund Organic Methods Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-002. January 2017.

USEPA 2017b. National Functional Guidelines for Inorganic Superfund Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-2017-001. January 2017.

Appendix D
Bioassay Report

Marine Sediment Toxicity Testing

Samples collected October 1 - 5, 2018

Final Report

January 18, 2019

Submitted to: **Anchor QEA**
Bellingham, WA

8664 Commerce Court, Burnaby, BC V5A 4N7

TABLE OF CONTENTS

List of Tables

List of Appendices

SIGNATURE PAGE

Report By:	Reviewed By:
Yvonne Lam, B.Sc.	Armando Tang, R.P.Bio.
Laboratory Biologist	Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

Sample ID	EHWW-REF17-SG-000010 EHWW-REF18-SG-000010 EHWW-01-SG-000010 EHWW-06-SG-000010 EHWW-08-SG-000010 EHWW-11-SG-000010 EHWW-12-SG-000010 EHWW-13-SG-000010 EHWW-15-SG-000010 EHWW-22-SG-000010 EHWW-29-SG-000010 EHWW-31-SG-000010 EHWW-39-SG-000010 EHWW-40-SG-000010 EHWW-42-SG-000010 EHWW-44-SG-000010 EHWW-50-SG-000010
Sample collection date	October 1, 2, 3, 4 and 5, 2018
Sample receipt date	October 2, 3, 4 and 6, 2018
Sample receipt temperature	5.0 – 17.1°C
Test types	48-h bivalve (*Mytilus galloprovincialis*) larval survival and development [SCCWRP method] 48-h bivalve (*Mytilus galloprovincialis*) larval survival and development [PSEP method]

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted marine sediment toxicity tests for Anchor QEA on 17 samples, including two reference sites. The samples were collected on October 1, 2, 3, 4 and 5, 2018 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on October 2, 3 4 and 6, 2018. The samples were each transported in one 3-L plastic bag and received at temperatures ranging from 5.0 to 17.1°C. The samples were stored in the dark at 4 ± 2°C prior to testing.

A 48-h bivalve (*Mytilus galloprovincialis*) larval survival and development test was conducted on the samples. Testing was initiated on November 22, 2018 and this report describes the results of the toxicity tests. Copies of raw laboratory data sheets and statistical analyses are provided in Appendices A and B. Descriptions of the sediment samples are provided in Appendix C and the chain-of-custody forms are provided in Appendix D.

2.0 METHODS

Sediment samples were homogenized thoroughly using stainless steel spoons and were not sieved prior to testing. While 51 samples were received, 17 samples were selected by the client for testing.

The methods for the *M. galloprovincialis* toxicity tests are summarized in Tables 1 and 2. Testing on all 17 samples was conducted according to procedures developed by the Southern California Coastal Water Research Project (SCCWRP, 2009), incorporating screened chambers to separate the larvae from the sediment.

Three samples were also tested following procedures described by the Puget Sound Estuary Program (PSEP, 1995). Similar to the SCCWRP test, the sediment was allowed to settle for 24 hours prior to the addition of larvae. While PSEP (1995) specifies a settling time of 4 hours, historical data has shown that extending the settling period to 24 hours reduces the impact of the physical effect associated with particles settling on the larvae, thereby burying them and causing artefactual toxicity.

Ammonia and sulphides were measured by ALS Environmental, Burnaby, BC. Overlying and interstitial ammonia, and overlying and interstitial sulphides were collected for the SCCWRP test, and overlying ammonia and sulphides were collected for the PSEP test (interstitial samples are not attainable for this method). In addition to the standard copper reference toxicant test, a concurrent ammonia reference toxicant test was also conducted. Statistical analyses for the tests were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: 48-h bivalve (*M. galloprovincialis*) larval survival and development [SCCWRP method].

Test species	*Mytilus galloprovincialis*
Organism source	Kamilche Seafarms, Shelton, WA
Organism age	<2-h post-fertilization
Test type	Static
Test duration	48 hours
Test vessel	375-mL glass container
Test volume	100 mL sediment; 175 mL overlying water
Test replicates	4 per sample
Number of organisms	Approximately 250 embryos per replicate
Control/dilution water	Natural seawater
Test solution renewal	None
Test temperature	15 ± 1°C
Test salinity	28 ± 2 ppt
Feeding	None
Light intensity	500 – 1000 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None, unless DO <60% saturation
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, overlying and interstitial ammonia, and overlying and interstitial sulphides measured at test initiation and termination
Test protocol	SCCWRP (2009)
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival, proportion normal, combined proportion normal
Test acceptability criteria for controls	≥70% combined proportion normal
Reference toxicant	Copper (added as $CuCl_2$)

Table 2. Summary of test conditions: 48-h bivalve (*M. galloprovincialis*) larval survival and development [PSEP method].

Test species	*Mytilus galloprovincialis*
Organism source	Kamilche Seafarms, Shelton, WA
Organism age	<2-h post-fertilization
Test type	Static
Test duration	48 hours
Test vessel	1-L glass container
Test volume	18 g sediment; 900 mL overlying water
Test replicates	5 per sample
Number of organisms	Approximately 20 – 40 embryos/mL
Control/dilution water	Natural seawater
Test solution renewal	None
Test temperature	16 ± 1°C
Test salinity	28 ± 2 ppt
Feeding	None
Light intensity	Ambient laboratory lighting
Photoperiod	14 hours light / 10 hours dark
Aeration	None, unless DO <60% saturation
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, overlying ammonia and overlying sulphides measured at test initiation and termination
Test protocol	PSEP (1995)
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival, proportion normal, combined proportion normal
Test acceptability criteria for controls	≥70% combined proportion normal
Reference toxicant	Copper (added as $CuCl_2$)

3.0 RESULTS

Results of the toxicity test on *M. galloprovincialis* following the SCCWRP method are summarized in Table 3. The samples were analyzed relative to the control seawater and reference sites EHWW-REF17 and EHWW-REF18. There were no adverse effects on the survival, proportion normal or combined proportion normal endpoints for any of the samples relative to the control seawater. There were significant differences on samples EHWW-06, -15, -22 and -50 for proportion normal relative to one or both of the reference sites.

The ammonia and sulphide concentrations measured during the SCCWRP test are summarized in Table 5. The concurrent ammonia reference toxicant test produced a proportion normal EC50 of 13.0 mg/L N, similar to previous in-house tests on this species which found the mean proportion normal EC50 to be 10.9 mg/L N. The SCCWRP method states the total overlying ammonia concentration should not exceed 4 mg/L N. Reference sites EHWW-REF17 and -REF18, and samples EHWW-01, -12, -15, -29, -31, -39 and -40 produced the total ammonia concentrations that exceeded one or more of these guideline values.

Wang and Chapman (1999) reported a 48-h NOEC for *Mytilus* embryo sp. at 0.05 mg/L S, and SCCWRP lists a tolerance of <0.09 mg/L S. Reference site EHWW-REF17 and samples EHWW-01, -08, -15, -22, -40, and -50 produced sulphide concentrations during this test that exceeded one or both of those values.

Results of the toxicity test on *M. galloprovincialis* following the PSEP method are summarized in Table 4, with the samples analyzed relative to the control seawater and control sediment. While all three samples were statistically significantly different relative to the control seawater for survival and combined proportion normal endpoints, only sample EHWW-50 produced adverse effects relative to the control sediment for combined proportion normal.

The ammonia and sulphide concentrations measured during the PSEP bivalve test are summarized in Table 6. They were not at levels expected to cause adverse effects in this species.

Table 3. Results: 48-h bivalve (*M. galloprovincialis*) larval survival and development test [SCCWRP method].

Sample ID	Survival (%) (Mean ± SD)	Proportion Normal (%) (Mean ± SD)	Combined Proportion Normal (%) (Mean ± SD)
Control Seawater	85.1 ± 4.2	86.7 ± 5.9	73.8 ± 5.8
EHWW-REF17-SG-000010	80.6 ± 11.9	93.3 ± 0.8	75.2 ± 10.7
EHWW-REF18-SG-000010	84.4 ± 5.7	92.0 ± 1.3	77.6 ± 5.1
EHWW-01-SG-000010	80.4 ± 11.8	90.5 ± 2.4	72.7 ± 10.6
EHWW-06-SG-000010	83.4 ± 7.2	86.6 ± 1.6 [1]	72.2 ± 5.7
EHWW-08-SG-000010	79.7 ± 7.6	91.5 ± 1.6	72.8 ± 5.8
EHWW-11-SG-000010	84.5 ± 9.0	90.2 ± 2.8	76.1 ± 5.9
EHWW-12-SG-000010	88.7 ± 6.6	92.0 ± 1.6	81.6 ± 6.3
EHWW-13-SG-000010	86.6 ± 6.3	88.8 ± 2.4	76.8 ± 3.6
EHWW-15-SG-000010	79.8 ± 5.2	83.5 ± 6.4 [1,2]	66.5 ± 5.5
EHWW-22-SG-000010	82.2 ± 12.0	87.0 ± 2.8 [1]	71.6 ± 12.0
EHWW-29-SG-000010	93.4 ± 4.7	92.2 ± 3.3	86.1 ± 6.1
EHWW-31-SG-000010	91.7 ± 5.7	92.0 ± 4.9	84.6 ± 8.9
EHWW-39-SG-000010	89.4 ± 7.5	88.2 ± 2.3	79.2 ± 7.3
EHWW-40-SG-000010	90.4 ± 7.9	91.1 ± 1.3	82.4 ± 8.3
EHWW-42-SG-000010	78.0 ± 5.5	89.8 ± 2.6	70.0 ± 4.1
EHWW-44-SG-000010	91.1 ± 6.7	92.2 ± 3.0	84.0 ± 6.1
EHWW-50-SG-000010	93.1 ± 5.3	86.4 ± 2.7 [1]	80.5 ± 4.4

SD = Standard Deviation
There were no statistically significant effects relative to the control seawater.
[1] Indicates samples that were statistically significantly different relative to reference site REF17.
[2] Indicates samples that were statistically significantly different relative to reference site REF18.

Table 4. Results: 48-h bivalve (*M. galloprovincialis*) larval survival and development test [PSEP method].

Sample ID	Survival (%) (Mean ± SD)	Proportion Normal (%) (Mean ± SD)	Combined Proportion Normal (%) (Mean ± SD)
Control Seawater	86.5 ± 3.8	90.9 ± 2.4	78.7 ± 4.8
Control Sediment	77.6 ± 4.3 *	91.3 ± 2.0	70.8 ± 4.5
EHWW-11-SG-000010	76.3 ± 6.5 *	88.0 ± 4.9	67.4 ± 8.4 *
EHWW-39-SG-000010	77.6 ± 5.2 *	86.6 ± 2.8	67.2 ± 5.6 *
EHWW-50-SG-000010	69.8 ± 6.2 *	87.3 ± 5.2	61.0 ± 6.6 *,†

SD = Standard Deviation

* Indicates samples that were statistically significantly different relative to the control seawater.

† Indicates samples that were statistically significantly different relative to the control sediment.

Table 5. **Ammonia and sulphide: 48-h bivalve (*M. galloprovincialis*) larval survival and development test [SCCWRP method].**

Sample ID	Overlying Water				Interstitial Water			
	Total Ammonia (mg/L N)		Total Sulphide (mg/L S)		Total Ammonia (mg/L N)		Total Sulphide (mg/L S)	
	0h	48h	0h	48h	0h	48h	0h	48h
Control Seawater	0.305	0.449	<0.018	<0.018	0.793	0.582	<0.018	<0.018
EHWW-REF17-SG-000010	2.61	8.53	<0.018	1.32	17.5	17.4	1.60	1.88
EHWW-REF18-SG-000010	0.965	2.89	<0.018	<0.018	5.57	5.50	0.021	<0.018
EHWW-01-SG-000010	1.02	3.98	<0.018	0.085	4.22	4.63	0.044	0.037
EHWW-06-SG-000010	0.892	2.20	<0.018	<0.018	3.45	3.99	0.020	0.048
EHWW-08-SG-000010	0.584	1.56	<0.018	0.019	2.57	2.74	0.060	0.055
EHWW-11-SG-000010	0.104	0.190	<0.018	<0.018	0.490	0.544	0.034	0.024
EHWW-12-SG-000010	0.851	2.62	<0.018	<0.018	3.36	4.37	0.031	<0.018
EHWW-13-SG-000010	0.151	0.374	<0.018	<0.018	0.880	0.811	0.035	<0.018
EHWW-15-SG-000010	2.10	5.55	<0.018	<0.018	8.37	8.15	0.051	0.023
EHWW-22-SG-000010	0.188	0.604	<0.018	<0.018	1.23	1.30	0.044	0.195
EHWW-29-SG-000010	1.72	4.25	<0.018	<0.018	6.55	5.45	0.020	0.020
EHWW-31-SG-000010	4.03	7.32	<0.018	0.047	12.2	10.2	<0.018	0.051
EHWW-39-SG-000010	1.81	3.82	<0.018	<0.018	6.38	5.59	0.036	0.032
EHWW-40-SG-000010	1.28	2.90	<0.018	0.023	5.22	5.45	0.79	5.19
EHWW-42-SG-000010	0.698	1.86	<0.018	<0.018	2.89	3.07	0.022	0.025
EHWW-44-SG-000010	0.625	1.46	<0.018	<0.018	2.25	2.63	0.020	<0.018
EHWW-50-SG-000010	0.830	2.23	<0.018	<0.018	3.28	3.78	<0.018	0.434

Table 6. Ammonia and sulphide: 48-h bivalve (*M. galloprovincialis*) larval survival and development test [PSEP method].

Sample ID	Overlying Water			
	Total Ammonia (mg/L N)		Total Sulphide (mg/L S)	
	0 hrs	48 hrs	0 hrs	48 hrs
Control Seawater	0.0077	<0.0050	<0.018	<0.018
Control Sediment	0.0466	<0.0050	<0.018	<0.018
EHWW-11-SG-000010	0.0170	<0.0050	<0.018	<0.018
EHWW-39-SG-000010	0.274	0.163	<0.018	<0.018
EHWW-50-SG-000010	0.157	0.0419	<0.018	<0.018

4.0 QA/QC

The health history of the test organisms used in the exposure was acceptable and met the requirements of the SCCWRP and PSEP protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. There were no deviations from the test methodologies. Uncertainty associated with these tests is best described by the standard deviation around the mean and/or the confidence intervals around the point estimates.

For samples EHWW-08, -11, -12, -40 and -42, only three replicates instead of four were used in the final statistical calculation due to one replicate producing a result that was inconsistent with the other three replicates.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 7. The results for the tests fell within the range for organism performance of the mean and two standard deviations, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in the tests was appropriate.

Table 7. Reference toxicant test results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
M. galloprovincialis	Proportion normal (EC50): 12.5 µg/L Cu	12.2 (8.4 – 17.8) µg/L Cu	19	November 22, 2018
M. galloprovincialis	Proportion normal (EC50): 13.0 mg/L N	10.9 (7.2 – 16.5) mg/L N	21	November 22, 2018

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration

5.0 REFERENCES

Puget Sound Estuary Program (PSEP). 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared for US Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA. Final Report, July 1995. 89 pp.

Southern California Coastal Watershed Research Program (SCCWRP) 2009. Sediment Quality Assessment Draft Technical Support Manual. Prepared by the State Water Board, SCCWRP, Costa Mesa, CA. May 2009. 132 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.9.4.11 Tidepool Scientific Software, McKinleyville, CA. 255 pp.

Wang, F. and Chapman, P.M. 1999. Biological implications of sulfide in sediment – A review focusing on sediment toxicity. Environmental Toxicology and Chemistry 18(11): 2526-2532.

APPENDIX A – *Mytilus galloprovincialis* (SCCWRP) Toxicity Test Data

Bivalve Larval Development Sediment Test Summary Sheet

Client: Anchor
Work Order No.: 181641

Start Date: November 22, 2018
Set up by: YYL

Sample Information:

Sample ID: Various - see below
Sample Date: October 1, 2, 3, 4 and 5, 2018
Date Received: October 2, 3, 4, and 6, 2018
Sample Volume: 1 x 3L per sample

Test Organism Information:

Species: *Mytilus galloprovincialis*
Supplier: Kamilche Seafarms, Shelton, WA
Date received: November 22, 2018

Copper Reference Toxicant Results:

Reference Toxicant ID: Mg52
Stock Solution ID: 18Cu03
Date Initiated: November 22, 2018

48-h EC50 Normal Larvae (95% CL): 12.5 (12.3 - 12.8) µg/L Cu

48-h EC50 Normal Larvae Reference Toxicant Mean ± 2 SD: 12.2 (8.4 - 17.8) µg/L Cu CV (%): 19

Test Results:

Sample ID	Survival ± SD (%)	Normal Larvae ± SD (%)	Combined Proportion Normal ± SD (%)
Control Seawater	85.1 ± 4.2	86.7 ± 5.9	73.8 ± 5.8
EHWW-REF-17-SG-000010	80.6 ± 11.9	93.3 ± 0.8	75.2 ± 10.7
EHWW-REF-18-SG-000010	84.4 ± 5.7	92.0 ± 1.3	77.6 ± 5.1
EHWW-01-SG-000010	80.4 ± 11.8	90.5 ± 2.4	72.7 ± 10.6
EHWW-06-SG-000010	83.4 ± 7.2	86.6 ± 1.6 [1]	72.2 ± 5.7
EHWW-08-SG-000010	79.7 ± 7.6	91.5 ± 1.6	72.8 ± 5.8
EHWW-11-SG-000010	84.5 ± 9.0	90.2 ± 2.8	76.1 ± 5.9
EHWW-12-SG-000010	88.7 ± 6.6	92.0 ± 1.6	81.6 ± 6.3
EHWW-13-SG-000010	86.6 ± 6.3	88.8 ± 2.4	76.8 ± 3.6
EHWW-15-SG-000010	79.8 ± 5.2	83.5 ± 6.4 [1,2]	66.5 ± 5.5
EHWW-22-SG-000010	82.2 ± 12.0	87.0 ± 2.8 [1]	71.6 ± 12.0
EHWW-29-SG-000010	93.4 ± 4.7	92.2 ± 3.3	86.1 ± 6.1
EHWW-31-SG-000010	91.7 ± 5.7	92.0 ± 4.9	84.6 ± 8.9
EHWW-39-SG-000010	89.4 ± 7.5	88.2 ± 2.3	79.2 ± 7.3
EHWW-40-SG-000010	90.4 ± 7.9	91.1 ± 1.3	82.4 ± 8.3
EHWW-42-SG-000010	78.0 ± 5.5	89.8 ± 2.6	70.0 ± 4.1
EHWW-44-SG-000010	91.1 ± 6.7	92.2 ± 3.0	84.0 ± 6.1
EHWW-50-SG-000010	93.1 ± 5.3	86.4 ± 2.7 [1]	80.5 ± 4.4

There were no significant effects relative to the control seawater
[1] Indicates samples that were significantly different relative to reference site REF-17
[2] Indicates samples that were significantly different relative to reference site REF-18

Reviewed by: A. Tong

Date reviewed: January 15, 2019

48-h Bivalve Development Sediment Toxicity Test Data Sheet

Client: Anchor
Work Order No.: 181641
Test Set up by: YML

Start Date & Time: November 22, 2018 @ 1645h
End Date & Time: November 24, 2018 @ 1710h
Test species: M. galloprovincialis

Sample ID	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Salinity (ppt)	
	0 h	24 h	48 h	0 h	24 h	48 h	0 h	24 h	48 h	0 h	48 h
Control ~~Sediment~~ Seawater	15.0	15.5	15.5	7.9	7.6	7.4	7.5	7.5	7.5	~~28~~ 29	29
EHWW-REF-17-SG-000010	15.0	15.5	15.5	6.0	5.8	5.2	7.6	7.6	7.7	29	30
EHWW-REF-18-SG-000010	15.0	15.5	15.5	6.3	5.8	5.4	7.6	7.6	7.7	29	30
EHWW-01-SG-000010	15.5	15.5	15.5	6.1	5.4	4.8	7.6	7.6	7.7	29	30
EHWW-06-SG-000010	15.0	15.5	15.5	5.3	5.8	5.4	~~7.6~~ 7.5	7.5	7.6	29	30
EHWW-08-SG-000010	15.5	15.5	15.5	5.5	5.6	5.5	7.6	7.5	7.5	29	30
EHWW-11-SG-000010	15.5	15.5	15.5	5.9	5.4	5.0	7.6	7.4	7.5	29	30
EHWW-12-SG-000010	15.5	15.5	15.5	5.6	5.9	5.7	7.6	7.6	7.6	29	30
EHWW-13-SG-000010	15.5	15.5	15.5	6.0	6.1	5.9	7.6	7.6	7.6	29	30
EHWW-15-SG-000010	15.5	15.5	15.5	5.8	5.9	5.4	7.6	7.6	7.6	29	30
EHWW-22-SG-000010	15.5	15.5	15.5	5.8	5.6	5.4	7.6	7.6	7.6	29	30
EHWW-29-SG-000010	15.5	15.5	15.5	5.7	6.0	5.6	7.6	~~7.7~~ 7.6	7.6	29	30
EHWW-31-SG-000010	15.5	15.5	15.5	5.5	5.4	4.9	7.7	7.7	7.8	29	30
EHWW-39-SG-000010	15.5	15.5	15.5	5.8	6.1	5.7	7.5	7.6	7.5	29	30
EHWW-40-SG-000010	15.5	15.5	15.5	5.8	6.0	5.7	7.5	7.5	7.5	29	30
EHWW-42-SG-000010	15.5	15.5	15.5	5.6	5.5	5.4	7.6	7.5	7.6	29	30
EHWW-44-SG-000010	15.5	15.5	15.5	5.4	5.3	4.7	7.6	7.6	7.6	29	30
EHWW-50-SG-000010	15.5	15.5	15.5	5.3	6.0	5.7	7.5	7.6	7.6	29	30
Analyst Initials	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM

Comments:
0 hrs:
24 hrs.
48 hrs.

Reviewed by: A. Tang
Date Reviewed: January 15, 2019

Bivalve Larvae Development Toxicity Test Data Sheet - Larval Counts

Client: Anchor
Work Order #: ~~N/A~~ 181641
Test set up by: VML

Start Date/Time: November 22, 2018 @ 1645h
End Date/Time: November 24, 2018 @ 1710h
Test species: *Mytilus galloprovincialis*

Initial Density/ 10 mL aliquot: 254

Sample ID	Rep	No. Normal	No. Abnormal	Comments	Initials
Control seawater	A	182	19		VML
	B	194	26		
	C	204	22		
	D	170	48		
EHWW-REF17-SG-000010	A	167	10		
	B	229	18		
	C	191	13		
	D	177	14		
EHWW-REF18-SG-000010	A	179	17		
	B	210	21		
	C	199	18		
	D	200	13		
EHWW-01-SG-000010	A	205	14		
	B	168	21		
	C	156	15		
	D	210	23		
EHWW-06-SG-000010	A	203	35		
	B	169	27		
	C	183	23		
	D	178	29		
EHWW-08-SG-000010	A	198	21		
	B	188	19		
	C	17	9	2nd count: 18/9 ①	
	D	169	12		
EHWW-11-SG-000010	A	208	31		
	B	30	4	2nd count: 30/4 ①	
	C	178	16		
	D	194	17		
EHWW-12-SG-000010	A	215	14		
	B	189	18		
	C	218	22		
	D	42	19	2nd count: 40/20 ①	
EHWW-13-SG-000010	A	192	21		
	B	199	27		
	C	184	18		
	D	205	34		

① outlier - rep not used in statistical analyses

Reviewed by: A. Tong
Date Reviewed: January 15, 2019

Bivalve Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Anchor
Work Order #: 181641
Sample ID: ~ ~~Hat~~ (Various)

Start Date/Time: November 22, 2018 @ 1645h
Test species: *Mytilus sp.*
Test set up by: YML
Initial Density/ 10mL: 254

~~Concentration~~ Sample ID	Rep	No. Normal	No. Abnormal	Comments	Initials
EHWW-15-SG-000010	A	186	20		YML
	B	170	50		
	C	152	41		
	D	168	24		
EHWW-22-SG-000010	A	178	21		
	B	226	28		
	C	159	32		
	D	165	26		
EHWW-29-SG-000010	A	216	12		
	B	233	14		
	C	198	28		
	D	228	20		
EHWW-31-SG-000010	A	186	33		
	B	236	9		
	C	229	17		
	D	208	14		
EHWW-39-SG-000010	A	192	34		
	B	228	30		
	C	194	24		
	D	190	20		
EHWW-40-SG-000010	A	231	20		
	B	189	22		
	C	21	10	2nd count: 20/11 ①	
	D	208	19		
EHWW-42-SG-000010	A	9	3	2nd count: 9/3 ①	
	B	178	14		
	C	167	21		
	D	188	26		
EHWW-44-SG-000010	A	203	15		
	B	231	11		
	C	198	18		
	D	221	29		
EHWW-50-SG-000010	A	217	38		
	B	196	39		
	C	211	25		
	D	194	27		✓

Comments: ① outlier - rep not used in statistical analyses

Reviewed by: A. Tong
Date Reviewed: January 15, 2019

CETIS Summary Report

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control	07-9348-4549	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control	Control SW	Anchor QEA	Control	
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1

Bivalve Larval Survival and Development Test — Nautilus Environmental

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1

Bivalve Larval Survival and Development Test **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1

Bivalve Larval Survival and Development Test **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	0.5035	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-31 passed combined proportion no	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	0.9453	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1

SIngle Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
02-3871-5703	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
20-7148-5003	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-22 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-44 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-31 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-01 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-39 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-06 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-29 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-42 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-40 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-08 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-12 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed combined proportio	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-15 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-11 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-13 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	EHWW-50 passed combined proportion no	1
21-1427-6474	Combined Proportion Norma	Bonferroni Adj t Test	1.0000	Control passed combined proportion norm	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-15 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-REF18 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-13 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-08 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-REF17 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-50 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	Control failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-01 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-06 failed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-22 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-42 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-12 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-29 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-44 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-11 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-40 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-39 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0127	EHWW-31 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1029	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-44 passed proportion normal	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.1827	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.9564	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-13 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-REF18 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-42 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-15 failed proportion normal	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-31 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-REF17 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-39 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-12 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-01 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-06 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-44 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-11 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-08 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-29 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	Control failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-22 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-40 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	3.6E-04	EHWW-50 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-44 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-13 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-11 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-29 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-REF18 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-12 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-42 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-50 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-01 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-06 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-REF17 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-39 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-40 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-22 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-08 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-15 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	EHWW-31 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0041	Control failed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-08 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-44 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-06 failed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-12 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-REF17 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-REF18 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-42 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-40 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-31 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-15 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-39 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-01 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-13 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-50 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-29 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-22 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	Control failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0235	EHWW-11 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.1752	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1

Bivalve Larval Survival and Development Test — Nautilus Environmental

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0961	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.5698	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	Control passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.7482	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-06 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-15 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-REF17 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-REF18 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-29 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-31 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	Control failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-22 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-12 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-13 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-42 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-40 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-44 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-11 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-08 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-39 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-50 failed proportion normal	1
13-2946-4594	Proportion Normal	Bonferroni Adj t Test	0.0111	EHWW-01 failed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-39 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	Control passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-29 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-22 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-11 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-01 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-40 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-42 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-REF18 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-31 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-13 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-50 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-12 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-15 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-08 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-06 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-44 passed proportion normal	1
14-6142-4225	Proportion Normal	Bonferroni Adj t Test	0.0914	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-06 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	Control passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-42 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-15 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-40 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-31 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-29 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-22 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF17 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-11 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-13 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-08 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-01 passed proportion normal	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-REF18 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-50 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-44 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-39 passed proportion normal	1
21-2426-0886	Proportion Normal	Bonferroni Adj t Test	1.0000	EHWW-12 passed proportion normal	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-29 passed survival rate	1

Bivalve Larval Survival and Development Test **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3286	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-29 passed survival rate	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.4429	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.3857	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-44 passed survival rate	1

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1

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Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-39 passed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.2000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.1143	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
11-5555-3882	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
12-6311-5380	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	Control passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF18 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-01 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-15 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-06 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-08 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-22 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-50 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-29 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-39 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-40 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-42 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-REF17 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-11 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-31 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-12 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-44 passed survival rate	1
20-0346-5055	Survival Rate	Kolmogorov-Smirnov Two-Sample Test	0.5000	EHWW-13 passed survival rate	1

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control	LC	4	0.7382	0.6459	0.8305	0.6693	0.8031	0.0290	0.0580	7.86%	0.00%
EHWW-REF17	RS	4	0.7520	0.5817	0.9222	0.6575	0.9016	0.0535	0.1070	14.23%	-1.87%
EHWW-REF18	XC	4	0.7756	0.6942	0.8570	0.7047	0.8268	0.0256	0.0511	6.59%	-5.07%
EHWW-01		4	0.7274	0.5595	0.8953	0.6142	0.8268	0.0528	0.1055	14.51%	1.47%
EHWW-06		4	0.7215	0.6313	0.8116	0.6654	0.7992	0.0283	0.0566	7.85%	2.27%
EHWW-08		3	0.7283	0.5843	0.8724	0.6654	0.7795	0.0335	0.0580	7.96%	1.33%
EHWW-11		3	0.7612	0.6143	0.9080	0.7008	0.8189	0.0341	0.0591	7.76%	-3.11%
EHWW-12		3	0.8163	0.6603	0.9722	0.7441	0.8583	0.0363	0.0628	7.69%	-10.58%
EHWW-13		4	0.7677	0.7110	0.8244	0.7244	0.8071	0.0178	0.0357	4.64%	-4.00%
EHWW-15		4	0.6654	0.5782	0.7525	0.5984	0.7323	0.0274	0.0547	8.23%	9.87%
EHWW-22		4	0.7165	0.5262	0.9069	0.6260	0.8898	0.0598	0.1196	16.70%	2.93%
EHWW-29		4	0.8612	0.7637	0.9587	0.7795	0.9173	0.0306	0.0613	7.12%	-16.67%
EHWW-31		4	0.8455	0.7041	0.9868	0.7323	0.9291	0.0444	0.0888	10.50%	-14.53%
EHWW-39		4	0.7923	0.6760	0.9087	0.7480	0.9016	0.0366	0.0731	9.23%	-7.33%
EHWW-40		3	0.8241	0.6185	1.0000	0.7441	0.9094	0.0478	0.0828	10.05%	-11.64%
EHWW-42		3	0.6995	0.5967	0.8022	0.6575	0.7402	0.0239	0.0414	5.91%	5.24%
EHWW-44		4	0.8396	0.7430	0.9361	0.7795	0.9094	0.0303	0.0607	7.23%	-13.73%
EHWW-50		4	0.8051	0.7345	0.8757	0.7638	0.8543	0.0222	0.0444	5.51%	-9.07%

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control	LC	4	0.8674	0.7730	0.9619	0.7798	0.9055	0.0297	0.0594	6.84%	0.00%
EHWW-REF17	RS	4	0.9334	0.9206	0.9462	0.9267	0.9435	0.0040	0.0081	0.86%	-7.60%
EHWW-REF18	XC	4	0.9196	0.8984	0.9408	0.9091	0.9390	0.0067	0.0133	1.45%	-6.01%
EHWW-01		4	0.9049	0.8660	0.9438	0.8824	0.9361	0.0122	0.0244	2.70%	-4.32%
EHWW-06		4	0.8659	0.8412	0.8905	0.8529	0.8883	0.0078	0.0155	1.79%	0.18%
EHWW-08		3	0.9153	0.8755	0.9552	0.9041	0.9337	0.0093	0.0160	1.75%	-5.52%
EHWW-11		3	0.9024	0.8333	0.9716	0.8703	0.9194	0.0161	0.0278	3.08%	-4.03%
EHWW-12		3	0.9201	0.8792	0.9609	0.9083	0.9389	0.0095	0.0164	1.79%	-6.07%
EHWW-13		4	0.8876	0.8500	0.9252	0.8577	0.9109	0.0118	0.0236	2.66%	-2.33%
EHWW-15		4	0.8346	0.7325	0.9366	0.7727	0.9029	0.0321	0.0641	7.68%	3.79%
EHWW-22		4	0.8701	0.8248	0.9155	0.8325	0.8945	0.0143	0.0285	3.27%	-0.31%
EHWW-29		4	0.9215	0.8695	0.9736	0.8761	0.9474	0.0164	0.0327	3.55%	-6.24%
EHWW-31		4	0.9201	0.8418	0.9985	0.8493	0.9633	0.0246	0.0492	5.35%	-6.07%
EHWW-39		4	0.8821	0.8449	0.9193	0.8496	0.9048	0.0117	0.0234	2.65%	-1.69%
EHWW-40		3	0.9108	0.8780	0.9435	0.8957	0.9203	0.0076	0.0132	1.45%	-5.00%
EHWW-42		3	0.8980	0.8341	0.9618	0.8785	0.9271	0.0148	0.0257	2.86%	-3.52%
EHWW-44		4	0.9216	0.8746	0.9686	0.8840	0.9545	0.0148	0.0295	3.20%	-6.24%
EHWW-50		4	0.8642	0.8215	0.9069	0.8340	0.8941	0.0134	0.0269	3.11%	0.37%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control	LC	4	0.8514	0.7842	0.9185	0.7913	0.8898	0.0211	0.0422	4.96%	0.00%
EHWW-REF17	RS	4	0.8061	0.6166	0.9956	0.6969	0.9724	0.0595	0.1191	14.77%	5.32%
EHWW-REF18	XC	4	0.8435	0.7532	0.9338	0.7717	0.9094	0.0284	0.0567	6.72%	0.92%
EHWW-01		4	0.8041	0.6164	0.9919	0.6732	0.9370	0.0590	0.1180	14.67%	5.55%
EHWW-06		4	0.8337	0.7197	0.9476	0.7717	0.9370	0.0358	0.0716	8.59%	2.08%
EHWW-08		3	0.7966	0.6066	0.9866	0.7126	0.8622	0.0442	0.0765	9.60%	6.44%
EHWW-11		3	0.8451	0.6229	1.0000	0.7638	0.9409	0.0517	0.0895	10.59%	0.73%
EHWW-12		3	0.8871	0.7228	1.0000	0.8150	0.9449	0.0382	0.0662	7.46%	-4.20%
EHWW-13		4	0.8661	0.7658	0.9665	0.7953	0.9409	0.0315	0.0631	7.28%	-1.73%
EHWW-15		4	0.7982	0.7158	0.8806	0.7559	0.8661	0.0259	0.0518	6.49%	6.24%
EHWW-22		4	0.8219	0.6314	1.0000	0.7520	1.0000	0.0599	0.1197	14.56%	3.47%
EHWW-29		4	0.9341	0.8597	1.0000	0.8898	0.9764	0.0234	0.0467	5.00%	-9.71%
EHWW-31		4	0.9173	0.8265	1.0000	0.8622	0.9685	0.0285	0.0571	6.22%	-7.75%
EHWW-39		4	0.8937	0.7737	1.0000	0.8268	1.0000	0.0377	0.0754	8.44%	-4.97%
EHWW-40		3	0.9042	0.7073	1.0000	0.8307	0.9882	0.0458	0.0793	8.77%	-6.20%
EHWW-42		3	0.7795	0.6426	0.9164	0.7402	0.8425	0.0318	0.0551	7.07%	8.44%
EHWW-44		4	0.9114	0.8044	1.0000	0.8504	0.9843	0.0336	0.0672	7.38%	-7.05%
EHWW-50		4	0.9311	0.8464	1.0000	0.8701	1.0000	0.0266	0.0533	5.72%	-9.36%

Bivalve Larval Survival and Development Test **Nautilus Environmental**

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	0.7165	0.7638	0.8031	0.6693
EHWW-REF17	RS	0.6575	0.9016	0.7520	0.6969
EHWW-REF18	XC	0.7047	0.8268	0.7835	0.7874
EHWW-01		0.8071	0.6614	0.6142	0.8268
EHWW-06		0.7992	0.6654	0.7205	0.7008
EHWW-08		0.7795	0.7402	0.6654	
EHWW-11		0.8189	0.7008	0.7638	
EHWW-12		0.8465	0.7441	0.8583	
EHWW-13		0.7559	0.7835	0.7244	0.8071
EHWW-15		0.7323	0.6693	0.5984	0.6614
EHWW-22		0.7008	0.8898	0.6260	0.6496
EHWW-29		0.8504	0.9173	0.7795	0.8976
EHWW-31		0.7323	0.9291	0.9016	0.8189
EHWW-39		0.7559	0.9016	0.7638	0.7480
EHWW-40		0.9094	0.7441	0.8189	
EHWW-42		0.7008	0.6575	0.7402	
EHWW-44		0.7992	0.9094	0.7795	0.8701
EHWW-50		0.8543	0.7717	0.8307	0.7638

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	0.9055	0.8818	0.9027	0.7798
EHWW-REF17	RS	0.9435	0.9271	0.9363	0.9267
EHWW-REF18	XC	0.9133	0.9091	0.9171	0.9390
EHWW-01		0.9361	0.8889	0.9123	0.8824
EHWW-06		0.8529	0.8622	0.8883	0.8599
EHWW-08		0.9041	0.9082	0.9337	
EHWW-11		0.8703	0.9175	0.9194	
EHWW-12		0.9389	0.9130	0.9083	
EHWW-13		0.9014	0.8805	0.9109	0.8577
EHWW-15		0.9029	0.7727	0.7876	0.8750
EHWW-22		0.8945	0.8898	0.8325	0.8639
EHWW-29		0.9474	0.9433	0.8761	0.9194
EHWW-31		0.8493	0.9633	0.9309	0.9369
EHWW-39		0.8496	0.8842	0.8899	0.9048
EHWW-40		0.9203	0.8957	0.9163	
EHWW-42		0.9271	0.8883	0.8785	
EHWW-44		0.9312	0.9545	0.9167	0.8840
EHWW-50		0.8510	0.8340	0.8941	0.8778

Bivalve Larval Survival and Development Test — Nautilus Environmental

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	0.7913	0.8661	0.8898	0.8583
EHWW-REF17	RS	0.6969	0.9724	0.8031	0.7520
EHWW-REF18	XC	0.7717	0.9094	0.8543	0.8386
EHWW-01		0.8622	0.7441	0.6732	0.9370
EHWW-06		0.9370	0.7717	0.8110	0.8150
EHWW-08		0.8622	0.8150	0.7126	
EHWW-11		0.9409	0.7638	0.8307	
EHWW-12		0.9016	0.8150	0.9449	
EHWW-13		0.8386	0.8898	0.7953	0.9409
EHWW-15		0.8110	0.8661	0.7598	0.7559
EHWW-22		0.7835	1.0000	0.7520	0.7520
EHWW-29		0.8976	0.9724	0.8898	0.9764
EHWW-31		0.8622	0.9646	0.9685	0.8740
EHWW-39		0.8898	1.0000	0.8583	0.8268
EHWW-40		0.9882	0.8307	0.8937	
EHWW-42		0.7559	0.7402	0.8425	
EHWW-44		0.8583	0.9528	0.8504	0.9843
EHWW-50		1.0000	0.9252	0.9291	0.8701

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	182/254	194/254	204/254	170/254
EHWW-REF17	RS	167/254	229/254	191/254	177/254
EHWW-REF18	XC	179/254	210/254	199/254	200/254
EHWW-01		205/254	168/254	156/254	210/254
EHWW-06		203/254	169/254	183/254	178/254
EHWW-08		198/254	188/254	169/254	
EHWW-11		208/254	178/254	194/254	
EHWW-12		215/254	189/254	218/254	
EHWW-13		192/254	199/254	184/254	205/254
EHWW-15		186/254	170/254	152/254	168/254
EHWW-22		178/254	226/254	159/254	165/254
EHWW-29		216/254	233/254	198/254	228/254
EHWW-31		186/254	236/254	229/254	208/254
EHWW-39		192/254	229/254	194/254	190/254
EHWW-40		231/254	189/254	208/254	
EHWW-42		178/254	167/254	188/254	
EHWW-44		203/254	231/254	198/254	221/254
EHWW-50		217/254	196/254	211/254	194/254

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	182/201	194/220	204/226	170/218
EHWW-REF17	RS	167/177	229/247	191/204	177/191
EHWW-REF18	XC	179/196	210/231	199/217	200/213
EHWW-01		205/219	168/189	156/171	210/238
EHWW-06		203/238	169/196	183/206	178/207
EHWW-08		198/219	188/207	169/181	
EHWW-11		208/239	178/194	194/211	
EHWW-12		215/229	189/207	218/240	
EHWW-13		192/213	199/226	184/202	205/239
EHWW-15		186/206	170/220	152/193	168/192
EHWW-22		178/199	226/254	159/191	165/191
EHWW-29		216/228	233/247	198/226	228/248
EHWW-31		186/219	236/245	229/246	208/222
EHWW-39		192/226	229/259	194/218	190/210
EHWW-40		231/251	189/211	208/227	
EHWW-42		178/192	167/188	188/214	
EHWW-44		203/218	231/242	198/216	221/250
EHWW-50		217/255	196/235	211/236	194/221

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	201/254	220/254	226/254	218/254
EHWW-REF17	RS	177/254	247/254	204/254	191/254
EHWW-REF18	XC	196/254	231/254	217/254	213/254
EHWW-01		219/254	189/254	171/254	238/254
EHWW-06		238/254	196/254	206/254	207/254
EHWW-08		219/254	207/254	181/254	
EHWW-11		239/254	194/254	211/254	
EHWW-12		229/254	207/254	240/254	
EHWW-13		213/254	226/254	202/254	239/254
EHWW-15		206/254	220/254	193/254	192/254
EHWW-22		199/254	254/254	191/254	191/254
EHWW-29		228/254	247/254	226/254	248/254
EHWW-31		219/254	245/254	246/254	222/254
EHWW-39		226/254	254/254	218/254	210/254
EHWW-40		251/254	211/254	227/254	
EHWW-42		192/254	188/254	214/254	
EHWW-44		218/254	242/254	216/254	250/254
EHWW-50		254/254	235/254	236/254	221/254

CETIS Analytical Report

Report Date:	05 Jan-19 15:21 (p 1 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-6311-5380	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:17	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam	
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater	
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**		
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms	**Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control	07-9348-4549	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control	Control SW	Anchor QEA	Control	
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-6311-5380	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:17	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Kolmogorov-Smirnov Two-Sample Test

Sample I	vs	Sample II	Test Stat	Critical	DF	P-Type	P-Value	Decision(α:5%)
Lab Control		EHWW-REF17	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
		EHWW-REF18	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
		EHWW-01	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
		EHWW-06	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
		EHWW-08	0.5	n/a	5	Exact	0.3286	Non-Significant Effect
		EHWW-11	0.4167	n/a	5	Exact	0.4429	Non-Significant Effect
		EHWW-12	0.08333	n/a	5	Exact	0.5000	Non-Significant Effect
		EHWW-13	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
		EHWW-15	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
		EHWW-22	0.75	n/a	6	Exact	0.1143	Non-Significant Effect
		EHWW-29	0	n/a	6	Exact	0.5000	Non-Significant Effect
		EHWW-31	0	n/a	6	Exact	0.5000	Non-Significant Effect
		EHWW-39	0	n/a	6	Exact	0.5000	Non-Significant Effect
		EHWW-40	0.08333	n/a	5	Exact	0.5000	Non-Significant Effect
		EHWW-42	0.75	n/a	5	Exact	0.1143	Non-Significant Effect
		EHWW-44	0	n/a	6	Exact	0.5000	Non-Significant Effect
		EHWW-50	0	n/a	6	Exact	0.5000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.396803	0.0233414	17	1.316	0.2224	Non-Significant Effect
Error	0.868769	0.01773	49			
Total	1.26557		66			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	12.25	33.41	0.7850	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9269	0.9508	7.2E-04	Non-Normal Distribution

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control	LC	4	0.8514	0.7842	0.9185	0.8622	0.7913	0.8898	0.0211	4.96%	0.00%
EHWW-REF17		4	0.8061	0.6166	0.9956	0.7776	0.6969	0.9724	0.0595	14.77%	5.32%
EHWW-REF18		4	0.8435	0.7532	0.9338	0.8465	0.7717	0.9094	0.0284	6.72%	0.92%
EHWW-01		4	0.8041	0.6164	0.9919	0.8031	0.6732	0.9370	0.0590	14.67%	5.55%
EHWW-06		4	0.8337	0.7197	0.9476	0.8130	0.7717	0.9370	0.0358	8.59%	2.08%
EHWW-08		3	0.7966	0.6066	0.9866	0.8150	0.7126	0.8622	0.0442	9.60%	6.44%
EHWW-11		3	0.8451	0.6229	1.0000	0.8307	0.7638	0.9409	0.0517	10.59%	0.73%
EHWW-12		3	0.8871	0.7228	1.0000	0.9016	0.8150	0.9449	0.0382	7.46%	-4.20%
EHWW-13		4	0.8661	0.7658	0.9665	0.8642	0.7953	0.9409	0.0315	7.28%	-1.73%
EHWW-15		4	0.7982	0.7158	0.8806	0.7854	0.7559	0.8661	0.0259	6.49%	6.24%
EHWW-22		4	0.8219	0.6314	1.0000	0.7677	0.7520	1.0000	0.0599	14.56%	3.47%
EHWW-29		4	0.9341	0.8597	1.0000	0.9350	0.8898	0.9764	0.0234	5.00%	-9.71%
EHWW-31		4	0.9173	0.8265	1.0000	0.9193	0.8622	0.9685	0.0285	6.22%	-7.75%
EHWW-39		4	0.8937	0.7737	1.0000	0.8740	0.8268	1.0000	0.0377	8.44%	-4.97%
EHWW-40		3	0.9042	0.7073	1.0000	0.8937	0.8307	0.9882	0.0458	8.77%	-6.20%
EHWW-42		3	0.7795	0.6426	0.9164	0.7559	0.7402	0.8425	0.0318	7.07%	8.44%
EHWW-44		4	0.9114	0.8044	1.0000	0.9055	0.8504	0.9843	0.0336	7.38%	-7.05%
EHWW-50		4	0.9311	0.8464	1.0000	0.9272	0.8701	1.0000	0.0266	5.72%	-9.36%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-6311-5380	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:17	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control	LC	4	1.177	1.086	1.269	1.191	1.096	1.232	0.02885	4.90%	0.00%
EHWW-REF17		4	1.138	0.8448	1.431	1.08	0.9877	1.404	0.09215	16.19%	3.34%
EHWW-REF18		4	1.169	1.043	1.294	1.168	1.073	1.265	0.03956	6.77%	0.75%
EHWW-01		4	1.128	0.8763	1.379	1.115	0.9623	1.317	0.07895	14.00%	4.24%
EHWW-06		4	1.159	0.9874	1.331	1.124	1.073	1.317	0.05399	9.32%	1.55%
EHWW-08		3	1.107	0.8732	1.341	1.126	1.005	1.19	0.05438	8.51%	5.97%
EHWW-11		3	1.178	0.8459	1.511	1.147	1.063	1.325	0.07729	11.36%	-0.08%
EHWW-12		3	1.237	0.9774	1.497	1.252	1.126	1.334	0.06039	8.45%	-5.07%
EHWW-13		4	1.204	1.05	1.358	1.195	1.101	1.325	0.04852	8.06%	-2.26%
EHWW-15		4	1.107	1.002	1.213	1.09	1.054	1.196	0.0333	6.01%	5.94%
EHWW-22		4	1.181	0.8003	1.562	1.068	1.049	1.539	0.1197	20.27%	-0.33%
EHWW-29		4	1.324	1.167	1.482	1.325	1.232	1.416	0.04965	7.50%	-12.49%
EHWW-31		4	1.293	1.12	1.466	1.295	1.19	1.392	0.05434	8.41%	-9.82%
EHWW-39		4	1.275	0.9874	1.562	1.209	1.142	1.539	0.09022	14.16%	-8.24%
EHWW-40		3	1.282	0.8798	1.685	1.239	1.147	1.462	0.09357	12.64%	-8.92%
EHWW-42		3	1.084	0.9138	1.255	1.054	1.036	1.163	0.0396	6.33%	7.92%
EHWW-44		4	1.289	1.078	1.499	1.268	1.174	1.445	0.06609	10.26%	-9.46%
EHWW-50		4	1.334	1.105	1.563	1.298	1.202	1.539	0.07205	10.80%	-13.31%

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	0.7913	0.8661	0.8898	0.8583
EHWW-REF17		0.6969	0.9724	0.8031	0.7520
EHWW-REF18		0.7717	0.9094	0.8543	0.8386
EHWW-01		0.8622	0.7441	0.6732	0.9370
EHWW-06		0.9370	0.7717	0.8110	0.8150
EHWW-08		0.8622	0.8150	0.7126	
EHWW-11		0.9409	0.7638	0.8307	
EHWW-12		0.9016	0.8150	0.9449	
EHWW-13		0.8386	0.8898	0.7953	0.9409
EHWW-15		0.8110	0.8661	0.7598	0.7559
EHWW-22		0.7835	1.0000	0.7520	0.7520
EHWW-29		0.8976	0.9724	0.8898	0.9764
EHWW-31		0.8622	0.9646	0.9685	0.8740
EHWW-39		0.8898	1.0000	0.8583	0.8268
EHWW-40		0.9882	0.8307	0.8937	
EHWW-42		0.7559	0.7402	0.8425	
EHWW-44		0.8583	0.9528	0.8504	0.9843
EHWW-50		1.0000	0.9252	0.9291	0.8701

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-6311-5380	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:17	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	1.096	1.196	1.232	1.185
EHWW-REF17		0.9877	1.404	1.111	1.049
EHWW-REF18		1.073	1.265	1.179	1.157
EHWW-01		1.19	1.04	0.9623	1.317
EHWW-06		1.317	1.073	1.121	1.126
EHWW-08		1.19	1.126	1.005	
EHWW-11		1.325	1.063	1.147	
EHWW-12		1.252	1.126	1.334	
EHWW-13		1.157	1.232	1.101	1.325
EHWW-15		1.121	1.196	1.059	1.054
EHWW-22		1.087	1.539	1.049	1.049
EHWW-29		1.245	1.404	1.232	1.416
EHWW-31		1.19	1.381	1.392	1.208
EHWW-39		1.232	1.539	1.185	1.142
EHWW-40		1.462	1.147	1.239	
EHWW-42		1.054	1.036	1.163	
EHWW-44		1.185	1.352	1.174	1.445
EHWW-50		1.539	1.294	1.301	1.202

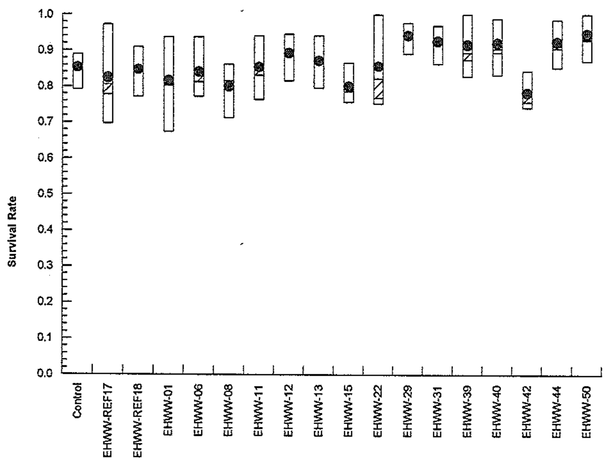
Survival Rate Binomials

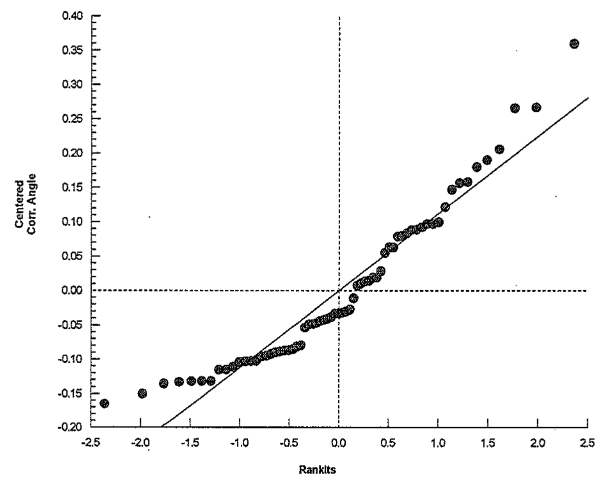
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	201/254	220/254	226/254	218/254
EHWW-REF17		177/254	247/254	204/254	191/254
EHWW-01		219/254	189/254	171/254	238/254
EHWW-06		238/254	196/254	206/254	207/254
EHWW-08		219/254	207/254	181/254	
EHWW-11		239/254	194/254	211/254	
EHWW-12		229/254	207/254	240/254	
EHWW-13		213/254	226/254	202/254	239/254
EHWW-15		206/254	220/254	193/254	192/254
EHWW-22		199/254	254/254	191/254	191/254
EHWW-29		228/254	247/254	226/254	248/254
EHWW-31		219/254	245/254	246/254	222/254
EHWW-39		226/254	254/254	218/254	210/254
EHWW-40		251/254	211/254	227/254	
EHWW-42		192/254	188/254	214/254	
EHWW-44		218/254	242/254	216/254	250/254
EHWW-50		254/254	235/254	236/254	221/254

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	12-6311-5380	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:17	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Graphics





Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-2426-0886	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control	07-9348-4549	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control	Control SW	Anchor QEA	Control	
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-2426-0886	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-REF17 passed proportion normal	8.43%
		EHWW-REF18 passed proportion normal	8.43%
		EHWW-01 passed proportion normal	8.43%
		EHWW-06 passed proportion normal	8.43%
		EHWW-08 passed proportion normal	8.43%
		EHWW-11 passed proportion normal	8.43%
		EHWW-12 passed proportion normal	8.43%
		EHWW-13 passed proportion normal	8.43%
		EHWW-15 passed proportion normal	8.43%
		EHWW-22 passed proportion normal	8.43%
		EHWW-29 passed proportion normal	8.43%
		EHWW-31 passed proportion normal	8.43%
		EHWW-39 passed proportion normal	8.43%
		EHWW-40 passed proportion normal	8.43%
		EHWW-42 passed proportion normal	8.43%
		EHWW-44 passed proportion normal	8.43%
		EHWW-50 passed proportion normal	8.43%

Bonferroni Adj t Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Lab Control		EHWW-REF17	-2.97	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-REF18	-2.244	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-01	-1.553	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-06	0.2018	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-08	-1.881	2.88	0.112	5	CDF	1.0000	Non-Significant Effect
		EHWW-11	-1.327	2.88	0.112	5	CDF	1.0000	Non-Significant Effect
		EHWW-12	-2.107	2.88	0.112	5	CDF	1.0000	Non-Significant Effect
		EHWW-13	-0.7451	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-15	1.288	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-22	-0.002055	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-29	-2.435	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-31	-2.492	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-39	-0.499	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-40	-1.663	2.88	0.112	5	CDF	1.0000	Non-Significant Effect
		EHWW-42	-1.132	2.88	0.112	5	CDF	1.0000	Non-Significant Effect
		EHWW-44	-2.427	2.88	0.103	6	CDF	1.0000	Non-Significant Effect
		EHWW-50	0.2459	2.88	0.103	6	CDF	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.126616	0.007448	17	2.89	0.0019	Significant Effect
Error	0.126274	0.0025770	49			
Total	0.25289		66			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	18.38	33.41	0.3651	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9749	0.9508	0.1942	Normal Distribution

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-2426-0886	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control	LC	4	0.8674	0.7730	0.9619	0.8922	0.7798	0.9055	0.0297	6.84%	0.00%
EHWW-REF17		4	0.9334	0.9206	0.9462	0.9317	0.9267	0.9435	0.0040	0.86%	-7.60%
EHWW-REF18		4	0.9196	0.8984	0.9408	0.9152	0.9091	0.9390	0.0067	1.45%	-6.01%
EHWW-01		4	0.9049	0.8660	0.9438	0.9006	0.8824	0.9361	0.0122	2.70%	-4.32%
EHWW-06		4	0.8659	0.8412	0.8905	0.8611	0.8529	0.8883	0.0078	1.79%	0.18%
EHWW-08		3	0.9153	0.8755	0.9552	0.9082	0.9041	0.9337	0.0093	1.75%	-5.52%
EHWW-11		3	0.9024	0.8333	0.9716	0.9175	0.8703	0.9194	0.0161	3.08%	-4.03%
EHWW-12		3	0.9201	0.8792	0.9609	0.9130	0.9083	0.9389	0.0095	1.79%	-6.07%
EHWW-13		4	0.8876	0.8500	0.9252	0.8910	0.8577	0.9109	0.0118	2.66%	-2.33%
EHWW-15		4	0.8346	0.7325	0.9366	0.8313	0.7727	0.9029	0.0321	7.68%	3.79%
EHWW-22		4	0.8701	0.8248	0.9155	0.8768	0.8325	0.8945	0.0143	3.27%	-0.31%
EHWW-29		4	0.9215	0.8695	0.9736	0.9313	0.8761	0.9474	0.0164	3.55%	-6.24%
EHWW-31		4	0.9201	0.8418	0.9985	0.9339	0.8493	0.9633	0.0246	5.35%	-6.07%
EHWW-39		4	0.8821	0.8449	0.9193	0.8870	0.8496	0.9048	0.0117	2.65%	-1.69%
EHWW-40		3	0.9108	0.8780	0.9435	0.9163	0.8957	0.9203	0.0076	1.45%	-5.00%
EHWW-42		3	0.8980	0.8341	0.9618	0.8883	0.8785	0.9271	0.0148	2.86%	-3.52%
EHWW-44		4	0.9216	0.8746	0.9686	0.9239	0.8840	0.9545	0.0148	3.20%	-6.24%
EHWW-50		4	0.8642	0.8215	0.9069	0.8644	0.8340	0.8941	0.0134	3.11%	0.37%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control	LC	4	1.204	1.072	1.335	1.237	1.082	1.258	0.04127	6.86%	0.00%
EHWW-REF17		4	1.31	1.284	1.336	1.307	1.297	1.331	0.008166	1.25%	-8.86%
EHWW-REF18		4	1.284	1.244	1.324	1.275	1.265	1.321	0.0127	1.98%	-6.69%
EHWW-01		4	1.259	1.191	1.328	1.251	1.221	1.315	0.02147	3.41%	-4.63%
EHWW-06		4	1.196	1.159	1.233	1.189	1.177	1.23	0.01163	1.94%	0.60%
EHWW-08		3	1.276	1.203	1.35	1.263	1.256	1.31	0.01709	2.32%	-6.06%
EHWW-11		3	1.255	1.142	1.368	1.28	1.202	1.283	0.02631	3.63%	-4.28%
EHWW-12		3	1.285	1.208	1.363	1.271	1.263	1.321	0.01803	2.43%	-6.79%
EHWW-13		4	1.23	1.171	1.289	1.235	1.184	1.268	0.01856	3.02%	-2.22%
EHWW-15		4	1.157	1.017	1.298	1.151	1.074	1.254	0.04407	7.62%	3.84%
EHWW-22		4	1.204	1.137	1.27	1.213	1.149	1.24	0.02088	3.47%	-0.01%
EHWW-29		4	1.291	1.198	1.384	1.307	1.211	1.339	0.02935	4.55%	-7.26%
EHWW-31		4	1.293	1.155	1.431	1.311	1.172	1.378	0.04334	6.70%	-7.43%
EHWW-39		4	1.221	1.165	1.278	1.228	1.172	1.257	0.01778	2.91%	-1.49%
EHWW-40		3	1.268	1.211	1.325	1.277	1.242	1.285	0.01316	1.80%	-5.36%
EHWW-42		3	1.247	1.138	1.357	1.23	1.215	1.297	0.02538	3.52%	-3.65%
EHWW-44		4	1.291	1.203	1.379	1.292	1.223	1.356	0.02766	4.29%	-7.24%
EHWW-50		4	1.195	1.132	1.257	1.194	1.151	1.239	0.01969	3.30%	0.73%

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	21-2426-0886	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	0.9055	0.8818	0.9027	0.7798
EHWW-REF17		0.9435	0.9271	0.9363	0.9267
EHWW-REF18		0.9133	0.9091	0.9171	0.9390
EHWW-01		0.9361	0.8889	0.9123	0.8824
EHWW-06		0.8529	0.8622	0.8883	0.8599
EHWW-08		0.9041	0.9082	0.9337	
EHWW-11		0.8703	0.9175	0.9194	
EHWW-12		0.9389	0.9130	0.9083	
EHWW-13		0.9014	0.8805	0.9109	0.8577
EHWW-15		0.9029	0.7727	0.7876	0.8750
EHWW-22		0.8945	0.8898	0.8325	0.8639
EHWW-29		0.9474	0.9433	0.8761	0.9194
EHWW-31		0.8493	0.9633	0.9309	0.9369
EHWW-39		0.8496	0.8842	0.8899	0.9048
EHWW-40		0.9203	0.8957	0.9163	
EHWW-42		0.9271	0.8883	0.8785	
EHWW-44		0.9312	0.9545	0.9167	0.8840
EHWW-50		0.8510	0.8340	0.8941	0.8778

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	1.258	1.22	1.253	1.082
EHWW-REF17		1.331	1.297	1.316	1.297
EHWW-REF18		1.272	1.265	1.279	1.321
EHWW-01		1.315	1.231	1.27	1.221
EHWW-06		1.177	1.191	1.23	1.187
EHWW-08		1.256	1.263	1.31	
EHWW-11		1.202	1.28	1.283	
EHWW-12		1.321	1.271	1.263	
EHWW-13		1.251	1.218	1.268	1.184
EHWW-15		1.254	1.074	1.092	1.209
EHWW-22		1.24	1.232	1.149	1.193
EHWW-29		1.339	1.33	1.211	1.283
EHWW-31		1.172	1.378	1.305	1.317
EHWW-39		1.172	1.224	1.233	1.257
EHWW-40		1.285	1.242	1.277	
EHWW-42		1.297	1.23	1.215	
EHWW-44		1.305	1.356	1.278	1.223
EHWW-50		1.174	1.151	1.239	1.214

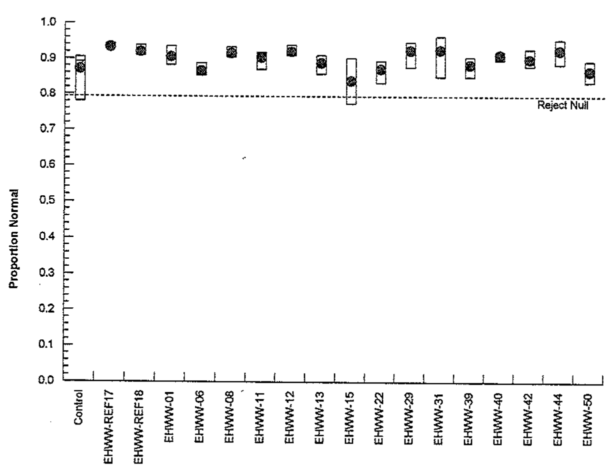
Bivalve Larval Survival and Development Test — **Nautilus Environmental**

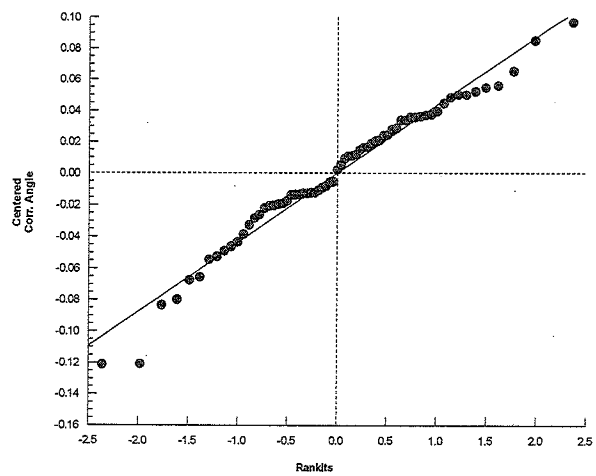
Analysis ID:	21-2426-0886	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	182/201	194/220	204/226	170/218
EHWW-REF17		167/177	229/247	191/204	177/191
EHWW-01		205/219	168/189	156/171	210/238
EHWW-06		203/238	169/196	183/206	178/207
EHWW-08		198/219	188/207	169/181	
EHWW-11		208/239	178/194	194/211	
EHWW-12		215/229	189/207	218/240	
EHWW-13		192/213	199/226	184/202	205/239
EHWW-15		186/206	170/220	152/193	168/192
EHWW-22		178/199	226/254	159/191	165/191
EHWW-29		216/228	233/247	198/226	228/248
EHWW-31		186/219	236/245	229/246	208/222
EHWW-39		192/226	229/259	194/218	190/210
EHWW-40		231/251	189/211	208/227	
EHWW-42		178/192	167/188	188/214	
EHWW-44		203/218	231/242	198/216	221/250
EHWW-50		217/255	196/235	211/236	194/221

Graphics





CETIS Analytical Report

Report Date:	05 Jan-19 15:21 (p 1 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-3871-5703	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam	
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater	
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**		
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms	**Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control	07-9348-4549	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control	Control SW	Anchor QEA	Control	
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-3871-5703	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-15 passed combined proportion norm	23.47%
		EHWW-22 passed combined proportion norm	23.47%
		EHWW-29 passed combined proportion norm	23.47%
		EHWW-31 passed combined proportion norm	23.47%
		EHWW-39 passed combined proportion norm	23.47%
		EHWW-40 passed combined proportion norm	23.47%
		EHWW-42 passed combined proportion norm	23.47%
		EHWW-44 passed combined proportion norm	23.47%
		EHWW-50 passed combined proportion norm	23.47%
		EHWW-REF17 passed combined proportion n	23.47%
		EHWW-REF18 passed combined proportion n	23.47%
		EHWW-01 passed combined proportion norm	23.47%
		EHWW-06 passed combined proportion norm	23.47%
		EHWW-08 passed combined proportion norm	23.47%
		EHWW-11 passed combined proportion norm	23.47%
		EHWW-12 passed combined proportion norm	23.47%
		EHWW-13 passed combined proportion norm	23.47%

Bonferroni Adj t Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Lab Control		EHWW-REF17	-0.3608	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-REF18	-0.679	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-01	0.1319	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-06	0.2958	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-08	0.1658	2.88	0.2	5	CDF	1.0000	Non-Significant Effect
		EHWW-11	-0.3851	2.88	0.2	5	CDF	1.0000	Non-Significant Effect
		EHWW-12	-1.379	2.88	0.2	5	CDF	1.0000	Non-Significant Effect
		EHWW-13	-0.5186	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-15	1.256	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-22	0.2622	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-29	-2.485	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-31	-2.217	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-39	-1.059	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-40	-1.588	2.88	0.2	5	CDF	1.0000	Non-Significant Effect
		EHWW-42	0.6384	2.88	0.2	5	CDF	1.0000	Non-Significant Effect
		EHWW-44	-2	2.88	0.185	6	CDF	1.0000	Non-Significant Effect
		EHWW-50	-1.246	2.88	0.185	6	CDF	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.295843	0.0174025	17	2.11	0.0215	Significant Effect
Error	0.404063	0.0082462	49			
Total	0.699906		66			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	11.2	33.41	0.8462	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9772	0.9508	0.2560	Normal Distribution

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-3871-5703	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control	LC	4	0.7382	0.6459	0.8305	0.7402	0.6693	0.8031	0.0290	7.86%	0.00%
EHWW-REF17		4	0.7520	0.5817	0.9222	0.7244	0.6575	0.9016	0.0535	14.23%	-1.87%
EHWW-REF18		4	0.7756	0.6942	0.8570	0.7854	0.7047	0.8268	0.0256	6.59%	-5.07%
EHWW-01		4	0.7274	0.5595	0.8953	0.7343	0.6142	0.8268	0.0528	14.51%	1.47%
EHWW-06		4	0.7215	0.6313	0.8116	0.7106	0.6654	0.7992	0.0283	7.85%	2.27%
EHWW-08		3	0.7283	0.5843	0.8724	0.7402	0.6654	0.7795	0.0335	7.96%	1.33%
EHWW-11		3	0.7612	0.6143	0.9080	0.7638	0.7008	0.8189	0.0341	7.76%	-3.11%
EHWW-12		3	0.8163	0.6603	0.9722	0.8465	0.7441	0.8583	0.0363	7.69%	-10.58%
EHWW-13		4	0.7677	0.7110	0.8244	0.7697	0.7244	0.8071	0.0178	4.64%	-4.00%
EHWW-15		4	0.6654	0.5782	0.7525	0.6654	0.5984	0.7323	0.0274	8.23%	9.87%
EHWW-22		4	0.7165	0.5262	0.9069	0.6752	0.6260	0.8898	0.0598	16.70%	2.93%
EHWW-29		4	0.8612	0.7637	0.9587	0.8740	0.7795	0.9173	0.0306	7.12%	-16.67%
EHWW-31		4	0.8455	0.7041	0.9868	0.8602	0.7323	0.9291	0.0444	10.50%	-14.53%
EHWW-39		4	0.7923	0.6760	0.9087	0.7598	0.7480	0.9016	0.0366	9.23%	-7.33%
EHWW-40		3	0.8241	0.6185	1.0000	0.8189	0.7441	0.9094	0.0478	10.05%	-11.64%
EHWW-42		3	0.6995	0.5967	0.8022	0.7008	0.6575	0.7402	0.0239	5.91%	5.24%
EHWW-44		4	0.8396	0.7430	0.9361	0.8346	0.7795	0.9094	0.0303	7.23%	-13.73%
EHWW-50		4	0.8051	0.7345	0.8757	0.8012	0.7638	0.8543	0.0222	5.51%	-9.07%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control	LC	4	1.035	0.9301	1.141	1.036	0.9581	1.111	0.03312	6.40%	0.00%
EHWW-REF17		4	1.059	0.8429	1.274	1.019	0.9456	1.252	0.0678	12.81%	-2.24%
EHWW-REF18		4	1.079	0.9829	1.175	1.089	0.9963	1.142	0.03023	5.60%	-4.21%
EHWW-01		4	1.027	0.8365	1.217	1.033	0.9006	1.142	0.05986	11.66%	0.82%
EHWW-06		4	1.016	0.9135	1.119	1.003	0.9539	1.106	0.03236	6.37%	1.83%
EHWW-08		3	1.024	0.8628	1.185	1.036	0.9539	1.082	0.03746	6.34%	1.11%
EHWW-11		3	1.062	0.8893	1.235	1.063	0.992	1.131	0.04019	6.55%	-2.58%
EHWW-12		3	1.131	0.9349	1.327	1.168	1.04	1.185	0.04561	6.98%	-9.24%
EHWW-13		4	1.069	1.002	1.136	1.07	1.018	1.116	0.0211	3.95%	-3.22%
EHWW-15		4	0.9548	0.8621	1.048	0.9539	0.8845	1.027	0.02914	6.10%	7.79%
EHWW-22		4	1.019	0.7858	1.251	0.9647	0.9128	1.232	0.07315	14.36%	1.63%
EHWW-29		4	1.195	1.056	1.334	1.209	1.082	1.279	0.0436	7.30%	-15.41%
EHWW-31		4	1.178	0.9815	1.374	1.191	1.027	1.301	0.06167	10.47%	-13.75%
EHWW-39		4	1.103	0.9458	1.261	1.059	1.045	1.252	0.04954	8.98%	-6.57%
EHWW-40		3	1.146	0.8647	1.426	1.131	1.04	1.265	0.06527	9.87%	-10.64%
EHWW-42		3	0.9912	0.879	1.103	0.992	0.9456	1.036	0.02607	4.56%	4.28%
EHWW-44		4	1.164	1.028	1.299	1.154	1.082	1.265	0.04257	7.31%	-12.40%
EHWW-50		4	1.115	1.025	1.205	1.11	1.063	1.179	0.02829	5.07%	-7.73%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-3871-5703	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	06 Dec-18 12:11	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	0.7165	0.7638	0.8031	0.6693
EHWW-REF17		0.6575	0.9016	0.7520	0.6969
EHWW-REF18		0.7047	0.8268	0.7835	0.7874
EHWW-01		0.8071	0.6614	0.6142	0.8268
EHWW-06		0.7992	0.6654	0.7205	0.7008
EHWW-08		0.7795	0.7402	0.6654	
EHWW-11		0.8189	0.7008	0.7638	
EHWW-12		0.8465	0.7441	0.8583	
EHWW-13		0.7559	0.7835	0.7244	0.8071
EHWW-15		0.7323	0.6693	0.5984	0.6614
EHWW-22		0.7008	0.8898	0.6260	0.6496
EHWW-29		0.8504	0.9173	0.7795	0.8976
EHWW-31		0.7323	0.9291	0.9016	0.8189
EHWW-39		0.7559	0.9016	0.7638	0.7480
EHWW-40		0.9094	0.7441	0.8189	
EHWW-42		0.7008	0.6575	0.7402	
EHWW-44		0.7992	0.9094	0.7795	0.8701
EHWW-50		0.8543	0.7717	0.8307	0.7638

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	1.009	1.063	1.111	0.9581
EHWW-REF17		0.9456	1.252	1.049	0.9877
EHWW-REF18		0.9963	1.142	1.087	1.092
EHWW-01		1.116	0.9498	0.9006	1.142
EHWW-06		1.106	0.9539	1.014	0.992
EHWW-08		1.082	1.036	0.9539	
EHWW-11		1.131	0.992	1.063	
EHWW-12		1.168	1.04	1.185	
EHWW-13		1.054	1.087	1.018	1.116
EHWW-15		1.027	0.9581	0.8845	0.9498
EHWW-22		0.992	1.232	0.9128	0.9373
EHWW-29		1.174	1.279	1.082	1.245
EHWW-31		1.027	1.301	1.252	1.131
EHWW-39		1.054	1.252	1.063	1.045
EHWW-40		1.265	1.04	1.131	
EHWW-42		0.992	0.9456	1.036	
EHWW-44		1.106	1.265	1.082	1.202
EHWW-50		1.179	1.073	1.147	1.063

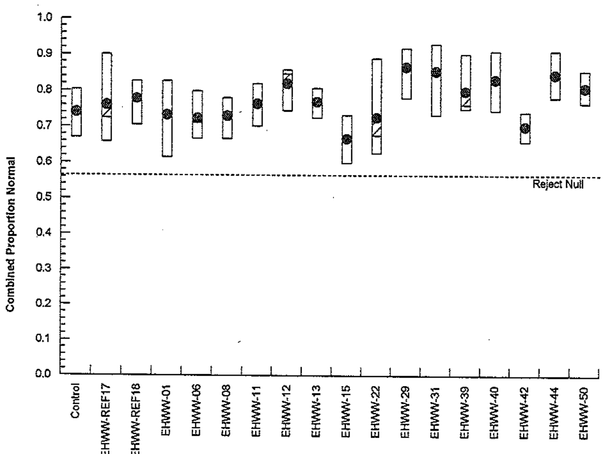
Bivalve Larval Survival and Development Test — **Nautilus Environmental**

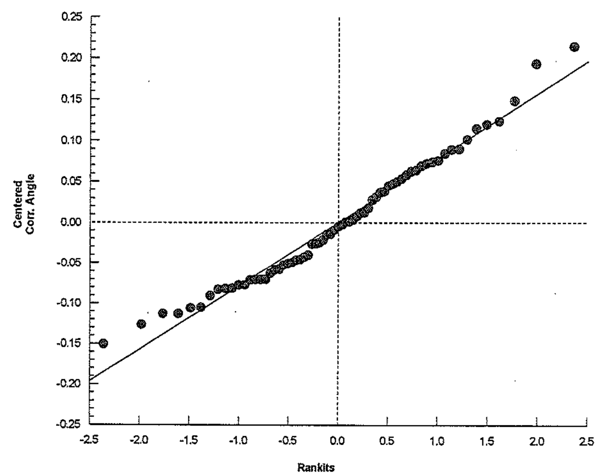
Analysis ID: 02-3871-5703	**Endpoint:** Combined Proportion Normal	**CETIS Version:** CETISv1.9.4	
Analyzed: 06 Dec-18 12:11	**Analysis:** Parametric-Multiple Comparison	**Status Level:** 1	

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	LC	182/254	194/254	204/254	170/254
EHWW-REF17		167/254	229/254	191/254	177/254
EHWW-01		205/254	168/254	156/254	210/254
EHWW-06		203/254	169/254	183/254	178/254
EHWW-08		198/254	188/254	169/254	
EHWW-11		208/254	178/254	194/254	
EHWW-12		215/254	189/254	218/254	
EHWW-13		192/254	199/254	184/254	205/254
EHWW-15		186/254	170/254	152/254	168/254
EHWW-22		178/254	226/254	159/254	165/254
EHWW-29		216/254	233/254	198/254	228/254
EHWW-31		186/254	236/254	229/254	208/254
EHWW-39		192/254	229/254	194/254	190/254
EHWW-40		231/254	189/254	208/254	
EHWW-42		178/254	167/254	188/254	
EHWW-44		203/254	231/254	198/254	221/254
EHWW-50		217/254	196/254	211/254	194/254

Graphics





Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-0346-5055	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)	Anchor QEA	
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-0346-5055	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Kolmogorov-Smirnov Two-Sample Test

Sample I vs	Sample II	Test Stat	Critical	DF	P-Type	P-Value	Decision(α:5%)
Reference Sed	EHWW-REF18	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-01	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-06	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-08	0.25	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-11	0.25	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-12	0.25	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-13	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-15	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-22	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-29	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-31	0.25	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-39	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-40	0	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-42	0.25	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-44	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-50	0	n/a	6	Exact	0.5000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.393403	0.0245877	16	1.317	0.2280	Non-Significant Effect
Error	0.858779	0.0186691	46			
Total	1.25218		62			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	9.902	32	0.8717	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9207	0.9481	5.9E-04	Non-Normal Distribution

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17	RS	4	0.8061	0.6166	0.9956	0.7776	0.6969	0.9724	0.0595	14.77%	0.00%
EHWW-REF18		4	0.8435	0.7532	0.9338	0.8465	0.7717	0.9094	0.0284	6.72%	-4.64%
EHWW-01		4	0.8041	0.6164	0.9919	0.8031	0.6732	0.9370	0.0590	14.67%	0.24%
EHWW-06		4	0.8337	0.7197	0.9476	0.8130	0.7717	0.9370	0.0358	8.59%	-3.42%
EHWW-08		3	0.7966	0.6066	0.9866	0.8150	0.7126	0.8622	0.0442	9.60%	1.18%
EHWW-11		3	0.8451	0.6229	1.0000	0.8307	0.7638	0.9409	0.0517	10.59%	-4.84%
EHWW-12		3	0.8871	0.7228	1.0000	0.9016	0.8150	0.9449	0.0382	7.46%	-10.05%
EHWW-13		4	0.8661	0.7658	0.9665	0.8642	0.7953	0.9409	0.0315	7.28%	-7.45%
EHWW-15		4	0.7982	0.7158	0.8806	0.7854	0.7559	0.8661	0.0259	6.49%	0.98%
EHWW-22		4	0.8219	0.6314	1.0000	0.7677	0.7520	1.0000	0.0599	14.56%	-1.95%
EHWW-29		4	0.9341	0.8597	1.0000	0.9350	0.8898	0.9764	0.0234	5.00%	-15.87%
EHWW-31		4	0.9173	0.8265	1.0000	0.9193	0.8622	0.9685	0.0285	6.22%	-13.80%
EHWW-39		4	0.8937	0.7737	1.0000	0.8740	0.8268	1.0000	0.0377	8.44%	-10.87%
EHWW-40		3	0.9042	0.7073	1.0000	0.8937	0.8307	0.9882	0.0458	8.77%	-12.17%
EHWW-42		3	0.7795	0.6426	0.9164	0.7559	0.7402	0.8425	0.0318	7.07%	3.30%
EHWW-44		4	0.9114	0.8044	1.0000	0.9055	0.8504	0.9843	0.0336	7.38%	-13.06%
EHWW-50		4	0.9311	0.8464	1.0000	0.9272	0.8701	1.0000	0.0266	5.72%	-15.51%

CETIS Analytical Report

Report Date:	05 Jan-19 15:22 (p 3 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-0346-5055	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17	RS	4	1.138	0.8448	1.431	1.08	0.9877	1.404	0.09215	16.19%	0.00%
EHWW-REF18		4	1.169	1.043	1.294	1.168	1.073	1.265	0.03956	6.77%	-2.68%
EHWW-01		4	1.128	0.8763	1.379	1.115	0.9623	1.317	0.07895	14.00%	0.92%
EHWW-06		4	1.159	0.9874	1.331	1.124	1.073	1.317	0.05399	9.32%	-1.86%
EHWW-08		3	1.107	0.8732	1.341	1.126	1.005	1.19	0.05438	8.51%	2.71%
EHWW-11		3	1.178	0.8459	1.511	1.147	1.063	1.325	0.07729	11.36%	-3.55%
EHWW-12		3	1.237	0.9774	1.497	1.252	1.126	1.334	0.06039	8.45%	-8.71%
EHWW-13		4	1.204	1.05	1.358	1.195	1.101	1.325	0.04852	8.06%	-5.80%
EHWW-15		4	1.107	1.002	1.213	1.09	1.054	1.196	0.0333	6.01%	2.69%
EHWW-22		4	1.181	0.8003	1.562	1.068	1.049	1.539	0.1197	20.27%	-3.80%
EHWW-29		4	1.324	1.167	1.482	1.325	1.232	1.416	0.04965	7.50%	-16.38%
EHWW-31		4	1.293	1.12	1.466	1.295	1.19	1.392	0.05434	8.41%	-13.62%
EHWW-39		4	1.275	0.9874	1.562	1.209	1.142	1.539	0.09022	14.16%	-11.99%
EHWW-40		3	1.282	0.8798	1.685	1.239	1.147	1.462	0.09357	12.64%	-12.69%
EHWW-42		3	1.084	0.9138	1.255	1.054	1.036	1.163	0.0396	6.33%	4.73%
EHWW-44		4	1.289	1.078	1.499	1.268	1.174	1.445	0.06609	10.26%	-13.24%
EHWW-50		4	1.334	1.105	1.563	1.298	1.202	1.539	0.07205	10.80%	-17.23%

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17	RS	0.6969	0.9724	0.8031	0.7520
EHWW-REF18		0.7717	0.9094	0.8543	0.8386
EHWW-01		0.8622	0.7441	0.6732	0.9370
EHWW-06		0.9370	0.7717	0.8110	0.8150
EHWW-08		0.8622	0.8150	0.7126	
EHWW-11		0.9409	0.7638	0.8307	
EHWW-12		0.9016	0.8150	0.9449	
EHWW-13		0.8386	0.8898	0.7953	0.9409
EHWW-15		0.8110	0.8661	0.7598	0.7559
EHWW-22		0.7835	1.0000	0.7520	0.7520
EHWW-29		0.8976	0.9724	0.8898	0.9764
EHWW-31		0.8622	0.9646	0.9685	0.8740
EHWW-39		0.8898	1.0000	0.8583	0.8268
EHWW-40		0.9882	0.8307	0.8937	
EHWW-42		0.7559	0.7402	0.8425	
EHWW-44		0.8583	0.9528	0.8504	0.9843
EHWW-50		1.0000	0.9252	0.9291	0.8701

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-0346-5055	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17	RS	0.9877	1.404	1.111	1.049
EHWW-REF18		1.073	1.265	1.179	1.157
EHWW-01		1.19	1.04	0.9623	1.317
EHWW-06		1.317	1.073	1.121	1.126
EHWW-08		1.19	1.126	1.005	
EHWW-11		1.325	1.063	1.147	
EHWW-12		1.252	1.126	1.334	
EHWW-13		1.157	1.232	1.101	1.325
EHWW-15		1.121	1.196	1.059	1.054
EHWW-22		1.087	1.539	1.049	1.049
EHWW-29		1.245	1.404	1.232	1.416
EHWW-31		1.19	1.381	1.392	1.208
EHWW-39		1.232	1.539	1.185	1.142
EHWW-40		1.462	1.147	1.239	
EHWW-42		1.054	1.036	1.163	
EHWW-44		1.185	1.352	1.174	1.445
EHWW-50		1.539	1.294	1.301	1.202

Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-01		219/254	189/254	171/254	238/254
EHWW-06		238/254	196/254	206/254	207/254
EHWW-08		219/254	207/254	181/254	
EHWW-11		239/254	194/254	211/254	
EHWW-12		229/254	207/254	240/254	
EHWW-13		213/254	226/254	202/254	239/254
EHWW-15		206/254	220/254	193/254	192/254
EHWW-22		199/254	254/254	191/254	191/254
EHWW-29		228/254	247/254	226/254	248/254
EHWW-31		219/254	245/254	246/254	222/254
EHWW-39		226/254	254/254	218/254	210/254
EHWW-40		251/254	211/254	227/254	
EHWW-42		192/254	188/254	214/254	
EHWW-44		218/254	242/254	216/254	250/254
EHWW-50		254/254	235/254	236/254	221/254

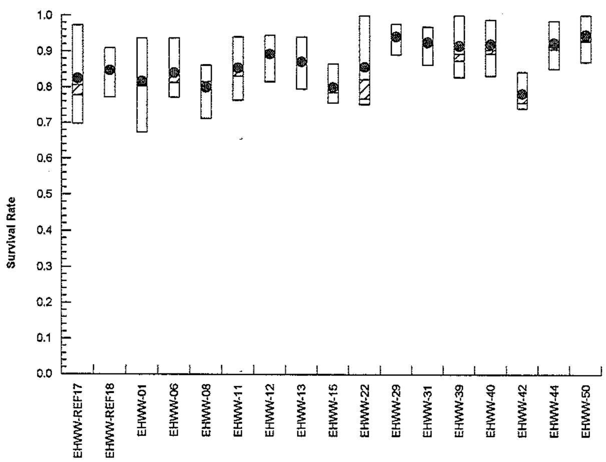
CETIS Analytical Report

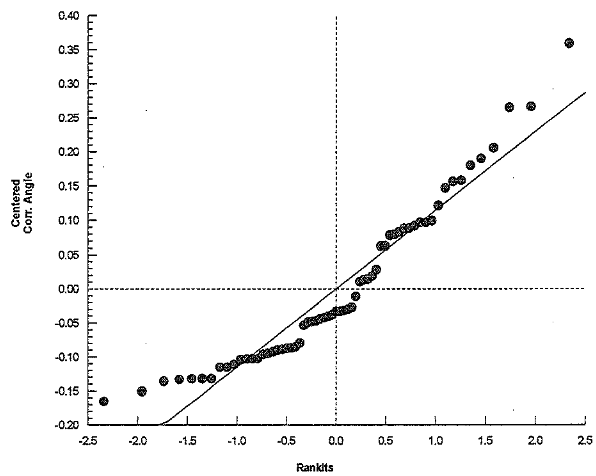
Report Date:	05 Jan-19 15:22 (p 5 of 5)		
Test Code/ID:	181641 / 12-6434-9271		

Bivalve Larval Survival and Development Test **Nautilus Environmental**

Analysis ID:	20-0346-5055	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Graphics





CETIS Analytical Report

Report Date:	05 Jan-19 15:22 (p 1 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	13-2946-4594	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam		
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater		
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**			
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms	**Age:**	

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)	Anchor QEA	
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	13-2946-4594	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-REF18 passed proportion normal	6.01%
		EHWW-01 passed proportion normal	6.01%
		EHWW-06 failed proportion normal	6.01%
		EHWW-08 passed proportion normal	6.01%
		EHWW-11 passed proportion normal	6.01%
		EHWW-12 passed proportion normal	6.01%
		EHWW-13 passed proportion normal	6.01%
		EHWW-15 failed proportion normal	6.01%
		EHWW-22 failed proportion normal	6.01%
		EHWW-29 passed proportion normal	6.01%
		EHWW-31 passed proportion normal	6.01%
		EHWW-39 passed proportion normal	6.01%
		EHWW-40 passed proportion normal	6.01%
		EHWW-42 passed proportion normal	6.01%
		EHWW-44 passed proportion normal	6.01%
		EHWW-50 failed proportion normal	6.01%

Bonferroni Adj t Test

Sample I vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Reference Sed	EHWW-REF18	0.7688	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
	EHWW-01	1.5	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
	EHWW-06*	3.357	2.866	0.097	6	CDF	0.0127	Significant Effect
	EHWW-08	0.9193	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
	EHWW-11	1.506	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
	EHWW-12	0.6802	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
	EHWW-13	2.355	2.866	0.097	6	CDF	0.1827	Non-Significant Effect
	EHWW-15*	4.507	2.866	0.097	6	CDF	3.6E-04	Significant Effect
	EHWW-22*	3.141	2.866	0.097	6	CDF	0.0235	Significant Effect
	EHWW-29	0.5661	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
	EHWW-31	0.5062	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
	EHWW-39	2.616	2.866	0.097	6	CDF	0.0961	Non-Significant Effect
	EHWW-40	1.151	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
	EHWW-42	1.713	2.866	0.105	5	CDF	0.7482	Non-Significant Effect
	EHWW-44	0.5746	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
	EHWW-50*	3.404	2.866	0.097	6	CDF	0.0111	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.118643	0.0074152	16	3.223	9.6E-04	Significant Effect
Error	0.105833	0.0023007	46			
Total	0.224476		62			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	16.33	32	0.4299	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9866	0.9481	0.7247	Normal Distribution

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	13-2946-4594	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17	RS	4	0.9334	0.9206	0.9462	0.9317	0.9267	0.9435	0.0040	0.86%	0.00%
EHWW-REF18		4	0.9196	0.8984	0.9408	0.9152	0.9091	0.9390	0.0067	1.45%	1.48%
EHWW-01		4	0.9049	0.8660	0.9438	0.9006	0.8824	0.9361	0.0122	2.70%	3.05%
EHWW-06		4	0.8659	0.8412	0.8905	0.8611	0.8529	0.8883	0.0078	1.79%	7.24%
EHWW-08		3	0.9153	0.8755	0.9552	0.9082	0.9041	0.9337	0.0093	1.75%	1.93%
EHWW-11		3	0.9024	0.8333	0.9716	0.9175	0.8703	0.9194	0.0161	3.08%	3.32%
EHWW-12		3	0.9201	0.8792	0.9609	0.9130	0.9083	0.9389	0.0095	1.79%	1.43%
EHWW-13		4	0.8876	0.8500	0.9252	0.8910	0.8577	0.9109	0.0118	2.66%	4.90%
EHWW-15		4	0.8346	0.7325	0.9366	0.8313	0.7727	0.9029	0.0321	7.68%	10.59%
EHWW-22		4	0.8701	0.8248	0.9155	0.8768	0.8325	0.8945	0.0143	3.27%	6.78%
EHWW-29		4	0.9215	0.8695	0.9736	0.9313	0.8761	0.9474	0.0164	3.55%	1.27%
EHWW-31		4	0.9201	0.8418	0.9985	0.9339	0.8493	0.9633	0.0246	5.35%	1.42%
EHWW-39		4	0.8821	0.8449	0.9193	0.8870	0.8496	0.9048	0.0117	2.65%	5.50%
EHWW-40		3	0.9108	0.8780	0.9435	0.9163	0.8957	0.9203	0.0076	1.45%	2.42%
EHWW-42		3	0.8980	0.8341	0.9618	0.8883	0.8785	0.9271	0.0148	2.86%	3.80%
EHWW-44		4	0.9216	0.8746	0.9686	0.9239	0.8840	0.9545	0.0148	3.20%	1.26%
EHWW-50		4	0.8642	0.8215	0.9069	0.8644	0.8340	0.8941	0.0134	3.11%	7.41%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17	RS	4	1.31	1.284	1.336	1.307	1.297	1.331	0.008166	1.25%	0.00%
EHWW-REF18		4	1.284	1.244	1.324	1.275	1.265	1.321	0.0127	1.98%	1.99%
EHWW-01		4	1.259	1.191	1.328	1.251	1.221	1.315	0.02147	3.41%	3.88%
EHWW-06		4	1.196	1.159	1.233	1.189	1.177	1.23	0.01163	1.94%	8.69%
EHWW-08		3	1.276	1.203	1.35	1.263	1.256	1.31	0.01709	2.32%	2.57%
EHWW-11		3	1.255	1.142	1.368	1.28	1.202	1.283	0.02631	3.63%	4.21%
EHWW-12		3	1.285	1.208	1.363	1.271	1.263	1.321	0.01803	2.43%	1.90%
EHWW-13		4	1.23	1.171	1.289	1.235	1.184	1.268	0.01856	3.02%	6.10%
EHWW-15		4	1.157	1.017	1.298	1.151	1.074	1.254	0.04407	7.62%	11.67%
EHWW-22		4	1.204	1.137	1.27	1.213	1.149	1.24	0.02088	3.47%	8.13%
EHWW-29		4	1.291	1.198	1.384	1.307	1.211	1.339	0.02935	4.55%	1.47%
EHWW-31		4	1.293	1.155	1.431	1.311	1.172	1.378	0.04334	6.70%	1.31%
EHWW-39		4	1.221	1.165	1.278	1.228	1.172	1.257	0.01778	2.91%	6.77%
EHWW-40		3	1.268	1.211	1.325	1.277	1.242	1.285	0.01316	1.80%	3.22%
EHWW-42		3	1.247	1.138	1.357	1.23	1.215	1.297	0.02538	3.52%	4.79%
EHWW-44		4	1.291	1.203	1.379	1.292	1.223	1.356	0.02766	4.29%	1.49%
EHWW-50		4	1.195	1.132	1.257	1.194	1.151	1.239	0.01969	3.30%	8.81%

Bivalve Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	13-2946-4594	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17	RS	0.9435	0.9271	0.9363	0.9267
EHWW-REF18		0.9133	0.9091	0.9171	0.9390
EHWW-01		0.9361	0.8889	0.9123	0.8824
EHWW-06		0.8529	0.8622	0.8883	0.8599
EHWW-08		0.9041	0.9082	0.9337	
EHWW-11		0.8703	0.9175	0.9194	
EHWW-12		0.9389	0.9130	0.9083	
EHWW-13		0.9014	0.8805	0.9109	0.8577
EHWW-15		0.9029	0.7727	0.7876	0.8750
EHWW-22		0.8945	0.8898	0.8325	0.8639
EHWW-29		0.9474	0.9433	0.8761	0.9194
EHWW-31		0.8493	0.9633	0.9309	0.9369
EHWW-39		0.8496	0.8842	0.8899	0.9048
EHWW-40		0.9203	0.8957	0.9163	
EHWW-42		0.9271	0.8883	0.8785	
EHWW-44		0.9312	0.9545	0.9167	0.8840
EHWW-50		0.8510	0.8340	0.8941	0.8778

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17	RS	1.331	1.297	1.316	1.297
EHWW-REF18		1.272	1.265	1.279	1.321
EHWW-01		1.315	1.231	1.27	1.221
EHWW-06		1.177	1.191	1.23	1.187
EHWW-08		1.256	1.263	1.31	
EHWW-11		1.202	1.28	1.283	
EHWW-12		1.321	1.271	1.263	
EHWW-13		1.251	1.218	1.268	1.184
EHWW-15		1.254	1.074	1.092	1.209
EHWW-22		1.24	1.232	1.149	1.193
EHWW-29		1.339	1.33	1.211	1.283
EHWW-31		1.172	1.378	1.305	1.317
EHWW-39		1.172	1.224	1.233	1.257
EHWW-40		1.285	1.242	1.277	
EHWW-42		1.297	1.23	1.215	
EHWW-44		1.305	1.356	1.278	1.223
EHWW-50		1.174	1.151	1.239	1.214

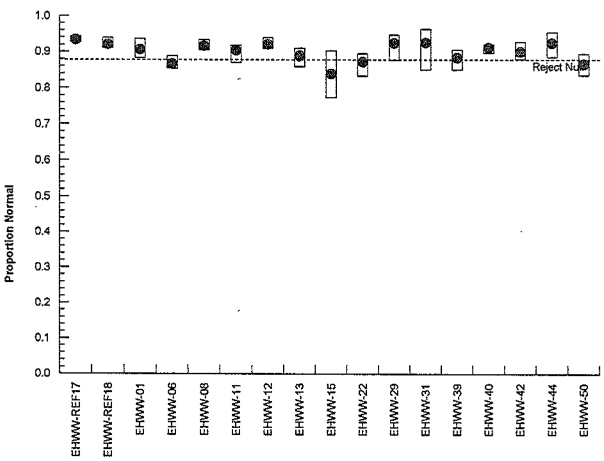
Bivalve Larval Survival and Development Test — **Nautilus Environmental**

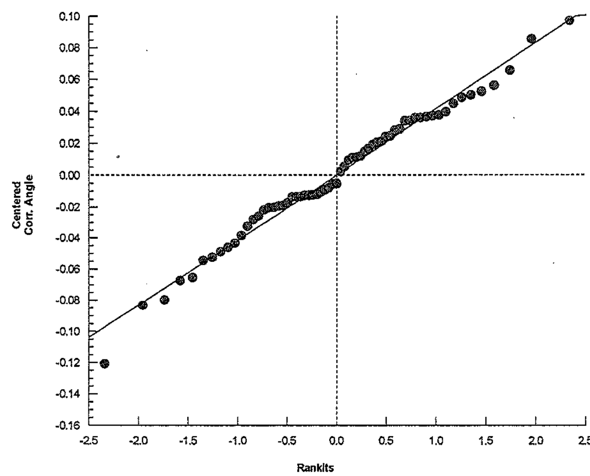
Analysis ID:	13-2946-4594	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:18	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-01		205/219	168/189	156/171	210/238
EHWW-06		203/238	169/196	183/206	178/207
EHWW-08		198/219	188/207	169/181	
EHWW-11		208/239	178/194	194/211	
EHWW-12		215/229	189/207	218/240	
EHWW-13		192/213	199/226	184/202	205/239
EHWW-15		186/206	170/220	152/193	168/192
EHWW-22		178/199	226/254	159/191	165/191
EHWW-29		216/228	233/247	198/226	228/248
EHWW-31		186/219	236/245	229/246	208/222
EHWW-39		192/226	229/259	194/218	190/210
EHWW-40		231/251	189/211	208/227	
EHWW-42		178/192	167/188	188/214	
EHWW-44		203/218	231/242	198/216	221/250
EHWW-50		217/255	196/235	211/236	194/221

Graphics





CETIS Analytical Report

Report Date:	05 Jan-19 15:22 (p 1 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-1427-6474	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:19	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam		
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater		
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**			
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms	**Age:**	

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)	Anchor QEA	
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

CETIS Analytical Report

Report Date:	05 Jan-19 15:22 (p 2 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-1427-6474	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:19	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-REF18 passed combined proportion n	22.07%
		EHWW-01 passed combined proportion norm	22.07%
		EHWW-06 passed combined proportion norm	22.07%
		EHWW-08 passed combined proportion norm	22.07%
		EHWW-11 passed combined proportion norm	22.07%
		EHWW-12 passed combined proportion norm	22.07%
		EHWW-13 passed combined proportion norm	22.07%
		EHWW-15 passed combined proportion norm	22.07%
		EHWW-22 passed combined proportion norm	22.07%
		EHWW-29 passed combined proportion norm	22.07%
		EHWW-31 passed combined proportion norm	22.07%
		EHWW-39 passed combined proportion norm	22.07%
		EHWW-40 passed combined proportion norm	22.07%
		EHWW-42 passed combined proportion norm	22.07%
		EHWW-44 passed combined proportion norm	22.07%
		EHWW-50 passed combined proportion norm	22.07%

Bonferroni Adj t Test

Sample I vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Reference Sed	EHWW-REF18	-0.3135	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-01	0.4853	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-06	0.6468	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-08	0.4924	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
	EHWW-11	-0.05032	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
	EHWW-12	-1.03	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
	EHWW-13	-0.1554	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-15	1.592	2.866	0.187	6	CDF	0.9453	Non-Significant Effect
	EHWW-22	0.6138	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-29	-2.092	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-31	-1.828	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-39	-0.6882	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-40	-1.235	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
	EHWW-42	0.9579	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
	EHWW-44	-1.614	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
	EHWW-50	-0.8718	2.866	0.187	6	CDF	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.288708	0.0180442	16	2.123	0.0238	Significant Effect
Error	0.390903	0.0084979	46			
Total	0.679611		62			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	10.73	32	0.8256	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9765	0.9481	0.2682	Normal Distribution

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-1427-6474	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:19	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17	RS	4	0.7520	0.5817	0.9222	0.7244	0.6575	0.9016	0.0535	14.23%	0.00%
EHWW-REF18		4	0.7756	0.6942	0.8570	0.7854	0.7047	0.8268	0.0256	6.59%	-3.14%
EHWW-01		4	0.7274	0.5595	0.8953	0.7343	0.6142	0.8268	0.0528	14.51%	3.27%
EHWW-06		4	0.7215	0.6313	0.8116	0.7106	0.6654	0.7992	0.0283	7.85%	4.06%
EHWW-08		3	0.7283	0.5843	0.8724	0.7402	0.6654	0.7795	0.0335	7.96%	3.14%
EHWW-11		3	0.7612	0.6143	0.9080	0.7638	0.7008	0.8189	0.0341	7.76%	-1.22%
EHWW-12		3	0.8163	0.6603	0.9722	0.8465	0.7441	0.8583	0.0363	7.69%	-8.55%
EHWW-13		4	0.7677	0.7110	0.8244	0.7697	0.7244	0.8071	0.0178	4.64%	-2.09%
EHWW-15		4	0.6654	0.5782	0.7525	0.6654	0.5984	0.7323	0.0274	8.23%	11.52%
EHWW-22		4	0.7165	0.5262	0.9069	0.6752	0.6260	0.8898	0.0598	16.70%	4.71%
EHWW-29		4	0.8612	0.7637	0.9587	0.8740	0.7795	0.9173	0.0306	7.12%	-14.53%
EHWW-31		4	0.8455	0.7041	0.9868	0.8602	0.7323	0.9291	0.0444	10.50%	-12.43%
EHWW-39		4	0.7923	0.6760	0.9087	0.7598	0.7480	0.9016	0.0366	9.23%	-5.37%
EHWW-40		3	0.8241	0.6185	1.0000	0.8189	0.7441	0.9094	0.0478	10.05%	-9.60%
EHWW-42		3	0.6995	0.5967	0.8022	0.7008	0.6575	0.7402	0.0239	5.91%	6.98%
EHWW-44		4	0.8396	0.7430	0.9361	0.8346	0.7795	0.9094	0.0303	7.23%	-11.65%
EHWW-50		4	0.8051	0.7345	0.8757	0.8012	0.7638	0.8543	0.0222	5.51%	-7.07%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17	RS	4	1.059	0.8429	1.274	1.019	0.9456	1.252	0.0678	12.81%	0.00%
EHWW-REF18		4	1.079	0.9829	1.175	1.089	0.9963	1.142	0.03023	5.60%	-1.93%
EHWW-01		4	1.027	0.8365	1.217	1.033	0.9006	1.142	0.05986	11.66%	2.99%
EHWW-06		4	1.016	0.9135	1.119	1.003	0.9539	1.106	0.03236	6.37%	3.98%
EHWW-08		3	1.024	0.8628	1.185	1.036	0.9539	1.082	0.03746	6.34%	3.28%
EHWW-11		3	1.062	0.8893	1.235	1.063	0.992	1.131	0.04019	6.55%	-0.33%
EHWW-12		3	1.131	0.9349	1.327	1.168	1.04	1.185	0.04561	6.98%	-6.85%
EHWW-13		4	1.069	1.002	1.136	1.07	1.018	1.116	0.0211	3.95%	-0.96%
EHWW-15		4	0.9548	0.8621	1.048	0.9539	0.8845	1.027	0.02914	6.10%	9.80%
EHWW-22		4	1.019	0.7858	1.251	0.9647	0.9128	1.232	0.07315	14.36%	3.78%
EHWW-29		4	1.195	1.056	1.334	1.209	1.082	1.279	0.0436	7.30%	-12.88%
EHWW-31		4	1.178	0.9815	1.374	1.191	1.027	1.301	0.06167	10.47%	-11.26%
EHWW-39		4	1.103	0.9458	1.261	1.059	1.045	1.252	0.04954	8.98%	-4.24%
EHWW-40		3	1.146	0.8647	1.426	1.131	1.04	1.265	0.06527	9.87%	-8.22%
EHWW-42		3	0.9912	0.879	1.103	0.992	0.9456	1.036	0.02607	4.56%	6.37%
EHWW-44		4	1.164	1.028	1.299	1.154	1.082	1.265	0.04257	7.31%	-9.94%
EHWW-50		4	1.115	1.025	1.205	1.11	1.063	1.179	0.02829	5.07%	-5.37%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	21-1427-6474	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:19	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17	RS	0.6575	0.9016	0.7520	0.6969
EHWW-REF18		0.7047	0.8268	0.7835	0.7874
EHWW-01		0.8071	0.6614	0.6142	0.8268
EHWW-06		0.7992	0.6654	0.7205	0.7008
EHWW-08		0.7795	0.7402	0.6654	
EHWW-11		0.8189	0.7008	0.7638	
EHWW-12		0.8465	0.7441	0.8583	
EHWW-13		0.7559	0.7835	0.7244	0.8071
EHWW-15		0.7323	0.6693	0.5984	0.6614
EHWW-22		0.7008	0.8898	0.6260	0.6496
EHWW-29		0.8504	0.9173	0.7795	0.8976
EHWW-31		0.7323	0.9291	0.9016	0.8189
EHWW-39		0.7559	0.9016	0.7638	0.7480
EHWW-40		0.9094	0.7441	0.8189	
EHWW-42		0.7008	0.6575	0.7402	
EHWW-44		0.7992	0.9094	0.7795	0.8701
EHWW-50		0.8543	0.7717	0.8307	0.7638

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17	RS	0.9456	1.252	1.049	0.9877
EHWW-REF18		0.9963	1.142	1.087	1.092
EHWW-01		1.116	0.9498	0.9006	1.142
EHWW-06		1.106	0.9539	1.014	0.992
EHWW-08		1.082	1.036	0.9539	
EHWW-11		1.131	0.992	1.063	
EHWW-12		1.168	1.04	1.185	
EHWW-13		1.054	1.087	1.018	1.116
EHWW-15		1.027	0.9581	0.8845	0.9498
EHWW-22		0.992	1.232	0.9128	0.9373
EHWW-29		1.174	1.279	1.082	1.245
EHWW-31		1.027	1.301	1.252	1.131
EHWW-39		1.054	1.252	1.063	1.045
EHWW-40		1.265	1.04	1.131	
EHWW-42		0.992	0.9456	1.036	
EHWW-44		1.106	1.265	1.082	1.202
EHWW-50		1.179	1.073	1.147	1.063

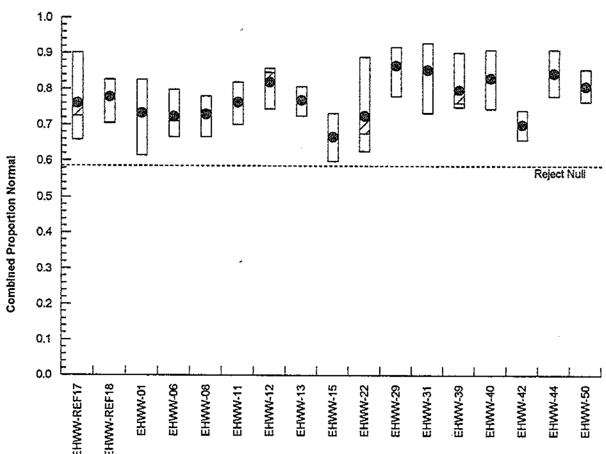
Bivalve Larval Survival and Development Test — **Nautilus Environmental**

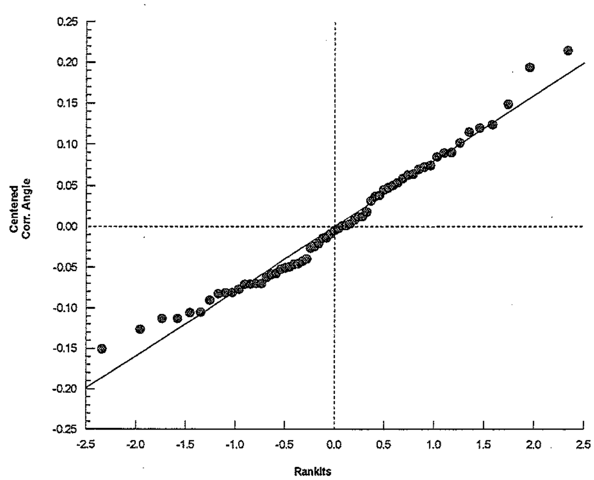
Analysis ID:	21-1427-6474	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:19	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-01		205/254	168/254	156/254	210/254
EHWW-06		203/254	169/254	183/254	178/254
EHWW-08		198/254	188/254	169/254	
EHWW-11		208/254	178/254	194/254	
EHWW-12		215/254	189/254	218/254	
EHWW-13		192/254	199/254	184/254	205/254
EHWW-15		186/254	170/254	152/254	168/254
EHWW-22		178/254	226/254	159/254	165/254
EHWW-29		216/254	233/254	198/254	228/254
EHWW-31		186/254	236/254	229/254	208/254
EHWW-39		192/254	229/254	194/254	190/254
EHWW-40		231/254	189/254	208/254	
EHWW-42		178/254	167/254	188/254	
EHWW-44		203/254	231/254	198/254	221/254
EHWW-50		217/254	196/254	211/254	194/254

Graphics





CETIS Analytical Report

Report Date:	05 Jan-19 15:22 (p 1 of 5)
Test Code/ID:	181641 / 12-6434-9271

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	11-5555-3882	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam		
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater		
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**			
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms	**Age:**	

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)	Anchor QEA	
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	11-5555-3882	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Kolmogorov-Smirnov Two-Sample Test

Sample I vs	Sample II	Test Stat	Critical	DF	P-Type	P-Value	Decision(α:5%)
Site Control	EHWW-REF17	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
	EHWW-01	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
	EHWW-06	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
	EHWW-08	0.4167	n/a	5	Exact	0.4429	Non-Significant Effect
	EHWW-11	0.4167	n/a	5	Exact	0.4429	Non-Significant Effect
	EHWW-12	0.08333	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-13	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-15	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
	EHWW-22	0.5	n/a	6	Exact	0.3857	Non-Significant Effect
	EHWW-29	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-31	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-39	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-40	0.08333	n/a	5	Exact	0.5000	Non-Significant Effect
	EHWW-42	0.6667	n/a	5	Exact	0.2000	Non-Significant Effect
	EHWW-44	0	n/a	6	Exact	0.5000	Non-Significant Effect
	EHWW-50	0	n/a	6	Exact	0.5000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.393403	0.0245877	16	1.317	0.2280	Non-Significant Effect
Error	0.858779	0.0186691	46			
Total	1.25218		62			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	9.902	32	0.8717	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9207	0.9481	5.9E-04	Non-Normal Distribution

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17		4	0.8061	0.6166	0.9956	0.7776	0.6969	0.9724	0.0595	14.77%	0.00%
EHWW-REF18	XC	4	0.8435	0.7532	0.9338	0.8465	0.7717	0.9094	0.0284	6.72%	-4.64%
EHWW-01		4	0.8041	0.6164	0.9919	0.8031	0.6732	0.9370	0.0590	14.67%	0.24%
EHWW-06		4	0.8337	0.7197	0.9476	0.8130	0.7717	0.9370	0.0358	8.59%	-3.42%
EHWW-08		3	0.7966	0.6066	0.9866	0.8150	0.7126	0.8622	0.0442	9.60%	1.18%
EHWW-11		3	0.8451	0.6229	1.0000	0.8307	0.7638	0.9409	0.0517	10.59%	-4.84%
EHWW-12		3	0.8871	0.7228	1.0000	0.9016	0.8150	0.9449	0.0382	7.46%	-10.05%
EHWW-13		4	0.8661	0.7658	0.9665	0.8642	0.7953	0.9409	0.0315	7.28%	-7.45%
EHWW-15		4	0.7982	0.7158	0.8806	0.7854	0.7559	0.8661	0.0259	6.49%	0.98%
EHWW-22		4	0.8219	0.6314	1.0000	0.7677	0.7520	1.0000	0.0599	14.56%	-1.95%
EHWW-29		4	0.9341	0.8597	1.0000	0.9350	0.8898	0.9764	0.0234	5.00%	-15.87%
EHWW-31		4	0.9173	0.8265	1.0000	0.9193	0.8622	0.9685	0.0285	6.22%	-13.80%
EHWW-39		4	0.8937	0.7737	1.0000	0.8740	0.8268	1.0000	0.0377	8.44%	-10.87%
EHWW-40		3	0.9042	0.7073	1.0000	0.8937	0.8307	0.9882	0.0458	8.77%	-12.17%
EHWW-42		3	0.7795	0.6426	0.9164	0.7559	0.7402	0.8425	0.0318	7.07%	3.30%
EHWW-44		4	0.9114	0.8044	1.0000	0.9055	0.8504	0.9843	0.0336	7.38%	-13.06%
EHWW-50		4	0.9311	0.8464	1.0000	0.9272	0.8701	1.0000	0.0266	5.72%	-15.51%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	11-5555-3882	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17		4	1.138	0.8448	1.431	1.08	0.9877	1.404	0.09215	16.19%	0.00%
EHWW-REF18	XC	4	1.169	1.043	1.294	1.168	1.073	1.265	0.03956	6.77%	-2.68%
EHWW-01		4	1.128	0.8763	1.379	1.115	0.9623	1.317	0.07895	14.00%	0.92%
EHWW-06		4	1.159	0.9874	1.331	1.124	1.073	1.317	0.05399	9.32%	-1.86%
EHWW-08		3	1.107	0.8732	1.341	1.126	1.005	1.19	0.05438	8.51%	2.71%
EHWW-11		3	1.178	0.8459	1.511	1.147	1.063	1.325	0.07729	11.36%	-3.55%
EHWW-12		3	1.237	0.9774	1.497	1.252	1.126	1.334	0.06039	8.45%	-8.71%
EHWW-13		4	1.204	1.05	1.358	1.195	1.101	1.325	0.04852	8.06%	-5.80%
EHWW-15		4	1.107	1.002	1.213	1.09	1.054	1.196	0.0333	6.01%	2.69%
EHWW-22		4	1.181	0.8003	1.562	1.068	1.049	1.539	0.1197	20.27%	-3.80%
EHWW-29		4	1.324	1.167	1.482	1.325	1.232	1.416	0.04965	7.50%	-16.38%
EHWW-31		4	1.293	1.12	1.466	1.295	1.19	1.392	0.05434	8.41%	-13.62%
EHWW-39		4	1.275	0.9874	1.562	1.209	1.142	1.539	0.09022	14.16%	-11.99%
EHWW-40		3	1.282	0.8798	1.685	1.239	1.147	1.462	0.09357	12.64%	-12.69%
EHWW-42		3	1.084	0.9138	1.255	1.054	1.036	1.163	0.0396	6.33%	4.73%
EHWW-44		4	1.289	1.078	1.499	1.268	1.174	1.445	0.06609	10.26%	-13.24%
EHWW-50		4	1.334	1.105	1.563	1.298	1.202	1.539	0.07205	10.80%	-17.23%

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		0.6969	0.9724	0.8031	0.7520
EHWW-REF18	XC	0.7717	0.9094	0.8543	0.8386
EHWW-01		0.8622	0.7441	0.6732	0.9370
EHWW-06		0.9370	0.7717	0.8110	0.8150
EHWW-08		0.8622	0.8150	0.7126	
EHWW-11		0.9409	0.7638	0.8307	
EHWW-12		0.9016	0.8150	0.9449	
EHWW-13		0.8386	0.8898	0.7953	0.9409
EHWW-15		0.8110	0.8661	0.7598	0.7559
EHWW-22		0.7835	1.0000	0.7520	0.7520
EHWW-29		0.8976	0.9724	0.8898	0.9764
EHWW-31		0.8622	0.9646	0.9685	0.8740
EHWW-39		0.8898	1.0000	0.8583	0.8268
EHWW-40		0.9882	0.8307	0.8937	
EHWW-42		0.7559	0.7402	0.8425	
EHWW-44		0.8583	0.9528	0.8504	0.9843
EHWW-50		1.0000	0.9252	0.9291	0.8701

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID: 11-5555-3882 **Endpoint:** Survival Rate **CETIS Version:** CETISv1.9.4
Analyzed: 05 Jan-19 15:20 **Analysis:** Nonparametric-Two Sample **Status Level:** 1

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		0.9877	1.404	1.111	1.049
EHWW-REF18	XC	1.073	1.265	1.179	1.157
EHWW-01		1.19	1.04	0.9623	1.317
EHWW-06		1.317	1.073	1.121	1.126
EHWW-08		1.19	1.126	1.005	
EHWW-11		1.325	1.063	1.147	
EHWW-12		1.252	1.126	1.334	
EHWW-13		1.157	1.232	1.101	1.325
EHWW-15		1.121	1.196	1.059	1.054
EHWW-22		1.087	1.539	1.049	1.049
EHWW-29		1.245	1.404	1.232	1.416
EHWW-31		1.19	1.381	1.392	1.208
EHWW-39		1.232	1.539	1.185	1.142
EHWW-40		1.462	1.147	1.239	
EHWW-42		1.054	1.036	1.163	
EHWW-44		1.185	1.352	1.174	1.445
EHWW-50		1.539	1.294	1.301	1.202

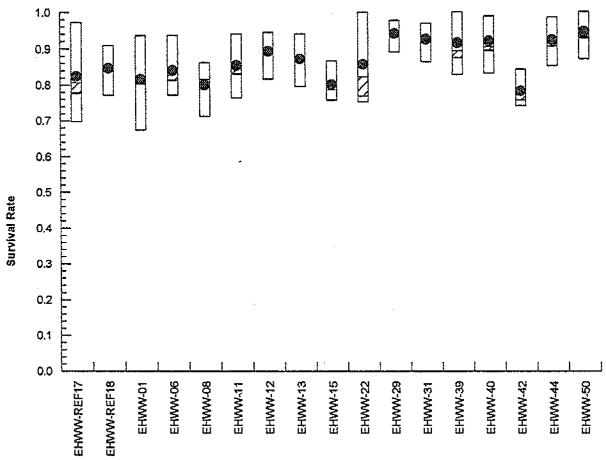
Survival Rate Binomials

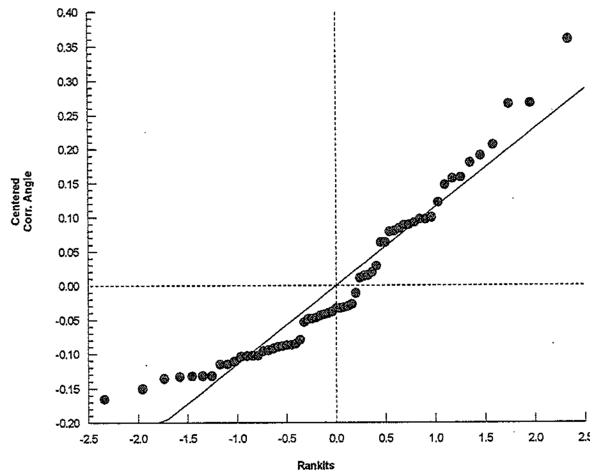
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		177/254	247/254	204/254	191/254
EHWW-REF18	XC	196/254	231/254	217/254	213/254
EHWW-01		219/254	189/254	171/254	238/254
EHWW-06		238/254	196/254	206/254	207/254
EHWW-08		219/254	207/254	181/254	
EHWW-11		239/254	194/254	211/254	
EHWW-12		229/254	207/254	240/254	
EHWW-13		213/254	226/254	202/254	239/254
EHWW-15		206/254	220/254	193/254	192/254
EHWW-22		199/254	254/254	191/254	191/254
EHWW-29		228/254	247/254	226/254	248/254
EHWW-31		219/254	245/254	246/254	222/254
EHWW-39		226/254	254/254	218/254	210/254
EHWW-40		251/254	211/254	227/254	
EHWW-42		192/254	188/254	214/254	
EHWW-44		218/254	242/254	216/254	250/254
EHWW-50		254/254	235/254	236/254	221/254

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	11-5555-3882	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Nonparametric-Two Sample	**Status Level:**	1

Graphics





CETIS Analytical Report

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	14-6142-4225	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)	Anchor QEA	
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	14-6142-4225	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-REF17 passed proportion normal	6.51%
		EHWW-01 passed proportion normal	6.51%
		EHWW-06 passed proportion normal	6.51%
		EHWW-08 passed proportion normal	6.51%
		EHWW-11 passed proportion normal	6.51%
		EHWW-12 passed proportion normal	6.51%
		EHWW-13 passed proportion normal	6.51%
		EHWW-15 failed proportion normal	6.51%
		EHWW-22 passed proportion normal	6.51%
		EHWW-29 passed proportion normal	6.51%
		EHWW-31 passed proportion normal	6.51%
		EHWW-39 passed proportion normal	6.51%
		EHWW-40 passed proportion normal	6.51%
		EHWW-42 passed proportion normal	6.51%
		EHWW-44 passed proportion normal	6.51%
		EHWW-50 passed proportion normal	6.51%

Bonferroni Adj t Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Site Control		EHWW-REF17	-0.7688	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
		EHWW-01	0.7315	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
		EHWW-06	2.588	2.866	0.097	6	CDF	0.1029	Non-Significant Effect
		EHWW-08	0.2075	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
		EHWW-11	0.794	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
		EHWW-12	-0.03162	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
		EHWW-13	1.586	2.866	0.097	6	CDF	0.9564	Non-Significant Effect
		EHWW-15*	3.738	2.866	0.097	6	CDF	0.0041	Significant Effect
		EHWW-22	2.373	2.866	0.097	6	CDF	0.1752	Non-Significant Effect
		EHWW-29	-0.2027	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
		EHWW-31	-0.2627	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
		EHWW-39	1.847	2.866	0.097	6	CDF	0.5698	Non-Significant Effect
		EHWW-40	0.4388	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
		EHWW-42	1.001	2.866	0.105	5	CDF	1.0000	Non-Significant Effect
		EHWW-44	-0.1942	2.866	0.097	6	CDF	1.0000	Non-Significant Effect
		EHWW-50	2.635	2.866	0.097	6	CDF	0.0914	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.118643	0.0074152	16	3.223	9.6E-04	Significant Effect
Error	0.105833	0.0023007	46			
Total	0.224476		62			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	16.33	32	0.4299	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9866	0.9481	0.7247	Normal Distribution

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	14-6142-4225	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17		4	0.9334	0.9206	0.9462	0.9317	0.9267	0.9435	0.0040	0.86%	0.00%
EHWW-REF18	XC	4	0.9196	0.8984	0.9408	0.9152	0.9091	0.9390	0.0067	1.45%	1.48%
EHWW-01		4	0.9049	0.8660	0.9438	0.9006	0.8824	0.9361	0.0122	2.70%	3.05%
EHWW-06		4	0.8659	0.8412	0.8905	0.8611	0.8529	0.8883	0.0078	1.79%	7.24%
EHWW-08		3	0.9153	0.8755	0.9552	0.9082	0.9041	0.9337	0.0093	1.75%	1.93%
EHWW-11		3	0.9024	0.8333	0.9716	0.9175	0.8703	0.9194	0.0161	3.08%	3.32%
EHWW-12		3	0.9201	0.8792	0.9609	0.9130	0.9083	0.9389	0.0095	1.79%	1.43%
EHWW-13		4	0.8876	0.8500	0.9252	0.8910	0.8577	0.9109	0.0118	2.66%	4.90%
EHWW-15		4	0.8346	0.7325	0.9366	0.8313	0.7727	0.9029	0.0321	7.68%	10.59%
EHWW-22		4	0.8701	0.8248	0.9155	0.8768	0.8325	0.8945	0.0143	3.27%	6.78%
EHWW-29		4	0.9215	0.8695	0.9736	0.9313	0.8761	0.9474	0.0164	3.55%	1.27%
EHWW-31		4	0.9201	0.8418	0.9985	0.9339	0.8493	0.9633	0.0246	5.35%	1.42%
EHWW-39		4	0.8821	0.8449	0.9193	0.8870	0.8496	0.9048	0.0117	2.65%	5.50%
EHWW-40		3	0.9108	0.8780	0.9435	0.9163	0.8957	0.9203	0.0076	1.45%	2.42%
EHWW-42		3	0.8980	0.8341	0.9618	0.8883	0.8785	0.9271	0.0148	2.86%	3.80%
EHWW-44		4	0.9216	0.8746	0.9686	0.9239	0.8840	0.9545	0.0148	3.20%	1.26%
EHWW-50		4	0.8642	0.8215	0.9069	0.8644	0.8340	0.8941	0.0134	3.11%	7.41%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17		4	1.31	1.284	1.336	1.307	1.297	1.331	0.008166	1.25%	0.00%
EHWW-REF18	XC	4	1.284	1.244	1.324	1.275	1.265	1.321	0.0127	1.98%	1.99%
EHWW-01		4	1.259	1.191	1.328	1.251	1.221	1.315	0.02147	3.41%	3.88%
EHWW-06		4	1.196	1.159	1.233	1.189	1.177	1.23	0.01163	1.94%	8.69%
EHWW-08		3	1.276	1.203	1.35	1.263	1.256	1.31	0.01709	2.32%	2.57%
EHWW-11		3	1.255	1.142	1.368	1.28	1.202	1.283	0.02631	3.63%	4.21%
EHWW-12		3	1.285	1.208	1.363	1.271	1.263	1.321	0.01803	2.43%	1.90%
EHWW-13		4	1.23	1.171	1.289	1.235	1.184	1.268	0.01856	3.02%	6.10%
EHWW-15		4	1.157	1.017	1.298	1.151	1.074	1.254	0.04407	7.62%	11.67%
EHWW-22		4	1.204	1.137	1.27	1.213	1.149	1.24	0.02088	3.47%	8.13%
EHWW-29		4	1.291	1.198	1.384	1.307	1.211	1.339	0.02935	4.55%	1.47%
EHWW-31		4	1.293	1.155	1.431	1.311	1.172	1.378	0.04334	6.70%	1.31%
EHWW-39		4	1.221	1.165	1.278	1.228	1.172	1.257	0.01778	2.91%	6.77%
EHWW-40		3	1.268	1.211	1.325	1.277	1.242	1.285	0.01316	1.80%	3.22%
EHWW-42		3	1.247	1.138	1.357	1.23	1.215	1.297	0.02538	3.52%	4.79%
EHWW-44		4	1.291	1.203	1.379	1.292	1.223	1.356	0.02766	4.29%	1.49%
EHWW-50		4	1.195	1.132	1.257	1.194	1.151	1.239	0.01969	3.30%	8.81%

Analyst: ww QA: AET Jan 15/19

Analysis ID:	14-6142-4225	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		0.9435	0.9271	0.9363	0.9267
EHWW-REF18	XC	0.9133	0.9091	0.9171	0.9390
EHWW-01		0.9361	0.8889	0.9123	0.8824
EHWW-06		0.8529	0.8622	0.8883	0.8599
EHWW-08		0.9041	0.9082	0.9337	
EHWW-11		0.8703	0.9175	0.9194	
EHWW-12		0.9389	0.9130	0.9083	
EHWW-13		0.9014	0.8805	0.9109	0.8577
EHWW-15		0.9029	0.7727	0.7876	0.8750
EHWW-22		0.8945	0.8898	0.8325	0.8639
EHWW-29		0.9474	0.9433	0.8761	0.9194
EHWW-31		0.8493	0.9633	0.9309	0.9369
EHWW-39		0.8496	0.8842	0.8899	0.9048
EHWW-40		0.9203	0.8957	0.9163	
EHWW-42		0.9271	0.8883	0.8785	
EHWW-44		0.9312	0.9545	0.9167	0.8840
EHWW-50		0.8510	0.8340	0.8941	0.8778

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		1.331	1.297	1.316	1.297
EHWW-REF18	XC	1.272	1.265	1.279	1.321
EHWW-01		1.315	1.231	1.27	1.221
EHWW-06		1.177	1.191	1.23	1.187
EHWW-08		1.256	1.263	1.31	
EHWW-11		1.202	1.28	1.283	
EHWW-12		1.321	1.271	1.263	
EHWW-13		1.251	1.218	1.268	1.184
EHWW-15		1.254	1.074	1.092	1.209
EHWW-22		1.24	1.232	1.149	1.193
EHWW-29		1.339	1.33	1.211	1.283
EHWW-31		1.172	1.378	1.305	1.317
EHWW-39		1.172	1.224	1.233	1.257
EHWW-40		1.285	1.242	1.277	
EHWW-42		1.297	1.23	1.215	
EHWW-44		1.305	1.356	1.278	1.223
EHWW-50		1.174	1.151	1.239	1.214

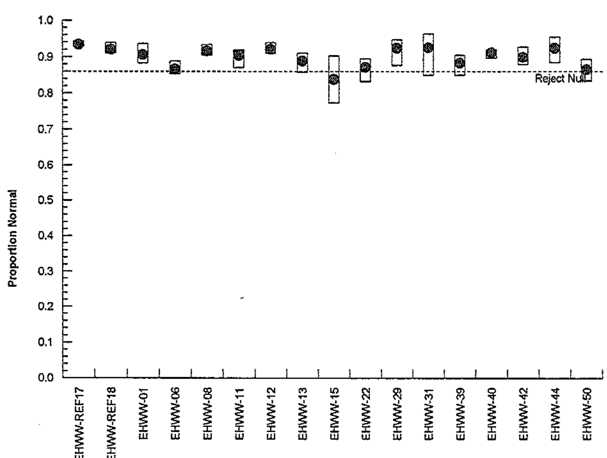
Bivalve Larval Survival and Development Test — **Nautilus Environmental**

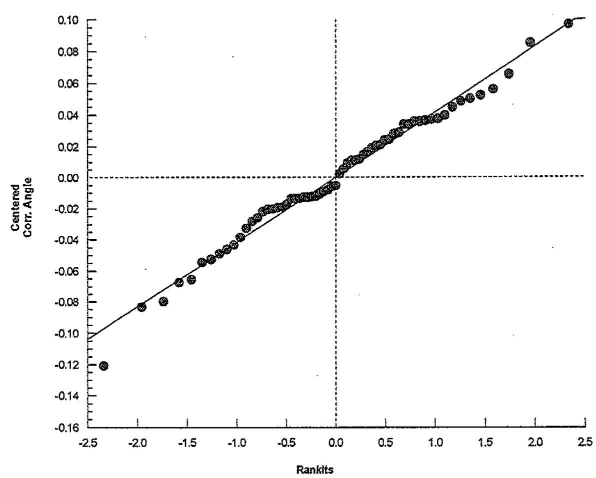
Analysis ID:	14-6142-4225	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		167/177	229/247	191/204	177/191
EHWW-REF18	XC	179/196	210/231	199/217	200/213
EHWW-01		205/219	168/189	156/171	210/238
EHWW-06		203/238	169/196	183/206	178/207
EHWW-08		198/219	188/207	169/181	
EHWW-11		208/239	178/194	194/211	
EHWW-12		215/229	189/207	218/240	
EHWW-13		192/213	199/226	184/202	205/239
EHWW-15		186/206	170/220	152/193	168/192
EHWW-22		178/199	226/254	159/191	165/191
EHWW-29		216/228	233/247	198/226	228/248
EHWW-31		186/219	236/245	229/246	208/222
EHWW-39		192/226	229/259	194/218	190/210
EHWW-40		231/251	189/211	208/227	
EHWW-42		178/192	167/188	188/214	
EHWW-44		203/218	231/242	198/216	221/250
EHWW-50		217/255	196/235	211/236	194/221

Graphics





CETIS Analytical Report

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-7148-5003	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Batch ID:	09-1380-8962	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 16:45	**Protocol:**	SCCWRP (2009)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:10	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	48h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
EHWW-REF17	11-6816-1975	03 Oct-18 08:25	04 Oct-18 16:25	50d 8h (5 °C)	Anchor QEA	
EHWW-REF18	04-9066-2063	03 Oct-18 09:00	04 Oct-18 16:25	50d 8h (5 °C)		
EHWW-01	09-4043-9892	01 Oct-18 14:15	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-06	07-6081-6733	01 Oct-18 14:55	02 Oct-18 16:20	52d 2h (10 °C)		
EHWW-08	11-6318-9477	01 Oct-18 15:35	02 Oct-18 16:20	52d 1h (10 °C)		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-12	20-9373-4766	04 Oct-18 14:10	06 Oct-18 13:55	49d 3h (10 °C)		
EHWW-13	17-9563-4578	03 Oct-18 12:55	04 Oct-18 16:25	50d 4h (5 °C)		
EHWW-15	06-7893-1202	02 Oct-18 08:30	03 Oct-18 13:45	51d 8h (17.1 °C)		
EHWW-22	07-9060-9507	03 Oct-18 15:00	04 Oct-18 16:25	50d 2h (5 °C)		
EHWW-29	18-8320-8134	04 Oct-18 13:05	06 Oct-18 13:55	49d 4h (10 °C)		
EHWW-31	14-3182-9114	02 Oct-18 15:00	03 Oct-18 13:45	51d 2h (17.1 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 6h (10 °C)		
EHWW-40	13-1189-2993	05 Oct-18 09:35	06 Oct-18 13:55	48d 7h (10 °C)		
EHWW-42	15-1638-8206	02 Oct-18 12:45	03 Oct-18 13:45	51d 4h (17.1 °C)		
EHWW-44	19-2142-0006	04 Oct-18 08:15	06 Oct-18 13:55	49d 8h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
EHWW-REF17	Sediment Sample	Anchor QEA	EHWW-REF17-SG-000010	
EHWW-REF18	Sediment Sample	Anchor QEA	EHWW-REF18-SG-000010	
EHWW-01	Sediment Sample	Anchor QEA	EHWW-01-SG-000010	
EHWW-06	Sediment Sample	Anchor QEA	EHWW-06-SG-000010	
EHWW-08	Sediment Sample	Anchor QEA	EHWW-08-SG-000010	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-12	Sediment Sample	Anchor QEA	EHWW-12-SG-000010	
EHWW-13	Sediment Sample	Anchor QEA	EHWW-13-SG-000010	
EHWW-15	Sediment Sample	Anchor QEA	EHWW-15-SG-000010	
EHWW-22	Sediment Sample	Anchor QEA	EHWW-22-SG-000010	
EHWW-29	Sediment Sample	Anchor QEA	EHWW-29-SG-000010	
EHWW-31	Sediment Sample	Anchor QEA	EHWW-31-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-40	Sediment Sample	Anchor QEA	EHWW-40-SG-000010	
EHWW-42	Sediment Sample	Anchor QEA	EHWW-42-SG-000010	
EHWW-44	Sediment Sample	Anchor QEA	EHWW-44-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-7148-5003	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-REF17 passed combined proportion n	21.86%
		EHWW-01 passed combined proportion norm	21.86%
		EHWW-06 passed combined proportion norm	21.86%
		EHWW-08 passed combined proportion norm	21.86%
		EHWW-11 passed combined proportion norm	21.86%
		EHWW-12 passed combined proportion norm	21.86%
		EHWW-13 passed combined proportion norm	21.86%
		EHWW-15 passed combined proportion norm	21.86%
		EHWW-22 passed combined proportion norm	21.86%
		EHWW-29 passed combined proportion norm	21.86%
		EHWW-31 passed combined proportion norm	21.86%
		EHWW-39 passed combined proportion norm	21.86%
		EHWW-40 passed combined proportion norm	21.86%
		EHWW-42 passed combined proportion norm	21.86%
		EHWW-44 passed combined proportion norm	21.86%
		EHWW-50 passed combined proportion norm	21.86%

Bonferroni Adj t Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Site Control		EHWW-REF17	0.3135	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-01	0.7988	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-06	0.9603	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-08	0.7826	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
		EHWW-11	0.2399	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
		EHWW-12	-0.7396	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
		EHWW-13	0.158	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-15	1.906	2.866	0.187	6	CDF	0.5035	Non-Significant Effect
		EHWW-22	0.9272	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-29	-1.779	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-31	-1.515	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-39	-0.3747	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-40	-0.945	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
		EHWW-42	1.248	2.866	0.202	5	CDF	1.0000	Non-Significant Effect
		EHWW-44	-1.301	2.866	0.187	6	CDF	1.0000	Non-Significant Effect
		EHWW-50	-0.5583	2.866	0.187	6	CDF	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.288708	0.0180442	16	2.123	0.0238	Significant Effect
Error	0.390903	0.0084979	46			
Total	0.679611		62			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	10.73	32	0.8256	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9765	0.9481	0.2682	Normal Distribution

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-7148-5003	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17		4	0.7520	0.5817	0.9222	0.7244	0.6575	0.9016	0.0535	14.23%	0.00%
EHWW-REF18	XC	4	0.7756	0.6942	0.8570	0.7854	0.7047	0.8268	0.0256	6.59%	-3.14%
EHWW-01		4	0.7274	0.5595	0.8953	0.7343	0.6142	0.8268	0.0528	14.51%	3.27%
EHWW-06		4	0.7215	0.6313	0.8116	0.7106	0.6654	0.7992	0.0283	7.85%	4.06%
EHWW-08		3	0.7283	0.5843	0.8724	0.7402	0.6654	0.7795	0.0335	7.96%	3.14%
EHWW-11		3	0.7612	0.6143	0.9080	0.7638	0.7008	0.8189	0.0341	7.76%	-1.22%
EHWW-12		3	0.8163	0.6603	0.9722	0.8465	0.7441	0.8583	0.0363	7.69%	-8.55%
EHWW-13		4	0.7677	0.7110	0.8244	0.7697	0.7244	0.8071	0.0178	4.64%	-2.09%
EHWW-15		4	0.6654	0.5782	0.7525	0.6654	0.5984	0.7323	0.0274	8.23%	11.52%
EHWW-22		4	0.7165	0.5262	0.9069	0.6752	0.6260	0.8898	0.0598	16.70%	4.71%
EHWW-29		4	0.8612	0.7637	0.9587	0.8740	0.7795	0.9173	0.0306	7.12%	-14.53%
EHWW-31		4	0.8455	0.7041	0.9868	0.8602	0.7323	0.9291	0.0444	10.50%	-12.43%
EHWW-39		4	0.7923	0.6760	0.9087	0.7598	0.7480	0.9016	0.0366	9.23%	-5.37%
EHWW-40		3	0.8241	0.6185	1.0000	0.8189	0.7441	0.9094	0.0478	10.05%	-9.60%
EHWW-42		3	0.6995	0.5967	0.8022	0.7008	0.6575	0.7402	0.0239	5.91%	6.98%
EHWW-44		4	0.8396	0.7430	0.9361	0.8346	0.7795	0.9094	0.0303	7.23%	-11.65%
EHWW-50		4	0.8051	0.7345	0.8757	0.8012	0.7638	0.8543	0.0222	5.51%	-7.07%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
EHWW-REF17		4	1.059	0.8429	1.274	1.019	0.9456	1.252	0.0678	12.81%	0.00%
EHWW-REF18	XC	4	1.079	0.9829	1.175	1.089	0.9963	1.142	0.03023	5.60%	-1.93%
EHWW-01		4	1.027	0.8365	1.217	1.033	0.9006	1.142	0.05986	11.66%	2.99%
EHWW-06		4	1.016	0.9135	1.119	1.003	0.9539	1.106	0.03236	6.37%	3.98%
EHWW-08		3	1.024	0.8628	1.185	1.036	0.9539	1.082	0.03746	6.34%	3.28%
EHWW-11		3	1.062	0.8893	1.235	1.063	0.992	1.131	0.04019	6.55%	-0.33%
EHWW-12		3	1.131	0.9349	1.327	1.168	1.04	1.185	0.04561	6.98%	-6.85%
EHWW-13		4	1.069	1.002	1.136	1.07	1.018	1.116	0.0211	3.95%	-0.96%
EHWW-15		4	0.9548	0.8621	1.048	0.9539	0.8845	1.027	0.02914	6.10%	9.80%
EHWW-22		4	1.019	0.7858	1.251	0.9647	0.9128	1.232	0.07315	14.36%	3.78%
EHWW-29		4	1.195	1.056	1.334	1.209	1.082	1.279	0.0436	7.30%	-12.88%
EHWW-31		4	1.178	0.9815	1.374	1.191	1.027	1.301	0.06167	10.47%	-11.26%
EHWW-39		4	1.103	0.9458	1.261	1.059	1.045	1.252	0.04954	8.98%	-4.24%
EHWW-40		3	1.146	0.8647	1.426	1.131	1.04	1.265	0.06527	9.87%	-8.22%
EHWW-42		3	0.9912	0.879	1.103	0.992	0.9456	1.036	0.02607	4.56%	6.37%
EHWW-44		4	1.164	1.028	1.299	1.154	1.082	1.265	0.04257	7.31%	-9.94%
EHWW-50		4	1.115	1.025	1.205	1.11	1.063	1.179	0.02829	5.07%	-5.37%

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	20-7148-5003	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		0.6575	0.9016	0.7520	0.6969
EHWW-REF18	XC	0.7047	0.8268	0.7835	0.7874
EHWW-01		0.8071	0.6614	0.6142	0.8268
EHWW-06		0.7992	0.6654	0.7205	0.7008
EHWW-08		0.7795	0.7402	0.6654	
EHWW-11		0.8189	0.7008	0.7638	
EHWW-12		0.8465	0.7441	0.8583	
EHWW-13		0.7559	0.7835	0.7244	0.8071
EHWW-15		0.7323	0.6693	0.5984	0.6614
EHWW-22		0.7008	0.8898	0.6260	0.6496
EHWW-29		0.8504	0.9173	0.7795	0.8976
EHWW-31		0.7323	0.9291	0.9016	0.8189
EHWW-39		0.7559	0.9016	0.7638	0.7480
EHWW-40		0.9094	0.7441	0.8189	
EHWW-42		0.7008	0.6575	0.7402	
EHWW-44		0.7992	0.9094	0.7795	0.8701
EHWW-50		0.8543	0.7717	0.8307	0.7638

Angular (Corrected) Transformed Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		0.9456	1.252	1.049	0.9877
EHWW-REF18	XC	0.9963	1.142	1.087	1.092
EHWW-01		1.116	0.9498	0.9006	1.142
EHWW-06		1.106	0.9539	1.014	0.992
EHWW-08		1.082	1.036	0.9539	
EHWW-11		1.131	0.992	1.063	
EHWW-12		1.168	1.04	1.185	
EHWW-13		1.054	1.087	1.018	1.116
EHWW-15		1.027	0.9581	0.8845	0.9498
EHWW-22		0.992	1.232	0.9128	0.9373
EHWW-29		1.174	1.279	1.082	1.245
EHWW-31		1.027	1.301	1.252	1.131
EHWW-39		1.054	1.252	1.063	1.045
EHWW-40		1.265	1.04	1.131	
EHWW-42		0.992	0.9456	1.036	
EHWW-44		1.106	1.265	1.082	1.202
EHWW-50		1.179	1.073	1.147	1.063

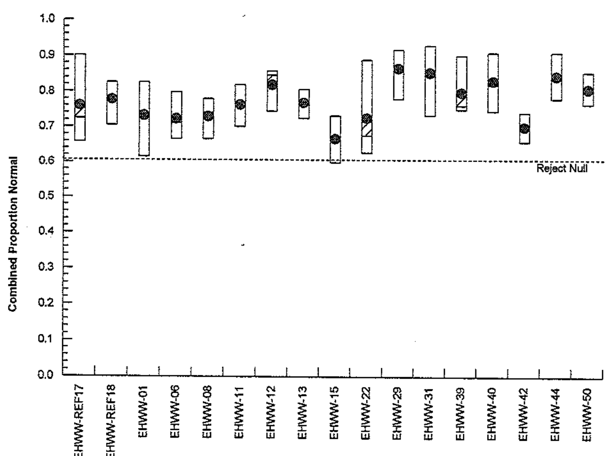
Bivalve Larval Survival and Development Test — **Nautilus Environmental**

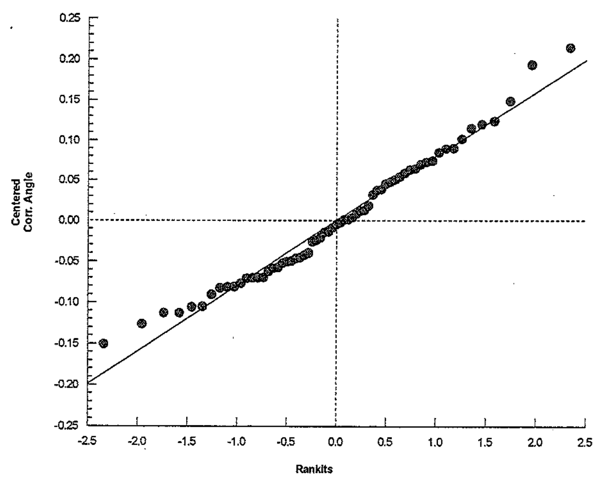
Analysis ID:	20-7148-5003	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	05 Jan-19 15:20	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4
EHWW-REF17		167/254	229/254	191/254	177/254
EHWW-REF18	XC	179/254	210/254	199/254	200/254
EHWW-01		205/254	168/254	156/254	210/254
EHWW-06		203/254	169/254	183/254	178/254
EHWW-08		198/254	188/254	169/254	
EHWW-11		208/254	178/254	194/254	
EHWW-12		215/254	189/254	218/254	
EHWW-13		192/254	199/254	184/254	205/254
EHWW-15		186/254	170/254	152/254	168/254
EHWW-22		178/254	226/254	159/254	165/254
EHWW-29		216/254	233/254	198/254	228/254
EHWW-31		186/254	236/254	229/254	208/254
EHWW-39		192/254	229/254	194/254	190/254
EHWW-40		231/254	189/254	208/254	
EHWW-42		178/254	167/254	188/254	
EHWW-44		203/254	231/254	198/254	221/254
EHWW-50		217/254	196/254	211/254	194/254

Graphics





Bivalve Larval Development Sediment Test - Ammonia

Client : Anchor
W.O.: 181641

Test Date: November 22, 2018
Species: *M. galloprovincialis*

Overlying Ammonia

	Sample ID	Temperature (°C)	pH	Salinity (ppt)	Total Ammonia as Nitrogen (mg/L)	pKa	Unionized Ammonia (mg/L)
0h							
	Control Seawater	15.0	7.5	29	0.305	9.737	0.002
	EHWW-**REF17**-SG-000010	15.0	7.6	29	2.61	9.737	0.019
	EHWW-**REF18**-SG-000010	15.0	7.6	29	0.965	9.737	0.007
	EHWW-**01**-SG-000010	15.5	7.6	29	1.02	9.737	0.007
	EHWW-**06**-SG-000010	15.0	7.5	29	0.892	9.737	0.005
	EHWW-**08**-SG-000010	15.5	7.6	29	0.584	9.737	0.004
	EHWW-**11**-SG-000010	15.5	7.6	29	0.104	9.737	0.001
	EHWW-**12**-SG-000010	15.5	7.6	29	0.851	9.737	0.006
	EHWW-**13**-SG-000010	15.5	7.6	29	0.151	9.737	0.001
	EHWW-**15**-SG-000010	15.5	7.6	29	2.10	9.737	0.015
	EHWW-**22**-SG-000010	15.5	7.6	29	0.188	9.737	0.001
	EHWW-**29**-SG-000010	15.5	7.6	29	1.72	9.737	0.012
	EHWW-**31**-SG-000010	15.5	7.7	29	4.03	9.737	0.037
	EHWW-**39**-SG-000010	15.5	7.5	29	1.81	9.737	0.010
	EHWW-**40**-SG-000010	15.5	7.5	29	1.28	9.737	0.007
	EHWW-**42**-SG-000010	15.5	7.6	29	0.698	9.737	0.005
	EHWW-**44**-SG-000010	15.5	7.6	29	0.625	9.737	0.005
	EHWW-**50**-SG-000010	15.5	7.5	29	0.830	9.737	0.005
48h							
	Control Seawater	15.5	7.5	29	0.449	9.737	0.003
	EHWW-**REF17**-SG-000010	15.5	7.7	30	8.53	9.737	0.078
	EHWW-**REF18**-SG-000010	15.5	7.7	30	2.89	9.737	0.026
	EHWW-**01**-SG-000010	15.5	7.7	30	3.98	9.737	0.036
	EHWW-**06**-SG-000010	15.5	7.6	30	2.20	9.737	0.016
	EHWW-**08**-SG-000010	15.5	7.5	30	1.56	9.737	0.009
	EHWW-**11**-SG-000010	15.5	7.5	30	0.190	9.737	0.001
	EHWW-**12**-SG-000010	15.5	7.6	30	2.62	9.737	0.019
	EHWW-**13**-SG-000010	15.5	7.6	30	0.374	9.737	0.003
	EHWW-**15**-SG-000010	15.5	7.6	30	5.55	9.737	0.040
	EHWW-**22**-SG-000010	15.5	7.6	30	0.604	9.737	0.004
	EHWW-**29**-SG-000010	15.5	7.6	30	4.25	9.737	0.031
	EHWW-**31**-SG-000010	15.5	7.8	30	7.32	9.737	0.084
	EHWW-**39**-SG-000010	15.5	7.5	30	3.82	9.737	0.022
	EHWW-**40**-SG-000010	15.5	7.5	30	2.90	9.737	0.017
	EHWW-**42**-SG-000010	15.5	7.6	30	1.86	9.737	0.013
	EHWW-**44**-SG-000010	15.5	7.6	30	1.46	9.737	0.011
	EHWW-**50**-SG-000010	15.5	7.6	30	2.23	9.737	0.016

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	250	2000	10	20	30
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	9.737
18	9.465	9.502	9.557	9.588	9.619	9.636
19						9.604
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
25	9.246	9.283	9.337	9.366	9.397	9.414

KG
Jan 15/19

Bivalve Larval Development Sediment Test - Ammonia

Client : Anchor
W.O.: 181641

Test Date: November 22, 2018
Species: *M. galloprovincialis*

Interstitial Ammonia

	Sample ID	Temperature (°C)	pH	Salinity (ppt)	Total Ammonia as Nitrogen (mg/L)	pKa	Unionized Ammonia (mg/L)
0h							
	Control Seawater	19.0	7.3	29	0.793	9.604	0.004
	EHWW-**REF17**-SG-000010	19.0	7.3	30	17.5	9.604	0.086
	EHWW-**REF18**-SG-000010	19.0	7.3	30	5.57	9.604	0.028
	EHWW-**01**-SG-000010	19.0	7.3	30	4.22	9.604	0.021
	EHWW-**06**-SG-000010	19.0	7.3	30	3.45	9.604	0.017
	EHWW-**08**-SG-000010	18.5	7.2	30	2.57	9.604	0.010
	EHWW-**11**-SG-000010	18.5	7.2	30	0.490	9.604	0.002
	EHWW-**12**-SG-000010	19.0	7.3	30	3.36	9.604	0.017
	EHWW-**13**-SG-000010	19.0	7.3	30	0.880	9.604	0.004
	EHWW-**15**-SG-000010	18.5	7.3	30	8.37	9.604	0.041
	EHWW-**22**-SG-000010	18.5	7.3	29	1.23	9.604	0.006
	EHWW-**29**-SG-000010	18.5	7.2	30	6.55	9.604	0.026
	EHWW-**31**-SG-000010	18.5	7.3	31	12.2	9.604	0.060
	EHWW-**39**-SG-000010	18.5	7.4	31	6.38	9.604	0.040
	EHWW-**40**-SG-000010	18.5	7.3	31	5.22	9.604	0.026
	EHWW-**42**-SG-000010	18.5	7.3	30	2.89	9.604	0.014
	EHWW-**44**-SG-000010	18.5	7.4	31	2.25	9.604	0.014
	EHWW-**50**-SG-000010	18.5	7.3	31	3.28	9.604	0.016
48h							
	Control Seawater	18.0	7.3	29	0.582	9.636	0.003
	EHWW-**REF17**-SG-000010	17.5	7.3	30	17.4	9.636	0.080
	EHWW-**REF18**-SG-000010	17.5	7.2	30	5.50	9.636	0.020
	EHWW-**01**-SG-000010	17.5	7.3	30	4.63	9.636	0.021
	EHWW-**06**-SG-000010	17.5	7.1	31	3.99	9.636	0.012
	EHWW-**08**-SG-000010	17.5	7.1	31	2.74	9.636	0.008
	EHWW-**11**-SG-000010	17.5	7.0	31	0.544	9.636	0.001
	EHWW-**12**-SG-000010	17.5	7.3	30	4.37	9.636	0.020
	EHWW-**13**-SG-000010	18.0	7.3	31	0.811	9.636	0.004
	EHWW-**15**-SG-000010	18.0	7.3	30	8.15	9.636	0.037
	EHWW-**22**-SG-000010	18.0	7.3	30	1.30	9.636	0.006
	EHWW-**29**-SG-000010	17.5	7.3	30	5.45	9.636	0.025
	EHWW-**31**-SG-000010	17.5	7.3	30	10.2	9.636	0.047
	EHWW-**39**-SG-000010	18.0	7.1	30	5.59	9.636	0.016
	EHWW-**40**-SG-000010	18.0	7.0	30	5.45	9.636	0.013
	EHWW-**42**-SG-000010	18.0	7.2	30	3.07	9.636	0.011
	EHWW-**44**-SG-000010	18.0	7.2	31	2.63	9.636	0.010
	EHWW-**50**-SG-000010	18.0	7.1	30	3.78	9.636	0.011

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	250	2000	10	20	30
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	9.737
18	9.465	9.502	9.557	9.588	9.619	9.636
19						9.604
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
25	9.246	9.283	9.337	9.366	9.397	9.414

LG
Jan 15/19

Nautilus Environmental
Water Quality Data For Ammonia

Client : Anchor

Work Order No: 181641

Species : M. galloprovincialis

Sample Type: Ammonia - Interstitial

Date Measured: Nov. 22/18 (oh)

	Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
	Nov. 22/18	Control Sediment	19.0	29	7.3	0.793	0.00~~3~~4	Vmc
1	↓	EHWW-REF17-SG-000010	19.0	30	7.3	17.5	0.0~~64~~86	↓
2		EHWW-REF18-SG-000010	19.0	30	7.3	5.57	0.02~~8~~8	
3		EHWW-01-SG-000010	19.0	30	7.3	4.22	0.0~~15~~21	
4		EHWW-06-SG-000010	19.0	30	7.3	3.45	0.01~~3~~7	
5		EHWW-08-SG-000010	18.5	~~29~~ 30	7.2	2.57	0.00~~7~~10	
6		EHWW-11-SG-000010	18.5	30	7.2	0.490	0.00~~8~~2	
7		EHWW-12-SG-000010	19.0	30	7.3	3.36	0.01~~2~~7	
8		EHWW-13-SG-000010	19.0	30	7.3	0.880	0.00~~3~~4	
9		EHWW-15-SG-000010	18.5	30	7.3	8.37	0.0~~30~~41	
10		EHWW-22-SG-000010	18.5	29	7.3	1.23	0.00~~4~~6	
11		EHWW-29-SG-000010	18.5	30	7.2	6.55	0.0~~1~~26	
12		EHWW-31-SG-000010	18.5	31	7.3	12.2	0.0~~4~~60	
13		EHWW-39-SG-000010	18.5	31	7.4	6.38	0.0~~2~~40	
14		EHWW-40-SG-000010	18.5	31	7.3	5.22	0.0~~1~~26	
15	↓	EHWW-42-SG-000010	18.5	30	7.3	2.89	0.014	↓

Ammonia Salicylate Lot #: NA

Ammonia Cyanurate Lot #: NA

Comments: Total ammonia concentrations were measured by ALS. Results are enclosed in the datapack

Reviewd by: A. Tong

Date Reviewed: Jan 10/19

Nautilus Environmental
Water Quality Data For Ammonia

Client : Anchor

Work Order No: 191641

Species : M. galloprovincialis

Sample Type: Ammonia - Interstitial

Date Measured: Nov. 22/18 (0h)

	Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
16	Nov. 22/18	EHWW-44-SG-000010	18.5	31	7.4	2.25	0.014	WM
17	↓	EHWW-50-SG-000010	18.5	31	7.3	3.28	0.026	↓

Ammonia Salicylate Lot #: n/a

Ammonia Cyanurate Lot #: n/a

Comments: Total ammonia concentrations were measured by ALS. Results are enclosed in the datapack.

Reviewd by: A. Tang

Date Reviewed: Jan 15/19

Nautilus Environmental
Water Quality Data For Ammonia

Client : Anchor

Work Order No: 181641

Species : M. galloprovincialis

Sample Type: Ammonia- Interstitial

Date Measured: Nov-24/18 (48h)

	Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
	Nov.24/18	Control ~~Sediment~~	18.0	29	7.83	0.582	0.003	WML
1		EHWW-REF17-SG-000010	17.5	30	7.3	17.4	0.080	
2		EHWW-REF18-SG-000010	17.5	30	7.2	5.50	0.020	
3		EHWW-01-SG-000010	17.5	30	7.3	4.63	0.021	
4		EHWW 06-SG-000010	17.5	31	7.1	3.99	0.012	
5		EHWW-08-SG-000010	17.5	31	7.1	2.74	0.008	
6		EHWW-11-SG-000010	17.5	31	7.0	0.544	0.001	
7		EHWW-12-SG-000010	17.5	30	7.3	4.37	0.020	
8		EHWW-13-SG-000010	18.0	31	7.3	0.811	0.004	
9		EHWW 15-SG-000010	18.0	30	7.3	8.15	0.037	
10		EHWW-22-SG-000010	18.0	30	7.3	1.30	0.006	
11		EHWW-29-SG-000010	17.5	30	7.3	5.45	0.025	
12		EHWW-31-SG-000010	17.5	30	7.13	10.2	0.047	
13		EHWW-39-SG-000010	18.0	30	7.1	5.59	0.016	
14		EHWW-40-SG-000010	18.0	30	7.0	5.45	0.013	
15		EHWW-42-SG-000010	18.0	30	7.2	3.07	0.011	

Ammonia Salicylate Lot #: n/a

Ammonia Cyanurate Lot #: n/a

Comments: Total ammonia concentrations ~~was~~ were measured by ALS. Results are enclosed in the datapack

Reviewd by: A. Tang

Date Reviewed: Jan 15/19

Nautilus Environmental
Water Quality Data For Ammonia

Client : Anchor

Work Order No: 181641

Species : M. galloprovincialis

Sample Type: Ammonia - Interstitial

Date Measured: Nov. 24/18 (48h)

	Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
46	Nov.24/18	EHWW-44-SG-000010	18.0	31	7.2	2.63	0.010	MM
47	↓	EHWW-50-SG-000010	18.0	30	7.1	3.78	0.011	↓

Ammonia Salicylate Lot #: n/a

Ammonia Cyanurate Lot #: n/a

Comments: Total ammonia concentrations were measured by ALS. Results are enclosed in the datapack.

Reviewd by: A. Tang

Date Reviewed: Jan 15/19

NAUTILUS ENVIRONMENTAL
ATTN: Yvonne Lam
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 29-NOV-18
Report Date: 07-DEC-18 18:07 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2203558

Project P.O. #: NOT SUBMITTED

Job Reference:

C of C Numbers:

Legal Site Desc:

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-1	L2203558-2	L2203558-3	L2203558-4	L2203558-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	CONT-OAM-0	REF17-OAM-0	REF18-OAM-0	01-OAM-0	06-OAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.305	2.61	0.965	1.02	0.892
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-6	L2203558-7	L2203558-8	L2203558-9	L2203558-10
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	08-OAM-0	11-OAM-0	12-OAM-0	13-OAM-0	15-OAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.584	0.104	0.851	0.151	2.10
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-11	L2203558-12	L2203558-13	L2203558-14	L2203558-15
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	22-OAM-0	29-OAM-0	31-OAM-0	39-OAM-0	40-OAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.188	1.72	4.03	1.81	1.28
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-16	L2203558-17	L2203558-18	L2203558-19	L2203558-20
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	42-OAM-0	44-OAM-0	50-OAM-0	CONT-OS-0	REF17-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.698	0.625	0.830		
	Sulphide as S (mg/L)				<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-21	L2203558-22	L2203558-23	L2203558-24	L2203558-25
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	REF18-OS-0	01-OS-0	06-OS-0	08-OS-0	11-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-26	L2203558-27	L2203558-28	L2203558-29	L2203558-30
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	12-OS-0	13-OS-0	15-OS-0	22-OS-0	29-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-31	L2203558-32	L2203558-33	L2203558-34	L2203558-35
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	31-OS-0	39-OS-0	40-OS-0	42-OS-0	44-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-36	L2203558-37	L2203558-38	L2203558-39	L2203558-40
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	50-OS-0	CONT-IAM-0	REF17-IAM-0	REF18-IAM-0	01-IAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)		0.793	17.5	5.57	4.22
	Sulphide as S (mg/L)	<0.018				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-41	L2203558-42	L2203558-43	L2203558-44	L2203558-45
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	06-IAM-0	08-IAM-0	11-IAM-0	12-IAM-0	13-IAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.45	2.57	0.490	3.36	0.880
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-46	L2203558-47	L2203558-48	L2203558-49	L2203558-50
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	15-IAM-0	22-IAM-0	29-IAM-0	31-IAM-0	39-IAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	8.37	1.23	6.55	12.2	6.38
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-51	L2203558-52	L2203558-53	L2203558-54	L2203558-55
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	40-IAM-0	42-IAM-0	44-IAM-0	50-IAM-0	CONT-IS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	5.22	2.89	2.25	3.28	
	Sulphide as S (mg/L)					<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L2203558-56	L2203558-57	L2203558-58	L2203558-59	L2203558-60
Description		Water	Water	Water	Water	Water
Sampled Date		22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
Sampled Time						
Client ID		REF17-IS-0	REF18-IS-0	01-IS-0	06-IS-0	08-IS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	1.60	0.021	0.044	0.020	0.060

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-61	L2203558-62	L2203558-63	L2203558-64	L2203558-65
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	11-IS-0	12-IS-0	13-IS-0	15-IS-0	22-IS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	0.034	0.031	0.035	0.051	0.044

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-66	L2203558-67	L2203558-68	L2203558-69	L2203558-70
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	29-IS-0	31-IS-0	39-IS-0	40-IS-0	42-IS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	0.020	<0.018	0.036	0.79	0.022

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-71	L2203558-72	L2203558-73	L2203558-74	L2203558-75
	Description	Water	Water	Water	Water	Water
	Sampled Date	22-NOV-18	22-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	44-IS-0	50-IS-0	CONT-OAM-48	REF17-OAM-48	REF18-OAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)			0.449	8.53	2.89
	Sulphide as S (mg/L)	0.020	<0.018			

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-76	L2203558-77	L2203558-78	L2203558-79	L2203558-80
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	01-OAM-48	06-OAM-48	08-OAM-48	11-OAM-48	12-OAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.98	2.20	1.56	0.190	2.62
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-81	L2203558-82	L2203558-83	L2203558-84	L2203558-85
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	13-OAM-48	15-OAM-48	22-OAM-48	29-OAM-48	31-OAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.374	5.55	0.604	4.25	7.32
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-86	L2203558-87	L2203558-88	L2203558-89	L2203558-90
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	39-OAM-48	40-OAM-48	42-OAM-48	44-OAM-48	50-OAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.82	2.90	1.86	1.46	2.23
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-91	L2203558-92	L2203558-93	L2203558-94	L2203558-95
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	CON-OS-48	REF17-OS-48	REF18-OS-48	01-OS-48	06-OS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	1.32	<0.018	0.085	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-96	L2203558-97	L2203558-98	L2203558-99	L2203558-100
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	08-OS-48	11-OS-48	12-OS-48	13-OS-48	15-OS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	0.019	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-101	L2203558-102	L2203558-103	L2203558-104	L2203558-105
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	22-OS-48	29-OS-48	31-OS-48	39-OS-48	40-OS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	0.047	<0.018	0.023

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-106	L2203558-107	L2203558-108	L2203558-109	L2203558-110
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	42-OS-48	44-OS-48	50-OS-48	CONT-IAM-48	REF17-IAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)				0.582	17.4
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018		

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-111	L2203558-112	L2203558-113	L2203558-114	L2203558-115
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	REF18-IAM-48	01-IAM-48	06-IAM-48	08-IAM-48	11-IAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	5.50	4.63	3.99	2.74	0.544
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-116	L2203558-117	L2203558-118	L2203558-119	L2203558-120
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	12-IAM-48	13-IAM-48	15-IAM-48	22-IAM-48	29-IAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	4.37	0.811	8.15	1.30	5.45
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-121	L2203558-122	L2203558-123	L2203558-124	L2203558-125
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	31-IAM-48	39-IAM-48	40-IAM-48	42-IAM-48	44-IAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	10.2	5.59	5.45	3.07	2.63
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-126	L2203558-127	L2203558-128	L2203558-129	L2203558-130
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	50-IAM-48	CONT-IS-48	REF17-IS-48	REF18-IS-48	01-IS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.78				
	Sulphide as S (mg/L)		<0.018	1.88	<0.018	0.037

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-131	L2203558-132	L2203558-133	L2203558-134	L2203558-135
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	06-IS-48	08-IS-48	11-IS-48	12-IS-48	13-IS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	0.048	0.055	0.024	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-136	L2203558-137	L2203558-138	L2203558-139	L2203558-140
	Description	Water	Water	Water	Water	Water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	15-IS-48	22-IS-48	29-IS-48	31-IS-48	39-IS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	0.023	0.195	0.020	0.051	0.032

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203558-141	L2203558-142	L2203558-143	L2203558-144	
	Description	Water	Water	Water	Water	
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	
	Sampled Time					
	Client ID	40-IS-48	42-IS-48	44-IS-48	50-IS-48	
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	5.19	0.025	<0.018	0.434	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date____ Page 1 of 16

Report to:		**Invoice To:**	
Company	Nautilus Environmental	**Company**	(same)
Address	8664 Commerce Court	**Address**	
City/Prov/PC	Burnaby, BC, V5A 4N7	**City/Prov/PC**	
Contact	Yvonne Lam	**Contact**	
Phone	604-420-8773	**Phone**	
Email	yvonne@nautilusenvironmental.ca	**Email**	
		PO No.	

Sample Collection By: **Sample Type:** Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Ammonia	Total Sulphides								Receipt Temperature (°C)
1	CONT-OAM-0	22/11/2018		water	1 x 125 mL		X									
2	REF17-OAM-0	22/11/2018		water	1 x 125 mL		X									
3	REF18-OAM-0	22/11/2018		water	1 x 125 mL		X									
4	01-OAM-0	22/11/2018		water	1 x 125 mL		X									
5	06-OAM-0	22/11/2018		water	1 x 125 mL		X									
6	08-OAM-0	22/11/2018		water	1 x 125 mL		X									
7	11-OAM-0	22/11/2018		water	1 x 125 mL		X									
8	12-OAM-0	22/11/2018		water	1 x 125 mL		X									
9	13-OAM-0	22/11/2018		water	1 x 125 mL		X									
10	15-OAM-0	22/11/2018		water	1 x 125 mL		X									

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)	**RECEIVED BY (LABORATORY)**
(Printed Name) Yvonne Lam (Signature)	(Printed Name) JC 2.3 3'C (Signature)
(Company) Nautilus (Date) Nov. 28/18 @ 0900h	(Company) JC NOV 29 2018 11:55AM (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
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Chain of Custody

Date____ Page 2 of 16

Report to:

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Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ○ OR Composite ○

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides									Receipt Temperature (°C)
1	22-OAM-0	22/11/2018		water	1 x 125 mL		X										
2	29-OAM-0	22/11/2018		water	1 x 125 mL		X										
3	31-OAM-0	22/11/2018		water	1 x 125 mL		X										
4	39-OAM-0	22/11/2018		water	1 x 125 mL		X										
5	40-OAM-0	22/11/2018		water	1 x 125 mL		X										
6	42-OAM-0	22/11/2018		water	1 x 125 mL		X										
7	44-OAM-0	22/11/2018		water	1 x 125 mL		X										
8	50-OAM-0	22/11/2018		water	1 x 125 mL		X										
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)

(Printed Name) Yvonne Lam (Signature)

(Company) Nautilus (Date) Nov. 28/18 @ 0900h

RECEIVED BY (LABORATORY)

(Printed Name) JC 2.3°C (Signature)

(Company) ALS NOV 29 2018 11:55am (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

TESTING LOCATION (Please Circle)

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Chain of Custody

Date______ Page 3 of 16

Report to:		**Invoice To:**	
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Contact	Yvonne Lam	**Contact**	
Phone	604-420-8773	**Phone**	
Email	yvonne@nautilusenvironmental.ca	**Email**	
		PO No.	

Sample Collection By: **Sample Type:** Grab ◯ OR Composite ◯

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides									Receipt Temperature (°C)
1	CONT-OS-0	22/11/2018		water	1 x 125 mL			X									
2	REF17-OS-0	22/11/2018		water	1 x 125 mL			X									
3	REF18-OS-0	22/11/2018		water	1 x 125 mL			X									
4	01-OS-0	22/11/2018		water	1 x 125 mL			X									
5	06-OS-0	22/11/2018		water	1 x 125 mL			X									
6	08-OS-0	22/11/2018		water	1 x 125 mL			X									
7	11-OS-0	22/11/2018		water	1 x 125 mL			X									
8	12-OS-0	22/11/2018		water	1 x 125 mL			X									
9	13-OS-0	22/11/2018		water	1 x 125 mL			X									
10	15-OS-0	22/11/2018		water	1 x 125 mL			X									

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)	**RECEIVED BY (LABORATORY)**
(Printed Name) Yvonne Lam (Signature)	(Printed Name) JC 2.9.3°C (Signature)
(Company) Nautilus (Date) Nov. 28/18 @ 0900h	(Company) ALS NOV 29 2018 11:55AM (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
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Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
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Chain of Custody

Date______ Page 4 of 16

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides									Receipt Temperature (°C)
1	22-OS-0	22/11/2018		water	1 x 125 mL			X									
2	29-OS-0	22/11/2018		water	1 x 125 mL			X									
3	31-OS-0	22/11/2018		water	1 x 125 mL			X									
4	39-OS-0	22/11/2018		water	1 x 125 mL			X									
5	40-OS-0	22/11/2018		water	1 x 125 mL			X									
6	42-OS-0	22/11/2018		water	1 x 125 mL			X									
7	44-OS-0	22/11/2018		water	1 x 125 mL			X									
8	50-OS-0	22/11/2018		water	1 x 125 mL			X									
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)

(Printed Name) Yvonne Lam (Signature)

(Company) Nautilus (Date) Nov. 28/18 @ 0900h

RECEIVED BY (LABORATORY)

(Printed Name) JC 2.3°C (Signature)

(Company) ALS NOV 29 2018 11:55AM (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby	Calgary
8664 Commerce Court	#4, 6125 12 Street SE
Burnaby, British Columbia, Canada	Calgary, Alberta, Canada
V5A 4N7	T2H 2K1
Phone 604.420.8773	Phone 403.253.7121

Chain of Custody

Date_______ Page 5 of 16

Report to:		Invoice To:	
Company	Nautilus Environmental	Company	(same)
Address	8664 Commerce Court	Address	
City/Prov/PC	Burnaby, BC, V5A 4N7	City/Prov/PC	
Contact	Yvonne Lam	Contact	
Phone	604-420-8773	Phone	
Email	yvonne@nautilusenvironmental.ca	Email	
		PO No.	

Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Ammonia	Total Sulphides									Receipt Temperature (°C)
1	CONT-IAM-0	22/11/2018		water	1 x 125 mL		X										
2	REF17-IAM-0	22/11/2018		water	1 x 125 mL		X										
3	REF18-IAM-0	22/11/2018		water	1 x 125 mL		X										
4	01-IAM-0	22/11/2018		water	1 x 125 mL		X										
5	06-IAM-0	22/11/2018		water	1 x 125 mL		X										
6	08-IAM-0	22/11/2018		water	1 x 125 mL		X										
7	11-IAM-0	22/11/2018		water	1 x 125 mL		X										
8	12-IAM-0	22/11/2018		water	1 x 125 mL		X										
9	13-IAM-0	22/11/2018		water	1 x 125 mL		X										
10	15-IAM-0	22/11/2018		water	1 x 125 mL		X										

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
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Chain of Custody

Date______ Page 6 of 16

Report to:		**Invoice To:**	
Company	Nautilus Environmental	Company	(same)
Address	8664 Commerce Court	Address	
City/Prov/PC	Burnaby, BC, V5A 4N7	City/Prov/PC	
Contact	Yvonne Lam	Contact	
Phone	604-420-8773	Phone	
Email	yvonne@nautilusenvironmental.ca	Email	
		PO No.	

Sample Collection By: **Sample Type:** Grab ○ OR Composite ○

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Ammonia	Total Sulphides									Receipt Temperature (°C)
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2	29-IAM-0	22/11/2018		water	1 x 125 mL		X										
3	31-IAM-0	22/11/2018		water	1 x 125 mL		X										
4	39-IAM-0	22/11/2018		water	1 x 125 mL		X										
5	40-IAM-0	22/11/2018		water	1 x 125 mL		X										
6	42-IAM-0	22/11/2018		water	1 x 125 mL		X										
7	44-IAM-0	22/11/2018		water	1 x 125 mL		X										
8	50-IAM-0	22/11/2018		water	1 x 125 mL		X										
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

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SAMPLE RECEIPT DETAILS (LABORATORY)

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SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)	**RECEIVED BY (LABORATORY)**
(Printed Name) Yvonne Lam (Signature)	(Printed Name) JC 2°3°C (Signature)
(Company) Nautilus (Date) Nov. 28/18 @ 0900h	(Company) ALS NOV 29 2018 11:55AM (Date DD/MM/YY and Time)

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Date________ Page 7 of 16

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1	CONT-IS-0	22/11/2018		water	1 x 125 mL			X									
2	REF17-IS-0	22/11/2018		water	1 x 125 mL			X									
3	REF18-IS-0	22/11/2018		water	1 x 125 mL			X									
4	01-IS-0	22/11/2018		water	1 x 125 mL			X									
5	06-IS-0	22/11/2018		water	1 x 125 mL			X									
6	08-IS-0	22/11/2018		water	1 x 125 mL			X									
7	11-IS-0	22/11/2018		water	1 x 125 mL			X									
8	12-IS-0	22/11/2018		water	1 x 125 mL			X									
9	13-IS-0	22/11/2018		water	1 x 125 mL			X									
10	15-IS-0	22/11/2018		water	1 x 125 mL			X									

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4	39-IS-0	22/11/2018		water	1 x 125 mL			X									
5	40-IS-0	22/11/2018		water	1 x 125 mL			X									
6	42-IS-0	22/11/2018		water	1 x 125 mL			X									
7	44-IS-0	22/11/2018		water	1 x 125 mL			X									
8	50-IS-0	22/11/2018		water	1 x 125 mL			X									
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1	CONT-OAM-48	24/11/2018		water	1 x 125 mL		X										
2	REF17-OAM-48	24/11/2018		water	1 x 125 mL		X										
3	REF18-OAM-48	24/11/2018		water	1 x 125 mL		X										
4	01-OAM-48	24/11/2018		water	1 x 125 mL		X										
5	06-OAM-48	24/11/2018		water	1 x 125 mL		X										
6	08-OAM-48	24/11/2018		water	1 x 125 mL		X										
7	11-OAM-48	24/11/2018		water	1 x 125 mL		X										
8	12-OAM-48	24/11/2018		water	1 x 125 mL		X										
9	13-OAM-48	24/11/2018		water	1 x 125 mL		X										
10	15-OAM-48	24/11/2018		water	1 x 125 mL		X										

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Chain of Custody

Date ______ Page 10 of 16

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
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Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides								Receipt Temperature (°C)
1	22-OAM-48	24/11/2018		water	1 x 125 mL		X									
2	29-OAM-48	24/11/2018		water	1 x 125 mL		X									
3	31-OAM-48	24/11/2018		water	1 x 125 mL		X									
4	39-OAM-48	24/11/2018		water	1 x 125 mL		X									
5	40-OAM-48	24/11/2018		water	1 x 125 mL		X									
6	42-OAM-48	24/11/2018		water	1 x 125 mL		X									
7	44-OAM-48	24/11/2018		water	1 x 125 mL		X									
8	50-OAM-48	24/11/2018		water	1 x 125 mL		X									
9																
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Date____ Page 11 of 16

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1	CONT-OS-48	24/11/2018		water	1 x 125 mL			X								
2	REF17-OS-48	24/11/2018		water	1 x 125 mL			X								
3	REF18-OS-48	24/11/2018		water	1 x 125 mL			X								
4	01-OS-48	24/11/2018		water	1 x 125 mL			X								
5	06-OS-48	24/11/2018		water	1 x 125 mL			X								
6	08-OS-48	24/11/2018		water	1 x 125 mL			X								
7	11-OS-48	24/11/2018		water	1 x 125 mL			X								
8	12-OS-48	24/11/2018		water	1 x 125 mL			X								
9	13-OS-48	24/11/2018		water	1 x 125 mL			X								
10	15-OS-48	24/11/2018		water	1 x 125 mL			X								

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(Printed Name) JC 2 & 3°C (Signature)

(Company) ALS NOV 29 2018 1155am (Date DD/MM/YY and Time)

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Date______ Page 12 of 16

Report to:

Company	Nautilus Environmental
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City/Prov/PC	Burnaby, BC, V5A 4N7
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1	22-OS-48	24/11/2018		water	1 x 125 mL			X									
2	29-OS-48	24/11/2018		water	1 x 125 mL			X									
3	31-OS-48	24/11/2018		water	1 x 125 mL			X									
4	39-OS-48	24/11/2018		water	1 x 125 mL			X									
5	40-OS-48	24/11/2018		water	1 x 125 mL			X									
6	42-OS-48	24/11/2018		water	1 x 125 mL			X									
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(Printed Name) Yvonne Lam (Signature)	(Printed Name) JC 2.3°C (Signature)
(Company) Nautilus (Date) Nov. 28/18 @ 0900h	(Company) ALS NOV 29 2018 11:55AM (Date DD/MM/YY and Time)

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Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides									Receipt Temperature (°C)
1	22-IAM-48	24/11/2018		water	1 x 125 mL		X										
2	29-IAM-48	24/11/2018		water	1 x 125 mL		X										
3	31-IAM-48	24/11/2018		water	1 x 125 mL		X										
4	39-IAM-48	24/11/2018		water	1 x 125 mL		X										
5	40-IAM-48	24/11/2018		water	1 x 125 mL		X										
6	42-IAM-48	24/11/2018		water	1 x 125 mL		X										
7	44-IAM-48	24/11/2018		water	1 x 125 mL		X										
8	50-IAM-48	24/11/2018		water	1 x 125 mL		X										
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)

(Printed Name) Yvonne Lam (Signature)

(Company) Nautilus (Date) Nov. 28/18 @ 0900h

RECEIVED BY (LABORATORY)

(Printed Name) JC 2.3 3C (Signature)

(Company) ALS NOV 29 2018 1155AM (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

TESTING LOCATION (Please Circle)

NAUTILUS ENVIRONMENTAL

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date______ Page 15 of 16

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ○ OR Composite ○

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides									Receipt Temperature (°C)
1	CONT-IS-48	24/11/2018		water	1 x 125 mL			X									
2	REF17-IS-48	24/11/2018		water	1 x 125 mL			X									
3	REF18-IS-48	24/11/2018		water	1 x 125 mL			X									
4	01-IS-48	24/11/2018		water	1 x 125 mL			X									
5	06-IS-48	24/11/2018		water	1 x 125 mL			X									
6	08-IS-48	24/11/2018		water	1 x 125 mL			X									
7	11-IS-48	24/11/2018		water	1 x 125 mL			X									
8	12-IS-48	24/11/2018		water	1 x 125 mL			X									
9	13-IS-48	24/11/2018		water	1 x 125 mL			X									
10	15-IS-48	24/11/2018		water	1 x 125 mL			X									

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)

(Printed Name) Yvonne Lam (Signature)

(Company) Nautilus (Date) Nov. 28/18 @ 0900h

RECEIVED BY (LABORATORY)

(Printed Name) JC 2 ↑ 3 °C (Signature)

(Company) ALS NOV 29 2018 11:55Am (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

TESTING LOCATION (Please Circle)

NAUTILUS ENVIRONMENTAL

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date_______ Page 16 of 16

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ○ OR Composite ○

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides								Receipt Temperature (°C)
1	22-IS-48	24/11/2018		water	1 x 125 mL			X								
2	29-IS-48	24/11/2018		water	1 x 125 mL			X								
3	31-IS-48	24/11/2018		water	1 x 125 mL			X								
4	39-IS-48	24/11/2018		water	1 x 125 mL			X								
5	40-IS-48	24/11/2018		water	1 x 125 mL			X								
6	42-IS-48	24/11/2018		water	1 x 125 mL			X								
7	44-IS-48	24/11/2018		water	1 x 125 mL			X								
8	50-IS-48	24/11/2018		water	1 x 125 mL			X								
9																
10																

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

L2203558-COFC

RELINQUISHED BY (CLIENT)

(Printed Name) Yvonne Lam (Signature)

(Company) Nautilus (Date) Nov. 28/18 @ 0900h

RECEIVED BY (LABORATORY)

(Printed Name) JC 2 ± 3°C (Signature)

(Company) ALS NOV 29 2018 1155Am (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020, Version 1.2; Revised by CC 2016/10/06

APPENDIX B – *Mytilus galloprovincialis* (PSEP) Toxicity Test Data

Bivalve Larval Development Sediment Test Summary Sheet

Client: Anchor
Work Order No.: 181647

Start Date: November 22, 2018
Set up by: YYL

Sample Information:

Sample ID: Various - see below
Sample Date: October 1, 2 and 3, 2018
Date Received: October 2, 3 and 4, 2018
Sample Volume: 1 x 3L per sample

Test Organism Information:

Species: *Mytilus galloprovincialis*
Supplier: Kamilche Seafarms, Shelton, WA
Date received: November 22, 2018

Copper Reference Toxicant Results:

Reference Toxicant ID: Mg52
Stock Solution ID: 18Cu03
Date Initiated: November 22, 2018

48-h EC50 Normal Larvae (95% CL): 12.5 (12.3 - 12.8) µg/L Cu

48-h EC50 Normal Larvae Reference Toxicant Mean ± 2 SD: 12.2 (8.4 - 17.8) µg/L Cu CV (%): 19

Test Results:

Sample ID	Survival ± SD (%)	Normal Larvae ± SD (%)	Combined Proportion Normal ± SD (%)
Control Seawater	86.5 ± 3.8	90.9 ± 2.4	78.7 ± 4.8
Control Sediment	77.6 ± 4.3 *	91.3 ± 2.0	70.8 ± 4.5
EHWW-11-SG-000010	76.3 ± 6.5 *	88.0 ± 4.9	67.4 ± 8.4 *
EHWW-39-SG-000010	77.6 ± 5.2 *	86.6 ± 2.8	67.2 ± 5.6 *
EHWW-50-SG-000010	69.8 ± 6.2 *	87.3 ± 5.2	61.0 ± 6.6 *,†

* Indicates samples that were significantly different relative to the control seawater
† Indicates samples that were significantly different relative to the control sediment

Reviewed by: A. Tang

Date reviewed: January 14, 2019

48-h Bivalve Development Sediment Toxicity Test Data Sheet

Client: Anchor
Work Order No.: 181647
Test Set up by: YML

Start Date & Time: November 22, 2018 @ 1715h
End Date & Time: November 24, 2018 @ 1745h
Test species: M. galloprovincialis

Sample ID	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Salinity (ppt)	
	0 h	24 h	48 h	0 h	24 h	48 h	0 h	24 h	48 h	0 h	48 h
Control Seawater	15.0	15.5	15.5	8.1	7.7	7.5	7.6	7.6	7.6	29	29
Control Sediment	15.0	15.5	15.5	8.0	7.7	7.4	7.6	7.6	7.6	29	29
EHWW-11-SG-000010	15.0	15.5	15.5	6.6	6.2	6.0	7.4	7.4	7.4	29	29
EHWW-39-SG-000010	15.0	15.5	15.5	6.6	6.3	5.9	7.4	7.4	7.4	29	29
EHWW-50-SG-000010	15.0	15.5	15.5	6.5	6.3	6.0	7.5	7.5	7.4	29	29
Analyst Initials	YML	YML	YML	YML	YML	YML	YML	YML	YML	YML	YML

Comments:
0 hrs:
24 hrs.
48 hrs.

Reviewed by: A. Tang

Date Reviewed: January 14/19

Bivalve Larvae Development Toxicity Test Data Sheet - Larval Counts

Client: Anchor
Work Order #: 181647
Test set up by: MWL

Start Date/Time: November 22, 2018 @ 1715h
End Date/Time: November 24, 2018 @ 1745h
Test species: *Mytilus galloprovincialis*

Initial Density/ 10 mL aliquot: 310

Sample ID	Rep	No. Normal	No. Abnormal	Comments	Initials
Control Seawater	A	241	23		MWL
	B	251	16		
	C	240	26		
	D	264	24		
	E	224	32		
Control Sediment	A	211	15		
	B	233	20		
	C	236	20		
	D	206	28		
	E	212	21		
EHWW-11 -SG-000010	A	165	41		
	B	215	32		
	C	227	27		
	D	208	18		
	E	229	21		
EHWW-39 -SG-000010	A	187	42		
	B	211	30		
	C	229	32		
	D	220	31		
	E	195	26		
EHWW-50 -SG-000010	A	184	14		
	B	208	34		
	C	156	41		
	D	200	26		
	E	197	22		
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				

Reviewed by: A. Tong

Date Reviewed: January 14, 2019

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control SW	17-8939-7448	22 Nov-18	22 Nov-18	17h	Anchor QEA	
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control SW	Control SW	Anchor QEA	Control SW	
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0601	Control Sed passed combined proportion n	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0601	EHWW-50 passed combined proportion no	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0601	EHWW-39 passed combined proportion no	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0601	EHWW-11 passed combined proportion no	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0601	Control SW passed combined proportion n	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3880	Control SW passed combined proportion n	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3880	Control Sed passed combined proportion n	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3880	EHWW-11 passed combined proportion no	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3880	EHWW-39 passed combined proportion no	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3880	EHWW-50 passed combined proportion no	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0098	EHWW-50 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0098	EHWW-39 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0098	EHWW-11 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0098	Control Sed failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0098	Control SW failed combined proportion nor	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3661	Control Sed passed combined proportion n	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3661	Control SW passed combined proportion n	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3661	EHWW-11 passed combined proportion no	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3661	EHWW-39 passed combined proportion no	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.3661	EHWW-50 passed combined proportion no	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0087	EHWW-50 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0087	EHWW-39 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0087	EHWW-11 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0087	Control Sed failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0087	Control SW failed combined proportion nor	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0327	Control Sed failed combined proportion nor	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0327	EHWW-11 failed combined proportion nor	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0327	EHWW-39 failed combined proportion nor	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0327	Control SW failed combined proportion nor	1
15-5849-9313	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.0327	EHWW-50 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	2.4E-04	EHWW-50 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	2.4E-04	EHWW-11 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	2.4E-04	EHWW-39 failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	2.4E-04	Control Sed failed combined proportion nor	1
20-5717-7987	Combined Proportion Norma	Dunnett Multiple Comparison Test	2.4E-04	Control SW failed combined proportion nor	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.8540	Control SW passed proportion normal	1

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.8540	EHWW-50 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.8540	EHWW-39 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.8540	EHWW-11 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.8540	Control Sed passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.2723	EHWW-50 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.2723	EHWW-39 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.2723	EHWW-11 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.2723	Control Sed passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.2723	Control SW passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.2012	Control SW passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.2012	EHWW-50 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.2012	EHWW-39 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.2012	EHWW-11 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.2012	Control Sed passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.0878	EHWW-50 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.0878	EHWW-39 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.0878	Control SW passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.0878	Control Sed passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.0878	EHWW-11 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.0662	Control SW passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.0662	Control Sed passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.0662	EHWW-39 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.0662	EHWW-50 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.0662	EHWW-11 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.1775	EHWW-39 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.1775	EHWW-11 passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.1775	Control Sed passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.1775	Control SW passed proportion normal	1
05-2295-0171	Proportion Normal	Dunnett Multiple Comparison Test	0.1775	EHWW-50 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.1307	EHWW-39 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.1307	EHWW-11 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.1307	Control Sed passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.1307	EHWW-50 passed proportion normal	1
15-8723-9048	Proportion Normal	Dunnett Multiple Comparison Test	0.1307	Control SW passed proportion normal	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0137	Control SW failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0137	EHWW-11 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0137	EHWW-39 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0137	EHWW-50 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0137	Control Sed failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0067	EHWW-50 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0067	Control SW failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0067	Control Sed failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0067	EHWW-11 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0067	EHWW-39 failed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.6221	Control SW passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.6221	Control Sed passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.6221	EHWW-39 passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.6221	EHWW-11 passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.6221	EHWW-50 passed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0148	EHWW-50 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0148	EHWW-39 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0148	Control Sed failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0148	EHWW-11 failed survival rate	1

Single Comparison Summary

Analysis ID	Endpoint	Comparison Method	P-Value	Comparison Result	S
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	0.0148	Control SW failed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.7625	EHWW-50 passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.7625	Control SW passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.7625	Control Sed passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.7625	EHWW-39 passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.7625	EHWW-11 passed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	1.0E-04	EHWW-39 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	1.0E-04	EHWW-50 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	1.0E-04	EHWW-11 failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	1.0E-04	Control Sed failed survival rate	1
03-3867-7903	Survival Rate	Dunnett Multiple Comparison Test	1.0E-04	Control SW failed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.0594	Control SW passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.0594	EHWW-11 passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.0594	EHWW-50 passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.0594	Control Sed passed survival rate	1
06-5132-6820	Survival Rate	Dunnett Multiple Comparison Test	0.0594	EHWW-39 passed survival rate	1

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control SW	N	5	0.7871	0.7279	0.8463	0.7226	0.8516	0.0213	0.0477	6.06%	0.00%
Control Sed	CS	5	0.7084	0.6530	0.7638	0.6645	0.7613	0.0200	0.0446	6.30%	10.00%
EHWW-11		5	0.6735	0.5695	0.7775	0.5323	0.7387	0.0375	0.0838	12.44%	14.43%
EHWW-39		5	0.6723	0.6028	0.7417	0.6032	0.7387	0.0250	0.0560	8.32%	14.59%
EHWW-50		5	0.6097	0.5281	0.6913	0.5032	0.6710	0.0294	0.0657	10.78%	22.54%

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control SW	N	5	0.9094	0.8800	0.9388	0.8750	0.9401	0.0106	0.0237	2.60%	0.00%
Control Sed	CS	5	0.9133	0.8882	0.9385	0.8803	0.9336	0.0091	0.0203	2.22%	-0.44%
EHWW-11		5	0.8803	0.8199	0.9406	0.8010	0.9204	0.0217	0.0486	5.52%	3.20%
EHWW-39		5	0.8657	0.8314	0.8999	0.8166	0.8824	0.0123	0.0276	3.18%	4.81%
EHWW-50		5	0.8730	0.8086	0.9375	0.7919	0.9293	0.0232	0.0519	5.95%	4.00%

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control SW	N	5	0.8652	0.8176	0.9128	0.8258	0.9290	0.0171	0.0383	4.43%	0.00%
Control Sed	CS	5	0.7755	0.7223	0.8287	0.7290	0.8258	0.0192	0.0428	5.52%	10.37%
EHWW-11		5	0.7632	0.6821	0.8443	0.6645	0.8194	0.0292	0.0653	8.56%	11.78%
EHWW-39		5	0.7761	0.7114	0.8408	0.7129	0.8419	0.0233	0.0521	6.71%	10.29%
EHWW-50		5	0.6981	0.6213	0.7748	0.6355	0.7806	0.0277	0.0618	8.86%	19.31%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	0.7774	0.8097	0.7742	0.8516	0.7226
Control Sed	CS	0.6806	0.7516	0.7613	0.6645	0.6839
EHWW-11		0.5323	0.6935	0.7323	0.6710	0.7387
EHWW-39		0.6032	0.6806	0.7387	0.7097	0.6290
EHWW-50		0.5935	0.6710	0.5032	0.6452	0.6355

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	0.9129	0.9401	0.9023	0.9167	0.8750
Control Sed	CS	0.9336	0.9209	0.9219	0.8803	0.9099
EHWW-11		0.8010	0.8704	0.8937	0.9204	0.9160
EHWW-39		0.8166	0.8755	0.8774	0.8765	0.8824
EHWW-50		0.9293	0.8595	0.7919	0.8850	0.8995

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	0.8516	0.8613	0.8581	0.9290	0.8258
Control Sed	CS	0.7290	0.8161	0.8258	0.7548	0.7516
EHWW-11		0.6645	0.7968	0.8194	0.7290	0.8065
EHWW-39		0.7387	0.7774	0.8419	0.8097	0.7129
EHWW-50		0.6387	0.7806	0.6355	0.7290	0.7065

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	241/310	251/310	240/310	264/310	224/310
Control Sed	CS	211/310	233/310	236/310	206/310	212/310
EHWW-11		165/310	215/310	227/310	208/310	229/310
EHWW-39		187/310	211/310	229/310	220/310	195/310
EHWW-50		184/310	208/310	156/310	200/310	197/310

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	241/264	251/267	240/266	264/288	224/256
Control Sed	CS	211/226	233/253	236/256	206/234	212/233
EHWW-11		165/206	215/247	227/254	208/226	229/250
EHWW-39		187/229	211/241	229/261	220/251	195/221
EHWW-50		184/198	208/242	156/197	200/226	197/219

Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	264/310	267/310	266/310	288/310	256/310
Control Sed	CS	226/310	253/310	256/310	234/310	233/310
EHWW-11		206/310	247/310	254/310	226/310	250/310
EHWW-39		229/310	241/310	261/310	251/310	221/310
EHWW-50		198/310	242/310	197/310	226/310	219/310

Bivalve Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	03-3867-7903	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:06	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control SW	17-8939-7448	22 Nov-18	22 Nov-18	17h	Anchor QEA	
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control SW	Control SW	Anchor QEA	Control SW	
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	Control Sed failed survival rate	7.79%
		EHWW-11 failed survival rate	7.79%
		EHWW-39 failed survival rate	7.79%
		EHWW-50 failed survival rate	7.79%

Dunnett Multiple Comparison Test

Sample I vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control	Control Sed*	2.937	2.305	0.094	8	CDF	0.0137	Significant Effect
	EHWW-11*	3.264	2.305	0.094	8	CDF	0.0067	Significant Effect
	EHWW-39*	2.901	2.305	0.094	8	CDF	0.0148	Significant Effect
	EHWW-50*	5.099	2.305	0.094	8	CDF	1.0E-04	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.110531	0.0276329	4	6.68	0.0014	Significant Effect
Error	0.0827307	0.0041365	20			
Total	0.193262		24			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	0.5422	13.28	0.9693	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9675	0.8877	0.5824	Normal Distribution

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	N	5	0.8652	0.8176	0.9128	0.8581	0.8258	0.9290	0.0171	4.43%	0.00%
Control Sed		5	0.7755	0.7223	0.8287	0.7548	0.7290	0.8258	0.0192	5.52%	10.37%
EHWW-11		5	0.7632	0.6821	0.8443	0.7968	0.6645	0.8194	0.0292	8.56%	11.78%
EHWW-39		5	0.7761	0.7114	0.8408	0.7774	0.7129	0.8419	0.0233	6.71%	10.29%
EHWW-50		5	0.6981	0.6213	0.7748	0.7065	0.6355	0.7806	0.0277	8.86%	19.31%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID: 03-3867-7903 **Endpoint:** Survival Rate **CETIS Version:** CETISv1.9.4
Analyzed: 07 Jan-19 17:06 **Analysis:** Parametric-Control vs Treatments **Status Level:** 1

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	N	5	1.198	1.123	1.273	1.185	1.14	1.301	0.02715	5.07%	0.00%
Control Sed		5	1.079	1.014	1.143	1.053	1.023	1.14	0.02324	4.82%	9.97%
EHWW-11		5	1.065	0.9717	1.159	1.103	0.953	1.132	0.0337	7.07%	11.08%
EHWW-39		5	1.08	1.002	1.158	1.079	1.005	1.162	0.02822	5.84%	9.85%
EHWW-50		5	0.9907	0.9062	1.075	0.9982	0.9226	1.083	0.03044	6.87%	17.31%

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	0.8516	0.8613	0.8581	0.9290	0.8258
Control Sed		0.7290	0.8161	0.8258	0.7548	0.7516
EHWW-11		0.6645	0.7968	0.8194	0.7290	0.8065
EHWW-39		0.7387	0.7774	0.8419	0.8097	0.7129
EHWW-50		0.6387	0.7806	0.6355	0.7290	0.7065

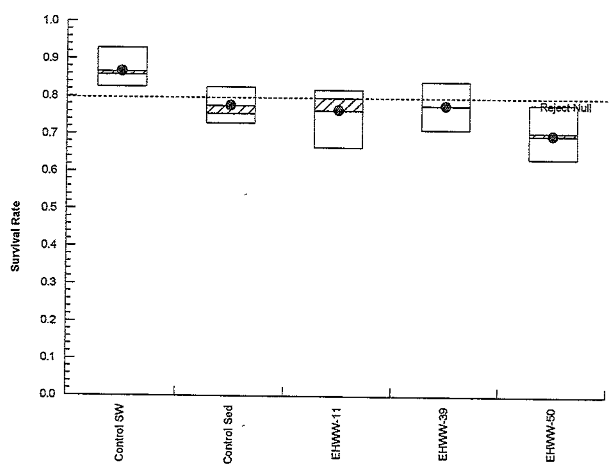
Angular (Corrected) Transformed Detail

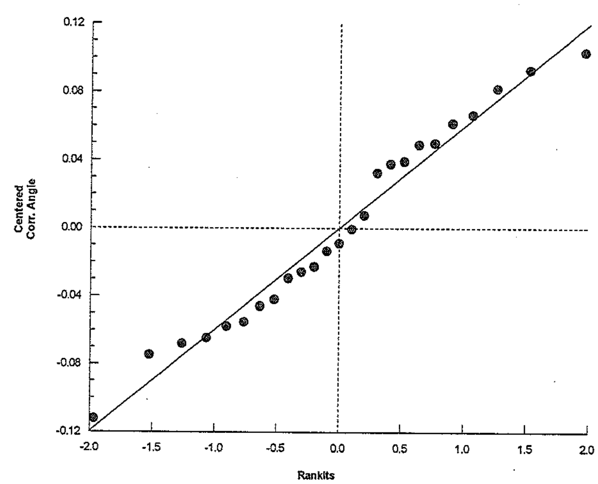
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	1.175	1.189	1.185	1.301	1.14
Control Sed		1.023	1.128	1.14	1.053	1.049
EHWW-11		0.953	1.103	1.132	1.023	1.115
EHWW-39		1.034	1.079	1.162	1.119	1.005
EHWW-50		0.926	1.083	0.9226	1.023	0.9982

Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	264/310	267/310	266/310	288/310	256/310
EHWW-11		206/310	247/310	254/310	226/310	250/310
EHWW-39		229/310	241/310	261/310	251/310	221/310
EHWW-50		198/310	242/310	197/310	226/310	219/310

Graphics





CETIS Analytical Report

Report Date: 07 Jan-19 17:08 (p 1 of 2)
Test Code/ID: 181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	05-2295-0171	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:06	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control SW	17-8939-7448	22 Nov-18	22 Nov-18	17h	Anchor QEA	
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control SW	Control SW	Anchor QEA	Control SW	
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	Control Sed passed proportion normal	5.52%
		EHWW-11 passed proportion normal	5.52%
		EHWW-39 passed proportion normal	5.52%
		EHWW-50 passed proportion normal	5.52%

Dunnett Multiple Comparison Test

Sample I vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control	Control Sed	-0.1832	2.305	0.081	8	CDF	0.8540	Non-Significant Effect
	EHWW-11	1.276	2.305	0.081	8	CDF	0.2723	Non-Significant Effect
	EHWW-39	2.001	2.305	0.081	8	CDF	0.0878	Non-Significant Effect
	EHWW-50	1.577	2.305	0.081	8	CDF	0.1775	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0233112	0.0058278	4	1.894	0.1509	Non-Significant Effect
Error	0.0615302	0.0030765	20			
Total	0.0848414		24			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	3.958	13.28	0.4117	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9293	0.8877	0.0837	Normal Distribution

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	N	5	0.9094	0.8800	0.9388	0.9129	0.8750	0.9401	0.0106	2.60%	0.00%
Control Sed		5	0.9133	0.8882	0.9385	0.9209	0.8803	0.9336	0.0091	2.22%	-0.44%
EHWW-11		5	0.8803	0.8199	0.9406	0.8937	0.8010	0.9204	0.0217	5.52%	3.20%
EHWW-39		5	0.8657	0.8314	0.8999	0.8765	0.8166	0.8824	0.0123	3.18%	4.81%
EHWW-50		5	0.8730	0.8086	0.9375	0.8850	0.7919	0.9293	0.0232	5.95%	4.00%

CETIS Analytical Report

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	05-2295-0171	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:06	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	N	5	1.267	1.216	1.318	1.271	1.209	1.323	0.0185	3.26%	0.00%
Control Sed		5	1.273	1.23	1.317	1.286	1.218	1.31	0.01562	2.74%	-0.51%
EHWW-11		5	1.222	1.133	1.311	1.239	1.108	1.285	0.03201	5.86%	3.53%
EHWW-39		5	1.197	1.149	1.245	1.212	1.128	1.221	0.01723	3.22%	5.54%
EHWW-50		5	1.212	1.117	1.307	1.225	1.097	1.302	0.03418	6.31%	4.37%

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	0.9129	0.9401	0.9023	0.9167	0.8750
Control Sed		0.9336	0.9209	0.9219	0.8803	0.9099
EHWW-11		0.8010	0.8704	0.8937	0.9204	0.9160
EHWW-39		0.8166	0.8755	0.8774	0.8765	0.8824
EHWW-50		0.9293	0.8595	0.7919	0.8850	0.8995

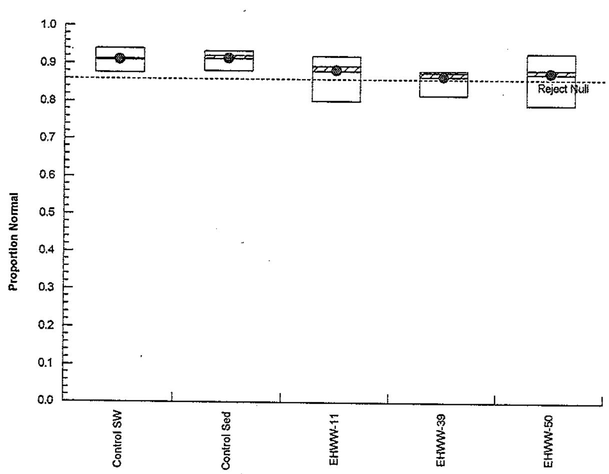
Angular (Corrected) Transformed Detail

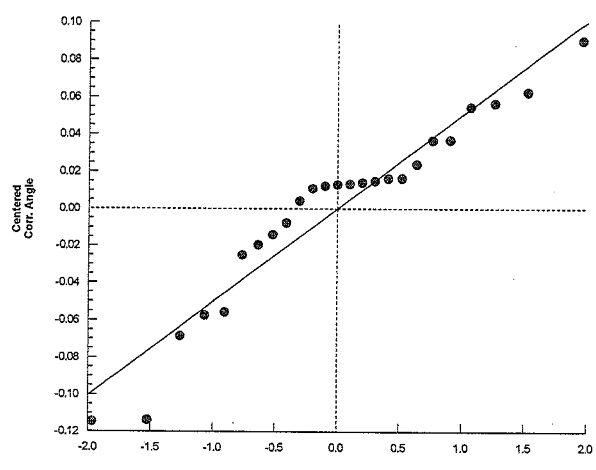
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	1.271	1.323	1.253	1.278	1.209
Control Sed		1.31	1.286	1.288	1.218	1.266
EHWW-11		1.108	1.203	1.239	1.285	1.277
EHWW-39		1.128	1.21	1.213	1.212	1.221
EHWW-50		1.302	1.187	1.097	1.225	1.248

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	241/264	251/267	240/266	264/288	224/256
EHWW-11		165/206	215/247	227/254	208/226	229/250
EHWW-39		187/229	211/241	229/261	220/251	195/221
EHWW-50		184/198	208/242	156/197	200/226	197/219

Graphics





CETIS Analytical Report

Report Date:	07 Jan-19 17:08 (p 1 of 2)
Test Code/ID:	181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-5717-7987	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam		
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater		
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**			
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms	**Age:**	

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control SW	17-8939-7448	22 Nov-18	22 Nov-18	17h	Anchor QEA	
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h		
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control SW	Control SW	Anchor QEA	Control SW	
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	Control Sed passed combined proportion nor	10.36%
		EHWW-11 failed combined proportion normal	10.36%
		EHWW-39 failed combined proportion normal	10.36%
		EHWW-50 failed combined proportion normal	10.36%

Dunnett Multiple Comparison Test

Sample I vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control	Control Sed	2.208	2.305	0.096	8	CDF	0.0601	Non-Significant Effect
	EHWW-11*	3.089	2.305	0.096	8	CDF	0.0098	Significant Effect
	EHWW-39*	3.144	2.305	0.096	8	CDF	0.0087	Significant Effect
	EHWW-50*	4.721	2.305	0.096	8	CDF	2.4E-04	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.103469	0.0258673	4	5.972	0.0025	Significant Effect
Error	0.0866351	0.0043318	20			
Total	0.190104		24			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	1.368	13.28	0.8498	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9478	0.8877	0.2239	Normal Distribution

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	N	5	0.7871	0.7279	0.8463	0.7774	0.7226	0.8516	0.0213	6.06%	0.00%
Control Sed		5	0.7084	0.6530	0.7638	0.6839	0.6645	0.7613	0.0200	6.30%	10.00%
EHWW-11		5	0.6735	0.5695	0.7775	0.6935	0.5323	0.7387	0.0375	12.44%	14.43%
EHWW-39		5	0.6723	0.6028	0.7417	0.6806	0.6032	0.7387	0.0250	8.32%	14.59%
EHWW-50		5	0.6097	0.5281	0.6913	0.6355	0.5032	0.6710	0.0294	10.78%	22.54%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-5717-7987	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	N	5	1.093	1.02	1.166	1.079	1.016	1.175	0.02634	5.39%	0.00%
Control Sed		5	1.001	0.9397	1.063	0.9737	0.953	1.06	0.02216	4.95%	8.41%
EHWW-11		5	0.9646	0.8558	1.073	0.9841	0.8177	1.034	0.0392	9.09%	11.76%
EHWW-39		5	0.9623	0.8881	1.036	0.9702	0.8894	1.034	0.02671	6.21%	11.97%
EHWW-50		5	0.8967	0.8135	0.9798	0.9226	0.7886	0.9599	0.02994	7.47%	17.98%

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	0.7774	0.8097	0.7742	0.8516	0.7226
Control Sed		0.6806	0.7516	0.7613	0.6645	0.6839
EHWW-11		0.5323	0.6935	0.7323	0.6710	0.7387
EHWW-39		0.6032	0.6806	0.7387	0.7097	0.6290
EHWW-50		0.5935	0.6710	0.5032	0.6452	0.6355

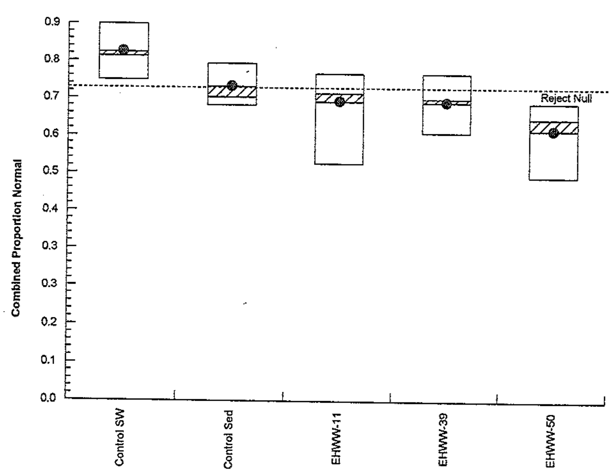
Angular (Corrected) Transformed Detail

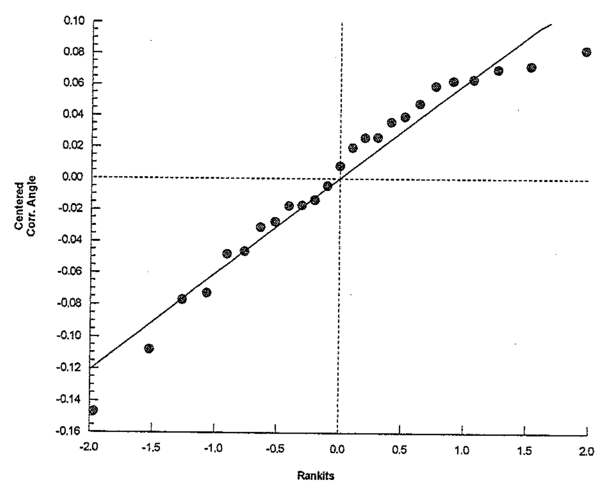
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	1.079	1.119	1.076	1.175	1.016
Control Sed		0.9702	1.049	1.06	0.953	0.9737
EHWW-11		0.8177	0.9841	1.027	0.9599	1.034
EHWW-39		0.8894	0.9702	1.034	1.002	0.9159
EHWW-50		0.8795	0.9599	0.7886	0.9327	0.9226

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	N	241/310	251/310	240/310	264/310	224/310
EHWW-11		165/310	215/310	227/310	208/310	229/310
EHWW-39		187/310	211/310	229/310	220/310	195/310
EHWW-50		184/310	208/310	156/310	200/310	197/310

Graphics





CETIS Analytical Report

Report Date:	07 Jan-19 17:08 (p 1 of 2)
Test Code/ID:	181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	06-5132-6820	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-11 passed survival rate	10.25%
		EHWW-39 passed survival rate	10.25%
		EHWW-50 passed survival rate	10.25%

Dunnett Multiple Comparison Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Control Sed		EHWW-11	0.3227	2.227	0.092	8	CDF	0.6221	Non-Significant Effect
		EHWW-39	-0.03538	2.227	0.092	8	CDF	0.7625	Non-Significant Effect
		EHWW-50	2.133	2.227	0.092	8	CDF	0.0594	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0271054	0.0090351	3	2.126	0.1370	Non-Significant Effect
Error	0.0679852	0.0042491	16			
Total	0.0950906		19			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	0.5118	11.34	0.9163	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9504	0.866	0.3737	Normal Distribution

Survival Rate Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	CS	5	0.7755	0.7223	0.8287	0.7548	0.7290	0.8258	0.0192	5.52%	0.00%
EHWW-11		5	0.7632	0.6821	0.8443	0.7968	0.6645	0.8194	0.0292	8.56%	1.58%
EHWW-39		5	0.7761	0.7114	0.8408	0.7774	0.7129	0.8419	0.0233	6.71%	-0.08%
EHWW-50		5	0.6981	0.6213	0.7748	0.7065	0.6355	0.7806	0.0277	8.86%	9.98%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	CS	5	1.079	1.014	1.143	1.053	1.023	1.14	0.02324	4.82%	0.00%
EHWW-11		5	1.065	0.9717	1.159	1.103	0.953	1.132	0.0337	7.07%	1.23%
EHWW-39		5	1.08	1.002	1.158	1.079	1.005	1.162	0.02822	5.84%	-0.14%
EHWW-50		5	0.9907	0.9062	1.075	0.9982	0.9226	1.083	0.03044	6.87%	8.15%

CETIS Analytical Report

Report Date: 07 Jan-19 17:08 (p 2 of 2)
Test Code/ID: 181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	06-5132-6820	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Survival Rate Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	0.7290	0.8161	0.8258	0.7548	0.7516
EHWW-11		0.6645	0.7968	0.8194	0.7290	0.8065
EHWW-39		0.7387	0.7774	0.8419	0.8097	0.7129
EHWW-50		0.6387	0.7806	0.6355	0.7290	0.7065

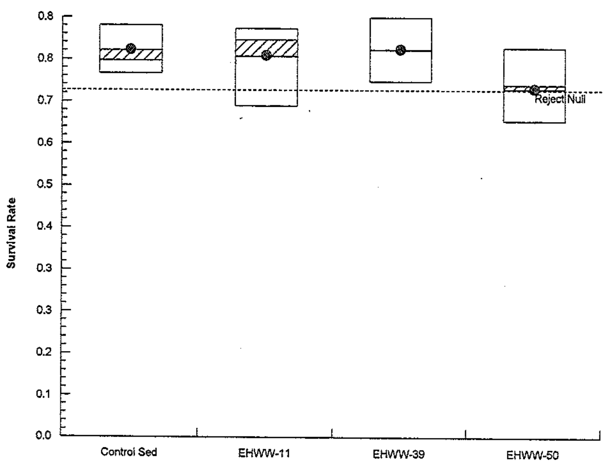
Angular (Corrected) Transformed Detail

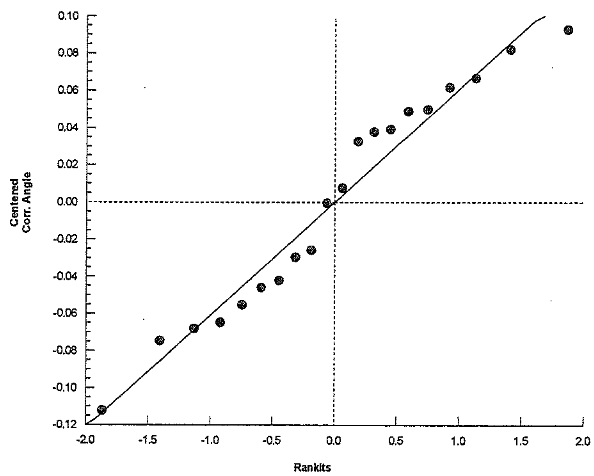
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	1.023	1.128	1.14	1.053	1.049
EHWW-11		0.953	1.103	1.132	1.023	1.115
EHWW-39		1.034	1.079	1.162	1.119	1.005
EHWW-50		0.926	1.083	0.9226	1.023	0.9982

Survival Rate Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	226/310	253/310	256/310	234/310	233/310
EHWW-11		206/310	247/310	254/310	226/310	250/310
EHWW-39		229/310	241/310	261/310	251/310	221/310
EHWW-50		198/310	242/310	197/310	226/310	219/310

Graphics





CETIS Analytical Report

Report Date: 07 Jan-19 17:08 (p 1 of 2)
Test Code/ID: 181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	15-8723-9048	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-11 passed proportion normal	5.56%
		EHWW-39 passed proportion normal	5.56%
		EHWW-50 passed proportion normal	5.56%

Dunnett Multiple Comparison Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Control Sed		EHWW-11	1.384	2.227	0.082	8	CDF	0.2012	Non-Significant Effect
		EHWW-39	2.072	2.227	0.082	8	CDF	0.0662	Non-Significant Effect
		EHWW-50	1.67	2.227	0.082	8	CDF	0.1307	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0166015	0.0055338	3	1.619	0.2244	Non-Significant Effect
Error	0.0546867	0.0034179	16			
Total	0.0712881		19			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	3.342	11.34	0.3418	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9123	0.866	0.0704	Normal Distribution

Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	CS	5	0.9133	0.8882	0.9385	0.9209	0.8803	0.9336	0.0091	2.22%	0.00%
EHWW-11		5	0.8803	0.8199	0.9406	0.8937	0.8010	0.9204	0.0217	5.52%	3.62%
EHWW-39		5	0.8657	0.8314	0.8999	0.8765	0.8166	0.8824	0.0123	3.18%	5.22%
EHWW-50		5	0.8730	0.8086	0.9375	0.8850	0.7919	0.9293	0.0232	5.95%	4.41%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	CS	5	1.273	1.23	1.317	1.286	1.218	1.31	0.01562	2.74%	0.00%
EHWW-11		5	1.222	1.133	1.311	1.239	1.108	1.285	0.03201	5.86%	4.02%
EHWW-39		5	1.197	1.149	1.245	1.212	1.128	1.221	0.01723	3.22%	6.02%
EHWW-50		5	1.212	1.117	1.307	1.225	1.097	1.302	0.03418	6.31%	4.85%

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	15-8723-9048	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	0.9336	0.9209	0.9219	0.8803	0.9099
EHWW-11		0.8010	0.8704	0.8937	0.9204	0.9160
EHWW-39		0.8166	0.8755	0.8774	0.8765	0.8824
EHWW-50		0.9293	0.8595	0.7919	0.8850	0.8995

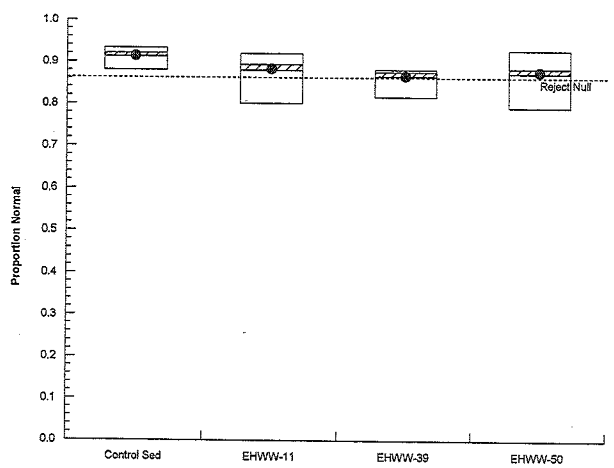
Angular (Corrected) Transformed Detail

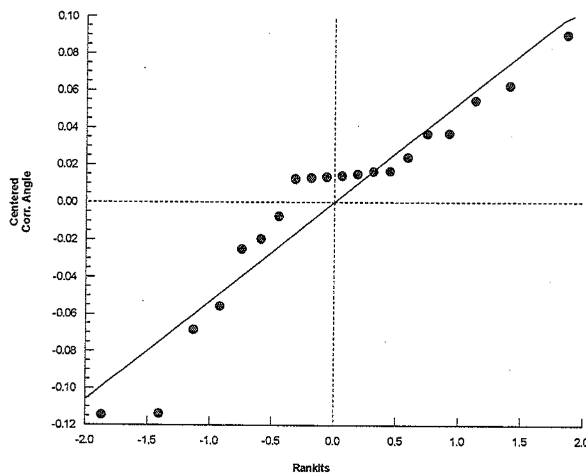
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	1.31	1.286	1.288	1.218	1.266
EHWW-11		1.108	1.203	1.239	1.285	1.277
EHWW-39		1.128	1.21	1.213	1.212	1.221
EHWW-50		1.302	1.187	1.097	1.225	1.248

Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	211/226	233/253	236/256	206/234	212/233
EHWW-11		165/206	215/247	227/254	208/226	229/250
EHWW-39		187/229	211/241	229/261	220/251	195/221
EHWW-50		184/198	208/242	156/197	200/226	197/219

Graphics





CETIS Analytical Report

Report Date:	07 Jan-19 17:08 (p 1 of 2)
Test Code/ID:	181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	15-5849-9313	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Batch ID:	18-9578-2855	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	22 Nov-18 17:15	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	24 Nov-18 17:45	**Species:**	Mytilus galloprovincialis	**Brine:**	
Test Length:	49h	**Taxon:**		**Source:**	Kamilche Seafarms **Age:**

Sample Code	Sample ID	Sample Date	Receipt Date	Sample Age	Client Name	Project
Control Sed	20-5725-3868	21 Nov-18	21 Nov-18	41h	Anchor QEA	
EHWW-11	09-5214-7885	03 Oct-18 13:52	04 Oct-18 16:25	50d 3h (5 °C)		
EHWW-39	18-6327-2153	01 Oct-18 10:40	02 Oct-18 16:20	52d 7h (10 °C)		
EHWW-50	02-6376-1429	02 Oct-18 16:10	03 Oct-18 13:45	51d 1h (17.1 °C)		

Sample Code	Material Type	Sample Source	Station Location	Lat/Long
Control Sed	Sediment Sample	Anchor QEA	Control Sediment	
EHWW-11	Sediment Sample	Anchor QEA	EHWW-11-SG-000010	
EHWW-39	Sediment Sample	Anchor QEA	EHWW-39-SG-000010	
EHWW-50	Sediment Sample	Anchor QEA	EHWW-50-SG-000010	

Data Transform	Alt Hyp	Comparison Result	PMSD
Angular (Corrected)	C > T	EHWW-11 passed combined proportion norm	12.52%
		EHWW-39 passed combined proportion norm	12.52%
		EHWW-50 failed combined proportion normal	12.52%

Dunnett Multiple Comparison Test

Sample I	vs	Sample II	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Control Sed		EHWW-11	0.8603	2.227	0.095	8	CDF	0.3880	Non-Significant Effect
		EHWW-39	0.9136	2.227	0.095	8	CDF	0.3661	Non-Significant Effect
		EHWW-50*	2.453	2.227	0.095	8	CDF	0.0327	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0284202	0.0094734	3	2.083	0.1427	Non-Significant Effect
Error	0.0727549	0.0045472	16			
Total	0.101175		19			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	1.262	11.34	0.7381	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.922	0.866	0.1081	Normal Distribution

Combined Proportion Normal Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	CS	5	0.7084	0.6530	0.7638	0.6839	0.6645	0.7613	0.0200	6.30%	0.00%
EHWW-11		5	0.6735	0.5695	0.7775	0.6935	0.5323	0.7387	0.0375	12.44%	4.92%
EHWW-39		5	0.6723	0.6028	0.7417	0.6806	0.6032	0.7387	0.0250	8.32%	5.10%
EHWW-50		5	0.6097	0.5281	0.6913	0.6355	0.5032	0.6710	0.0294	10.78%	13.93%

Angular (Corrected) Transformed Summary

Sample	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	CS	5	1.001	0.9397	1.063	0.9737	0.953	1.06	0.02216	4.95%	0.00%
EHWW-11		5	0.9646	0.8558	1.073	0.9841	0.8177	1.034	0.0392	9.09%	3.66%
EHWW-39		5	0.9623	0.8881	1.036	0.9702	0.8894	1.034	0.02671	6.21%	3.89%
EHWW-50		5	0.8967	0.8135	0.9798	0.9226	0.7886	0.9599	0.02994	7.47%	10.45%

CETIS Analytical Report

Report Date: 07 Jan-19 17:08 (p 2 of 2)
Test Code/ID: 181647 / 15-4827-4837

Bivalve Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	15-5849-9313	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.9.4
Analyzed:	07 Jan-19 17:07	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1

Combined Proportion Normal Detail

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	0.6806	0.7516	0.7613	0.6645	0.6839
EHWW-11		0.5323	0.6935	0.7323	0.6710	0.7387
EHWW-39		0.6032	0.6806	0.7387	0.7097	0.6290
EHWW-50		0.5935	0.6710	0.5032	0.6452	0.6355

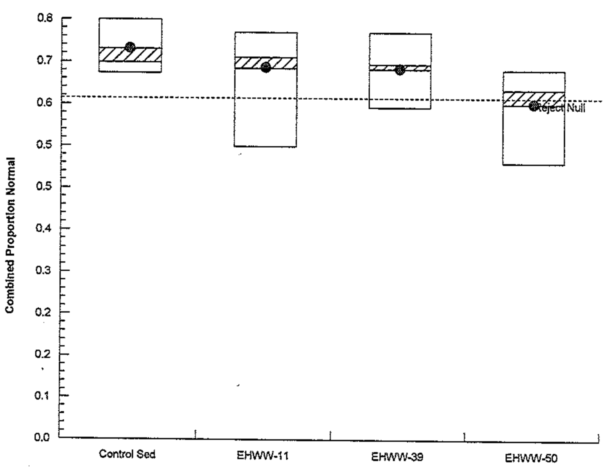
Angular (Corrected) Transformed Detail

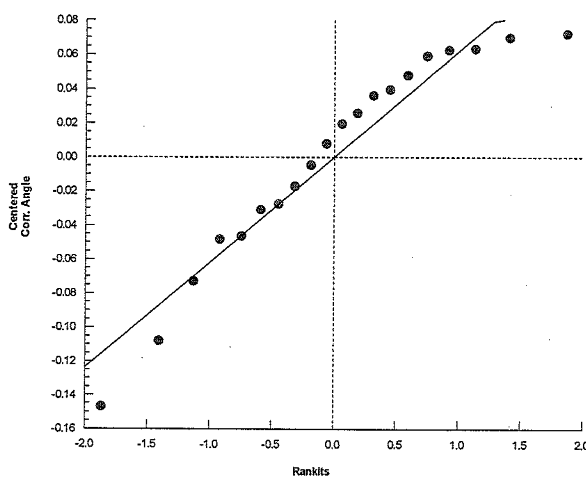
Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	0.9702	1.049	1.06	0.953	0.9737
EHWW-11		0.8177	0.9841	1.027	0.9599	1.034
EHWW-39		0.8894	0.9702	1.034	1.002	0.9159
EHWW-50		0.8795	0.9599	0.7886	0.9327	0.9226

Combined Proportion Normal Binomials

Sample	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	CS	211/310	233/310	236/310	206/310	212/310
EHWW-11		165/310	215/310	227/310	208/310	229/310
EHWW-39		187/310	211/310	229/310	220/310	195/310
EHWW-50		184/310	208/310	156/310	200/310	197/310

Graphics





Bivalve Larvae Development Toxicity Sediment Weight Data Sheet

Client: Anchor

Work Order #: 181647

Test set up by: YuL

Start Date/Time: November 22, 2018 @ 1715h

End Date/Time: November 24, 2018 @ 1745h

Test species: *Mytilus galloprovincialis*

Sample ID	Rep	Weight (g)	Initials	Sample ID	Rep	Weight (g)	Initials
Control Sediment	A	17.95	uuL		A		
	B	17.91			B		
	C	18.05			C		
	D	18.09			D		
	E	17.90			E		
EHWW-11-SG-000010	A	18.08			A		
	B	18.12			B		
	C	18.00			C		
	D	17.95			D		
	E	18.02			E		
EHWW-39-SG-000010	A	17.92			A		
	B	18.09			B		
	C	17.99			C		
	D	18.11			D		
	E	17.94			E		
EHWW-50-SG-000010	A	18.08			A		
	B	17.88			B		
	C	18.07			C		
	D	18.05			D		
	E	18.00			E		
	A				A		
	B				B		
	C				C		
	D				D		
	E				E		
	A				A		
	B				B		
	C				C		
	D				D		
	E				E		
	A				A		
	B				B		
	C				C		
	D				D		
	E				E		
	A				A		
	B				B		
	C				C		
	D				D		
	E				E		

Comments:

Reviewed by: A. Teng

Date Reviewed: Jan 14/19

Bivalve Larval Development Sediment Test - Ammonia

Client : Anchor
W.O.: 1816417

Test Date: November 22, 2018
Species: *M. galloprovincialis*

Overlying Ammonia

	Sample ID	Temperature (°C)	pH	Salinity (ppt)	Total Ammonia as Nitrogen (mg/L)	pKa	Unionized Ammonia (mg/L)
0h							
	Control Seawater	15.0	7.6	29	0.0077	9.737	0.000
	Control Sediment	15.0	7.6	29	0.0466	9.737	0.000
	EHWW-**11**-SG-000010	15.0	7.4	29	0.0170	9.737	0.000
	EHWW-**39**-SG-000010	15.0	7.4	29	0.274	9.737	0.001
	EHWW-**50**-SG-000010	15.5	7.5	29	0.157	9.737	0.001
48h							
	Control Seawater	15.5	7.6	29	<0.0050	9.737	(below detection limit)
	Control Sediment	15.5	7.6	29	<0.0050	9.737	(below detection limit)
	EHWW-**11**-SG-000010	15.5	7.4	29	<0.0050	9.737	(below detection limit)
	EHWW-**39**-SG-000010	15.5	7.4	29	0.163	9.737	0.001
	EHWW-**50**-SG-000010	15.5	7.4	29	0.0419	9.737	0.000

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	250	2000	10	20	30
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	9.737
18	9.465	9.502	9.557	9.588	9.619	9.636
19						9.604
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
25	9.246	9.283	9.337	9.366	9.397	9.414

AFT
Jan 14/19

NAUTILUS ENVIRONMENTAL
ATTN: Yvonne Lam
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 29-NOV-18
Report Date: 06-DEC-18 18:26 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2203552
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

H McKenzie

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2203552-1 water 22-NOV-18 CONTSW-OAM-0	L2203552-2 water 22-NOV-18 CONTSED-OAM-0	L2203552-3 water 22-NOV-18 11-OAM-0	L2203552-4 water 22-NOV-18 39-OAM-0	L2203552-5 water 22-NOV-18 50-OAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0077	0.0466	0.0170	0.274	0.157
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203552-6	L2203552-7	L2203552-8	L2203552-9	L2203552-10
	Description	water	water	water	water	water
	Sampled Date	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18	22-NOV-18
	Sampled Time					
	Client ID	CONTSW-OS-0	CONTSED-OS-0	11-OS-0	39-OS-0	50-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203552-11	L2203552-12	L2203552-13	L2203552-14	L2203552-15
	Description	water	water	water	water	water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	CONTSW-OAM-48	CONTSED-OAM-48	11-OAM-48	39-OAM-48	50-OAM-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.163	0.0419
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2203552-16	L2203552-17	L2203552-18	L2203552-19	L2203552-20
	Description	water	water	water	water	water
	Sampled Date	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18	24-NOV-18
	Sampled Time					
	Client ID	CONTSW-OS-48	CONTSED-OS-48	11-OS-48	39-OS-48	50-OS-48
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date________ Page 1 of 2

L2203552-COFC

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By: **Sample Type:** Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides								Receipt Temperature (°C)
1	CONTSW-OAM-0	22/11/2018		water	1 x 125 mL		X									
2	CONTSED-OAM-0	22/11/2018		water	1 x 125 mL		X									
3	11-OAM-0	22/11/2018		water	1 x 125 mL		X									
4	39-OAM-0	22/11/2018		water	1 x 125 mL		X									
5	50-OAM-0	22/11/2018		water	1 x 125 mL		X									
6	CONTSW-OS-0	22/11/2018		water	1 x 125 mL			X								
7	CONTSED-OS-0	22/11/2018		water	1 x 125 mL			X								
8	11-OS-0	22/11/2018		water	1 x 125 mL			X								
9	39-OS-0	22/11/2018		water	1 x 125 mL			X								
10	50-OS-0	22/11/2018		water	1 x 125 mL			X								

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

RELINQUISHED BY (CLIENT)	RECEIVED BY (LABORATORY)
Yvonne Lam (Printed Name) (Signature)	JC A1 5°C (Printed Name) (Signature)
Nautilus (Company) 28/11/18@0900h (Date DD/MM/YY and Time)	ALS (Company) NOV 29 2018 11:55Am (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date________ Page 2 of 2

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC, V5A 4N7
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

ANALYSES REQUIRED

L2203552-COFC

Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Toal Ammonia	Total Sulphides									Receipt Temperature (°C)
1	CONTSW-OAM-48	24/11/2018		water	1 x 125 mL		X										
2	CONTSED-OAM-48	24/11/2018		water	1 x 125 mL		X										
3	11-OAM-48	24/11/2018		water	1 x 125 mL		X										
4	39-OAM-48	24/11/2018		water	1 x 125 mL		X										
5	50-OAM-48	24/11/2018		water	1 x 125 mL		X										
6	CONTSW-OS-48	24/11/2018		water	1 x 125 mL			X									
7	CONTSED-OS-48	24/11/2018		water	1 x 125 mL			X									
8	11-OS-48	24/11/2018		water	1 x 125 mL			X									
9	39-OS-48	24/11/2018		water	1 x 125 mL			X									
10	50-OS-48	24/11/2018		water	1 x 125 mL			X									

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples are preserved - thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus (Company) 28/11/18 @ 0900h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

JC A1 5°C 11:55am (Printed Name) (Signature)

JC ALS (Company) NOV 29 2018 (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

APPENDIX C – Sediment Descriptions

Sediment Description Data Sheet

Client: Anchor
Work Order No.: 181641 /181647

Date: November 21, 2018
Test Organism: M. galloprovincialis

Sample ID	Grain Size	Colour	Odour	Debris	Other	Initials
Control Sediment	sand	grey-brown	(none)	(none)		WRL
EHWW-REF-17 ①	silt/clay	dark brown	sulphide	some twigs		
EHWW-REF-18 ①	silt/clay	brown	(~~none~~) earthy	(none)		
EHWW-01 ①	silt	dark brown	sulphide	woody debris		
EHWW-06 ①	silt	brown	(~~none~~) earthy	a few woody debris		
EHWW-08 ①	silt	brown	sulphide	lots of woody debris		
EHWW-11 ①	silt	brown	sulphide	woody debris		
EHWW-12 ①	silt/clay	dark brown	sulphide	slight woody debris		
EHWW-13 ①	silt/clay	dark brown	sulphide	woody debris		
EHWW-15 ①	silt	brown	(~~none~~) earthy	a few twigs		
EHWW-22 ①	silt	dark brown	slight sulphide	a few twigs, shells		
EHWW-29 ①	silt	brown	(~~none~~) earthy	(none)		
EHWW-31 ①	silt/clay	dark brown	sulphide	slight woody debris		
EHWW-39 ①	silt/clay	dark brown	earthy, slight sulphide	a few shells		
EHWW-40 ①	silt (~~coarse~~) (coarse)	brown	earthy	lots of woody debris		
EHWW-42 ①	silt	brown	sulphide	(none)		
EHWW-44 ①	silt	dark brown	slight sulphide	a few shells		
EHWW-50 ①	silt	brown	earthy	(none)		

① -36-000010

Reviewed by: A. Tang

Date Reviewed: January 14, 2019

APPENDIX D – Chain-of-Custody Forms

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/1/2018
Laboratory: **Nautilus**
Project Name: **EHRP Wood Debris Remediation**
Project Number: **170553-11.05**
Project Contact: **Cheronne Oreiro**
Phone Number: **206.971.2680**
Shipment Method: **Delivery**

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers (in 3L plastic bags)	Bioassay Archive	181641	48h bivalve larval development (SCCWRP)	48h BLD (PSEP) 181647	Temp (°C)	Comments
1	EHWW-01-SG-000010	10/1/18 1415	SE	1	X		X		10.0	
2	EHWW-02-SG-000010	1305	SE	1	X		X			
3	EHWW-03-SG-000010	1330	SE	1	X		X			
4	EHWW-06-SG-000010	1455	SE	1	X		X			
5	EHWW-07-SG-000010	0940	SE	1	X		X			
6	EHWW-08-SG-000010	1535	SE	1	X		X			
7	EHWW-09-SG-000010	1610	SE	1	X		X			
8	EHWW-24-SG-000010	1132	SE	1	X		X			
9	EHWW-39-SG-000010	1040	SE	1	X		X	X		
10			SE							
11			SE							
12			SE							
13			SE							
14			SE							

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
EVAN MALCZYK (Signature/Printed Name)	Anchor QEA LLC. 10/1/18 1913 (Date/Time)	TH Tyrone Hamilton (Signature/Printed Name)	Nautilus Oct. 02/18 @ 16:20 (Date/Time)
Relinquished By: Signature/Printed Name	Company: Date/Time	Received By: Signature/Printed Name	Company: Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/2/2018
Laboratory: **Nautilus**
Project Name: **EHRP Wood Debris Remediation**
Project Number: **170553-11.05**
Project Contact: **Cheronne Oreiro**
Phone Number: **206.971.2680**
Shipment Method: **Delivery**

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers (in 3L plastic bags)	Bioassay Archive	48h bivalve larval Development		181647 (SCCWRP)		48h BCD (PSEP) 181647	Comments
1	EHWW-04-SG-000010	10/2/2018 1545	SE	1	X						17.1°C
2	EHWW-15-SG-000010	0830	SE	1	X			X			
3	EHWW-16-SG-000010	0900	SE	1	X						
4	EHWW-17-SG-000010	0930	SE	1	X						
5	EHWW-18-SG-000010	1005	SE	1	X						
6	EHWW-19-SG-000010	1055	SE	1	X						
7	EHWW-20-SG-000010	1155	SE	1	X						
8	~~EHWW-21-SG-000010~~		SE								
9	EHWW-31-SG-000010	1500	SE	1	X			X			
10	EHWW-42-SG-000010	1245	SE	1	X			X			
11	EHWW-48-SG-000010	1420	SE	1	X						
12	EHWW-50-SG-000010	1610	SE	1	X			X		X	
13			SE								
14			SE								

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
EVAN MALCZYK [signature]	Anchor QEA LLC.	Tyrone Hamilton [signature]	Nautilus
Signature/Printed Name	Date/Time: 10/2/2018 ~~0700~~ 1900 pm 10/2	Signature/Printed Name	Date/Time: O.J. 03/18 @ ~~02:11~~ 13:45

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page ______ of ______

Chain of Custo[...]ecord and Laboratory Analysis Request — **COC#**

ANCHOR QEA

Date: 10/3/18
Laboratory : Nautilus
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers (in 3L plastic bags)	Bioassay Archive	48H Bivalve Larval Develop 1816~~80~~41 (SSCWRP)	48h BLD (PSEP) 181647	Temp °C	Comments
1	EHWW-27-SG-000010	10/3/18 1545	SE	1				5.0	
2	EHWW-22-SG-000010	1500	SE	1		X			
3	EHWW-26-SG-000010	1428	SE	1					
4	EHWW-11-SG-000010	1352	SE	1		X	X		
5	EHWW-11-SG-000010	1255	SE	1					
6	EHWW-14-SG-000010	1208	SE	1					
7	EHWW-33-SG-000010	1120	SE	1					
8	EHWW-30-SG-000010	1035	SE	1					
9	EHWW-10-SG-000010	0950	SE	1					
10	EHWW-REF17-SG-000010	0825	SE	1		X			
11	EHWW-REF18-SG-000010	0900	SE	1		X			
12	EHWW-13-SG-000010	1255	SE	1		X			
13			SE						
14			SE						

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By: Evan Malczyk	Company: Anchor QEA LLC.	Received By: Tyrone Hamilton	Company: Nautilus
Signature/Printed Name	Date/Time: 10/3/2018 1930	Signature/Printed Name	Date/Time: Oct. 04/18 @ 16:25
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Chain of Custody Record and Laboratory Analysis Request | **COC#**

Anchor QEA

Date: 10/5/2018
Laboratory: **Nautilus**
Project Name: **EHRP Wood Debris Remediation**
Project Number: **170553-11.05**
Project Contact: **Cheronne Oreiro**
Phone Number: **206.971.2680**
Shipment Method: **Delivery**

Sediment and Field QC

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers (in 3L plastic bag)	Bioassay Archive	48H bivalve larval	Development	WO# 181728 by	(SCCWRP)	Comments
1	EHWW-44-SG-000010	10/4/18 0815	SE	1	✓			X		[illegible]
2	EHWW-45-SG-000010	10/4/18 0850	SE	1	✓					8.9°C to 10.0°C temp. rec
3	EHWW-46-SG-000010	10/4/18 0930	SE	1	✓					
4	EHWW-47-SG-000010	10/4/18 1005	SE	1	✓					
5	EHWW-49-SG-000010	10/4/18 1049	SE	1	✓					
6	EHWW-41-SG-000010	10/4/18 1115	SE	1	✓					
7	EHWW-28-SG-000010	10/4/18 1200	SE	1	✓					
8	EHWW-29-SG-000010	10/4/18 1305	SE	1	✓			X		
9	EHWW-12-SG-000010	10/4/18 1410	SE	1	✓			X		
10	EHWW-35-SG-000010	10/4/18 1458	SE	1	✓					
11	EHWW-34-SG-000010	10/4/18 1540	SE	1	✓					
12	EHWW-32-SG-000010	10/4/18 1610	SE	1	✓					
13	EHWW-25-SG-000010	10/5/18 0755	SE	1	✓					
14	EHWW-23-SG-000010	10/5/18 0910	SE	1	✓					

1 See project SAP/QAPP for analyte lists and test methods
2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
[signature] EVAN MALCZYK	Anchor QEA LLC. 10/5/18 1500	[signature] Mika Davis	Hemmera 10/5/18 1501
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
[signature]	Hemmera 10/6/18	[signature]	Nautilus Env
Signature/Printed Name	Date/Time	Signature/Printed Name [signature]	Date/Time Oct 6/18 @ 1355h

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Chain of Custody Record and Laboratory Analysis Request

COC#

ANCHOR QEA

Date: 10/5/18
Laboratory: Nautilus
Project Name: EHRP Wood Debris Remediation
Project Number: 170553-11.05
Project Contact: Cheronne Oreiro
Phone Number: 206.971.2680
Shipment Method: Delivery

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers (in 3L plastic bags)	Bioassay Archive	48H Bivalve Larval Development	WO # 1817286+1	Comments
1	EHWW-40-SG-000010	10/5/18 0935	SE	1	✓		X	8.9-10.0°C rec'd
2	EHWW-43-SG-000010	10/5/18 1000	SE	1	✓			
3	EHWW-36-SG-000010	10/5/18 1040	SE	1	✓			
4	EHWW-37-SG-000010	10/5/18 1110	SE	1	✓			
5	EHWW-05-SG-000010	10/5/18 1150	SE	1	✓			
6			SE					
7			SE					
8			SE					
9			SE					
10			SE					
11			SE					
12			SE					
13			SE					
14			SE					

Sediment and Field QC

1 See project SAP/QAPP for analyte lists and test methods

2 Email sample confirmation report to labdata@anchorqea.com

Additional notes/comments:

Relinquished By:	Company:	Received By:	Company:
Evan Maczulak (signature)	Anchor QEA LLC.	Mika Davis (signature)	Hemmera
Signature/Printed Name: EVAN MACZULAK	Date/Time: 10/5/18 1520	Signature/Printed Name: Mika Davis	Date/Time: 10/5/18 1520

Relinquished By:	Company:	Received By:	Company:
(signature)	Hemmera	(signature)	Nautilus Env
Signature/Printed Name	Date/Time: 10/6/18.	Signature/Printed Name: [illegible]	Date/Time: 10/6/18 1355h

Distribution: *A copy will be made for the laboratory and client. The Project file will retain the original.*

Page 2 of 2

END OF REPORT

Appendix E
Statistical Evaluation

Multivariate Statistical Evaluation in Esquimalt Harbor

Multivariate patterns among bioassay results, sulphides, and wood waste in Esquimalt Harbour were evaluated using factor analysis for mixed data (FAMD), principal components analysis (PCA), hierarchical clustering, and k-means clustering. Bioassay tests were conducted for 17 sampling locations using the screen tube method. Replicate results were averaged for a single combined proportion normal for each location, which was used in this analysis to look at small gradations in toxicity between locations. These data represent a range of geographical locations, porewater sulphide concentrations, wood waste abundance, wood thickness, and wood types. This analysis was conducted to assess whether statistical associations between toxicity and any combination of sulphide and wood waste variables were present.

Patterns with categorical variables were evaluated through FAMD, using the FactoMineR and factoextra packages in R. Combined proportion normal and wood thickness in meters were treated as numerical variables. Diffusive gradients in thin films (DGT) porewater sulphide concentration was right-censored, due to saturated values. For this reason, it was treated as a categorical variable (low $\leq$10 mg/L, med $>$10 mg/L and $<$51.6 mg/L, high/saturated $\geq$51.6 mg/L). Surface wood abundance was categorized from no wood to substantial wood. Wood type was categorized according to presence of fibers, fragments, or bark. As part of the FAMD, all data were normalized to balance the influence of numerical and categorical variables. Sulphide and toxicity were analyzed with various combinations of the wood variables. The results were then clustered using hierarchical clustering and k-means clustering. No significant patterns emerged.

Relationships among exclusively continuous, numerical variables were analyzed with PCA and clustering, using FactoMineR, factoextra, and the R stats package. Combined proportion normal, wood thickness in meters, and percent cover were treated as numerical variables. Saturated DGT porewater sulphide concentrations were set to 51.6 mg/L, the upper limit of detection in the majority of this data set, and treated as numerical. All variables were centered about the mean and scaled by dividing by standard deviation. Hierarchical clustering using Euclidean distance with Ward's Method failed to describe the patterns observed in the substrate. PCA and k-means clustering results showed consistent patterns. K-means clustering was selected as the preferred analysis method because it is more directly interpretable.

A pair of k-means analyses for three centers was performed on the toxicity and sulphide data with either wood thickness or percent cover to represent wood waste presence. Radar plots were used to identify wood thickness as the better predictor of toxicity by highlighting non-random associations in the clusters (Figure E-1). The corners of the radar plot represent the centroid of each cluster within the scaled data, so the corner closest to the outer edge represents the greatest sulphide concentration, wood depth, or toxicity (expressed as the inverse of the combined proportion normal centroid). As such, the centroid of Cluster 1 is typified by lower than average toxicity, wood thickness, and sulphide. The Cluster 3 centroid is associated with greater than average toxicity, wood thickness, and sulphide. The Cluster 2 centroid represents low toxicity and wood thickness, despite high sulphide concentrations.

These patterns can also be visualized using scatterplots of the data, colored by cluster and labeled by sample location ID (Figure E-2). As these clusters represent multivariate relationships, they are not simply associated with either wood thickness or sulphide. However, the Cluster 3 points can be seen gathered in the lower range for combined proportion normal and the higher range for wood depth. These plots suggest that the relationship between toxicity and wood depth may be stronger than that between toxicity and sulphide, though neither relationship is tightly correlated.

The geographical distribution of the clusters can be seen with the wood thickness interpolation in Figure E-3. As in the scatterplots, the clusters do not directly follow either wood thickness or sulphide concentration, but some combination of the two along with small variations in toxicity. This exploratory analysis can be used to inform further consideration of the relationship between wood thickness and benthic toxicity.

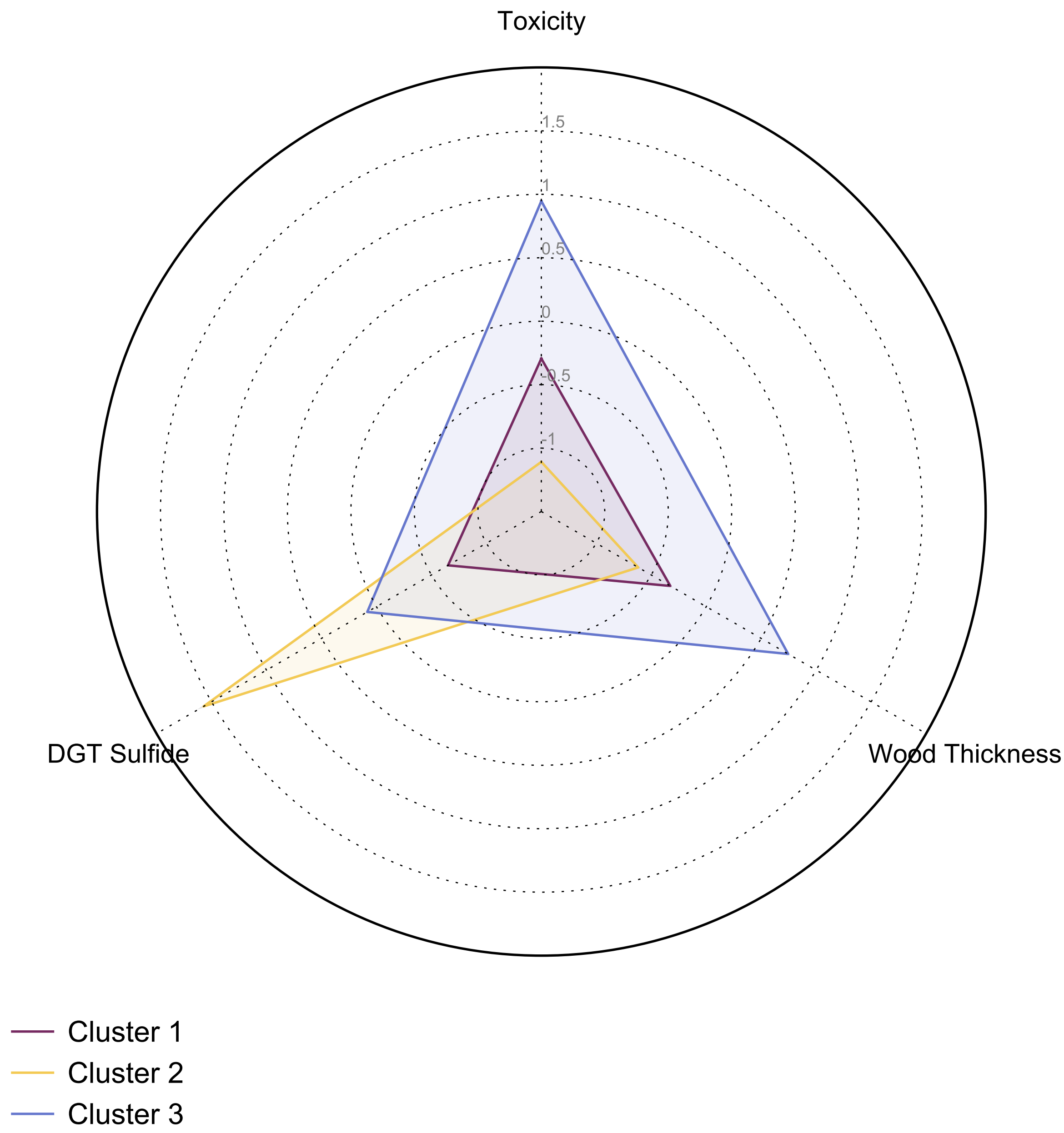
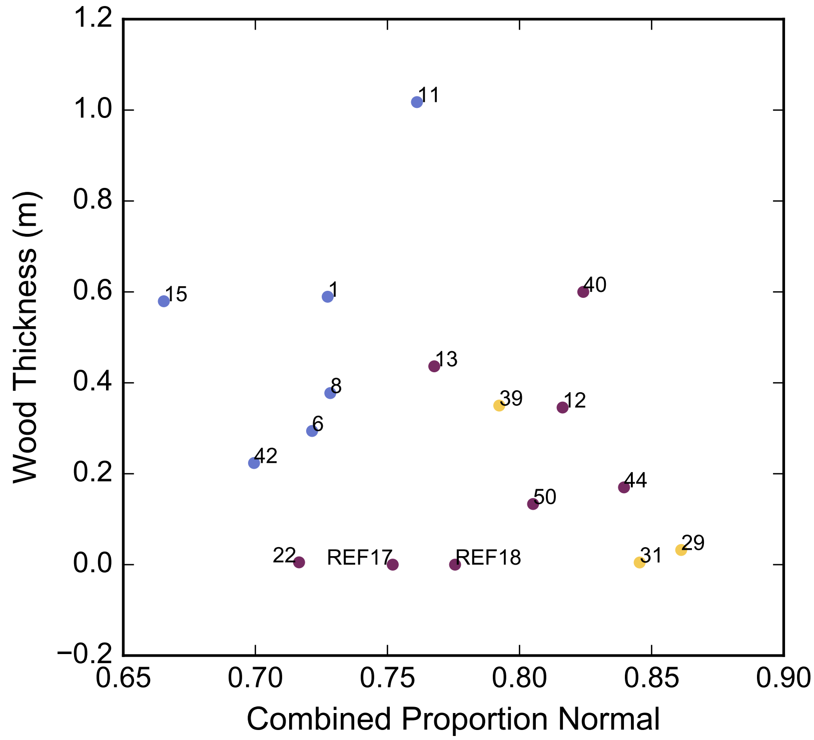
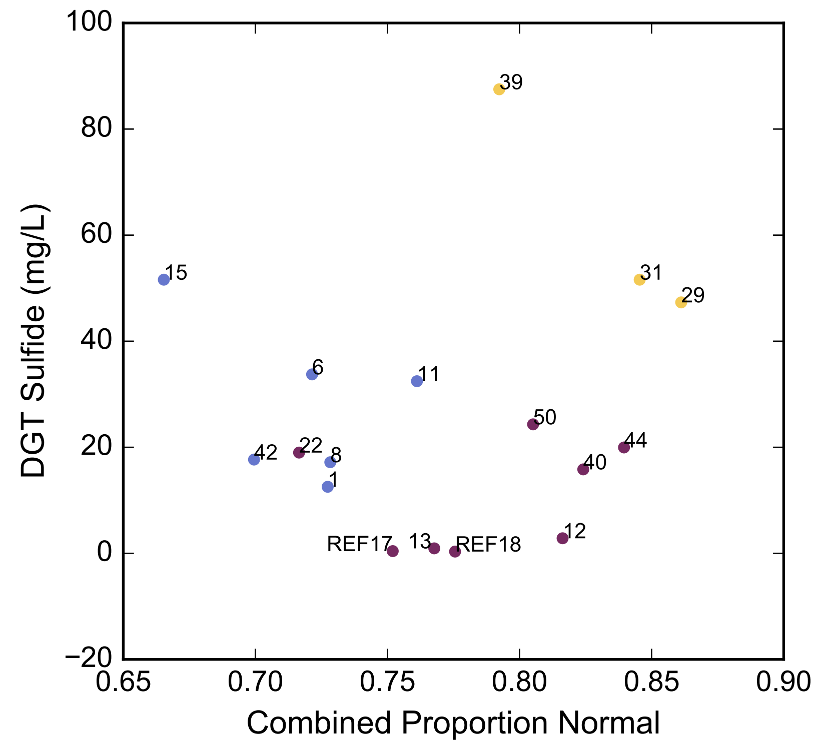


Figure E-1

Radar Plot of K-means Clusters

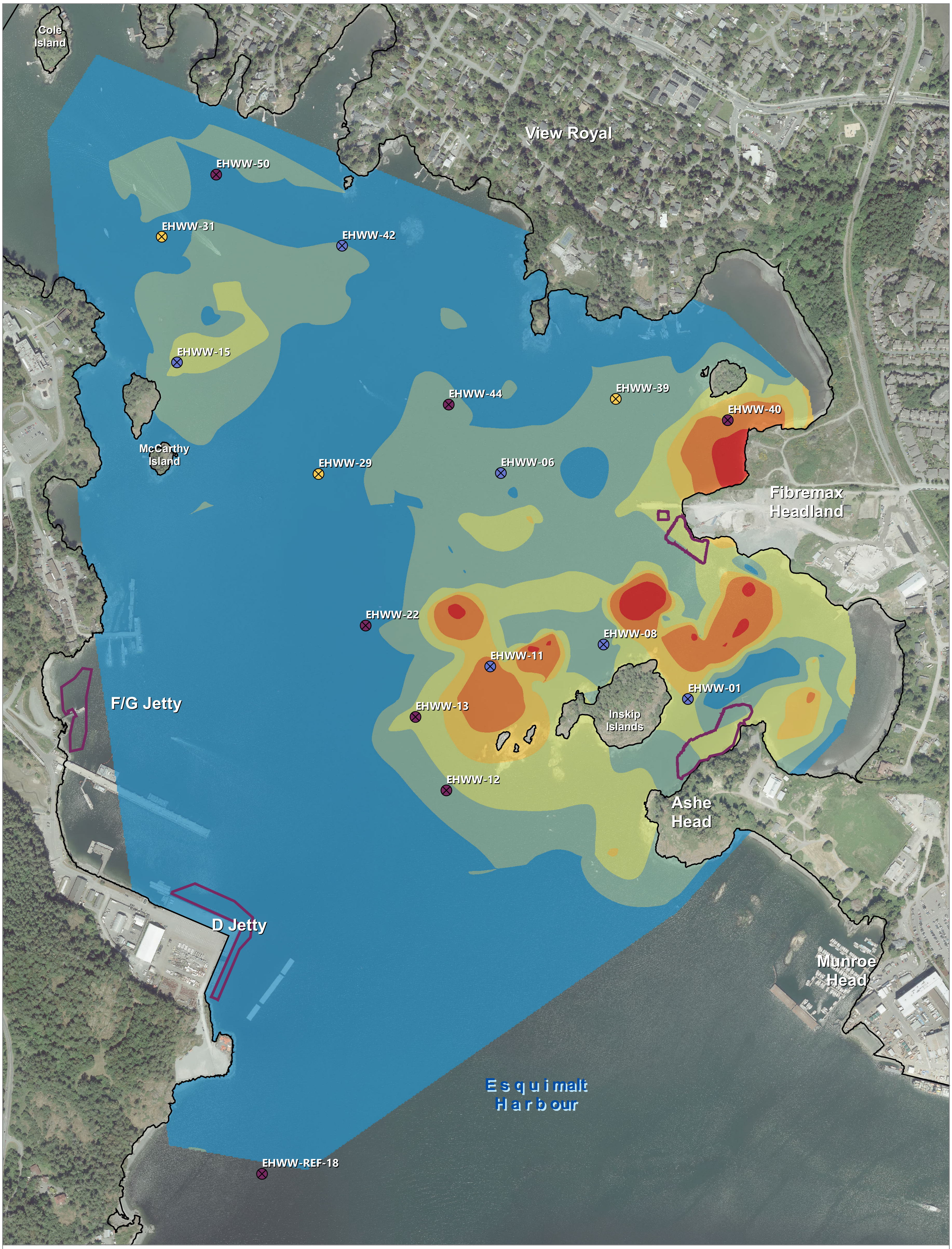
Corners of the radar plot represent the centroid of each cluster within the scaled data.
Corner closest to the outer edge of circles represents greatest sulfide concentration, wood depth, or toxicity.
Toxicity is expressed as the inverse of the combined proportion normal centroid.





Cluster 1
Cluster 2
Cluster 3

Figure E-2
Scatter Plot of K-means Clusters
Points are labeled with sample location ID.



LEGEND:

- Cluster 1 centroid has lower than average toxicity, wood thickness, and sulphide
- Cluster 2 centroid has lower than average toxicity and wood thickness, with high sulphide
- Cluster 3 centroid has higher than average toxicity, wood thickness, and sulphide
- Completed Remediation Projects

Wood Waste Thickness (metres)

- 0 - 0.2
- 0.21 - 0.4
- 0.41 - 0.6
- 0.61 - 0.8
- 0.81 - 1.5
- 1.51 - 3.55

NOTE:
The wood waste thickness was created using a Natural Neighbor interpolation method.

0 200
Metres

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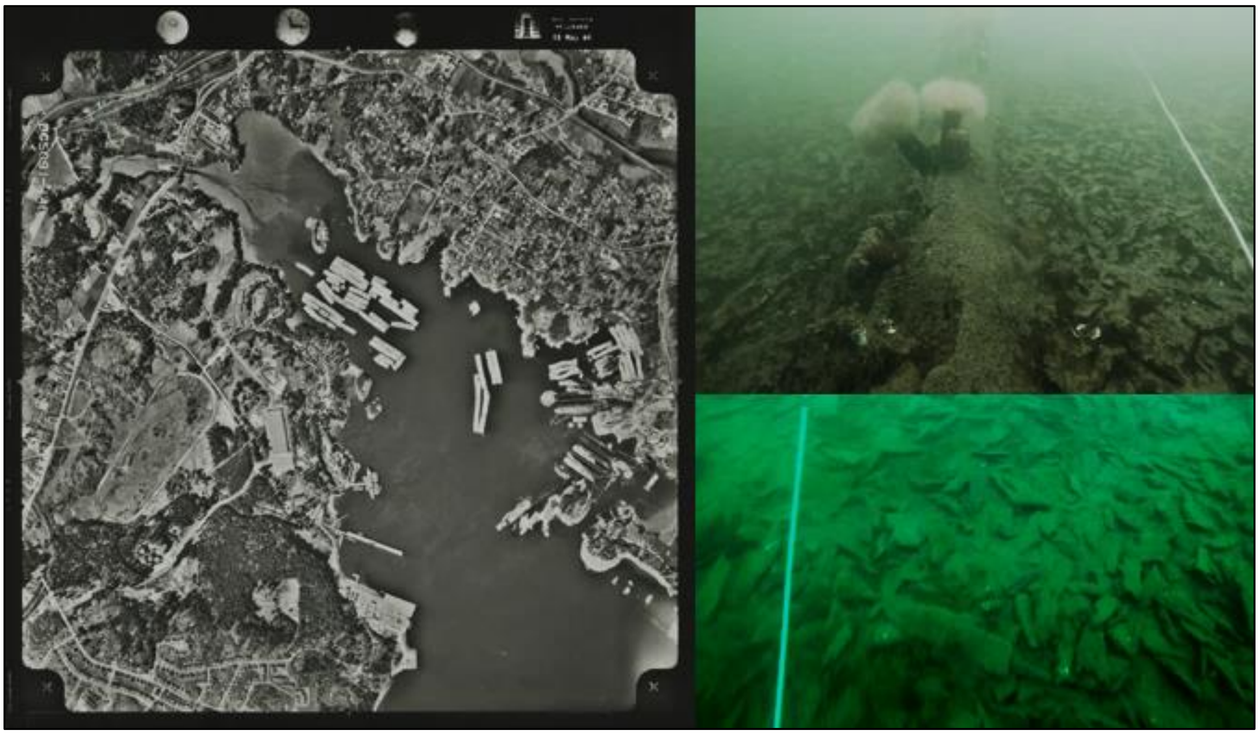
ANCHOR QEA

Figure E-3
Spatial Distribution of K-means Clusters
Wood Waste Remediation Project Data Memorandum

Appendix A-2
Characterization and Management Plan

Department of National Defence Esquimalt Harbour Wood Waste Assessment, Characterization and Management Plan



Prepared for:

Public Services and Procurement Canada
1230 Government Street
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Project No: R.091121.001

Project No. 989593-08

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March 1, 2018

EXECUTIVE SUMMARY

Esquimalt Harbour has historically been used for log booming, log storage and wood milling operations over the last 70 years. These activities have led to the accumulation of wood and wood debris deposits in the subtidal area of the Harbour. Wood waste deposits can negatively affect marine benthic communities through physical alteration of sediments and increased toxicity through contamination by leachate or the by-products of anaerobic decomposition. An assessment of the effects of wood waste on the subtidal marine environment was conducted on behalf of the Department of National Defence and in support of the Esquimalt Harbour Remediation Project.

This report documents the approach and findings of the assessment including:

- A review of the impacts of wood waste on marine subtidal habitats, a review of Esquimalt Harbour historical industrial activities and existing biophysical studies relating to the Project area, and wood waste delineations in the Harbour (Section 2.0)
- Results from field surveys undertaken to determine the nature and extent (lateral extent and depth) of the wood waste deposits, to document biophysical site conditions, and analyze sediment chemistry results (**Section 3.0**)
- An impact assessment of wood waste on the subtidal benthic community in Esquimalt Harbour (**Section 3.0**)
- Evaluation of remedial options and provide recommendations for next steps (**Section 4.0**)
- Development of a recommended site-specific pilot project to test the effectiveness of proposed remediation measures (**Section 5.0**).

Main findings of the assessment include:

- Wood Waste Delineation

  Wood waste is distributed in two large areas (>100 m wide) north of Inskip Island and reaching into Plumper Bay and south of Cole Island and two smaller areas of wood waste (<50 m wide). The spatial distribution of wood waste deposits was greater than visual observations of the surficial extent of wood waste. The nature of the wood waste was indicative of log storage and log booming areas, primarily small woody debris, composed of bark chips and scattered cut logs and some finer wood pulp/fibre. Wood pulp/fibre could be from historical wood-processing activities that occurred within the harbour (**Section 2.3**) or from the breakdown of small woody debris. The total volume of wood waste and overlying impacted sediments in the Harbour was estimated to be 332,299 m^3.

- Biophysical Conditions

  Esquimalt Harbour epibenthic communities documented for this report were similar to those documented by earlier assessments. In areas of known wood waste deposits epibenthic organisms were sparse with evidence of bacterial mats (Beggiatoa sp.) that are often associated with wood waste impacted sediments. Areas with exposed logs, provided hard substrate for rocky reef organisms to colonize/use as complex habitat structure for refuge. Infauna holes and mounds were relatively absent, indicating the lack of large bioturbators. The abundance and diversity of infauna communities varied across the harbour; however, most stations were dominated by a single second-order opportunistic polychaete species.

- Sediment Chemistry

  Decomposition by-products were assessed to determine drivers of impairment. Total organic carbon (TOC) levels were elevated in comparison to reference locations and had a distribution pattern that was correlated with the assessed extent of wood waste deposits. Pore-water sulphide and Ammonia did not show as tight of a relationship with the delineated area of wood waste.

- Impact Assessment

  Due to its strong correlation with TOC and areas of wood waste deposits, the presence of *Beggiatoa* sp. can be considered an indicator of benthic community impairment from wood waste deposits. Other epibenthic species, such as Dungeness and graceful crabs, were observed in areas of wood waste during surveys but been shown by other studies to use these areas as habitat if the overlying water quality is not impaired.

  Areas of greatest impact on the subtidal benthic community were determined using multivariate analysis and indicated that the sediment chemistry parameter most strongly linked with known areas of wood waste deposits and to differences in benthic infauna community composition and species richness was TOC. Benthic community impairment between 1 – 3% TOC was variable; however, a 3% TOC level has been determined to be a site-specific indicator for the impairment of benthic infauna due to wood waste deposits, with greater impacts observed at TOC levels >5%. The benthic infauna community in Esquimalt Harbour shows general signs of impairment (ranging from somewhat disturbed/impacted to low – moderate impairment) and is dominated by opportunistic polychaete species and the lack of larger bioturbators or species that are pollution-sensitive.

In general, the recommended approach for site-specific remediation of wood waste, and wood waste impacted sediments, is as follows:

- Dredging

  Complete removal of sediment/wood waste in areas where wood waste deposits are > 0.25m deep. Placement of clean fill following dredging to reduce residuals and provide clean substrate for the recruitment and establishment of productive infauna communities. Following the implementation of remediation efforts, a monitoring program will be required to track the recovery of the benthic community and remediated bottom sediments, in order to qualify the remediation for the DND Habitat Bank.

- Pilot Study Project

  Conduct an experimental in-field pilot study within the Harbour to investigate the site-specific effectiveness and feasibility of economical and less invasive remedial options (Monitored Natural and Enhanced Natural Recovery) for areas of discontinuous and/or shallow wood waste deposits (0 – 0.25 m).

ACKNOWLEDGEMENTS

We would like to acknowledge the efforts and valuable input to this Project from both Ashley Rabey, Environmental Specialist, and Kristen Ritchot, Environmental Specialist with Environmental Services, Public Services and Procurement Canada as well as Mike Waters, Environment Officer, Department of National Defence.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Photographs

List of Appendices

ACRONYMS

APEC	Areas of Potential Environmental Concern
AST	Above ground storage tank
BACI	Before After Control Impact
BC	British Columbia
BC MOE	British Columbia Ministry of Environment
BMP	Best Management Practice
BOD	Biological oxygen demand
CCA	Canonical correspondence analysis
CCME	Canadian Council of Ministers of the Environment
CD	Chart datum (where zero metres CD is equal to the average low water level)
CDF	Confined disposal facility
COPC	Contaminant of Potential Concern
DAS	Disposal at sea
DND	Department of National Defence
DQO	Data quality objectives
EMAP	Environmental Monitoring and Assessment Program
ENR	Enhanced natural recovery
EPA	Environmental Protection Agency
FCSI	Federal Contaminated Sites Inventory
FCSAP	Federal Contaminated Sites Action Plan
FPIP	Fisheries Productivity Investment Policy
HWL	High water level (approximately 4.5 m CD)
LWD	Large woody debris
MNR	Monitored Natural Recovery
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
QA/QC	Quality assurance and quality control
RPD	Relative percent differences
SQG	Sediment quality guidelines
SWI	Sediment-water Interface
TOC	Total organic carbon
UST	Underground storage tank
WWI	World War I
WWII	World War II

GLOSSARY

Aerobic Conditions	Presence of dissolved oxygen
Anaerobic Conditions	Depleted of dissolved oxygen
Anaerobic Decomposition	Metabolic functions without oxygen
Benthic Fauna	Organisms within the sediment, in the sediment-water interface, and immediately adjacent overlying water
Biological Oxygen Demand	A process used to determine the rate at which biological organisms use up oxygen in the water. High BOD reduces or removes available dissolved oxygen in the water column and pore water in the sediment.
Cellulolysis	The process of breaking down cellulose
Chemosynthetic	Organisms that use energy released in inorganic chemical reactions to produce sugars and amino acids
Epibenthic	Describes organisms that live on the surface of the sediment on the seafloor
Fibre Blanket	Wood waste not visible to the eye and defined by TOC levels above background levels attributed to wood, wood by-products and wood processing
Heterotrophic	An organism that cannot synthesize its own food and instead depends on organic carbon as a source of energy for growth
Infauna	Organisms that live within the bottom sediment of a body of water
Large Woody Debris	Naturally occurring woody debris that has not been cut or processed in the wood-processing industry, may contain roots or limbs
Methanogenic	Organisms that produce methane as a by-product of anaerobic respiration
Surficial Sediment	The surface layer of sediments (approximately 0-10cm)
Wood Waste	Any wood by-product of the wood processing industry, such as cut logs, bark, wood chips, sawdust or wood fibre

1.0 INTRODUCTION

Forestry and wood product processing has a long and important history in British Columbia (BC), with waterways providing the most efficient and economical way to transport and store timber. As a result, forestry-related activities, such as log booming, log storage and sawmill operations, have resulted in wood waste deposits accumulating in intertidal and subtidal nearshore habitats along the coast of BC. In Esquimalt Harbour (the Harbour), Federal leaseholds have been used for log booming over the last 70 years (most intensively in the 1940s to 1980s), leading to the accumulation of a large amount of wood and wood debris deposited on the Harbour floor.

Wood waste deposits can negatively affect marine benthic communities through physical alteration of sediments and increased toxicity through contamination by leachate or the by-products of anaerobic decomposition (i.e., hydrogen sulphide, ammonia and methane). Assessing the effects of wood waste on the marine environment is a priority for the Department of National Defence (DND) in alignment with the Esquimalt Harbour Remediation Project. To address this, the Esquimalt Harbour Wood Waste Assessment, Characterization and Management Plan Project (the Project) was undertaken over two fiscal years, from 2016-2018, by Public Services and Procurement Canada on behalf of DND (see **Figure 1.1** and **Figure 1.2** for Project location).

The objectives of the Project are to:

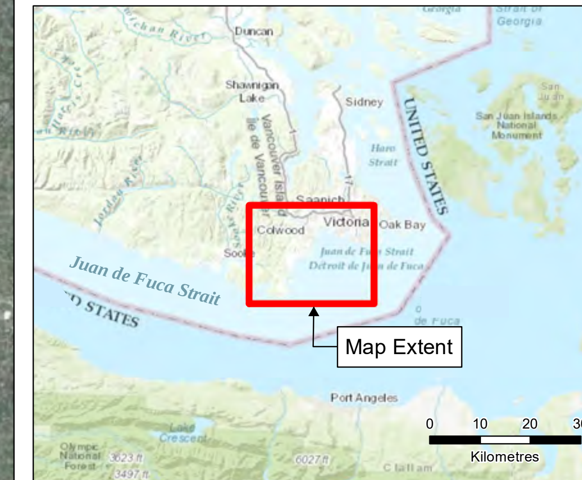
- Determine the nature (e.g. composition) and extent (lateral coverage and depth) of the wood waste deposits in Esquimalt Harbour
- Characterize the biophysical habitat conditions within areas of known wood waste deposits, transition zones, and areas without wood waste
- Analyze sediment chemistry parameters to determine the distribution of conventional contaminants of concern and conventional sediment chemistry parameters associated with wood waste or wood waste decomposition by-products
- Identify and assess the impacts of wood waste deposits on marine benthic community in Esquimalt Harbour
- Evaluate wood waste remediation options considering the site-specific conditions and results of the impact assessment and provide recommendations for remediation
- Develop a recommended site-specific pilot study project to test the effectiveness of more economical and less invasive remediation measures

This report documents the approach and findings of the assessment (Project) including:

- A review of the impacts of wood waste on marine subtidal habitats, a review of Esquimalt Harbour historical industrial activities and existing biophysical studies relating to the Project area, and wood waste delineations in the Harbour (**Section 2.0**)
- Results from field surveys undertaken to determine the nature and extent (lateral extent and depth) of the wood waste deposits, and to document biophysical site conditions (**Section 3.0**)
- An impact assessment of wood waste on the subtidal benthic community in Esquimalt Harbour (**Section 3.0**)
- A remedial management options analysis and recommendations for next steps (**Section 4.0**)
- Proposed plan for a remedial pilot project and publication of findings (**Section 5.0**)

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Project Site Locations



Legend

Limit of Federal Harbour

Project Site Location

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Limit of Federal Harbour: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: BING Imagery
- Inset Basemap: ESRI World Topographic Map

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Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Project Area

Legend

Limit of Federal Harbour

Notes

1. Locations should be considered approximate.
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Sources

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- Aerial Image: Capital Regional District, 2015.

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2.0 BACKGROUND INFORMATION REVIEW

This section contains a review of the impacts of wood waste on marine subtidal habitats, a review of Esquimalt Harbour historical industrial activities and existing biophysical studies relating to the Project area, and wood waste delineations in the Harbour.

2.1 OVERVIEW OF THE EFFECTS OF WOOD WASTE ON THE MARINE ENVIRONMENT

The processing of timber and wood products in coastal BC is common within and near aquatic and marine environments due to the ease of transportation; however, these activities result in widespread wood waste deposits on the seafloor. While aquatic ecosystems are adapted to breakdown and store naturally occurring large woody debris (LWD; e.g. Wood debris that has not been processed or cut, may still contain roots or limbs), increased volumes from industrial sources can exceed the natural assimilative capacity of marine ecosystems (Breems and Goodman 2009). The resulting direct and indirect impacts include physical alteration of sediments, the release of leachates, and the generation of toxic by-products during decomposition. Impacts of wood waste on the marine environment are largely site-specific depending on the type or size of wood waste (**Table 2.1**), the species from which it was derived, the degree of incorporation into the sediment, the volume present, local water movement, and the extent of decomposition (Kendall and Michelsen 1997).

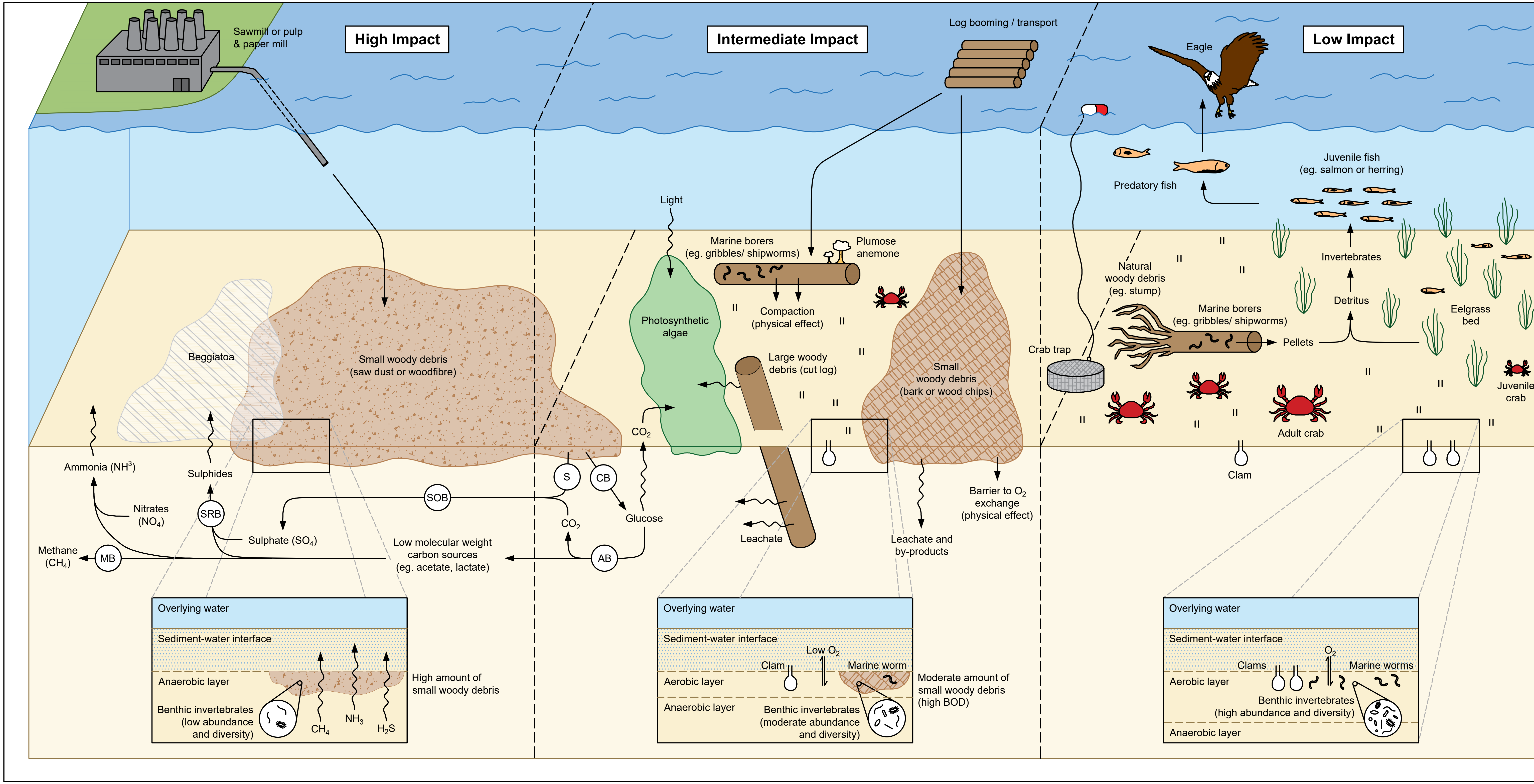
Natural wood debris deposited at the sediment-water interface (SWI) is typically broken down by various marine organisms in the nearshore environment (Maser and Sedell 1994). Large woody debris functions as the primary food source of wood-boring invertebrates, which recycle its nutrients and energy. Wood-boring Crustacea, (e.g. gribbles) and wood-boring bivalve mollusks (e.g. shipworms), colonize LWD before microbial decomposition takes place and ingest the wood through boring (Breems and Goodman 2009). The cellulose portion of the wood is used for nutrition and the remainder excreted as pellets of finely ground wood fibres containing lignin and cellulosic materials (Gonor et al. 1988, Maser and Sedell 1994, Breems and Goodman 2009). While gribbles can use approximately 45 percent of the consumed material, shipworms use approximately 58 percent (Gonor et al. 1988, Maser and Sedell 1994). The fine particulate material of the pellets is easily transported by currents and tides and contributes to the detrital food web that supports species such as forage fish, juvenile salmon and marine birds (Gonor et al 1988, Maser and Sedell 1994, Breems and Goodman 2009; see **Figure 2.1**).

However, small wood waste (e.g. bark, sawdust, or wood fibre) does not meet the habitat requirements of wood-boring invertebrates, wood-borers prefer freshly-deposited wood that has not undergone much decomposition, and industrial wood waste tends to accumulate too rapidly in large volumes, overwhelming the assimilative capacity of benthic communities and leading to an anthropogenic increase in organic content in the sediments of nearshore marine habitats (Breems and Goodman 2009, Washington State 2013). Wood waste-associated impacts to nearshore benthic communities can result in impairing productive habitats, which form the foundation of nearshore marine food webs, and are integral to recycling nutrients between the SWI (Washington State 2013).

Finer-textured wood waste (e.g. wood chips to sawdust) has a greater surface area to volume ration, and my have a greater ecological impact with less coverage (Washington State 2013). Therefore, an understanding of how each type of wood waste reacts in the marine environment is critical to understanding short- and long-term impacts and developing effective site-specific remediation strategies. Each of these impacts are described in detail in the sections below and highlighted in **Figure 2.1**.

Table 2.1 Summary of Subtidal Wood Waste Types, Sources, and Potential Impacts on Marine Ecosystems (Based on Breems and Goodman 2009)

Wood Waste Type	Potential Source	Definition	Potential Impact
Cut logs	Log booming, transport, and storage	Cut timbers of various lengths free of roots and limbs	• Leachate production (slow release rate) • Compaction of sediment • Bark production • Navigational hazard • Can mimic functions of Natural wood
Small woody debris - Bark and small branches	Log booming, log storage, and sawmills, depositional areas	Mainly bark and small wood less than 10 cm in diameter	• Physical barrier/smothering • H_2S, methane, or ammonia production • Leachate production
Small woody debris - Wood chips	Wood chipping and transport facilities	6-10 cm^2	• Physical barrier/smothering • H_2S, methane, or ammonia production • Leachate production
Small woody debris - Sawdust	Sawmills	10 mm^2	• Physical barrier/smothering • H_2S, methane, or ammonia production • Leachate production (rapidly depleted)
Wood fibre	Pulp and Paper mills	< 10 mm^2	• Physical barrier/smothering • H_2S, methane, or ammonia production



Legend

- Beggiatoa
- Photosynthetic algae
- **Small Woody Debris**
- Bark / wood chips
- Sawdust or wood fibre

- AB Aerobic heterotrophic bacteria
- CB Cellulolytic bacteria
- S Elemental sulphur (S)
- MB Methanogenic Bacteria
- SOB Sulphur oxidizing bacteria
- SRB Sulphide reducing bacteria

Notes

1. This figure is not intended to be a "stand-alone" document, but a visual aid to the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Figure not to scale.

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Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Conceptual Site Model

376-240.08	Production Date: Jan 11, 2019	Figure 2.1

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2.1.1 Physical Effects

Wood waste can have a physical effect on marine benthic habitat conditions and benthic fauna. The thickness and composition of wood waste can physically isolate the sediment surface, acting as a barrier to the movement and colonization of benthic invertebrates by limiting their ability to settle on the appropriate substrate type and/or burrow into sediments (e.g. Samis et al. 1999). Wood waste accumulations as shallow as 1 cm can lead to a decline in the abundance of suspension feeders, while deposits up 15 cm can greatly reduce invertebrate biomass and diversity (Conlan and Ellis 1979). Similarly, Jackson (1986) demonstrated that bark accumulations >2.5 cm may eliminate mollusks and several polychaete worm species.

Many benthic species rely on the nutrients and oxygen supplied by an adequately flushed sediment column. A breakdown in the exchange of nutrients and oxygen alters the composition and distribution of the benthic invertebrate population. Accumulated wood waste can form a physical barrier to the transfer of nutrients and oxygen between the SWI and the sediment interstitial spaces (**Figure 2.1**). Critically, accumulation of wood waste at the SWI results in the smothering of any present biota, which in turn reduces mixing of the upper sediment layer by burrowing invertebrates and results in a reduction in the presence of oxygen and ultimately produces an anaerobic environment. Full coverage of benthic sediments with bark, in depths of up to 10 cm, can decrease the dissolved oxygen concentration at the sediment surface from 10 mg/L to 2.5 mg/L (Pentec 1997). The alteration of the upper sediment layer from an aerobic to an anaerobic environment is a key driver in reducing species diversity and the production of toxic by-products from the breakdown of total organic carbon (TOC).

Finally, the texture, size and potential mobility of smaller wood waste may limit the attachment of species requiring immobile rocky substrates such as kelps; however, larger logs can provide a source of attachment or cover for marine borers and some species of algae, anemone, crab and fish (Breems and Goodman 2009; **Figure 2.1**). The natural nearshore environment is a highly productive ecosystem and the decline or loss of habitat and biological communities from physical impacts can have a significant impact on the overall ecosystem. For effective recovery, sediments require the elimination of wood waste and sources, improved dissolved oxygen at the SWI and within surficial sediments through flushing and bioturbation by benthic invertebrates within the surficial sediments (ie. Benthic infauna).

2.1.2 Leachate Production

When wood waste is in contact with water, chemical compounds that are toxic to a range of benthic invertebrates and fish species, leach into the surrounding environment (Pearse 1974, Peters et al. 1976, Buchanan et al. 1976, Samis et al. 1999). The composition of compounds and their concentrations in the leachate vary depending upon the tree species, size, and age, but may include: tropolones, lignins, fatty acids and resin acids (Samis et al. 1999). Although the amount of leachate released from wood waste is reduced as the wood becomes saturated and sinks, it can still be toxic to marine organisms. However, toxins may not accumulate to lethal concentrations in areas with sufficient water exchange (Samis et al. 1999). Larger logs tend to slowly release leachate over a longer duration as the inner, unsaturated wood contains higher concentrations of contaminants that remain available to the environment as they degrade (Yücel et al 2012). Daily tidal movement may further reduce the impacts of leachate through flushing; although this likely has little effect on contaminants accumulated in the pore water sediment adjacent to and beneath wood waste deposits (Breems and Goodman 2009).

2.1.3 By-Products from the Breakdown of Wood Waste

The breakdown of smaller wood waste is largely the result of the microbial metabolism, where bacteria feed on the wood, break it down, and create decomposition by-products under either aerobic or anaerobic conditions. Under aerobic conditions, heterotrophic bacteria assist in the breakdown of wood waste by metabolizing sugars (i.e., glucose; generated during the degradation of cellulose by cellulolytic bacteria) and producing carbon dioxide and simple carbon-based compounds (lower molecular weight carbon sources as by-products (i.e. acetate; Maser and Sedell 1994; see **Figure 2.1**). However, the consumption of oxygen by bacteria, known as biological oxygen demand (BOD), further decreases the availability of dissolved oxygen in the interstitial pore water and at the SWI (Samis et al. 1999). In marine systems, the renewal of dissolved oxygen at the SWI is normally rapid, unless wood waste accumulations are excessively high, blocking circulation or flushing (Pearson et al. 1980; **Figure 2.1**).

Under anaerobic conditions, wood waste decomposition can still occur through anaerobic decomposition, whereby bacteria use chemicals other than oxygen (Pearson 1980). There are various types of anaerobic heterotrophs that breakdown cellulose (via cellulolysis) into low molecular weight organic acid metabolites (e.g. acetate, lactate, succinate and other organic acids; Pearson 1980). In the absence of oxygen, bacteria preferentially use commonly found nitrates (NO_4), along with a low molecular weight organic carbon source, producing ammonia (NH_3) as a by-product (**Figure 2.1**; Pearson 1980). Ammonia, exists in equilibrium between the un-ionized (NH_3) and ionized form (NH_4^+) and is typically found in higher concentrations within sediment porewater than the overlying water column, but can diffuse in stagnant conditions (**Figure 2.1**; Pearson 1980, Gray et al. 2002). At low concentrations ammonia can be acutely toxic to fish and other marine organisms, in particular un-ionized ammonia (Gray et al. 2002).

Once nitrates have been depleted, sulphate reducing bacteria, particularly *Desulfovibrio*, use the low molecular weight carbon sources and the abundance of sulfate (SO_4^{2-}) in marine sediments as an electron receptor to produce sulphide (HS^-), generally in the form of hydrogen sulphide (H_2S; **Figure 2.1;** Pearson 1980, Goodman et al. 1995, Samis et al. 1999 Wang and Chapman 1999, Hyland et al. 2005). The sulphide gradient is often characterized by a black iron sulphide precipitate and a distinct rotten egg odour (Podger unpublished). Within sediments and porewater, the hydrogen sulphide may become trapped and remain acutely toxic to benthic infaunal invertebrates for extended periods of time. However, at the SWI, H_2S readily converts to the non-toxic SO_4 in the presence of oxygen (Podger unpublished), with a short half-life (approximately 20 minutes, Östlund and Alexander 1963). Hydrogen sulphide can have a toxic effect on benthic marine invertebrates, fish and marine vegetation such as eelgrass (e.g. Goodman et al. 1995, Wang and Chapman 1999, Pederson et al. 2004, Hyland et al. 2005, Elliott et al. 2006, Podger Unpublished). The ability to mix oxygen into the upper sediment layers that contain wood waste may help to reduce H_2S production.

Sulphides in the sediment can also be oxidized to the non-toxic SO_4 by species of the multicellular filamentous chemosynthetic bacteria, *Beggiatoa* (Pearson 1980). *Beggiatoa* spp. are widely distributed in coastal sediments with a high organic load (Amend et al. 2004) and are limited to the zone of transition between aerobic and anaerobic environments. Dense white bacterial mats (between 0.5 – 3.0 cm thick) form when the oxygen-sulphide transition zone exists at the SWI (**Figure 2.1**; Podger unpublished, Pearson 1980, Jørgensen 1977, Muβmann et al. 2003). *Beggiatoa* spp. will continue to use hydrogen sulphides, keeping the underlying sediment anaerobic by creating a membrane of dense bacterial mats over the sediment, and obstructing the recovery of degraded sediments. In these conditions fish prey species occur in extremely low abundances and the resulting low dissolved oxygen conditions can become uninhabitable to many fish species (SAIC 1999). The presence of *Beggiatoa* mats can therefore be a good indicator of organic enrichment (i.e. TOC) from anthropogenic activities such as aquaculture or wood-processing (Fenchel and Bernard 1995, Elliott et al. 2006). However, the presence of the dense white mats is dependent on site-specific conditions, namely the presence of the oxygen-sulphide transition zone at the SWI. When the aerobic-anaerobic boundary falls below the sediment surface, large numbers of inconspicuous *Beggiatoa* spp. may occur in the top few centimeters of the sediment (predominantly 0.5 – 2.5 cm), often as the dominant organism, without forming large white mats on the surface (Jørgensen 1977, Muβmann et al. 2003). *Beggiatoa* spp. are classified by their gliding motility and have been shown to vertically migrate in sediment with a rapid change in the depth of the oxygen-sulphide transition zone (Jørgensen 1977, Muβmann et al. 2003). The presence of oxygen at the SWI, or within the first few centimeters of the sediment, can be both temporal (influenced by season) or spatial (influenced by wave action transporting oxygen into the SWI, by the bioturbation of benthic marine invertebrates in the surficial sediment layers, or by heterogenous distribution of wood waste in surfical sediments) (Podger unpublished, Jørgensen 1977, Fenchel and Bernard 1995, Elliott et al. 2006). For example, a study by Jørgensen (1977) found that the mats were only visible for short periods of the summer when bottom waters became stagnant and partially or totally depleted of oxygen.

In addition to nitrate and sulphate, bacteria in anaerobic marine sediments can also produce methane (CH_4) (see **Figure 2.1**). In this process, the lower molecular weight organic forms, such as lactate and acetate, are fermented by anaerobic methanogenic bacteria to produce methane (CH_4; **Figure 2.1**; Pearson 1980). In marine sediments, methane production does not normally occur, with the exception of pockets of decaying material (Pearson 1980), possibly due to reduced activity at temperatures below 10°C (Samis et al. 1999) As with hydrogen sulphide, methane may remain in the interstitial spaces of the sediment until it migrates up to the water column.

2.1.4 Impacts to Benthic Communities

Benthic infauna are important components of nearshore marine ecosystems, driving detrital decomposition and nutrient cycling and providing a food source for higher trophic level organisms. Since these organisms live in close association with the surface sediment, and are often sedentary, they are influenced by the direct and indirect effects of wood waste (see **Section 2.1.1** to **Section 2.1.3**). A small amount of natural organic matter in nearshore marine benthic ecosystems provides an important source of food to benthic communities; however, high levels of organic matter lead to oxygen depletion, a build-up of toxic by-products, and decreases in abundance, biomass and species richness of benthic infauna community organisms (e.g. Hyland et al. 2005; **Figure 2.1** and **Figure 2.2**).

If wood waste is thinly deposited, sedimentation over the wood waste may allow for the natural recovery of the benthic infauna community over longer time periods. However, if wood waste accumulations are deep, sedimentation will not allow for recovery, since sulphides, ammonia, and to a lesser extent methane, will permeate through recently deposited materials (**Figure 2.1**; Washington State Ecology 2013).

2.1.5 Indicators of Impact

The impacts of wood waste on an area depend on the nature and extent of the wood waste in combination with site-specific biophysical conditions (Washington State 2013). Therefore, universal thresholds of impact do not exist and must be developed for a site based on the results of the impact assessment. However, certain indicators can be used in the assessment of impacts from wood waste on the benthic community.

2.1.5.1 Wood Waste Surficial Cover

Assessments of wood waste impacted sites in Washington state have used Kendall and Michelsen's (1997) findings to develop initial screening guidelines to target potential areas of wood waste impacts (Washington State 2013). Under these guidelines, surficial cover of 5 – 25% wood waste indicates a possible need for further investigation, while >25% should be investigated further due to the adverse impacts to the benthic community. However, wood waste assessments in Washington State have found that areas with finer wood waste accumulations (such as small chips or sawdust) have a greater impact with less surficial coverage, and propose using a visual surficial cover of 5%, as opposed to 25%, to screen for potential biological impacts (Washington State 2013).

2.1.5.2 Bacterial Mats

While the presence of white bacterial (*Beggiatoa* sp) mats are indicative of high organic content (i.e. high TOC concentrations), they can be variable and indistinguishable under certain conditions, particularly seasonally with differences in oxygen at the SWI (outlined in **Section 2.1.3**). In combination with bacterial mats, several sediment chemistry analyses can also be used as indicators of degraded sediment conditions and deleterious effects on benthic fauna; however, natural baseline levels for sediment chemistry analyses vary between habitat types and should be considered in the interpretation of habitat quality impacts.

2.1.5.3 Total Organic Carbon

Naturally elevated levels of organic carbon are found associated with productive habitats in nearshore coastal ecosystems that generate high levels of detrital organic material, such as estuaries, eelgrass beds and kelp beds. Aside from these habitats, marine sediments generally have a low organic composition, measured as total organic carbon (Phillips 1984, Libes 1992). Therefore, elevated organic matter can result from accumulation of organic material derived from the detrital food chain or from organic enrichment by anthropogenic activities (e.g. aquaculture industry, sewage outfalls, and wood waste deposits). While naturally-derived organic matter forms an important food source for benthic fauna, an overabundance in surficial sediments will lead to a depletion of oxygen, the production of toxic by-products (e.g. sulphides and ammonia) and the subsequent impairment of benthic communities (decreases in species abundance, species richness, and biomass; F**igure 2.2**, **Section 2.1.3**; Hyland et al 2005). As a result, total organic carbon (TOC) can be used to help identify degraded habitat quality and the presence of wood waste deposits.

The Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines (SQG) for the Protection of Aquatic Life and the environmental quality standards set by BC Contaminated Sites Regulation (BC CSR) do not have a developed marine sediment TOC potential level of concern. However, the US Environmental Protection Agency (EPA) was evaluating threshold effect levels for TOC based on data from the Environmental Monitoring and Assessment Program (EMAP) which demonstrated that impaired benthic communities in estuarine systems were associated with muddy sediment (>80% silt-clay) with moderate TOC content (1 – 3%) while unimpacted communities were associated with sandy sediment (<20% silt-clay) and low TOC content (<1% ; US EPA 1999). Similarly, a global meta-analysis conducted by Hyland et al. (2005) for coastal marine ecosystems proposes that TOC levels can be used as a general screening-level indicator for evaluating the likelihood of reduced sediment quality and associated impairment of the benthic community (low ≤1%, intermediate 1 – 3.5%, and high ≥3.5 %).

While most benthic communities will decrease in species abundance and diversity (measured as species richness) with increasing TOC, there are some Polychaete species that are dominant in polluted or degraded habitats (e.g. log handling facilities) and are good biological indicator species of elevated TOC, including (Reish and Barnard 1960, Rosenberg 1972, Conlan 1977, Kathman et al. 1984, Borja et al. 2000, Teixera et al. 2012):

- *Capitella capitata*;
- *Armandia brevis*; and,
- *Prionospio cirrifera*.

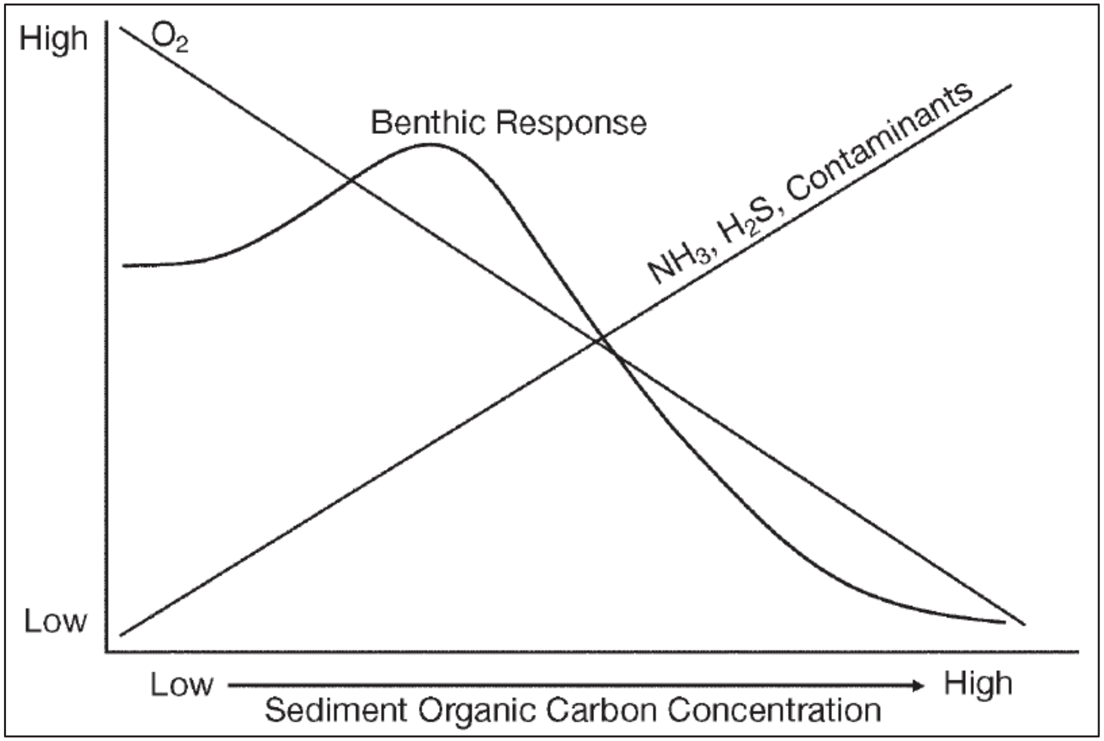


Figure 2.2 **Conceptual Model of the Relationship between Increasing Sediment Organic Carbon, Benthic Community Response, and other Related Environmental Factors, including Oxygen Depletion and Presence of other Co-varying, Sediment-associated Stressors (Hyland et al. 2005)**

2.1.5.4 Hydrogen Sulphide

Hydrogen sulphide is an indicator of sediment health since higher concentrations are directly correlated with increasing TOC and impacted benthic communities (**Figure 2.2**). Sulphide influences sediment toxicity in three ways: (i) increasing sediment toxicity, (ii) decreasing metal toxicity by binding with free metals and forming precipitates and/or complexes, and (iii) by affecting animal behavior (Wang and Chapman 1999). Hydrogen sulfide toxicity varies with pH and by species and life history stage; therefore, threshold levels are developed for a specific organism (Podger Unpublished, Wang and Chapman 1999). In sediment pore-water, sulphide occurs in two forms, as un-ionized hydrogen sulphide (H_2S) and as a sulphide ion (HS^-). Since H_2S can readily diffuse across the cell membranes of organisms, it has a higher toxicity and, at lower pH levels (i.e. more acidic conditions), a greater proportion of H_2S is present in the water (Wang and Chapman 1999).

Community-level effects can also occur indirectly, or as a cascading effect, when dominant or structural species such as eelgrass (*Zostera marina*) or horse clams (*Tresus* spp.) are negatively impacted. For example, hydrogen sulfide can reduce the distribution and health of native eelgrass beds, which normally provide cover for invertebrates and fish that feed sea birds and marine mammals (Pederson et al. 2004, Elliott et al. 2006). Hydrogen sulfide has also been shown to reduce the diversity of benthic invertebrate communities that aerate the sediment through bioturbation and are a large source of food for higher trophic species including crab, river otters and sea birds (Goodman et al. 1995, Wang and Chapman 1999, Hyland et al. 2005).

The CCME SQG for the Protection of Aquatic Life and the US EPA Marine Sediment Screening Benchmarks have not developed a marine sulphide (as H_2S) potential level of concern. However, the US EPA saltwater quality criterion for hydrogen sulphide is 2 µg/L (US EPA 1986), which can be used as a general indicator of water quality.

2.1.5.5 Ammonia

High levels of ammonia are difficult for marine organisms to excrete, leading to a buildup in the tissues and potentially death. Ammonia toxicity can change with environmental factors, such as pH and temperature, as this influences the equilibrium between un-ionized (NH_3) and ionized ammonia (NH_4^+) (Wang and Chapman 1999). An increase in one pH unit will increase the concentration of the more toxic un-ionized form tenfold, while a 5^o C increase in temperature can increase this form 40-50% (CCME 2010). CCME SQG for the Protection of Aquatic Life and the US EPA Marine Sediment Screening Benchmarks have not developed a total ammonia potential level of concern for marine ecosystems; however, the US EPA saltwater quality criterion for un-ionized ammonia is 35 µg/L, which can be used as a general indicator of water quality. Ammonia is easily diluted and flushed in the water column and not likely to be as critical an indicator as H_2S.

2.1.5.6 PH

CCME water quality guidelines for the Protection of Aquatic Life outline an acceptable range of pH 7.0 – 8.7 for marine and estuarine environments based on the pH range observed in Canadian coastal water, unless it can be demonstrated that pH is a result of natural processes (CCME 2010).

2.2 STUDY LOCATION AND SITE DESCRIPTIONS

2.2.1 Esquimalt Harbour Marine Environment

Esquimalt Harbour is located along the southeastern end of Vancouver Island off the Strait of Juan de Fuca and comprises several smaller bays and coves with many small rocky islets (**Figure 1.2**; BCMCA 2016). In its entirety, the Harbour encompasses approximately 354 hectares (50 hectares of intertidal area and 304 hectares of subtidal area) and 20.0 km of shoreline (excluding islands; Archipelago 2004), with the federal DND portion of the Harbour encompassing an area of 343 hectares.

The natural shoreline, ranges from sand and gravel beaches to rocky shores, which has largely been maintained along the west and northeast sides of the Harbour. Shoreline in the southwest and much in the southeast (i.e. Constance Cove) has been altered by dredging, infilling, and hardening to support industrial and naval activities (CRD 2016). The Harbour is relatively quiescent, with semi-protected to protected shoreline exposure (i.e. relative exposure to the elements, primarily waves) classification and very low tidal currents (0.001 – 0.045 m/s) (BCMCA 2016). Research investigating the sediment transport pathways in the harbour indicates that the harbour is in a dynamic equilibrium with little net sediment transport. Two major transport regimes are present and converge around the mouth of Constance Cove and the DND Jetties at Colwood - one moving from the Harbour mouth and one down from the head of the Harbour (Hemmera 2002).

The Harbour is relatively shallow, ranging from five to 12 m Chart Datum (CD) in depth within the limits of the Federal Harbour, and a maximum depth of 16 m CD at the Harbour entrance (CRD 2016; **Figure 1.2**). The subtidal benthic substrate is dominated by 87% fines (gravel, sand, and mud) with a few subtidal bedrock outcrops (CRD 2016). Sediment in the upper portion of the Harbour and around Plumper Bay is mainly silt, with large areas of organic wood waste cover, while the southern areas have higher proportions of sand.

There are several natural and manmade freshwater inputs into the Harbour. Millstream Creek flows into the head of the Harbour, draining a watershed of 2,842 hectares (including a storm drain network), with a stream length of 16.5 km terminating in a large intertidal mudflat (extending as far out as Cole Island during some low tides) (CRD 2016; **Figure 1.1**). Flooding and erosion of the lower watershed streambanks have been identified as a main environmental concern for the Millstream Creek Watershed, which can deliver large quantities of fines to the Harbour. Additionally, there is an unidentified stream in the View Royal area, at the north end of the harbour, outside of the federal harbour limit, that discharges the Price Creek Watershed (CRD 2016). The stream is approximately one kilometre long. There are 97 storm water drains that discharge directly into the Harbour (CRD 2016). The Capital Regional District (CRD) completes an annual stormwater quality sampling program for Victoria and Esquimalt harbours which include fecal coliform (human health) levels for the stormwater discharges and an evaluation of contaminants of concern in stormwater sediments (Hemmera 2002).

2.2.2 Pedder Bay Marine Environment

Pedder Bay is located approximately twelve kilometers to the southwest of Esquimalt Harbour, in the Strait of Juan de Fuca, and was chosen as an out-of-Harbour reference location (**Figure 1.2**) due to its proximity to Esquimalt Harbour, similarities in bathymetry, in shoreline and subtidal substrates, and in wind and wave exposure, and its use in previous studies as a reference location not anticipated to have contamination that substantially affects the environmental conditions (studies summarized in SLR 2016).

The natural shoreline primarily consists primarily of rocky intertidal shores, with a mudflat located at the back of Pedder Bay at the terminus of Pedder and Cripple Creeks (BCMCA 2016). Minimal infrastructure are present within the harbour; however, the shoreline along the southwest has undergone some alterations to support Canadian Forces activities at Rocky Point. Like Esquimalt Harbour, the tidal currents are very low (0.001 – 0.045 m/s; BCMCA 2016) and shoreline exposure is categorized primarily as semi-protected to very protected; however, the southwest shoreline is semi-exposed to waves generated locally within the Juan de Fuca Strait (Baird and Associates Coastal Engineering Ltd 1991, BCMCA 2016). No information is available on the sediment transport pathways within Pedder Bay.

Similar to Esquimalt Harbour, Pedder Bay is also relatively shallow, ranging from 5-10 m CD in depth; although depths do exceed 20 m at the entrance to the Bay (Baird and Associates Coastal Engineering Ltd 1991). Subtidal benthic substrates are classified as a mixture of flats and depressions with a mudflat extending into the subtidal at the back of the Bay. Freshwater input to Pedder Bay is received from both Pedder Creek (107.0 ha watershed including storm drain areas, 1.5 km main stream length) and Cripple Creek (296.7 ha watershed including storm drain areas, 3.5 km main stream length) drains (CRD 2016).

2.3 Historical Activities and Contamination

The objective of this section is to document historical use of the Harbour and associated upland properties, to review previously identified Areas of Potential Environmental Concern (APECs) and Contaminants of Potential Concern (COPCs) associated with on and off-site activities and that may have impacted sediment quality in the Harbour. Additionally, this review was also used to identify the sources of wood waste deposition that may be affecting benthic sediment quality and communities. For the purposes of this historical review, the area from the high water level (HWL) seaward, including the subtidal zones within the Federal limits of the Harbour, was investigated (see **Figures 1.1** and **1.2**). Lands above the HWL were classified as being out of the study area or offsite.

2.3.1 Activities and Contamination Review Methods

The review is consistent with guidance from Breems and Goodman (2009) and Washington State (2013) and includes both current and historical operations within the Harbour, as well as concerns associated with the historical use of adjacent and up-gradient properties. Sources of information reviewed included:

1. Previous environmental reports;
2. Aerial photographs review;
3. Search of the Federal Contaminated Sites Inventory (FCSI);
4. Search of the British Columbia Ministry of Environment (BC MOE) Environmental Violations and Management Authorization databases; and,
5. Search of the CRD Online Harbours Atlas for any reliable data/background.

The background review relied on the information presented in past environmental reports of the Harbour to compile relevant information on the history of property development and land use in and along the shore of the Harbour. Reports summarizing environmental investigations included significant information on historic operations that may have affected the seafloor in the study area, including:

- Bright 1993. An Environmental Survey of Esquimalt Harbour: Part I. Historical Inputs, Marine Sediment Contamination, and Biological Uptake. Report prepared for the Director General Environment, Department of National Defence by the Environmental Sciences Group, Royal Roads Military College;
- Hemmera 2002. Esquimalt Harbour Environmental Baseline Study. Esquimalt Harbour, British Columbia. Prepared for Transport Canada; and,
- Golder 2006a. Phase I Environmental Site Assessment and Supplemental Sediment and Crab Sampling Investigation, Esquimalt Harbour. Volume I of III. Prepared for Public Services and Procurement Canada Project. Victoria, British Columbia.

Previous investigations have focused on contamination issues resulting from ship repair activities, filling of Harbour areas and poor handling of chemicals. The sections following provide additional information by identifying the nature of historic land use and site development activities on the properties and tracing the lease history.

As the Project Area is comprised mainly of the Harbour floor, the review of historical activities and contamination was focused on the potential environmental impact on the federal harbour resulting from operations within the Harbour as well as, at neighbouring and surrounding properties. The review covers nine (9) areas that have been placed into 6 headings based on their location (**Figure 2.3**), and covers the following properties:

Esquimalt (Including the Township of Esquimalt and the Department of National Defence Facilities; Areas 1-4)

- DND - CFB Esquimalt Dockyard
- Former Yarrow's Shipyard
- Lang Cove / DND - Naden
- Public Services and Procurement Canada – Graving Dock
- Public Services and Procurement Canada – Munroe Head

Esquimalt First Nations Reserve (Area 5)

- Former West Isle Site
- Former Fibremax Site
- A & M Auto Site
- Fill Sites

Songhees First Nation Reserve (Area 5)

- Ashe Head
- Dallas Bank
- Fill Sites

View Royal (Area 6)

- Residential Properties
- Former Victoria Plywood Site

Colwood (Areas 7 & 8)

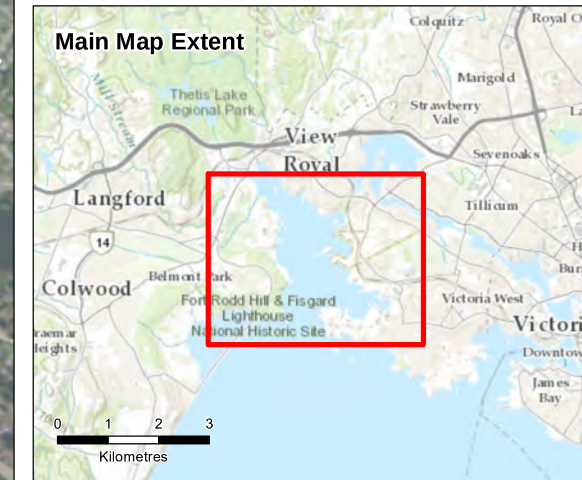
- CFB Esquimalt Colwood – North and Central, including:
  - Colwood Supply Depot
  - Fire Fighting Training Area (FFTA)
  - Fleet Diving Unit
  - Fuel Depot
  - Belmont Park

Harbour Floor (Area 9)

- Leased Areas, Un-leased Areas and Water Lots
- Inskip Island
- Macarthy Island
- Smart Island

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Overview and Areas



Legend

Federal Harbour Limit

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- APECs: Golder, 2006
- Organic Cover, Un-surveyed Seafloor: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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2.3.2 Aerial Photograph Review

A summary of aerial photographs provides general information with regards to site configurations and activities (**Table 2.2**). A review of aerial photographs dated 1932, 1946, 1954, 1964, 1975, 1980, 1992 and 1997 (**Appendix A**) have been incorporated into the analysis of land use history presented in **Section 2.3.4**.

Aerial photograph review of the Harbour floor and related to the deposition of wood waste are summarized in the following table**.** Based on the review, the last observable date for large-scale log booming was in 1997; however, occasional log booming still occurs infrequently in the harbour within the Jones marine Lease Area.

Table 2.2 Aerial Photograph Review Summary

Chronology	Land Use
1932	Log booms are present near the entrance to Thetis Cove. Four wharves extend from a cannery operation at the location of the Fibremax log sort operation and from the former location of the Victoria Plywood Site.
1946	No log booms are present, otherwise the harbour looks unchanged.
1954	Sawmills appear to be active on the West Isle and the Victoria Plywood sites. Approximately 60-70% of Plumper Bay and Thetis Cove are covered with log booms supplying these operations. Log booms are present on the west side of Inskip Islands and in Paddy Passage.
1964	A sawmill is in operation on the West Isle site. Approximately 20-30% of Plumper Bay and 50-60 % of Thetis Cove are covered with log booms supplying logs to this and the neighbouring Victoria Plywood operations. Log booms are now empty in Paddy Passage.
1975	Sawmills are in operation on the West Isle and Victoria Plywood sites. Approximately 50-60% of Plumper Bay and Thetis Cove are covered with log booms supplying logs to these operations.
1980	Sawmills are in operation on the West Isle and Victoria Plywood sites. Approximately 70-80% of Plumper Bay is covered with log booms supplying logs to these operations. Large log booms are present north of the Inskip Islands.
1992	Sawmills are no longer in operation on the West Isle and Victoria Plywood sites. There is a large reduction of log boom activity with booms only present west of the Fibremax site. Empty log booms remain in Plumper Bay and Thetis Cove. Log booms, which appear to be associated with the log sort facility on the Fibremax site.
1997	There are no log booms on the west side of Esquimalt harbour, in Thetis Cove, or Plumper Bay. Limited log boom activity appears to be associated with the log sort facility on the Fibremax site.

Additional aerial photographs from 2003, 2010, 2011, 2012, 2013, 2014, 2015 and 2016 have been reviewed using Google Earth Pro. While minor changes have occurred between 2003 and 2016, there does not appear to be any significant industrial or infilling changes within the Harbour.

2.3.3 Regulatory Information

2.3.3.1 Federal Contaminated Site Search

The FCSI includes information on all known federal contaminated sites under the custodianship of departments, agencies and consolidated Crown corporations as well as those that are being or have been investigated to determine whether they have contamination arising from past use that could pose a risk to human health or the environment. The inventory also includes non-federal contaminated sites for which the Government of Canada has accepted some or all financial responsibility.

A search of the Online FCSI was conducted on September 8, 2016 and generated greater than 100 federal contaminated sites within Esquimalt Harbour or close proximity. The results of the federal contaminated sites search are located in **Appendix B: Regulatory Information**. It should be noted that Esquimalt harbour was assessed under the Federal Contaminated Sites Action Plan (FCSAP) as one FCSI number and assigned as a Level 1 site.

2.3.3.2 BC MOE Environmental Violations Database

The Environmental Violations Database reports non-compliance orders, administrative sanctions, tickets and court convictions against twenty-four acts regulated by BC MOE since 2006. A search was completed for violations on September 6, 2016 and no environmental violations were listed within proximity to Esquimalt Harbour.

2.3.3.3 BC MOE Environmental Management Authorization Database

A search was conducted of the Environmental Management Authorization Database on November 9, 2016 for approved and permitted waste discharges within the vicinity of the Site. Twenty-one authorizations were on file for Victoria. None of these authorizations were within the vicinity of Esquimalt Harbour. Select details of these authorizations are provided in **Appendix B**.

2.3.3.4 Other Historical Information

Bright (1993) provided a series of tables in Appendix B-1 of the report, which provide a chronological listing of the Esquimalt Harbour occupants as of 1873, 1896, 1925, 1967, and current users as of the report date (1993). Copies of these tables are provided in **Appendix C: Harbour Occupants**.

Additionally, Hemmera (2004) reported current and historic leases of the harbour. These lease agreements are summarized in the following **Table 2.3**.

Table 2.3 Summary of Current and Historical Leasehold Properties

Leaseholder	Lease #	Status	Lease Use	UTM Northing	UTM Easting
Plumper Bay Log Booming	W0306609	Current[1]	Log Booming	5365622.75	467813.067
Plumper Bay Log Booming	W9596354	Former	Log Booming	5365622.75	467813.067
Plumper Bay Sawmills Ltd.	104899	Former	Log Booming	5365608.057	468115.159
Greater Victoria Mill Operators Association (GVMOA)	89482 102058	Former	Log Booming	5366263.803 5365709.496	466872.966 467626.289
Avenor Inc. (Victoria Plywood site)	W8691194	Former	Log booming	5365931.808	467955.718

2.3.4 Site and Surrounding Land Use History

The following historical description of the Harbour is summarized from the Royal Roads Military College (RRMC) report “An Environmental Study of Esquimalt Harbour” (1993).

Prior to the British occupation of the Harbour, Lekwungen-speaking people, ancestors of present day Esquimalt Nation people, were the sole users of the Harbour. Hudson’s Bay Company Chief Factor James Douglas (later Governor of the Crown Colonies of Vancouver Island and British Columbia) visited the Harbour in 1843 on a mission to seek a new site for the HBC’s operations north of the 49th parallel. Although Douglas established the new fort on the shore of Victoria Harbour, he evidently saw the agricultural potential of the land that is now Esquimalt. After signing a series of treaties with local native people to acquire the area for the HBC, Douglas established three farms here to supply Fort Victoria and other HBC forts in the northwest with agricultural products. Farms were established at Colwood, in Constance Cove and in Plumper Bay with the exclusion of the First Nations Reserve at Plumper Bay.

In 1848-49 the first industrial sites were developed; a sawmill and gristmill at Mill Stream Falls. Additional infrastructure was built on the Constance Cove farm including a sawmill, flour mill and trades shops. During this period (1840s), the Royal Navy also had a presence within the Harbour and they conducted the first hydrographic survey. In 1855, the start of the first naval base was seen in the form of hospitals constructed to prepare for a potential battle with the Americans. As tensions mounted, increased construction of the naval base was seen in the Harbour. In 1860, two structures on Cole Island were built for use as powder magazines. In the early 1860’s two large wooden coal sheds (1,500 ton capacity) and the Fisgard Island Lighthouse were built. The construction of the Esquimalt Naval Base was started in 1867 at Signal Hill in Constance Cove.

[1] Current at the time of reporting (2002).

By 1883 the Navel Base had expanded onto the Duntze Head area and included approximately 58 buildings. The base was transferred from the Royal Navy to the Royal Canadian Navy in 1910. Pressure for a graving dock in Esquimalt Harbour increased as the base size grew. Shipbuilding and repair was already taking place by this time within the Harbour. In 1867, the construction of a graving dock was started on the southern shore of Constance Cove. By 1887, the dock was finished and began to service naval and commercial ships. Over the next 40 years the dock would service 855 ships until it was transferred to Esquimalt Naval Base.

2.3.4.1 Esquimalt (Areas 1-4)

In the late 1890s an additional shipyard was constructed in Constance Cove and in 1914 the shipyard was purchased by Alfred Yarrow. The village of Esquimalt was incorporated into the area in 1912 and began construction of a sewer system. The area of Grant Knoll was chosen for the construction of a marine railway (building 116) for the Naval Dockyard. Buildings just east of the railway (buildings 115 and 120) were built for boat maintenance. The “Factory” building (built in the mid 1860s) was the site of an engine shop, smelter and smith shop and during WWI was busy galvanizing ship parts and equipment.

Public Services and Procurement Canada began construction in 1921 on a new graving dock in Skinner’s Cove, just east of Munroe Head, which disappeared as a result. By 1926 the Public Works Graving Dock was receiving ships (see **Figure 2.3**). Continued construction of facilities occurred following WWI. In 1925 fire destroyed the torpedo building, the old boat shed and the rigging loft, but they were replaced immediately (building 115). With the onset of World War II (WWII), increased demand in the base’s facility meant increased expansion. In 1939 construction included a close-range weapons workshop, an indoor testing range building, an electroplating and chemical cleaning facility and a new gun mounting shop. The jetties were referred to as the “Dockyard Jetty” (A-Jetty), the “Refitting Jetty” (B-Jetty) and a “Naval Ordnance Jetty” (C-Jetty, the old coal wharf) (see **Figure 2.3**).

In the early 1940s Yarrows constructed an additional shipyard, situated just north of Munroe Head, to handle the large workload brought on by the war. Approximately 500,000 m^3 of rock was blasted and used as fill in the area. Facilities at the new shipyard (Yarrows 2 Yard) included a marine railway, two building berths, lumber racks, an aluminum storage building, a finishing and paint shop, a compressor and boiler house, a winch house, an electrical shop, a joiner and pattern shop, sheet metal shop, shipwrights, riggers, plate shop/mold loft over, a pre-fabrication shop, an acetylene plant, a blacksmith shop, steel stock storage, rail and spur lines, two wharves, docking space and two cranes. Both the Yarrows shipyards and the Public Works Graving Dock saw many ships during WWII. At the end of the war the old Esquimalt Dry Dock was taken over and renovated by HMC Dockyard. In the mid-1900s shops were split and moved and new ones were built. Of note was the sheet metal workshop, which was constructed in the corner of the coal shed.

Following WWII, the Yarrows #2 Shipyard was shut down. A portion of the yard was a crown lease, which expired in June, 1948. The Yarrows owned portion of the property was sold to Manning Timber Products for use in their sawmill operation. The mill included a drying kiln, a spur line from the Esquimalt and Nanaimo (E & N) Railway, a transformer station and an electrical substation. The mill was in operation for only a short period and in 1959, DND acquired the property and presently has storage areas and facilities on the site. West of this area is the current Canadian Forces Sailing Association. During the 1960s, Yarrows became Versatile Shipyards (later changed back to Yarrows) and Public Works constructed E-Jetty adjacent to the Graving Dock. The Yarrows shipyard shut down in 1992 and the property was acquired by DND. Since then the site has undergone extensive environmental investigation. DND's C-Jetty, a ship repair facility, was closed in 1987, the area was dredged and a new concrete twin C-jetty was constructed.

2.3.4.2 Esquimalt and Songhees First Nations Reserves (Area 5)

In 1886 the E & N Railway was built and the Esquimalt station was located near the boundary between Esquimalt First Nations Reserve and the View Royal. Todd's Cannery (1896) in the Plumper Bay area used the rail facility to export fish. In 1912, a large fuel storage tank was installed as a result of the switch to oil from coal. A machine shop was noted on the 1918 hydrographic chart. During WWII, an oil wharf, ferry slip and oil tank operated by E & N Railway were present in Plumper Bay. The Cannery (now called Empire Cannery) was replaced in 1960 with a sawmill (West Isle Forest Products, later renamed Futura Forest Products). During this time, extensive log booming occurred at the mouth of Plumper Bay.

The 1970s and 1980s saw West Isle Forest Products (Futura Forest Products), Pacific Forest Products, Fibremax Timber Corp. and Victoria Plywood occupy the land south of Plumper Bay. All but the Fibremax site became inactive in the 1990s and clean-up/decommissioning of the sites has either been completed or is ongoing.

2.3.4.3 View Royal (Area 6)

In the 1930s, a floatplane base was located in Limekiln Cove. There was also additional industrial activity in the northern end of the harbour. In the mid-1900s, a masons yard existed in the Parsons Bridge area (over Mill Stream) as did a blacksmith shop and brass foundry. A high voltage electrical transmission line was routed to Dyke Point in 1947 for the harbour (see **Figure 2.3**). Extensive log Booming continued in the 1960s in the northern end of the harbour. During the 1970s and 1980s, the View Royal section of the Harbour (northern section) experienced a residential development boom. Questions exist however, about effectiveness of the septic systems of the older residences.

2.3.4.4 Colwood (Areas 7 & 8)

In 1926, Frank Wilfert built a sawmill where the F-Jetty site is today (see **Figure 2.3**). A Former employee (Paul Cox) stated that the mill didn't use any chemical wood treatment and there were two booming sites, one directly in front of the mill site and the other across the harbour near the First Nations Reserve. Additional communications with residents indicated that log booming was present from Paterson Point to Dyke Point (see **Figure 2.3**), all the way up to Cole Island. Additional industrial activity during this time included a limekiln opposite Limekiln Cove (Patterson Point). The Cole Island magazines were moved to Patterson Point in the late 1930s, due to the requirement for fresh water access. In 1943, a "Magazine Jetty" (G-Jetty), associated with existing magazines, was present and by 1947, the "Fuel Oil Jetty" (F-Jetty) was in service (see **Figure 2.3**). The DND magazines were moved again, this time from Patterson Point to Rocky Point, which is southwest of Victoria (1955). The Naval Supply Depot was built in 1958, using the existing F-jetty. Later Fisgard Island was connected to Rodd Point through the addition of coarse fill material (see **Figure 2.3**). Little change occurred in the Colwood area during the 1960s, 1970s and 1980s. Further development of the area by DND, brought the Naval Fleet School (Pacific), the Fleet Diving Unit (Pacific), and storage space.

2.3.4.5 Harbour Floor (Area 90)

During World War I (WWI), the Royal Navy, the Royal Canadian Navy, and the Army used the magazines on Cole Island. The magazines were later moved to Patterson Point (1930s) and ownership of the island was transferred to the provincial government. Cole Island is currently under the jurisdiction of the provincial government's Heritage Properties Branch (see **Figure 2.3**).

With the exception of log booming in the northern portion of the Harbour from the 1940s to the 1980s and booming in the mouth of Plumper Bay to 1997[2], there has been little to no marine activity, with the exception of navigation, within the federal harbour historically. Influences are linked to the activities of the adjacent lots. These influences include the infilling of portions of the Harbour.

Marine sediments in Esquimalt Harbour have been contaminated by historical and current operations within and adjacent to the harbour (Golder 2006).

[2] As identified in Table 2.4, Section 2.3.3.4, a lease for log booming was current in 2005. However, no log booming was observed on aerial footage review after 1997.

2.3.5 Summary of Areas of Potential Environmental Concern

Golder (2006) included an extensive review of historical literature relating to Esquimalt Harbour and surrounding areas, which was used to identify APECs for the Harbour and adjacent properties. No additional APECs were identified as part of this background review. Golder identified these APECs, in part, to develop a risk management strategy for the harbour.

In total, 104 APECs were identified which are summarized in **Appendix D: Areas of Potential Environmental Concern** (Table and Figures). The APECs were divided into seven categories by Golder, as follows:

- APEC Group A – Fill;
- APEC Group B – ASTs, USTs, other hydrocarbons;
- APEC Group C – Operational activities (including historical operations);
- APEC Group D – Treated timber piles;
- APEC Group E – Polychlorinated Biphenyls (PCBs);
- APEC Group F – Spills; and,
- APEC Group H – Stormwater outfalls.

Typically, a Phase I Environmental Site Assessment would link the APEC sources with areas of identified contamination. However, owing to the long, complex and varied nature of the historical activities at the Site, varied migration of contamination into sediments, and the potential for sediment transport, the source of the contaminants associated with each of the APEC was not always clear and, in most cases, could not be identified without being highly speculative. This process also does not target leachate from wood waste, or the physical impacts of wood waste.

The APECs deemed more relevant to the wood waste assessment, are excerpted from the complete table included in **Appendix D** and are outlined in **Table 2.**4.

Table 2.4 Related Areas of Potential Environmental Concern

APEC ID	Location	Issue(s) / Activity(ies)	Media Type	COPC
C7	West Isle Site, Plumper Bay	Historical operational activities associated with mill	Soil, Groundwater	Unknown
C8	Fibremax, Plumper Bay	Historical activities associated with mill	Soil, Groundwater Sediment	Unknown
C9	Victoria Plywood, Thetis Cove	Former mill activities	Soil, Groundwater, Sediment	Hydrocarbons, metals, PCBs, phenols, PAHs
C15	Cole Island	Potential waste materials from historical operational activities	Soil	Metals, hydrocarbons Possible Organics
C26	Victoria Plywood, Thetis Cove	Pollution Control Permit for discharge into harbour	Sediment	Phenols, hydrocarbons Metals
C27	Northern part of Esquimalt Harbour	Log booming causing accumulation of wood waste on sea floor	Sediments, Aquatic life	Organic material
C31	Upland area to the north and west of F-Jetty, Colwood	Historical presence of a limestone handling facility, historical presence of a sawmill and booming grounds.	Soil, Groundwater, Sediment	Not known
C32	Shoreline of View Royal	Historical commercial activities in the area	Sediment, Aquatic life	Not known
C34	Esquimalt Harbour	Cable ties from log booming activities in the harbour	Sediment, Aquatic life	Metals
F1	West Isle Site, Plumper Bay	Chlorophenols from spill	Soil, Groundwater	Chlorophenols
G1	Harbour wide stormwater outfalls	Discharge of contaminated sediments from upland sources	Sediment, Aquatic life	Metals, PAHs
G2	Esquimalt Graving Dock stormwater outfalls	Stormwater outfalls	Sediment	Metals TBT

2.3.6 Background Review Conclusion

Esquimalt Harbour, and the surrounding area, have been heavily industrialized since 1848 with a long history of sawmilling and federal maritime activities. Leaseholds within the harbour used for log booming, have resulted in a large amount of wood debris being deposited on the harbour floor along with other contaminants resulting from infilling of the foreshore and historic operations and infrastructure within upland properties. While many COPCs have been studied extensively in the harbour, the assessment of wood waste and its associated physical impacts have not been examined historically.

2.4 HISTORICAL BIOPHYSICAL INFORMATION REVIEW

This section summarizes the historical biophysical information collected for the Study Area (i.e. subtidal sea floor within the Federal limits of Esquimalt Harbour, 'Harbour Floor' on **Figure 2.3**) and to fill any gaps through a review of pertinent existing databases to ultimately inform the current site characterization, impact assessment and future management options.

2.4.1 Biophysical Review Methods

The background review is consistent with guidance from Breems and Goodman (2009) and includes both current and historical data within the Harbour and Pedder Bay. Sources of information reviewed include:

- Duffus, H.J, J.W. Madill, W.t. MacFarlane, and P.J. Schurer. 1978. First Report on Bottom Studies of Esquimalt Harbour. Royal Roads Military College, Coastal Marine Science Laboratory Manuscript Report No 78-3. 23pp.
- Schurer, P.J., W.T. MacFarlane, and H.J. Duffus. 1979. Sub-bottom Survey of Harbours Near Victoria, B.C. 17pp
- Bright. 1995. An Environmental Survey of Esquimalt Harbour: Part I. Historical Inputs, Marine Sediment Contamination, and Biological Uptake. Report prepared for the Director General Environment, Department of National Defence by the Environmental Sciences Group, Royal Roads Military College.
- Hemmera. 2004. Victoria & Esquimalt Harbours Environmental Baseline Study. Volume 18 (Addendum#3) Lot A. Lot 18. Prepared for Transport Canada, Victoria & Esquimalt Harbours Environmental Program.
- Archipelago. 2004. Subtidal survey of Physical and Biological Features of Esquimalt Harbour. Prepared for Transport Canada, Victoria and Esquimalt Harbours Environmental Program.
- SLR Consulting Ltd. 2016. Detailed Quantitative Ecological Risk Assessment to Support Environmental Risk Management, Esquimalt Harbour, BC, Esquimalt Harbour Remediation Project (EHRP), Draft #3.

The following databases and information systems were also used:

- Capital Regional District online mapping application (CRD Atlas) and harbours information website;
- Ecosystems of British Columbia;
- Sensitive Habitat Inventory and Mapping (SHIM);
- iMapBC;
- BC Coastal Resource Information Management System (CRIMS database);
- British Columbia Marine Conservation Analysis (BCMCA);
- BC Conservation Data Centre (CDC) Species and Ecosystem Explorer;
- North Coast Watershed Atlas (NCWA), Community Mapping Network; and
- Pacific Coastal Resources Atlas (PCRA), Community Mapping Network.

2.4.2 Regional Overview

The upland areas of both Esquimalt Harbour and Pedder Bay lie within the Eastern Vancouver Island Ecoregion and the Leeward Island Mountains Ecosection and are classified as a Coastal Douglas-fir Moist Maritime Biogeoclimatic Zone (CDFmm). The CDFmm occurs along the southeastern Vancouver Island, on several Gulf Islands, and a small strip of the mainland and is limited to elevations below 150 m. Lying in the rain shadow of Vancouver Island and the Olympic mountains, it is characterized by warm, dry summers and mild, wet winters with mean annual temperature from 9.2 - 10.5 ^{o}C. The most common tree species in upland forest is the coastal variety of Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) which is frequently found with western redcedar (*Thuja plicata*), grand fir (*Abies grandis*), arbutus (*Arbutus menziesii*), Garry oak (*Quercus garryana*), and red alder (*Alnus rubra*), depending on site moisture and nutrient regime (Nuszdorfer et al. 1991).

The marine waters of both Esquimalt Harbour and Pedder Bay fall within the Georgia-Puget Basin Ecoregion, within the Strait of Juan de Fuca Marine Ecosection. Marine ecosections are defined according to physical, oceanographic and biological characteristics, with the Strait of Juan de Fuca Ecosection described as a deep trough marine area with semi-protected coastal waters and a strong “estuarine-like” outflow current (BCMCA 2016, BCMEC 2002). It is the major water exchange conduit between the Georgia - Puget Basin Ecoregion and the open Pacific Ocean (BCMEC 2002). Except for a few islets, such as Race Rocks, most of the ecosection is comprised of warm (i.e. 9 – 15 ^{o}C) nearshore marine waters (BCMEC 2002). Surface waters (0 – 25 m) within the Juan de Fuca Straight are characterized by an average winter temperature of approximately 8.2^{o}C and average summer temperature of 10.0 ^{o}C (Davenne and Masson 2001). The area of Juan de Fuca Strait surrounding Esquimalt Harbour and Pedder Bay is characterized as more marine than the Strait of Georgia and has an average surface salinity of 16 – 33 ppt (BCMEC 2002).

2.4.3 Historic Distribution of Habitats and Species in Esquimalt Harbour

2.4.3.1 Substrate

The majority (87%) of subtidal surficial substrates in the Federal portion of the Harbour is classified as mud, sand or gravel (**Table 2.5**). By grain size, most of the sediments were silt and sand (33% of total subtidal area) or gravelly mud and sand (40% of total subtidal area) (Hemmera 2004, Archipelago 2004). Some isolated bedrock outcrops are present, along with rocky seafloor adjoining rocky islands, but this only comprises 2% of subtidal area surveyed (Hemmera 2004, Archipelago 2004). Wood and bark debris were documented as mainly covering areas associated with log booming operations (**Appendix E: Subtidal Survey of the Physical and Biological Features of Esquimalt**, **Figure 5**; see **Section 2.1** for a review of wood waste in Esquimalt Harbour; Hemmera 2004, Archipelago 2004).

Table 2.5 Subtidal Sediment Breakdown from Subtidal Habitat Survey of Esquimalt Harbour (Archipelago 2004)

Sediment Size	Subtidal Area	
	Area (ha)	%
Gravel (>30%)	41.0	15.3
Gravelly Mud and Sand (trace – 30% gravel)	122.5	45.8
Sand	3.5	1.3
Silt and Sand	100.5	37.6
Silt	0	0
Total	**267.5**	**100**

2.4.3.2 Marine Vegetation

In 2004, vegetation, consisting of macroalgae or eelgrass, covered approximately 30% of the subtidal Harbour seafloor (**Appendix E, Figure 11**; Archipelago 2004). Similar to Victoria Harbour, less than 10% of the total subtidal area in the Harbour had moderate to dense vegetative cover. In general, vegetative cover was not found on mud-sand sediments and was sparse to absent on gravel-sand-mud substrates. In the areas of >30% wood waste (% organic cover) vegetation was primarily sparse to negligible, with the exception of Paddy Passage, north of Inskip Islands (Archipelago 2004). In Paddy Passage macroalgae cover was moderate to dense consisting of broad kelp, green algae, or eelgrass, while sparse cover consisted primarily of filamentous red algae (Archipelago 2004).

Since depositional sediments throughout most of the Harbour are suitable for native eelgrass (*Zostera marina*), it was likely that the total area of native eelgrass was historically larger than today. However, dredging, infilling, and wood waste including bark and wood debris may have impacted the distribution. In 2004, a total area of 0.5 ha of eelgrass was mapped in the Harbour, split between eight small beds, ranging in size from 60 m^2 to 1,630 m^2, in depths of +0.5 to -0.9 m CD (Archipelago 2004). Substrates where eelgrass occurred was mainly a mix of mud and sand with gravel and shell content (barnacle hash). Of the beds identified, three had sparse to low cover (<25%; **Table 2.6**, **Appendix E, Figure 12)**. Epiphytic red algae *(Smithora naiadum*) and diatoms were found on eelgrass blades, and other species co-occurred including: *Laminaria* sp., *Ulva* sp., *Sargassum muticum*, *Alaria* sp. and *Neoagardhiella* sp.

Table 2.6 Estimate of Eelgrass Bed Areas within Esquimalt Harbour in 2004

Bed Number	Location	Area (m^2)
1	Grant Knoll	60
2	Lang Cove South	810
3	Lang Cove North	620
4	Munroe Head North	900
5	Ashe Head South	120
6	Thetis Cove	700
7	Limekiln Cove	1,320
8	Smart Island	820
Total	-	**5,350**

Source: Archipelago 2004

2.4.3.3 Benthic Invertebrate Fauna

Benthic invertebrate fauna is a broad grouping of species that live within (infauna) and on (epibenthic) the surficial substrates of the seafloor. Infauna are divided into two size classes based on body size: meiofauna (63 to 500 µm) and macrofauna (>500 µm in length).

Infauna

Two previous environmental investigations conducted in Esquimalt Harbour have enumerated the macroinvertebrate infauna communities:

- Bright 1995 – 17 stations (17 in September 1993); and,
- SLR 2015 – 56 stations (12 in February 2013, 46 in July 2015).

However, these studies largely avoided areas of known wood waste debris. A subset of results from these studies are presented later in the report (**Section 3.0**).

Larger infauna within the Harbour has also previously been enumerated by using observations of infaunal burrows to indicate the presence of burrowing shrimp, worms, and bivalves (Archipelago 2004). Burrows were primarily found with the gravelly mud - sand substrates along the harbour entrance and western side of the upper harbour, and were not apparent in areas of wood and bark debris (Archipelago 2004). Of all the observations of fauna that Archipelago (2004) made from video surveys, the majority (81%) were made up of unmounded and mounded infaunal burrows.

Epibenthic

Both Dungeness (*Metacarcinus magister*) and graceful crabs (*Cancer gracilis*) have been observed to be distributed throughout the subtidal habitats of the Harbour on mud-sand and gravelly mud - sand substrates, while red rock crab (*C. productus*) are associated with coarser gravel and rocky substrates. Within eelgrass beds, Dungeness crab, graceful crab, helmet crab (*Telmessus cheiragonus*), and horse clams (*Tresus capax*) were the most common invertebrate species (Archipelago 2004). Plumose anemones were frequently attached to logs and larger pieces of wood debris with crabs relatively abundant (Archipelago 2004). Echinoderms such as the California sea cucumber (*Parastichopus californicus*) and red sea urchin (*Strongylocentrotus franciscanus*) were noted in rocky substrates at the harbour entrance and Inskip Islands (Archipelago 2004). For observations refer to **Appendix E**, **Figure 18-21**.

Observations of Northern Abalone (*Haliotis kamchatcana*) have been documented within the harbour, refer to **Section 2.4.4.1** below.

2.4.3.4 Fish and Fisheries

As with larger invertebrate macrofauna, fish that have been previously been identified in the subtidal environment throughout the Harbour varied in their distributions by habitat type. Fish commonly found in eelgrass beds, include: striped (*Embiotoca lateralis*) and pile perch (*Rhacochilus vacca*), threespine stickleback (*Gasterosteus aculeatus*), bay pipefish (*Syngnathus griseolineatus*), Northern ronquil (*Ronquilus jordani*) and gunnels (Archipelago 2004). In 2004, flatfish were the most commonly identified fish species in the outer area of the Harbour and off Inskip Islands (Archipelago 2004). Other fish such as perch and rockfish were associated mainly with the kelp beds adjacent to the islands (Archipelago 2004). For observations of fish during 2004 surveys refer to **Appendix E**, **Figure 22**).

The entirety of the Harbour and surrounding waters of the Greater Victoria area (DFO Are 19-1) are subject to a permanent bivalve sanitary closure due to concerns around potential presence of fecal coliform bacteria and other contaminants resulting from domestic sewage discharge from outfalls, docks, wharves, live-aboard boats and other sources (Golder 2006). In 2006, commercial fisheries within the Harbour were very limited. A commercial crab fishery consisting of only two licences was active in Esquimalt Harbour but restricted to specific areas due to DND security concerns, and red and green commercial sea urchin harvesting were generally conducted well outside of the harbour limits (Golder 2006). Recreationally, finfish and crab fishing was documented as occurring within Esquimalt Harbour in 2006; however, this was mostly near the mouth of the harbour and near Fisgard Island (Golder 2006).

2.4.4 Esquimalt Harbour Environmentally Sensitive Areas

North of Cole Island at the head of the Harbour is an area of shallow water and mudlfats. This habitat is used by many marine species, such as gulls and ducks, for foraging and occurs at the mouth of Millstream Creek, which is recognized as a coho spawning stream (SHIM Atlas 2016). Other fish species in the stream include: brown bullhead (Ameiurus nebulosus), cutthroat trout (*Oncorhynchus clarkia)*, prickly sculpin (*Cottus asper*), pumpkinseed (*Lepomis gibbosus*), smallmouth bass (*Micropterus dolomieu*) and threespine stickleback (*Gasterosteus aculeatus*). Eelgrass habitat has been documented as providing critical rearing habitat for juvenile fish, such as salmon and herring, and aides in erosion control by trapping the sediment in the marine and estuarine environments. Before the harbour was industrialized, first nations harvested large numbers of herring. Cumulative herring spawn habitat index (SHI) data from Fisheries and oceans Canada based on spawn records from 1928-2009 classifies Esquimalt harbour as minor (lowest 25%) to low (next 25%) (BCMA: Marine Atlas of Pacific Canada).

2.4.4.1 SARA Species

A search of the BC CDC *Species and Ecosystems Explorer* showed that there are 7 provincially and/or federally listed marine species or sub-populations that may potentially occur in the Project area (**Table 2.7**, BC CDC, 2016).

Northern abalone (*Haliotis kamchatcana*) have previously been observed within Esquimalt Harbour associated with rocky nearshore habitat in the Esquimalt Harbour Remediation Project of C-Jetty work zone (Balance 2012), along with Duntz Head and ML Floats (Mike Waters, Pers. Comm.). There is little suitable habitat occurring within the present Project area, as much of the harbour seafloor is comprised of soft sediments (see **Section 2.4.3.1** above)

Transient killer whales (*Orcinus orca*), harbour porpoises (*Phocena phocena*), and Steller sea lions (*Eumetopias jubatus)* have also been observed within the harbour (Mike Waters, Pers. Comm.).

Table 2.7 Marine Species at Risk with the Potential to Occur within the Project Area

Listed Species Name	COSEWIC Status	SARA Status	BC Status*	Habitat and Range Description	Likelihood of Occurrence
Steller sea lion (*Eumetopias jubatus*)	Special Concern	Schedule 1-Special Concern	Blue	Marine habitats include coastal waters near shore and over the continental slope; sometimes rivers are ascended in pursuit of prey. When not on land, the sea lions may congregate at nearshore traditional rafting sites, or move out to the edge of the continental shelf	Steller sea lions have been observed in the Project Area; however, the Project Area is not considered important habitat for the Steller sea lion
Harbour porpoise (*Phocoena phocoena*)	Special Concern	Schedule 1-Special Concern	Blue	Coastal waters and adjacent offshore shallows and also inhabits inshore areas such as bays, channels, and rivers. Mothers and young tend to move into sheltered coves and similar sites soon after parturition.	The Project Area is not considered primary habitat for this porpoise but may occur in areas adjacent to the Project area (this species has not been observed in the Project Area during surveys).
Killer whale (NE Pacific Southern resident population) *(Orcinus orca)*	Endangered	Schedule 1-Endangered	Red	The range during spring, summer, and fall includes the waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Little is known about winter movements and range.	The Project Area is not considered primary habitat for killer whales, which are found more frequently in the nearshore waters of Juan de Fuca; however, they are not known to frequent the active harbours of Esquimalt and Victoria. It is considered unlikely that killer whales would enter within or adjacent to the Project Area.
Killer whale (West Coast transient [Bigg's] population) *(Orcinus orca)*	Threatened	Schedule 1-Threatened	Red		

Listed Species Name	COSEWIC Status	SARA Status	BC Status*	Habitat and Range Description	Likelihood of Occurrence
Cutthroat trout (*Oncorhynchus clarkii clarkii*)	Not at risk	Not at risk	Blue	Preferred habitats are eelgrass meadows and kelp beds. Travels from streams to estuaries remaining close to shore.	The last recorded cutthroat trout in Mill Stream (flows into northeast Esquimalt Harbour) was in 1977; therefore, it is unknown if they still exist in the area (BCMOE, 2010). Cutthroat trout have not been observed in the Project Area to date.
Northern abalone (*Haliotis kamtschatkana)*	Threatened	Schedule 1-Threatened	Red	Found near kelp beds in the shallow subtidal and lower intertidal zones on hard substrates. Prefers areas with high wave action and currents.	There are some characteristics of the Project Area that would be favourable for abalone; however, the low wave action and currents and contaminated sediments are unfavourable. abalone were observed at the in the C jetty adjacent to the Project Area (Balanced 2012).
Olympia Oyster (*Ostrea conchaphila*)	Special Concern	Schedule 1-Special Concern	Blue	Mainly found in the lower intertidal and shallow subtidal zones of saltwater lagoons and estuaries. They have also been found on tidal flats, tidal channels, bays and sounds, in splash pools, near freshwater seepage, or attached to pilings or the undersides of floats. On the outer coast, this oyster species is only found in protected locations. Within suitable habitat, Olympia oysters need hard substrate for settlement.	No known occurrences of Olympia oysters within the Project Area.

* Red - Extirpated, Endangered, or Threatened, Blue – Special Concern, Yellow - apparently secure and not at risk of extinction

3.0 SITE CHARACTERIZATION AND IMPACT ASSESSMENT

Wood waste impacts to nearshore benthic communities are site-specific, depending on site conditions (e.g. bathymetry, currents, sedimentation rates) and the nature of wood waste, and require a detailed site assessment and determination of site-specific impacts (Washington State 2013).

3.1 METHODS

Site characterization methods were informed by wood waste assessment and remediation procedures developed by Breems and Goodman (2009) and Washington State Department of Ecology (2013), and included:

- Delineation of the nature (composition, see **Table 2.1**) and extent (lateral percent coverage and depth) of wood waste deposits in Esquimalt Harbour
- Characterization of existing biophysical conditions, within areas of known wood waste deposits, transition zones, and areas without wood waste including: substrate type, spatial distribution, and abundance of epibenthic and infauna biological communities
- Analysis of sediment chemistry to determine the distribution of COPCs and conventional sediment chemistry parameters associated with wood waste or wood waste decomposition by-products (including total organic carbon (TOC), pore water sulphides, ammonia, and pH).

Site characterization employed of a series of complimentary field methods to develop a comprehensive understanding of existing conditions in the Study area (see **Table 3.1**).

Table 3.1 Summary of Field Survey Methods Used to Determine Existing Conditions in Esquimalt Harbour

Survey Method	Objective		
	Wood Waste Delineation	Biophysical Assessment	Sediment chemistry
Side scan sonar	✓	✓	**N/A**
SCUBA Biophysical surveys	✓	✓	**N/A**
Sediment Collection (Hand cores, 0.65 m) (Van Veen, 0.2 m) (Sonic Drill Boreholes, ~5.0m)	✓	**N/A**	✓
Benthic Infauna sampling (Van Veen, 0.2 m)	**N/A**	✓	**N/A**

Following the site assessment, the data were used to determine any areas of Esquimalt Harbour that were impaired by wood waste, the results of which were used to inform remediation or management options (**Section 4.0**).

3.1.1 Field Sampling

Field sampling methods for side scan sonar, SCUBA biophysical surveys, core sampling and grab sampling are described in the following sub-sections.

3.1.1.1 Side Scan Sonar

Side scan sonar was used initially to collect imagery of the seafloor and provide information about larger features such as the distribution of larger wood waste (e.g. cut logs) and other underwater structures (e.g. debris, pilings), as well as sediment surface profiles and contours (e.g. can inform substrate composition assessment). Results were used to focus biophysical assessments on areas with wood waste deposits, and aid in the determination of the extent of wood waste.

Imaging was conducted on August 30, 2016 by Terra Remote Sensing Inc. using a towed Edge Tech 4200 operated at 300 and 900 kHz. Side scan survey lines were conducted primarily in a north-south direction and separated by 25 and 75 m to ensure adequate coverage of the seafloor. The horizontal scan range was 50 m to each side of the vessel. Mapping operations were conducted at three knots and kept at one metre depth (below the surface) throughout the survey.

3.1.1.2 SCUBA Biophysical Surveys

SCUBA surveys provide detailed information on sediment composition, the distribution of surficial wood waste and its composition, and the epibenthic community, and allow for some sub-surface sediment observations with the use of hand-held cores. While less rapid and less expensive then underwater towed video surveys, they are a more precise visual assessment method (Breems and Goodman 2009, Washington State 2013).

Survey and sample design were chosen to safely assess areas of wood waste deposits (initially delineated using the side scan sonar results), transition zones, and areas without wood waste both within the Harbour and at a nearby reference location, to:

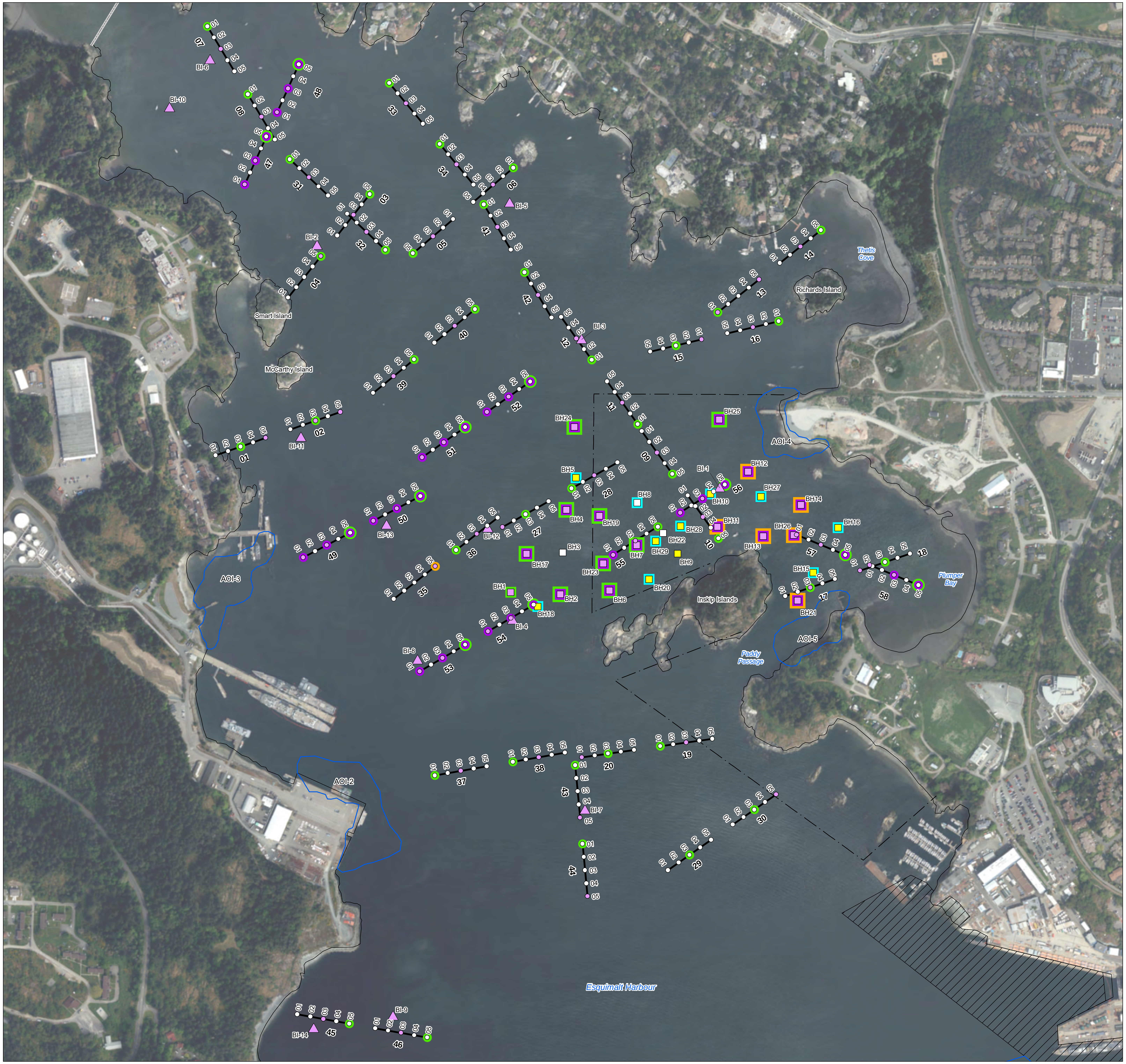
- Visually delineate the extent of surficial wood waste and characterize the composition
- Observe and record biophysical features

Over the course of three field surveys, a total of fifty-eight 100 m long transects were surveyed: 52 within Esquimalt Harbour and six within Pedder Bay (**Figure 3.1** and **Figure 3.2**).

- Field Survey 1: September 19 - 23, 2016
- Field Survey 2: October 19 - 21, 2016
- Field Survey 4: January 23 - 25, 2017

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Sampling Areas



Legend

- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour

Sampling Location Type

- Benthic Infauna Sample Station
- Drill Borehole
- Biophysical Sample Station
- Dive Transect

Completed Sampling Analysis

- DAS Analytics
- pH
- Ammonia / pH
- Poer Water Sulphide / Ammonia / pH
- Total Organic Carbon - Surficial (0-10cm)
- Total Organic Carbon - Deeper (30-40cm)

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:5,000

0 100 200 300 400

Metres

NAD 1983 UTM Zone 10N

Page Size: 17" x 22"

376-240.08	Production Date: Jan 11, 2019	Figure 3.1

Hemmera
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Public Works and Government Services Canada

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Pedder Bay Sampling Areas

Legend

Sampling Location Type

- Biophysical Sample Station
- Dive Transect

Completed Sampling Analysis

- Pore Water Sulphide / Ammonia / pH
- Total Organic Carbon - Surficial (0-10cm)

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: Capital Regional District, 2015

N

1:5,000

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

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376-240.08	Production Date: Jan 11, 2019	Figure 3.2

Hemmera
An Ausenco Company

Public Works and Government Services Canada

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Survey methods followed those outlined in the Marine Foreshore Environmental Assessment Procedure (DFO 2003). Each transect was delineated with a 100 m long lead-weighted line and sampling occurred at stations spaced at 25 m intervals (0, 25, 50, 75, 100m). Transect endpoints were georeferenced using a handheld GPS unit from the surface-support vessel. The 25 m interval sample positions were interpolated using distance along the transect with ArcGIS. At each of the five sampling locations, a 1.0 m x 1.0 m quadrat was used to assess:

- Substrate type (including woody debris; % cover; **Table 3.2**)
- Marine vegetation (% cover)
- Sessile invertebrates (% cover)
- Mobile invertebrates and fish (count)

The abundance of mobile invertebrates and fish were also documented as they were encountered along the transect. All transects were recorded using an underwater video camera for future review, as required.

Table 3.2 Biophysical Assessment Substrate Classification

Substrate Type	Size Range (Diameter)	
Bedrock/ Boulder	>256 mm	
Cobble	64 – 256 mm	
Gravel	2 – 64 mm	
Sand	0.06 – 2 mm	
Silt/Clay/Mud	<0.06 mm	
Other*	N/A*	
Large woody debris	Varies	
Wood waste	Cut Logs	Full size logs
	Small wood debris	<10cm diameter
	Wood chips	6-10cm^2
	Sawdust	10mm^2
	Woodfibre	<10mm^2

Note: *Substrates can also include anthropogenic structures, debris and shell hash etc., all of which were characterized under "substrate – other" during field sampling.

3.1.1.3 Sediment Collection

To delineate the presence and depth of wood waste deposits, and collect sediment samples for chemical analyses, sediment cores were collected throughout the Project area, including the Pedder Bay reference location.

Three sub-surface cores were taken at 50 m intervals (stations 0, 50, and 100 m) along each SCUBA transect (**Section 3.1.1.2**), to a maximum depth of 0.65 m below the sediment surface. The core (0.80 m long by 0.05 m diameter PVC tube) was pushed into the sediments by hand or using a one-kilogram hammer to a depth where it could no longer penetrate. The core was then capped, removed from the sediment, and a second cap placed on the bottom of the core to ensure the contents were not released. The sediment was retained in the corer during removal from the sediment due to suction created by the cap. Aboard the dive vessel, each core was visually inspected, photo-documented, and a borehole log was completed to document the vertical profile of substrate and wood waste stratification (**Table 3.2**). Additional information on the depth of hard substrate below the sediment surface was collected (stations 25 and 75 m) along each SCUBA transect using a one metre long metal probe marked at 10 cm intervals.

Surficial sediment samples (0 – 10 cm) were collected for chemical analyses during the SCUBA surveys using the hand driven cores and during Field Survey 3 (October 26 -27, 2016) using a Ponar grab sampler (~0.15 m by 0.15 m) operated from the waters surface. Analysis of conventional sediment chemistry parameters can aid in the identification of areas affected by wood waste decomposition by-products (Washington State 2013). For each transect, sediment was analyzed for the following parameters (**Figure 3.1** and **Figure 3.2**):

- Total organic carbon (TOC) – one to three samples
- Ammonia (NH_3) and pH – one sample
- Pore-water sulphides – one sample

Total volatile solids and TOC can both provide measures of sediment organic content and are indicators of wood waste in sediments. TOC was analyzed for this Project. Pore water sulphides were chosen over bulk sulphides as they provide a more accurate measure of H_2S; the more toxic form to organisms (see **Section 2.1.4.2**; Breems and Goodman 2009). Biochemical oxygen demand may help evaluate the potential for a reduced oxygen environment but is not considered necessary to determine wood waste impacts (Washington State 2013).

Water quality data were collected during Field Survey 3, within one tidal cycle, using a YSI 600 XL MP Sonde 1.65, with an extended 50 m cord, to record values approximately one metre above the seafloor. Parameters recorded included: water temperature (^oC), salinity (g/kg), dissolved oxygen (DO % and mg/L), pH and conductivity (µs).

Following the completion of the first phase of the project (Fiscal Year 2016/2017), it was recommended that further delineation of wood waste depth be conducted in an area immediately north of Inskip Island where hand-held surface cores were not able to determine the maximum depth of wood waste deposits (wood waste deposits were characterized as “open at depth”) during SCUBA surveys. This area was identified during the review of site history as a frequent location for log storage and near the former West Isle Sawmill and Fibremax log sort sites. In November 2017, Field Survey 6 (November 6 – 9th 2017) was initiated to determine the depth of the wood waste in this area using a sonic-drill rig mounted on a spudding barge. A total of 29 boreholes were completed during the survey; a borehole was considered complete if the borehole remained intact during extraction and native sediment was reached below wood waste deposits (**Figure 3.1**). Runs were completed in 5.0 m below ground surface intervals (i.e. below the sea floor), however, in some cases, up to 10.0 m penetration was required to ensure the borehole was complete (i.e. native sediment was reached).

As each run was removed from the water, cores were extruded from the drill into a sealed plastic bag and placed into a core box. Each borehole was visually inspected, photo-documented, and a borehole log was completed to document the vertical profile of substrate and wood waste stratification (**Table 3.2**). Once boreholes were logged and samples collected, drill cuttings were placed into labelled drums prior to characterization using the analytical laboratory results from the samples collected for disposal considerations. Drums were transported to an upland facility that could accept salt-impacted sediments for disposal. As with sediment cores above, sediment chemistry samples were taken from boreholes for the analysis of:

- TOC
- Ammonia
- Pore water sulphides
- pH

To determine the potential for dredged materials to qualify for disposal at sea (DAS), a preliminary investigation was conducted using samples taken from 10 of the boreholes during Field Survey 6 (**Figure 3.1**). Samples were collected from boreholes within the area of wood waste deposits north of Inskip Island and Plumper bay, along the border of, and within, the 5% TOC indicator threshold and analyzed for the DAS Minimum Sample Analytical Requirements[3]:

- Metals
  - Cadmium, mercury, arsenic, chromium, copper, lead, zinc
- Organics
  - Total polychlorinated biphenyls (PCB)
  - Total polycyclic aromatic hydrocarbons (PAH)
- Physical Parameters
  - TOC
  - Moisture (%)
  - Grain Size Distribution (%)

[3] It should be noted that these are the minimum requirements for projects with no contaminant history, and Environment Canada was not contacted to determine needs for additional site-specific analytical requirements.

Sediment chemistry samples from all field surveys (Field Survey 1 – 6) were processed on the support vessel after borehole log entries were completed (**Table 3.3**). Sample jars were identified using labels supplied by Maxxam Analytics (Maxxam) noting the sample number and type of analysis. The sample jars were then temporarily stored in insulated coolers at approximately 4ºC to minimize chemical alteration prior to laboratory analysis. The coolers were transported to Maxxam as soon as possible after sediment sampling was complete (and within acceptable hold times). A site-specific chain-of-custody form accompanied the samples when delivered to Maxxam.

Table 3.3 Surficial Sediment Sample Sizes Analyzed for Sediment Chemistry from Esquimalt Harbour and Pedder Bay

Location	TOC	Porewater Sulphides	NH_3	pH	DAS Analytics (Minimum requirements)
Esquimalt Harbour	95	61	68	78	10
Pedder Bay	6	6	6	6	-

3.1.1.4 Benthic Infauna Sampling

Extensive benthic infauna datasets exist for the Harbour; including a small number at reference stations; however, most sampling has actively avoided areas of known wood waste deposits:

- Bright 1995 – 17 stations (17 in September 1993)
- SLR 2016 – 56 stations (12 in February 2013, 46 in July 2015)

In order to examine the impacts of wood waste on the benthic infauna community, a total of 14 benthic infauna samples were collected during Field Survey 5 (March 7 – 10th 2017), across sediments that exhibited a range of TOC levels in Esquimalt Harbour. Two replicate samples were collected with a Van Veen sediment grab (0.1m^2) at each station and field-screened through a 1.0 mm sieve using unfiltered seawater. Material retained on the screen was transferred to jars and preserved with 10% buffered formalin. Only samples penetrating at least 10cm into the sediment, with no evidence of major washout or slumping, were processed. Sediment in Pedder Bay was very consolidated and grab samples were unsuccessful (i.e. sediment recovery did not meet the required quantities for analysis of benthic infauna community).

3.1.2 Laboratory Analysis

Sediment chemistry analysis and benthic infauna community analysis were performed at independent accredited lab facilities as follows.

3.1.2.1 Sediment Chemistry

All sediment chemistry analysis was performed by Maxxam Analytics.

Quality assurance and quality control (QA/QC) for the sediment samples included collecting a minimum of one duplicate sample for every ten samples analyzed (*i.e.*, 10% field duplicates) and submitting to the lab using a blind sample ID. The relative percent differences (RPDs) between the characterization sample and the field duplicate were calculated and RPDs compared to data quality objectives (DQOs).

RPD = (Absolute Value [A-B] / Average Value ((A+B)/2)) x 100%
where A = field sample and B = duplicate sample

In 2016 the CCME updated their Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 4 Analytical Methods which contains recommended DQOs for laboratory duplicate RPDs (**Table 3.4**; CCME 2016). It is recognized that these DQOs are intended for laboratory duplicates and do not include provisions for additional variability in field duplicates. However, these DQOs are considered a conservative screen for assessing the quality of field duplicates.

Table 3.4 Recommended Data Quality Objectives for Soil, Sediment and Groundwater

Parameter Category	Data Quality Objectives
Organics in Soil and Sediment	
Polycyclic Aromatic Hydrocarbons (PAHs)	50%
Volatile organic Compounds (VOC, including BTEX*)	50%
Hydrocarbon Fractions F1-F4	30%
Metals in Soil and Sediment	
High variability metals: Ag, Al, Ba, Hg, K, Mo, Na, Pb, Sn, Sr, Ti	40%
Other metals	30%
Nutrients in Soil and Sediment	30%
Organics in Water	
VOCs (including BTEX, F1-F4)	30%
PAHs	30%
Metals in Water	20%
Nutrients in Water	20%

*BTEX refers to chemicals benzene, toluene, ethylbenzene and xylene

High RPDs may reflect variability within the sample, which can be present due to the heterogeneity of the media or nature of the contaminant distribution. Values exceeding the above DQOs are examined on a case-by-case basis.

3.1.2.2 Benthic Infauna

Benthic infauna community was analyzed by Biologica Environmental Services Ltd. (Biologica). After a period of fixation, samples were transferred to 70% ethanol and stained with Rose Bengal to aid sorting. All samples and debris retained during field screening were sorted by trained technicians using a dissecting microscope at 10-40x magnification. Samples from high volume wood waste areas were sub-sampled.

Sorting efficiency QA/QC was conducted to ensure sorting efficiency was >95%. QA/QC was performed on 19% of the samples, and any samples below 95% sorting efficiency were re-sorted in their entirety. Subsampling accuracy was assessed by sorting the remaining sample for 10% of all subsampled samples and comparing the fractions to one another to ensure a >95% accuracy.

Organisms were identified to the lowest practicable taxonomic classification level (species wherever possible), using standard taxonomic keys and Biologica's verified reference collections, and enumerated by trained taxonomists.

3.1.3 Data Analysis

To delineate the presence of wood waste and its potential effects within Esquimalt Harbour, the surficial extent and depth of wood waste were mapped and compared with sediment chemistry and existing benthic community data.

3.1.3.1 Wood Waste Delineation

The lateral or surficial extent of the wood waste was documented during SCUBA surveys and mapped as percent cover, while the depth was estimated and mapped using measurements of wood waste collected from the hand-held sediment core and sonic drill data. The sonic drill investigation (Field Survey 6) followed previous field surveys, in order to target an area immediately north of Inskip Island where hand-held surface cores were not able to determine the maximum depth of wood waste deposits (wood waste deposits were characterized as "open at depth") during SCUBA surveys. Wood waste was characterized by size as described in **Table 2.1**. The depth of wood waste was estimated by interpolating the beginning and ending wood waste depths within the core to create top and bottom surfaces and estimating the volume between these two surfaces. In cases where wood waste occurred to the bottom end of the core, the layer was marked as 'open at depth' indicating that the wood waste depth is unknown for this sample location.

Since wood waste surficial cover and depth measurements were based on point observations at sample stations along transects, distribution maps were developed by interpolation using kriging and Surfer v14®. Kriging models the relationships between known sample station values by assuming that the distance or direction between sample points reflects a spatial correlation that can be used to explain changes in the pattern, the resulting figure represents estimates of distribution for each parameter between known sample station values. The interpolated figures were created in ArcGIS 10.5® to visualize the distribution of wood waste coverage and wood waste depth patterns.

The total volume of the wood waste in Esquimalt Harbour was estimated using ArcMap 10.5® to calculate the volume between the sea floor and the bottom of the wood waste deposit, using interpolated results. Wood waste deposits were covered with varying depths of silt in some areas and, in these cases, the overlying surficial sediment was included in the total volume estimated, as it would also need to be dredged during remediation. To visualize the wood waste deposits, information on wood waste depths were also imported into ArcGIS 10.4® from the borehole logs and used to create stratification/cross section profiles at six locations in Esquimalt Harbour.

3.1.3.2 Biophysical Assessment

Epibenthic Observations

Epibenthic communities were recorded during SCUBA surveys as percent cover for each of the sample stations along each transect for vegetation and sessile organisms, and as counts of individuals for mobile organisms. Descriptions of the biophysical environment were summarized qualitatively. Similar to the distribution maps for wood waste surficial coverage and depth, distribution maps were created for both bacterial mats (*Beggiatoa* spp.) and diatoms using percent cover observations and the interpolation method described above (**Section 3.1.2.1**).

Infauna Community

Summary metrics from the results of the benthic infauna sampling were calculated for each sample station to assess the distribution of community composition and included:

- Quantity Indices
  - Abundance (total number of individuals)
- Diversity and Evenness Indices
  - Species Richness (S) – Total number of unique taxonomic groups
  - Shannon-Weiner Diversity Index (H') – Accounts for species richness and evenness
  - Pielou's Evenness (J) – Quantifies distribution of individuals among the taxa
  - Swartz's Dominance Index (SDI) – the number of taxa that account for 75% of the total sample abundance. A lower SDI indicates the sample is dominated by only a few species.

The relative proportion of taxonomic groups was also calculated to highlight the dominant species in each sample.

3.1.3.3 Sediment Chemistry

Sediment chemistry was characterized using TOC, pore water sulphides, ammonia, and pH as indicators of areas impacted by wood waste decomposition by-products (see **Figure 2.1**). Sediment chemistry distribution maps of TOC, pore-water sulphides, ammonia, and pH were created using the interpolation methods described above (see **Section 3.1.2.1**).

Since TOC is a measure of organic content in the sediment, it is assumed that TOC levels are indicative of particulates/wood fibres resulting from historic log boom storage/sorting practices in the Harbour. Pore water sulfides and ammonia provide an additional indication of potential toxic by-products resulting from the anaerobic breakdown of TOC. Finally, pH values influence the toxicity of both sulphides (**Section 2.1.5.4**) and ammonia (**Section 2.1.5.5**) to aquatic life and should be considered in the analysis.

3.1.3.4 Wood waste Impact Assessment

To assess the relationship between the benthic community, the presence of wood waste, and sediment chemistry parameters associated with the breakdown of wood waste in Esquimalt Harbour, multivariate statistical analyses was undertaken to investigate the impact to both infauna and epibenthic communities. Depending on site-specific conditions statistically significant correlations between biological data and sediment chemistry data may or may not be present (Washington State 2013).

Sediment Chemistry

Spatial regression analyses were conducted using GeoDa™ software (Anselin 2003) to determine the relationship between each of the dependent sediment chemistry parameters measured (TOC, pore-water sulphides, ammonia, and pH) and wood waste deposit depths. A stepwise regression comparison approach was used. First, four ordinary least squares regressions were created for each of the dependent variables. Several diagnostics were used to assess for presence and type of spatial dependencies in the data (Anselin et al. 1996), with Moran's I, Lagrange Multiplier, and Robust Lagrange Multiplier tests used to estimate spatial autocorrelation. If autocorrelation was detected, the appropriate spatial model was run (Anselin 2005). Finally, an assessment for heteroskedasticity and non-normality was conducted.

Epibenthic Community

Analysis of the epibenthic community was also conducted using multivariate analyses in PIMER software (v.6.1.2, Primer-E Ltd.). To test for differences among epibenthic species assemblages within varying levels of TOC, a permutational MANOVA (perMANOVA) was conducted using the software package PERMANOVA (Anderson 2001, Andersen et al. 2008). PerMANOVA can determine within group variation, which addresses many common violations of analyzing ecological data. Significant differences among groups of species (*P*) were determined by permutation tests under the null hypothesis of no relationship, termed *pseudo-F*. To test for significant differences among levels of TOC, a one-way perMANOVA was run, which is similar in nature to a one-way ANOVA, except it compares how all the species in each group relate among TOC levels, rather than just a single species or variable.

An analysis of species contribution to the similarity among areas of differing TOC levels was also conducted using SIMPER (similarity percentage analysis) within PRIMER ver.6 (Clarke and Gorley 2006). SIMPER identifies the amount each taxon contributes to the Bray-Curtis similarity within each habitat and the dissimilarity among habitats. In addition, a SIMPER was used to identify key indicator species for each TOC level and how consistently a species contributes to this difference. When the dissimilarity value (δ) is divided by the standard deviation (SD), values greater than approximately 1.4 indicating a strong indicator species (Clarke and Warwick 2001).

A distance-based linear model procedure (DISTLM) in PERMANOVA was used to identify sediment chemistry parameters (TOC, sulphide, ammonia, and pH) explaining variation among the epibenthic community of sample locations. DISTLM is a multivariate multiple regression or distance-based redundancy analysis (dbRDA) technique (McArdle and Anderson 2001) that can fit environmental variables to biotic variables. Marginal tests were conducted to quantify the relationship of each sediment chemistry parameter alone, while conditional tests identify the best combination of sediment chemistry parameters, given the relationship of those previously selected in the model (i.e., the best order of variables to explain the data). The BEST routine within DISTLM was used to identify sediment chemistry parameters that exhibit the greatest correlation with the epibenthic community using model selection criteria. A pseudo-F test statistic was generated using 4999 permutations to allow for a P-value of 0.0002 (Andersen et al. 2008). Results were illustrated using a dbRDA with vector overlay, showing the direction and strength of sediment chemistry parameters with the biotic data summarized by sample locations. The selection criteria R^2 was used to explain the proportion of variation for each of the sediment chemistry parameters.

The stepwise regression comparison approach outlined above for sediment chemistry was also repeated to test for relationships between each of the sediment chemistry parameters as independent variables and bacterial mat coverage (% cover) as a dependent variable.

Infauna Community

Both species composition and species richness were used to test for differences among sample locations as a function of varying levels of sediment chemistry parameters (TOC, pore water sulphides, and ammonia). If sediment chemistry values (TOC, pore-water sulphides, and ammonia) were not co-located with each benthic infauna station, values for the benthic infauna station were extrapolated from the interpolation of sediment chemistry data (**Section 3.1.3.3**). All analysis of the infauna community data was conducted using multivariate analyses in R Statistical software (R Core Team 217).

Differences in species abundance were examined with Canonical Correspondence Analysis (CCA; using the VEGAN community package; Oksanen et al. 2018). The CCA analysis is a multivariate method used to examine the relationships between biological assemblages of species and their environment and was used to identify sediment chemistry parameters driving any variation in community composition between sample locations. Significant differences among species composition at each sample location were determined by permutation tests under the null hypothesis of no relationship. The strength of the fitted sediment chemistry parameter is estimated using the R-squared values and the p-value, the probability that the random permutation of R-squared is larger or equal to the observed value of the fitted value. A p-value < 0.05 was used to determine significant difference from random.

Linear modelling was used to examine differences in species richness. The species richness was rarefied to the minimum sample numbers and a correlation test is performed between the rarefied richness and the environmental variables. The relationship between species richness at each sample location and the sediment chemistry parameters was examined by creating a linear model with all environmental variables and selecting the best model using a stepwise model selectin approach. The best model was then used to examine correlations among species richness and each environmental parameter in the model. Correlations were then tested for significance.

Of the sediment chemistry parameters tested, the parameter identified as the best predictor of changes in community composition and richness was then used to determine the threshold of that parameter that had an impact to infauna community. The summary metrics for each benthic infauna sample locations (**Section 3.1.3.2**) were then plotted against the threshold and used to provide an estimate of threshold impact to species diversity. Finally, to visually display the threshold, bubble plots of summary metrics for each benthic infauna location were overlaid on the interpolated distribution for TOC, and the US EPA TOC threshold.

3.2 RESULTS

3.2.1 Wood Waste Delineation

Side scan sonar results were used to identify the area of wood waste deposits, with a combination of visual assessments (using SCUBA surveys) and sediment coring used to refine the lateral extent and depth of deposits.

3.2.1.1 Side Scan Sonar

Side scan sonar produced 19 high resolution images of the Esquimalt Harbour sea floor (see **Appendix F: Side Scan Sonar Results**). From these images, seafloor features were identified, including (**Figure 3.3**):

- Two large areas (>100 m wide) of wood waste (i.e., sunken logs) north of Inskip Island and into Plumper Bay, and south of Cole Island
- Two smaller areas of wood waste (<50 m wide), one near the mouth of Thetis Cove and one in southeast Plumper Bay
- Subtidal rocky outcrops through the Harbour
- Numerous unidentified targets such as anchor blocks, a wreck, and other anthropomorphic debris
- Bathymetric elevations

Side scan sonar data illustrated that visible surficial wood waste (logs and wood waste debris) are mainly distributed in areas of wood waste previously identified (Archipelago 2004; **Appendix D**, **Figure 8**); however, logs identified on the side scan sonar imagery did not appear as dense as those identified during Archipelago (2004) video tow surveys. Since the majority of log booming and sorting operations ceased in the late 1990’s, and no log removal efforts have occurred, sediment movements within the Harbour may have resulted in the deposition of sediment over the wood waste.

NOTES

1. ON 30 AUGUST 2016, TERRA REMOTE SENSING INC (TRSI) CONDUCTED A SIDE SCAN SONAR SURVEY OF THE ESQUIMALT HARBOUR. DATA WERE COLLECTED FROM FROM ASH HEAD NORTH TO COLE I. THE AREA NORTH OF COLE ISLAND DRIES AT LOW TIDE AND WAS TOO SHALLOW TO COLLECT REASONABLE SIDE SCAN DATA, PARTICULARLY WHEN THE SEABED IS VISIBLE AT LOW TIDE.
2. POSITION AND HEADING DATA WERE COLLECTED USING A HEMISPHERE VS-111 GPS. DIFFERENTIAL CORRECTORS WERE RECEIVED FROM RICHMOND COAST GUARD BEACON. GPS DATA WERE RECORDED AT ONE SECOND INTERVALS TO TRSI's PROPRIETARY NAVIGATION AND DATA LOGGING SOFTWARE *RTC*.
3. SIDE SCAN SONAR DATA WERE COLLECTED USING AN EDGETECH 4200 DUAL FREQUENCY SYSTEM TOWED NEAR THE WATER SURFACE. THE DATA WERE COLLECTED AT 50 METRE HORIZONTAL SCAN RANGE (100 METRE SWATH) AT BOTH 300 AND 900 KHZ. DATA WERE LOGGED TO JSF AND XTF FORMAT USING DISCOVER SOFTWARE AND PROCESSED USING SONAR WIZ. WHERE SHOWN, SIDE SCAN IMAGERY (900 KHZ) DEPICTS HIGHER SEABED REFLECTIVITY AS LIGHTER (WHITE), AND LOWER SEABED REFLECTIVITY (IE. ACOUSTIC SHADOWS) AS DARKER (BLACK).
4. BATHYMETRIC DATA WERE COLLECTED ALONG THE SIDE SCAN LINES USING A KNUDSEN 320M SINGLE BEAM ECHOSOUNDER WITH A 200 KHZ - 6 DEGREE BEAM-WIDTH TRANSDUCER.
5. WATER LEVELS DURING THE BATHYMETRIC DATA COLLECTION WERE COLLECTED USING RTK GPS.
6. THE SHORELINE AND LAND FEATURES SHOWN ON THE DRAWINGS ARE FROM CHS ECN DATA.

LEGEND

S□□B□D D□PTHS □WH□R□ SHOW□□

CONTOURED DEPTHS ARE FOR REFERENCE ONLY AND ARE FROM CHS ECN DATA, ALL REFERENCED TO CHART DATUM

S□□B□D □□□T□R□S □WH□R□ SHOW□□ □□ROM SID□ SC□□ SO□□R D□T□ (30 AUGUST 2016)

ROCK OUTCROP, INCLUDING ADJACENT SUBCROP

WOOD WASTE ZONE (PRIMARILY LOGS)

ANCHOR BLOCK (CONCRETE)

UNIDENTIFIED SONAR TARGET (VARIOUS SIZES AND SHAPES)

S□R□□Y TR□C□S □WH□R□ SHOW□□

15:30 15:30 15:30

TRSI SIDE SCAN SURVEY TRACKLINE (30 AUGUST 2016)

KEY MAP

REVISIONS

NO	REMARKS	DATE	TRADE	INDEP CHKD	DFTG	DFTG CHKD	INSPD	REV	ACPT
0	Submitted in Final	27 Oct 2016	EXISTING CONDITIONS	KK	KK	MR	client	TA	TA
A	Submitted in draft	16 Sept 2016	EXISTING CONDITIONS	trsi	KK	MR	client	client	client

SURV	KK,TCB	30Aug2016
PROCD	KK	31Aug2016
DFTG	KK	1Sept2016
CHKD	MR	16Sept2016
INSPD	———	———
REV	———	———
ACPT	———	———

GENERAL NOTES

Equipment

Survey vessel: *Doppler*
Surface Positioning: Hemesphere VS111 GPS
Navigation/Acquisition Software: RTC(TRSI)
Bathymetry: Knudsen 320M, 200kHz - 8° beam
Morphology and Stratigraphy: EdgeTech 4200

Drawing Parameters

Projection: UTM Zone 10N Datum: NAD83
Central Meridian (CM): 123°W
Scale Factor at CM: 0.9996
False Easting: 500000 False Northing: 0
Vertical Datum: LLWLT (Chart Datum)

CLIENT

HEMMERA

TERRA REMOTE SENSING INC.
1962 Mills Road
Sidney, BC Canada
V8L 5Y3
Ph: (250) 656-0931
Fax: (250) 656-4604
Web: www.terraremote.com

PROJECT

Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

TITLE

Side Scan Sonar Results

- with contoured bathymetry -

m | DWG NO | CAD | R | SHT NO. 3.3

TRSI PROJECT No.: 000-2795

T:\PROJ-Marine\000-2795 Hemmera - Esquimalt BC\Drawings\2795 Hemmera Esquimalt Harbour.dwg, Surficial Features - Sht 3, 27/10/2016 8:57:28 AM, Kelvin.Kopeck

3.2.1.2 Field Surveys

Surficial Extent

Visual SCUBA surveys within Esquimalt Harbour supported side scan sonar data, with areas of scattered logs (**Photo 1**), at times concentrated, or bark cover (**Photo 2**) observed in two areas: north of Inskip Island and reaching into Plumber Bay, and north of Smart Island (**Figure 3.4**). Areas of Esquimalt Harbour without wood waste were generally characterized by soft sediment with some minor drift marine vegetation (**Photo 3**). In comparison, surficial wood waste cover was not observed during any of the SCUBA surveys conducted in Pedder Bay (**Photo 4**).

The majority of surveyed areas within Esquimalt Harbour are categorized as having little to no visible surficial wood waste (0 – 5%; **Table 3.5**). Although a previous subtidal video survey by Archipelago (2004) covered a greater extent of the harbour (see **Appendix E**, **Figure 3**), due to different study objectives, the surveyed areas that fall outside of the Hemmera towed video and sampling areas (e.g. Constance Cove) were categorized as having little to no wood waste coverage (see **Appendix E**, **Figure 4**). Therefore, surveyed areas of minimal to high wood waste coverage (> 5%) mostly overlapped between the two studies. Since 2004, it appears that the percent cover of extremely high wood waste (>80%) has decreased and the area of moderate wood waste has increased (5 – 30%). Differences between the two studies may be due to variations in study area, but given the side scan sonar observations, are likely due to sedimentation burying wood waste deposits in areas of extremely high wood waste cover (>80%). Since net current velocities and rates of natural sedimentation in Esquimalt Harbour are quite low (< 0.003 m/second tidally averaged current velocities north of Inskip Island; Anchor QEA), burial of wood waste may be attributed to the resuspension and settlement of fine-grained sediments from Harbour activities, such as propeller wash and scour, or from the net influx of sediment from Juan de Fuca Strait (Burd 216, Geosea 2009).

Initial screening guidelines, outlined by Washington State (2013), to target potential areas of wood waste impacts use surficial cover of 5 – 25% wood waste to indicate a possible need for further investigation, while >25% (or 5% where wood waste is finer chips or sawdust) should be investigated further due to the adverse impacts to the benthic community (**Section 2.1.5.1**).

Table 3.5 Estimates of Surficial Wood Waste Cover on the Subtidal Seafloor of Esquimalt Harbour

Wood Waste Coverage (% cover)	Archipelago 2004		Hemmera 2017	
	Subtidal Area (ha)	% of Area Surveyed	Subtidal Area (ha)	% of Area Surveyed
0 – 5	225.7	77	136.53	66
5 - 30	19.5	7	48.91	24
30 - 80	11.0	4	19.19	9
>80	36.9	12	1.49	1
-	**293.10**	**100**	**206.12**	**100**

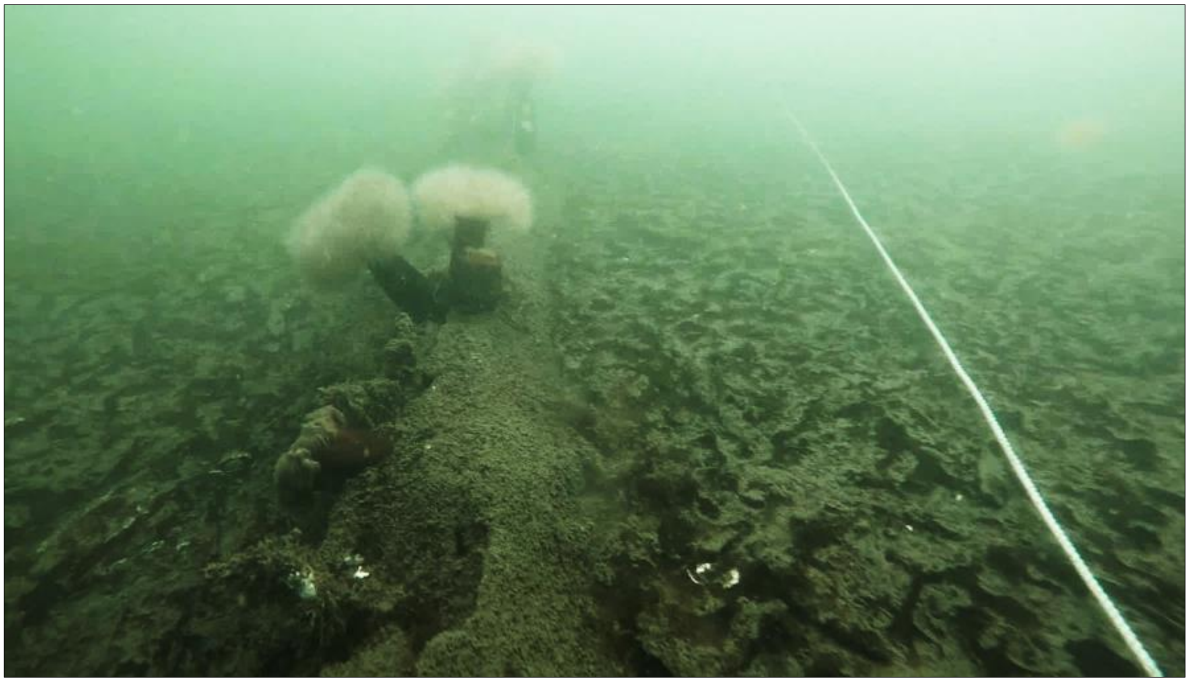
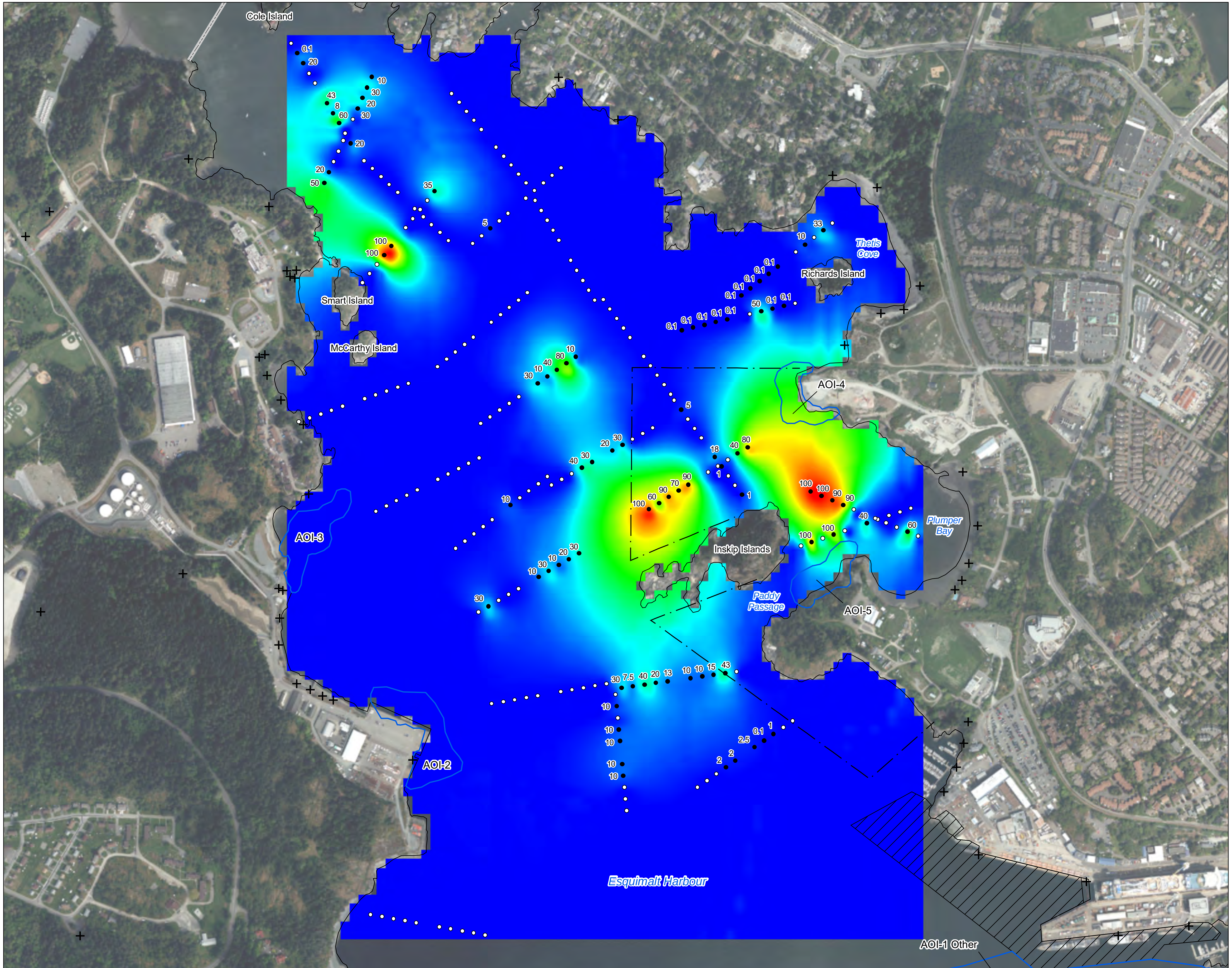


Photo 1 Representative view of a subtidal area in Esquimalt Harbour with scattered logs and fine layer of sediment and fine wood waste surrounded by bacterial mats

Photo 2 Representative view of a subtidal area in Esquimalt Harbour with continuous small woody debris and fine layer of sediment and fine wood waste

Photo 3 Representative view of a subtidal area in Esquimalt Harbour containing a silty sand substrate with drift understory kelp, shell debris, and only very sparse detritus and small woody debris

Photo 4 Representative view of a subtidal area in Pedder Bay containing silty sand substrate, with drift understory kelps, and an active infauna community signified by observable mounds and siphons



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Surficial Wood Waste Cover from SCUBA Surveys

Legend

- Sampling Location (Surficial Wood Waste Coverage = 0%)
- Sampling Location (Surficial Wood Waste Coverage >0%)
- 0.65 Surficial Wood Waste Coverage (%)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Wood Waste Coverage (%)
100
75
50
25
0

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Wood Waste Depth and Volume

Sediment cores (hand-held and sonic drill) showed variation in the stratification of wood waste and surficial sediment across the Harbour, with no wood waste observed in sediment cores from the Pedder Bay reference location (**Figure 3.5**; **Appendix G: Sediment Core Photo Examples**). To further visualize the distribution of wood waste across the harbour, cross sections were also developed from borehole logs (**Appendix H: Wood Waste Depth Cross Sections**).

Overall, the wood waste observed below the sediment surface (i.e. not observable during SCUBA surveys) was greater than observable surficial cover (**Figure 3.4**), confirming that wood waste deposits in some areas of the Harbour have become mixed with, or covered by, varying depths of surficial sediments (**Figure 3.5**). The interpolated depth results confirmed that the two large areas of wood waste identified by side scan sonar, north of Inskip Island and south of Cole Island, are the areas with deepest wood waste deposits in Esquimalt Harbour (**Figure 3.5**).

Wood waste deposits in Esquimalt Harbour are characterized by small woody debris, primarily large amounts of bark with some finer wood debris (e.g. sawdust or woodfibre), with interspersed cut logs (**Table 2.1**). While previous studies (Archipelago 2004) and side-scan sonar results show the presence of scattered logs in areas of wood waste, the diameter of the hand-held core was too small to capture this information and logs were only encountered once during the drilling program, north of Inskip Island (Field Survey 6). Decomposition of wood waste was indicated by the presence of dark organic fine sediment in sediment cores containing decomposing wood waste (see examples in **Appendix G**). In areas containing wood waste, a variety of conditions were characterized during borehole logging:

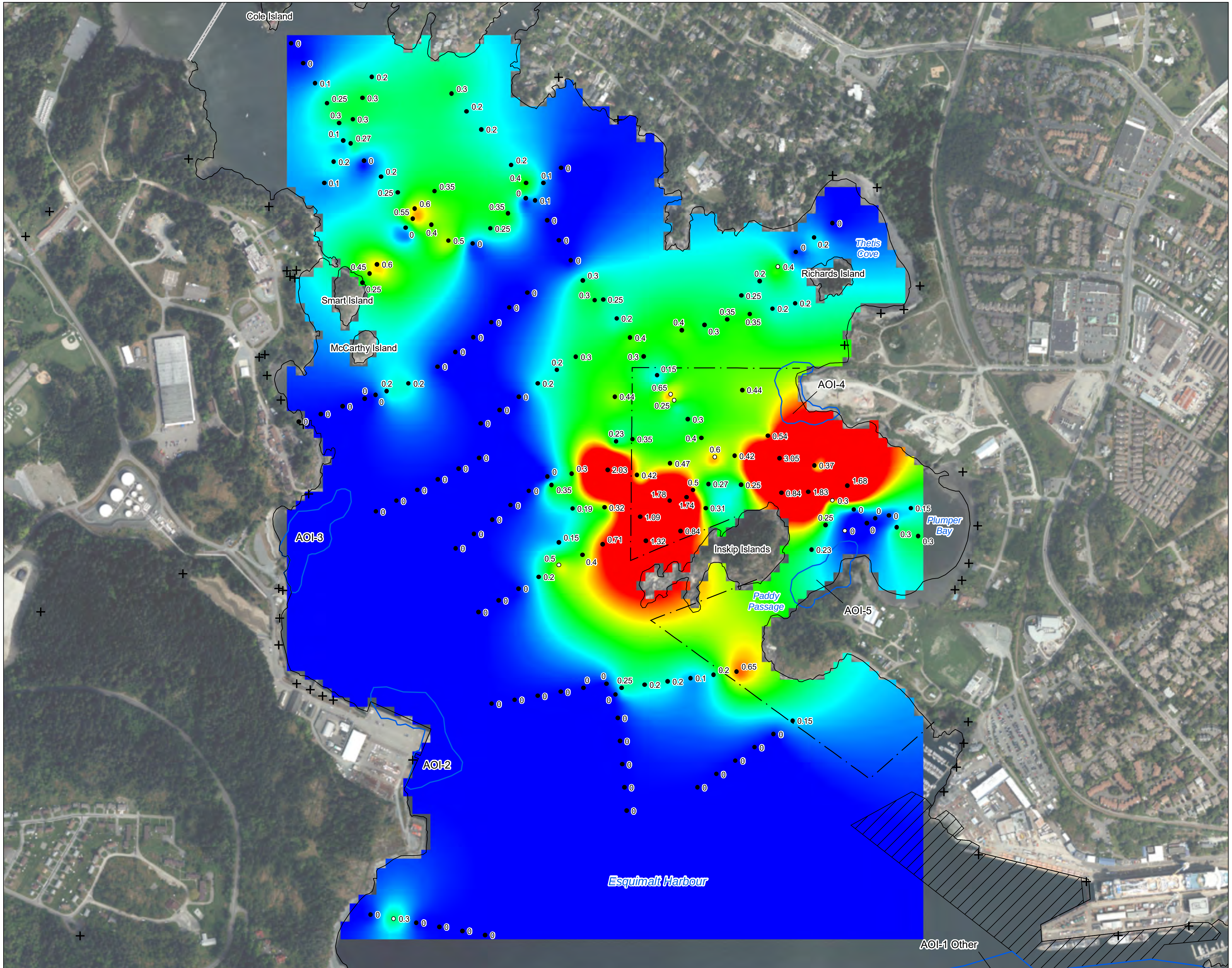
- Organic sediment mixed with high volumes of wood waste (fibre and wood debris)
- Organic sediment mixed with trace to low volumes of wood waste (fibre and wood debris)
- Entirely consisting of small wood waste (fibre and wood debris)

In some boreholes, a mixture of the above conditions was present (e.g. organic sediment mixed with high levels of wood waste overlying a layer entirely consisting of small wood waste before transitioning to native silt/sand sediment). The nature of the wood waste in Esquimalt Harbour is consistent with the extensive log storage activities that occurred until the late 1990’s, and the log sort and sawmills located in Thetis Cove and the headland at the Ralmax facility near Plumper Bay (**Section 2.4**). Wood waste deposits transitioned to underlying bedrock or native sediment, which was typically light grey to grey/brown silt/ sand with some shell debris/ shell hash, eventually reaching native clays (in areas where the sonic-drill reached these depths (see examples in **Appendix G**).

The total volume of wood waste and overlying impacted sediments in Esquimalt Harbour is estimated to be 332,299 m^3, with the deeper wood waste deposits (>0.25 m) calculated to be 227,819 m^3 north of Inskip Island and 31,182 m^3 south of Cole Island.

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Wood Waste Depth from Core Samples



Legend

- • Sampling Location (Bottom depth of wood waste was reached during sampling)
- ○ Sampling Location (Bottom depth of wood waste was not reached during sampling)
- 0.65 Sampled Wood Waste Depth (m)
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Wood Waste Depth (m)

0.69 - 2.65
0.52
0.35
0.17
0

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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3.2.2 Biophysical Assessment

Biophysical results from all field surveys were summarized to determine impacts of wood waste on the marine benthic community (see **Appendix I: Raw Field Observations and Sediment Chemistry Data).**

3.2.2.1 Physical Characteristics

The subtidal area of Esquimalt Harbour that was surveyed was characterized primarily by unconsolidated soft sediments (mean percent cover silt = 82%, sand = 12%). Small debris wood waste and logs were observed overlying sediments in two areas within the Harbour as identified in **Section 3.2.1** above. Similar to Archipelago's survey in 2004, in shallow surveyed areas outside of the wood waste deposits, sediments were more consolidated and contained higher quantities of gravel/sand: Thetis Cove (Transect 14), immediately adjacent to Cole Island (Transect 7) and in the outer Harbour (Transect 45; Archipelago 2004)). Recent work by Anchor QEA determined that deeper areas of the Harbour are generally characterized by fines, with coarser grained sediment in pockets that may have been stripped of fines by tidal currents and propeller wash. Three small patches of rocky reef habitat, surrounded by soft sediments, were observed in the outer Harbour (Transect 45/46; **Figure 3.1**).

In Pedder Bay sediments were more consolidated and had higher sand content than most of the areas surveyed in Esquimalt.

3.2.2.2 Water Quality Results

Both Esquimalt Harbour and Pedder Bay are tidally driven, with low volume freshwater inputs and low wave exposure (**Section 2.2**). In Esquimalt Harbour, dissolved oxygen and pH near sea bottom was characterized as being moderate (DO % mean = 78.9, SD = 6.8) and (pH mean = 7.9, SD = 0.08), with similar conditions in Pedder Bay (DO % mean = 77.14, SD = 4.68) and (pH mean = 7.7, SD = 0.14). Since conditions are comparable and Pedder Bay did not contain any surficial wood waste, or deposits of wood waste, water quality at or near the SWI in Esquimalt does not appear to be impacted by wood waste.

3.2.2.3 Benthic Community

Epibenthic Community

Esquimalt Harbour epibenthic communities were similar to those documented by Archipelago (2004). The epibenthic community in Esquimalt Harbour was relatively sparse, with several common soft bottom species observed throughout survey areas, such as: Dungeness crabs (*Metacarcinus magister*), graceful crab (*Metacarcinus gracilis*), shrimp (*Pandalus spp*.), and hermit crabs (*Pagurus spp*.). White bacterial mats (e.g. *Beggiatoa spp.*) appear common throughout the inner Harbour area (**Photo 5**, **Figure 3.6**) and are inversely distributed with diatomaceous mats. Diatomaceous mats were observed more commonly from mid-Harbour to the outer Harbour area (**Photo 6**, **Figure 3.7**). Similarly, Archipelago (2004) documented concentrated bacterial mats in areas of highest organic debris, such as Plumper Bay. Bacterial mats are commonly associated with coastal sediments containing high organic content (Amend et al. 2004), such as wood waste, and will outcompete naturally occurring diatom mat communities. Fewer areas with white bacterial mats were observed during surveys conducted in winter months, likely due to increased levels of oxygen at the SWI, or the first few centimeters of the sediment, allowing for the bacteria to migrate into the sediment with the change in the oxygen-sulphide transition zone (for further explanation see **Section 2.1.3**). Similar to Archipelago (2004) marine vegetation was sparse to absent in soft bottomed areas and areas with surficial wood waste cover and consisted solely of drift senescent understory kelps (e.g. *Saccharina latissima* and *S. groenlandica*). Although eelgrass (*Zostera marina*) beds occur in the Harbour, they were not observed in the project area.

Areas with hard structure (e.g. exposed logs and rocky reef habitat) were colonized by typical encrusting and hard substrate organisms. Rocky reef habitat was colonized by coralline algae (*Corallina* spp), ochre stars (*Pisaster ochraceus*), barnacles (*Balanus glandula*), and red sea urchins (*Strongylocentrotus fransicanus*) (**Photo 7**), while exposed logs provided substrate for plumose anemones (*Metridium senile)*, hydroids (Phylum Cnidaria, Class Hydrozoa) and tunicates (subphylum Tunicata; **Photo 1** and **Photo 8**). Areas with high structural complexity also attracted recruiting fish communities of black rockfish (*Sebastes melanops*) (e.g. **Photo 8**).

In comparison, Pedder Bay transects (Transect 21 – 26) had greater presence of shrimp (*Pandalus* sp.) and contained a higher coverage of drift senescent kelps (e.g. *S. latissima* and *S. groenlandica*), *Sarcodietheca gaudichaudii*, and diatoms (**Photo 4**). Bacterial mats were not observed along any of the transects surveyed in Pedder Bay.

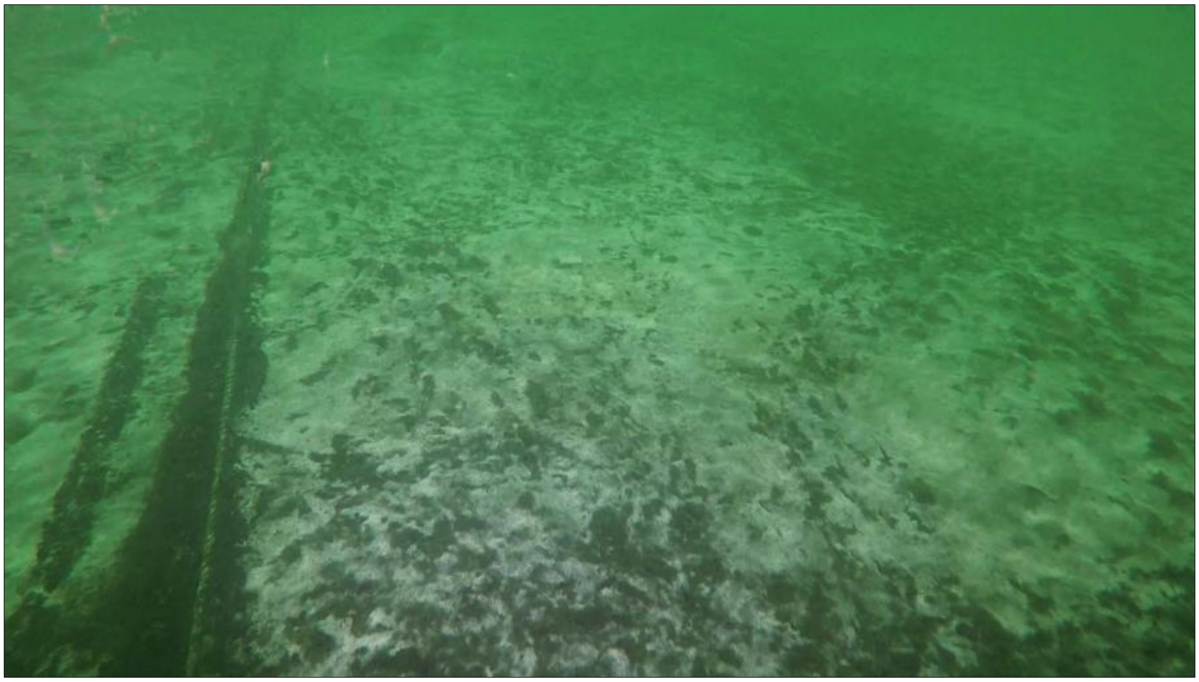


Photo 5 Representative view of a subtidal area in Esquimalt Harbour with fibre mat intermixed with silt and *Beggiatoa* bacterial mat

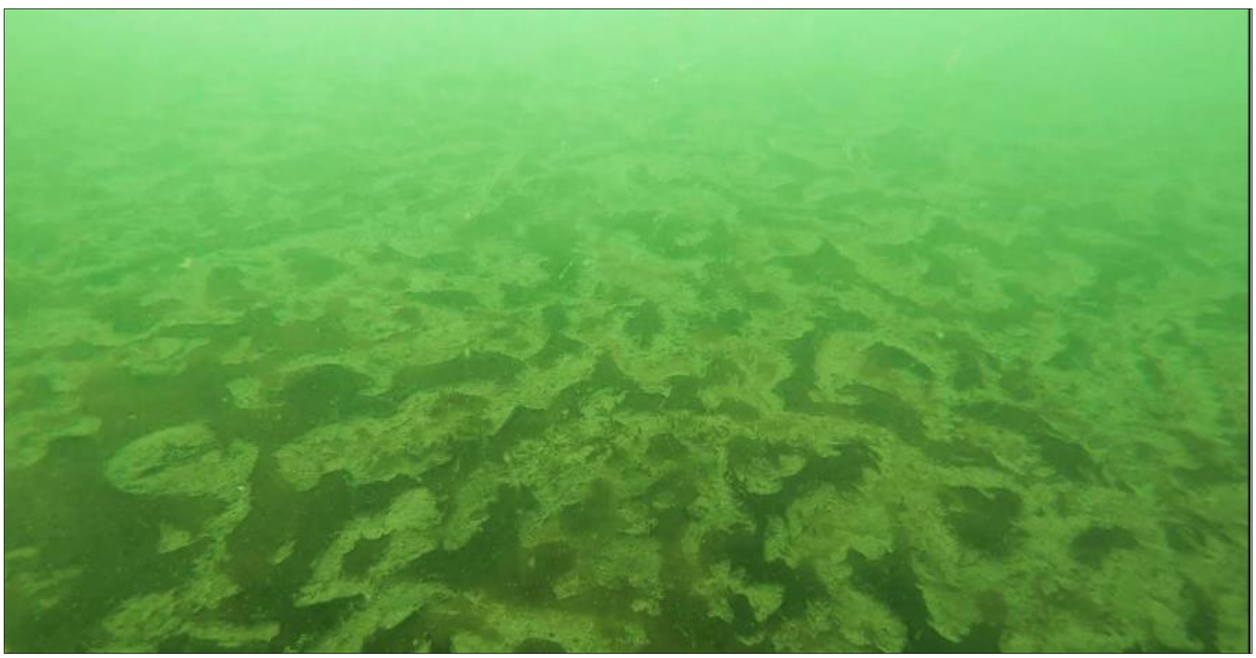


Photo 6 Representative view of a subtidal area in Esquimalt Harbour with silty substrate and a mix of diatoms and *Beggiatoa* bacterial mat

Photo 7 Rocky habitat with encrusting species including a red sea urchin

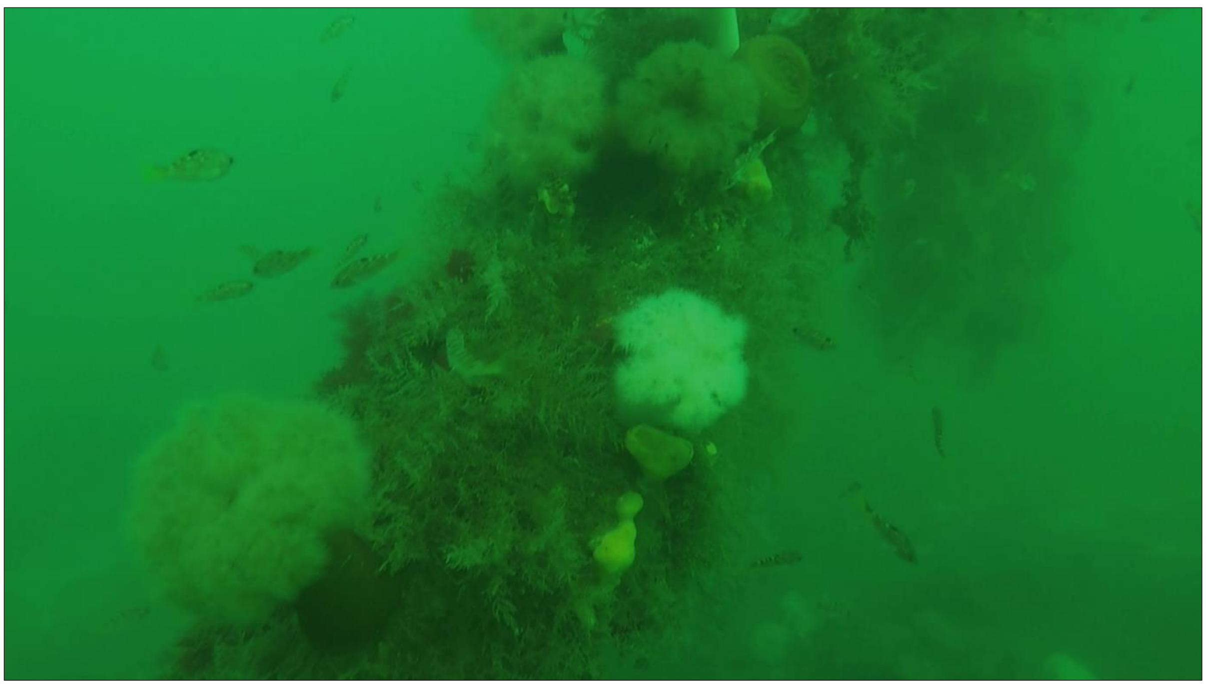
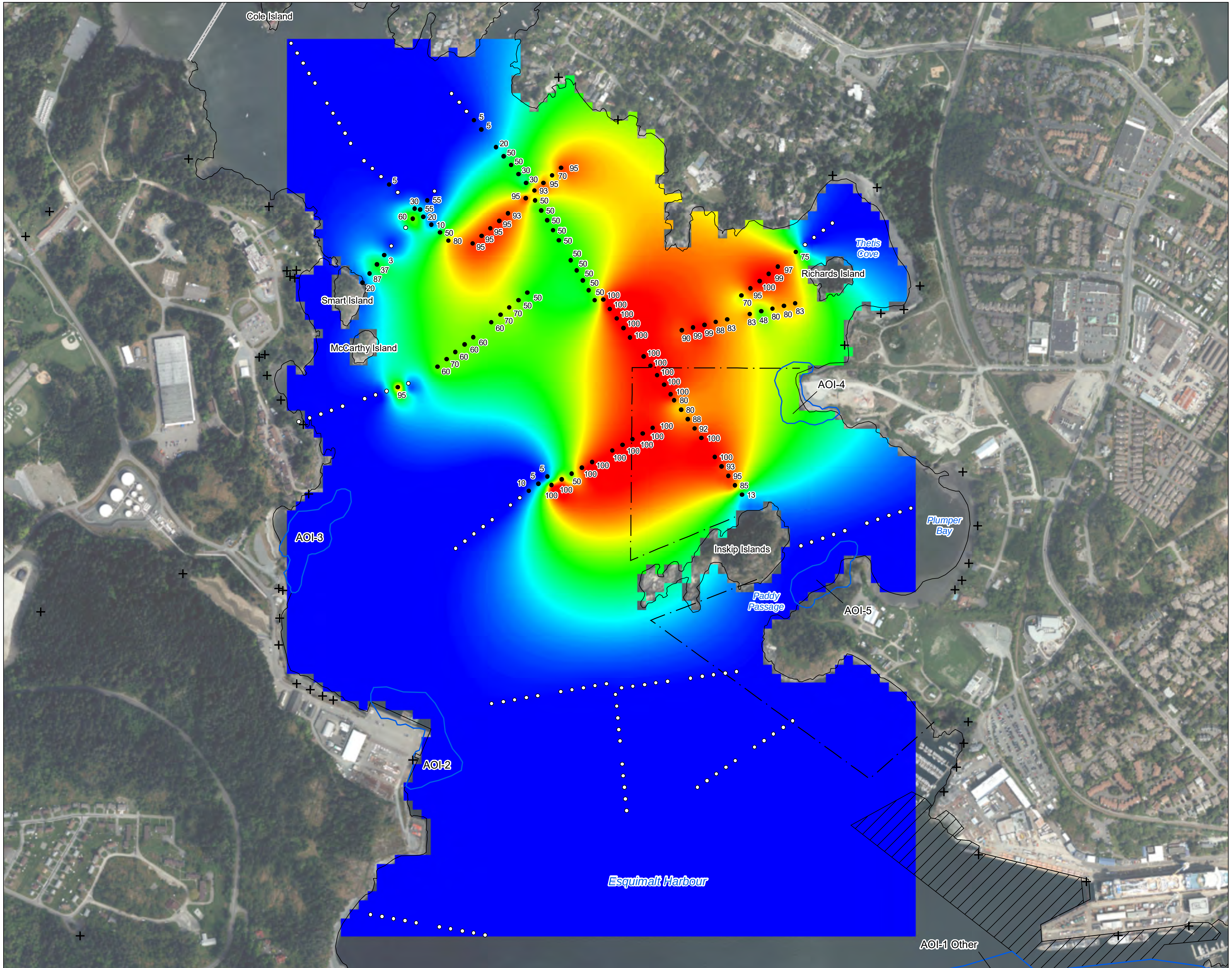


Photo 8 Exposed log covered in plumose anemones and diatoms, surrounded by young of the year black rockfish



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Beggiatoa Coverage

Legend

- Sampling Location (Beggatoea Coverage = 0%)
- Sampling Location (Beggiatoa Coverage >0%)
- 75 Sampled Beggiatoa Coverage (%)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Beggiatoa Coverage (%)

100
75
50
25
0

Notes

1. Locations should be considered approximate.
2. All locations were sampled for beggatoea coverage; however, only sampled coverages greater that 0% have been been labelled.
3. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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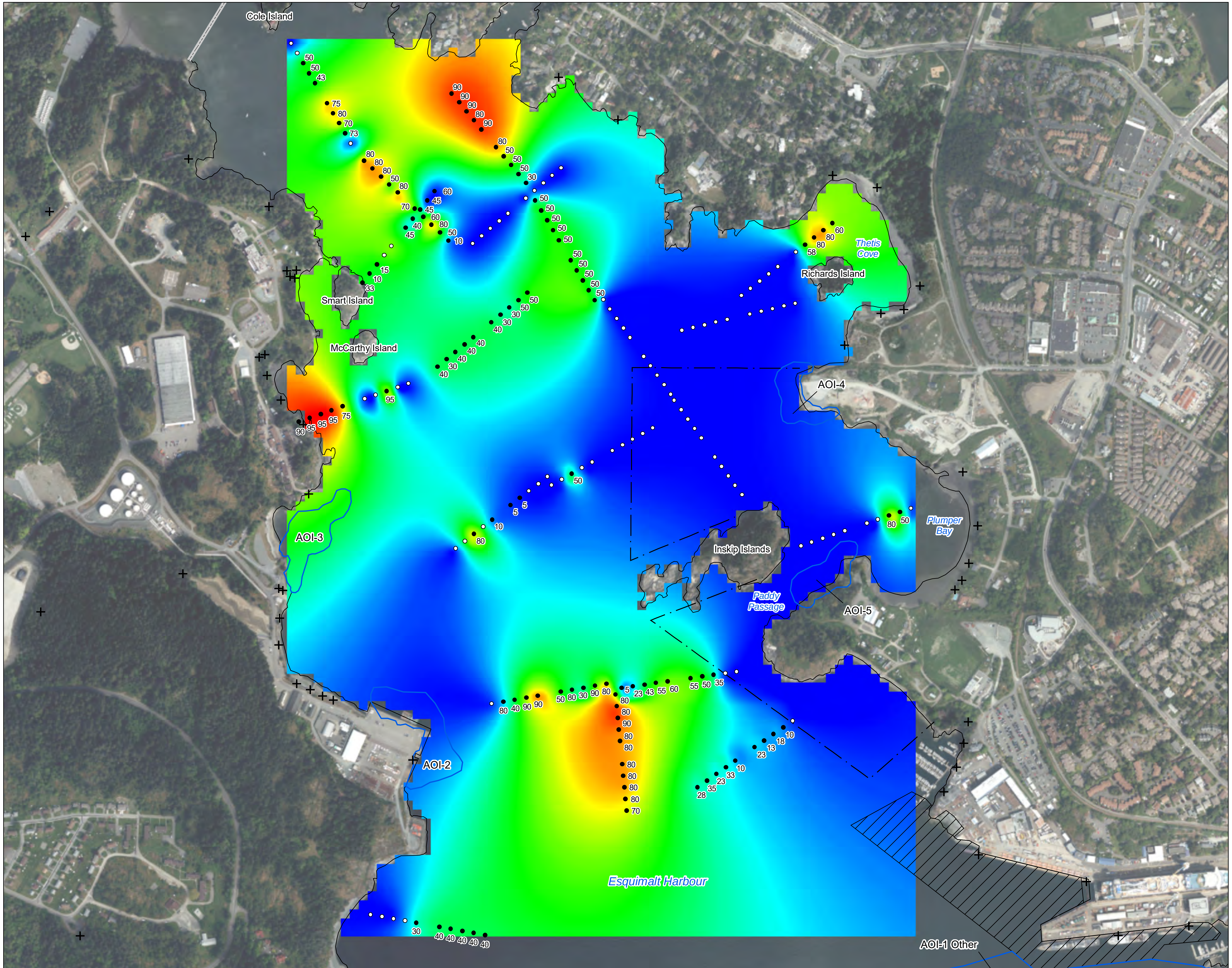
Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Diatom Coverage



Legend

- ○ Sampling Location (Diatom Coverage = 0%)
- ● Sampling Location (Diatom Coverage >0%)
- 75 Sampled Diatom Coverage (%)
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Diatom Coverage (%)
95
75
50
25
0

Notes

1. Locations should be considered approximate.
2. All locations were sampled for diatom coverage; however, only sampled coverages greater that 0% have been been labelled.
3. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Infauna Observations

Infauna holes and mounds, generally indicative of burrowing shrimps, worms and bivalves, were relatively absent from most transects. Archipelago (2004) documented patchy occurrences of infaunal burrows in areas outside of known wood waste deposits and an absence of holes and mounds in wood waste areas (**Appendix E**, **Figure 18**). In comparison, Pedder Bay had a higher incidence of holes and mounds (**Photo 4**).

Benthic infauna data from fourteen paired benthic invertebrate sample locations within Esquimalt Harbour were summarized to examine variation among sample locations (see Benthic Infauna Stations **Figure 3.1**). The distribution of abundance, species richness, species diversity and evenness indices, and relative abundance of dominant taxa are presented in **Table 3.6** (complete benthic infauna data available in **Appendix I**).

Both abundance and species richness varied across sample locations with a high of 1321 individual organisms and 44 species for location BI-14 Rep 02 and a low of 13 individuals and 3 species at location BI-04 Rep 02 (**Figure 3.1** and **Table 3.6**). The number of species contributing to the 75% total abundance ranged from 1 to 10 across sample stations (**Table 3.6**). Species composition was also variable across sample locations with most stations dominated by a single second-order opportunistic polychaete species (*Armandia brevis*) and two other second-order opportunistic species dominating at the remaining stations (*Prionospio* ***(****Minuspio****)*** *lighti* and *Aphelochaeta glandaria* complex; **Table 3.6** and **Figure 3.8**). Sample locations furthest from wood waste deposits (i.e. sample locations closer to the mouth of the harbour and furthest inside the harbour) had higher diversity metrics.

Table 3.6 Benthic Infauna Community Summary Statistics by Sample Location and Level of TOC

Sample ID	Replicate	Wood Debris Indicator	Quantity	Diversity				Dominant Species	Relative Proportion (%)
		TOC	Total Abundance (N)	Species Richness (S)	Shannon Diversity Index (H')	Pielou's Evenness (J')	Swartz's Dominance Index (SDI)		
BI – 1	**01**	85,000	125	15	1.75	0.65	1	*Armandia brevis*	89
	02		95	16	2.24	0.81	1	*Armandia brevis*	91
BI – 2	**01**	63,000	128	11	1.41	0.59	5	*Armandia brevis*	38
	02		68	11	1.57	0.65	4	*Prionospio (Minuspio) lighti*	53
BI – 3	**01**	55,000	249	16	1.31	0.47	1	*Armandia brevis*	90
	02		183	17	1.70	0.60	1	*Armandia brevis*	85
BI – 4	**01**	41,000	19	9	1.98	0.90	2	*Armandia brevis*	65
	02		13	3	0.54	0.49	4	*Prionospio (Minuspio) lighti*	22
BI – 5	**01**	21,000	668	27	2.06	0.62	1	*Armandia brevis*	90
	02		310	35	2.91	0.82	2	*Armandia brevis*	69
BI – 6	**01**	19,000	516	13	0.55	0.22	7	*Ampharete.labrops*	29
	02		375	5	0.38	0.24	6	*Prionospio (Minuspio) lighti*	22
BI – 7	**01**	23,000	267	20	1.99	0.66	2	*Aphelochaeta glandaria* complex	53
	02		659	26	1.82	0.56	3	*Aphelochaeta glandaria* complex	46
BI – 8	**01**	25,000	187	4	0.38	0.28	1	*Armandia brevis*	69
	02		408	11	0.66	0.28	5	*Prionospio (Minuspio) lighti*	42
BI – 9	**01**	18,000	234	15	1.43	0.53	2	*Aphelochaeta glandaria* complex	55
	02		291	23	2.26	0.72	3	*Aphelochaeta glandaria* complex	48
BI – 10	**01**	18,000	230	8	0.48	0.23	4	*Armandia brevis*	53
	02		196	13	1.13	0.44	5	*Armandia brevis*	31
BI – 11	**01**	9,800	513	28	2.43	0.73	2	*Armandia brevis*	51
	02		844	43	2.53	0.67	2	*Armandia brevis*	47
BI – 12	**01**	39,000	817	39	1.70	0.46	2	*Armandia brevis*	62
	02		952	43	1.88	0.50	3	*Armandia brevis*	56
BI – 13	**01**	25,000	72	12	1.29	0.52	5	*Armandia brevis*	26
	02		71	12	1.70	0.68	1	*Armandia brevis*	85
BI – 14	**01**	15,000	991	33	1.50	0.43	5	*Aoroides intermedia*	30
	02		1321	44	1.89	0.50	10	*Tectidrilus.sp.*	15

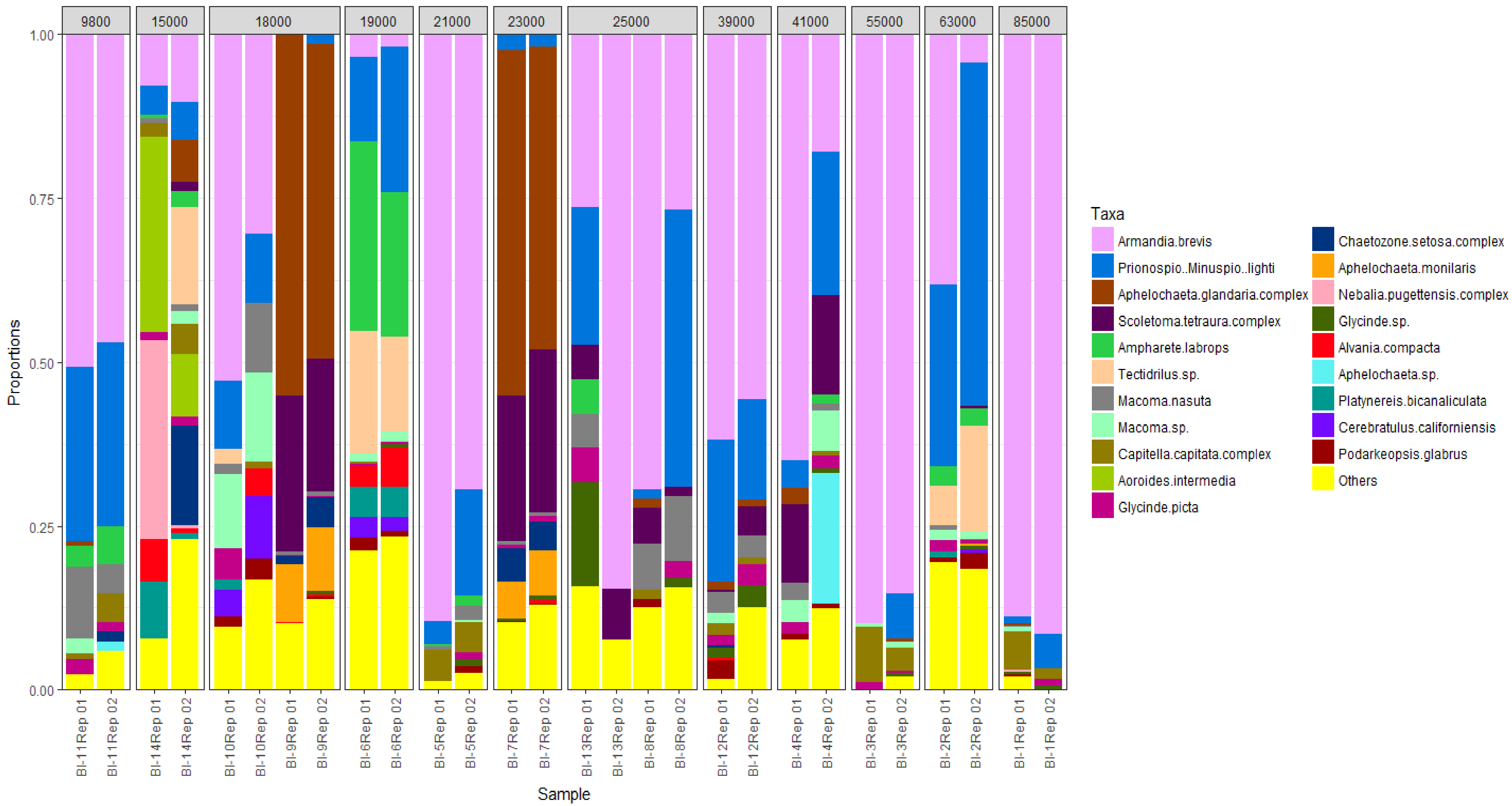


Figure 3.8 **Relative proportion of each Taxonomic Group by Sample Station, Replicate, and TOC Level**

3.2.3 Sediment Chemistry

The analysis of sediment chemistry parameters focussed on wood waste degradation by-products commonly associated with wood waste deposits (TOC, pore water sulphides and ammonia). Raw results by sampling station can be found in **Appendix I.**

3.2.3.1 TOC

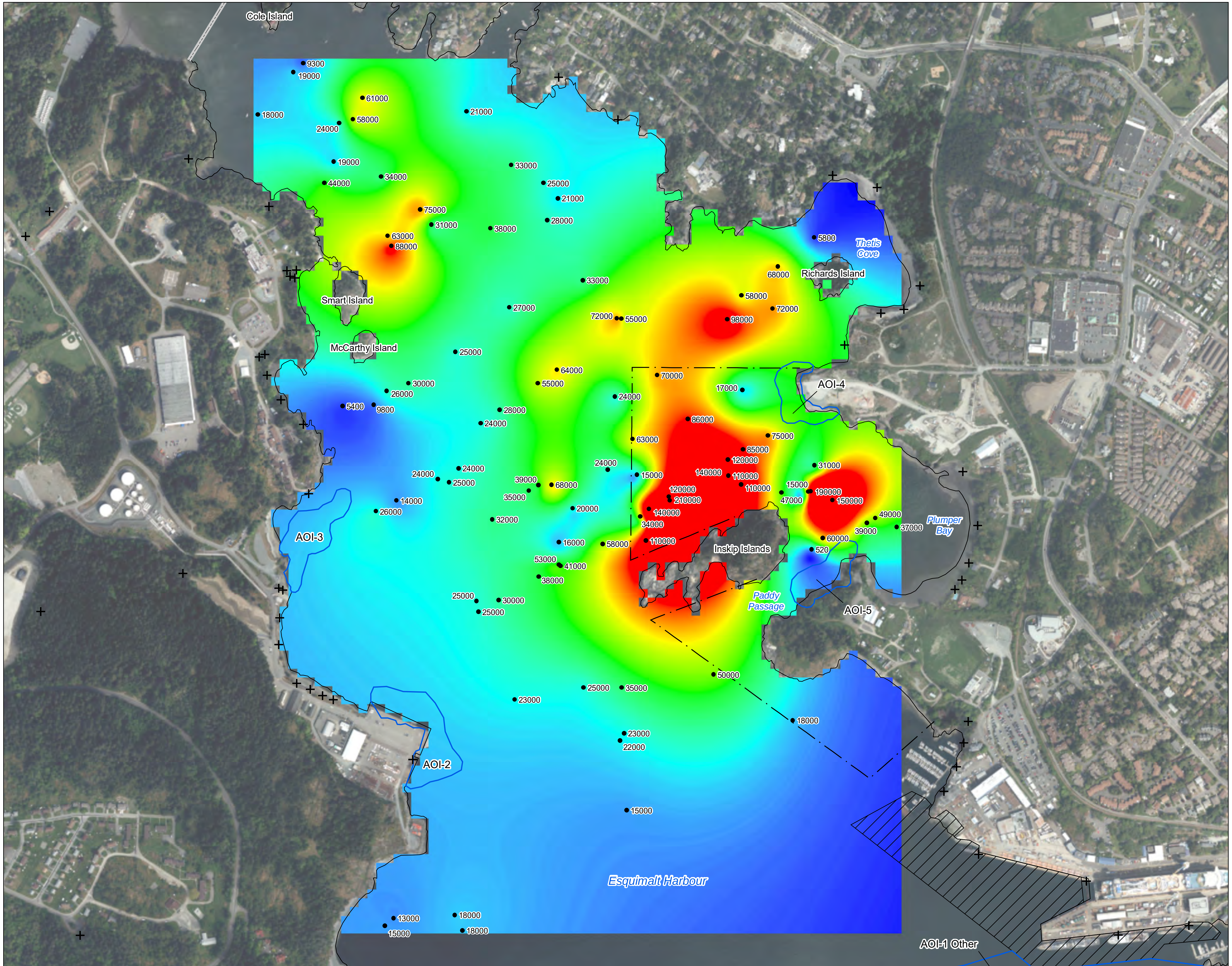
Naturally elevated levels of organic carbon are found associated with productive habitats in nearshore coastal ecosystems that generate high levels of detrital organic material, such as eelgrass beds and kelp beds. However, organic enrichment of nearshore environments also occurs from anthropogenic activities, such as the aquaculture industry, sewage outfalls, and wood waste deposits (**Section 2.1.3**). To interpret TOC measurements, it is necessary to determine if site-specific levels are naturally elevated, using nearby reference locations, or if anthropogenic activities are contributing (e.g. locations of aquaculture tenures, storm water outfall locations, log handling and storage tenures, etc).

TOC measurements within the Harbour ranged from 5,400 to 204,000 mg/L while in Pedder Bay measurements ranged from 1,600 to 8,700 mg/L (**Figure 3.9** and **Figure 3.10**). Elevated TOC measurements within Esquimalt Harbour do not appear correlated with storm-water outfall locations but overlap with the identified areas of wood waste deposits (**Figure 3.5** and **Figure 3.8**). There are no known, or active, log handling/storage tenures or aquaculture facilities in proximity to Pedder Bay or Esquimalt Harbour; however, the Jones Marine Lease Area within the Harbour may occasionally be used to store log booms.

When comparing against TOC screening-level indicators for benthic impairment (**Section 2.1.4**), most of the area covered by the interpolated TOC distribution (200.6 ha) fell within the intermediate (1 – 3%) and high (>3%) impact ranges. In the area of wood waste deposit north of Inskip Island and into Plumper Bay (**Figure 3.**5) TOC values ranged from 33,000 mg/L or 3.3% to 210,000 mg/L or 21% (**Table 3.7**, **Figure 3.9**). TOC values within the wood waste deposit north of Smart Island (**Figure 3.5**) ranged from 21,000 mg/L or 2.1% to 88,00 mg/L or 8.8% (**Table 3.7**, **Figure 3.9**). A few areas in the Harbour were below the 1% TOC screening-level indicator for little to no impairment, including Thetis Cove, adjacent to Cole Island and the western shoreline south of McCarthy Island (**Table 3.7**, **Figure 3.9**). All samples collected at the out-of-Harbour reference location (Pedder Bay) were below 1% or low chance of benthic impairment (**Figure 3.10**).

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Total Organic Carbon



Legend

- ● Sampling Location
- 5400 Sampled Total Organic Carbon (mg/L)
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

TOC Concentration (mg/L)

- 79,700 - 204,000
- 60,200
- 40,700
- 21,100
- 1,600

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

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376-240.08	Production Date: Jan 11, 2019	Figure 3.9

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Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Pedder Bay Interpolated
Total Organic Carbon Concentration

Legend

- ● Sampling Location
- 5400 Sampled Total Organic Carbon Concentration (mg/L)

TOC Concentration (mg/L)

- 79,700 - 204,000
- 60,200
- 40,700
- 21,100
- 1,600

Notes

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Sources

- Aerial Image: Capital Regional District, 2015

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376-240.08	Production Date: Jan 11, 2019	Figure 3.10

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Public Works and Government Services Canada

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Table 3.7 Estimates of Subtidal Seafloor Area by TOC Screening-Level Indicators of Benthic Impairment in Esquimalt Harbour

TOC Screening Level (%)	Benthic Impairment	Study Area	
		Area (ha)	% of Area
0 – 1	Low	14.4	7
1 – 3	Intermediate	98.4	49
>3	High	87.9	44
-	-	200.6	100

3.2.3.2 Sulphides

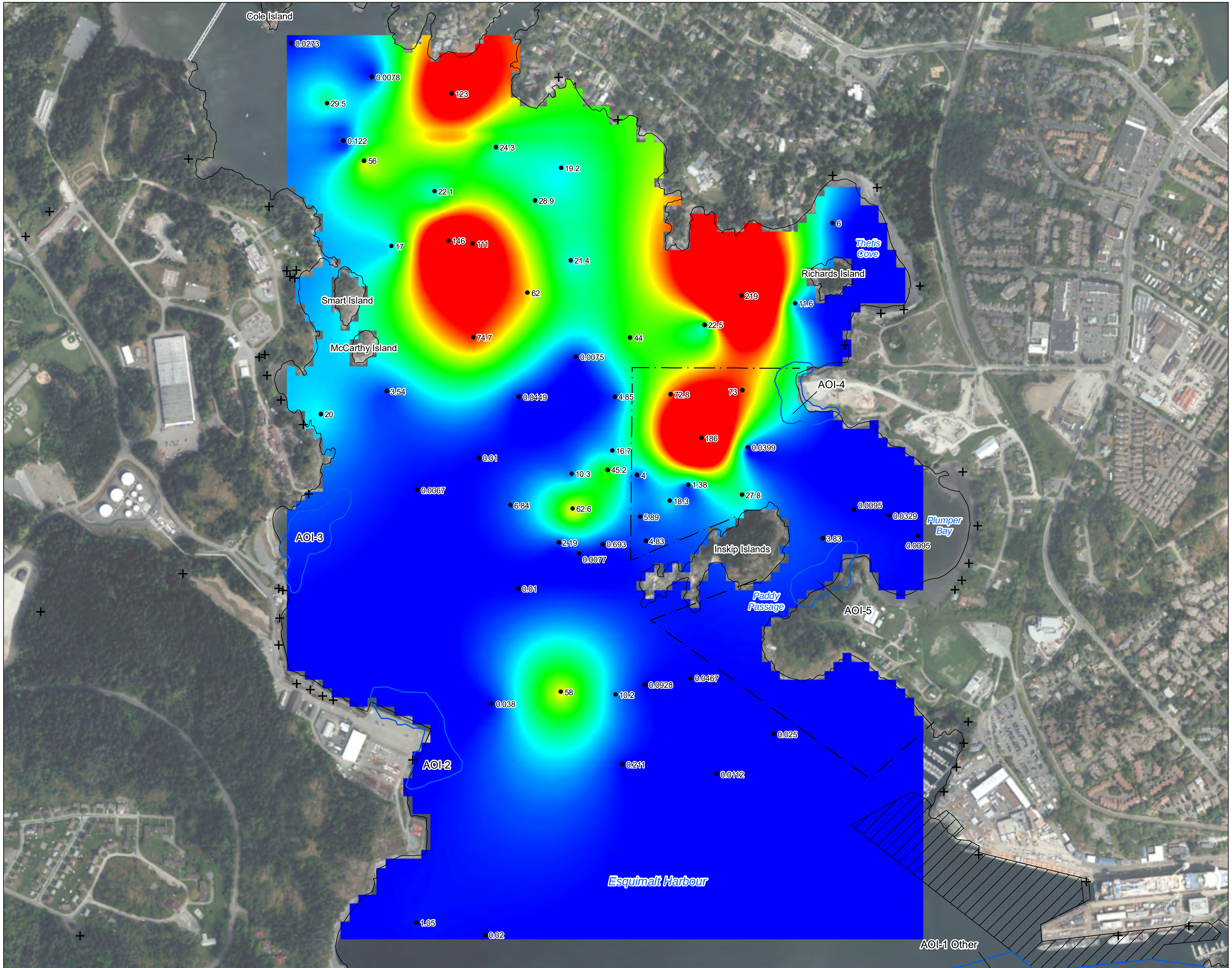
Pore-water sulphides are a by-product of bacterial wood waste decomposition in an anaerobic environment (**Section 2.1.3** and **Figure 2.1**) and may provide an additional indicator of wood waste impacts (Washington State 2013).

Pore-water sulphides in Esquimalt Harbour ranged from 0.01 to 219 mg/L and from 0.01 to 13.1 mg/L at Pedder Bay reference location (**Figure 3.11**). The Detailed Quantitative Ecological Risk Assessment to Support Environmental Risk Management in Esquimalt harbour (SLR 2016) reported pore-water sulphides in a similar range (0.0062 to 161 mg/L) across Esquimalt Harbour sediments and concluded that it may be occurring at concentrations high enough to affect benthic infauna. Results of a bioassay and follow-up study with the amphipod, *Rhepoxynius abronius,* suggested that toxicity (i.e. increased mortality) was observed at pore-water concentrations > 10mg/L and that elevated concentrations of pore-water sulphides are contributing to sediment toxicity in the Harbour.

While there is some overlap of higher sulphide measurements with identified areas of wood waste deposits, some sample locations with higher sulphide measurements are not correlated with known areas of wood waste (**Figure 3.5** and **Figure 3.11**). This may indicate that sulphide levels could be driven by other factors within the harbour. However, accurate pore-water sulphide measurements can also be difficult to obtain as hydrogen sulphide readily oxidizes into less toxic forms when sediment becomes disturbed and volatilization occurs during sampling, transport, and storage (Washington State 2013, Azimuth 2017). Given the pore-water sulphide results, sulphides may not be the best indicator of wood waste-associated impacts to the benthic community.

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Sulphide Concentration



Legend

- Sampling Location
- 22.5 Sampled Sulphide Concentration (mg/L)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Sulphide Concentration (mg/L)

78 - 210
59
39
20
0

Notes

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Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

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Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure 3.11

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3.2.3.3 Ammonia

Ammonia is a by-product of bacterial wood waste decomposition in an anaerobic environment (**Section 2.1.3** and **Figure 2.1**) and may provide an additional indicator of wood waste impacts (Washington State 2013).

Ammonia ranged from 2.0 to 67.5 mg/L in Esquimalt Harbour, while at the Pedder Bay reference location it ranged from 7.0 to 19.8 mg/L (**Figure 3.12**). The interpolated distribution of ammonia shows more overlap with the distribution of wood waste and elevated levels of TOC than pore-water sulphides, with two areas of elevated measurements (**Figure 3.5**, **Figure 3.8** and **Figure 3.12**).

3.2.3.4 pH

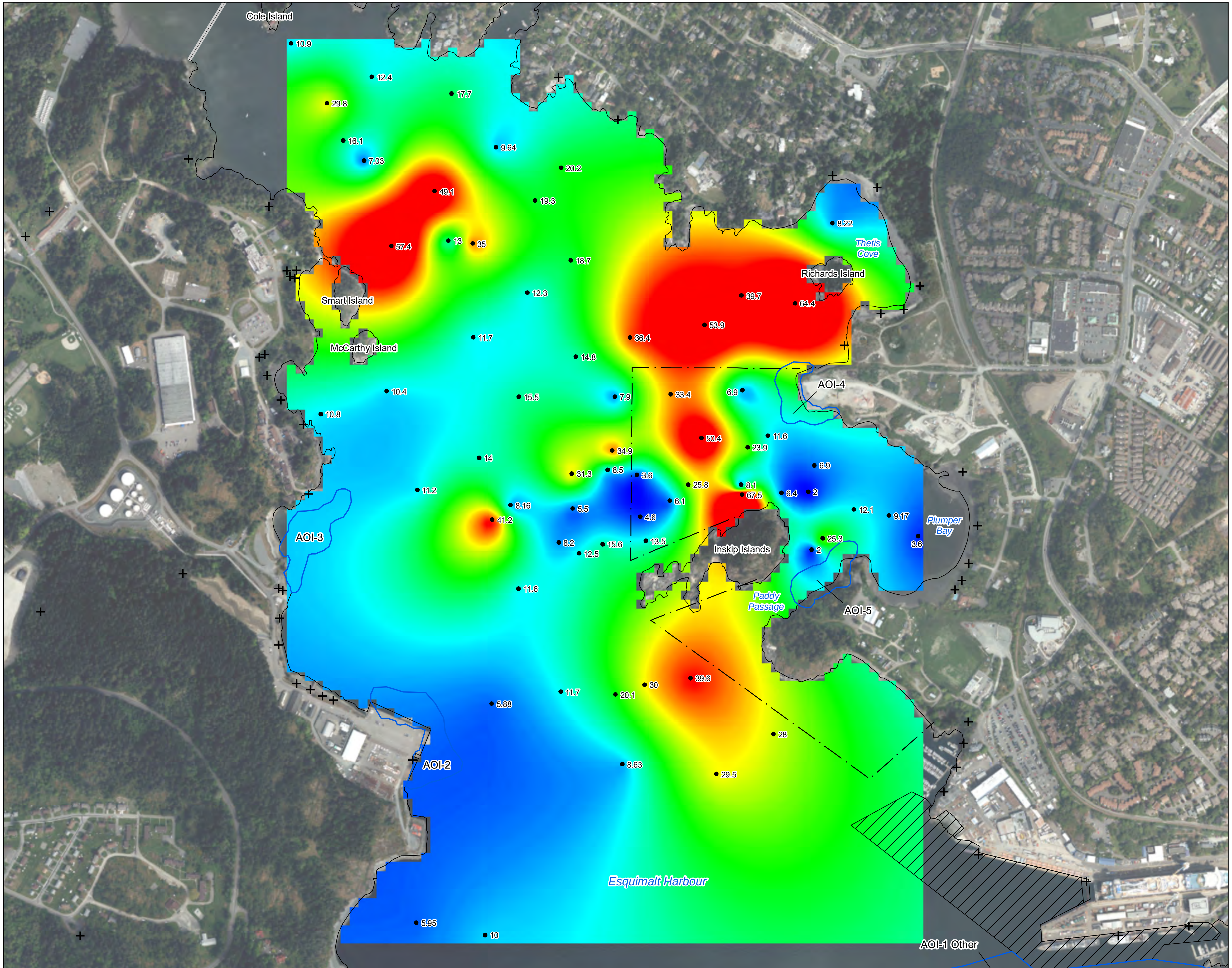
A lower sediment pH will increase the concentration of the more toxic un-ionized forms of sulphide (H2S) and ammonia (NH3) and should be considered in the sediment chemistry analysis when identifying areas impacted by decomposition by-products of wood waste.

Sediment pH in Esquimalt Harbour ranged from 7.02 to 8.27 and from 7.91 to 8.24 at Pedder Bay reference location (**Figure 3.13**). While the range experienced in Esquimalt Harbour sediments is within the range observed in Canadian coastal waters (**Section 2.1.3**), pH was lower (<7.91) in certain areas of Esquimalt Harbour than in all Pedder Bay samples.

While it is variable, the interpolated distribution of sediment pH does show some overlap with the distribution of wood waste, in particular surficial coverage of wood waste (**Figure 3.4** and **Figure 3.13**). The area of deeper wood waste deposits immediately north of the western end of Inskip Islands (**Figure 3.5**) exhibits consistently lower pH values (<7.7).

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Ammonia Concentration



Legend

- Sampling Location
- 39.7 Sampled Ammonia Concentration (mg/L)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Ammonia Concentration (mg/L)

39 - 63
30
21
12
2

Notes

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Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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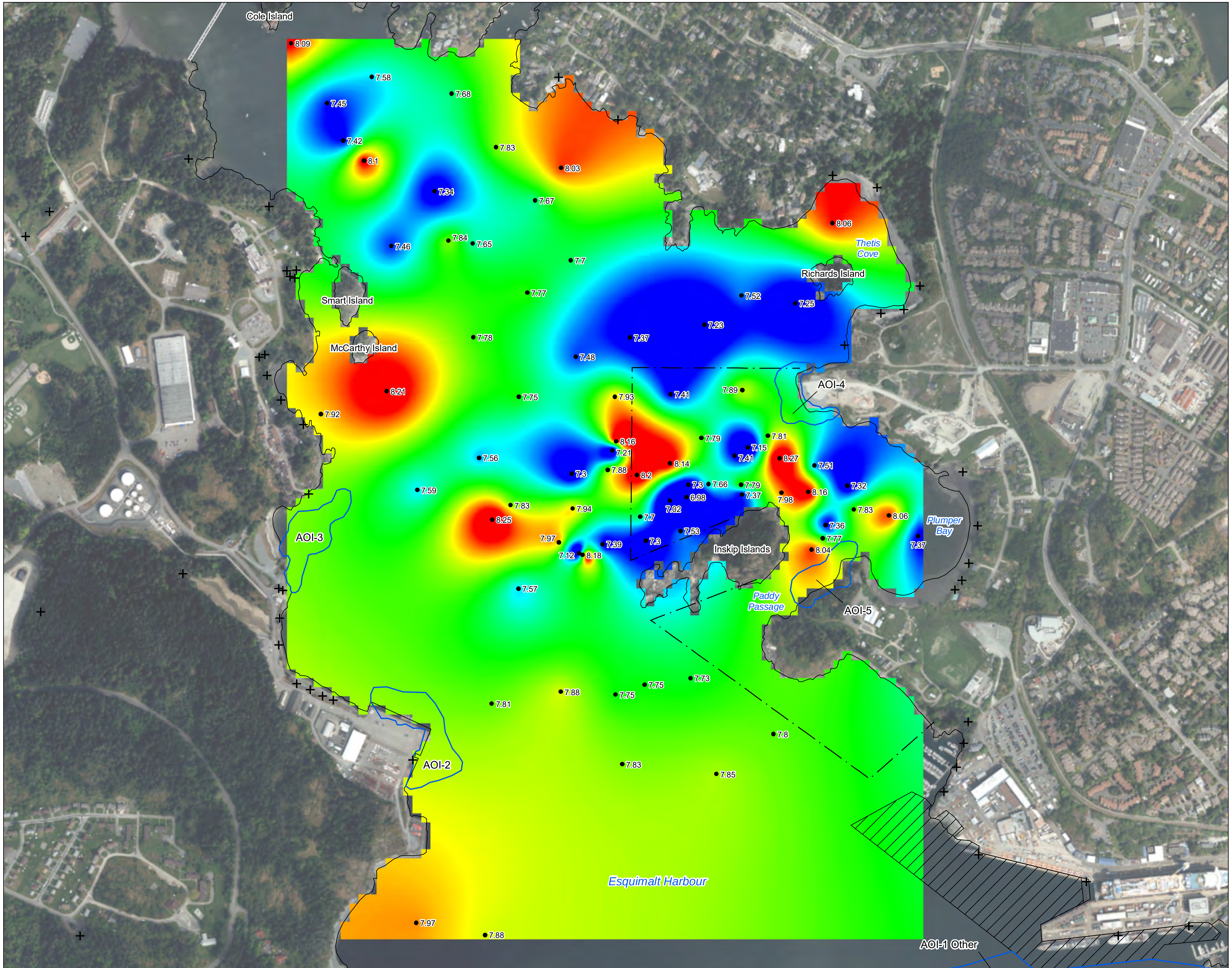

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated pH Concentration

Legend

- Sampling Location
- 7.23 Sampled pH Concentration
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

pH Concentration

8.06 - 8.20
7.91
7.75
7.60
7.02 - 7.44

Notes

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2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
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Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
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Metres

NAD 1983 UTM Zone 10N

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3.3 Wood Waste Impact Analysis

3.3.1 Wood Waste Delineation

Observable surficial wood waste cover ranged from 0 to 100% across surveyed areas of Esquimalt Harbour (**Figure 3.4**). The majority of the surveyed areas of the Harbour (66%; **Table 3.5**) had little to no wood waste cover (0 – 5 %), with 24% of the surveyed area covered by 5 – 30% wood waste, indicating the need for further investigation of impacts (using Washington State's initial screening guidelines, **Section 2.1.5.1**), and 10% of the study area covered by > 30% wood waste, indicating it is likely to have adverse impacts on the benthic community.

The area of wood waste deposits was greater than the observable surficial coverage (**Figure 3.5**), indicating that in some areas wood waste has become mixed with fine sediments or partially covered. However, notable sedimentation overlying wood waste deposits was not observed in most areas of the harbour.

3.3.2 Sediment Chemistry

Wood waste depth was a good predictor of the four sediment chemistry parameters measured (TOC, ammonia, sulphide, and pH). All regression models had significant spatial autocorrelation and required spatial models to best describe the linkages between the predictor variable, wood waste depth, and the dependent chemical variables. TOC exhibited the strongest linkage with wood waste depth (R-squared 0.54 and coefficient value of 75,528; **Table 3.8**). Ammonia and pH were also strongly linked to wood waste depth (R-squared 0.37 and 0.40, and coefficient values of 42.93 and -/082 respectively; **Table 3.8**). Pore-water sulphides had the weakest linkage to wood waste depth (R-squared 0.11 and coefficient value 88.63).

Table 3.8 Spatial Regression Model Combinations and Outputs for Wood Waste Depth as an Independent Variable

Independent Variable	Dependent Variable	Coefficient	Std. Error	z-value	Probability	R-squared	Regression
Wood Waste	TOC	75528.3	16709.7	4.52	<0.001	0.54	Spatial Lag
Wood Waste	Ammonia	42.93	9.38	4.57	<0.001	0.37	Spatial Lag
Wood Waste	pH	-0.82	0.15	-5.24	<0.001	0.40	Spatial Lag
Wood Waste	Sulphide	88.63	34.73	2.55	<0.001	0.11	Spatial Lag

3.3.3 Benthic Community

3.3.3.1 Epibenthic

Although a variety of epibenthic species were observed during field surveys, the epibenthic community in Esquimalt Harbour was dominated by the following groups or organisms: bacterial mats (*Beggiatoa* spp.), diatom mats, and sugar kelp (*Saccharina latissimia*; **Table 3.9**). Given that TOC can be used as an indicator of the percentage of wood waste present in the sediment (Washington 2013), four categories of TOC were used to examine differences in the composition of the epibenthic community. Since there are no developed thresholds of benthic community impact for wood waste, thresholds need to be developed on a site-specific basis. TOC categories were based on the TOC screening-level indicators for benthic impairments (**Section 2.1**): Pedder Bay reference (<1%TOC), in harbour <1% TOC, 1-3% TOC, and >3% TOC). Differences between the categories were identified to be statistically different (P = <0.001) and pairwise tests between each were conducted to determine differences (**Figure 3.14**). The epibenthic community for all three in-harbour TOC categories was significantly different from the Pedder Bay reference location (P = 0.05; **Table 3.9**). Within Esquimalt Harbour no statistical difference was determined between the in-harbour low TOC and intermediate TOC (P = 0.898), indicating the epibenthic community in each was relatively similar and dominated by a high abundance of diatoms (**Table 3.9**). A statistical difference occurred between the in-harbour low TOC and the high TOC areas (P = 0.01) due to the high abundance of *Beggiatoa* sp. bacterial mats associated with areas of wood waste (**Figures 3.5** and **Figure 3.6**; **Table 3.9**) while diatom mat distribution showed an inverse relationship, although slightly less consistent, with bacterial mats (**Figure 3.6 and Figure 3.7**).

Table 3.9 Dominant Epibenthic Species Observed at each of the Four TOC screening-level indicators for benthic impairments

Species	Mean Abundance	Contribution to Group Similarity
Pedder Bay Reference <1% TOC		
Diatoms	68.53	71.56
Drift *Saccharina latissima*	29.83	15.27
Drift *Saccharina groenlandica*	22.33	9.21
In Harbour <1% TOC		
Diatoms	59.55	96.97
In Harbour 1 to 3% TOC		
Diatoms	57.57	94.37
In Harbour >3% TOC		
Beggiatoa spp.	43.04	59.10
Diatoms	27.68	39.19

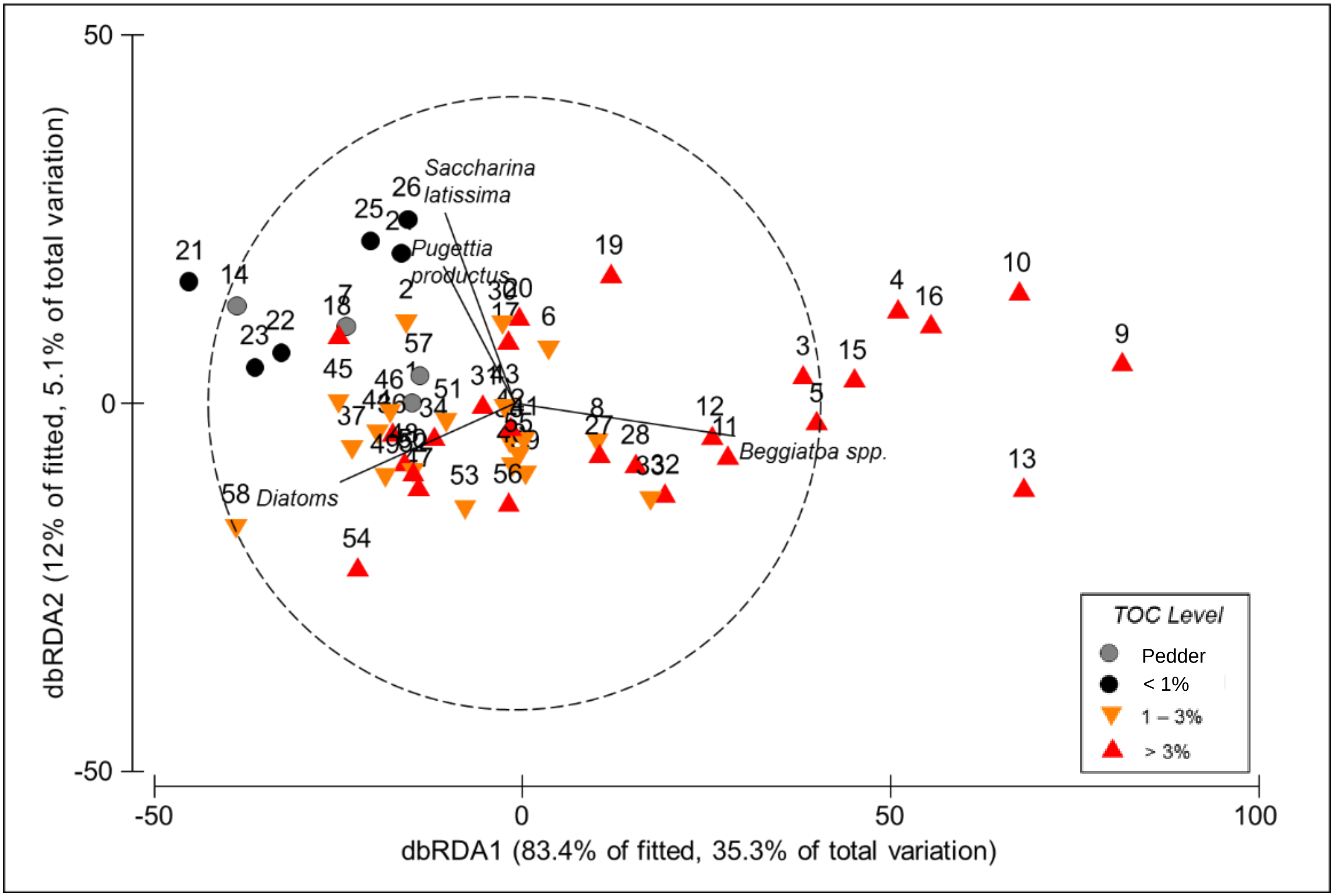


Figure 3.14 Distance-based redundancy analysis showing the relative similarity among sample locations of differing TOC Screening-level Indicators and the dominant species.

While all four sediment chemistry parameters were considered predictors of bacterial mat coverage, TOC and sulphide were the strongest predictors (R-squared 0.60 and 0.49 and coefficients 0.0007 and 0.26 respectively; **Table 3.10**). *Beggiatoa* sp. is known to be associated with high levels or organic carbon, requires sulphides to produce energy, and occurs at the oxygen-sulphide transition zone (Amend et al. 2004, Pearson 1980, Jørgensen 1977, Muβmann et al. 2003). Due to its strong correlation with TOC and areas of wood waste deposits, the presence of *Beggiatoa* sp. can be considered an indicator of benthic community impairment from wood waste deposits.

Table 3.10 Spatial Regression Model Combinations and Outputs for Bacterial Mat Coverage as a Dependent Variable

Independent Variable	Dependent Variable	Coefficient	Std. Error	z-value	Probability	R-squared	Regression
TOC	Bacteria	0.0007	0.0002	4.15	<0.001	0.60	Spatial Lag
Sulphide	Bacteria	0.26	0.08	3.17	<0.001	0.49	Spatial Lag
pH	Bacteria	-43.15	18.97	-2.28	0.023	0.41	Spatial Lag
Ammonia	Bacteria	0.49	0.29	1.69	0.091	0.40	Spatial Lag

Other epibenthic species observed during field surveys included Dungeness and graceful crabs and shrimp. A wood waste study in Port Angeles Harbour concluded that areas of sparse, scattered, small wood debris on the sediment surface, offshore of log booming areas, provided habitat for mobile epibenthic organisms such as shrimp, crabs, and fish as long as overlying water quality was not impacted (SAIC 1999).

Large wood debris (e.g. cut log piles) have also previously been shown to function as suitable epi-benthic habitat (SAIC 1999). Both these results and those of SAIC (1999) demonstrate that logs provide hard substrate for the colonization by sessile rocky reef organisms, such as plumose anemones, and rockfish (*Sebastes* spp.) use the logs as habitat. However, the benefits of large woody debris as habitat for epibenthic communities can come at the expense of the benthic infauna community, due to smothering and decomposition creating anaerobic conditions (discussed in **Section 2.1**; SAIC 1999).

Although sparse, epi-benthic species common to nearshore marine ecosystems were present, especially in areas where epibenthic organisms were separated from the sediment-water interface (e.g. log piles). Evidence of extensive *Beggiatoa* sp. bacterial mats indicate some degree of benthic impairment, which requires analysis of the infauna community to determine the nature and extent.

3.3.3.2 Infauna Community

Benthic infauna community composition and species richness were influenced by all three of the wood waste decomposition by-products investigated (TOC, pore-water sulphides, and ammonia). TOC and ammonia were significant drivers (TOC $p = 0.002$, Ammonia $p = 0.008$) of community composition among sample locations while there was greater variation in the relationship between community composition and porewater sulphides ($p = 0.18$; **Table 3.11**). All three sediment chemistry parameters were significantly correlated with species richness (**Table 3.12**); however, TOC had the strongest relationship with the least variability (correlation -0.63).

Table 3.11 CCA Model Output of Community Composition as a Function of Wood Waste Decomposition By-products

Sediment Chemistry Parameter	Df	Sum of Squares	R-squared	p-value
TOC	1	0.90	0.11	0.002
Pore-water sulphides	1	0.37	0.04	0.18
Ammonia	1	0.76	0.09	0.008
Residual	24	6.24	0.75	-
Total	27	8.27	1.00	-

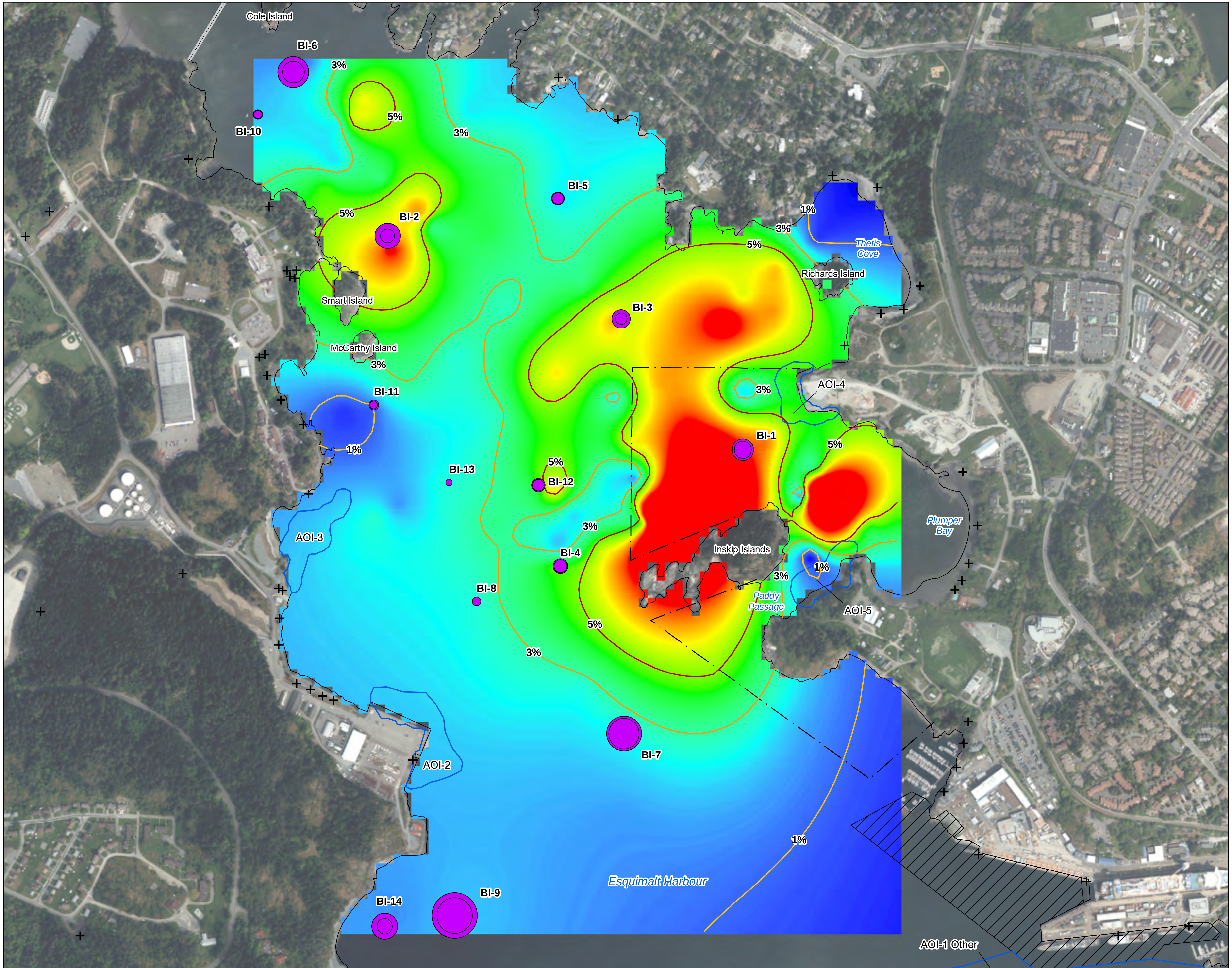
Table 3.12 Linear Model Outputs and Correlation Values of Species Richness as a Function of Wood Waste Decomposition By-products

Sediment Chemistry Parameter	Estimate	Standard Error	t-value	p-value	Correlation Value
Intercept	24	2.4	10.3	<0.001	-
TOC	-0.0003	0.0001	-4.5	0.001	-0.63 **
Pore-water sulphides	-4.96E-01	0.2	-2.9	0.01	-0.35
Ammonia	5.17E	0.2	3.0	0.01	-0.22

As described in **Section 2.1**, impacts of wood waste depend on both the nature and extent of the wood waste as well as the site-specific conditions. Therefore, screening-level indicators (**Section 2.1.5.**1) for potential impairment can be used to guide wood waste assessments but site-specific thresholds should be developed to determine impairment and management options. Since TOC is the sediment chemistry parameter most strongly linked with known areas of wood waste deposits (**Figure 3.5** and **Figure 3.9**) and to differences in benthic infauna community composition and species richness, it was chosen as the best decomposition by-product to use for the establishment of site-specific thresholds for areas of impairment of the benthic infauna community. A global meta-analysis conducted by Hyland et al (2005) proposes a screening-level indicator of intermediate benthic infauna impairment between 1 – 3.5% TOC. While results of the benthic infauna analysis show increased variability in the distribution of community composition and species diversity between 1 – 3% TOC in Esquimalt Harbour, the strength of the relationship for these moderate levels of TOC is unclear. A 3% TOC level is more consistent with the distribution of benthic infauna community composition and species diversity among samples stations and is considered the site-specific indicator for determination of impairment of benthic infauna due to wood waste deposits (**Figure 3.15** to **Figure 3.19**).

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Total Abundance by Sample Location



Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Total Abundance (N)

13 1321

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

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2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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0 100 200 300 400

Metres

NAD 1983 UTM Zone 10N

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376-240.08	Production Date: Jan 11, 2019	Figure 3.15

Hemmera
An Ausenco Company

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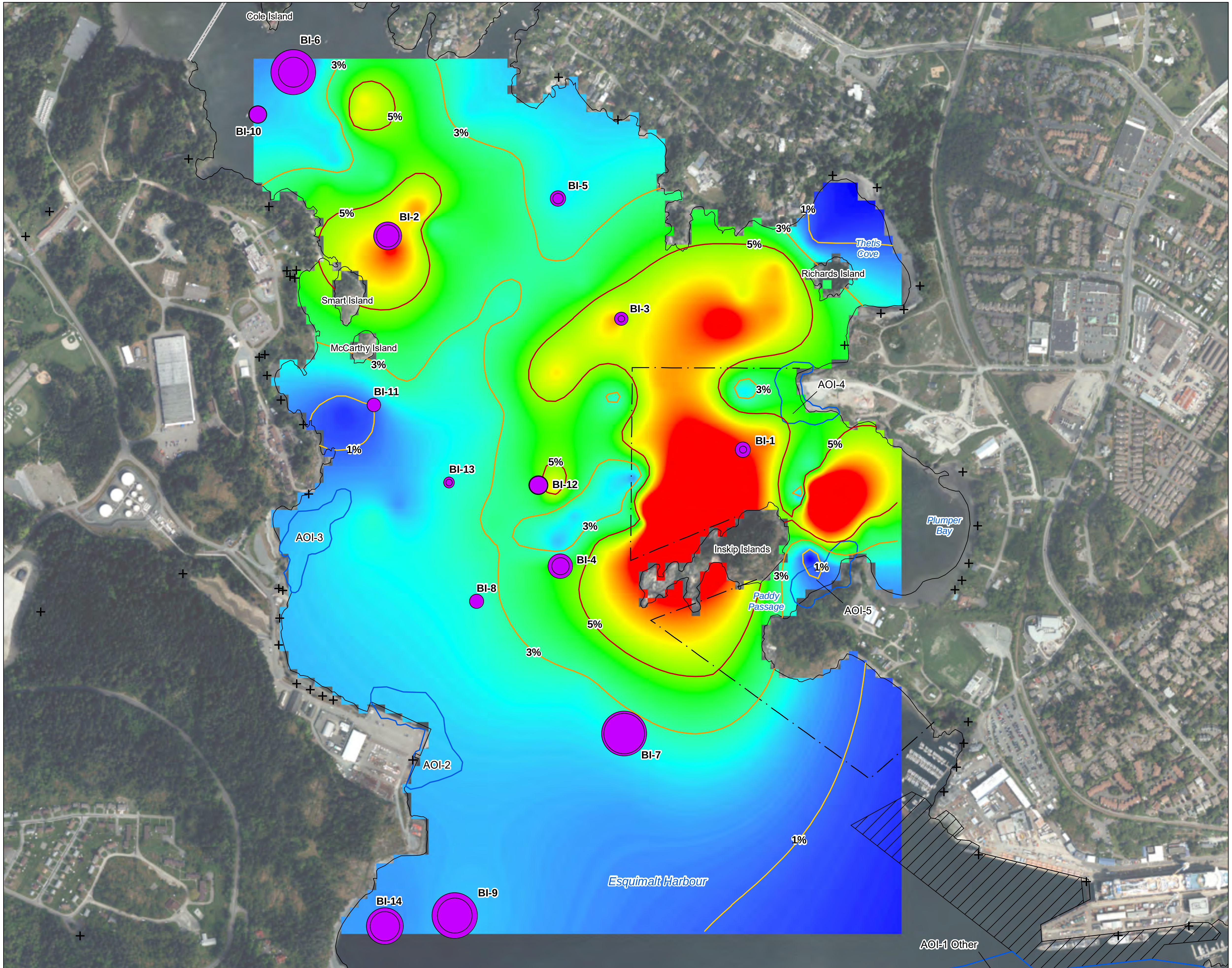

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Species Richness by Sample Location

Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Species Richness (S)

3
44

Total Organic Carbon Threshold Contours

< 1
> 3
> 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

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376-240.08	Production Date: Jan 11, 2019	Figure 3.16

Hemmera
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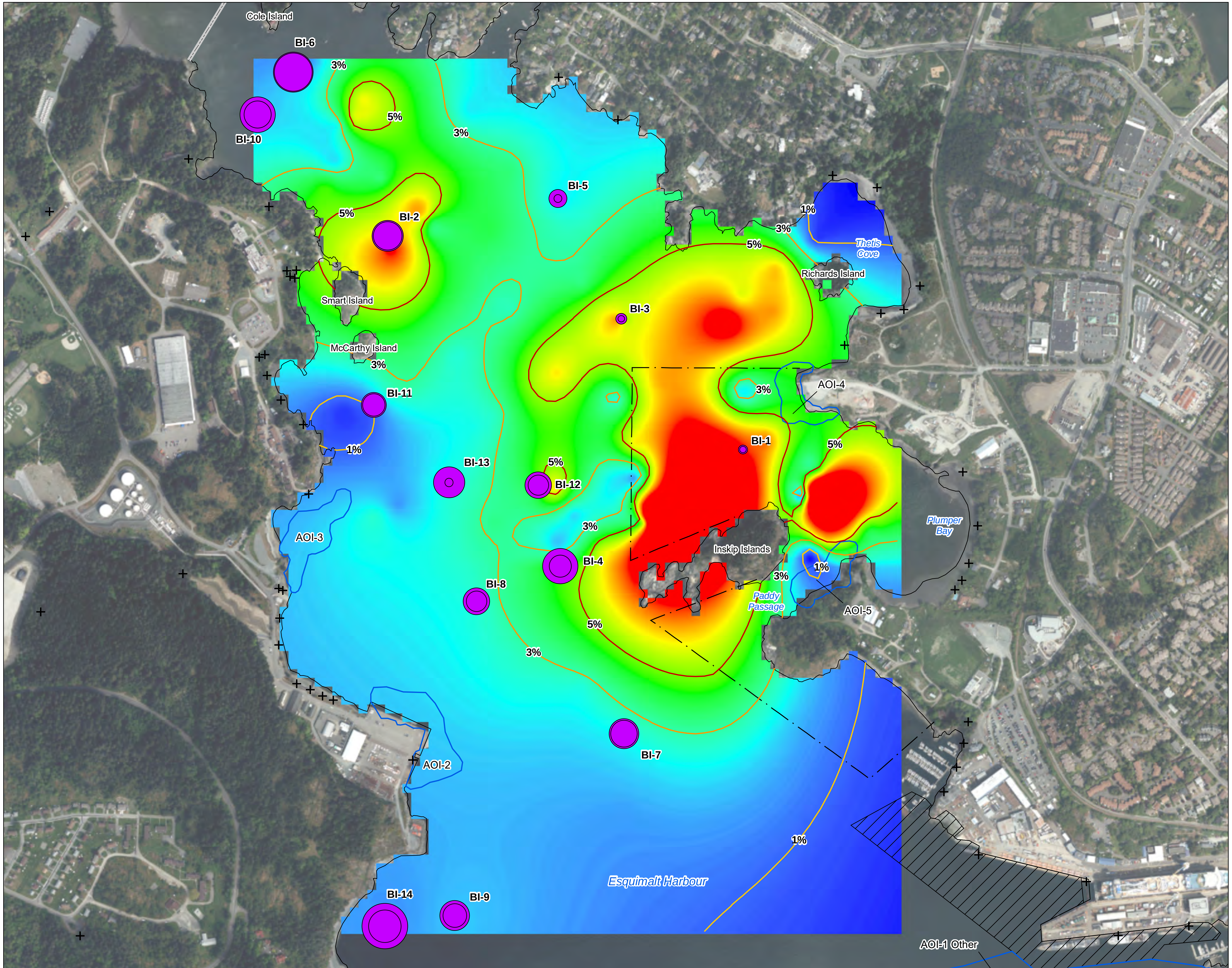

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Shannon Diversity Index by Sample Location

Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Shannon Diversity Index (H)

0.38
2.91

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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0 100 200 300 400
Metres

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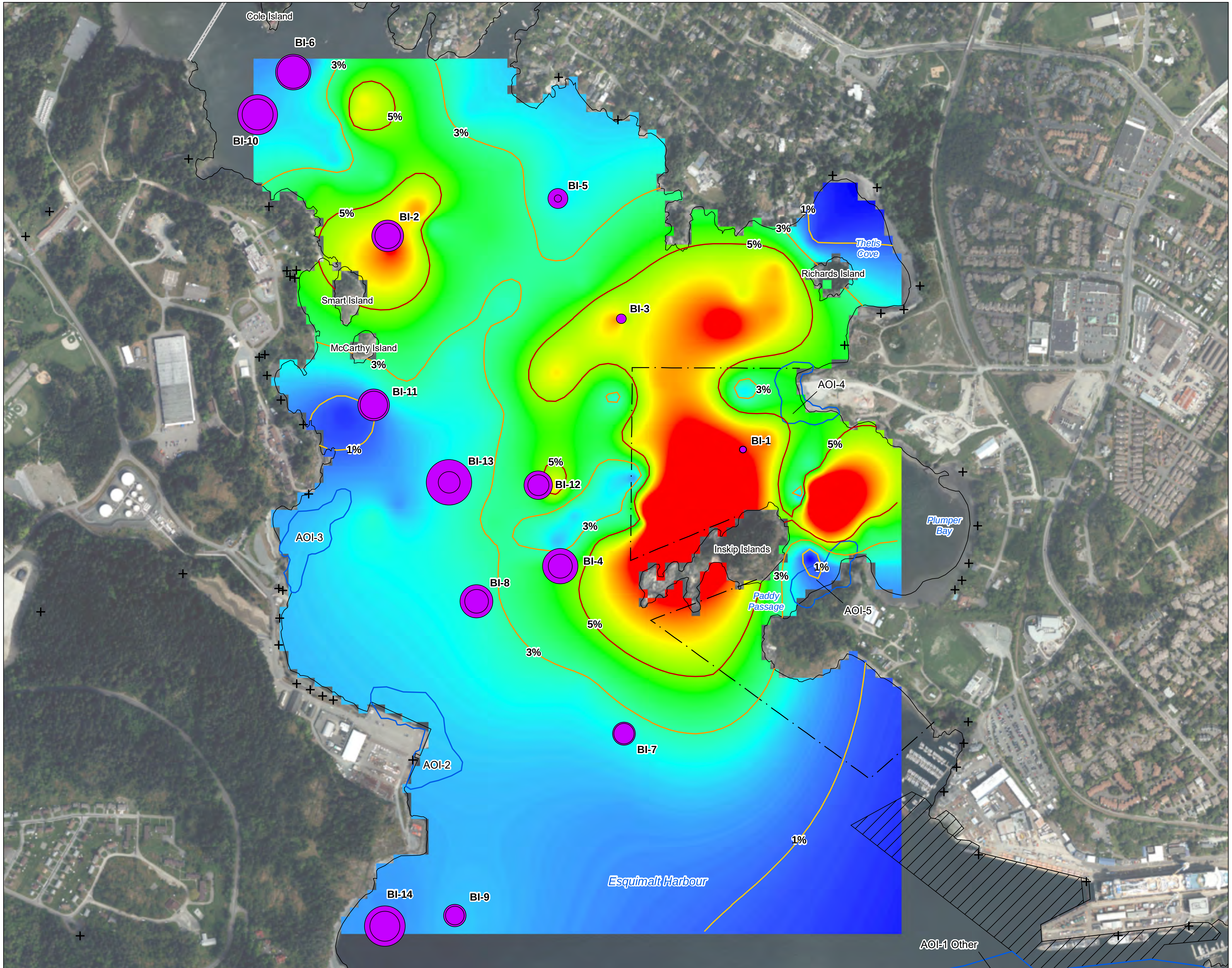
Hemmera
An Ausenco Company

Public Works and Government Services Canada



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Pielou's Evenness Index by Sample Location

Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Pielou's Evenness Index (J)

0.22 | 0.90

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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0 100 200 300 400

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure 3.18

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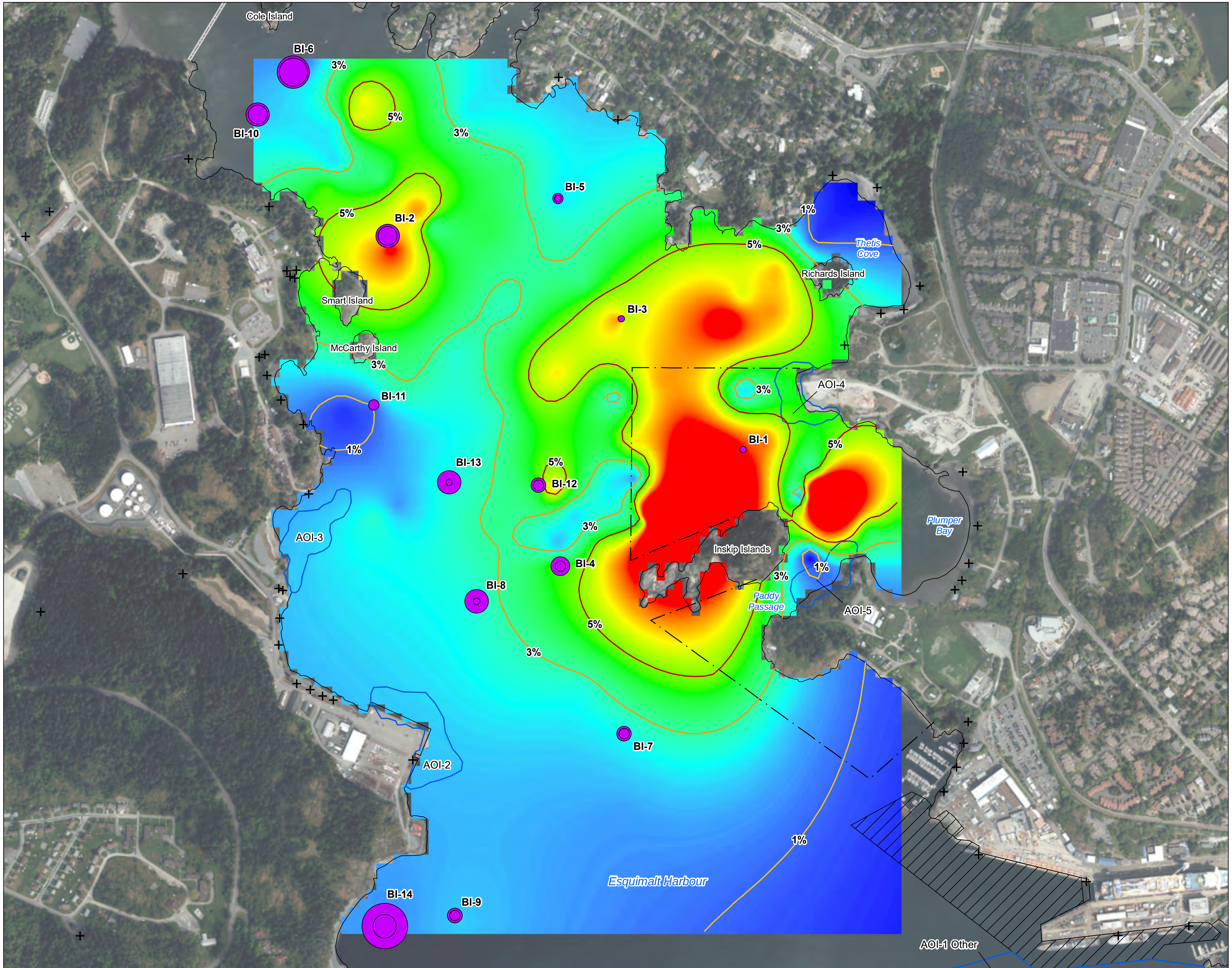
Public Works and Government Services Canada

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Swartz's Dominance by Sample Location



Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Swartz's Dominance

1 10

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:8,000

0 100 200 300 400

Metres

NAD 1983 UTM Zone 10N

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Public Works and Government Services Canada

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These results are consistent with a recent study of benthic infuana in Esquimalt Harbour, which concluded that benthic infauna communities generally show signs of impairment, with stations ranging in their categorization of benthic community health from heavily impacted through to low/moderate impairment with opportunist-dominated areas (i.e. sample areas indicative of slight to pronounced imbalanced situations dominated by subsurface polychaete deposit-feeders; Biologica 2016). However, the sampling effort did not include areas of known wood waste deposits, except for three sample stations that were taken within the Ashe Head Remediation Area in Plumper Bay. The Ashe Head Remediation Area falls within the lower range of TOC values (1 – 3%) and stations were categorized by Biologica (2016) as low/moderate benthic community impairment, due to high summary metrics (e.g. abundance, species richness, diversity) along with the presence of pollution-sensitive taxa, some large bioturbators, and a large number of non-cirratulid opportunistic polychaetes indicative of reduced sediments or organic pollution.

Similar to Biologica (2016), all benthic infauna stations had very few large bioturbators or pollution-sensitive taxa and an elevated abundance of pollution- or disturbance-tolerant, opportunistic taxa. Other studies have documented similar results, for example, in Port Angeles Harbour the infauna community associated with log booming grounds (characterized as having abundant small woody debris such as bark and logs) consisted primarily of small, pioneering organisms that live at or near the SWI (e.g. surface feeding or filtering organisms), with some azoic areas showing no evidence of benthic infauna colonization (SAIC 1999). However, none of the benthic infauna stations sampled for this Project were classified as functionally azoic with minimal microbenthic function; therefore, benthic infauna communities ranged from somewhat disturbed/impacted to low to moderate impairment. Impairment to benthic infaunal communities appears highest north of Inskip Island, where *Beggiatoa* sp. mats were most concentrated and quantities of infauna organisms were moderate to normal but dominated by one opportunist species (SDI = 1).

Annelid Polychaete worms (Spionid Polychaete *Prionospio (Minuspio) lighti* and Opheliid Polychaete *Armandia brevis*) were present at all fourteen benthic infauna stations monitored during this Project, with the majority of stations dominated by one or the other (**Table 6**). Both species inhabit the top surface layer of sediments, deposit-feeding only at the SWI and are categorized as second-order opportunists which thrive under impacted conditions prohibitive to other species (e.g. *P. lighti*) or are associated with high levels of wood waste (*A. brevis*; Borja 2000, Kathman et al 1984, Teixera et a. 2012). Station BI-9 and BI-7, closer to the outer harbour, were dominated by the second-order opportunistic Cirratulid Polychaete complex *Aphelochaeta glandaria*.

The presence of large bioturbators allows for sediment reworking and oxygenation, particularly if they reach mature size, but many are pollution-sensitive or have unknown tolerance to disturbance (Biologica 2016). All benthic infauna stations in Esquimalt Harbour were relatively devoid of commonly-found large bioturbators, with the exception of *Macoma nasuta*, a bivalve Mollusc found at all stations in low numbers and commonly found in organically enriched sediments (Ranasinghe et al. 2013; **Table 3.13**). The occurrences of *M. nasuta* were primarily juveniles, with only a few intermediates and adults noted. Observations of pollution- or organic enrichment-sensitive taxa were limited to stations located between 1 – 3% TOC, with the exception of BI-4 (4.1%) and were almost entirely juveniles (**Table 3.13**).

Table 3.13 Summary of Benthic Infauna Impacts

Sample ID	Quantity*	Diversity*	Proliferating opportunists (>50%)	Stimulated by organic enrichment	Sensitive to Enrichment	large bioturbator
BI – 1	Moderate to Normal	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Macoma nasuta (1 a) Macoma sp (1 a, 2 juv)
BI – 2	Moderately Impoverished	very low	-	Spionidae (*Prionospio (Minuspio) lightii*)	-	Cerebratulus californiensis (4 int) Macoma nasuta (1 a, 2 int Macoma sp (4 int, 2 juv)
BI – 3	Moderate to Normal	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Macoma sp (2 int, 3 juv)
BI – 4	Impoverished	very low	-	Spionidae (*Prionospio (Minuspio) lightii*)	*Lanassa venusta venusta* (2 juv)	Macoma nasuta (1 a, 2 int, 6 juv) Macoma sp (26 juv)
BI – 5	Opportunist Proliferation	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	*Lanassa venusta venusta* (1 int)	Macoma nasuta (5 juv), Macoma sp (5 juv)
BI – 6	Opportunist Proliferation	very low	-	Spionidae (*Prionospio (Minuspio) lightii*)	*Clinocardium nuttalli* (18 juv)	Cerebratulus californiensis (17 a, 11 int, 6 juv), Macoma sp (8 int, 11 juv)
BI – 7	Opportunist Proliferation	opportunist dominated	Cirratulidae (*Aphelochaeta glandaria* complex)	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Glycera americana (1 int), Macoma nasuta (5 int, 3 juv) Macoma sp. (1 juv)
BI – 8	Moderate to Normal	very low/opportunist dominated	-	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (1 a, 2 int, 9 juv)
BI – 9	Moderate to Normal	opportunist dominated	Cirratulidae (*Aphelochaeta glandaria* complex)	Spionidae (*Prionospio (Minuspio) lightii*) very low	*Heterophoxus affinus* (1 a, 1 juv) *Lanassa venusta venusta* (1 int)	Macoma nasuta (3 int, 11 juv)
BI – 10	Moderate to Normal	very low	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Cerebratulus californiensis (3 int, 2 juv), Macoma nasuta (12 juv) Macoma sp (6 int, 21 juv)
BI – 11	Opportunist Proliferation	moderate or opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (17 juv), Macoma sp (3 juv)
BI – 12	Opportunist Proliferation	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (4 int, 10 juv), Macoma sp (4 juv)
BI – 13	Moderately Impoverished	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (1 juv)
BI – 14	Opportunist Proliferation	moderate	-	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Macoma nasuta (2 a, 3 int, 2 juv) Macoma sp (6 juv)

*Source: Biologica 2016 – Categories of benthic impairment based on calculated indices

4.0 REMEDIAL AND MANAGEMENT OPTIONS

The following sections identify potential remedial options, evaluate the remedial options applicable to Esquimalt Harbour, including the rationale and basis for preferred treatments, provide a preliminary approach to the restoration of wood waste impacted subtidal sediments, and include an analysis of the potential for inclusion of these remediated areas in the DND habitat bank.

4.1 IDENTIFICATION OF POTENTIAL REMEDIAL OPTIONS

Due to the relatively slow decomposition of wood waste by bacteria, accumulations can persist for decades and continue to negatively affect benthic communities and higher trophic level organisms dependent on those communities (Conlan 1977; **Section 2.1**).

Remedial options for wood waste rely on decomposition, isolation and removal mechanisms and may include the use of one treatment or approach, or a combination of approaches for more complex sites (**Table 4.1**). Remediation options include post-remediation monitoring to determine the effectiveness of the chosen approach.

4.1.1 Monitored Natural Recovery

Monitored Natural Recovery (MNR) relies on natural processes such as bioturbation, sedimentation, erosion, and biological decomposition. No physical works are prescribed for MNR. A monitoring program is established to track the progress of natural recovery (e.g. monitoring parameters of concern and biological recovery of infauna through bioassays and/or benthic infauna community analysis).

Site specific physical and biological conditions will determine the feasibility of natural recovery within a reasonable period. If natural recovery is predicted to take greater than 10 years, other, more active, approaches are generally recommended. MNR is generally prescribed for areas where wood waste coverage is discontinuous, deposits are shallow, and impairment of the bottom ecology is minimal. Site-specific conditions required include: adequate dissolved oxygen, flushing and water exchange, high natural sedimentation rates, and sediment turnover (e.g. presence of bioturbators). Washington State Department of Ecology (WSDOE) has determined that natural recovery is unlikely to occur at locations with thick wood waste deposits (e.g. approximately >0.9 m deep), since decomposition by-products will permeate through recently deposited sediment, conditions will remain anaerobic, and few bioturbators will colonize (Washington State 2013). Natural recovery for sites with low sedimentation rates can take decades to return to pre-impact productivity (Picard et al 2003).

MNR is a cost-effective approach for very large sites that meet the above criteria, where other approaches may be cost prohibitive and for areas where seafloor disturbance should be avoided (e.g. existing bivalve shellfish beds).

Table 4.1 Overview of Potential Wood Waste Remediation Options

Remedial Option	Application	Description	Benefits and Constraints
Monitored Natural Recovery	Suitable for sites where wood waste coverage is discontinuous and/or thinly deposited, and only low or moderate impairment	• No modifications or physical works (removal, caps) • Relies on naturally occurring bioturbation and sedimentation • Can take up to 10 years for sites with high bioturbation and natural sedimentation to recover. • Sites with low sedimentation/erosion can take decades to recover.	• Cost effective • Non-invasive • Ineffective at sites with deep accumulations of wood waste, or a lack of dissolved oxygen, flushing and water exchange, and sediment turnover
Enhanced Natural Recovery	Suitable for sites with discontinuous coverage and/ or thin wood waste deposits	• Augments natural recovery with the placement of a thin layer (15cm) of clean sand • Sand provides oxygenated layer that promotes benthic infauna recruitment and establishes a productive benthic community • Bioturbators will mix sand with underlying wood waste overtime, diluting wood waste and accelerating aerobic decomposition	• Cost effective • Minimally invasive • Ineffective at sites with deep accumulations
Dredging	Suitable for sites with continuous coverage and/or deeper wood waste deposits	• Barge platform with clam shell dredge removes wood waste and impacted sediments • Dredge to native sediment and backfill with clean sediment • Variety of disposal options for dredge materials	• Most effective and permanent remedial option • Typically most expensive option
Capping	Suitable for sites with continuous coverage and/or deeper wood waste deposits. May require removal of some wood waste if there are significant volumes	• Thick layer of material placed over wood waste to physically and chemically isolate underlying sediment from contact with marine organisms • Cap thickness is designed by professional engineer for the site-specific conditions but typically one meter, employing medium to fine sand • Typically, sand caps are used in low velocity waterways to protect them from scouring by strong (high energy) currents.	• Least preferred remedial option as the long-term efficacy has not been demonstrated • Expensive, but typically less expensive then dredging • Potential problems include anaerobic off gassing, leaching of soluble by-products, and differential settling • Activities such as prop wash can reduce long-term effectiveness • Raises seafloor by approximately 1 m (before settlement)

Source: Breems and Goodman 2009, Washington State 2013

4.1.2 Enhanced Natural Recovery

Enhanced natural recovery (ENR) augments natural recovery with placement of a thin layer (approximately 15 cm) of unconsolidated clean sand materials that boosts natural recovery processes. The sand layer is not a true engineered cap as wood waste contaminated sediments are not meant to be isolated. Instead, the added thin layer provides oxygenated substrate that promotes benthic infauna recruitment and development of a productive community (Breems and Goodman 2009, Washington State 2013). As benthic communities develop over the long term, the presence of bioturbators will naturally mix or re-work the sand layer with underlying wood waste and accelerate aerobic decomposition.

ENR is only suitable for areas with discontinuous coverage and/or thin wood waste accumulations (< 0.2 m), and for areas that would naturally recover in 10 years or less (Breems and Goodman 2009). The effectiveness of ENR is determined through a post remediation monitoring program.

4.1.3 Dredging

Dredging is the most effective and permanent remedial option for wood waste contaminated sediments, although it is generally the most costly approach. Effective dredging at some locations may require multiple dredging passes. For example, some wood waste is large, and the dredge bucket may not always be able to fully close, dropping material into the water as it is removed. Washington State (2013) recommends that a first pass is conducted with large equipment, followed by a second pass with a smaller, square-faced buckets if required.

Removal of wood waste through dredging exposes native sediments or bedrock. Depending on the depth of wood waste removed, dredging may result in unfavorable bottom depths or the creation of depressions that act as sinks for detritus and other debris and fine wood waste residual material, as much as several inches, can accumulate following dredging. Therefore, backfilling with a layer of clean sand (as with ENR) is a common best management practice (BMP) to fill in depressions, cover any residual material, and promote benthic infauna recolonization.

Dredging is generally performed during least-risk works windows to protect aquatic resources which can affect project scheduling.

Monitoring to ensure wood waste layers have been removed will confirm the efficacy of the dredge operation. Post construction bathymetric surveys will determine the need for additional treatment. Recovery is tracked through a monitoring program that will measure benthic invertebrate community succession.

4.1.3.1 Options for Disposal of Dredge Materials

Disposal at Sea

The most cost-effective means of disposing of dredge materials composed primarily of wood waste is Disposal at Sea (DAS), an activity that is regulated by Environment and Climate Change Canada (ECCC). The distance to established disposal sites is a determining factor in evaluation the cost effectiveness of the DAS option. Wood waste qualifies for DAS if it can be characterized as waste or other matter, as outlined in Schedule 5 *Canadian Environmental Protection Act, 1999*, and is considered clean.

Confined Aquatic Disposal

An alternative to DAS is to engineer a disposal site where dredged material is placed and covered by a cap to ensure long-term isolation and effectiveness. This approach has been utilized in Washington State, but is considered costly, and would require long-term monitoring to ensure effectiveness.

Beneficial Use

As an alternative to DAS, dredged material may be beneficially re-used for nearshore marine projects below the high-water mark so long as there is a demonstrated need or purpose for the use of the sediment, the sediment meets DAS sediment chemistry screening criteria, it can be demonstrated that there is no anticipated marine pollution or deleterious effects from the placement of the fill, and the beneficial use has DFO and local First Nations endorsement. A beneficial use exemption does not require a DAS permit; however, it does require engagement and approval from ECCC regulators with the DAS Program, DFO, and First nations. Similar to the DAS permit-process, a Sediment Sample and Analysis Plan will also need to be prepared and submitted to ECCC for review and input prior to conducting sediment sampling and analysis of the fill and completing a Sediment Characterization Report.

Upland Disposal

If dredgeate does not qualify for DAS or beneficial use, upland disposal at a landfill facility near the project site is feasible but can be costly to transport and to treat, as sediments are categorized as salt-impacted and may contain other forms of contamination (depending on site conditions).

Engineered Nearshore Confined Disposal Facility (CDF)

A second option for contaminated dredged materials is the use to infill a clean berm built along the shoreline and capped with clean sediment. This disposal option requires the determination that tidally driven groundwater exchange will lead to the release of decomposition by-products (e.g. Sulphide and ammonia) into the marine environment. The area on top of the CDF can then potentially be used for port or other water-dependent shoreline development activities. This approach has been used in Washington State at several clean-up sites, but is costly to build and maintain.

Alternative Use

A full review of alternative re-use options has been conducted by Azimuth (2017) and includes alternatives such as: combustion of wood waste can be used to produce power or heat, biomass gasification or pyrolysis to produced power, liquid fuels an/or biochar, and composting. However, **t**he moisture and salt content of dredged wood waste, along with its mixture with sediment, may make its re-use prohibitive from a technical or cost-effectiveness perspective (Azimuth 2017).

4.1.4 In-Situ Capping

A cap is a thicker layer of material, such as sand, placed on top of contaminated sediment which has been engineered to isolate the underlying contaminated sediment. Caps are designed so that the rate of desorption of contaminants in porewater that passes through the cap does not exceed applicable water quality criteria at or near the surface. The cap prevents the contaminated sediment from coming into direct contact with marine organisms; therefore, must be designed to be thick enough that deep-burrowing bioturbators do not come in contact. Caps need to be engineered for the conditions of each site. In Puget Sound, a 1 m thick cap comprised of medium to fine sand is commonly prescribed for wood waste contaminated sediments (Breems and Goodman 2009).

Capping is the least preferred remedial technology for wood waste sites with thick accumulations of wood waste since the long-term efficacy has not been fully demonstrated and potential issues could include anaerobic off-gassing, leaching of soluble by-products, and differential settling, which could compromise the integrity of the cap and prevent the establishment of a healthy and productive benthic community (Breems and Goodman 2009, Washtington 2013). This remedial option is typically expensive, but less expensive then dredging of wood waste. Other constraints of this remedial option include: cap design must provide complete cover of the wood waste (i.e. significant volumes of wood waste may require the removal of some before in-situ capping since capping requirements include limits on the volume of wood waste in the sediment; Washington 2013), and activities such as prop wash can also reduce the long-term effectiveness of the cap. However, this remedial option can be a less complex and less expensive approach to remediation (Washington 2013).

As capping can generate sediment plumes during installation, works should be scheduled to take place during least risk work windows. Proposed capping projects will be subject to a *Fisheries Act* Serious Harm assessment. Recovery is tracked through a monitoring program to demonstrate long-term effectiveness

4.1.5 In-Situ Treatment

In-situ treatments would involve alternate forms of ENR by treating wood waste deposits on-site without movement, in order to facilitate natural in-situ decomposition. To our knowledge, the use of in-situ treatments as a remedial option for benthic communities impaired by wood waste has not been investigated. Previous work on wood waste remediation (Breems and Goodman 2009, Washington State 2013) has not identified any effective in-situ remediation approaches for the treatment of wood waste in the marine environment, only flagged that further research on the rates and mechanisms of decomposition of wood waste components is required to inform other options.

The impacts of wood waste on nearshore benthic communities are similar to those from aquaculture/fish farming (i.e. buildup of organic material on the seafloor, oxygen depletion within and above sediments, increase in sulphides and changes to the benthic community structure, Brooks et al 2003) and research on the impacts to, and potential remediation of, benthic communities beneath aquaculture facilities has been widely explored. Since the impacts of wood waste on nearshore benthic communities are similar to aquaculture, potential approaches to in-situ remediation of wood waste could be drawn from this body of work. However, some differences between impacts of the two activities do exist (e.g. other contaminants, including zinc and copper, accumulate in the sediment below aquaculture pens during the breakdown of aquaculture feed waste, SAG 2011) and remedial approaches used in aquaculture but would require investigation prior to their implementation in Esquimalt Harbour.

Some potential approaches include:

- Oxygenation – Toxic anaerobic by-products of wood waste decomposition (e.g. hydrogen sulphide and ammonia) are oxidized to non-toxic forms when exposed to oxygen. The introduction of oxygen to wood waste deposits may also allow for the aerobic breakdown of wood waste by heterotrophic bacteria, eliminating further production of toxic by-products. This could be conducted by harrowing, or heavy raking of the seafloor, or irrigation with oxygenated surface-water (Keeley et al 2017). However, this has only been explored for remediation of sediments impacted by salmon farm aquaculture in New Zealand and has only been applied to small-scale pilot study field plots (~15m^2) – therefore, may not be feasible for large-scale application.
- Shell hash addition – Low pH can cause a greater proportion of the toxic hydrogen sulphide form to occur in sediment porewater. The addition of a thin layer of crushed bivalve shells (e.g. by-products of shellfish aquaculture) may help to buffer pore-water pH and lower the toxicity of decomposition by-products. This has been used in aquaculture to deal with ocean acidification, in particular addition to the sediment of mudflats on the Atlantic Coast to enhance pore-water pH and clam survival (Green et al 2009, Green et al 2013). Shell hash addition has also proven successful in reducing hydrogen sulphide in organically enriched mudflats in Japan (Yamamoto et al 2012).
- Scavenging sulphides – This approach would include the addition of iron to sediments to precipitate iron-sulphides in order to suppress the sulphate reduction pathways and reduce toxic H_2S by-products. It is used in seagrass systems in the Mediterranean that are impacted by eutrophication (e.g. increases in organic matter, Holmer et al 2005).

4.2 Analysis of Remedial Options

Management options for wood waste remediation are developed on a site-specific basis using results of the site assessment (**Section 3.2.3**) and drawing on effective approaches from other wood waste assessment and remediation projects. The evaluation of remedial options for Esquimalt Harbour should also consider remedial objectives, short- and long-term effectiveness, technical feasibility, and cost (including permitting, equipment, mobilization, remedial treatment, monitoring). Further evaluation of a remedial option is generally not warranted if the option is technically unsuitable or cost prohibitive.

Given that wood waste, and its associated decomposition by-products, are not regulated contaminants of concern in the Canadian marine environment, the driver for the remediation of impaired benthic communities in Esquimalt Harbour is to re-establish a balanced and productive benthic community that will restore fish habitats and drive the productivity of upper trophic-level commercial, recreational or Aboriginal (CRA) fisheries species (e.g. Dungeness crabs, fish), so that remediated habitats can be deposited as credits in the DND Habitat Bank.

4.2.1 No Action

Wood waste, in particular bark, is extremely slow to break down and can persist for decades or centuries. Since the cessation of wood-processing activities in the late 1990's (nearly 20 years ago), and the assessment of wood waste by Archipelago (2004; approximately 15 years ago), very little burial of wood waste has occurred, and biophysical conditions within known areas of wood waste appear to have remained unchanged (e.g. relatively sparse epibenthic organisms and very little evidence of infauna activity, such as holes and mounds indicative of burrowing worms and bivalves). Exposed log piles within the Harbour do provide habitat for typical rocky reef species but will not contribute to the recovery of benthic infauna and soft-bottom communities.

Natural sedimentation rates within Esquimalt Harbour are very low and ongoing bottom disturbance occurs in many areas of the Harbour from ship propwash and local dredging resuspending fine sediments creates patchy disturbances to benthic sediments (Burd 2016, Geosea 2009). Without sufficient clean sediment for pollution-sensitive benthic infauna to colonize, an infauna community dominated by low species richness and opportunistic, organic enrichment-tolerant species will continue to prevail. Impacts to benthic infauna can lead to lower food sources for higher trophic organisms, such as Dungeness crabs and juvenile salmonids (**Section 2.1.4**). Due to the presence of *Beggiatoa* sp mats, and without the presence of large infauna bioturbators, oxygen is unlikely to permeate the SWI, and toxic anaerobic by-products will continue to be produced.

Since wood waste decomposition and impacts are site-specific, there is very little information available on the rate of wood waste breakdown and benthic community recovery without remedial action. Conditions in areas containing deeper wood waste deposits (> 0.25 m) within the harbour are expected to persist; however, areas with shallow deposits (0 – 0.25 m) may recover naturally in 10-15 years, depending on sedimentation rates and any disruption to unconsolidated sediments (e.g. propeller wash).

4.2.2 Monitored Natural Recovery

MNR would be implemented in concert with a No Action approach, but monitoring of recovery. In Esquimalt Harbour it is unlikely to lead to the successful recovery of the benthic infauna community in areas containing deeper wood waste deposits (> 0.25 m) in a reasonable time frame. Areas with shallow deposits (0 – 0.25 m) may recover naturally in 10-15 years, depending on sedimentation rates and any disruption to unconsolidated sediments (e.g. propeller wash).

4.2.3 Enhanced Natural Recovery

ENR is generally recommended for areas with continuous coverage and thin wood waste deposits that would naturally recover in 10 years or less. The placement of 15 cm of sand in areas with shallow deposits (0 – 0.25 m), and approximately between 3-5% TOC, may allow for the successful recruitment of a productive benthic infauna community. The presence of some sensitive taxa within the harbour, while patchy, may aid in the establishment of productive infauna communities if physical disturbances (e.g. propeller wash) to unconsolidated benthic environments are minimized Burd (2016).

ENR will not likely be a successful long-term remediation option in areas of deeper wood waste deposits, since anaerobic decomposition will continue to occur below the clean sand layer, decomposition by-products will permeate through recently deposited sediment, and toxic conditions will re-establish preventing recruitment of large bioturbators and other sensitive infauna.

4.2.4 Dredging

Remediation of continuous and/or deeper wood waste deposits in Esquimalt Harbour will require the application of a remedial option that is more intensive then MNR or ENR. Dredging has been proven to be the most effective and permanent approach to removing wood waste accumulations, and often applied in wood waste remediation projects in Washington. However, given the volume of wood waste deposits, and associated impacted sediments, in Esquimalt Harbour this option is logistically complex and very expensive. Site-specific disposal options for dredged materials will, in part, determine the cost and are outlined below.

4.2.4.1 Options for Disposal of Dredge Materials

Should dredging be pursued as a remedial option, Esquimalt Harbour sediments are not likely to be suitable for Beneficial Use (e.g. soft unconsolidated sediments with high quantities of wood are not likely to be structurally suitable fill for nearshore marine construction works, and wood waste could continue decomposing and releasing by-products) and other less common options are costly and their long-term effectiveness is uncertain (e.g. Confined Aquatic Disposal or CDF) or has not been developed to the point of feasible implementation (e.g. Alternative Use) (**Section 4.2.4.1**). Based on this, disposal of dredged materials from Esquimalt Harbour is best done by Disposal at Sea or Upland Disposal.

Disposal at Sea

A preliminary sediment investigation was conducted during Field Survey 6 to characterize the sediment within the wood waste deposit north of Inskip Island, in order to determine if sediment is likely to qualify for a Disposal at Sea Permit and inform site-specific remedial options. Results of the sediment characterization indicate that several contaminant parameters exceed the applicable CCME ISQG and PEL guidelines, as well as the BC CSR sediment standards (Schedule 3.4), including arsenic, cadmium, copper, chromium, lead mercury, zinc, various PAHs, and total PCBs (see **Appendix I**). The sediment characterization data was also screened against the Disposal at Sea Lower Level of the National Action List criteria for cadmium, mercury, total PAHs, and total PCBs, with all four constituents exceeding these criteria in numerous samples. However, detection limits exceed applicable standard criteria (i.e. results were below the laboratory detection limit but above the DAS criteria) and the actual concentrations of metals, PCBs and PAHs cannot be determined. This anomaly may be due to a high water content and level of wood waste organics in the sediment.

Based on Disposal at Sea guidance, and the anticipated exceedances of DAS screening criteria, the sediment associated with the wood waste would be considered by ECCC to have a “high certainty” of future exceedances and indicates that the sediment may not be suitable for DAS. However, DAS permitting requires consultation with ECCC DAS program staff to determine if sediments qualify (https://www.canada.ca/en/environment-climate-change/services/disposal-at-sea/permit-applicant-guide/dredged-material/applicant-guide-permit-dredged-material/chapter-3-1.html). If DAS is a desirable approach to disposing of wood waste, a project description (outlining site history, previous sediment sampling results, etc) and sediment sampling plan will need to be approved by ECCC, sediment sampling conducted, and a sediment and characterization report submitted for review. Sediments determined by ECCC to have a “higher certainty” of exceedance could still qualify for DAS but may be requested to undergo toxicity testing. If DAS is pursued, more finite testing areas should be included in the sediment sampling plan, to focus dredge management units, as sediments from some areas may qualify for DAS even if others do not.

Upland Disposal

Drill cuttings from Field Survey 6 were disposed of at an upland facility located on Vancouver Island that can accept salt-impacted sediments. Should upland disposal of dredged materials be required, it would likely need to be treated for metal stabilization, based on preliminary investigation results (**Appendix I**).

4.2.5 In-Situ Capping

While the long-term efficacy of in-situ capping is uncertain, this remedial option would be likely be a less expensive approach to remediation in Esquimalt Harbour. Given the large spatial extent of deeper wood waste deposits in Esquimalt Harbour (**Figure 3.5**), and that the in-situ cap design would need to completely cover the wood waste, use of this remedial technique in Esquimalt Harbour would likely be logistically complex and require the removal of some wood waste, and irregularly oriented logs in the surface material, to allow for the cap to completely cover. Combined with the uncertainty around long-term effectiveness, this is not considered a feasible option for remediation of wood waste in Esquimalt Harbour at this time.

4.2.6 In-Situ Treatments

To our knowledge, the use of in-situ treatments as a remedial option for benthic communities impaired by wood waste has not been investigated. Research into the impacts to and potential remediation of benthic communities beneath aquaculture facilities has been widely explored. Since the impacts from wood waste are similar to aquaculture, potential approaches to in-situ remediation of wood waste can be drawn from this body of work. However, some differences between impacts of the two activities do exist (e.g. other contaminants, including zinc and copper, accumulate in the sediment below aquaculture pens during the breakdown of aquaculture feed waste, SAG 2011) and remedial approaches used in aquaculture but would require investigation prior to their implementation in Esquimalt Harbour. It is possible that the use of biological or chemical treatments (possible treatments are outline in **Section 4.1.5**) applied to areas of wood waste in Esquimalt Harbour could enhance the natural recovery of the area by increasing the decomposition rate of wood waste or eliminating toxic by-products.

The application of an experimental in-situ approach (such as scavenging sulphides) in the field can lead to un-intended consequences, particularly given the differences in the nature of the organic enrichment between aquaculture and wood waste, and may be challenging to obtain regulatory (ECCC and DFO) support. The oxygenation of sediments does not seem logistically feasible on a larger scale across Esquimalt Harbour. If an in-situ approach were to be pursued, the use of shell hash addition to lower pH and reduce hydrogen sulphide may be the most likely to be logistically feasible and to obtain regulatory support.

4.3 RECOMMENDED OPTIONS AND APPROACHES

After evaluating existing site-specific conditions for Esquimalt Harbour (wood waste distribution and wood waste depth, TOC content, the distribution of *Beggiatoa* sp bacterial mats, and impacts to the benthic infauna community) and remedial options, two wood waste management options are recommended based on the remediation objective:

- To promote recovery of benthic communities and enhancement of fish habitats so that remediated habitats can be deposited as credits to the DND Habitat Bank.

The recommended approach for sediment remediation includes two options, as outlined in **Table 4.2** below, including a field-based pilot study project of cost-effective and less invasive remediation options in areas of shallow wood waste accumulations and the complete removal, through dredging of wood waste, of deeper accumulations (**Figure 4.1**).

Table 4.2 Recommended Options for Remediation of Wood Waste in Esquimalt Harbour

Management Option	Bottom Condition	Area / volume Affected
Dredge with Backfill	• Deep accumulations (>0.25 m) • mostly within the >5% TOC contour	• North Deposit 31,182 m3 • South Deposit 227,819 m3
Field Pilot Study Project	• Shallow accumulations (0-0.25 m) • mostly within the 3-5% TOC contours	-

4.3.1 Dredge and Placement of Clean Fill

MNR and ENR are not considered feasible options for the remediation of deeper wood waste deposits, given the existing information on the impacts and persistence of deeper wood waste deposits, and the low sedimentation rates within the harbour.

Removal of the deeper wood waste deposits and placement of clean fill is considered the most effective and permanent option for remediating the two areas of deeper wood waste deposits (>0.25 m), approximately in areas where TOC is > 5%, that have been determined to impair the function of the benthic community in Esquimalt Harbour (**Figure 4.1**):

- Immediately north of Inskip Island and into Plumper Bay (approximately 227,819 m^3)
- North of Smart Island (approximately 31,182 m^3)

Immediately after dredging and backfilling, confirmatory monitoring is desirable to demonstrate effectiveness (dredge depth and residual wood waste) and backfill thickness. The deposit of remediated habitats to the DND habitat bank would occur after the remediated habitat is proven to be restored back to a productive soft-bottom community. This will entail an effectiveness monitoring program, of sediment chemistry (e.g. wood waste decomposition by-products) and bioassays, to demonstrate benthic infauna recovery (Washington State 2013).

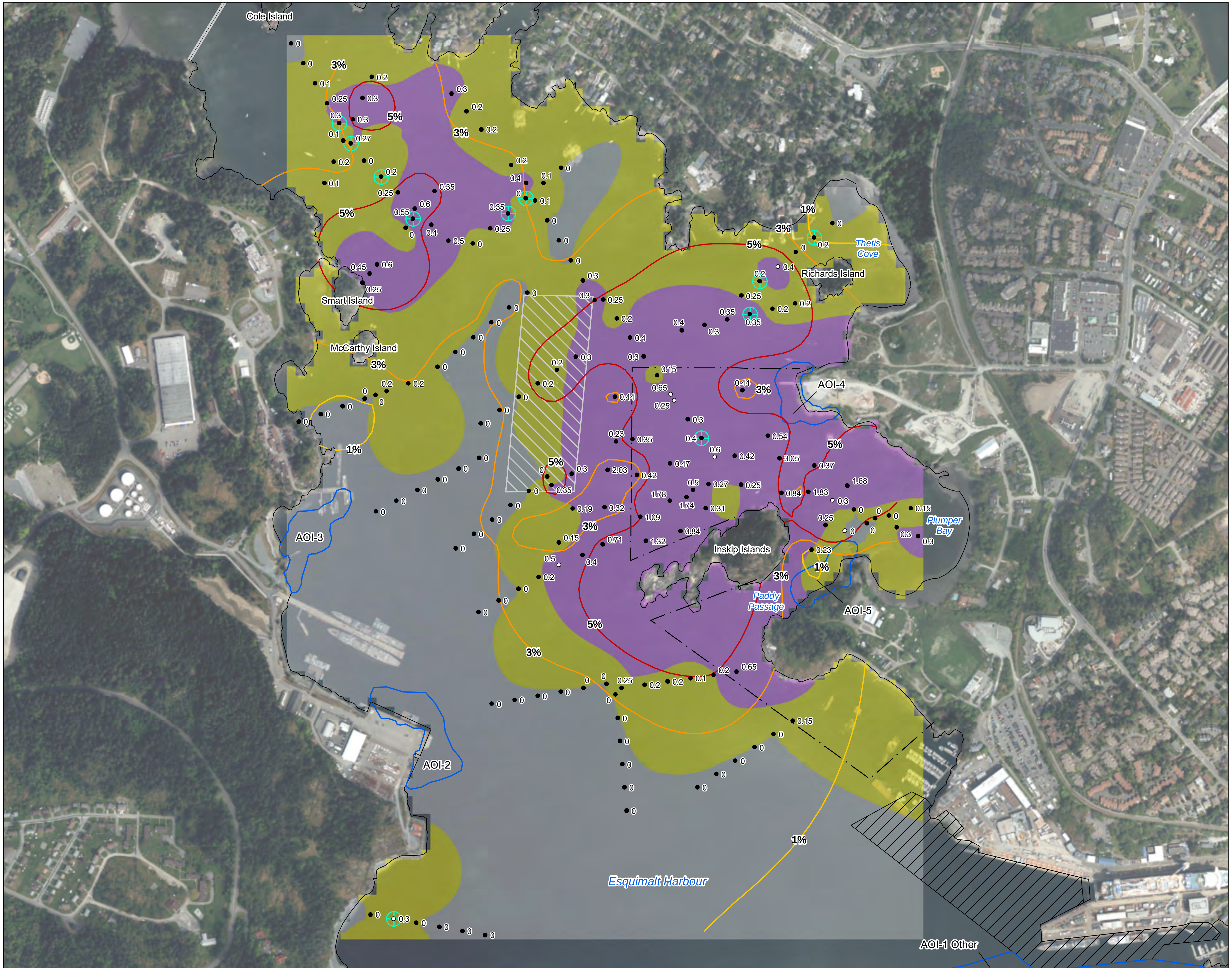
A detailed cost estimate for dredging, including scoping options for disposal of dredge materials, can be provided if DND chooses to pursue this remediation option, once spatial extent and volume have been determined and project design/engineering have occurred. Currently, deep surficial wood waste deposits are mapped based on interpolative distribution modelling around known depths (**Figure 4.1**). The boundaries of deeper deposits should be delineated prior to pursing this as a remediation option, in order to avoid un-necessary dredging and related costs. For example, just south of Inskip Island is categorized as deep based on modelling but should be confirmed. Approximate unit costs for works associated with dredging and capping with sand are presented below (**Table 4.3**).

Table 4.3 Approximate Unit Costs for Remedial Dredge Works in Esquimalt Harbour

Work Description	Unit Cost	Comment
Permitting	$100,000	DAS, Fisheries Act and other permitting processes
Mobilization	$20,000	One-time cost
Dredging	$15,000/day	Clam shell dredge, flat barge, support tug
Sand (clean fill)	$50/tonne	-
Sand Placement	$15,000/day	Clam shell dredge, flat barge, support tug
Disposal fees	$150/tonne	Assumes wood waste qualifies for DAS
Environmental Monitoring	$113/hr	Environmental monitor rate
Demobilization	$20,000	One-time cost
Effectiveness Monitoring	$200,000/year	For a period of three to five years as stipulated by DFO. With sediment chemistry, bioassays, and Scuba surveys

4.3.2 Pilot Study Project

A field-based pilot study project is recommended to determine the site-specific effectiveness and feasibility of economical and less invasive remediation options in areas of shallower wood waste deposits. The details and cost scoping of the recommended pilot study project are provided below in **Section 5.0**.



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Wood Waste Depths for Remediation Options

Legend

- Sampling Location (Bottom depth of wood waste was reached during sampling)
- Sampling Location (Bottom depth of wood waste was not reached during sampling)
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Jones Marine Group Lease Area
- Study Area

Management Options

- Shallow surficial wood waste deposit (0 - 0.25m)
- Deep surficial wood waste deposit (>0.25m)
- Surficial sediment overlying wood waste deposit
- No wood waste

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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4.4 REGULATORY FRAMEWORK AND REQUIREMENTS

4.4.1 DFO *Fisheries Act* Authorization

Under the *Fisheries Act*, proponents are responsible for avoiding and mitigating serious harm to fish that are part of or support commercial, recreational or Aboriginal (CRA) fisheries:

> *35. (1) No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery (DFO 2012).*

The Fisheries Protection Policy Statement (2013) defines *serious harm to fish* as:

- **The death of a fish;**
- **A permanent alteration of fish habitat** of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursey, rearing, or food supply areas, or a mitigation corridor, or any other area in order to carry out one or more of their life processes;
- **The destruction of fish habitat** of a spatial scale, duration, or intensity that fish can no longer reply upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one of more of their life processes.

On a project-by-project basis, DFO expects proponents, and/or qualified practitioners working on their behalf, to consult DFO's Pathways of Effects and evaluate project-related effects and determine, by way of a serious harm assessment, if the Project will result in Serious Harm. If the proponent cannot avoid or mitigate serious harm to fish (i.e. the Project will result in residual serious harm) then an Authorization under section 35(2)(b) of the *Fisheries Act* is required (DFO 2012).

Prior to the commencement of any physical remediation works in Esquimalt Harbour, a Serious Harm Assessment should be undertaken by a Qualified Environmental Professional. However, the nature of the remediation works is not anticipated to result in residual Serous Harm and not require a *Fisheries Act* Authorization (FAA). A Request for Review form should be completed and submitted to DFO to ensure the avoidance and mitigation measures, along with the determination of no residual serious harm, are considered suitable.

4.4.2 Disposal at Sea Permit

Environment and Climate Change Canada (ECCC) administers the Disposal at Sea (DAS) Program under the *Canadian Environmental Protection Act*. DAS permits may be granted if dredge materials proposed for disposal meet established disposal guidelines. As discussed in **Section 4.2.4.1**, wood waste contaminated sediments may not qualify for DAS and, if DAS is pursued, more finite testing areas should be included in the sediment sampling plan, to focus dredge management units, as sediments from some areas may qualify for DAS even if others do not. ECCC should be consulted prior to finalizing disposal options to determine the feasibility of DAS. Established and active DAS disposal sites may be too distant to achieve cost effective project objectives.

During remediation, placement of clean fill materials will constitute DAS if comprised of dredged sediments; however, the placement of clean materials during remedial works will constitute a beneficial use exemption under the DAS program. This can be applied for through a similar, but less involved process to a DAS permit with ECCC. Regardless of the source of fill material, the proponent will be responsible for ensuring the material is clean, suitable for the intended purpose, and not likely to cause marine pollution.

Esquimalt Harbour is primarily federal crown land and this provincial and local government legislation and statutes do not apply. If dredged material is proposed for upland disposal, provincial waste management regulations may apply.

4.4.3 Navigation Protection Act Notice of Works

Under the *Navigation Protection Act* (formerly the *Navigable Waters Protection Act*), any works that may affect navigation on navigable waters in Canada require approval. Placement of clean fill materials should not greatly alter the bathymetry of the Harbour and will not interfere with navigation in a substantial way. As such, remedial works should fall under permitted works that may proceed without the Minister's approval under the *Navigation Protection Act* (formerly the Navigable Waters Protection Act) administered by the Navigation Protection Program. A Notice of Works Form is required for all work on navigable waters listed on the schedule to the NPA and should be completed and submitted to Transport Canada prior to the commencement of any remediation works.

4.5 POTENTIAL HABITAT BANK CREDIT ASSESSMENT

The "Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting November 2013" (FPIP 2013) describes a "proponent-led habitat bank" as a formalized approach for creating offsets through habitat creation, enhancement or restoration in advance of projects that result in Serious Harm. The habitat bank is managed to enhance or improve fisheries productivity.

DND maintains a Habitat Bank through a Memorandum of Understanding (MOU) with DFO Pacific Region. The existing habitat banking MOU has expired and a draft Habitat Banking Arrangement between the DND and DFO has been developed to fit modern legislation and policy. The renewed Arrangement will provide up-to-date guidance for management of the habitat bank guided by DFO's "Fisheries Protection Program's Interim Guide to Proponent-led Habitat Banking" (October 2016). The Arrangement, once finalized, will be in effect for 10 years with options to renew.

At present, areas affected by wood waste sustain low quality fish habitat as ecological function is impaired (**Section 3.3**). For a restoration project to be eligible for inclusion in the habitat bank, it must demonstrate an increase in fish habitat productivity over existing conditions. Productive nearshore benthic communities contain unconsolidated fine sediments that support several CRA fishery species and species groups including forage fish, flatfish, Dungeness crabs and bivalve shellfish. The treatments recommended to remediate wood waste in Esquimalt Harbour are designed to promote the re-establishment of a balanced and productive benthic infauna community recovery of the seafloor. Since benthic infauna are important components of nearshore marine ecosystems, driving detrital decomposition and nutrient cycling and providing a food source for higher trophic level organisms, the restoration of unconsolidated subtidal habitats should qualify the area for the DND Habitat Bank. Additionally, while Esquimalt Harbour is included in the DFO Area 19-1 permanent bivalve sanitary closure, it can be argued that bivalves within the harbour provide a source of reproductive larval material that can recruit to harvestable areas.

Temporary physical effects to substrates and benthic organisms will result from ENR and dredging. However, if these areas remain undisturbed following the application of the remedial treatments, they are expected to colonize with opportunistic infauna species relatively rapidly (e.g., six months to one year), and develop into a healthy and productive infauna community (e.g. balanced mix of functions, such as large bioturbators, through the recruitment of annelids, arthropods, and bivalves) over time thus contributing to fish habitat that supports CRA fishery species.

The predicted time to recovery of each remediation approach and the eligibility for inclusion of restored habitat to the habitat bank is presented below in **Table 4.4**. Most remedial treatment types, if they progress as predicted, would be result in productive habitat within a reasonable time frame. The deposit of habitat credits to the bank would be confirmed through monitoring of sediment chemistry (e.g. wood waste decomposition by-products) and bioassays to demonstrate benthic infauna recovery and productive habitat function (Washington State 2013). Effectiveness monitoring would require the establishment of baseline conditions (using sediment chemistry and bioassays) for the targeted areas of remediation immediately prior to restoration treatments being applied in order for comparison to monitoring data in subsequent years.

Table 4.4 Proposed Potential Habitat Banking Bottom Treatments, Restoration Times and Banking Potential

Proposed Treatment	Restoration Period	Habitat Banking Potential
MNR	Unknown (Under 10 years if sedimentation rates are high, sediments are well flushed with dissolved oxygen)	Delayed - dependent on monitoring results
ENR	6 months – 3 years	Yes
Dredging (with backfill)	6 months – 3 years	Yes

DND may also consider value-added habitat enhancement opportunities, such as the creation of subtidal rocky reefs or kelp beds. These enhancements would be constructed over the remediated sediment areas at appropriate depths for productive biological function. An enhancement of this nature is expected to be successful given the results of the impact assessment demonstrating that natural rocky reef areas, and log piles, in Esquimalt Harbour provide functional habitat for invertebrates that require hard substrate (e.g. sea urchins, plumose anemones, coralline algae or understory kelps) and juvenile rockfish (Photo 8). Targeted CRA species for these enhanced habitats would include rockfish (*Sebastes* sp) and lingcod (*Ophiodon elongatus*), forage fish, bivalve shellfish, crabs and urchins. This value-added approach may be the best course of action if operational or future development activities may negatively impact the remediated sediments (e.g. anticipated disturbance of remediated unconsolidated sediments by prop-wash creating patchy disturbances and impacting recruitment and establishment of healthy and productive benthic infauna communities) or, if future DND development will impact nearshore rocky reef habitat and require the offsetting of this type of habitat.

5.0 REMEDIAL PILOT STUDY PROJECT

Given that the remediation of wood waste impacted marine environments is a relatively new objective for water lot managers in British Columbia there are currently no CCME or CSR standards for wood waste remediation. Additionally, dredging and disposal of deeper wood waste deposits is a costly remediation option. Prior to the execution of a larger scale remediation effort, a focused field-based pilot study project has been recommended and designed to fulfill the following objective:

- Determine the site-specific effectiveness and feasibility of economical and less invasive remediation options, MNR and ENR, for areas of discontinuous and/or shallow wood waste deposits in Esquimalt Harbour.

The basic scoping of the pilot study project, including site selection, design, study implementation, and a detailed cost estimate, are provided below for DND to consider implementing in the future. Following the implementation, monitoring, and determination of effectiveness of the pilot project, a full-scale remediation and potential value-added habitat enhancement opportunity can be assessed and implemented.

5.1 SITE SELECTION

The pilot study site(s) should be representative of shallow wood waste deposits, have similar biophysical conditions across the site (and between sites if multiple sites are chosen), and not be affected by DND operational requirements or recontamination by log handling over the duration of the pilot study.

To select suitable sites for the pilot project implementation, areas of the Harbour with shallow (0–0.25 m deep) and deep (> 0.25 m) wood waste deposits were first identified and mapped as follows (**Figure 5.1**):

- 50 m buffer applied to each sample location (wood waste depth was sampled in 50 m intervals)
- Polygons created for shallow and deep deposits
- TOC thresholds (1, 3, and 5%) were overlaid

Following this initial mapping, areas with shallow wood waste deposits, that are approximately within a 3% TOC threshold, were examined to look for locations that possess similar biophysical conditions (e.g. current, bathymetry, biophysical impacts based on sediment chemistry and benthic infauna analysis). Since the pilot project will be conducted in the Harbour, rather than a controlled laboratory setting, it is important to consider other variables that may impact the determination of treatment effectiveness and keep as many of these constant to ensure that the results of the remediation treatments are not influenced by other factors. Based on results, three areas of approximately 100m wide by 170m long have been identified as possible candidate pilot study sites (**Figure 5.1**). The location south of Inskip Islands has been identified as the best candidate for pilot project implementation given that wood waste depths, bathymetry (range from -10.5 to -11.0 m deep), and sediment type (gravelly mud/sand) and sediment chemistry conditions (e.g. TOC) and are relatively equivalent across the location (**Figure 5.1**). Two other areas south of Cole Island are tentatively proposed as back-up or additional locations; however, there is a greater range in bathymetry across the locations (west side of harbour -3.0 to -4.0m; east side of harbour -4.5 to -6.0 m deep), the west location has more variability in wood waste depth, and the sediment characteristics (e.g. unconsolidated almost suspended layer of fine sand/mud bottom sediments) at these two locations may impact the feasibility of pilot study treatments (e.g. placing a sand layer on top of unconsolidated materials could lead to it sinking into the material rather than remaining as a surficial layer).

Additional suitable candidate pilot study sites may exist, but due to the nature of the field assessments (**Section 3.0**), some data gaps remain between transects/sample locations (**Figure 5.1**). Should further field assessments be conducted prior to the selection of a candidate pilot study site(s), the potential site locations should be re-assessed to determine if the boundaries of the identified locations could be expanded and/or to determine if more suitable locations are available.

A reference site location will also be established in the outer Harbour area, ideally in a location that possesses similar bathymetry, sediment type, and current dynamics to the pilot study site.

Prior to finalizing a pilot study and reference site(s), input is required from PWGSC and DND to ensure that operational requirements of the harbour will not impact the site location over the duration of treatment and monitoring.

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Wood Waste Proposed Pilot Project Locations

Legend

- Proposed Pilot Project Location
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Management Options

- Shallow surficial wood waste deposit (0 - 0.25m)
- Deep surficial wood waste deposit (>0.25m)
- Surficial sediment overlying wood waste deposit
- No wood waste

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

Notes

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2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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5.2 STUDY DESIGN

The pilot study design can be applied at one site or at multiple sites. The more sites that are included in the study the greater the confidence in the resulting observations. The cost estimate currently includes pricing for the implementation of the pilot study at one study site location (**Section 5.4**).

Regardless off how many sites are chosen, three treatment types are proposed per study site (for a full description of each treatment type refer to **Section 4.1** and **Table 4.1**):

- MNR – no modifications to the treatment area
- ENR – placement of a thin layer of clean fill over existing sediments (approximately 15 cm deep)
- Dredging – dredge wood waste and impacted sediments and backfill with clean fill

The study design includes both spatial and temporal replication following a Before After Control Impact (BACI) design. Replication in experimental design is required to account for natural variation and reduces the influence of measurement error in analyses; therefore, the pilot study has been designed to include three replicates of each treatment type (in approximately 20 m circular plots) at each site (for a total of nine treatment plots), with a minimum of 3-5 sample locations within each treatment plot (for statistical power; see **Figure 5.2**). A circular treatment plot was selected over a square plot due to the difficulty of placing clean fill from a barge and to allow for some spillover into the surrounding area, so that the treatment can be applied up to, and just over, the boundary of the treatment plot.

The pilot study site(s) need to cover a large enough area that the treatment plots can be spaced far enough apart to avoid edge-effects and prevent incidental influence on the results of other treatment plots. Within the pilot site, the placement of treatment plots should be randomized in order to maximize the statistical power, as this helps to ensure any differences found are attributable to the treatment, rather than a confounding variable.

The four corners of the pilot site, and the center point of each circular treatment plot, will be marked with a cement cinder block, and a small float that is suspended off the seafloor by no more than 1 – 2 m, depending on site depth, to allow for easy detection during sampling while not impeding navigation within the Harbour. Each time the treatment plot is sampled, the sample locations should be randomized.

A reference site location, with two plots, will also be established in the outer Harbour area and sampled as described above. No treatments will be applied to the reference location.

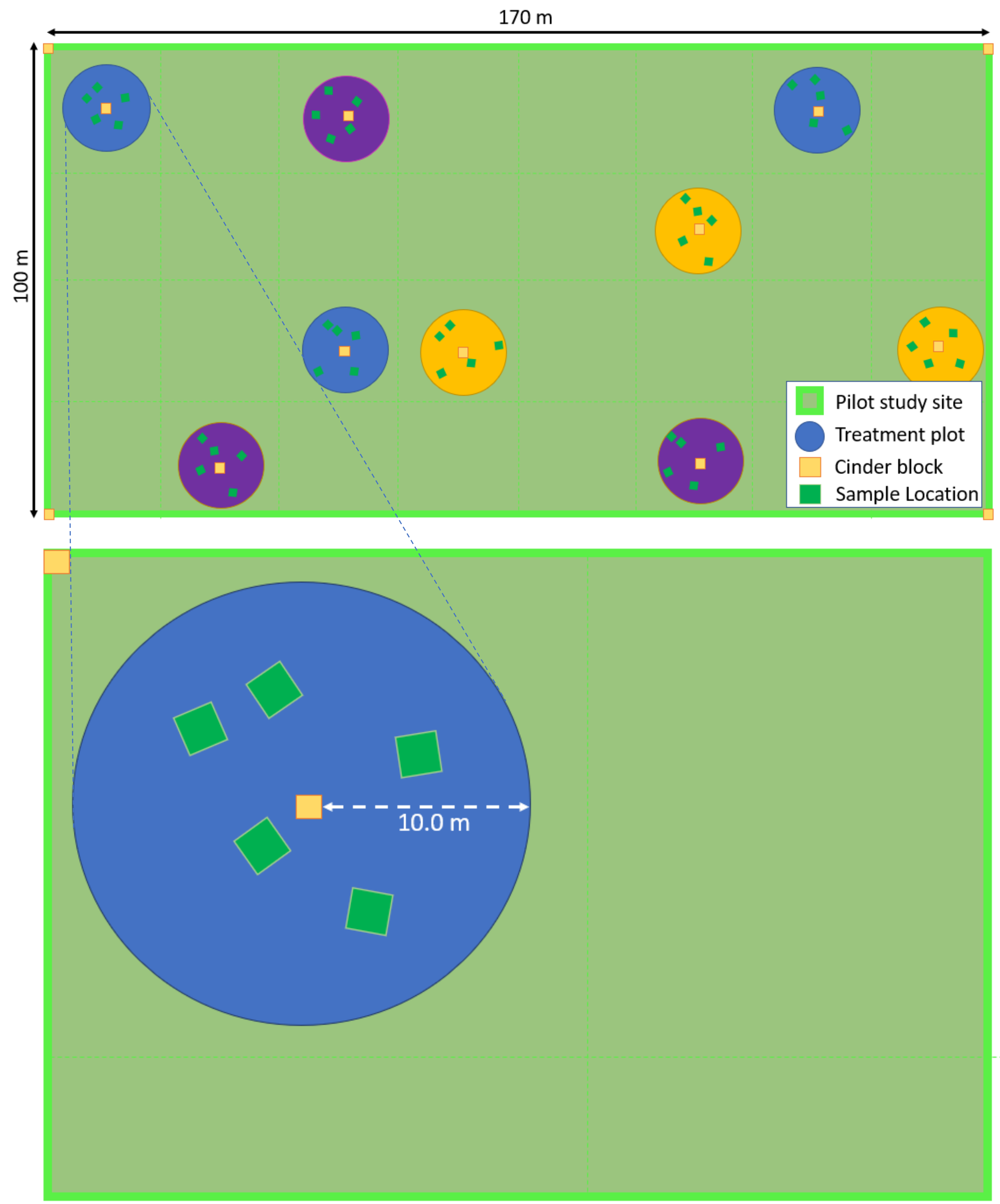

Figure 5.2 Proposed Pilot Project Site Design Includes Three Replicates of each Proposed Treatment Type (MNR, ENR, and Dredge).

5.3 STUDY IMPLEMENTATION

The pilot project implementation has been scoped in a phased approach because it will need to be executed over multiple years. The steps are outlined in the sections below and are proposed to occur with the following timing to coincide with federal government fiscal years:

- Fiscal Year 1 – Completion of regulatory requirements
- Fiscal Year 2 – Baseline conditions (May/June) and application of treatment types (July/August)
- Fiscal Year 3 – Effectiveness monitoring Year 1 (May/June)
- Fiscal Year 4 – Effectiveness monitoring Year 2 (May/June) and final reporting (July – December)

5.3.1 Finalized Site Selection and Pilot Study Regulatory Framework

Regulatory requirements and permitting could be conducted concurrently with **Section 5.3.2 Baseline Conditions**. However, to move forward with the application of the treatment types a few regulatory criteria must be satisfied as outlined below. It is recommended that regulatory requirements be completed well in advance of the application of treatments (Year 1), so that baseline conditions and application of treatments can be completed within the same fiscal year (Year 2), and within the DFO Summer Timing Window for the Protection of Fish and Fish habitat (Area 19 July 1 – October 1).

5.3.1.1 Finalized Site Selection

Before moving forward with regulatory requirements, a final selection of the pilot study site and reference site need to be made in concert with PWGSC and DND.

5.3.1.2 Navigation Protection Act - Notice of Works

Under the *Navigation Protection Act* (formerly the *Navigable Waters Protection Act*), any works that may affect navigation on navigable waters in Canada require approval (**Section 4.4.3**). Because the pilot project will not greatly change the existing bathymetry, or place any obstructions to navigation, a permit approval will not be required. Instead, a *Navigation Protection* Act Notice of Works Form should be completed and submitted to the Transport Canada Navigation Protection Program.

5.3.1.3 Disposal at Sea - Beneficial Use Exemption for Clean Fill

Regardless of the source of fill material, the proponent will be responsible for ensuring the material is clean, suitable for the intended purpose, and not likely to cause marine pollution. The Disposal at Sea Program currently only regulates the placement of dredged material in the marine environment. Therefore, if fill for the ENR and dredge treatments is sourced from an upland quarry, and is comprised of clean construction-grade material, it is Hemmera's understanding that this material will not be required to undergo a DAS beneficial use exemption. Should the clean fill be sourced from dredged marine sediments, the placement of fill from a barge into subtidal areas of Esquimalt Harbour would require a review by the DAS program to determine if it would qualify for a beneficial use exemption.

In order to qualify for beneficial use, there must be a demonstrated need or purpose for the use of the sediment, the sediment must be proven to meet DAS sediment chemistry screening criteria, demonstrate there is no anticipated marine pollution or deleterious effects from the placement of the fill, and have DFO and local First Nations endorsement. After fill has been sourced, a Project Description will be compiled and submitted to DFO and ECCC for consultation and approval. The Project Description will outline:

- Esquimalt Harbour site history and the pilot project objectives (high level overview)
- Fill source location site history/background information
- Dredge area boundary (if fill is dredged) and estimated fill volumes

Depending on the source of dredged materials, a Sediment Sample and Analysis Plan will also need to be prepared and submitted to ECCC for review and input prior to conducting sediment sampling and analysis of the fill and completing a Sediment Characterization Report. If suitable sediment chemistry results already exist, it is possible that ECCC will not require further analysis/reporting. The quantity of fill required for the pilot study will vary based on the dimensions of the final pilot study site location, and treatment plot size, but will be less than 10,000 m^3. Therefore, ECCC will require a minimum of 7 samples (6 samples and 1 duplicate) be analyzed for the minimum analytical requirements, as outlined in **Figure 5.3** below. The Sediment Characterization Report will also be submitted to ECCC to allow for beneficial use signoff. Unlike a full DAS permit application, ECCC does not need sediment chemistry, extended site history information, bathymetric surveys, and dispersion modelling for the receiving pilot study site in Esquimalt Harbour.

5.3.1.4 Disposal at Sea – DAS Permit for Dredged Materials

Before a final pilot study site is selected, and investigatory sediment chemistry conducted to look at DAS Program minimum sample analytical requirements (**Figure 5.3**), it cannot be determined whether sediments from the pilot study site might qualify for a DAS permit. In order to provide a conservative cost estimate, it has been assumed that sediments from the dredge treatment will be disposed of at a permitted upland facility. The DAS permitting process can be lengthy as it must include the compilation of site information and selection of a suitable DAS site, along with First Nations consultation. However, disposal at an upland facility is costly and can have limitations based on the facilities that are able to accept salt-laden waste.

Should PWGSC and DND wish to pursue a DAS permit for dredged materials, ECCC will require detailed Project Description be submitted for review prior to providing input on a Sediment Sampling Plan. Sediment Sampling and a resulting Sediment Characterization Report must be submitted for ECCC to determine whether sediments meet DAS requirements for permitting, at which time, PWGSC and DND could pursue an DAS permit application.

5.3.1.5 **DFO *Fisheries Act – Serious Harm Assessment***

Given the nature and extent of the pilot study design, a serious harm self-assessment is recommended to assess the pilot project-related effects to fish and fish habitat, outline recommended avoidance and mitigation measures for pilot study implementation, and determine residual serious harm. A Request for Review form should be completed and submitted to DFO to ensure the avoidance and mitigation measures, along with the determination of no residual serious harm, are considered suitable. A full *Fisheries Act* Authorization is not expected to be necessary for the implementation of the pilot study.

Disposal at Sea
Minimum Sample Analytical Requirements

The table below outlines minimum analytical requirements for projects with no contaminant history. Prior to sampling, Environment Canada should be consulted to determine the need for additional site-specific analytical requirements.

Metals	Digestion Method	Analytical Method[1]	Target Detection Limit (mg/kg dry weight)	Reference Criterion (mg/kg dry weight)
Cadmium	EPA 3050B	EPA 6020A	0.20	0.60[2]
Mercury	EPA 3050B	EPA 7471	0.05	0.75[2]
Arsenic	EPA 3050B	EPA 6020A	1.00	7.24[3]
Chromium	EPA 3050B	EPA 6020A	1.00	52.3[3]
Copper	EPA 3050B	EPA 6020A	1.00	18.7[3]
Lead	EPA 3050B	EPA 6020A	0.50	30.2[3]
Zinc	EPA 3050B	EPA 6020A	1.00	124[3]
Organics		**Analytical Method[1]**	**Target Detection Limit (mg/kg dry weight)**	**Reference Criterion (mg/kg dry weight)**
Total polychlorinated biphenyls (PCB)		EPA 8080	0.04	0.10[2]
Total polycyclic aromatic hydrocarbons (PAH), [Σ16]		EPA 8270C	0.05	2.50[2]
Acenapthene		EPA 8270C	0.05	
Napthalene		EPA 8270C	0.05	
Acenapthylene		EPA 8270C	0.05	
Anthracene		EPA 8270C	0.05	
Phenanthrene		EPA 8270C	0.05	
Flourene		EPA 8270C	0.05	
Fluoranthene		EPA 8270C	0.05	
Benz[a]anthracene		EPA 8270C	0.05	
Benzo[a]pyrene		EPA 8270C	0.05	
Benzo[b]fluoranthene		EPA 8270C	0.05	
Benzo[k]fluoranthene		EPA 8270C	0.05	
Chrysene		EPA 8270C	0.05	
Benzo[ghi]perylene		EPA 8270C	0.05	
Dibenz[a,h]anthracene		EPA 8270C	0.05	
Indeno[1,2,-cd]pyrene		EPA 8270C	0.05	
Pyrene		EPA 8270C	0.05	
Physical Parameters		**Analytical Method[1]**	**Measurement**	
Total Organic Carbon		EPA 9060A	0.01% dry weight	
Percent Moisture		ASTM D2794-00	1%	
Percent Grain Size Distribution		ASTM D422-63	Sieve and pipette analysis	
Gravel		ASTM D422-63	16 mm – 2 mm	
Sand		ASTM D422-63	2 mm - 0.0625 mm	
Silt		ASTM D422-63	0.0625 mm - 0.0039 mm	
Clay		ASTM D422-63	< 0.0039 mm	

Notes:

[1] An equivalent method certified under the Canadian Association for Laboratory Accreditation that can achieve the specified target detection limit is acceptable.

[2] *Canadian Environmental Protection Act, 1999, Disposal at Sea Regulations.*

[3] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines, Sediment Quality Guidelines for the Protection of Aquatic Life (Marine).

Figure 5.3 Environment and Climate Change Canada Disposal at Sea Program Minimum Sample Analytical Requirements

5.3.2 Pilot Study Site Setup and Characterization of Baseline Conditions

Once the final pilot study site(s) has been chosen, a pre-treatment determination of baseline conditions should be conducted to allow for the comparison of the effectiveness monitoring results and allow for the determination of remedial standards. Some data will already exist for the pilot study site, based on field assessments conducted as part of this Project (**Section 3.0**); however, further data will need to be collected to fully characterize the entire pilot study site, and include additional metrics that have not been previously sampled.

5.3.2.1 Fieldwork Planning and logistics

Characterization of baseline conditions should be planned for earlier summer months (May/June) in Year 2 of the pilot study so that sampling takes place after the benthic infauna community has had time to flourish (late spring) and, so that the application of treatment types can occur immediately following, within the same fiscal year (July/August), to (i) coincide with the DFO Summer Timing Window for the Protection of Fish and Fish habitat (Area 19 July 1 – October 1) and (ii) allow time for fill to settle and colonization to occur before the effectiveness monitoring begins in the next fiscal year.

A detailed sampling plan will be completed, outlining specifics of the pilot study site(s) setup, sampling of biophysical conditions, and reporting and provided to PWGSC and DND for review. Prior to the commencement of fieldwork, a Health and Safety Plan will also be provided for PWGSC and DND review.

ArcGIS will be used to determine the coordinate locations of the pilot study site boundaries, as well as the center points of each treatment plot and five sample location coordinates within each treatment plot. The sample location coordinates can then be used to determine the compass bearings and distances from the center cinder block.

5.3.2.2 Fieldwork

All fieldwork will be conducted by SCUBA and assisted by a surface-support vessel. For each pilot site and the reference site, the vessel will transit to the pre-determined coordinates for the location and divers will setup the cement cinder blocks at each of the four corners, and at the centre point of each treatment plot (**Figure 5.2**). With diver support, cinder blocks will be slowly lowered from the surface-support vessel on a temporary leadline with a buoy float. Divers will then descend the float line to re-position the cinder block, as necessary, and attach a smaller/shorter marker float for future treatment plot identification (**Figure 5.4**). All cinder block locations will be georeferenced in the field using a handheld GPS unit from the surface-support vessel and the temporary surface buoy as the location.

After setup, and before seafloor sediments are disturbed at each treatment/reference plot by grab sampling and divers, water quality measurements will be assessed using a YSI© handheld multi-parameter meter and the temporary surface buoy as a marker. Parameters will be measured at the surface (-1.0 m) and just above the seafloor, and will include temperature (ºC), dissolved oxygen (%), conductivity (µs/cm), salinity (PPT), pH, and redox potential data was collected.

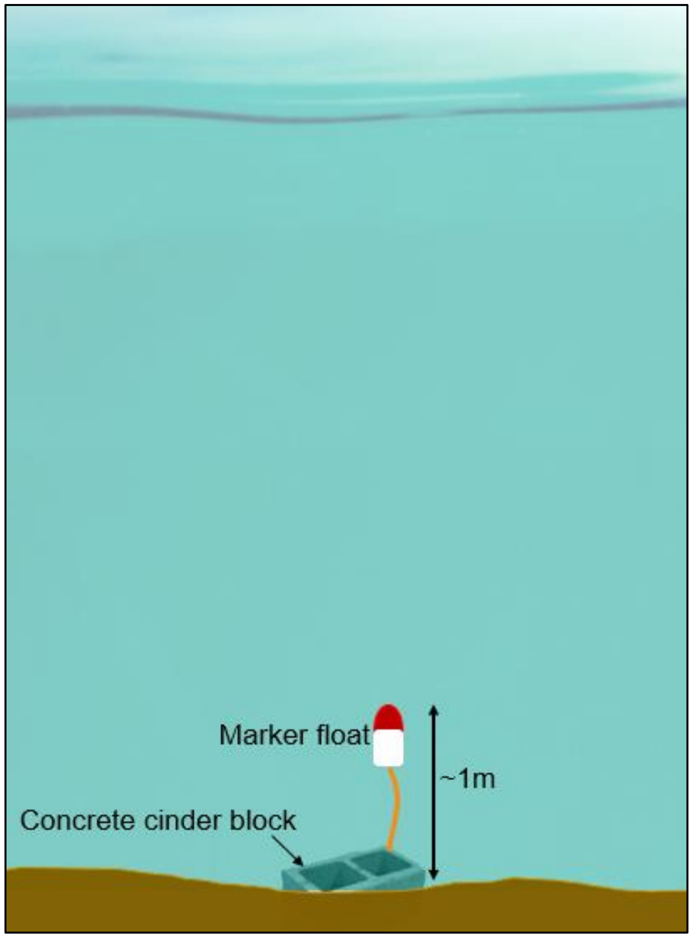

Figure 5.4 Example of Pilot Study Marker Setup

A sediment grab sampler (e.g. Van Veen) will then be deployed at the center point of each treatment plot and reference plot and field-screened by a Biologica technician through a 1.0 mm sieve using unfiltered seawater. Material retained on the screen will be transferred to jars and preserved with 10% buffered formalin for laboratory benthic infauna community analysis. It is recommended that benthic infauna community analysis be conducted during the establishment of baseline conditions, and again at the conclusion of the pilot study, to investigate differences in the benthic infauna community structure, rates of colonization, and determine if larger bioturbators and pollution-sensitive species are present. Benthic infauna communities undergo succession as they reach a mature community, with a greater presence of larger microbenthic and pollution-sensitive species in later stage or healthier productive communities. Larger taxa play a role in the bioturbation of sediments through their burrowing activities, this re-working of the sediments provides oxygenation and can aid in the recovery of wood-waste impacted areas. However, benthic infauna community data for the Harbour currently indicates that pollution-tolerant or opportunistic species dominate, with very few large bioturbators or sensitive species present. The presence of bioturbators will be an integral part of the success of enhanced natural recovery treatments. While this analysis is costly, it would be informative of the likelihood of a healthy and productive mature benthic infuana community developing within the Harbour.

After setup and grab sampling, biophysical conditions within each of the nine treatment plots and two reference plots will be surveyed. At each plot, divers will descend the temporary line to the center cinder block and use the predetermined compass bearings and a transect tape to navigate to the five randomized sample locations. At each of the five sample locations, divers will place a 1.0 m x 1.0 m quadrat, use an underwater camera to take a photo of each sample location quadrat, and record:

- Seafloor depth
- Substrate type (% cover; **Table 3.2**)
- Marine vegetation, bacteria (*Beggiatoa* sp.) and sessile invertebrates (% cover)
- Mobile invertebrates and fish observed within a few metres of the quadrat (abundance)

At three sample locations (i.e. quadrat) within each plot, divers will also collect surficial sediment using push cores, to delineate the depth of wood waste and collect sediment for the analysis of biophysical and chemical parameters as follows:

- One long core (0.80 m long by 0.05 m diameter PVC tube) will be pushed into the sediments by hand or using a one-kilogram hammer to a depth where it could no longer penetrate. The core will be capped, removed from the sediment, and a second cap placed on the bottom of the core to ensure the contents were not released. The sediment is retained in the corer during removal from the sediment due to suction created by the cap.
- Three short squat cores (0.30 m long by 0.10 m diameter PVC tube) will be pushed into the sediments by hand or using a one-kilogram hammer to a depth where it could no longer penetrate and capped as above.
- A one-meter long metal probe, marked with 10cm intervals, could also be used within the transect to collect additional information on the depth of hard substrates, shell hash/debris, and/or wood waste.

Aboard the surface-support vessel, sediment within the long core will be extruded into a core box and visually inspected, photo-documented, and a borehole log completed to document the vertical profile of substrate types and wood waste stratification (**Table 3.2**), along with other sediment observations (e.g. texture, colour, odour, presence of biota).

Sediment from the shorter cores will be used for analysis of physical and chemical sediment parameters, along with bioassays. Water will be decanted from the cores and the sediment immediately placed in clean containers/polyethylene bags, labelled with project information, recorded on a chain-of-custody form, and placed in coolers with ice packs to maintain temperatures below 6 ºC until they can be shipped to the appropriate laboratory facility. Approximately one duplicate for every ten samples will also be selected at random for data QA/QC procedures.

Following the completion of sampling at each of the nine treatment plots and two reference plots, the temporary surface line/buoy used for setup can be untied and reeled back into the surface-support vessel, and the shorter marker buoy left to help with location identification during future phases (**Figure 5.4**).

5.3.2.3 Analysis and Reporting

Benthic infauna community samples collected in the field will be analyzed by Biologica after a period of fixation, similar to that described in **Section 3.1.2.2**. Sediment core samples collected in the field will be sent to an accredited laboratory facility for analysis of physical and sediment chemistry parameters and to Nautilus Environmental for bioassay testing.

Sediment will be analyzed for the following physical and chemical parameters, which includes wood waste by-products along with contaminants which could impact results of the pilot study:

- Grain size distribution
- TOC
- Ammonia (NH_3) and pH
- Pore-water sulphides
- Heavy metals
- PAHs
- PCBs
- Dioxins/furans

Bioassays are an analytical method used to determine the toxicity of the sediment on living animals, they are a confirmatory tool used to demonstrate whether wood waste is adversely impacting benthic community and will be used to determine the short-term effectiveness of selected pilot project treatments by correlating wood waste and wood waste by-products with bioassay results. Provincial ecological risk assessment guidelines and the FCSAP provide guidance on bioassay testing but there are no Canadian criteria. Washington State SMS criteria stipulates the use of 2 acute and 1 chronic bioassay test for marine sediment (Washington 2013). Once the timing of the baseline conditions fieldwork has been confirmed, Nautilus Environmental can be contacted to determine the seasonal availability of species. Nautilus requires a minimum of one week's notice prior to submitting samples; however, samples can be held for up to 6 weeks before conducting bioassay testing. The bioassay toxicity tests outlined in **Table 5.1** have been selected as suitable for the pilot study, based on locally-relevant infauna/epifauna that naturally occur in soft sediment habitats. The cost of one chronic and one acute test have been included in the cost estimate, it is recommended that at least one of the tests include a benthic infauna organism type (**Section 5.4**).

Table 5.1 Locally-relevant Toxicity Tests, Species and their Classification

Toxicity Test (Duration/Endpoint)	Species	Organism Type	Test Classification
48 – 96 h larval development and survival	Sea urchin (*Strongylocentrotus purpuratus*) or sand dollar (*Dendraster excentricus*)	Epibenthic	Chronic
10-minute fertilization	Sea urchin (*Strongylocentrotus purpuratus*) or sand dollar (*Dendraster excentricus*)	Epibenthic	Acute
20-day survival and growth	Polychaete worm (*Neanthes arenaceodentata*)	Benthic Infauna	Chronic
10-day survival	Amphipod (*Rhepoxynius abronius*)	Benthic Infauna	Acute

Site-specific remedial standards will need to be developed based on site-specific conditions. Data analysis results from the pilot study site and outer harbour reference site will be compared to determine remedial endpoint goals. Results of the baseline conditions and remedial standards will be summarized in a short letter-style report for use in determining effectiveness of pilot study treatments in future fiscal years.

5.3.3 Application of Pilot Study Treatments

Following the completion of regulatory requirements and collection of baseline conditions, the various treatment types can be applied to the treatment plots as outlined below.

5.3.3.1 Fieldwork Planning and logistics

Characterization of baseline conditions should be planned for earlier summer months (May/June), after benthic community has had time to flourish, so that the application of treatments can occur immediately following, within the same fiscal year (July/August). The application of treatments to each treatment plot should be conducted within the DFO Summer Timing Window for the Protection of Fish and Fish habitat (Area 19 July 1 – October 1) and follow avoidance and mitigation measures outlined in the Serious Harm Assessment.

Prior to the commencement of fieldwork, a detailed Implementation Plan will be completed, outlining the specific details of implementation. A Health and Safety Plan will also be provided for PWGSC and DND review.

Treatment types applied to each of the nine treatment plots will be randomized and determined in advance of the fieldwork.

5.3.3.2 Fieldwork and Reporting

Application of the various treatment types will commence with the dredging and removal of wood waste and impacted sediments from the three treatment plots assigned to the dredge treatment and wrap up with the placement of clean fill for the ENR and dredge treatments. To assist with the application of treatments (i.e. move/replace treatment plot markers and confirm treatments have been applied appropriately), a dive team will also be onsite with a surface support vessel.

For the dredge treatment plots, a spudding, crane barge (with dredge bucket size approximately 3-4 m^3) will mobilize to site and use previously-marked GPS coordinates to position at each of the three dredge treatment plots. Divers will confirm the treatment plot marker locations and remove them prior to the dredging. As dredgeate is removed it will be placed in a contained barge. Following the completion of dredging at a treatment plot, divers will visually confirm dredging parameters, and place a temporary center marker using a concrete cinder block with leadline and surface buoy.

Total volume of dredgeate is estimated to be approximately 400 m^3, assuming three 20 m diameter treatment plots are dredged to approximately 0.4 m depth. Once the pilot study site has been selected, and baseline conditions collected, the total dredge volume can be more accurately determined.

Sediment samples will be collected from the dredgeate of each of the treatment plots and sent for sediment chemistry analytics to inform upland disposal facilities of contents and cost of disposal. For each of the three dredge treatment plots, 3 composite samples will be created. The sediment samples will be placed in clean containers/polyethylene bags, labelled with project information, recorded on a chain-of-custody form, and placed in coolers with ice packs to maintain temperatures below 6 ^{o}C until they can be shipped to the appropriate laboratory facility. Approximately one duplicate for every ten samples will also be selected at random for data QA/QC procedures. Sediment samples collected in the field will be sent to an accredited laboratory facility for analysis of the following sediment chemistry parameters:

- Grain size distribution and % moisture
- TOC
- TCLP metals (including sulphur)
- LEPH/HEPH/PAH
- PCB
- BTEX
- Na/Cl

Once analytical results are received, the dredgeate can be towed to a location where it can be offloaded to dump trucks and transported to an upland facility that can accept salt-impacted sediments for disposal.

Once dredging is complete, placement of clean fill can commence. A spudding, crane barge will position itself using GPS waypoints for treatment plots, and the temporary surface buoy markers placed by divers, and place fill with the dredge at both the ENR treatment plots and the dredged treatment plots. Before fill is placed, divers will move the treatment plot markers and, following the placement of fill, divers will visually confirm that fill is placed appropriately (i.e. confirm thickness or provide feedback to crane operator on further areas to fill) and replace the treatment plot markers as per **Figure 5.4**. Approximately 600 m^3 of clean fill has been estimated to be required, 190 m^3 to place 15-20 cm of sand across the ENR treatment plots, and 400 m^3 of fill to backfill the dredged treatment plots.

Onsite dive team members can serve as Environmental Monitors, to ensure that avoidance and mitigation measures outlined in the *Fisheries Act* Serious Harm Assessment are being implemented appropriately.

Results of the application of treatment types will be summarized in a short letter-style report. If the application of treatment types is completed within the same fiscal year as the baseline conditions, these results can be included in the same report. An environmental monitoring report will also be submitted at the completion of treatment application, summarizing on-site environmental activities and documenting any issues that arose.

5.3.4 Effectiveness Monitoring

Benthic infauna communities undergo succession as they reach a mature community, with a greater presence of larger microbenthic and pollution-sensitive species in later stage or healthier communities. The colonization and re-establishment of the benthic infauna community could take several years to establish. For example, results from Esquimalt Graving Dock Remediation Project's Year 1 and Year 3 effectiveness monitoring provides an indication of both rates of colonization/re-establishment and community composition following remediation within Esquimalt Harbour (Keystone 2015). Year 1 results indicate that the benthic infauna community was dominated by small, quick colonizers or species known to be pollution-tolerant (Keystone 2015)[4]. Therefore, effectiveness monitoring is recommended to occur annually for a minimum of two consecutive years following the application of treatment types (within pilot study Years 3 and 4). The presence of bioturbators will be an integral part of the success of enhanced natural recovery treatment (as described in **Section 4.1.2**); therefore, time should be allowed for larger bioturbators to colonize and begin bioturbating the clean fill, before the determination of pilot study effectiveness. Effectiveness monitoring must occur at the same time of year as the characterization of baseline conditions (May/June), to avoid any impacts of seasonality on the results, as was observed with the Esquimalt Graving Dock work (Keystone 2015).

4 Bathymetry at the Esquimalt Graving Docks may differ significantly from wood waste remediation areas, and benthic invertebrate community structure varies with seafloor depth.

Sampling of the treatment and reference plots will follow the exact procedures used for sampling baseline conditions, outlined in **Section 5.3.2** above. In short, SCUBA divers will transit to the pilot study site and reference site using a surface-support vessel. Treatment plots will be located using previously determined GPS coordinates for the center marker of each plot. Before seafloor sediments are disturbed, water quality measurements will be taken at the center point of each plot. Divers will then locate the center cinder block of each plot and use predetermined compass bearings and a transect tape to navigate to five randomized sample locations. At each location a quadrat will be used to record biophysical observations, and push cores will be used to collect sediment at three of the locations. Sediment cores will be processed on the deck of the support vessel and sent to the appropriate laboratory facilities for analysis of physical and chemical parameters, along with bioassay testing.

Benthic infauna community analysis will only be conducted during the second year of effectiveness monitoring. Here, divers can attach temporary surface buoys to the treatment and reference plot center markers so that the sediment grab sampler can be deployed. Methods for field screening and laboratory analysis are as described above (**Section 5.3.2**).

Results of the first year of effectiveness monitoring will be summarized in a short letter-style report, comparing data to baseline conditions, while results of the second year of effectiveness monitoring will be rolled into the final report.

After the second year of effectiveness monitoring is complete, the pilot study and reference site and treatment plot markers can be removed by the divers. However, PWGSC and DND may decide to maintain these for potential future monitoring.

5.3.5 Determination of Pilot Study Effectiveness Report

Once the analytical results for the second year of effectiveness monitoring have been received (approximately 2-3 months following fieldwork), the data for pre-treatment baseline conditions and the two years of effectiveness monitoring can be compiled, analyzed and a final report for the pilot study project compiled.

Results will be used to determine whether there are any significant differences in wood waste by-product levels (i.e. TOC, ammonia, sulphides), bioassay toxicity results, and benthic infauna community structure between the three treatment types and the reference location. This will aid in the determination of which treatment type was most effective for the restoration of a productive benthic community. Based on the outcome, recommendations will be made for the remediation of the discontinuous and/or shallow areas of wood-waste deposits within Esquimalt Harbour.

5.4 COST ESTIMATE

Given the level of information available for basic scoping of the pilot study permitting, phased design implementation, and determination of effectiveness, a detailed, but not definitive, cost estimate is provided. The total estimated cost for the pilot study project implementation is **$3,132,020.00,** plus applicable taxes, with a breakdown of totals by year provided in **Table 5.2** below and the detailed cost estimate breakdown included in **Appendix J: Detailed Pilot Project Cost Estimate**.

Table 5.2 Pilot Study Project Cost Estimate Totals by Year

Category	Cost
Year 1: Finalized Site Selection and Regulatory Requirements	$ 21,581.00
Year 2: Pilot Setup, Baseline Conditions, Application of Treatments	$ 2,712,523.00
Year 3: Effectiveness Monitoring Year 1	$ 164,298.00
Year 4: Effectiveness Monitoring Year 2 and Determination of Effectiveness	$ 233,618.00
Total Pilot Study	**$ 3,132,020.00**

Assumptions and notes on the cost estimate:

- Cost estimate currently includes pricing for the implementation of the pilot study at one study site. It is noted that additional sites would improve the margin of error
- Dredgeate volume is assumed to be approximately 400 m^3 – based on three, 20 m diameter dredge treatment plots are dredged to approximately 0.4 m depth. Once the pilot study site has been selected, and baseline conditions collected, the total dredge volume can be more accurately determined
- Cost estimate is based on disposal of dredgeate at a Vancouver-Island based facility.
- The weight of dredged sediments is assumed to be 2000 kg/1 m^3 and based the cost of upland disposal on the cost of drill cutting sediments disposed of following Field Survey 6 ($1.86/kg). Physical stabilization of sediments may be required, and the upland facility may not accept cut logs within the dredgeate.
- The dredging costs will vary with contractor, equipment type, and study site depths (greater depths will take longer to dredge and backfill)
- Cost estimate assumes that approximately 600 m^3 of clean fill will be required – based on 190 m^3 to place 15-20 cm of sand across the three ENR treatment plots, and 400 m^3 of fill to backfill the dredged treatment plots.

6.0 PUBLICATION RECOMMENDATIONS

The publication of wood waste assessment and remediation case studies contributes to the working knowledge of the success of wood waste remediation and provides valuable information to waterlot managers in British Columbia on the regional impacts of wood waste and success of site-specific designed remediation efforts. Therefore, recommendations for the publication of assessment and remediation results have been included here for PWGSC and DND's consideration.

Given that the site characterization and assessment data is extensive, and the pilot study project has a separate objective, two or three targeted scientific publications are proposed as follows:

1. Assessment of Wood Waste Impacts to Benthic Communities within Esquimalt Harbour
2. Site-specific Effectiveness and Feasibility of Three Wood Waste Remediation Treatments on Areas of Discontinuous or Shallow Wood Waste Deposits in Esquimalt Harbour
3. Remediation of Wood Waste Impacted Sediments in Esquimalt Harbour

An initial list of suggested journals for publications has been provided in **Table 6.1** for consideration.

Table 6.1 Proposed Scientific Journals for Publication of Wood Waste Assessment and Remediation Results

Journal	Journal Scope	Notes
Marine Pollution Bulletin	Concerned with the rational use of maritime and marine resources in estuaries, the seas and oceans, as well as with documenting marine pollution and introducing new forms of measurement and analysis. Topics include effluent disposal and pollution control, but also the management, economic aspects and protection of the marine environment in general. Several different categories of articles are published, including, 'baselines' which document measurements which are expected to have value in the future.	• International • Publication fee • Open Access
Water Quality Research Journal of Canada	The Water Quality Research Journal is a forum for original research dealing with the aquatic environment and reports new and significant findings that advance the understanding of the field. General subject areas can include: Impact of current and emerging contaminants on aquatic ecosystems, Aquatic ecology, Conservation and protection of aquatic environments, Responsible resource development and water quality (mining, forestry, hydropower, oil and gas), wastewater and stormwater treatment technologies and strategies, Industrial water quality, Groundwater quality (management, remediation, fracking, legacy contaminants), Assessment of surface and subsurface water quality, Regulations, economics, strategies and policies related to water quality.	• Canadian journal - more relevant regionally. • No publication fee • Open Access (for a fee) • Easier/faster to get published
Water Environment Research	Water Environment Research is a multidisciplinary water resource management journal for the dissemination of fundamental and applied research in all scientific and technical areas related to water quality and resource recovery. Goal is to foster communication and interdisciplinary research between water sciences and related fields such as environmental toxicology, agriculture, public and occupational health, microbiology, and ecology. In addition to original research articles, short communications, case studies, reviews, and perspectives are encouraged.	• International • Engineering audience

7.0 CONCLUSIONS

We sincerely appreciate the opportunity to have assisted you with this project and if there are any questions, please do not hesitate to contact the undersigned by phone at 604.669.0424.

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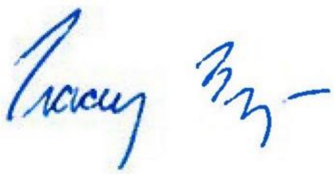

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APPENDIX A
Aerial Photos


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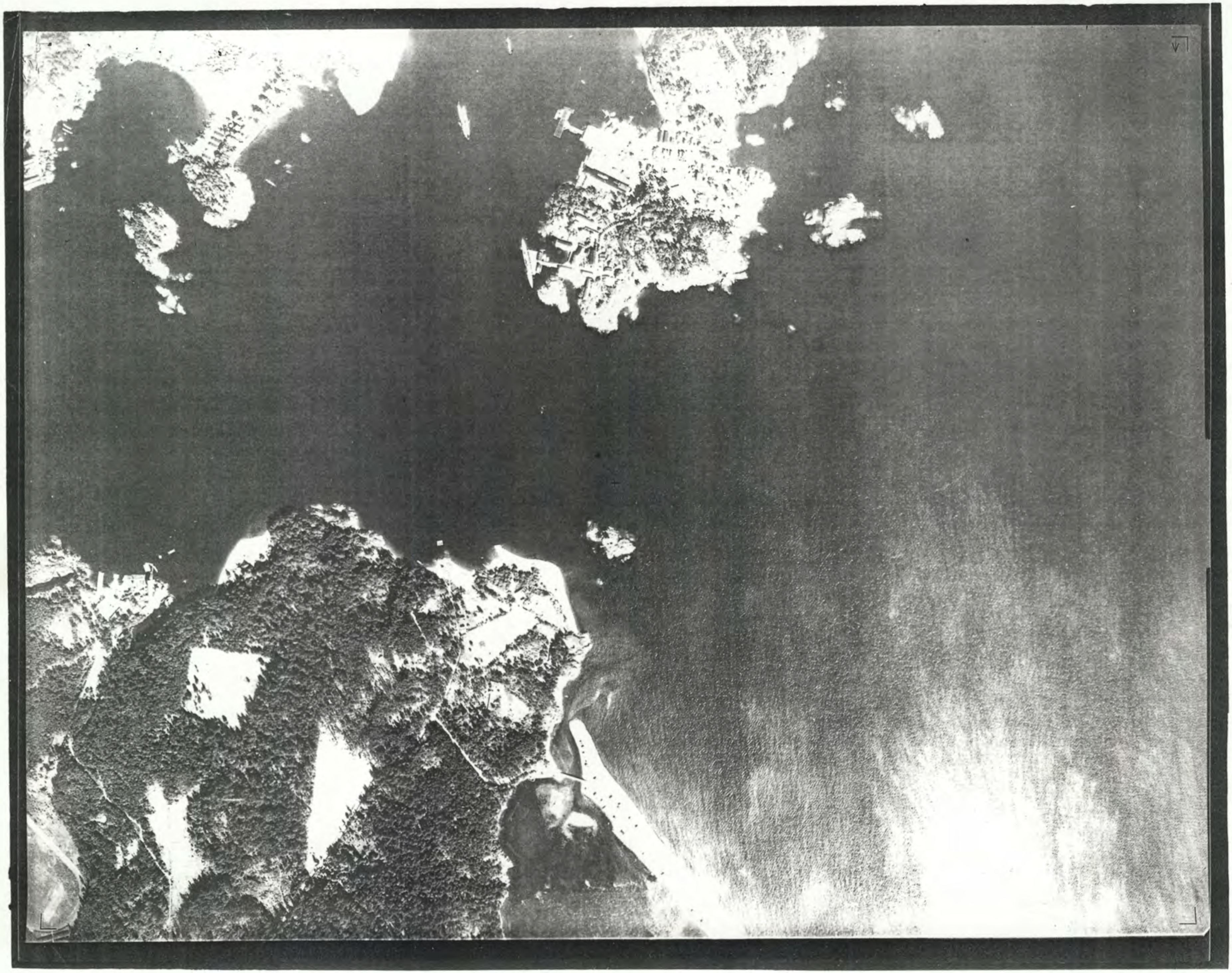


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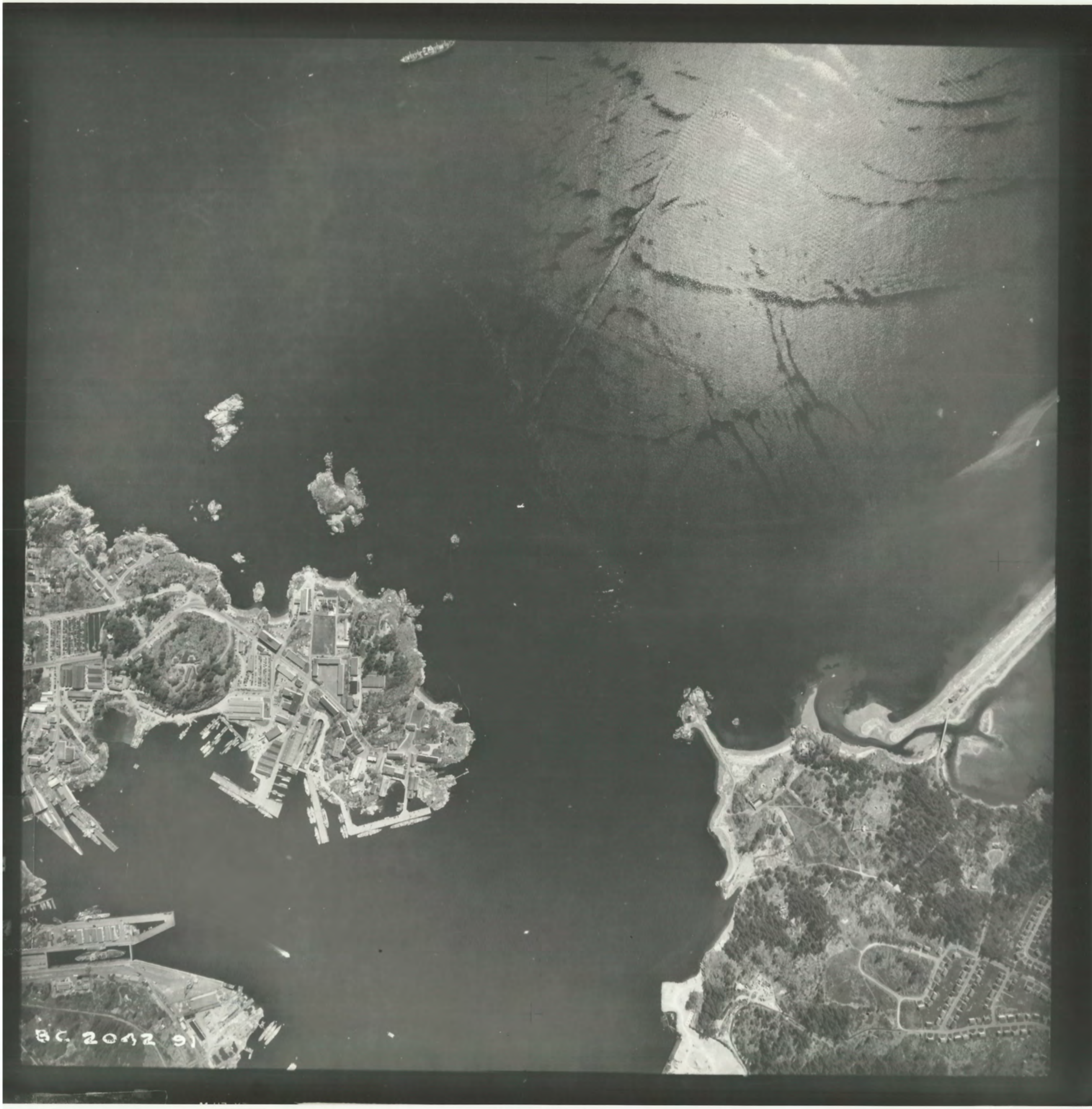
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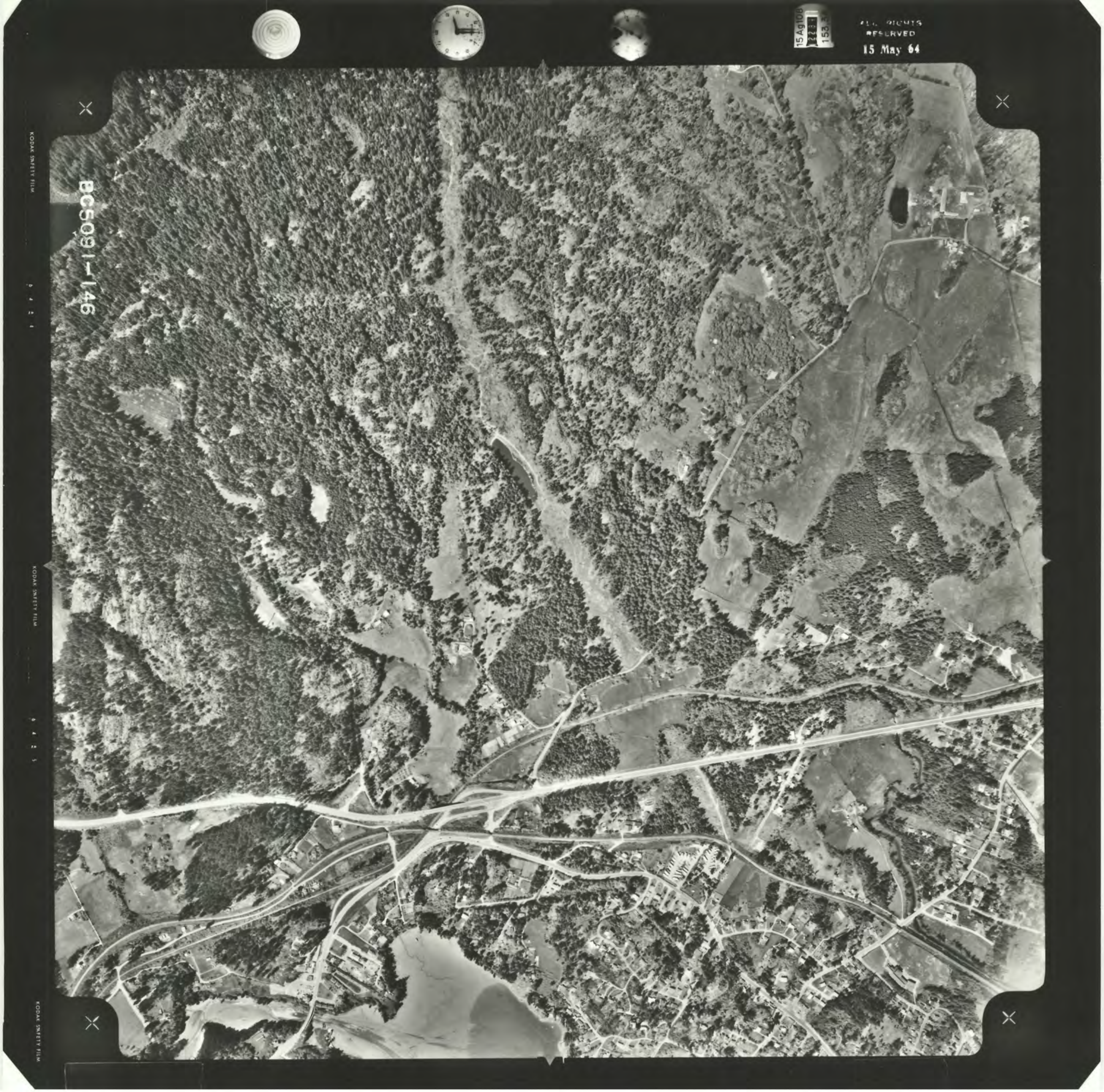

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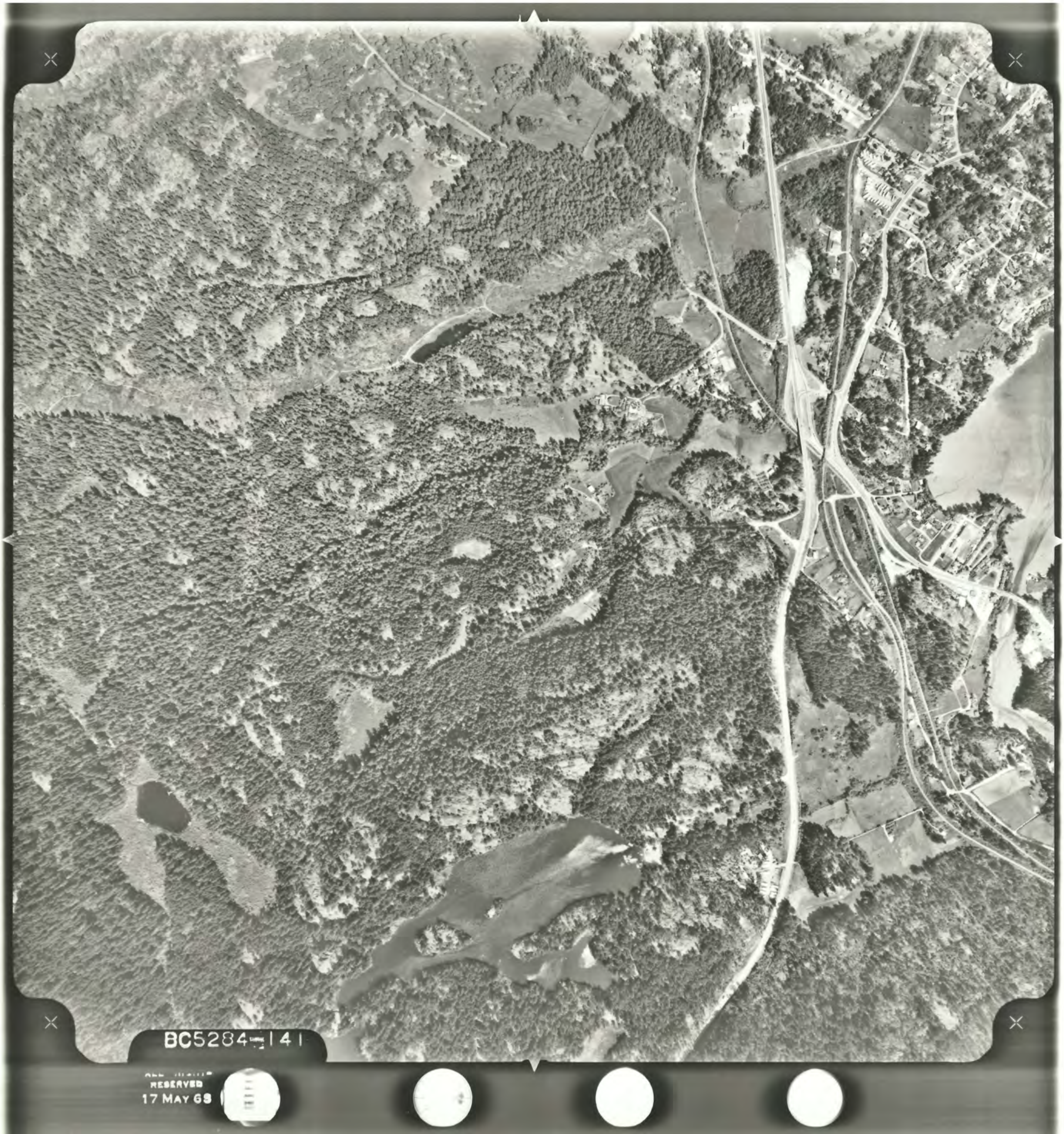
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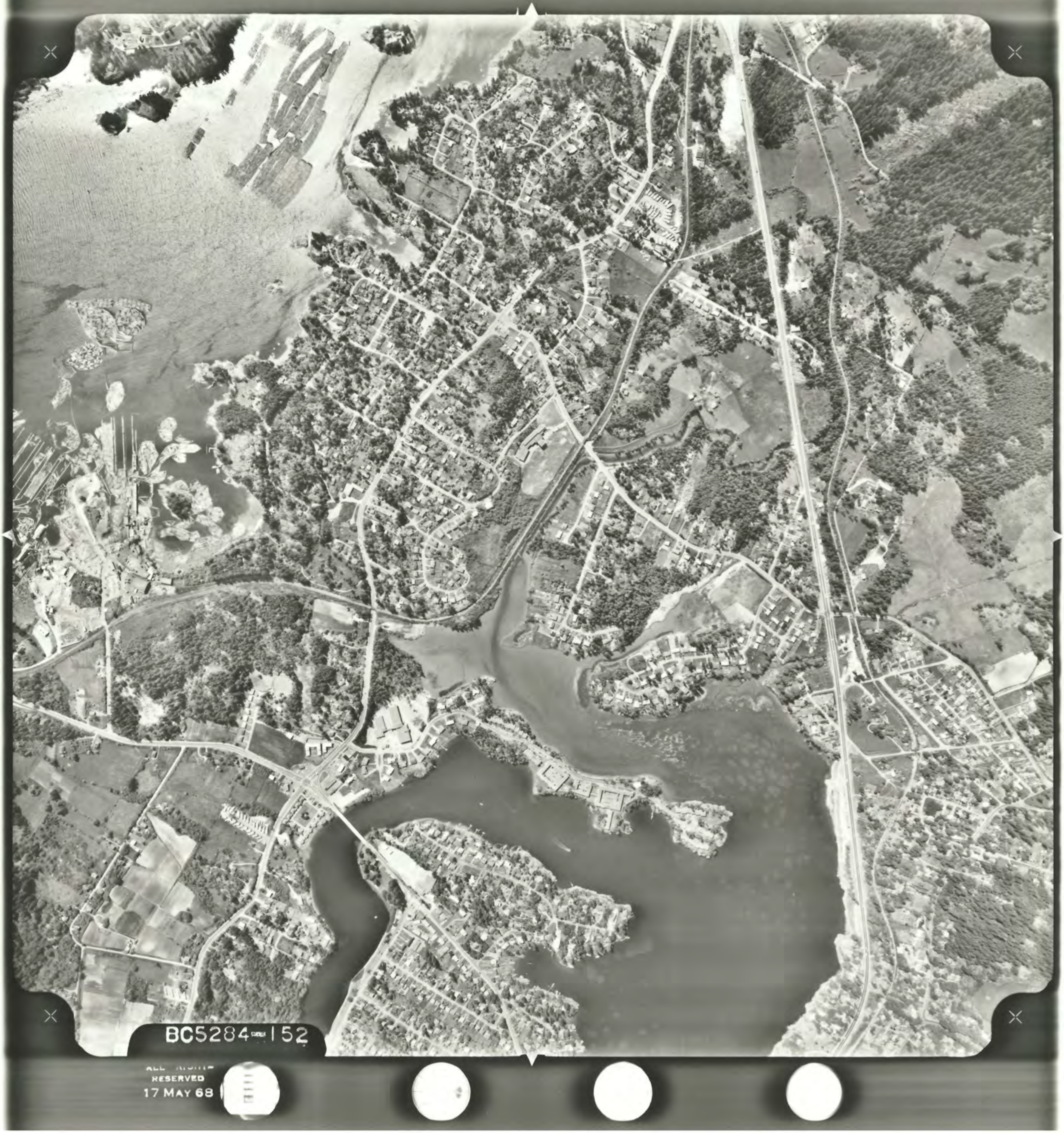
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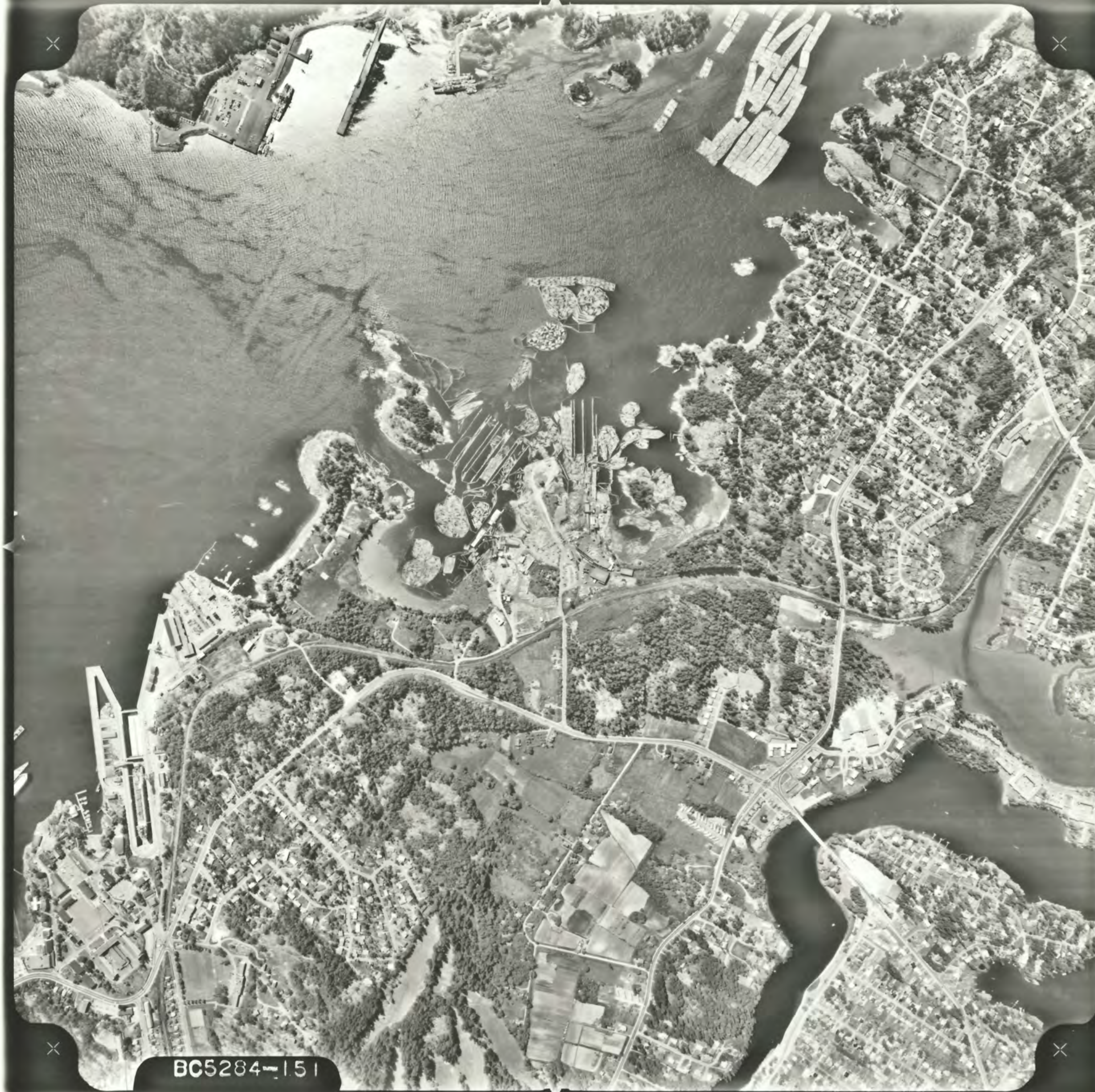
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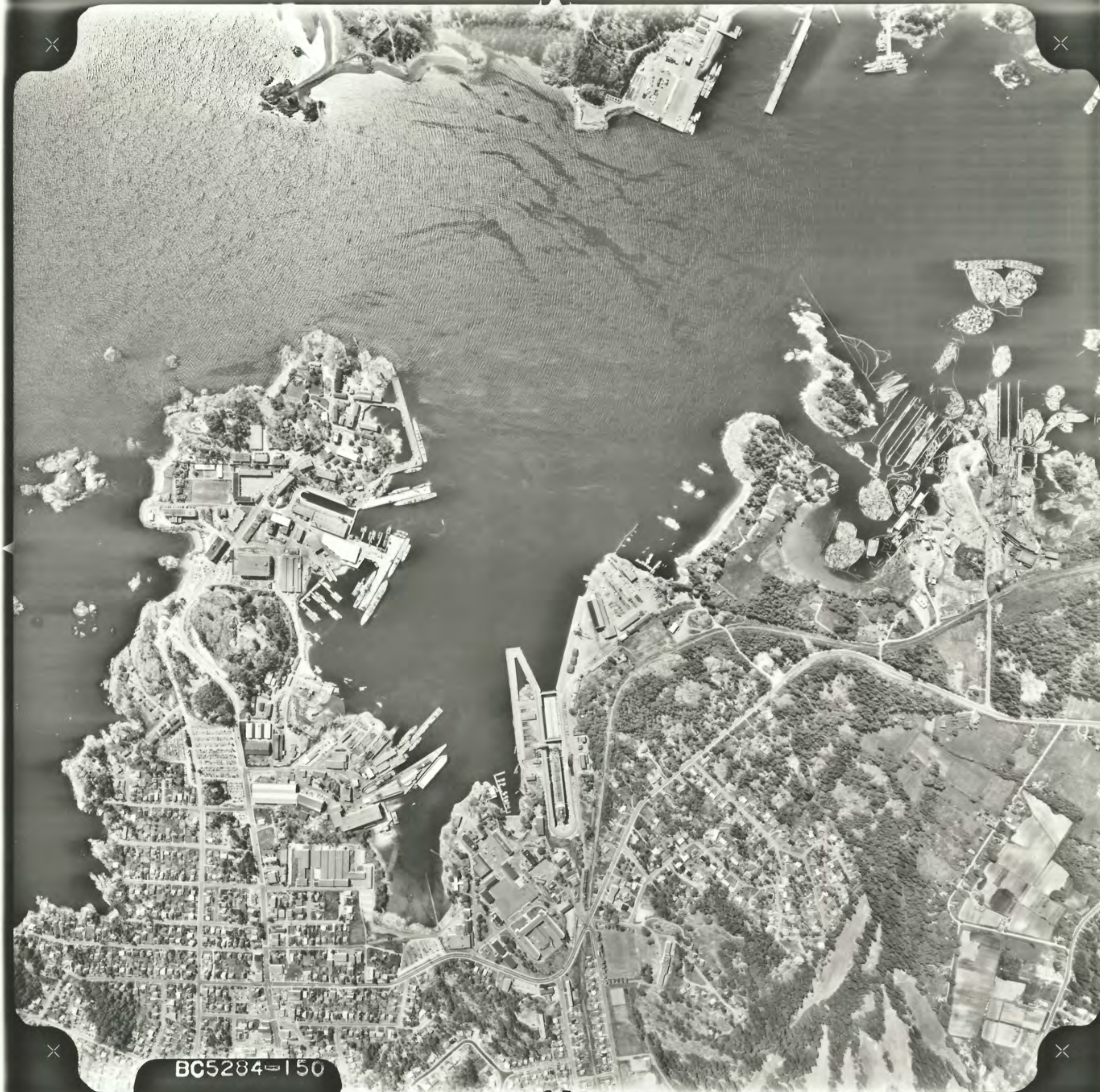

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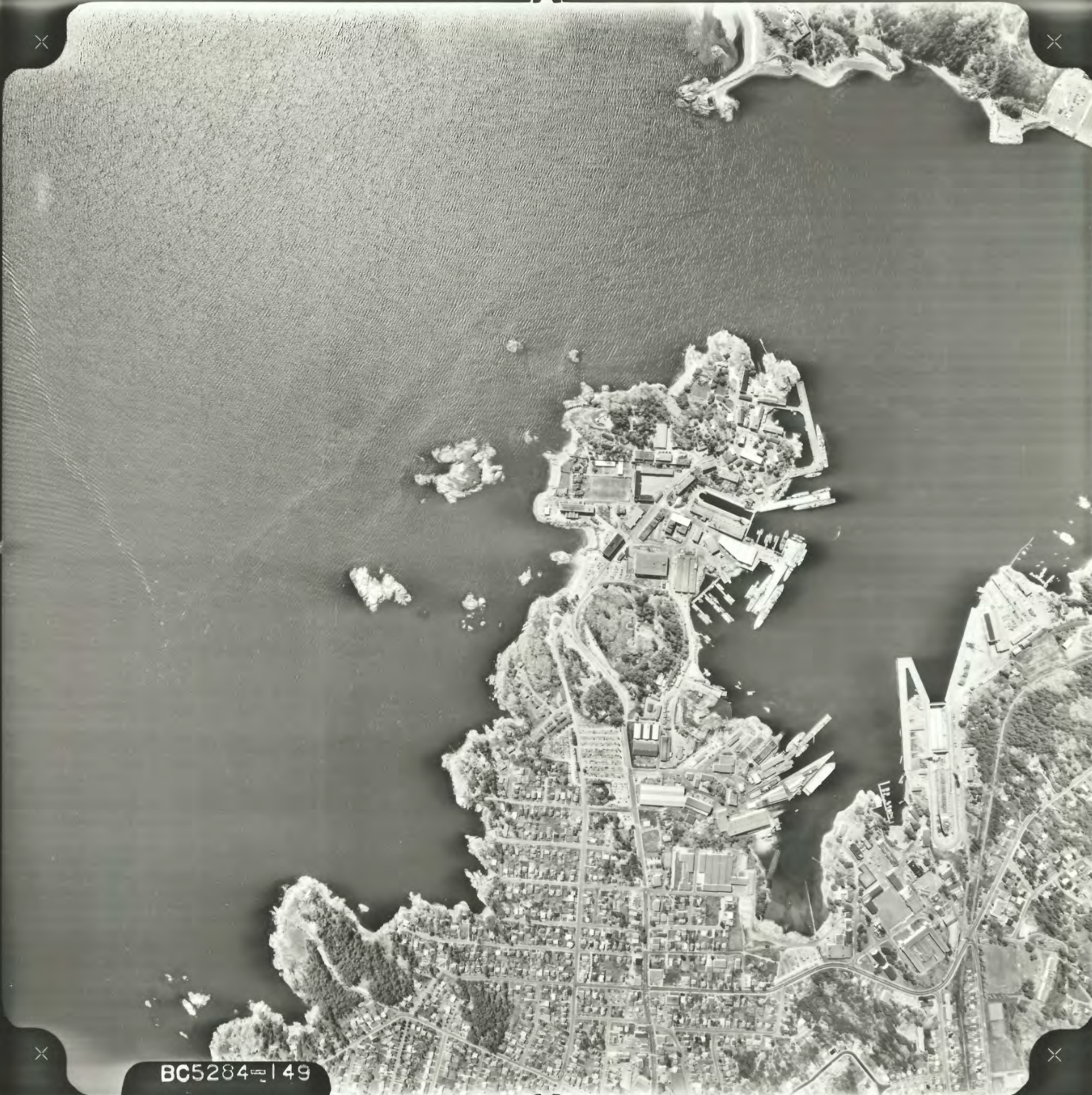

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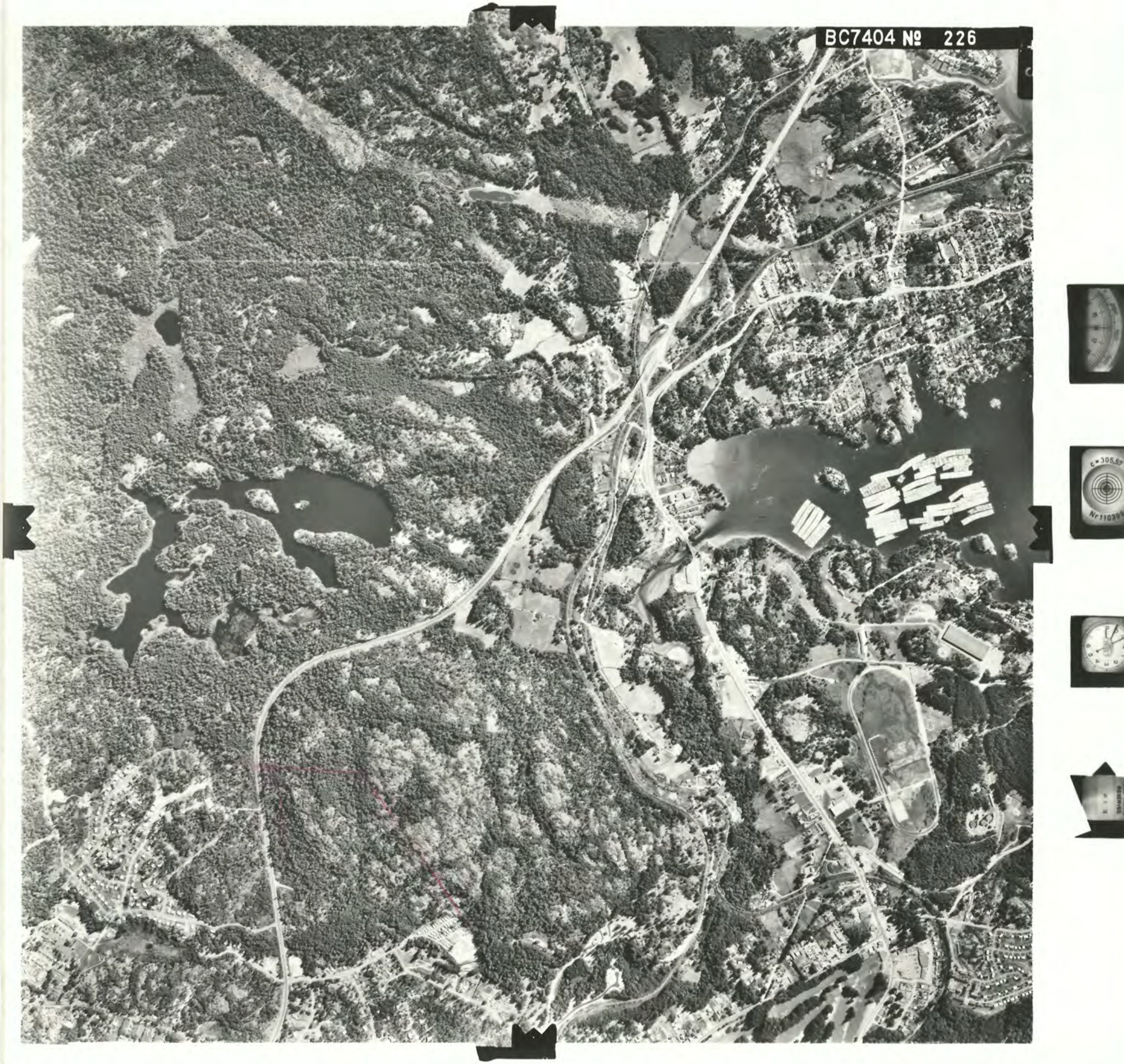
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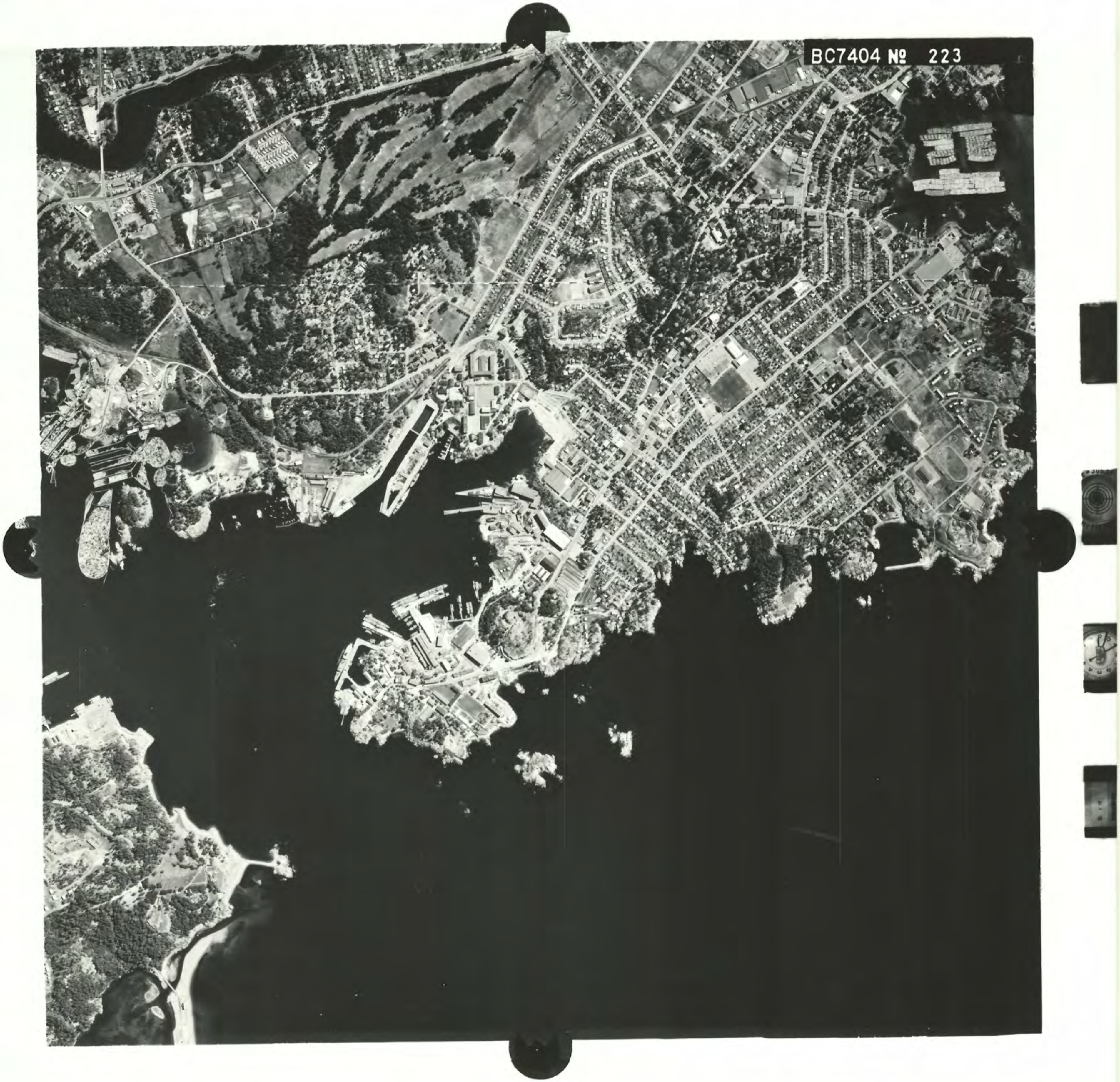
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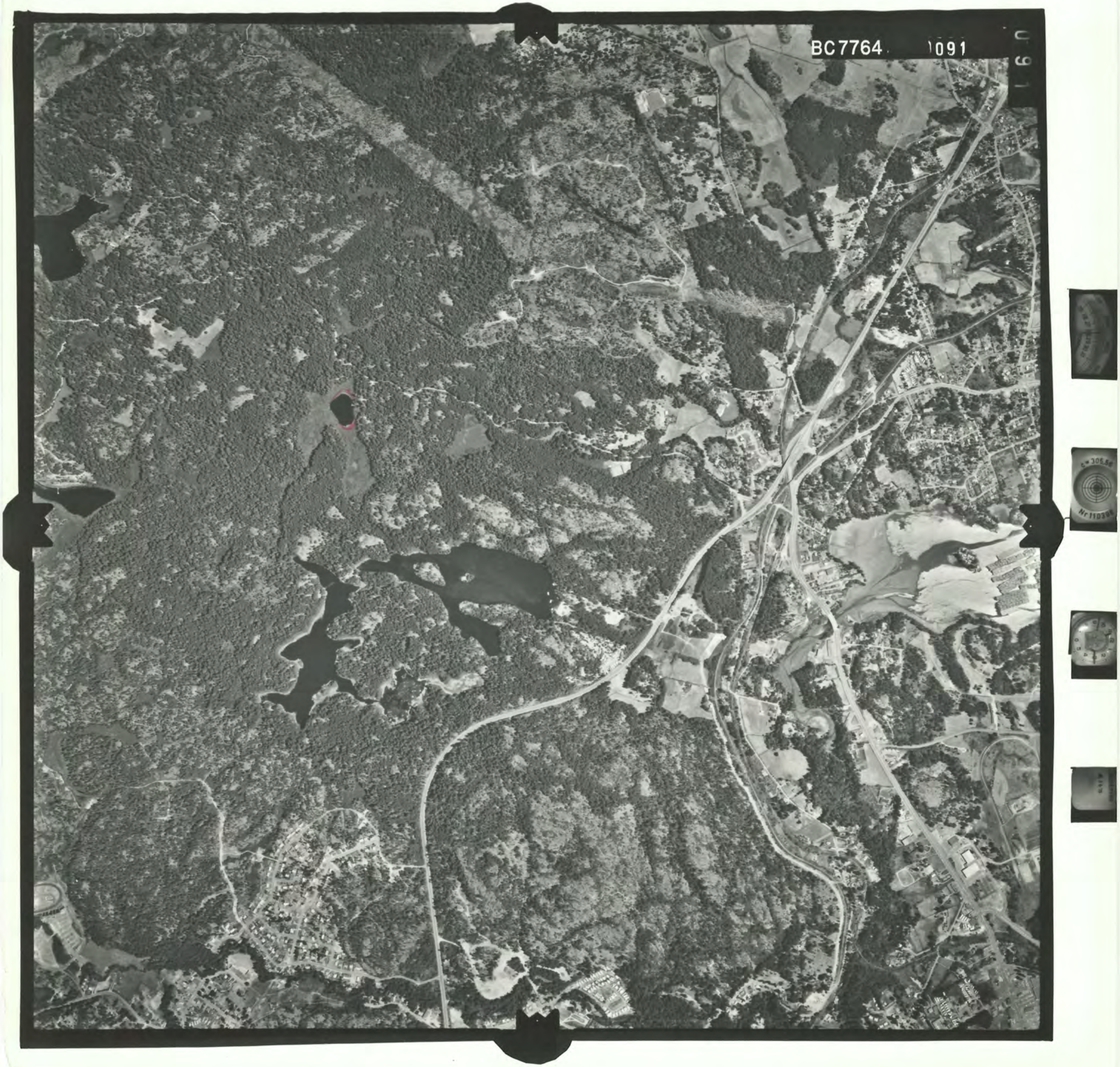
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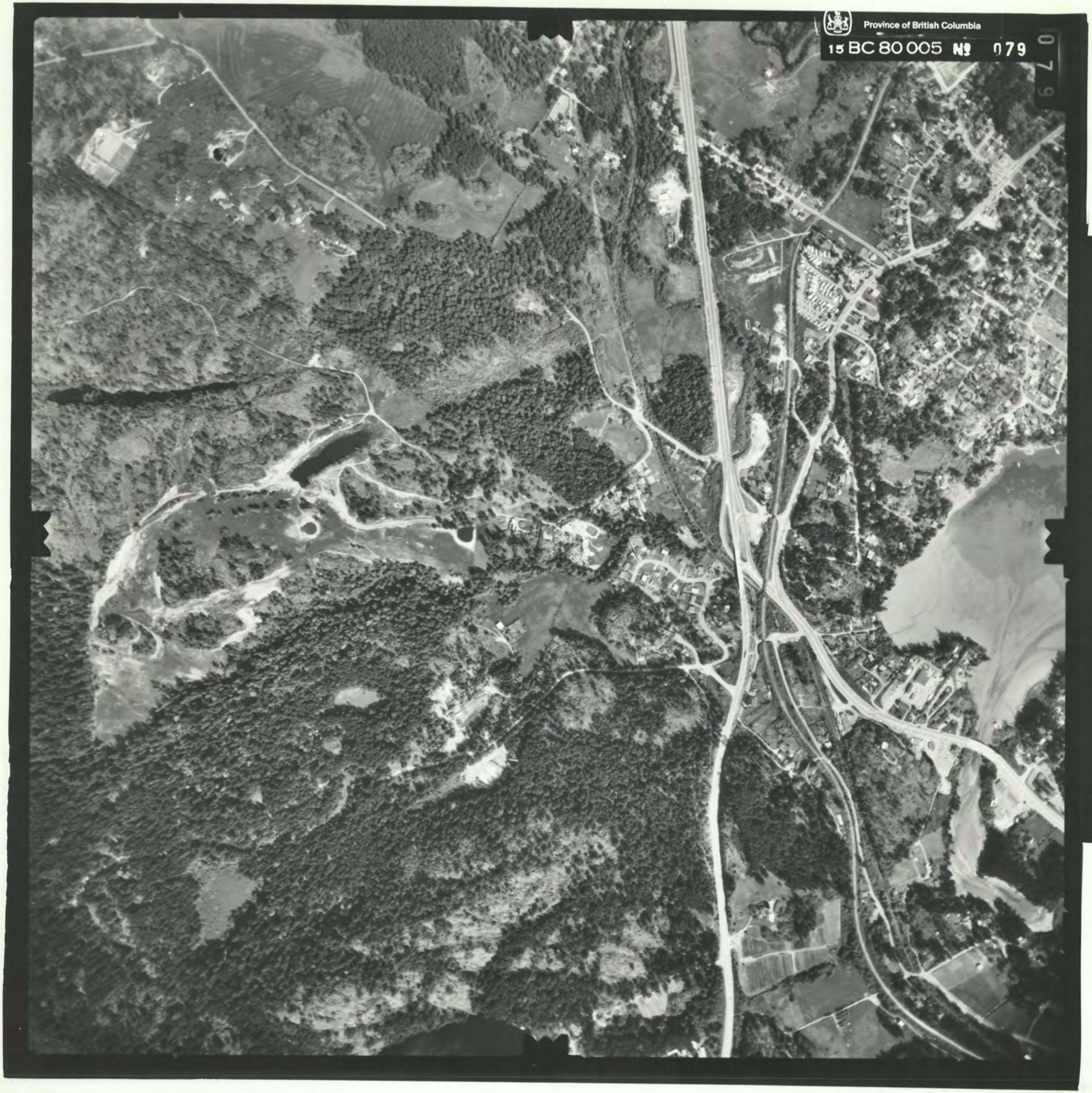
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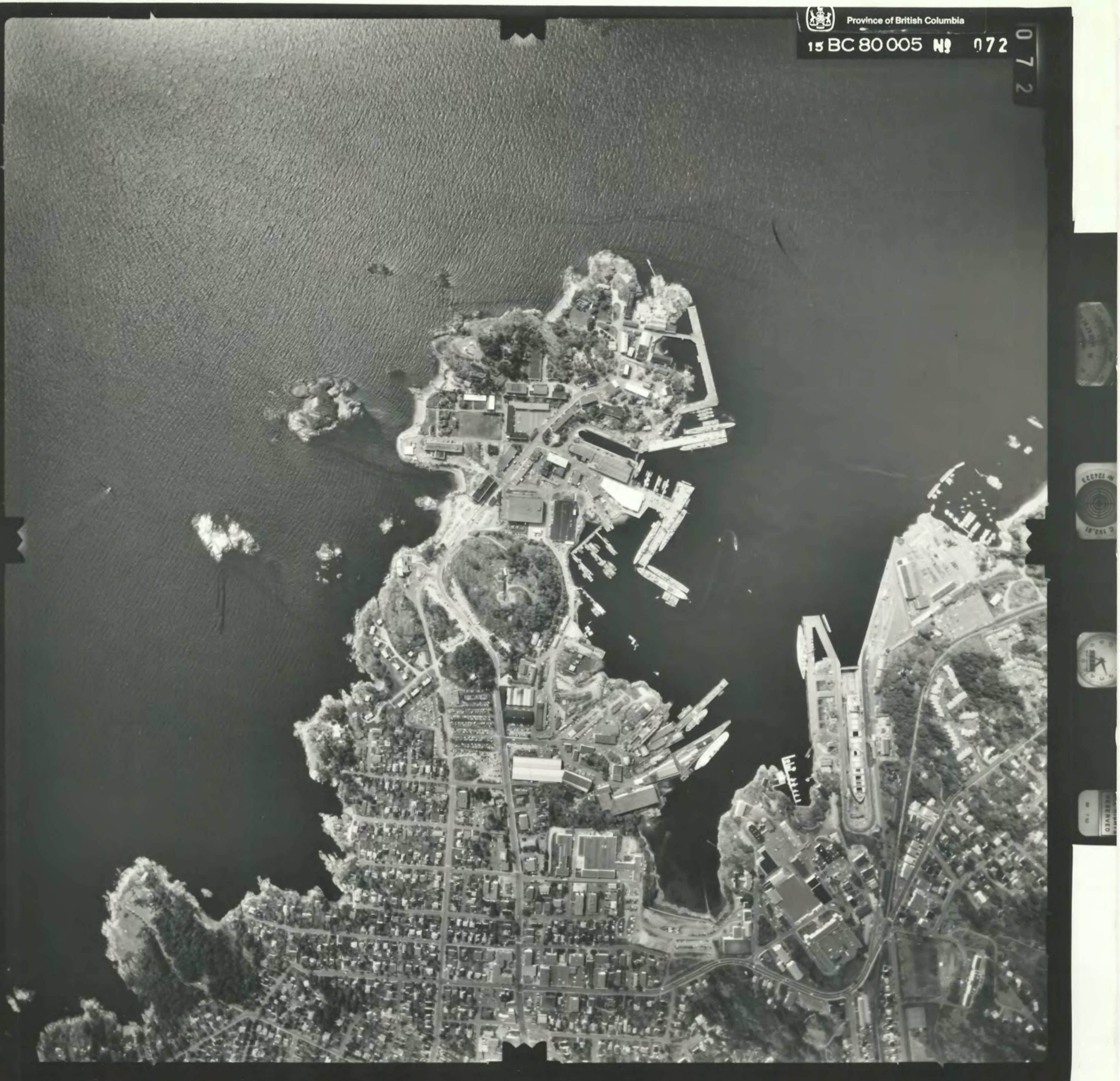
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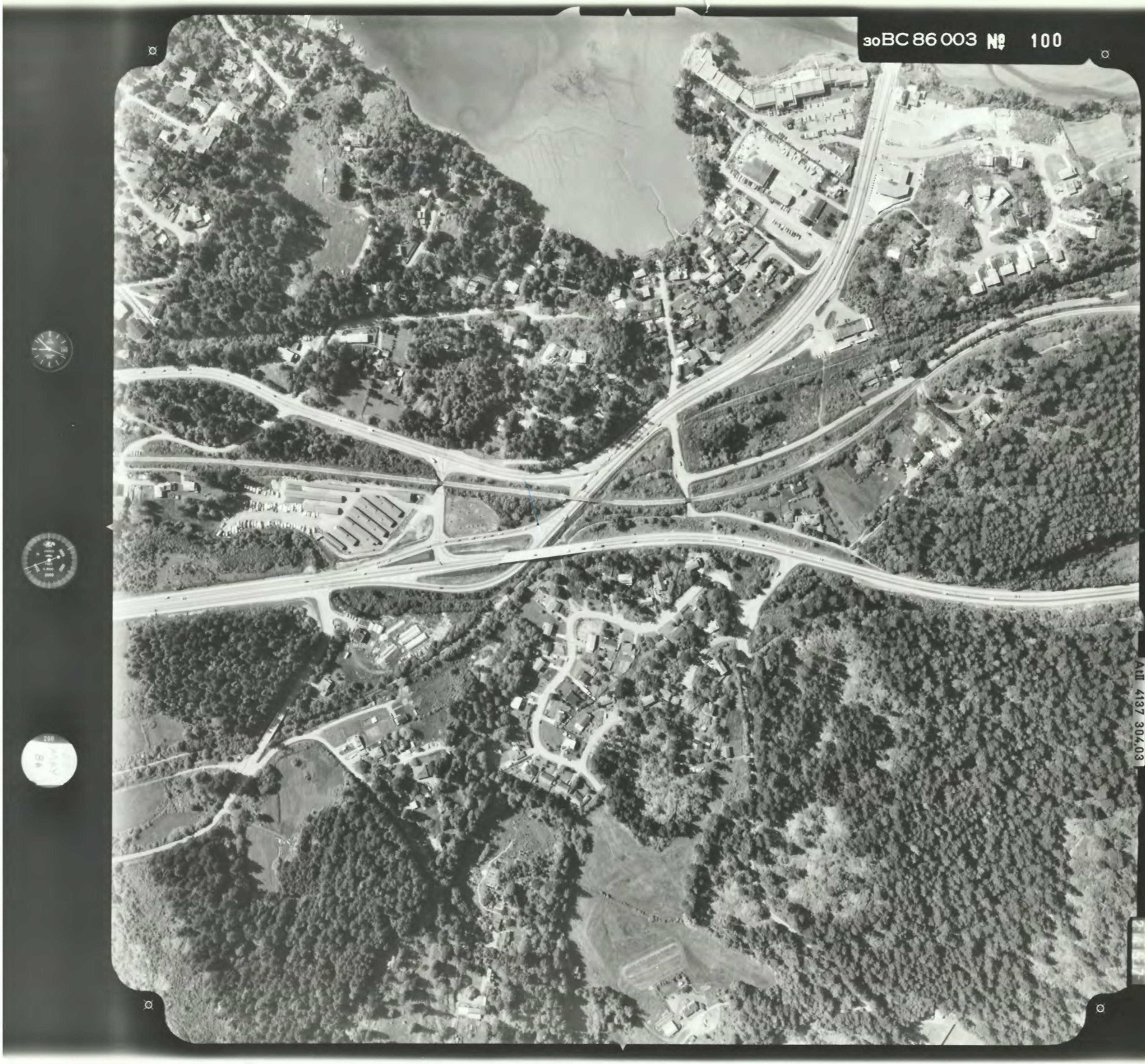
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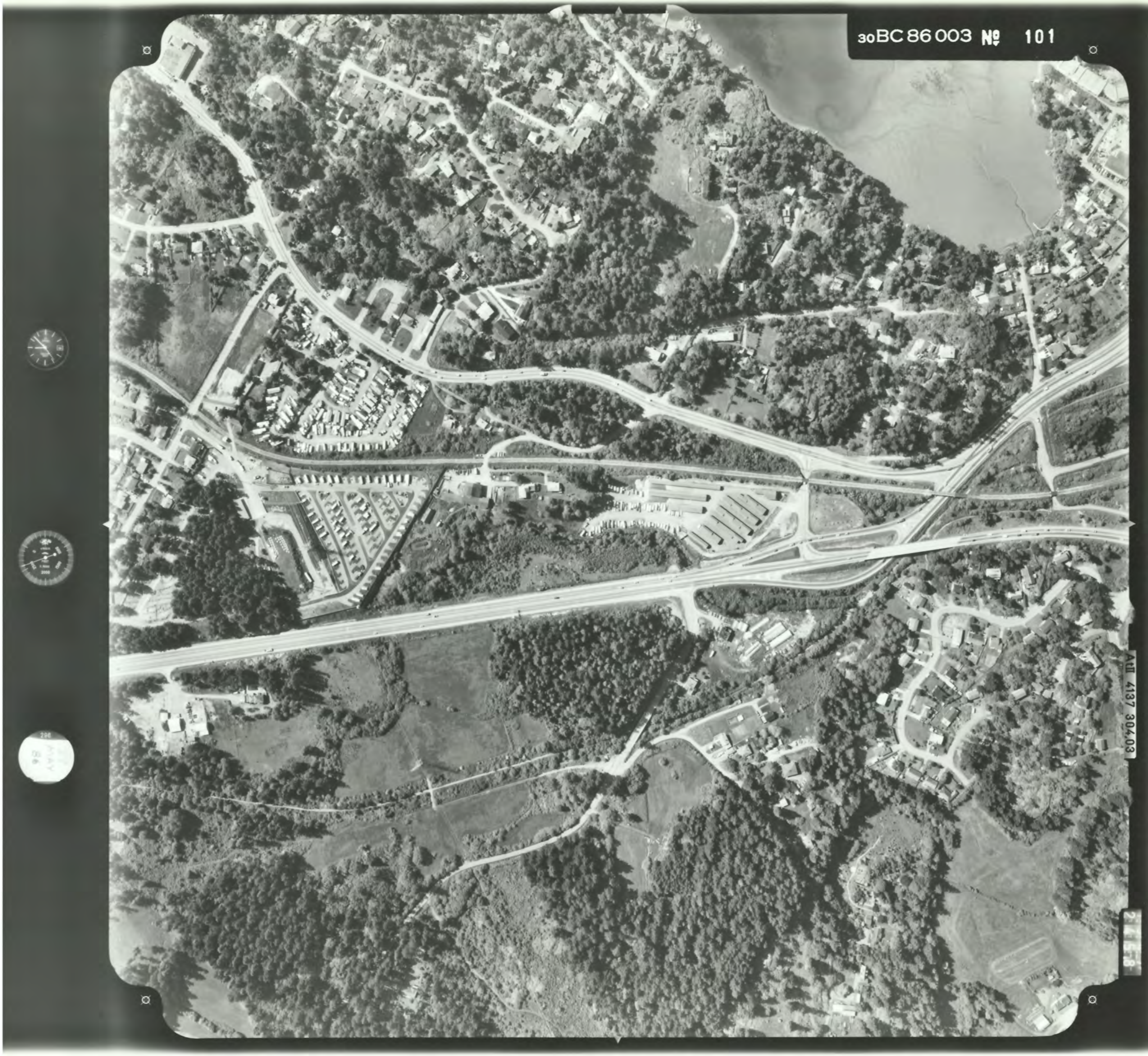
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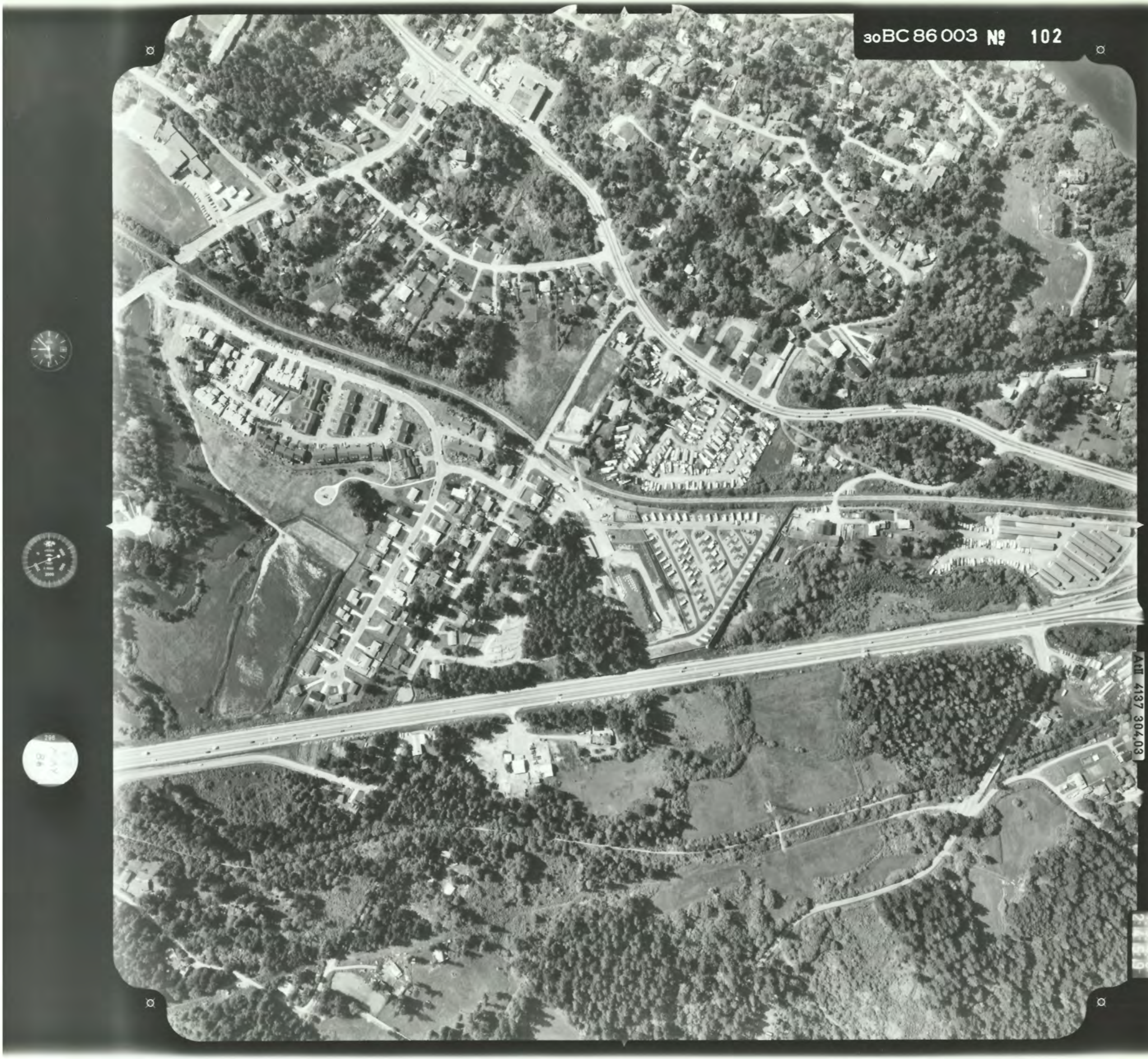
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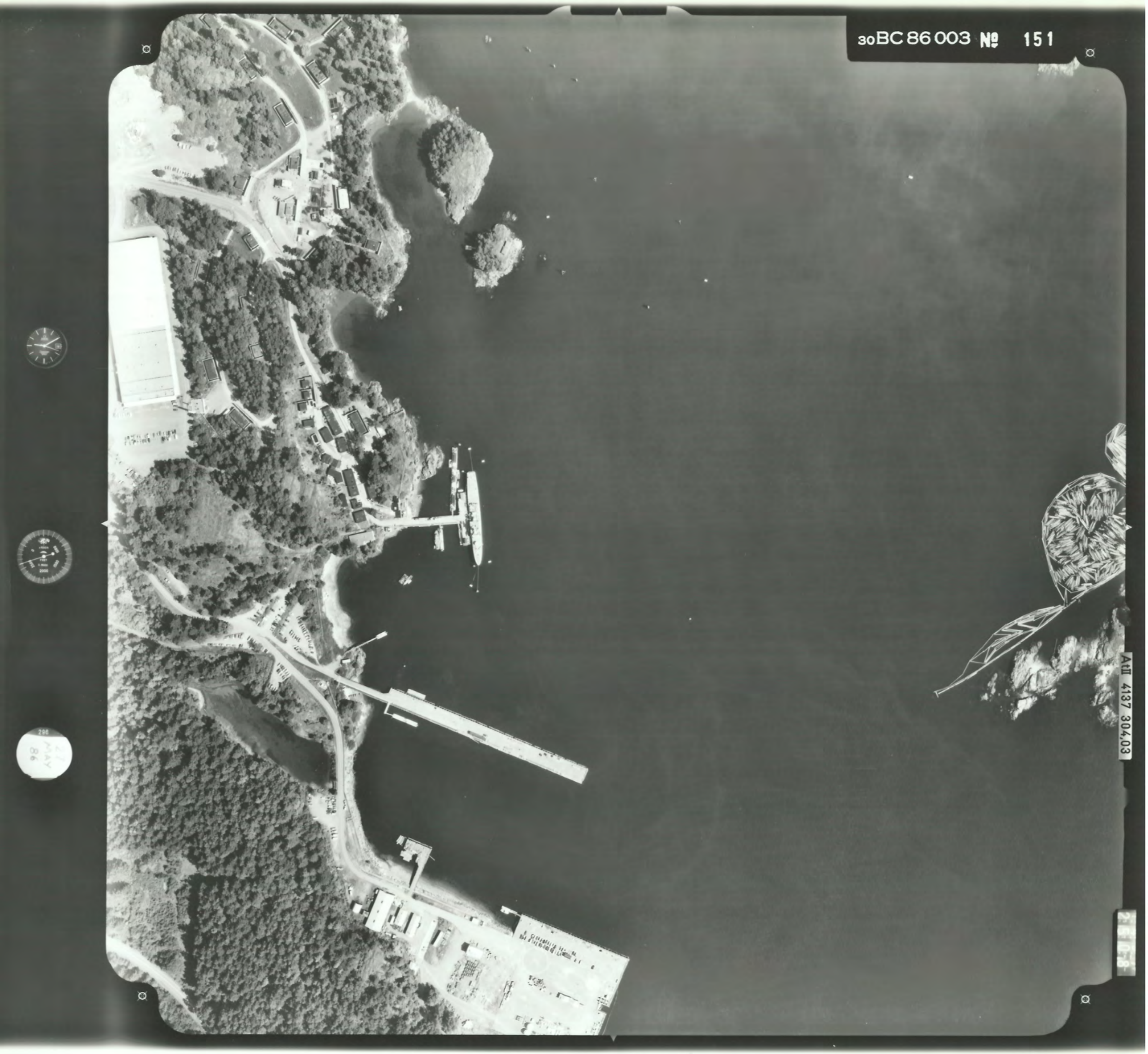

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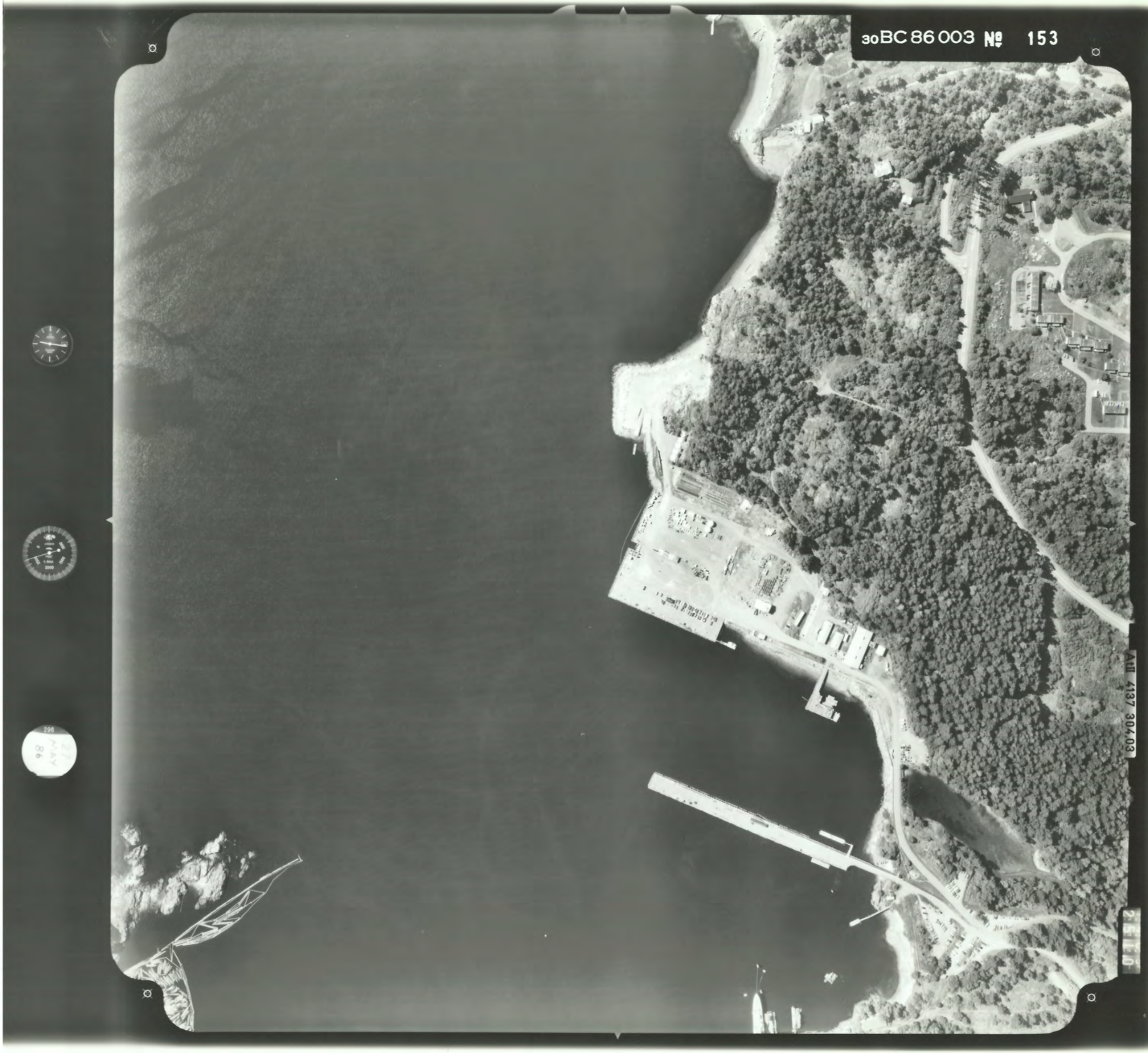
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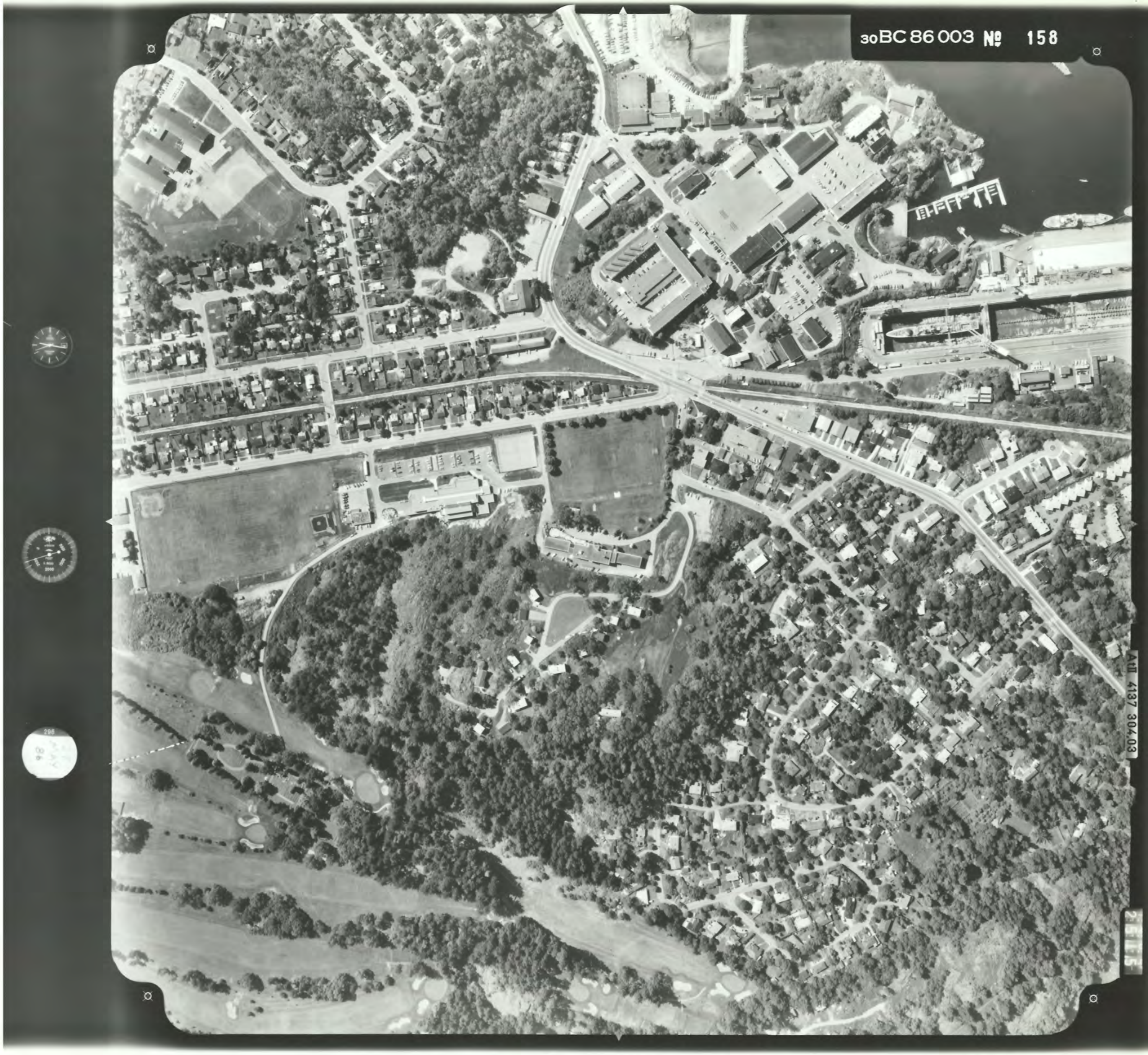
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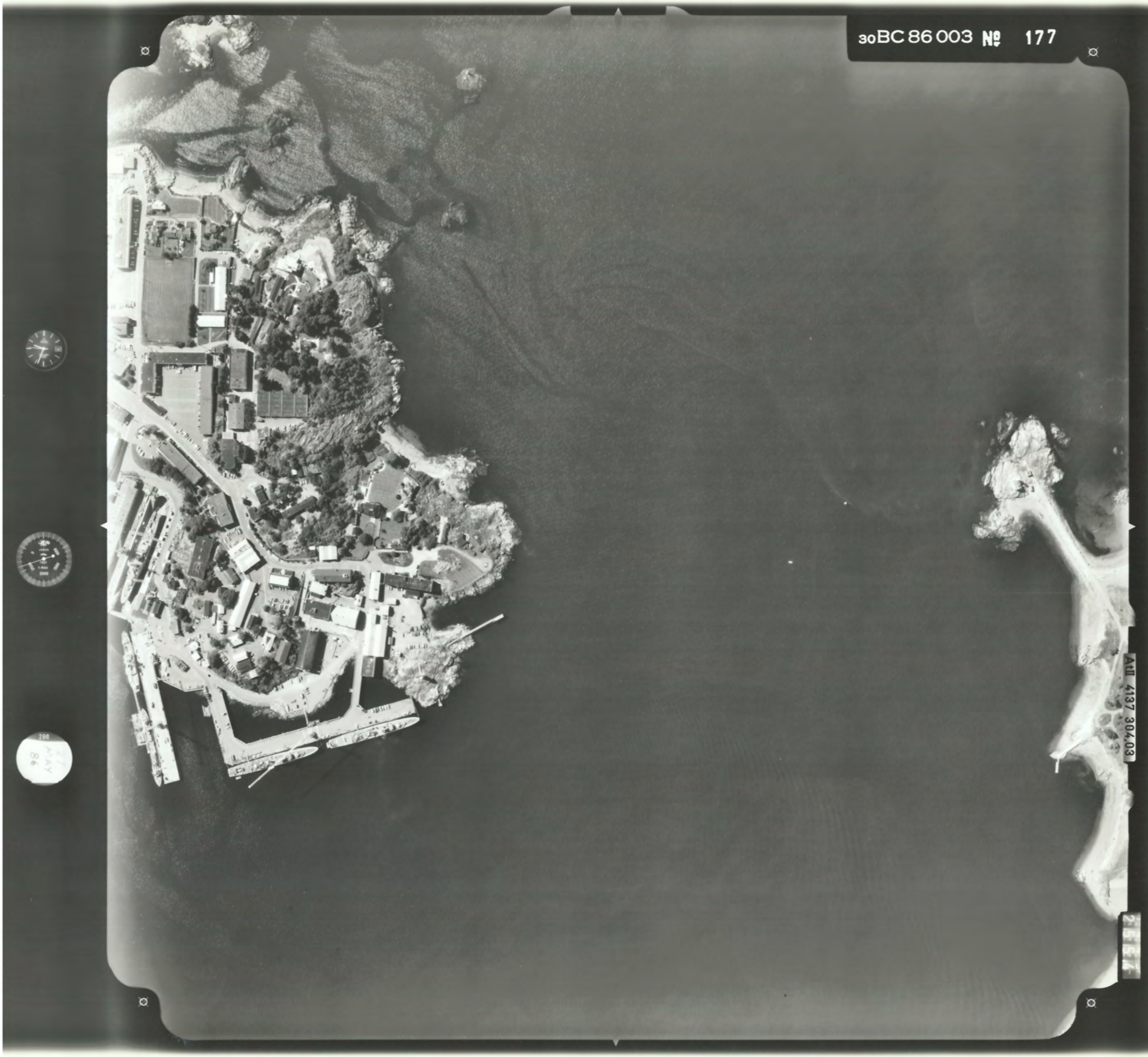
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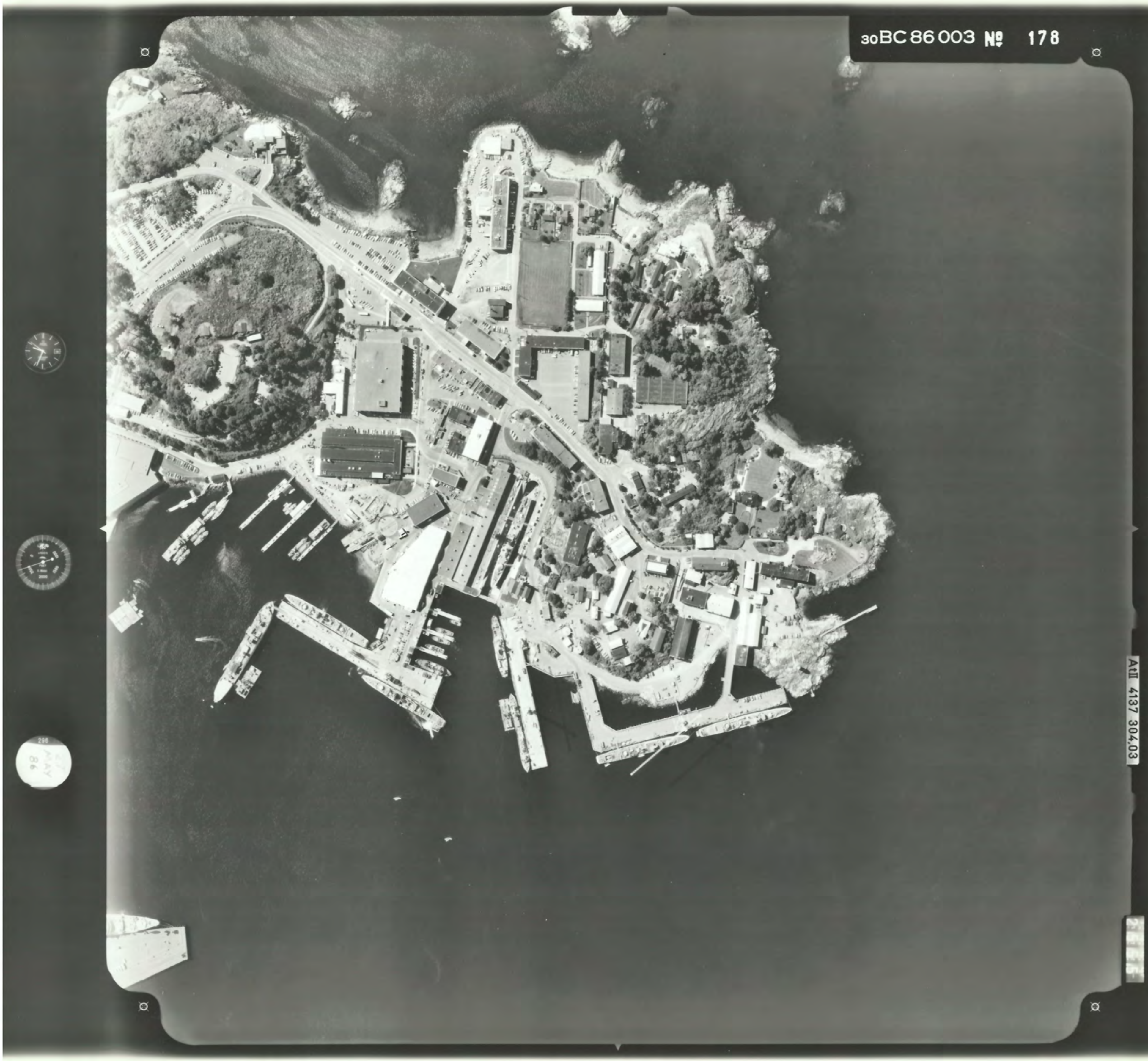
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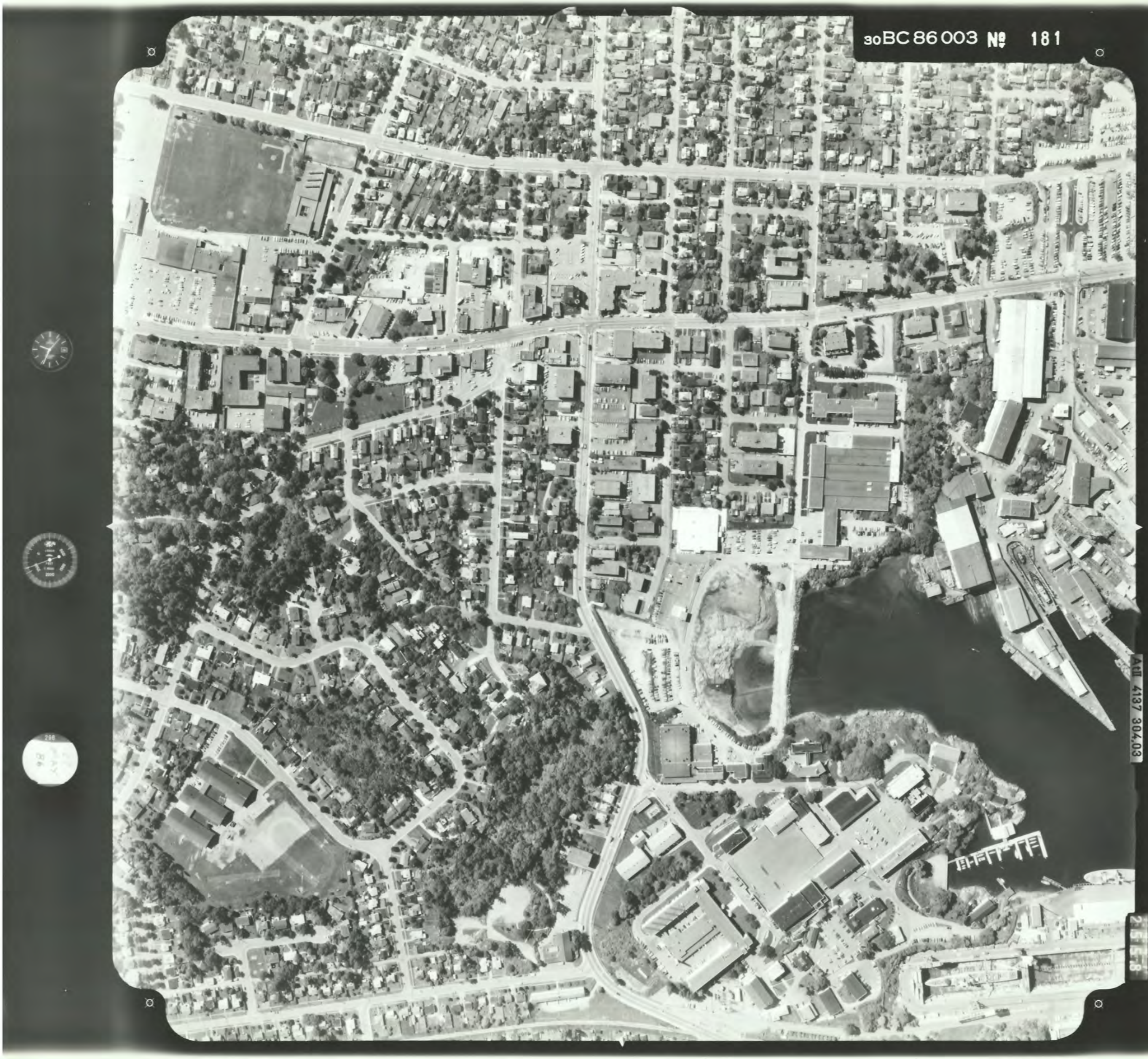
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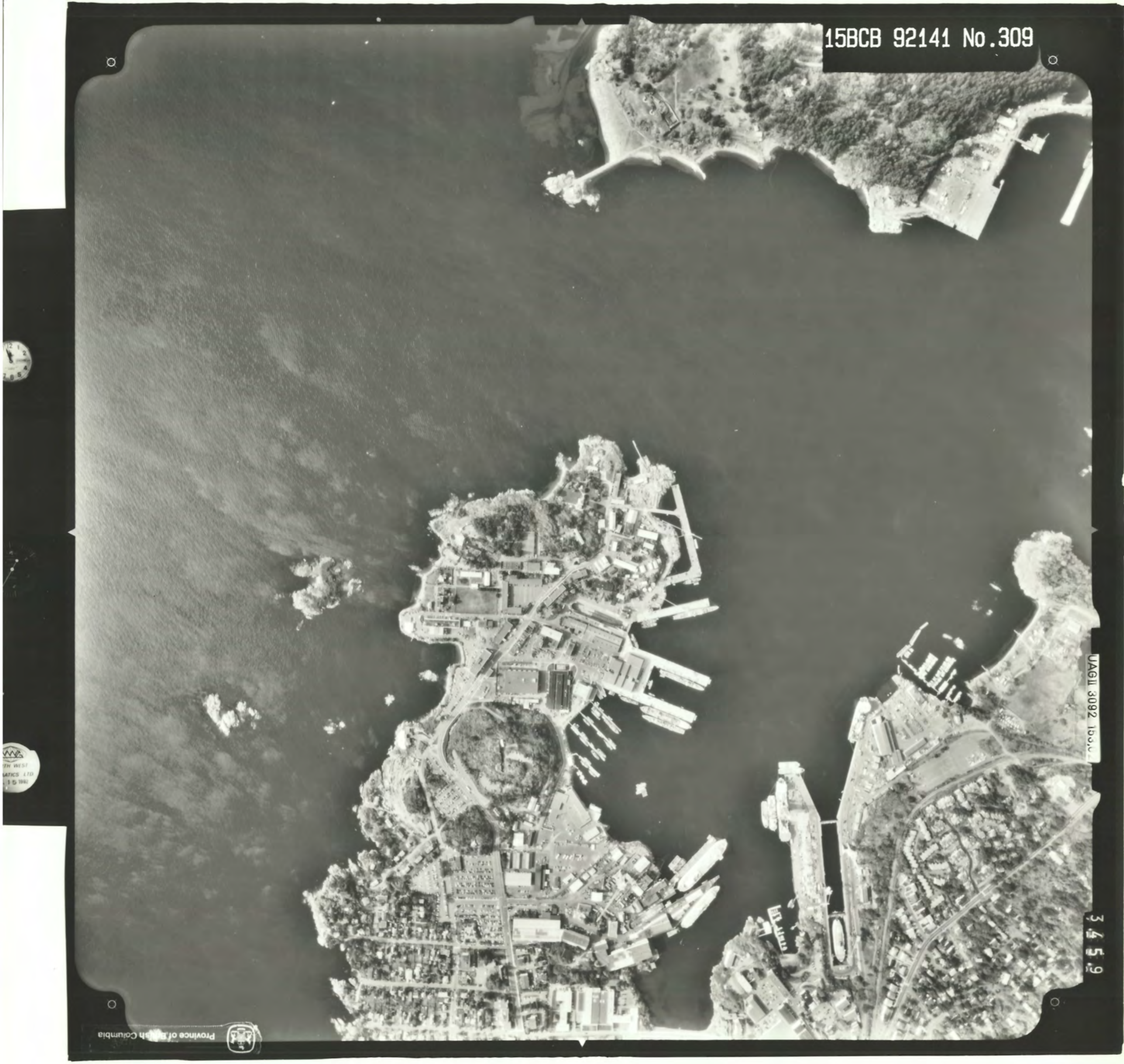
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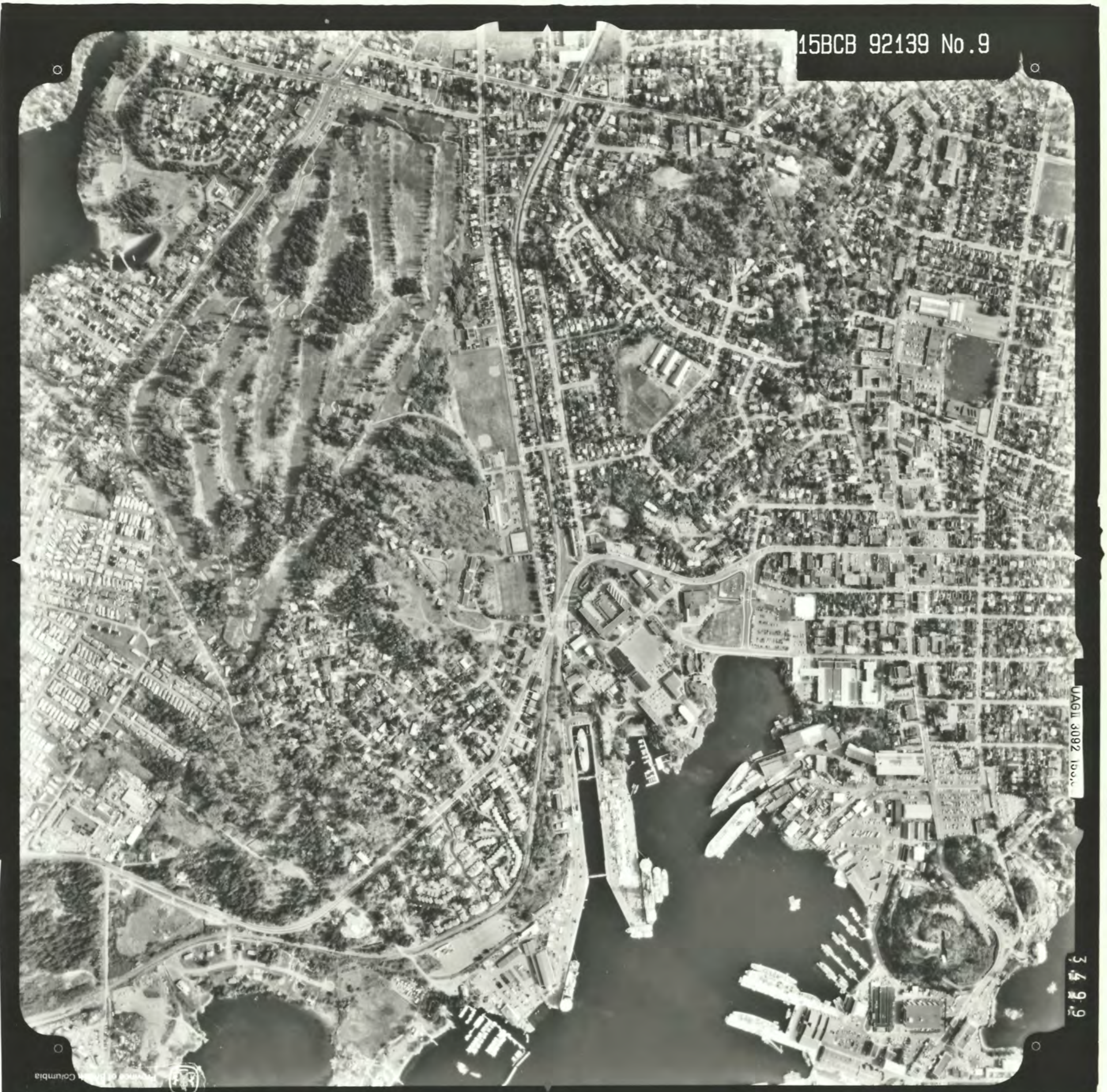
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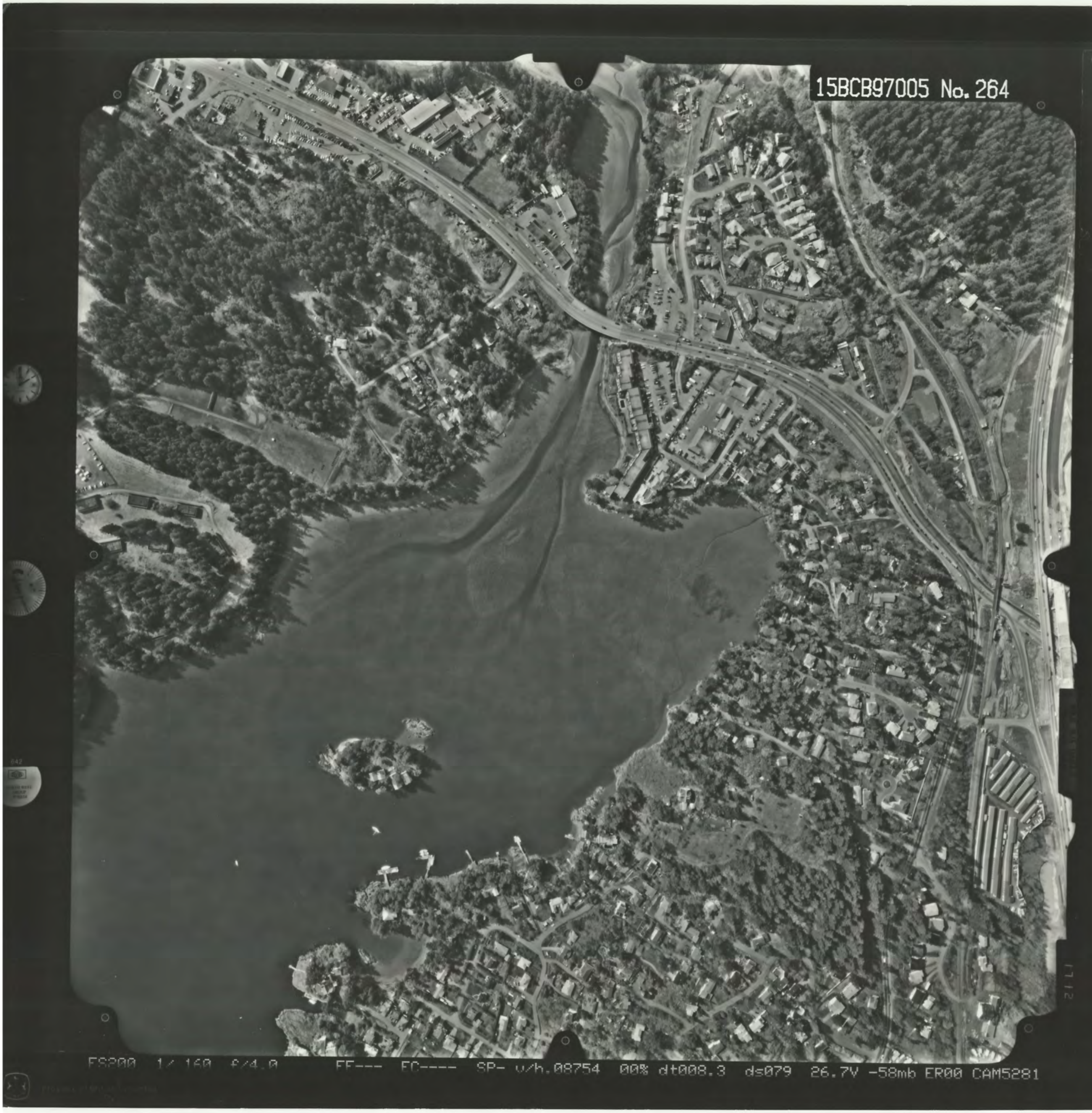
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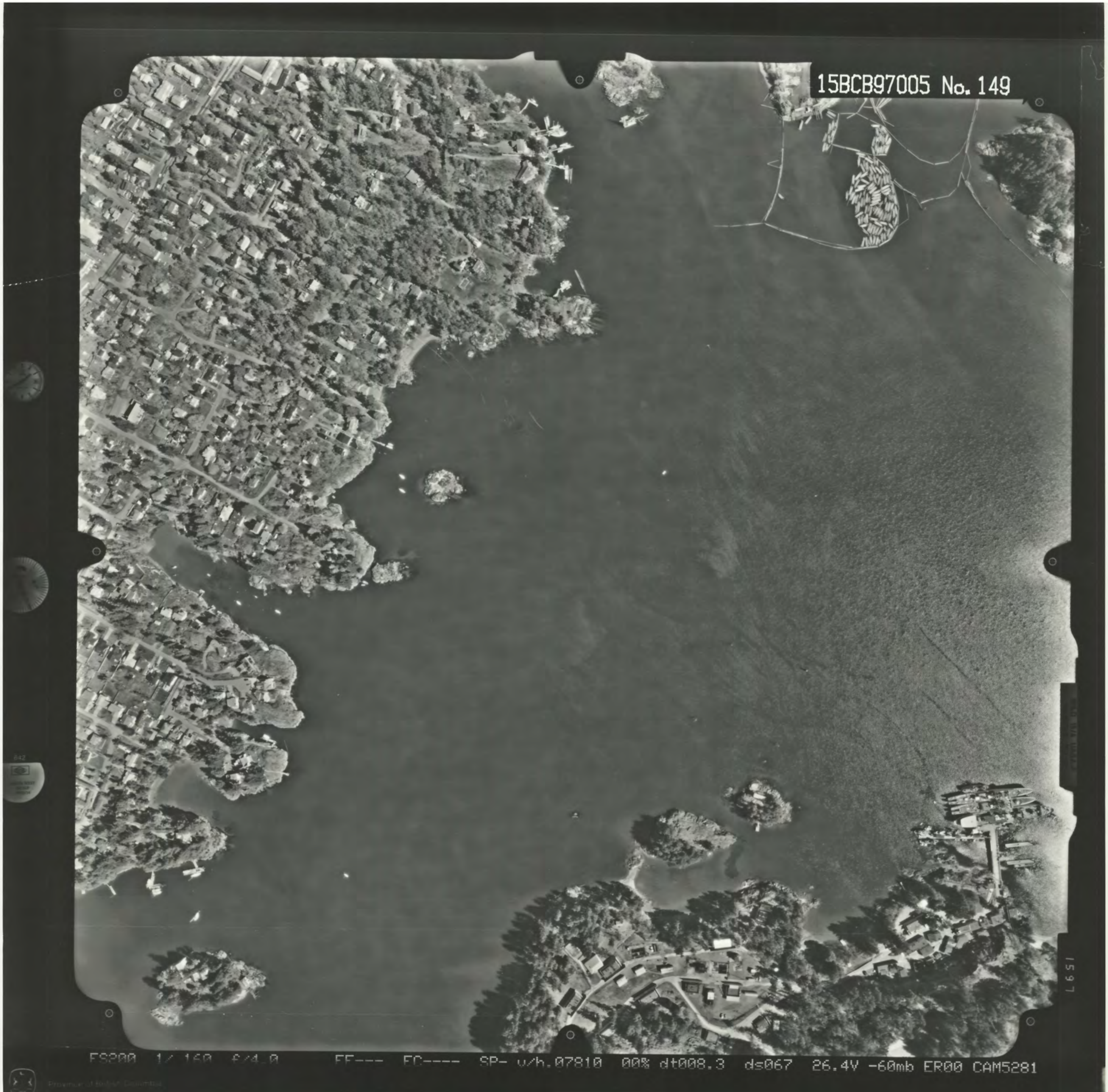
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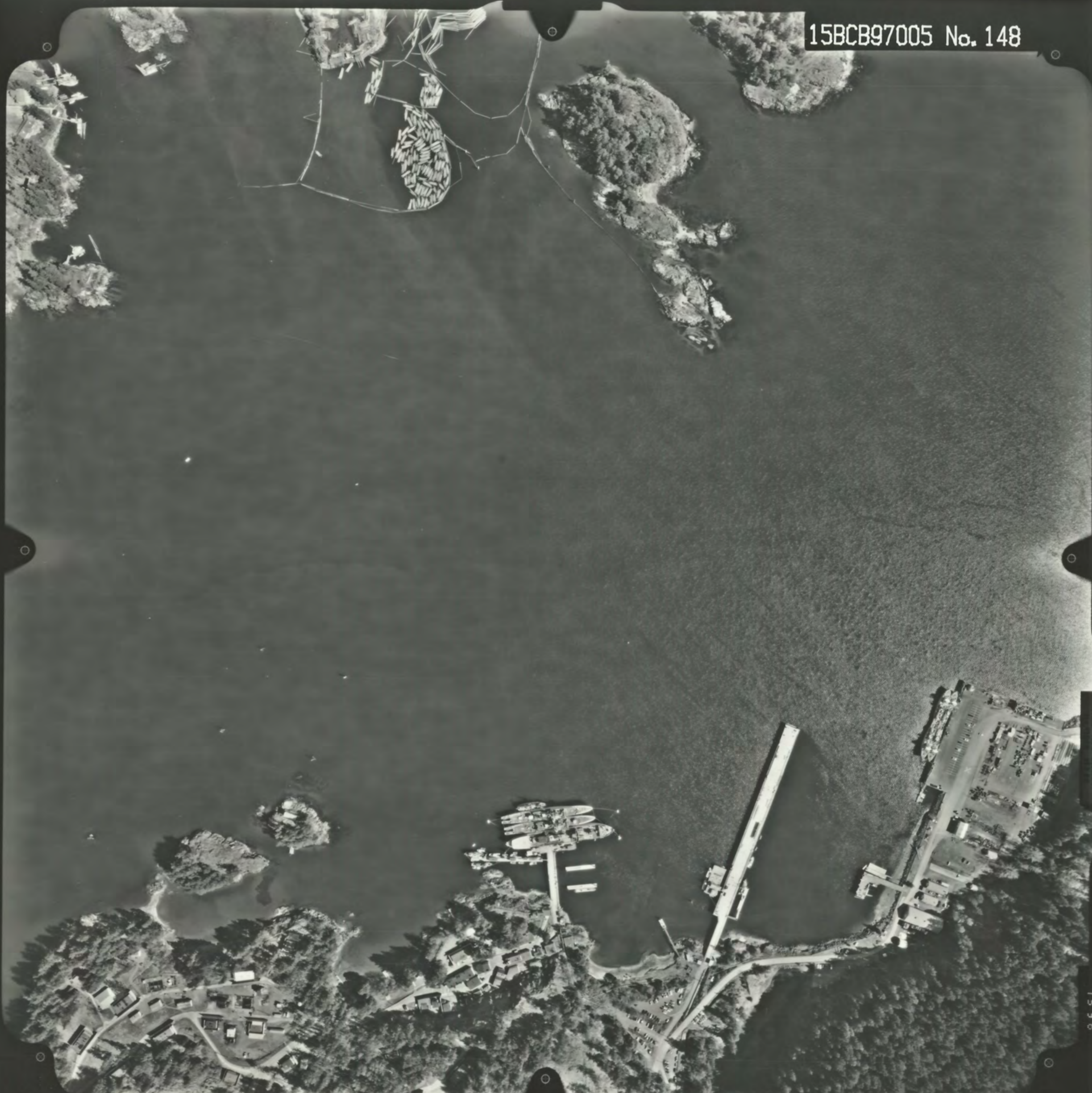

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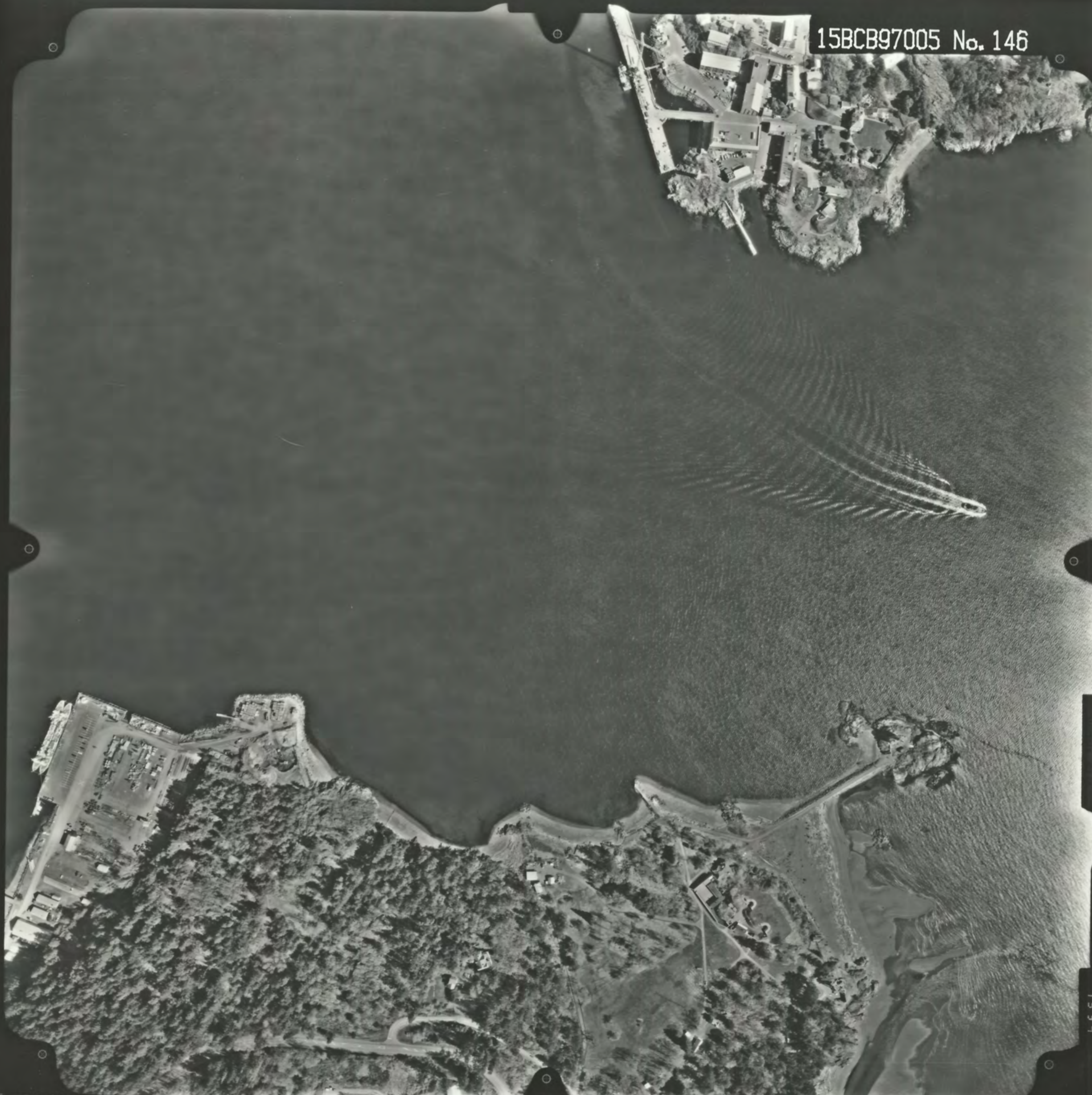

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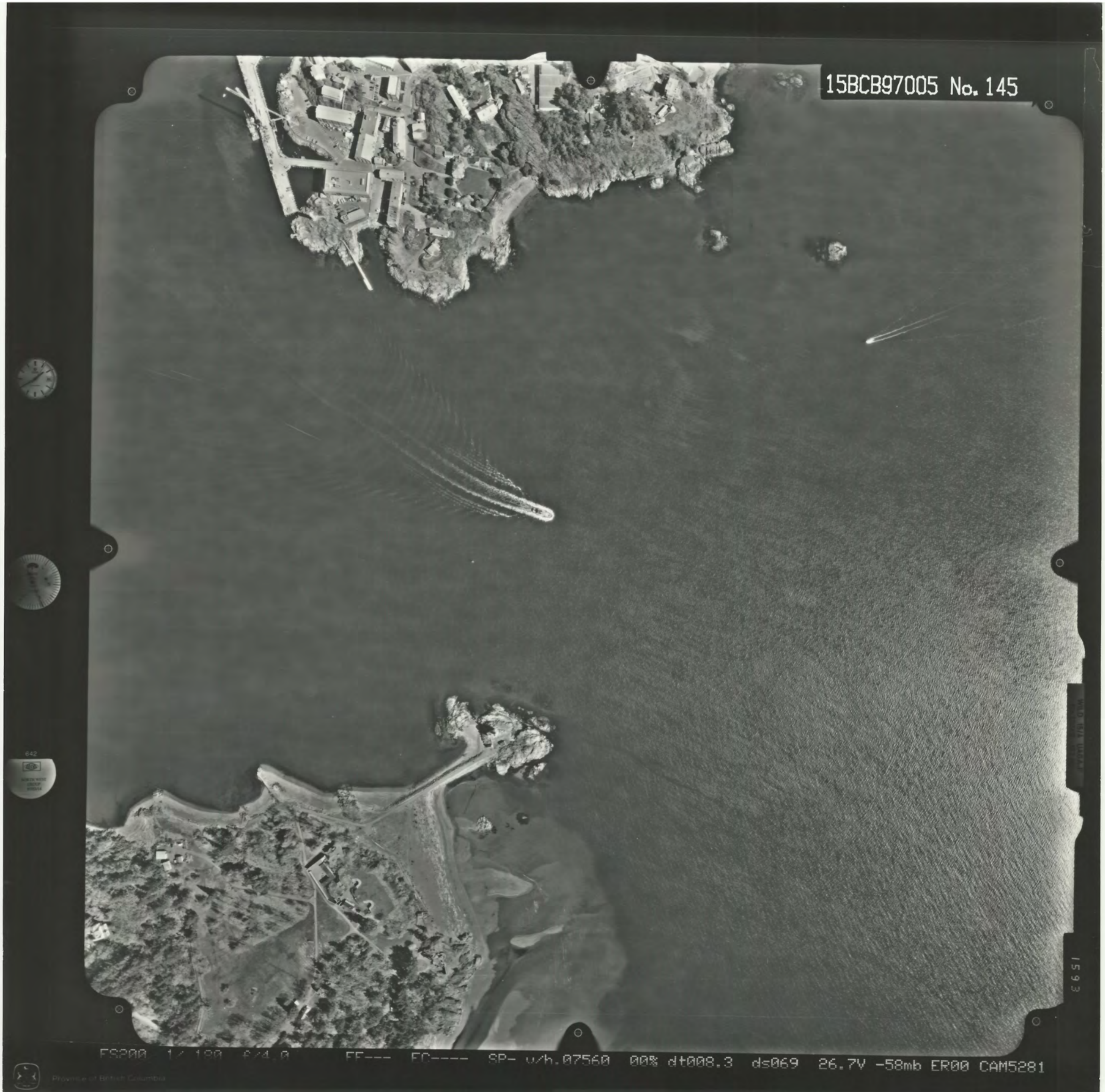
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Province of British Columbia

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Province of British Columbia


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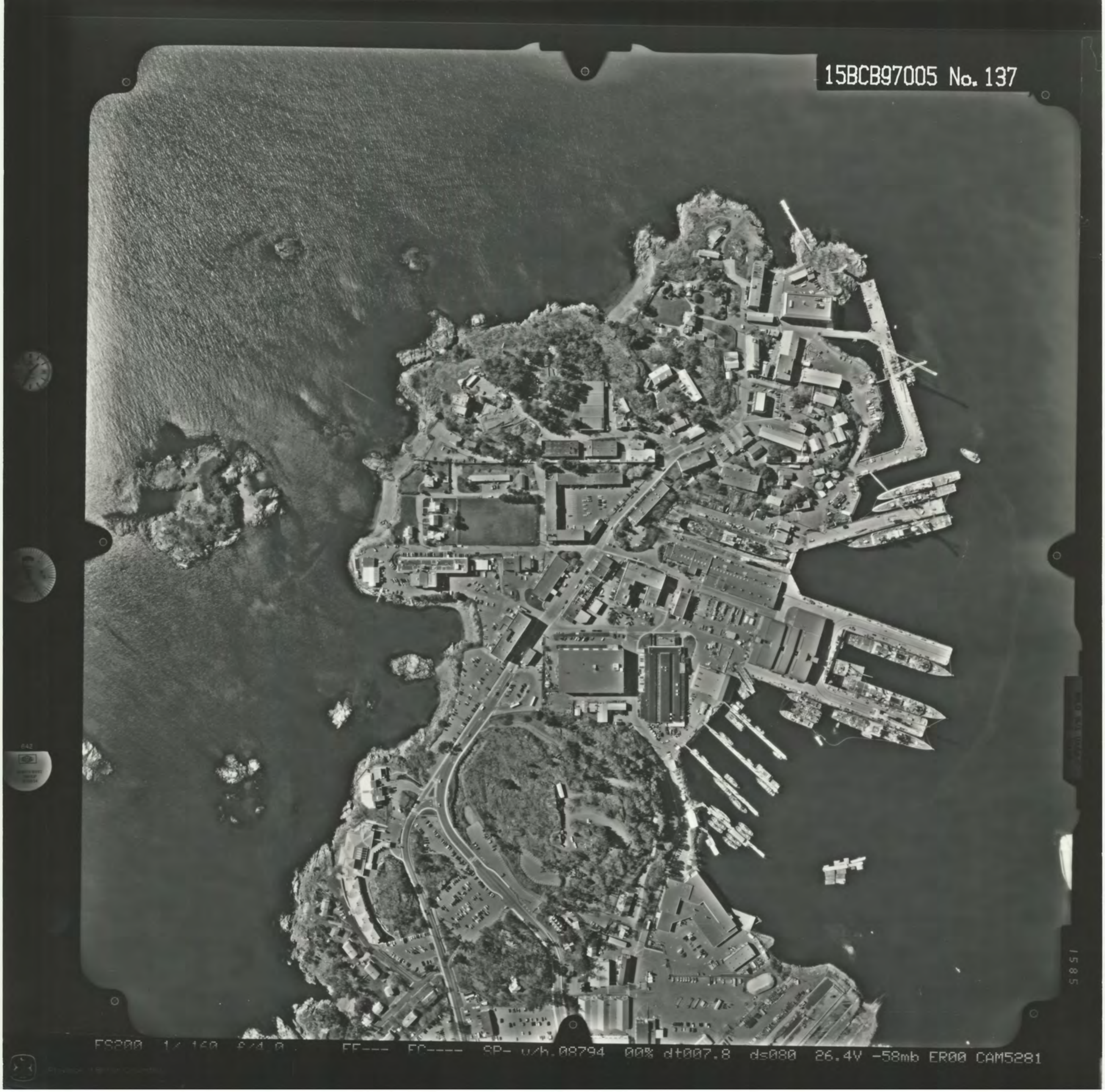
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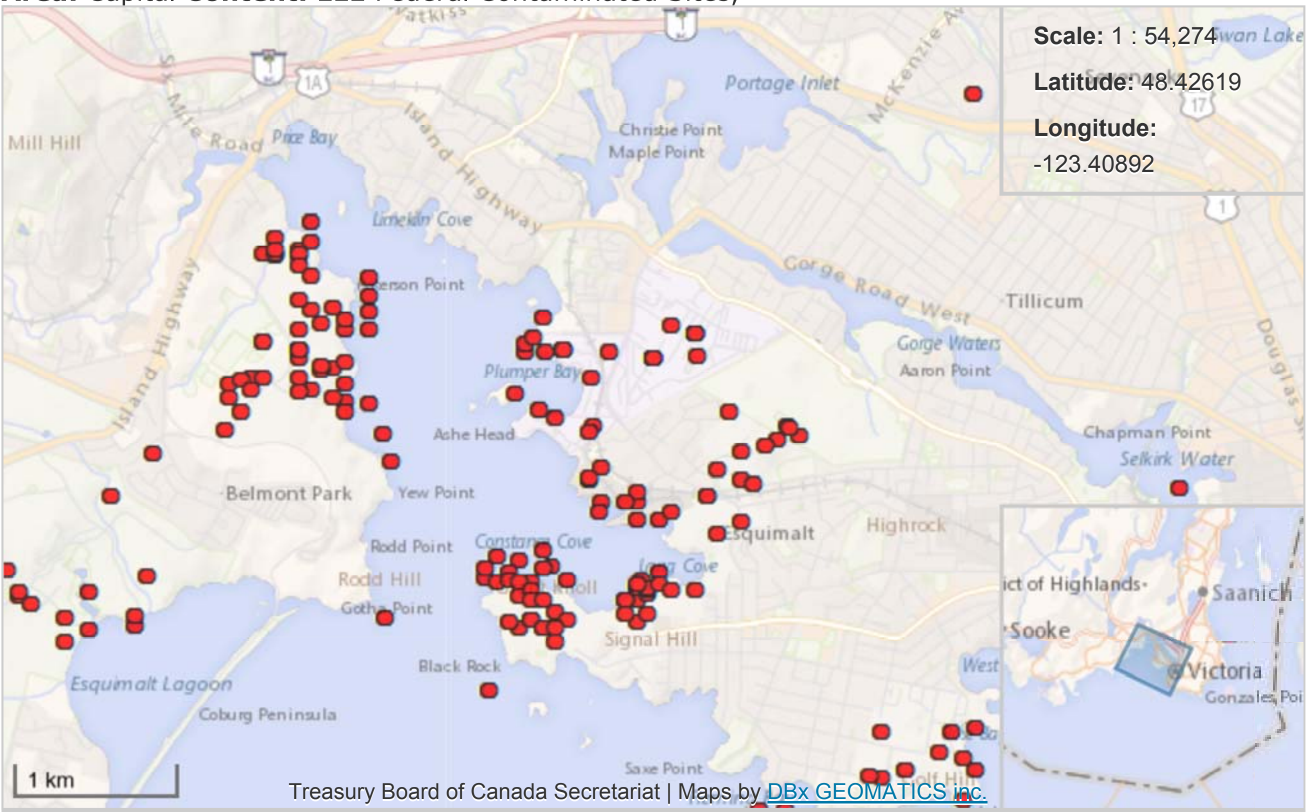
APPENDIX B
Regulatory Information

Treasury Board of Canada Secretariat

DFRP/FCSI - Map Navigator

Area: Capital **Content:** 222 Federal Contaminated Sites,



Layers

★ Federal Properties

★ Federal Buildings

Federal Contaminated Sites

Economic Region

Census Divisions

Census Subdivisions

Metropolitan Areas

Federal Electoral Districts

Treaty Areas

[1] This layer is visible only when the map scale is smaller than 1:3,000,000.

[2] Google base maps are only available when the map scale is smaller than 1:60,000.

IMPORTANT NOTE: The tables below are currently not synchronized with the map content. Please click on the following hyperlink if you want to update the tables content: **UPDATE TABLES**

Federal Properties

Federal Properties
Page(s):

Select the number of rows per page 5

Federal Buildings

Federal Contaminated Sites

Appendix B: Regulatory Information

Authorization Number	Authorization Type	Issue Date	Waste Type	State	Facility Type - Description	Facility Address
4772	Permit	08/08/1977	Effluent	Cancelled	Elementary School - sewage	3291 Happy Valley Road, Victoria
6081	Asphalt Plant Regulation	26/09/1997	Air	Active	Asphalt Plant	740 Industrial Way, Victoria BC V9B 6E2
8241	Permit	11/05/1989	Effluent	Cancelled	Chlorination/Dechlorination	680 Montreal Street, CRD BC V8V 1Z8
15601	Permit	18/09/2000	Air	Active	n/a	765 Industrial Way, Victoria
18363	Operational Certificate	19/02/2008	Effluent	Active	Reclaimed water production plant Reclaimed water production facility at Victoria inner harbour Reclaimed water used for toilet flushing, landscape irrigation and impoundment. Overflow from impoundment into Victoria Harbour	101-1117 Wharf Street, Victoria BC V8W 2S6
100051	Hazardous Waste Regulation	20/09/2007		Active	Biocell at Highwest Landfill	1943 Millstream Road, Victoria BC V9B 6E2
100174	Organic Matter Recycling Regulation	06/03/2008		Active	Compost	1416 B Alan Road, Victoria BC V9E 2C5
100183	Organic Matter Recycling Regulation	07/03/2008		Cancelled	Compost	UVic Finerty Road Victoria
100184	Organic Matter Recycling Regulation	07/03/2008		Active	Compost	4370 Interurban Rd Victoria BC V9E 2C3
100302	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	28/07/2008		Active	Automotive recycler Automotive recycler	232 Trans Canada Highway, Malahat BC V0R 2L0
100327	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	01/08/2008		Active	Steel Recycling Facility Waste metal collection and recycling depot, including wet/dry vehicles. A diesel powered metal shredder is used to shred and sort, metals (ferrous, non-ferrous and non-metals). This site also accepts demolition wastes, bottles for recycling	2770 Pleasant St, Victoria BC
100382	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	13/08/2008		Active	automobile dismantling Automobile dismantling	1297 Glenshire Drive, Victoria BC V9C 3W7
100384	Code of Practice for Concrete and Concrete Products	26/08/2008		Active	Concrete Production	439 Bay Street, Victoria BC V8T 1P5
103167	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	05/02/2009		Withdrawn	Sales and service of new and used motorcycles, their parts and accessories. Sales and service of new and used motorcycles, their parts and accessories.	D-611 David Street, Victoria BC V8T 2C9
103821	Permit	31/03/2010	Air	Active	Electric motor rebuilding Electric motor rebuilding shop	859 Viewfield Road, Victoria BC V9A 4V2

Appendix B: Regulatory Information

Authorization Number	Authorization Type	Issue Date	Waste Type	State	Facility Type - Description	Facility Address
103965	Petroleum Storage and Distribution Facilities Storm Water Regulation	09/09/2009		Withdrawn	Transfer area is drained into an oil/water sparator that discharges into the storm sewer situated adjacent to the property	2515 Rock Bay Ave, Victoria BC V8T 4R5
104612	Petroleum Storage and Distribution Facilities Storm Water Regulation	03/03/2010		Active	Petroleum products storage and distribution facility	2515 Rock Bay Avenue, Victoria BC V8T 4R5
105554	Hazardous Waste Regulation	20/04/2011	Hazardous Waste	Cancelled	Ellice Recycle and Ralmax Development's barge ramp facility	2800 Bridge Street, Victoria BC x
106038	Hazardous Waste Regulation	27/02/2012	Hazardous Waste	Active	Soil Treatment Biocell - Landfill	1943 Millstream Rd, Victoria BC
106597	Petroleum Storage and Distribution Facilities Storm Water Regulation	08/02/2013		Active	Langford Cardlock	2596 Sooke Road, Colwood BC V9B 1X7
106843	Permit	09/01/2014	Refuse	Active	Soil storage three fill areas (Fill area 1, 2 and 3) for permanent storage of contaminated soil	203 Harbour Road, Victoria BC V9A 3S2

APPENDIX C
Harbour Occupants

APPENDIX A-1: Harbour Occupants as of 1873

Area	Usage	Dates
Northern Shore - Cole Island	- munitions magazine	- 1860-1938
East Side - land between southern shore Thetis Cove & northern Plumper Bay - north shore Thetis Cove	- "Indian Village" - unidentified building	- 1873 - by 1860-1873
Constance Cove - Lang Cove - Skinner Cove	- named "Village Bay" - intact, with inland stream	- ca 1873 - 1848-1920s
Duntze Head/Naval Yard Peninsula Area - Thetis Island - Esquimalt Village - Western part/naval yard - Western part/naval yard inland - East of Grant Knoll - SE of landing East of Grant Knoll - directly inland east of Duntze Head, near first Naval Yard Boundary Line (West of Signal Hill) - inland east of Grant Knoll & south of "Landing"	- Naval Coal Wharf Naval Coal Store/Note: island still intact, separate - Fraser's River ("Cariboo") Gold Rush traffic landing here/Esquimalt Village & Wharf St. developed/small wharf - Admiralty/Naval land has enlarged wharf - "The Factory": Smith shop, Smelter/Engine House - cable, paint, chain, timber, lumber, ordnance, cordage/stores; fitting house - Boathouse - Landing - "Factory" - Paint, Oil, Ordnance, Victualling Stores, Naval stores, Condemned Stores, Engine	- (1860-1880) - 1858 - 68 - 1865 - by 1873 - by 1858 - by 1863-67 - by 1863-67
West Side - Southern entrance, west side	- Fisgard Lighthouse	- 1860-present

APPENDIX A-2: Harbour Occupants as of 1896

Area	Usage	Dates
Northern Shore		
- Northern harbour, inland	- Esquimalt & Nanaimo Railway	- 1886-present?
- Cole Island	- magazine, incl. boathouse, jetty, mine & shell store, shell filling house, ordnance store, 4 powder magazines, quick firing ammunition store, store for empty cases	- 1860-1938
East Side		
- North of Skinner Cove	- Hudson's Bay Co. Post	- ca 1896
- Land between southern shore Thetis Cove & northern Plumper Bay	- "Indian Village"	-
- Along eastern side of harbour	- E & N Railway (splits & runs down peninsula area in Plumper Bay)	- construction starts 1884; operative 1886-present
- Plumper Bay peninsula area, southwest of Thetis Cove	- "Cannery" (platform extends out into water; appears on 1896 hydrographic chart)	- by 1896-(on 1947 chart; not present on 1967 chart)
Constance Cove		
- Lang Cove area	- Isbestor's Pier (identified as Foster's Pier in 1896)	- ca 1895
- between Pilgrim & Lang	- Infectious ward	- ca 1895
- Pilgrim Cove area	- Jetty/landing stage/wharf	-
- West of Skinner Cove	- Hudson's Bay Co. wharf	- by 1895
- Lang Cove area	- Brown family operated Slipway cradle & jetty/BC Marine slipway (known in 1895 as "Marine Slipway"/1896 "slipway"/1897-1914 BC Marine Railway Co. Cradle)	- 1893-1914
- North of Skinner Cove	- E&N Railway/Esquimalt & Craigflower Rd./Hudson's Bay Co./4 large bldgs	- ca 1896
- Pilgrim Cove	- Royal Naval Hospital	- ca 1896
- Northeast Signal Hill	- Fosters Pier	- ca 1896
- North of Signal Hill	- wharf with bldgs	- ca 1895
- Shoreline N.E. of Signal Hill	- Isbestor's Pier (identified as Foster's Pier in 1896)	- ca 1895
- North of Signal Hill	- Submarine Mine Establishment, with tramway	- ca 1895
- Shoreline N.W. of Signal Hill	- boathouse; cement & timber store	
- West of Signal Hill	- War Department boundary	

APPENDIX A-2 (CONT.) Duntze Head/Naval Yard Peninsula Area		
- adjacent to Grant Knoll	- additional boathouse built with small shipwright shop next to it	- 1879
- Western portion - Naval Yard	- Drydock built - Boat store/additional slipway to boat house - Graving dock used by Royal Navy, Canadian gov't, private commercial ships (highest usage period)	- 1886-87 - ca 1883 - 1887-1927
- Esquimalt Village	- Larger dock/landing/Wharf St. runs north to south	- 1858-1940s
- Thetis Island	- Drydock excavations fill to unite island to land - Coal sheds 12' high with increased storage capacity - now 2673 tons	- 1880 - 1895
- West of Thetis Island	- Current bldgs constructed by 1903, capacity of 10,000 tons	- ca 1899-1903
- Western area	- Pumphouse - housed all pumping equipment for drydock	- 1886
- Grant Knoll	- Wharf further enlarged to "A" Jetty/coal wharf/drydock fenced gov't prop.	- 1885
- The "Factory"	- (another) boathouse, small shipwright shop, torpedo boat slipway - New building for the "Factory". Housed: machine shops; blacksmith boiler shops; moulding shop (w/blast furnaces); coppersmith; galvanizing tank (busy during WWI); pattern makers shop	- 1879 - 1891-present?
- Shoreline northwest of Signal Hill and northeast of Duntze Head	- Esquimalt wharf and landing stage (at the northern end of Wharf St.)	- ca 1895
- Grant Knoll, Duntze Head & slightly east	- Royal Naval Yard: major ship repairs; factory size tripled. Yard included iron store, oil store, lumber store, electrical store, cordage store, boat house, boat slip, torpedo boat house, torpedo boat slip, torpedo sub depot, chain cable store, sail loft & paint store, timber store.	- developed late 1870s - early 1890s
- Duntze Head & south	- War Office Encroachments #3, #4, Royal Naval Yard paddock, War Office Encroachment #1, War Office Encroachment #2	- ca 1895
West Side		
- Rodd Pt.	- Belmont/SW Belmont has 2 bldgs	1896

APPENDIX A-3: Harbour Occupants in 1925

Area	Usage	Dates
Northern Shore		
- Parsons Bridge	- Blacksmith shop/brass foundry (slaughterhouse/piggery)/tannery ?	- 1900-1930s
- Cole Island	- Magazines used by Royal Navy/Royal Canadian Navy/Army	- WWI
- Inland northern harbour	- Esquimalt and Namaimo railway	- 1886-present?
- Northern harbour	- oyster beds	- up to1920-1930s
East Side		
- Thetis Cove, opposite Richards Island	- Large, fuel wharf	- 1920s
- Plumper Bay & North	- E & N Railway	- by 1886-?
- inland Plumper Bay	- Oil tank "(conspicuous)"	- 1921 (on chart)-1947
- Thetis Cove	- Machine shop (off of E & N Railway)	- 1918
- Indian Reserve	- Star Shipyard	- 1905-77 (?)
- Plumper Bay area	- Empire Cannery/V.H. Todd & Sons, Ltd. Empire owned by Todds	- by 1896-1947
- Southwestern shore of Thetis Cove	- Oil wharf	- 1925-present
	- Small vessel wharf	- Early 1900s-present
Constance Cove		
- Pilgrim Cove	- Boat House/RCN Barracks inland	- 1920s
- Skinner Cove	- Proposed Esquimalt Graving Dock	- (opens 1926)
- Lang Cove	- Slipway becomes Yarrows (graving dock & shipyard)	- 1914-1946
- Inland Pilgrim Cove	- Royal Navy Hospital (incl. dead house, infectious ward, disinfecting house)	- ca 1913-1914
	- Joint Services Magazine	
- Signal Hill and northern shoreline	- Submarine Mining Establishment, including offices, shops, stores and stone jetty for handling mines jutting into Constance Cove	- 1899-1906
	- Imperial forces returned to England, minefield operation discontinued; abandoned buildings become part of Canadian Ordnance complex.	- 1906
	- 9.2" gun battery	- 1912-1939

APPENDIX A-3(CONT.)		
<u>Duntze Head/Naval Yard Peninsula Area</u>		
- Western portion	- Drydock used by Royal Navy/Royal Canadian Navy/ Can. Gov't./Commerical ships	- 1887-1927
- Western portion	- Drydock closed	- 1927-1945 closure
- Esquimalt Village	- Pioneer St. northern end - hotel/public landing	- 1858-1939
	- float plane lounge	- 1920s-30s
	- Esquimalt wharf smaller	- by 1910
- Thetis Island	- Naval Coal store capacity of 10,000 tons, with coal chute and crane	- 1903-1942
- Grant Knoll	- filled w/unknown substance when marine railway built	- 1910-1911
- Esquimalt Village	- incorporated; gets sewer system	- 1912
- Western portion	- Naval Land - now Royal Canadian Navy	- 1910-11
- Works Dept. Yard	- painters, smithers, galvanizing shops	- by 1903
- West Cove (north from Bldg 115)	- Marine railway (Bldg 116)	- 1913-46
		- 1910-1984
- Adjacent to Grant Knoll (Bldg 109)	- Sail loft & oil store	- 1903
	- receiving & sale store	- 1920
	- sail loft & pitch deposit	- 1923
- Adjacent to Grant Knoll (Bldg 113)	- Shipwright shop & spar shed	- built 1901-1917 1922-1950s
- Adjacent to Grant Knoll (Bldg 115)	- "Shipwright & riggers marine ship repair unit" ("concrete floor with open slope to the sea")	- 1913-1946
- Northeastern shoreline of Duntze' Head (Southwestern shoreline of Constance Cove)	- The "Factory" <u>cf</u> 1896 chart (machine shops, blacksmith boiler ships, moulding shops, etc.)	- 1891-present
	- Heavy usage of galvanizing tank	- WWII
<u>West Side</u>		
- up from Limekiln Cove	- Lime kilns	- 1925

APPENDIX A-4: Harbour Users as of 1967

Area	Usage	Dates
Northern shore		
- Northern harbour	- very dense log boom storage	- 1930s-1960s
- Inland northern harbour	- Esquimalt and Nanaimo Railway	- 1886-present
East Side		
- Plumper Bay & north	- E & N Railway	- 1886-?
- Along Hallowell Rd., adj. to Esquimalt Band Reserve	- West Isle Logging, Ltd./Futura Forest Products sawmill (PCBs & chlorophenol contaminants found later)	- 1967-1983
- Southwestern shore of Thetis Cove	- Wharf (old oil wharf; now serving sawmill?)	- by 1925-present
- Munroe Head	- Yarrows Ltd # 2 Plant	- by 1947 (on charts) to 1958
- South of Richard Island, north of Plumper Bay	- numerous piles	- 1967 chart
- Plumper Bay	- "Booming Ground & numerous piles"; also "Ruins"	- 1967 chart
- Paddy Pass	- dead heads	- 1967 chart
- Esquimalt Band Reserve, southern portion	- piles	- 1967 chart
- Munroe Head	- floats in northern portion - floating breakwater off of tip, running NW/SE - several large buildings & "travelling crane" - small square platform offshore	- 1967 chart
- View Royal	- residential development, and small business development; septic tanks on rocky ground	- 1970s-present
Constance Cove		
- (Skinner Cove)	- Esquimalt Graving Dock high usage period	- 1965-1973
- Lang Cove	- "Wallace" owned (or titled) shipyard & drydock	- 1946-72 (since 1893)
- South of Esquimalt Graving Dock	- Government Jetty E, Dept. of Public Works	- ?-present
- Pilgrim Cove	- piles/2 small (? piers) on north shore/8 piers along south	- 1967
- Lang Cove	- "Yarrows" (?) substantially built up	- ca 1967
- Signal Hill and northern shoreline	- buildings absorbed by HMC Dockyard Esquimalt & occupied by civilian work force	- since WWII

APPENDIX A-4(CONT.)		
Duntze Head/Naval Yard Peninsula Area:		
-Western portion	- Drydock used by Royal Canadian Navy; peak usage 1954-1964.	- 1945-present
-Thetis Island	- Gun shed and carpenter shop	- 1951-1970
-Thetis Island	- Jetty A; enlarged Jetty B; ways southwest of jettys; complex pier structure east & south of Jetty C; 3 piers off of Jetty C	- ca 1967
- Lang Cove	- small jetty southwest of Jetty A	- ca 1967
- Area adjacent to Grant Knoll (Bldg 109) - Grant Knoll area (Bldg 113) - b/n Grant Knoll & Jetty A	- electric store - shipwright & spar shed - carpenter shop - Civilian paint shop - Bldg 114 - Torpedo storage - Bldg 115B - Shipwright's cradle shop-Bldg 117 - Haulout - Bldg 116 - Civilian Paint Shop - Bldg 119 - Boat store - Bldg 120	- 1951 - 1920-1950s - 1950s - 1950s- (?) (1953/55 Dockyard, Naden utilities map)
- Inland between Jetty A & B	- P.N.L. Jetty - Bldg 133 - The "Factory" still operative - Above called "Naval Stores"	- 1891-present - 1951 - 1955
- Northeastern shoreline of Duntze Head (southwestern shoreline of Constance Cove)	- Third section of factory (moulding shop; coppersmith; galvanizing tank; pattern makers shop) demolished & replaced by parking lot	
- Various parts of dockyard and Duntze Head area	- sandblasting	- 1949-present
West Side		
- Southern tip Smart Is., to northern McCarthy Is., to fuel oil jetty	- power line/"dol s." & piles McCarthy Is. area	- 1967 chart
- Between Dunn's Nook & Patterson Point	- "G Jetty"/float north of G Jetty/very large Naval Supply Depot with tank	- 1967
- Southern entrance	- Fisgard Island & Rodd Pt. connected (Fill?)	- 1967
- North of Yew Pt.	- "D Jetty"/ (w/4 bldgs/wharf-like structures); ship traffic & minor repairs - sandblasting inland from "D" Jetty	- ?-present - ?-present
- Dunn's Nook	- Fuel oil jetty "F"/piles within Nook	- ?-present

APPENDIX A-5: Harbour Users as of 1987

Area	Usage	Dates
<u>Northern Entrance</u>		
- Inland northern harbour	- Esquimalt & Nanaimo Railway	- 1886-present (?)
- Cole Island	- Prov. Gov't of Parks Canada"takeover & stabilization" (ex-magazines)	- 1974
- View Royal	- (possibly) faulty septic tank discharge from residential & small business areas	- 1970s-present
- Mill Stream	- PETRO CAN OIL holdings upstream	- ( )
- Northern harbour	- sparse log boom storage	- 1970s-present
<u>East Side</u>		
- Inland Plumper Bay & North	- E & N Railway	- 1886-present
- Along Hallowell Rd. adjacent to Esquimalt Bank Reserve	- Futura Forest Products mill (& West Isle Logging Ltd), with wharf (old oil wharf)	- (1970-late 1980s)
- End of Hallowell Rd/south shore Thetis Cove	- Fibermax Timber Corp. - Victoria Plywood	- 1986-present - ?-late 1980s
<u>Constance Cove</u>		
- Lang Cove	- Private graving dock/Ship yard = Versatile Pacific	- 1972-1989
- Between Yarrows & Signal Hill	- Bldg 508 Shipwright & plastic shops	- 1985
- South of & adj. to DPW Graving Dock	- Government Jetty E	- (?-present)
- Signal Hill and northern shoreline	- Ship Repair Unit (Pacific) plastic shop & sandblasting site; Base Transportation Vehicle park on extensive landfill into Constance Cove; Base Supply use of Ordnance store buildings; Naval Officers' Training Centre small training vessels berthed & maintained; some Queen's Harbour Master's department facilities	- <u>ca</u> 1981

APPENDIX A-5(CONT.)		
<u>Duntze Head/Naval Yard Peninsula Area</u>		
- Northern shore of CFB Esquimalt, b/n Jetty A & B	- Oily Waste Water Treatment Plant initiated; no previous treatment	- (1980s)
- Thetis Island	- sheet metal shop (?)	- 1970
	- ship repair functions	- current ?
- Northern shore of CFB Esquimalt, b/n Jetty A & B	- The "Factory" now known as "Pipe Shop-MSRU-RCMP offices"	- 1970
	- The "Factory" now known as "Pipe Shop & offices"	- 1981
- Between Jetty A & B, Northern shore of CFB Esquimalt	- (next to above) Bldg 55: general lagging. Steam pipes, turbo blowers, refrigeration pipes	- by 1985
- Inland & slightly west of B Jetty	- Bldg 176: Painters/sandblasting	- as of 1985
- Immed. east of drydock	- Bldg 190: Machine shop mechanical - Bldg 190B: Diesel shop - Bldg 191: Outside fitting shop	- as of 1985
- Inland from C Jetty	- Bldg 130: Sheet metal shop/sealers and cleaners - sandblasting	- as of 1985
- Inland from C Jetty	- Bldg 143: Shipwright & plastic shops	- as of 1985
- Near main gate (near "neck" of peninsula)	- Bldg 213: Metal finishing/chemical cleaning, etc. - Bldg 215: Weapon systems mechanical (outside fitting & installation)	- as of 1985
- Drydock area & Duntze Head area	- sandblasting	- 1949-present
- Northern shoreline of CFB Esquimalt	- Jetty A: Ship traffic, ship discharge, repair & minor fueling	- (?-present)
	- Jetty B: Ship traffic, ship discharge, repair & minor fueling	- (?-present)
	- Jetty C: "Refit Jetty" for major repairs, refits, and minor fueling	- (?-present)
<u>West Side</u>		
- Yew Point	- crab deaths due to "Black Spot Disease" (eventually throughout harbour)	- <u>ca</u> 1984
- North of Dunn's Nook	- "F" Jetty: Naval Fuel jetty, ship traffic, discharge	- ?-present
- North of Dunn's Nook	- "G Jetty" small vessal traffic	- ?-present
- North of Yew Point	- sandblasting inland from "D" Jetty	- ?-present
- North of Yew Point	- "D" Jetty patrol boat traffic, minor repairs	- ?-present

APPENDIX A-6: Current Major Harbour Users

Area	Usage	Dates
Northern Entrance		
- View Royal	- (Possibly) faulty septic tanks/residential & small business development	- 1970s-present
- Northern Harbour	- sparse log boom storage	- 1970s-present
- Inland Northern harbour	- Esquimalt & Nanaimo Railway	- 1886-present?
East Side		
- Plumper Bay & north	- E & N Railway	- 1886-present
- end of Hallowell Rd	- Fibermax Timber Corp;	- 1986-present
	- Victoria Plywood Co-op	- ?-present
- Along Hallowell Rd	- Pacific Forest	- (1990)
- View Royal	- residential & small business development; faulty septic systems	- 1990-present
Constance Cove		
- Lang Cove	- Dredging	- (Lt(N) Smith)
- Signal Hill and northern shoreline	- Further expansion of HMC Dockyard Esquimalt facilities	- 1980s-present
- Lang Cove	- Drydock/shipyd know as "Yarrows" again	- 1989-present
- Esquimalt (DPW) Graving Dock	- Ship refit & repair activities; Government "E" Jetty	- 1926-present
Duntze Head/Naval Yard Peninsula Area		
- North shore CFB Esquimalt, between Jetty A & B	- Bldg 243, unidentified outfall pipe	- current
- Western tip	- FMG construction site: discovery of lead contaminated soils	- summer-winter 1992
- Dockyard & Western portion of Duntze Head	- Continued industrial activity	- 1870s-present
- Northern shoreline CFB Esquimalt	- "A" Jetty: ship traffic, discharge & repair; minor fueling	- to present
	- "B" Jetty: ship traffic, discharge & repair; minor fueling	- to present
	- "C" Jetty: "Refit Jetty" for major repairs, refits and minor refueling	- to present
West Side		
- Patterson Pt.	- DND Fire Training Area	- to present
- North of Yew Pt.	- "D" Jetty: patrol boat traffic, ship discharge & repair	- post WWII to present
- North of Yew Pt.	- Sandblasting inland from "D" Jetty	- to present
- North of Dunn's Nook	- "F" Jetty ship traffic, discharge & repair; Naval Fuel Jetty	- to present
- North of Dunn's Nook	- "G" Jetty ship traffic, discharge & repair	- to present

APPENDIX D

Areas of Potential Environmental Concern

Areas of Potential Environmental Concern

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
APEC A – Fill				
A1	Southern part of Dockyard	Metals dump/fill material	Soil, Groundwater	Metals
A2	Fill between Grants Knoll and Dockyard	Fill used to join island to mainland prior to 1946	Soil, Groundwater	Metals, PAH
A3	Dockyard A-Jetty and B-Jetty Fill	Shoreline filling to raise ground level	Soil, Groundwater	Metals, PAHs
A4	Dockyard shoreline fill materials	Filling activities	Soil, Groundwater	Metals, hydrocarbons
A5	Infilled cove on north side of Signal Hill	Fill activities – backfilled with waste materials	Soil, Groundwater	Metals, PAH, hydrocarbons
A6	Soil capsules, Yarrows	Contaminated soil dredgeate containment cell	Soil, Groundwater	PAHs, metals
A7	Black Sands Beach, Yarrows	Deposition of black sandblast grit	Soil, Groundwater, Sediment	Metals
A8	Yarrows area	Fill activity	Soil, Groundwater	Metals, hydrocarbons
A9	Lang Cove	Deposition of contaminated sediments and fill material to reclaim land	Soil, Groundwater, Sediment	Metals, hydrocarbons
A10	Pilgrim Cove	Historical filling	Soil, Groundwater	Metals, hydrocarbons
A11	Skinner Cove	Historical filling	Soil, Groundwater	Metals, hydrocarbons
A12	Munroe Head	Historical filling	Soil, Groundwater, Sediment	Metals, PAHs, hydrocarbons. PCBs
A13	Dallas Bank	Foreshore fill material	Sediments Soil	N/A
A14	Ashe Head	Infilled cove	Soil, Groundwater	Metals, PAHs
A15	South side of Plumper Bay	Fill materials	Soil	Metals
A16	Fill material on south east side of Plumper Bay	Fill materials	Soil	Metals, PAHs, hydrocarbons
A17	Central part of Plumper Bay	Fill material on shoreline	Soil	Metals, hydrocarbons
A18	Southeast of West Isle site, Plumper Bay	Fill material on shoreline	Soil	Metals, PAHs, hydrocarbons
A19	West Isle shoreline, Plumper Bay	Fill material on shoreline	Soil	Metals, PAHs, hydrocarbons, chlorophenols
A20	West Isle Site, Plumper Bay	Fill material	Soil, Groundwater	Metals, hydrocarbons, chlorophenols

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
A21	Fibremax fill material north shore of Plumper Bay	Fill material	Soil	Metals, hydrocarbons
A22	Fibremax fill material on Fibremax peninsular, Plumper Bay	Fill material	Soil	Metals, hydrocarbons, PAHs
A23	Fibremax fill material north side of property, Plumper Bay/Thetis Cove	Fill materials	Soil	Metal
A24	Fibremax site, Plumper Bay	Fill material	Soil, Groundwater	Metals, hydrocarbons, phenols
A25	Victoria Plywood, Thetis Cove	Filled embayment area	Soil, Groundwater	Metals and hydrocarbons
A26	Thetis Cove shoreline	Fill material	Soil, Groundwater	Metals and hydrocarbons
A27	Thetis Cove shoreline	Fill material	Soil, Groundwater	Metals, hydrocarbons
A28	Dunns Nook/F-Jetty, Colwood	Shoreline fill materials	Soil, Groundwater, Sediment	Metals, hydrocarbons
A29	Colwood D-Jetty	Fill materials to the west of D-Jetty, including sandblast material	Soil, Groundwater, Sediment	Metals
A30	Colwood D-Jetty	Fill material adjacent to west side of D-Jetty	Soil, Groundwater, Sediment	Metals
A31	Yew Point, Colwood	Fill materials	Soil, Groundwater, Sediment	Metals
A32	Fisgard Island	Unknown fill quality used in constructing the causeway to the lighthouse	Soil, Sediments	Metals, hydrocarbons
A33	Thetis Cove shoreline	Fill material	Sediment	Metals, PAHs, hydrocarbons
A34	Thetis Cove shoreline	Fill material	Sediment	Metals, PAHs hydrocarbons
APEC B - ASTs, USTs, Other Hydrocarbons				
B1	Infilled cove on north side of Signal Hill	Tanks		Hydrocarbons, metals
B2	OWWTP at Dockyard	Potential for accidental release to harbour	Soil, groundwater, sediments	Hydrocarbons, PAHs
B3	B-Jetty at Dockyard	6 fuel tanks	Soil, groundwater, sediments	Hydrocarbons
B4	Pilgrim Cove	Fuel tanks/fuel pump	Soil, Groundwater	Hydrocarbons
B5	CFSA, Munroe Head	Presence of ASTs	Soil, Groundwater	Hydrocarbons

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
B6	Victoria Plywood, Thetis Cove	Oil wharf	Soil, Groundwater, Sediment	Hydrocarbons
B7	Indian Reserve	Former fuel tank located at north end of reserve-	Soil, Groundwater	Hydrocarbons (Bunker C)
B8	Victoria Plywood, Thetis Cove	Former tanks; 11 ASTs and 2 USTs	Soil, Groundwater, Sediment	Hydrocarbons, metals
B9	Victoria Plywood, Thetis Cove	Pipeline	Soil, Groundwater	Hydrocarbons
B10	Gasoline Dock, north of F-Jetty, Colwood	AST on shoreline	Soil, Groundwater Sediments, Aquatic receptors	Hydrocarbons
B11	F-Jetty at Colwood	Fuel supply lines to F-Jetty	Soil, Groundwater, Sediment	Hydrocarbons
B12	Esquimalt Graving Dock	AST	Soil, Groundwater, Sediment	Hydrocarbons
APEC C - Operational Activities				
C1	Dockyard	Historical and current activities associated with ship building, repair and maintenance	Soil, Groundwater	Metals, PCBs, hydrocarbons
C2	DND dry dock at Dockyard	Sandblasting activities	Sediments	Metals, hydrocarbons
C3	Yarrows ship building activities	Historical activities associated with ship building and repair (blacksmith, machine and sheet metal shop) and the Signal Hill lease lots	Soil, Groundwater	Metals, PCBs, hydrocarbons
C4	Esquimalt Graving Dock	Operational practices such as sandblasting activities	Soil, Groundwater, Sediment	Metals, PCBs, hydrocarbons, TBT
C5	Jenkins Marine, Munroe Head	Boat building and operational activities	Soil, Groundwater	Metals, hydrocarbons, PCBs, TBT
C6	Plumper Bay	Cement/Concrete plant on north side of Plumper Bay – operational activities	Soil, Groundwater, Sediment	Unknown
C7	West Isle Site, Plumper Bay	Historical operational activities associated with mill	Soil, Groundwater	Unknown
C8	Fibremax, Plumper Bay	Historical activities associated with mill	Soil, Groundwater Sediment	Unknown
C9	Victoria Plywood, Thetis Cove	Former mill activities	Soil, Groundwater, Sediment	Hydrocarbons, metals, PCBs, phenols, PAHs
C10	Seaplane operation, Limekiln cove, View Royal	Refuelling of small planes and operational activities	Sediment	Hydrocarbons
C11	Fire Fighting Training Area, Colwood	Historical and current FFTA operational activities	Soil, Groundwater, Sediment	Hydrocarbons, PFOS/PFOA

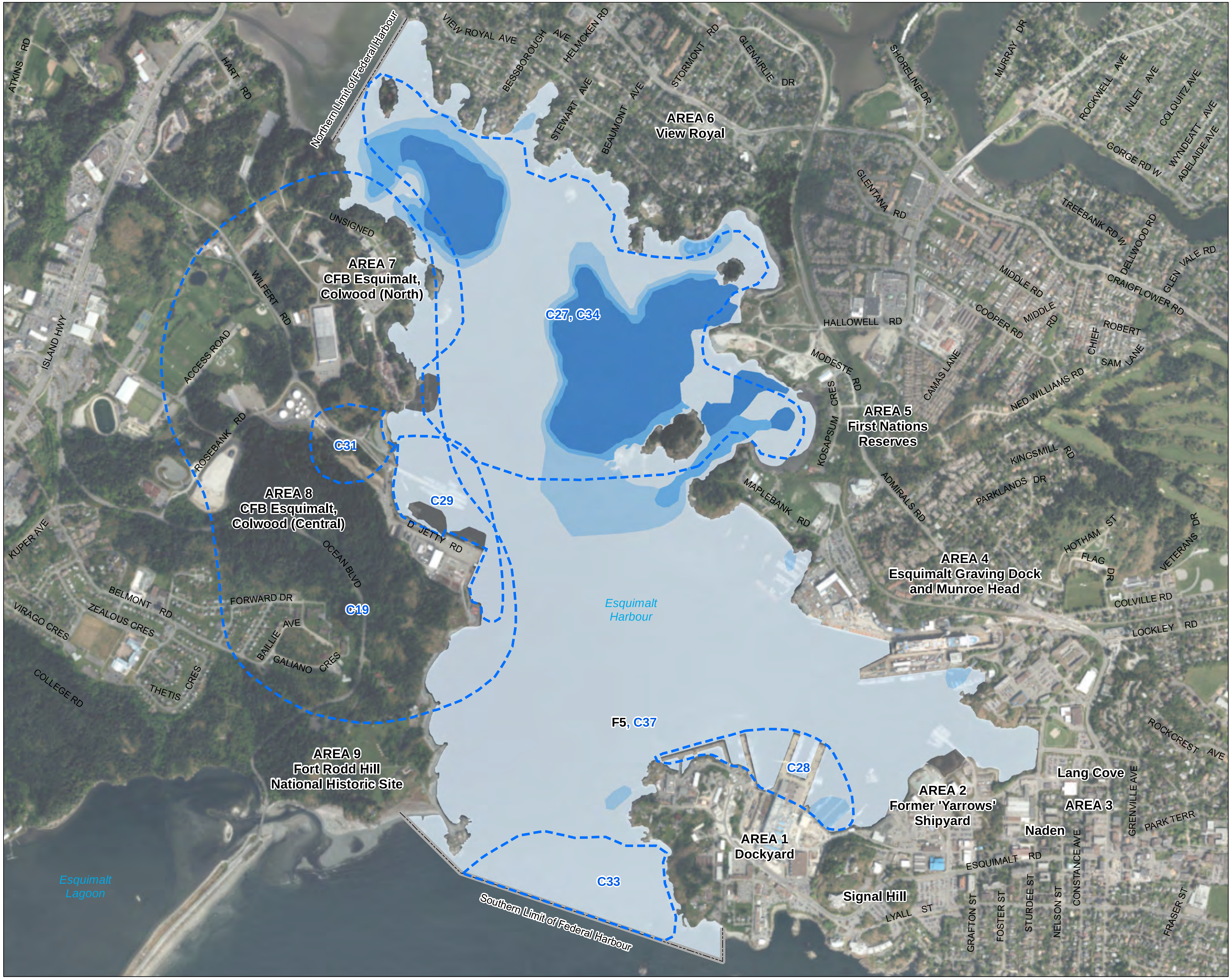
APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
C12	Colwood bunkers	Operational activities - bunkers historically used to store munitions, more recently hazardous chemicals	Soil, Groundwater	Metals, PCBs, hydrocarbons
C13	Smart Island	Soil contamination from activities on the island	Soil	Metals
C14	McCarthy Island	Soil contamination from activities on the island	Soil	Metals
C15	Cole Island	Potential waste materials from historical operational activities	Soil	Metals, hydrocarbons
C16	Dunns Nook, Colwood	Sandblast grit from operational activities in the area	Sediments	Metals
C17	D-Jetty, Colwood	Maintenance and operational activities	Sediments	PAHs, PCB's, metals, hydrocarbons
C18	Yew Point, Colwood	Dredgeate material from operational activities	Soil, Groundwater, Sediment	Metals
C19	DND Colwood	Historical and current operational activities associated with supply depot, sandblasting, refuelling and dredgeate storage	Soil, Groundwater, Sediment	Metals, hydrocarbons
C20	Fisgard Island	Maintenance and operational activities	Soil, Groundwater, Sediment	Metals, hydrocarbons
C21	Dockyard and Signal Hill	Historical sandblasting activities	Soil, Groundwater, Sediment	Metals
C22	Munroe Head	Historical operational activities associated with welding and pipe shop and an overhead crane.	Soil, Groundwater	Metals, hydrocarbons PCBs
C23	Munroe Head	Former slipway area	Soils	Metals
C24	Pilgrim Cove	Shipwright	Soil, Groundwater, Sediment	Metals, hydrocarbons TBT
C25	Esquimalt Graving Dock	AEC 11 – Waterlot sediments	Sediment	Metals, PAHs, PCBs, TBT Hydrocarbons
C26	Victoria Plywood, Thetis Cove	Pollution Control Permit for discharge into harbour	Sediment	Phenols, hydrocarbons Metals
C27	Northern part of Esquimalt Harbour	Log booming causing accumulation of wood waste on sea floor	Sediments, Aquatic life	Organic material
C28	Dockyard	Operational activities associated with moored ships at docks at Dockyard	Sediment, Aquatic life	Metals, PAHs, TBT,

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
C29	Colwood	Operational activities associated with moored ships at docks at CFB Esquimalt, Colwood	Sediment, Aquatic life	Metals, PAHs, TBT
C30	CFSA, Munroe Head	Operational activities associated with small docks, including scraping and repainting small boats	Sediment, Aquatic life	Metals, PAHs, TBT
C31	Upland area to the north and west of F-Jetty, Colwood	Historical presence of a limestone handling facility, historical presence of a sawmill and booming grounds.	Soil, Groundwater, Sediment	Not known
C32	Shoreline of View Royal	Historical commercial activities in the area	Sediment, Aquatic life	Not known
C33	Esquimalt Harbour mouth	Antisubmarine cables, potentially lead lined	Sediment, Aquatic life	Metals
C34	Esquimalt Harbour	Cable ties from log booming activities in the harbour	Sediment, Aquatic life	Metals
C35	Millstream Creek (entering Esquimalt Harbour)	Upstream historical and current activities	Sediment, Aquatic life	Not known
C36	G-Jetty, Colwood	Ship maintenance	Sediment, Aquatic life	Metals, PAHs, TBT
C37	F-Jetty, Colwood	Harbour basin used as a mortar range	Sediment, Aquatic life	Metals
C38	D-Jetty, Colwood	Materials store	Soil, Groundwater, Sediment	Not known
C39	Small wharf in Pilgrim Cover	Activities associated with small wharfs	Sediment Aquatic life	Not known
APEC D - Treated Timbers				
D1	A-Jetty and floating docks, Dockyard and Signal Hill	Leaching of preservatives from treated timber piles	Sediments	PAHs
D2	Pilgrim Cove	Leaching of preservatives from treated timber piles	Sediments	PAHs
D3	Esquimalt Graving Dock	Leaching of preservatives from treated timber piles	Sediments	PAHs
D4	CFSA, Munroe Head	Leaching of preservatives from treated timber piles	Sediment	PAHs
D5	Shoreline of View Royal	Leaching of preservatives from small docks and jetties constructed using treated timber piles.	Aquatic receptors, Sediments	PAHs, metals, hydrocarbons
D6	G-Jetty, Colwood	Leaching of preservatives from treated timber piles	Sediments, Aquatic receptors	PAHs

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
D7	D-Jetty, Colwood	Leaching of preservatives from treated timber piles	Sediments, Aquatic receptors	PAHs
D8	Plumper Bay	Leaching of preservatives from treated timber piles	Sediments, Aquatic receptors	PAHs
APEC E - PCBs				
E1	East of C-Jetty, adjacent to Yarrows area	Pole mounted transformers	Soil, groundwater, sediments	PCBs
E2	Victoria Plywood, Thetis Cove	PCB contamination from improperly stored capacitors	Soil, Groundwater	PCBs
E3	G-Jetty, Colwood	Pole mounted transformers	Soil, Groundwater, Sediment	PCBs
E4	Colwood Bunkers	PCB storage	Soil, Groundwater, Sediment	PCBs
APEC F - Spills				
F1	West Isle Site, Plumper Bay	Chlorophenols from spill	Soil, Groundwater	Chlorophenols
F2	Victoria Plywood, Thetis Cove	Leak of hydraulic oil and chain oil	Soil, Groundwater	Hydrocarbons
F3	Shoreline of View Royal	Local storage of domestic quantities of chemicals and paints with spill potential.	Aquatic receptors, Sediments	PAHs, metals, hydrocarbons
F4	Dunns Nook, Colwood	Spillage	Soil, Groundwater, Sediment	Hydrocarbons
F5	Harbour wide	Spillages into the harbour	Sediments, Aquatic life	Unknown
APEC G - Stormwater Outfalls				
G1	Harbour wide stormwater outfalls	Discharge of contaminated sediments from upland sources	Sediment, Aquatic life	Metals, PAHs
G2	Esquimalt Graving Dock stormwater outfalls	Stormwater outfalls	Sediment	Metals TBT

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Esquimalt Harbour Overview & Areas



Main Map Extent

Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Un-surveyed seafloor
- Federal Harbour Limit

APECs

- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or PAHs

Notes

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2. Locations should be considered approximate.
3. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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0 200 400 600 800
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

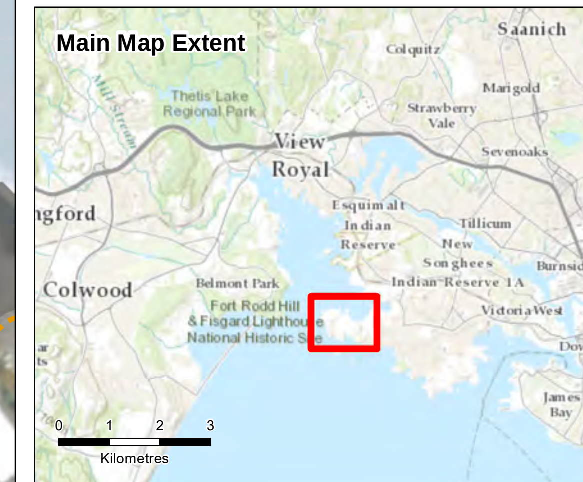
376-240.04	Production Date: Nov 23, 2016	Figure 1

HEMMERA

Public Works and Government Services Canada

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Dockyard & Signal Hill



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- Un-surveyed seafloor
- Federal Harbour Limit

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 2

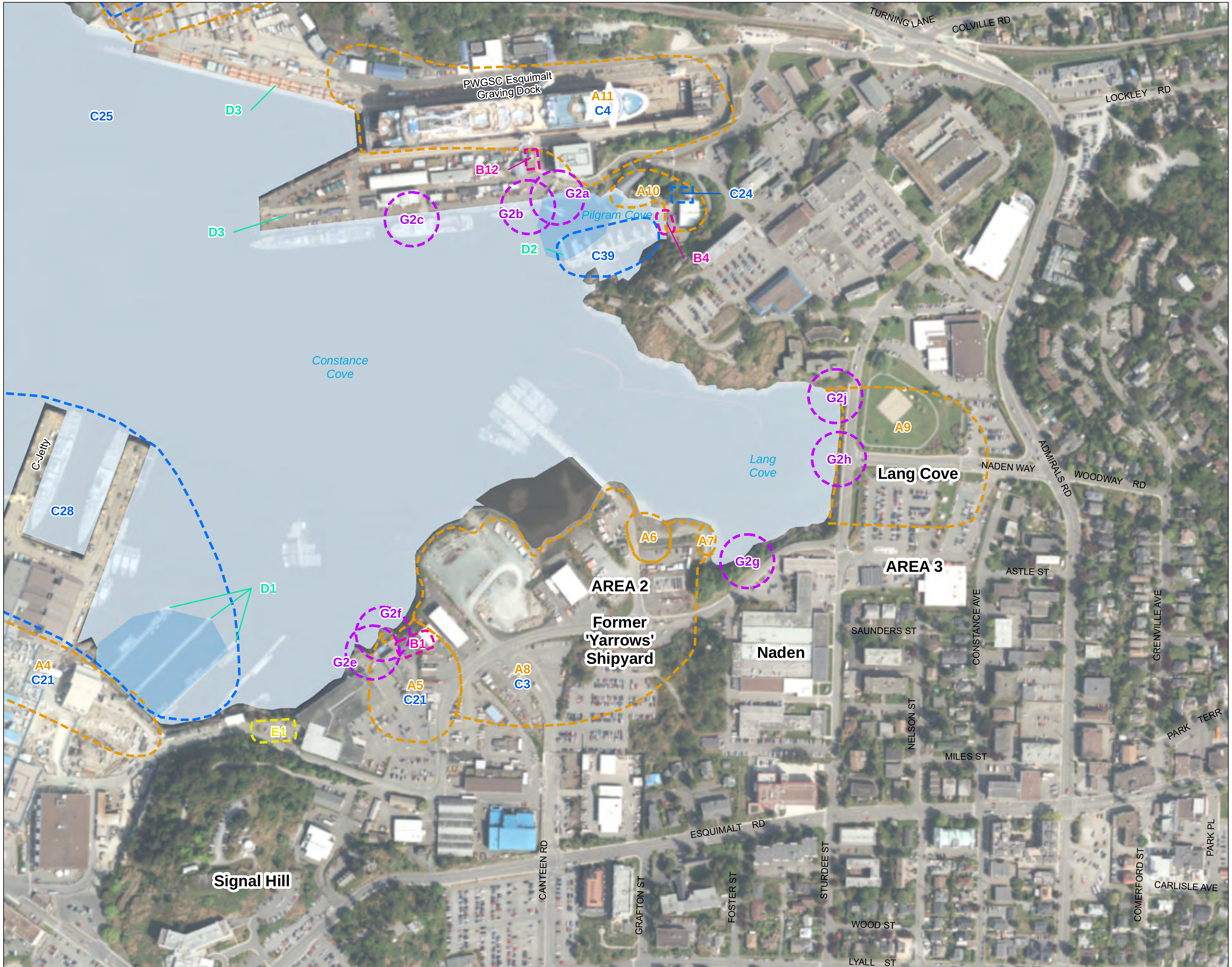
HEMMERA

Public Works and Government Services Canada

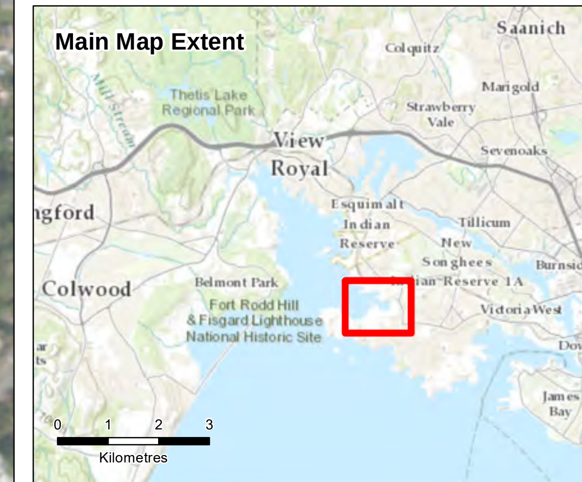
Path: O:\376\240\04\mxd\Fig2-9_376_240_04_APECs_Detailed_161024.mxd

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Yarrows, Naden, & Lang



Main Map Extent



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- Un-surveyed seafloor

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

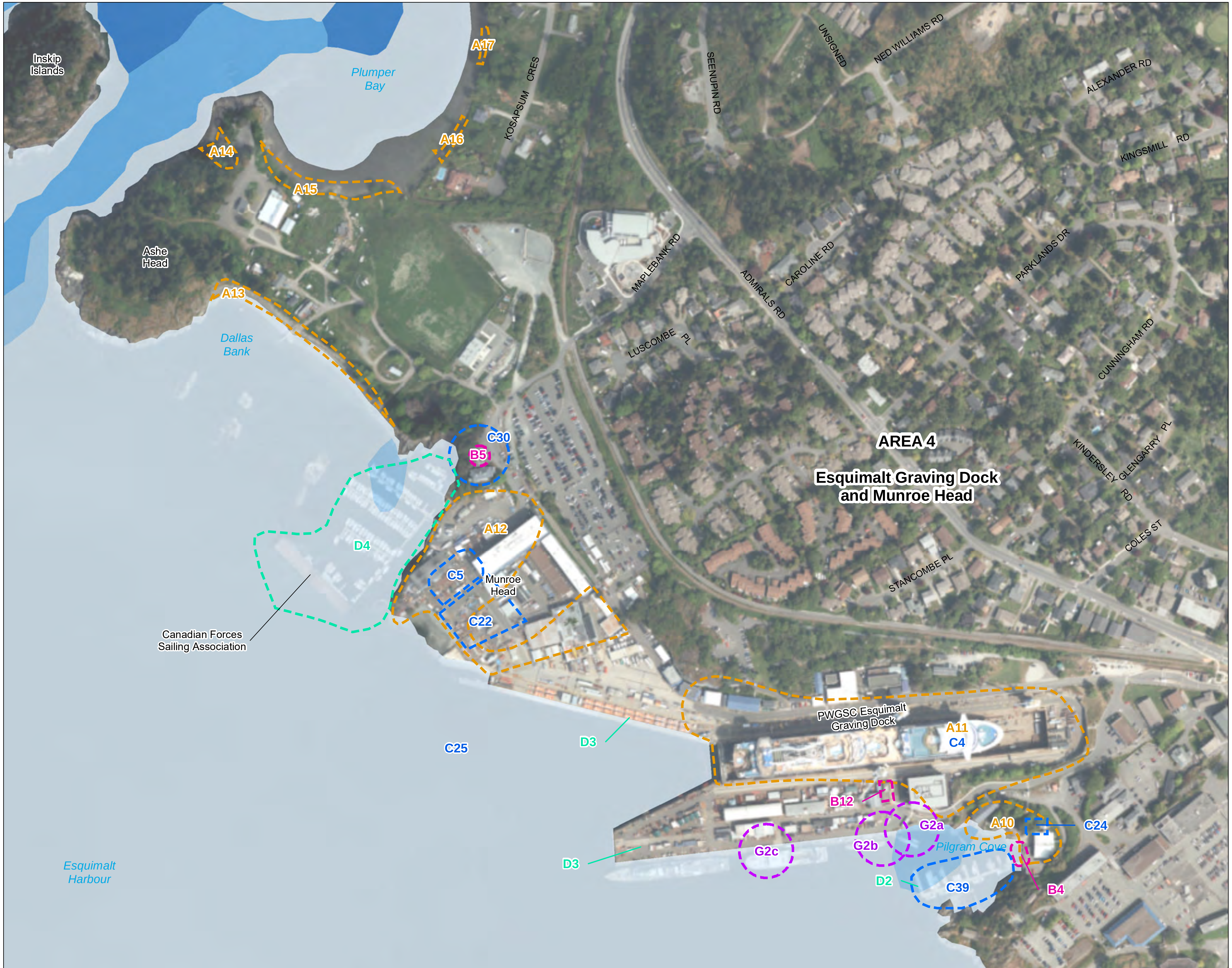
Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 3

HEMMERA
Public Works and Government Services Canada

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Graving Dock & Munroe Head



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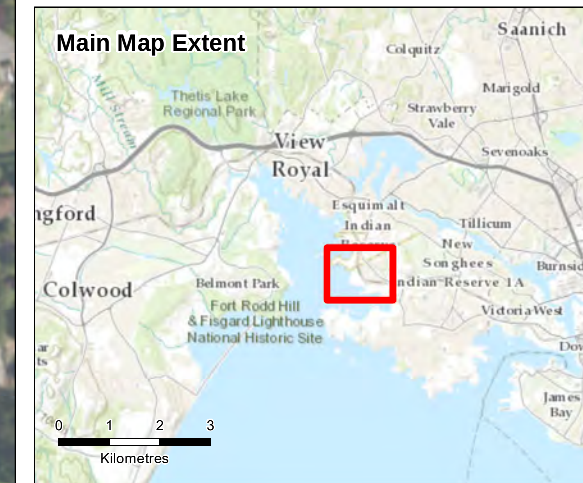

Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 4

HEMMERA

Public Works and Government Services Canada

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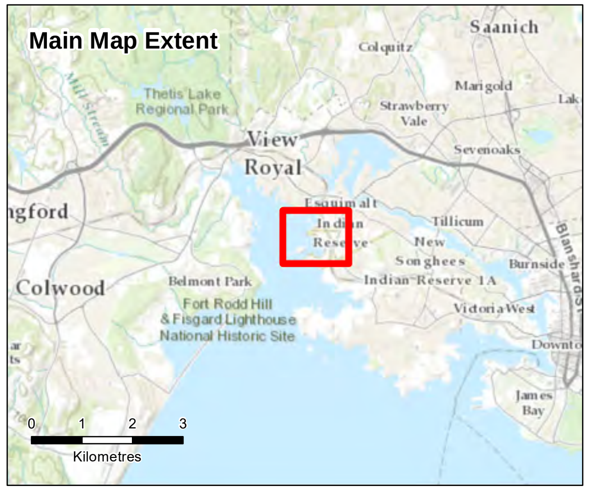
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Esquimalt and Songhees Reserve

Main Map Extent



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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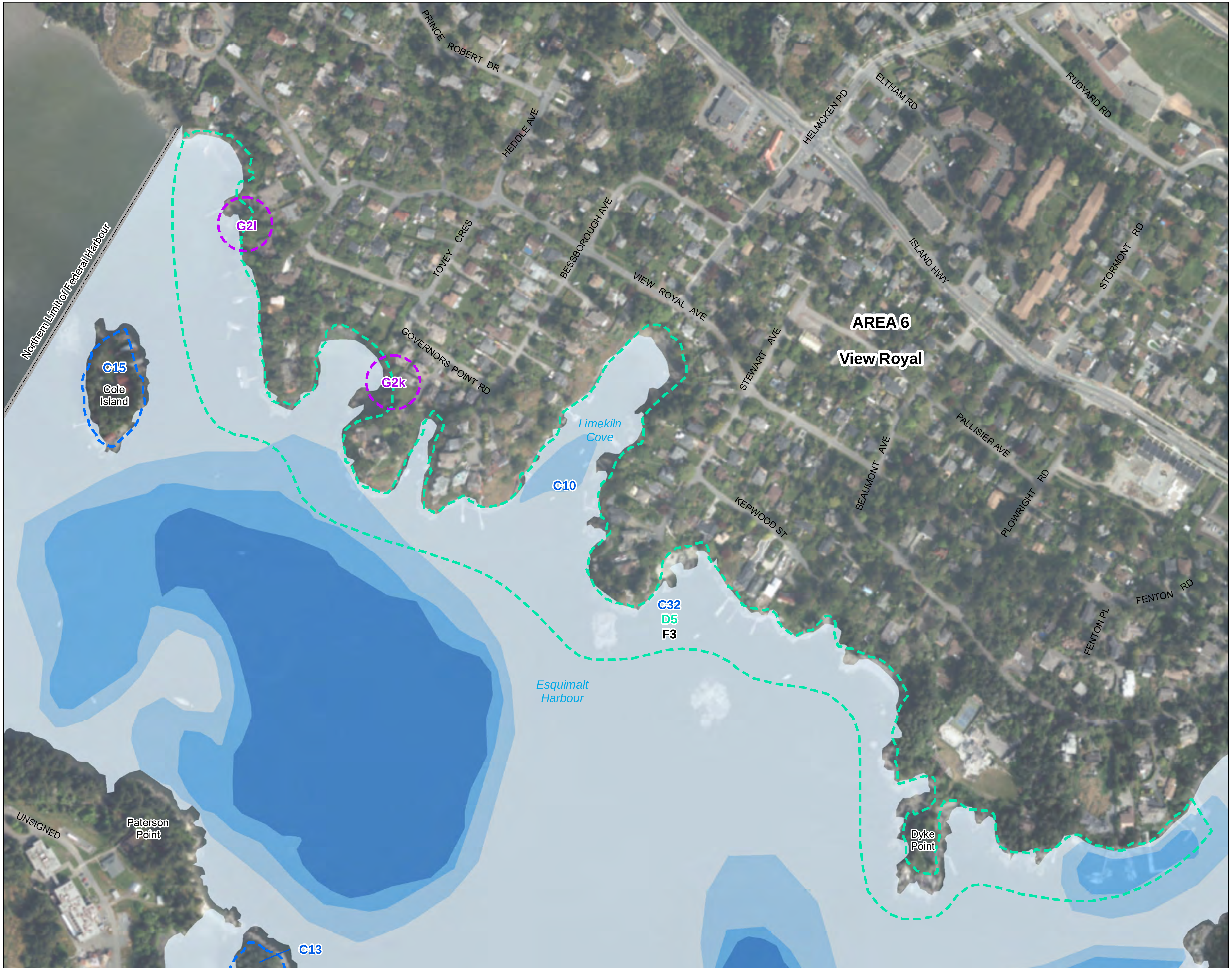
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

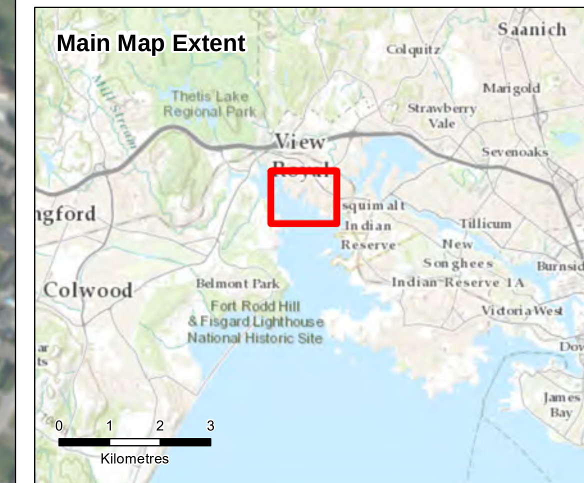
376-240.04	Production Date: Nov 23, 2016	Figure 5

HEMMERA
Public Works and Government Services Canada



Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - View Royal



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Federal Harbour Limit

APECs

- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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0 50 100 150 200

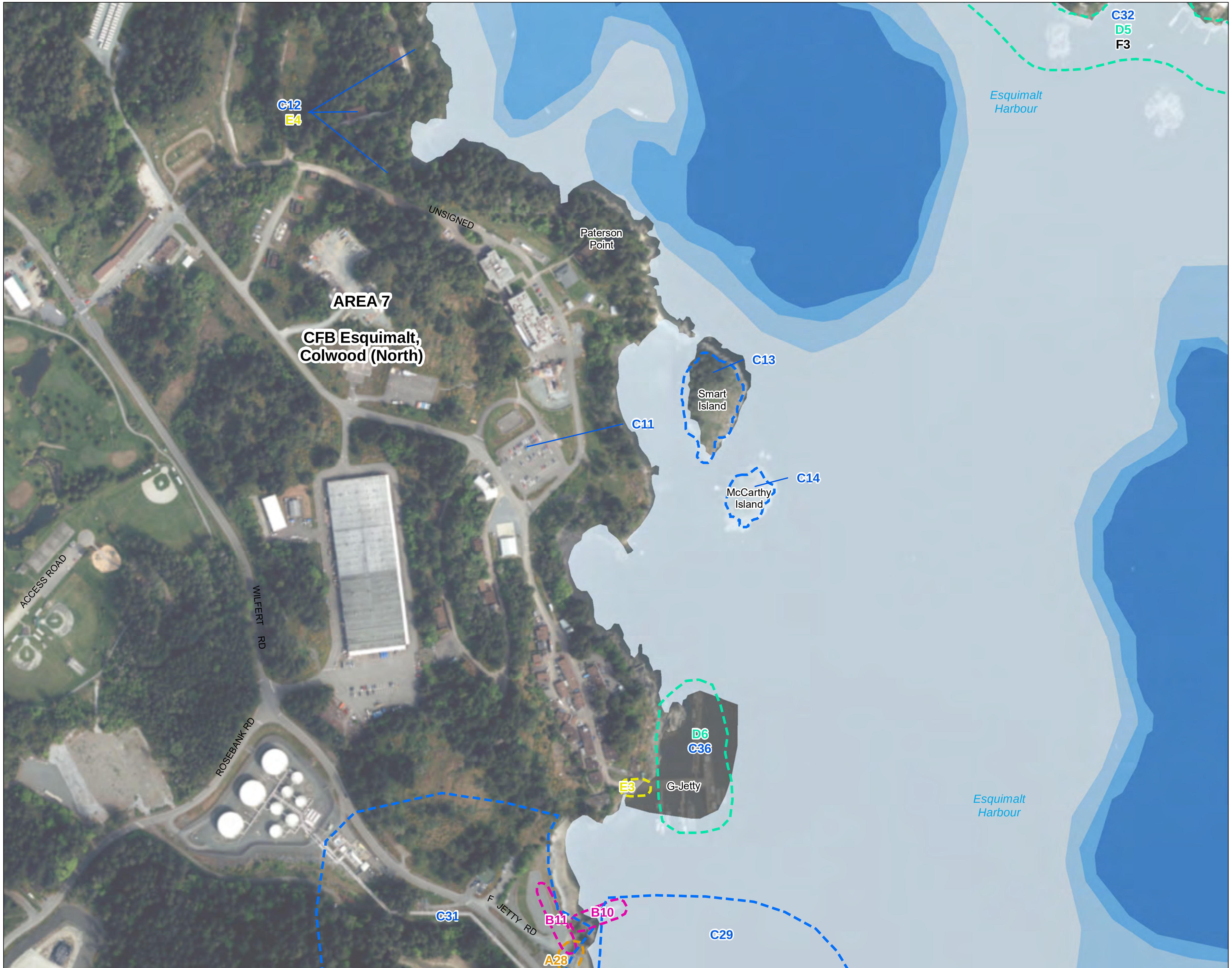
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

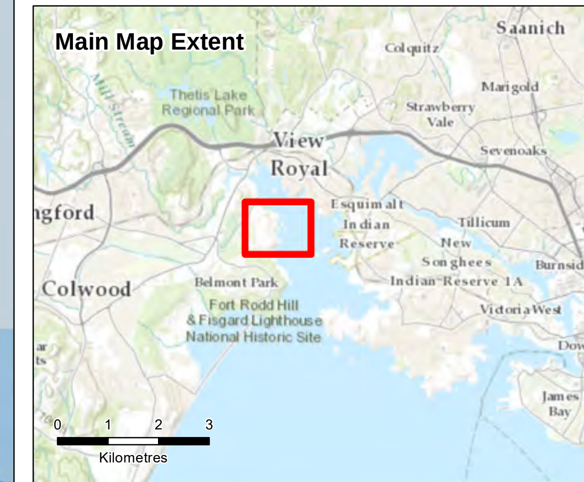
376-240.04	Production Date: Nov 23, 2016	Figure 6

HEMMERA Public Works and Government Services Canada



Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - CFB Esquimalt, Colwood (North)



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Un-surveyed seafloor

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

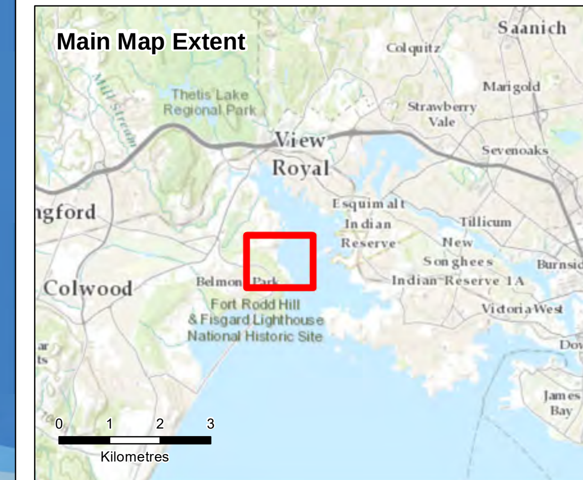
376-240.04	Production Date: Nov 23, 2016	Figure 7

HEMMERA
Public Works and Government Services Canada

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - CFB Esquimalt, Colwood (Central)

Main Map Extent



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Un-surveyed seafloor

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 8

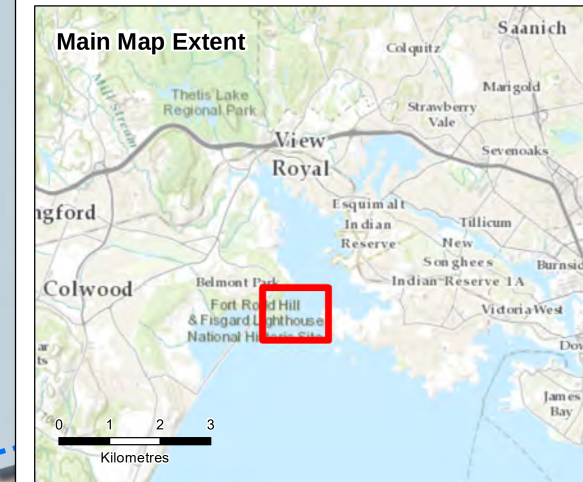
HEMMERA

Public Works and Government Services Canada

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Fort Redd Hill National Historic Site

Main Map Extent



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- Federal Harbour Limit

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:4,000

0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 9

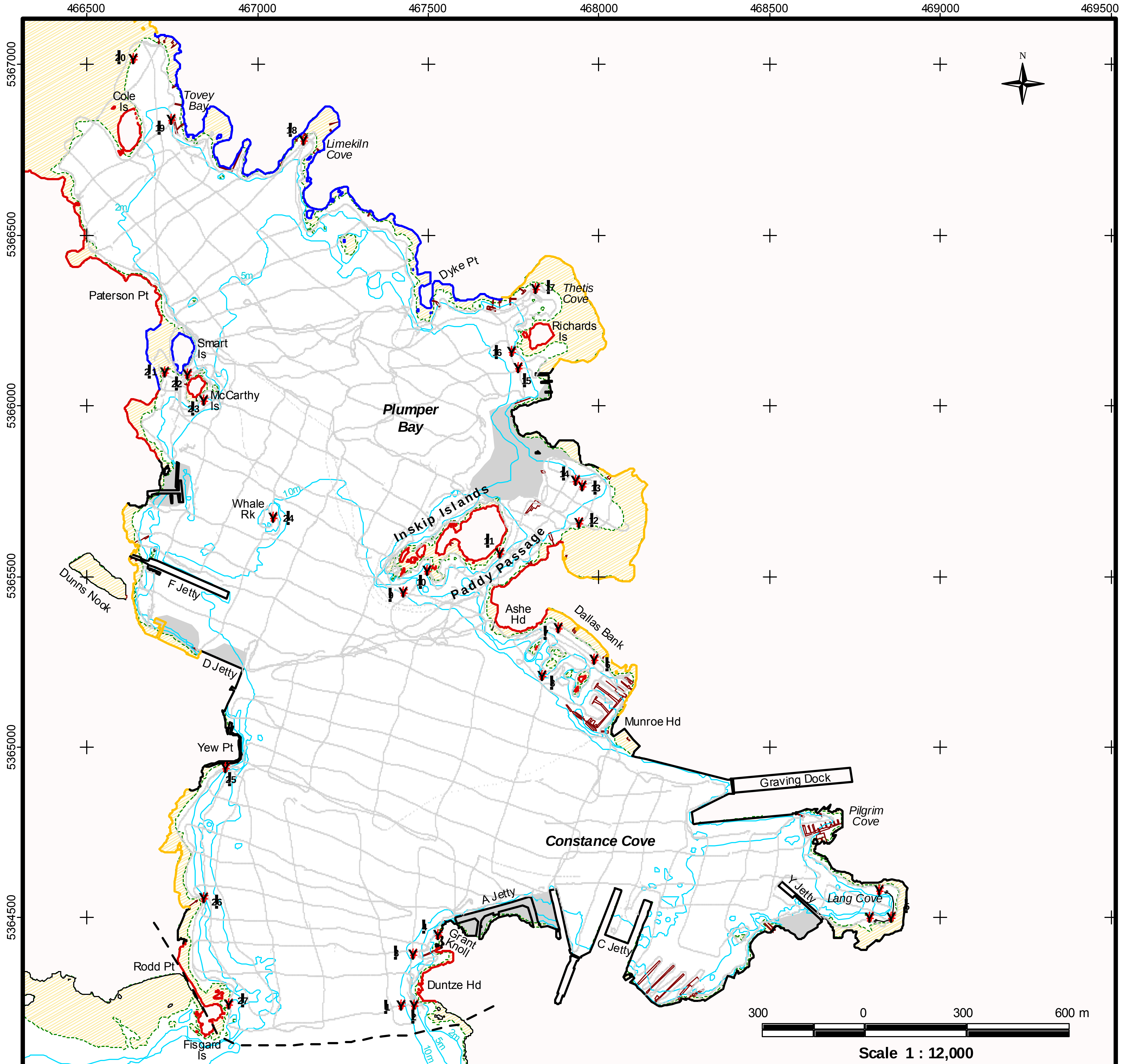
HEMMERA

Public Works and Government Services Canada

APPENDIX E

Background Biophysical Conditions of Esquimalt Harbour

7.0 MAP FOLIO



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 3. Video Survey Tracklines & Dive Observation Sites

Dive Sites

Site number (see Report text, Table 3)

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
0m Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

Physical Shore Type *

Rock

Rock and Sediment

Sediment

Estuary, Marsh or Lagoon

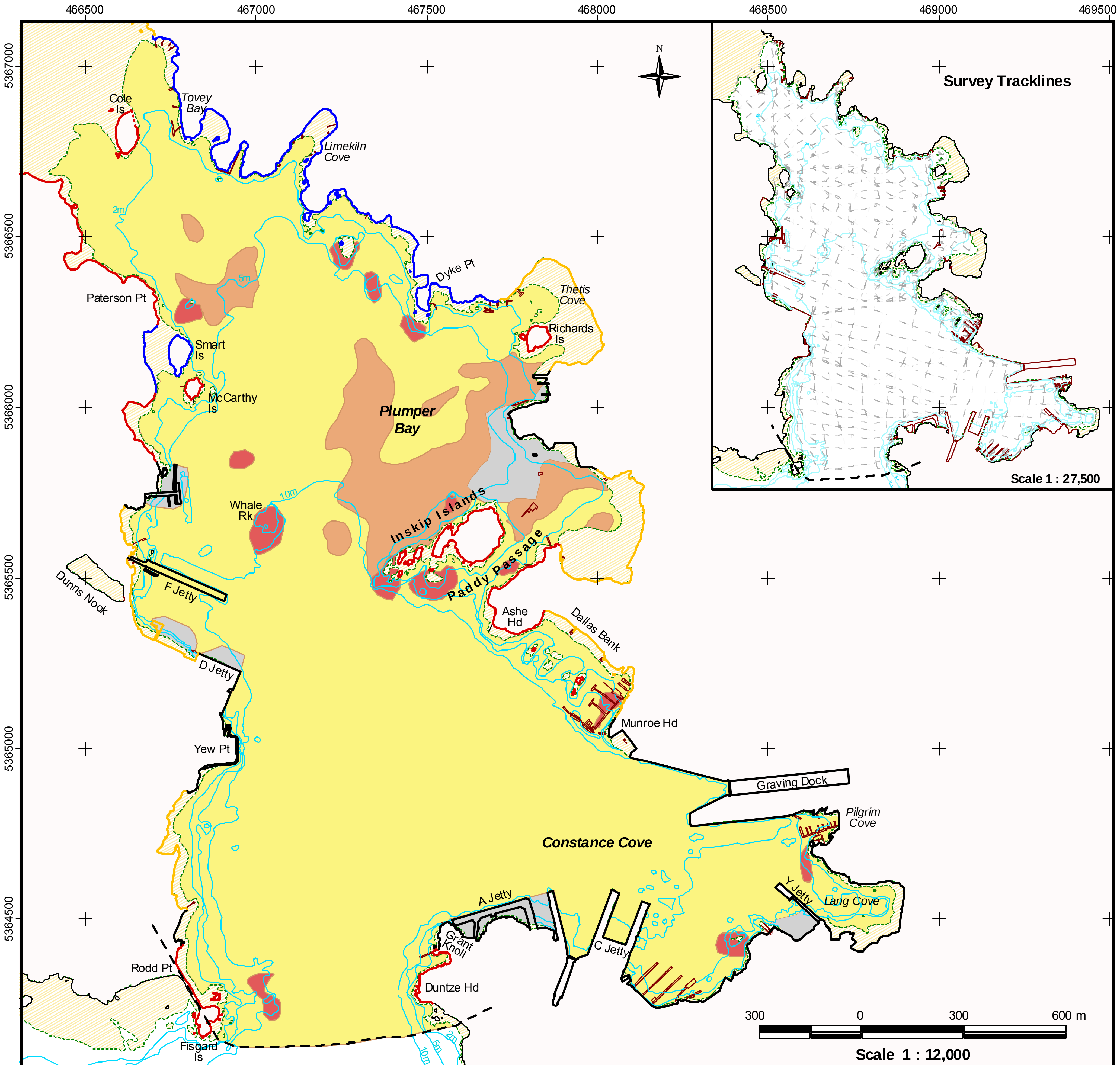
Man-Made

* Source: Westland, 2000

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 4. Substrate Type

Sediment

Rock or rock with sediment veneer

Wood & bark debris (substrate obscured)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

Physical Shore Type *

Rock

Rock and Sediment

Sediment

Estuary, Marsh or Lagoon

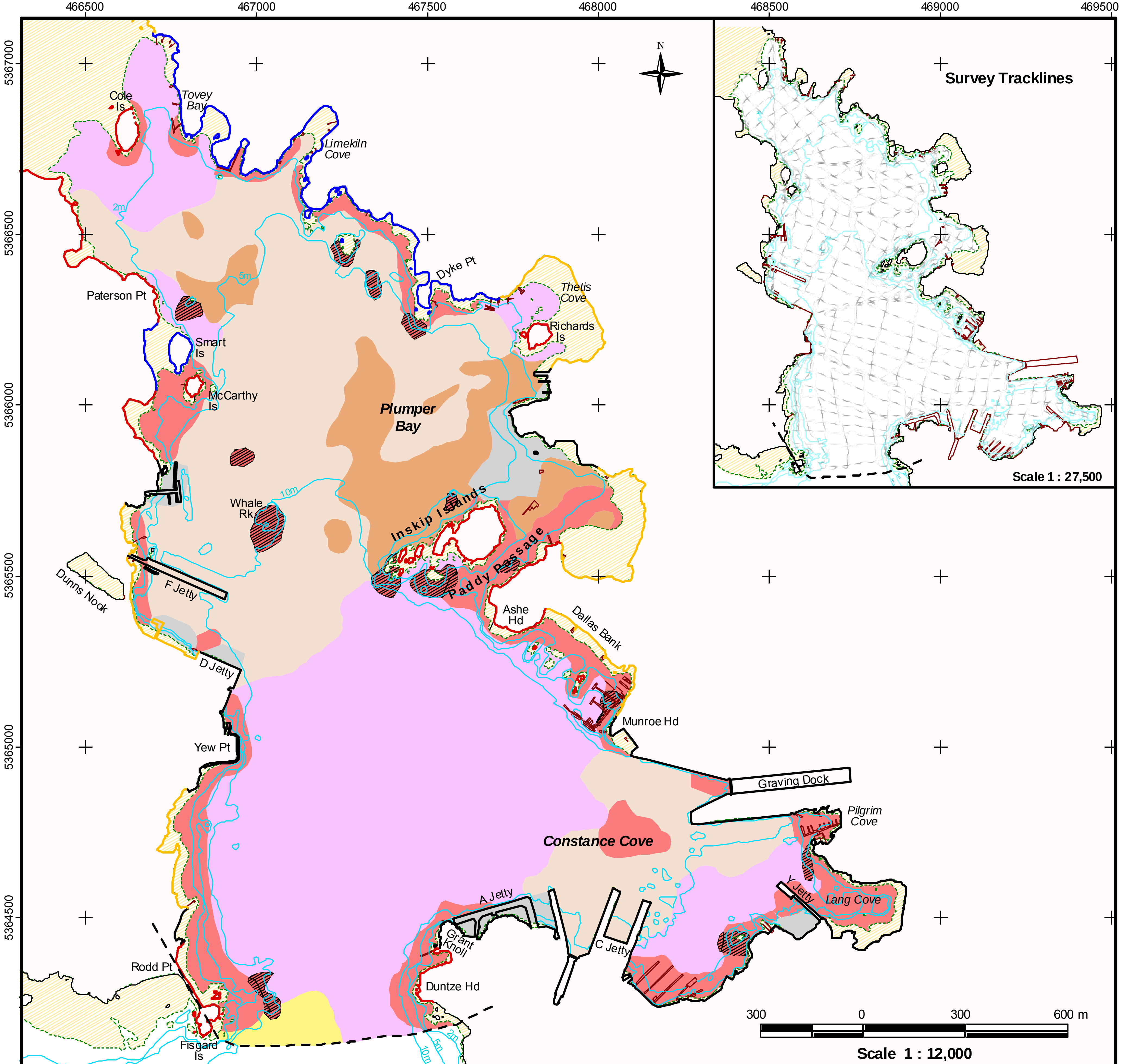
Man-Made

* Source: Westland, 2000

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 5. Sediment Size Class

- Gravel
- Gravelly Mud/Sand
- Mud/Sand
- Sand
- Rock or rock with sediment veneer
- Wood & bark debris (substrate obscured)

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

Physical Shore Type *

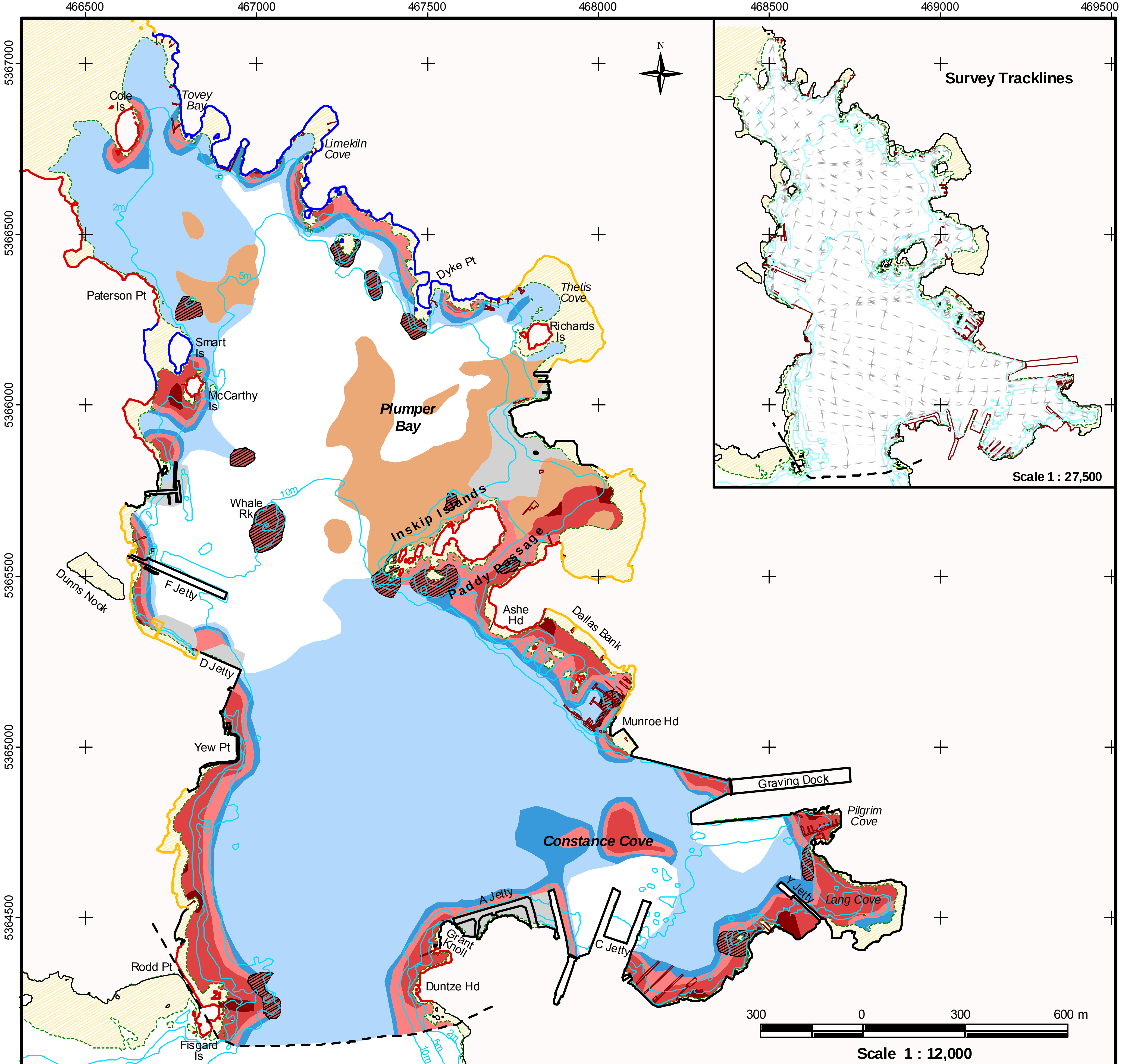
- Rock
- Rock and Sediment
- Sediment
- Estuary, Marsh or Lagoon
- Man-Made

* Source: Westland, 2000

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 6. Gravel Cover

- Trace - 5%
- 5 - 30%
- 30 - 50%
- 50 - 80%
- > 80%
- Rock or rock with sediment veneer
- Wood & bark debris (substrate obscured)

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

Physical Shore Type *

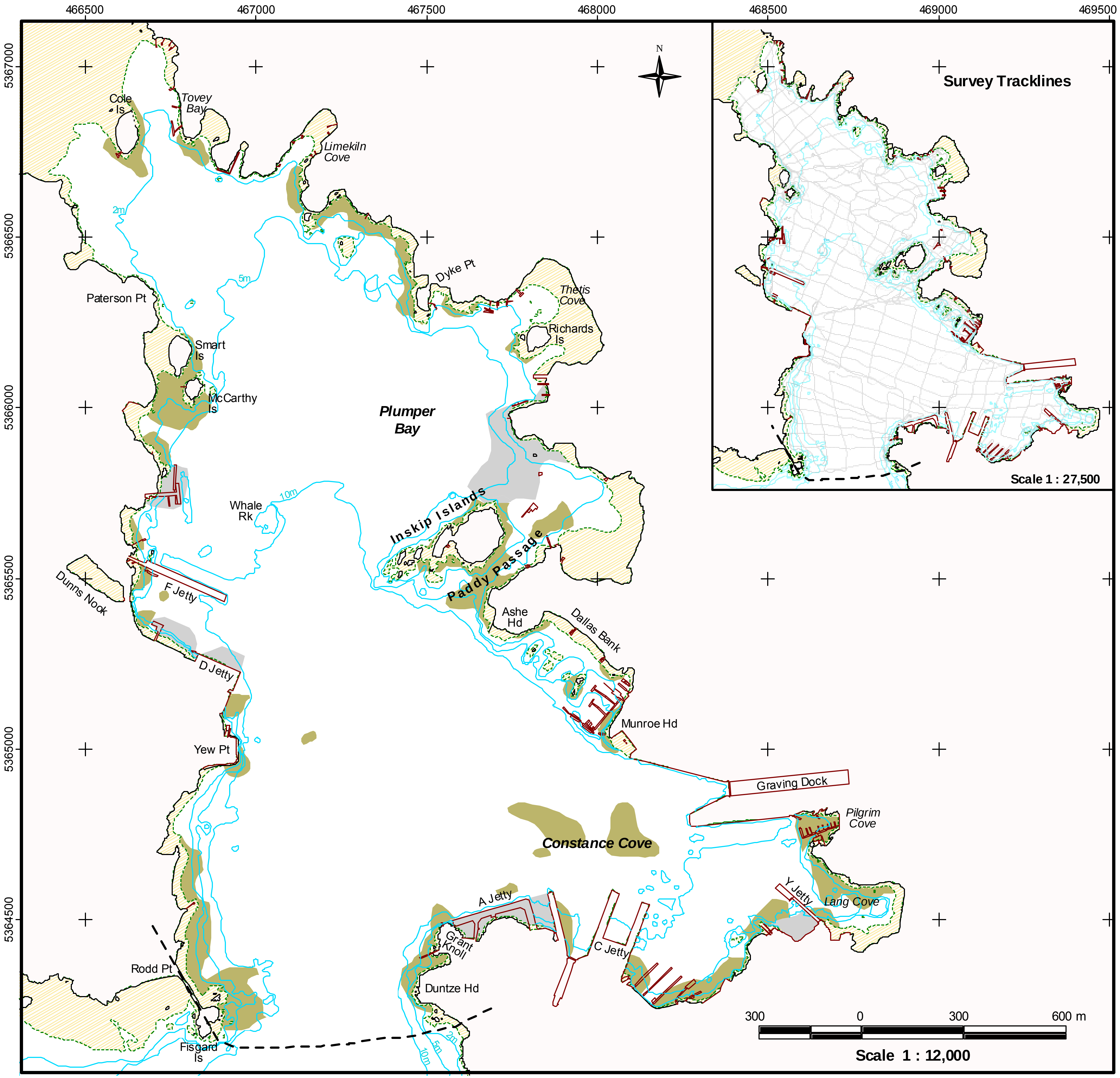
- Rock
- Rock and Sediment
- Sediment
- Estuary, Marsh or Lagoon
- Man-Made

* Source: Westland, 2000

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 7. Boulder and Cobble Cover

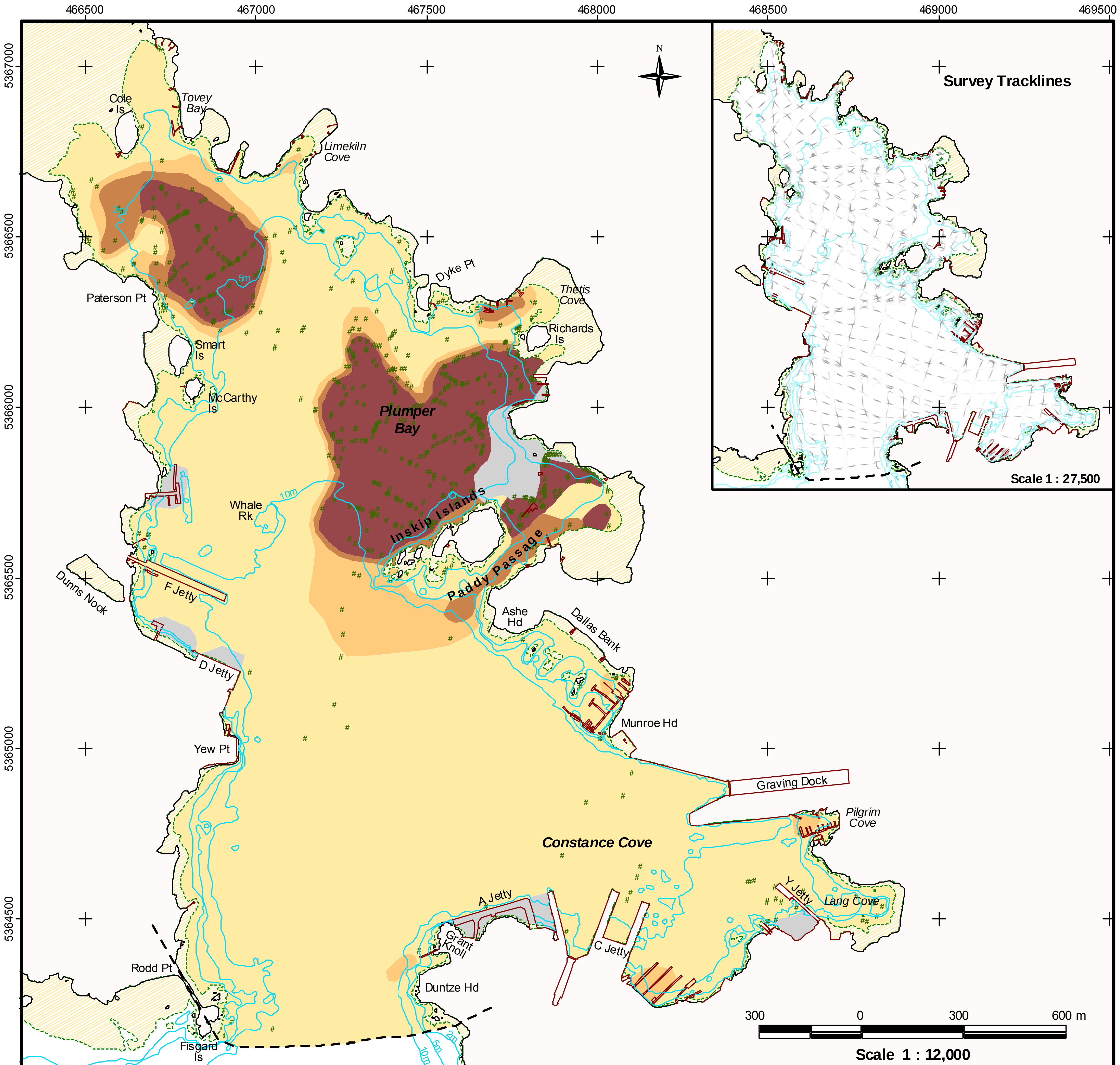
Trace to 5%

Shoreline
Pier/Wharf/Jetty/Dock
0m Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 8. Organic Cover

Trace - 5%
5 - 30%
30 - 80%
> 80%

Logs

Shoreline
Pier/Wharf/Jetty/Dock
Om Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

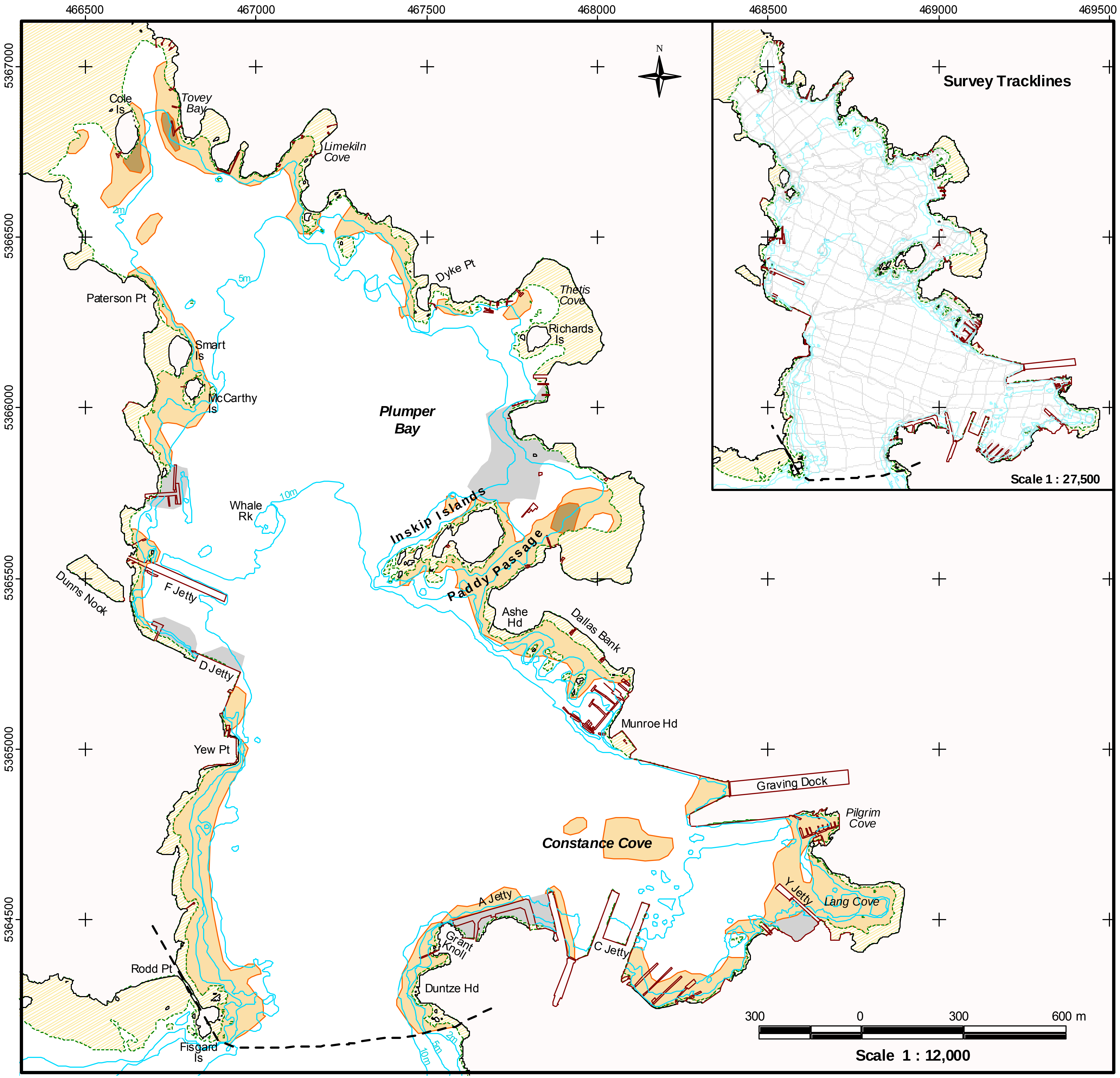
ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 9. Shell Cover



5 - 30%

30 - 50%

Shoreline

Pier/Wharf/Jetty/Dock

0m Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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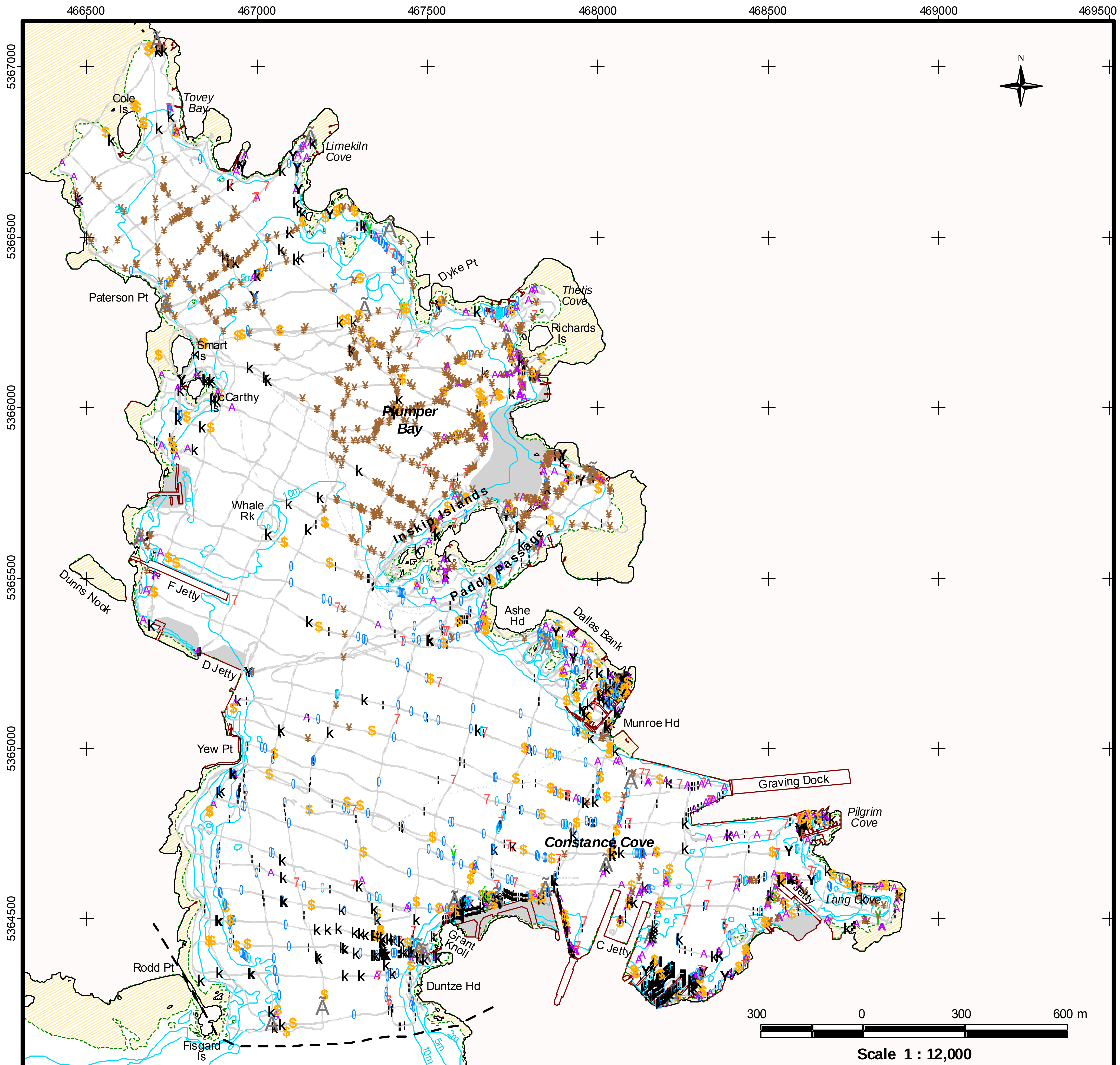
Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 10. Man-made Objects

- Bottle
- Aggregation of Bottles
- Cable/Wire/Rope
- Cans
- Garbage
- Logs
- Metal Objects
- Other
- Pipe
- Tire
- Wood Debris

- Shoreline
- Pier/Wharf/Jetty/Dock
- Om Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

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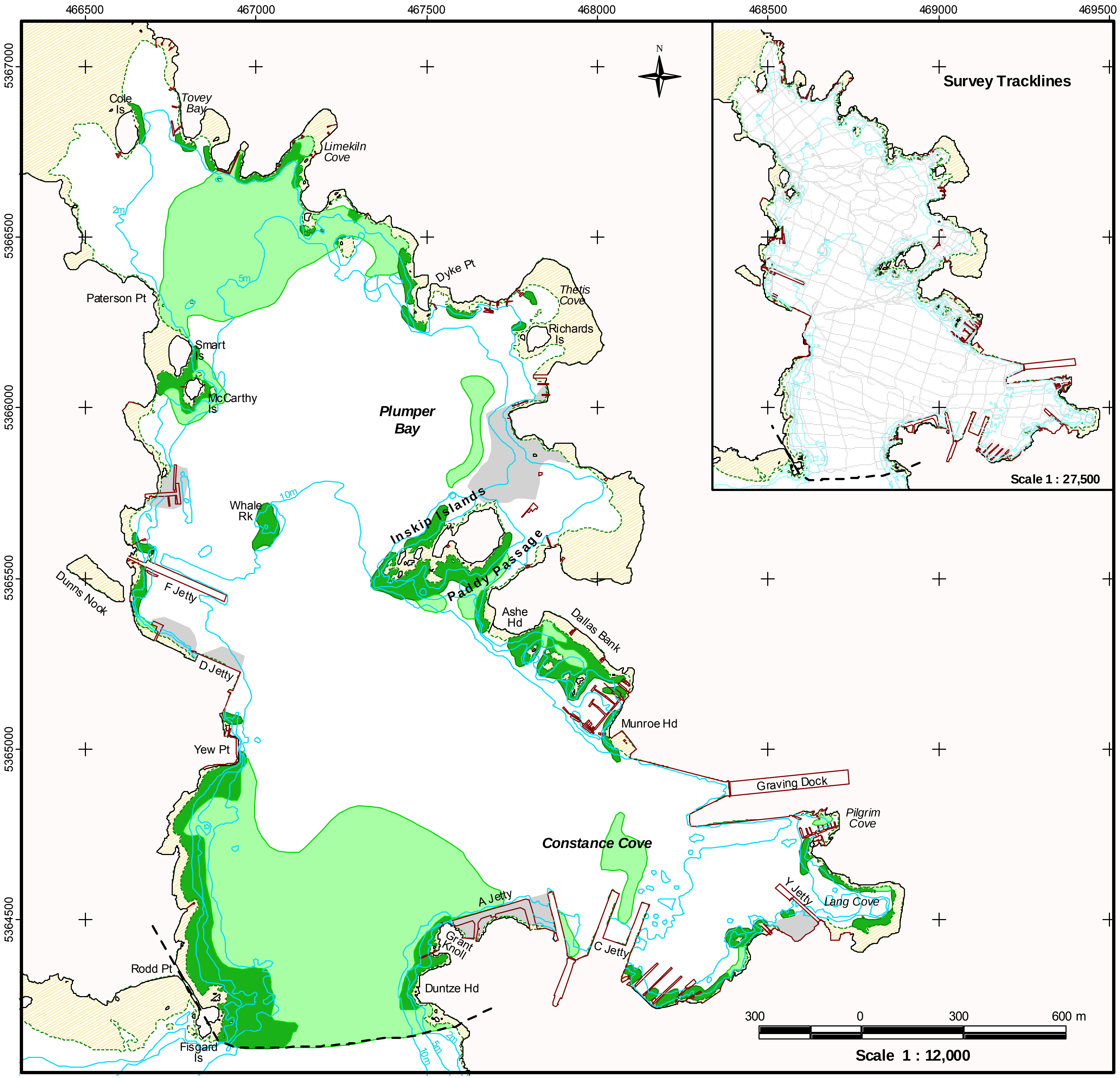
Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 11. Vegetation Cover

Sparse - Low Cover (Trace - 25%)
Moderate - Dense Cover (25 - 100%)

Shoreline
Pier/Wharf/Jetty/Dock
Om Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

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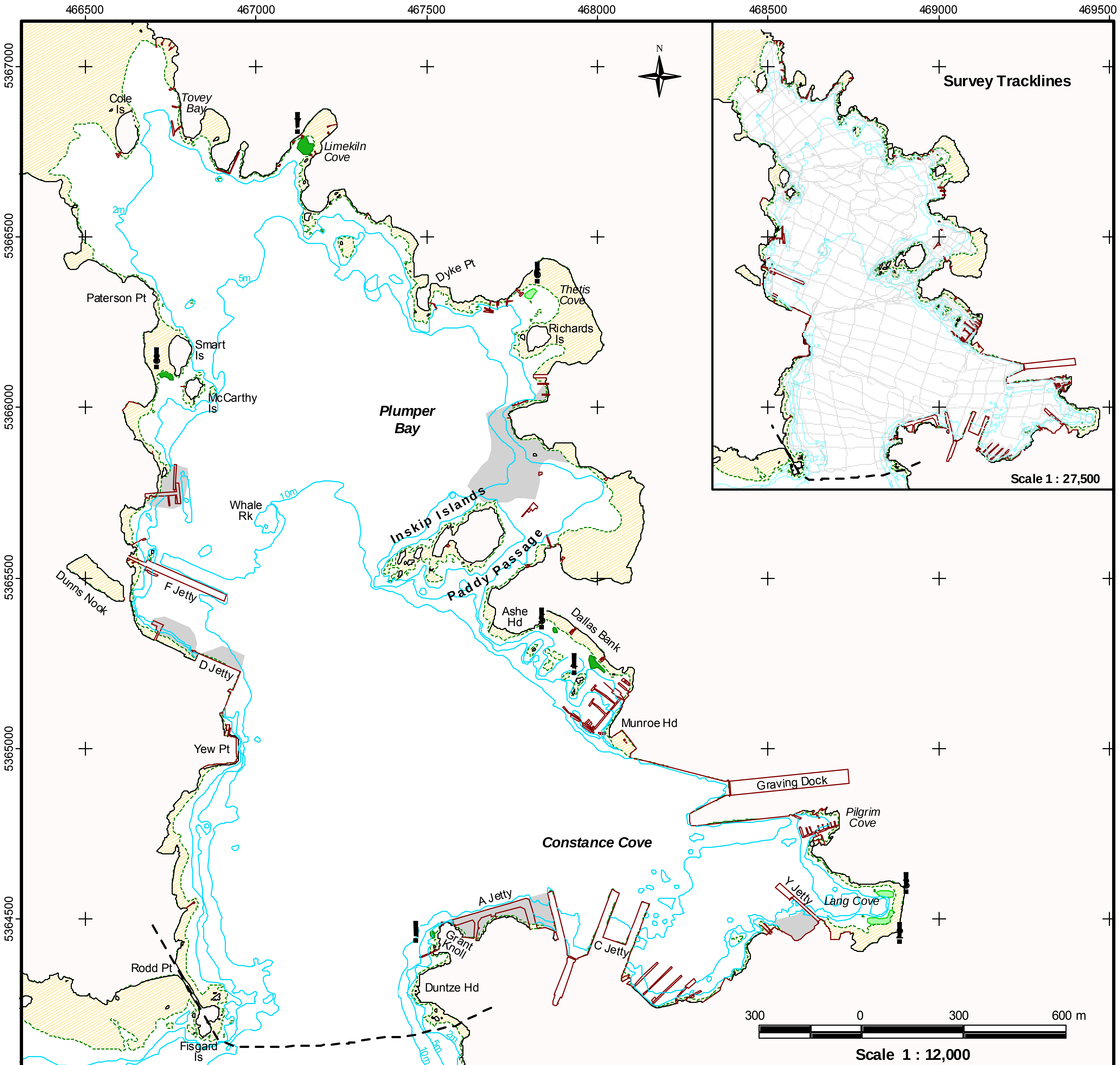
A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 12. Eelgrass Beds *(Zostera marina)*



Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

(#) Eelgrass Bed number (see Report text, Table 10)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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SIMS: March 21-31, 2000
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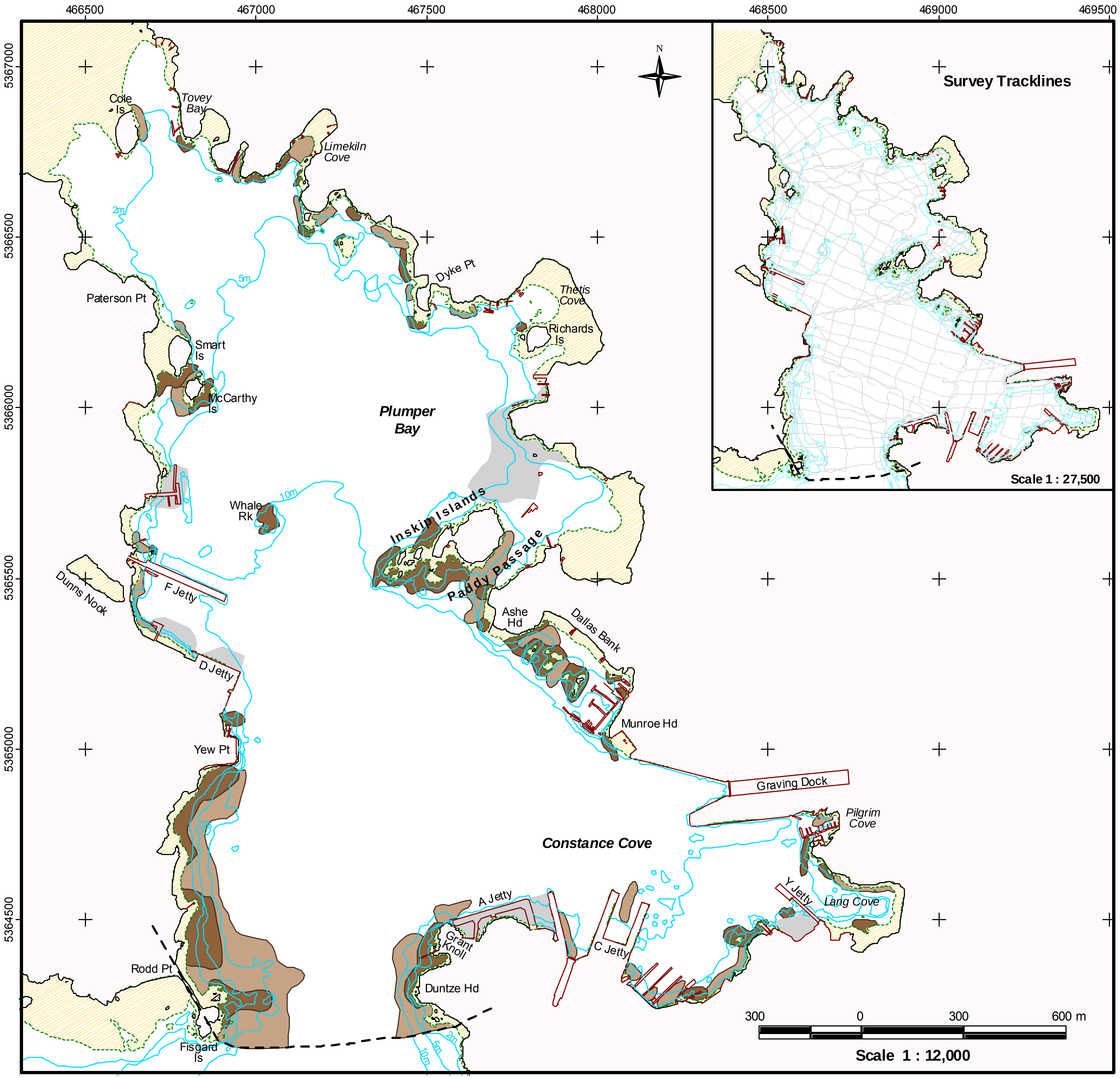
Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 13. Kelps

Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
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Map Edition:
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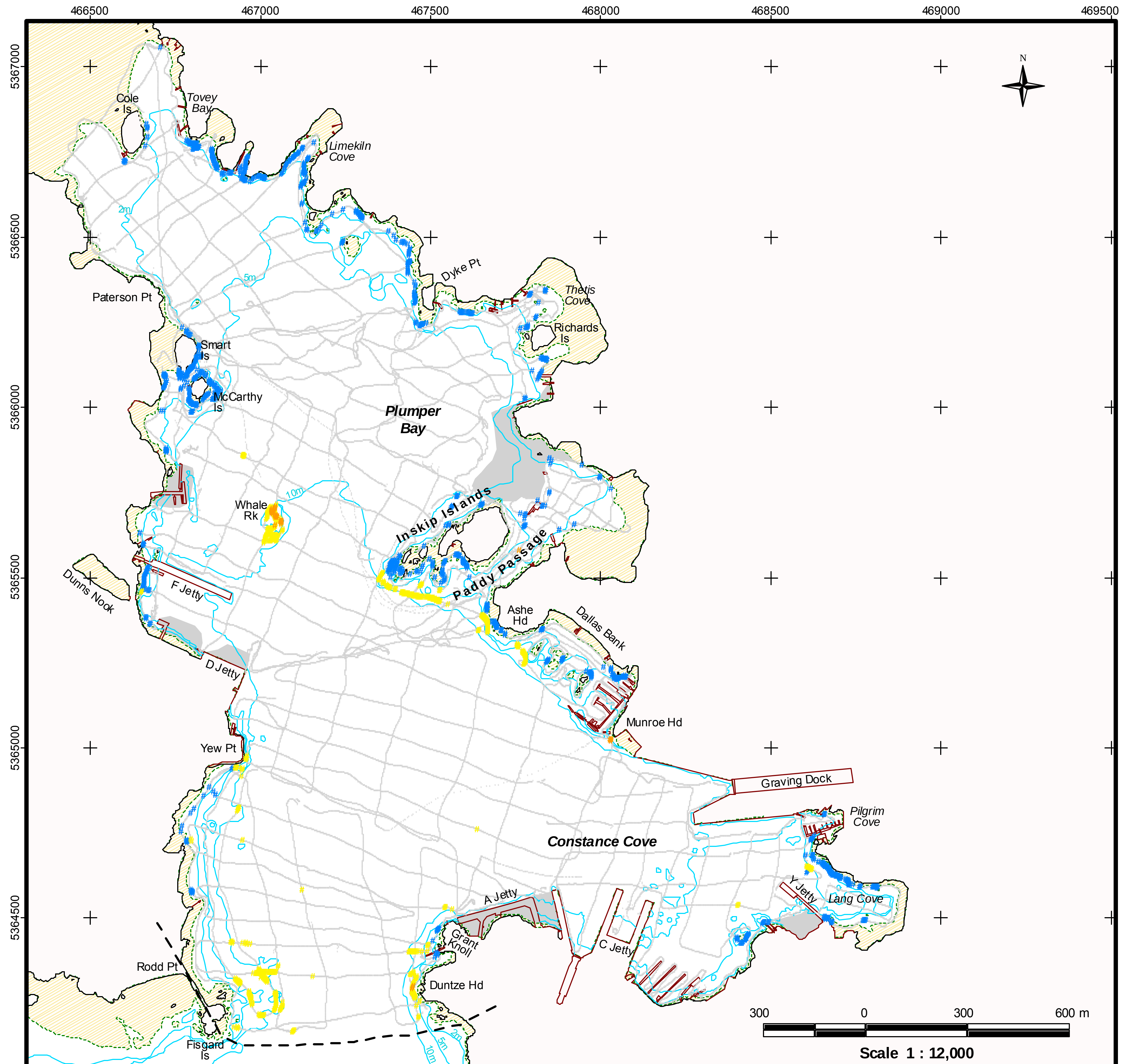

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 14.
Agarum, Nereocystis and Sargassum

Nereocystis leutkeana
Agarum
Sargassum muticum

Shoreline
Pier/Wharf/Jetty/Dock
Om Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

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Survey Dates:
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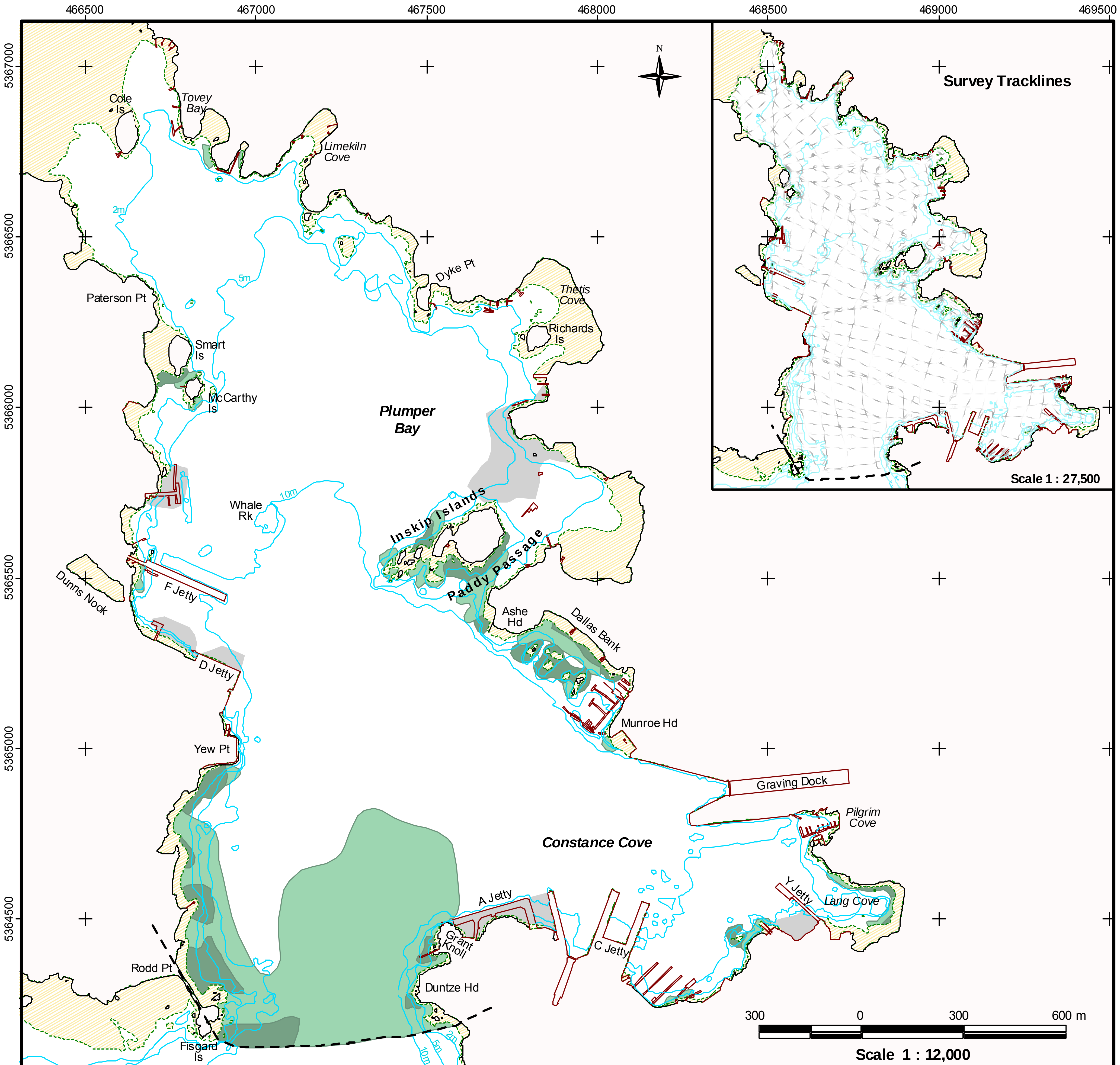

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 15. Foliose Green Algae

Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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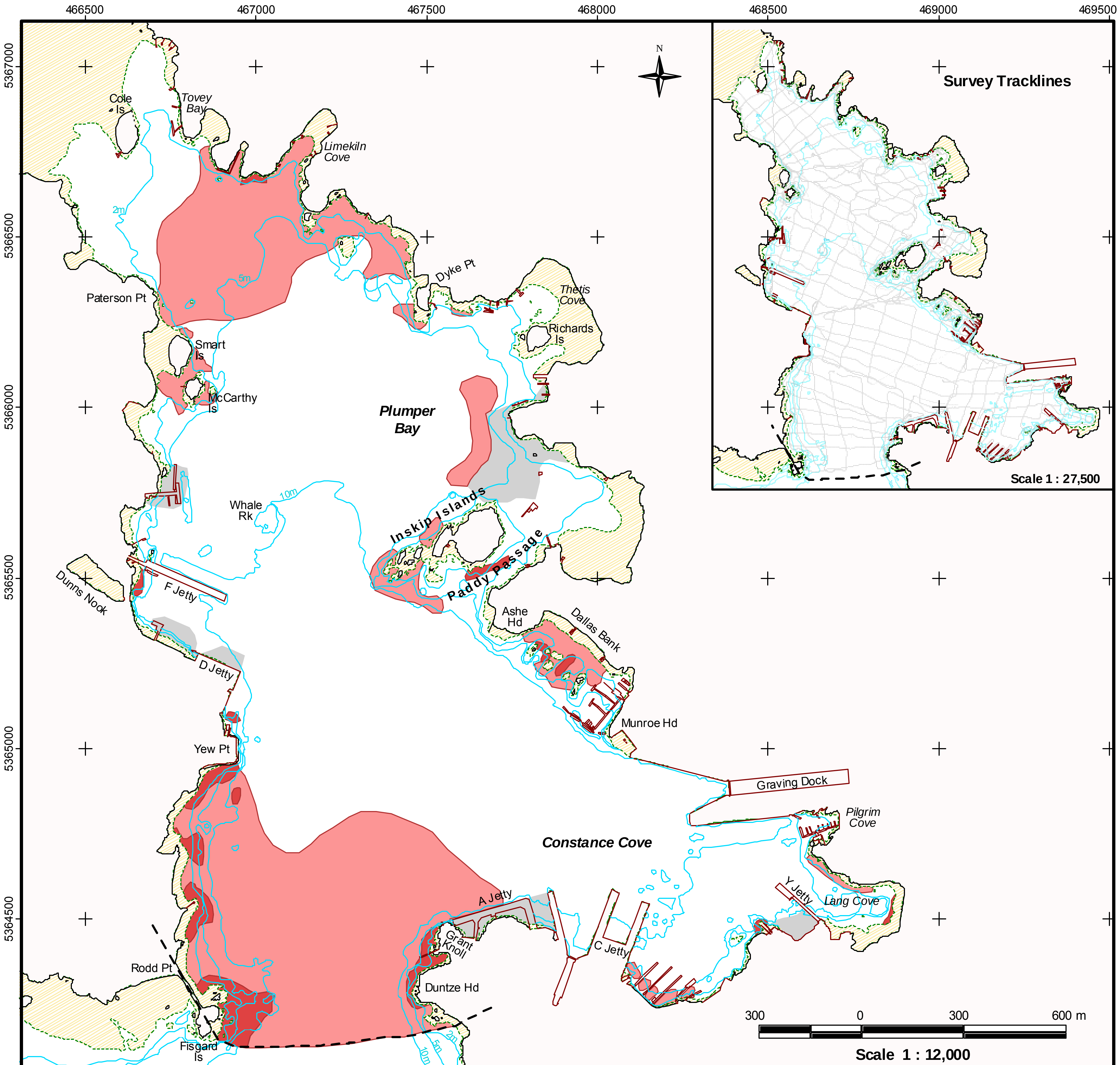

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 16. Filamentous Red Algae

- Sparse - Low Cover (Trace - 25%)
- Moderate - Dense Cover (25 - 100%)

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

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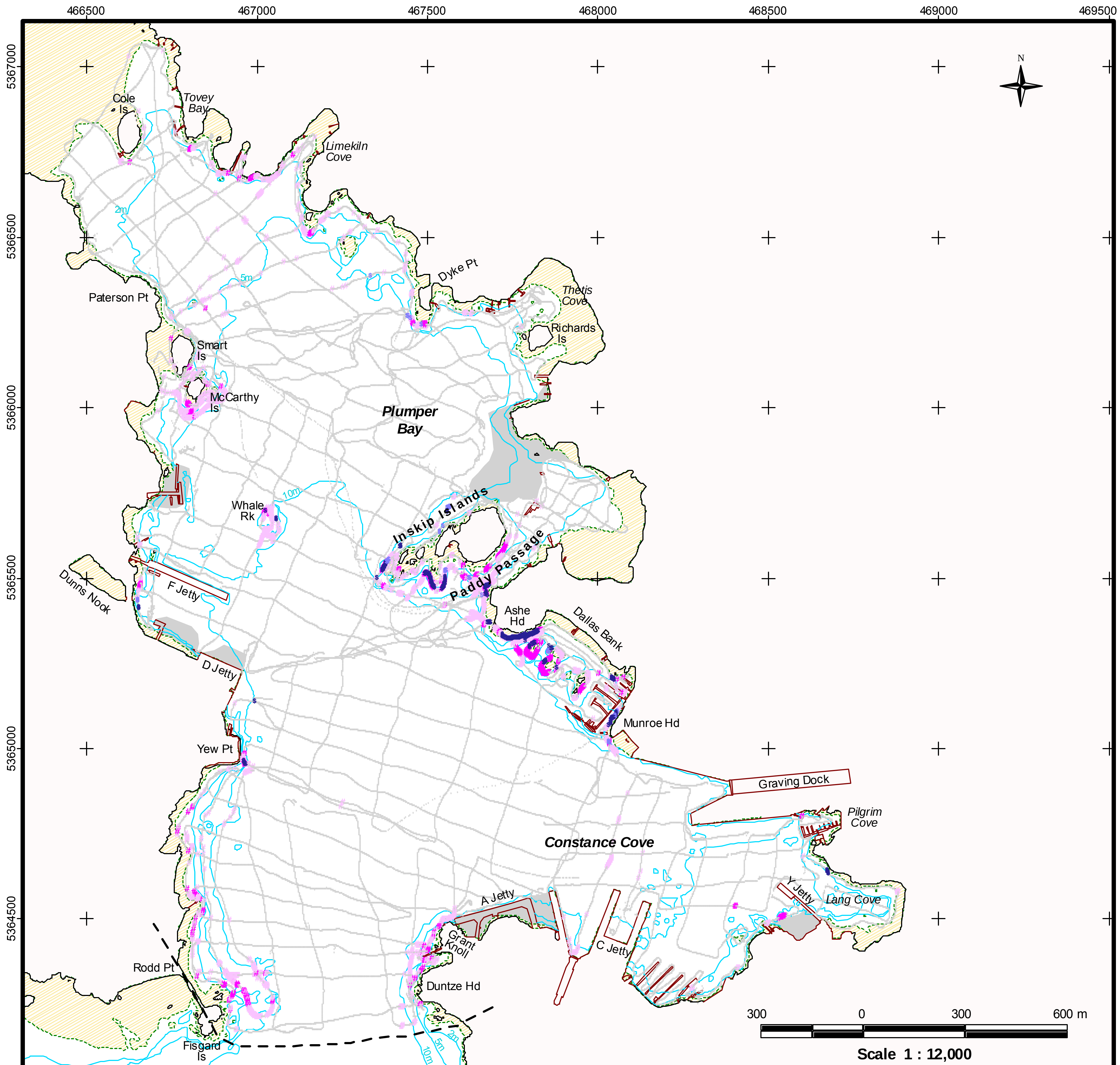
A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 17. Foliose & Coralline Red Algae



Foliose Red Algae

- Sparse - Low Cover (Trace - 25%)
- Moderate - Dense Cover (25 - 100%)

Coralline Red Algae

- Sparse - Low Cover (Trace - 25%)
- Moderate - Dense Cover (25 - 100%)

Shoreline
Pier/Wharf/Jetty/Dock
0m Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
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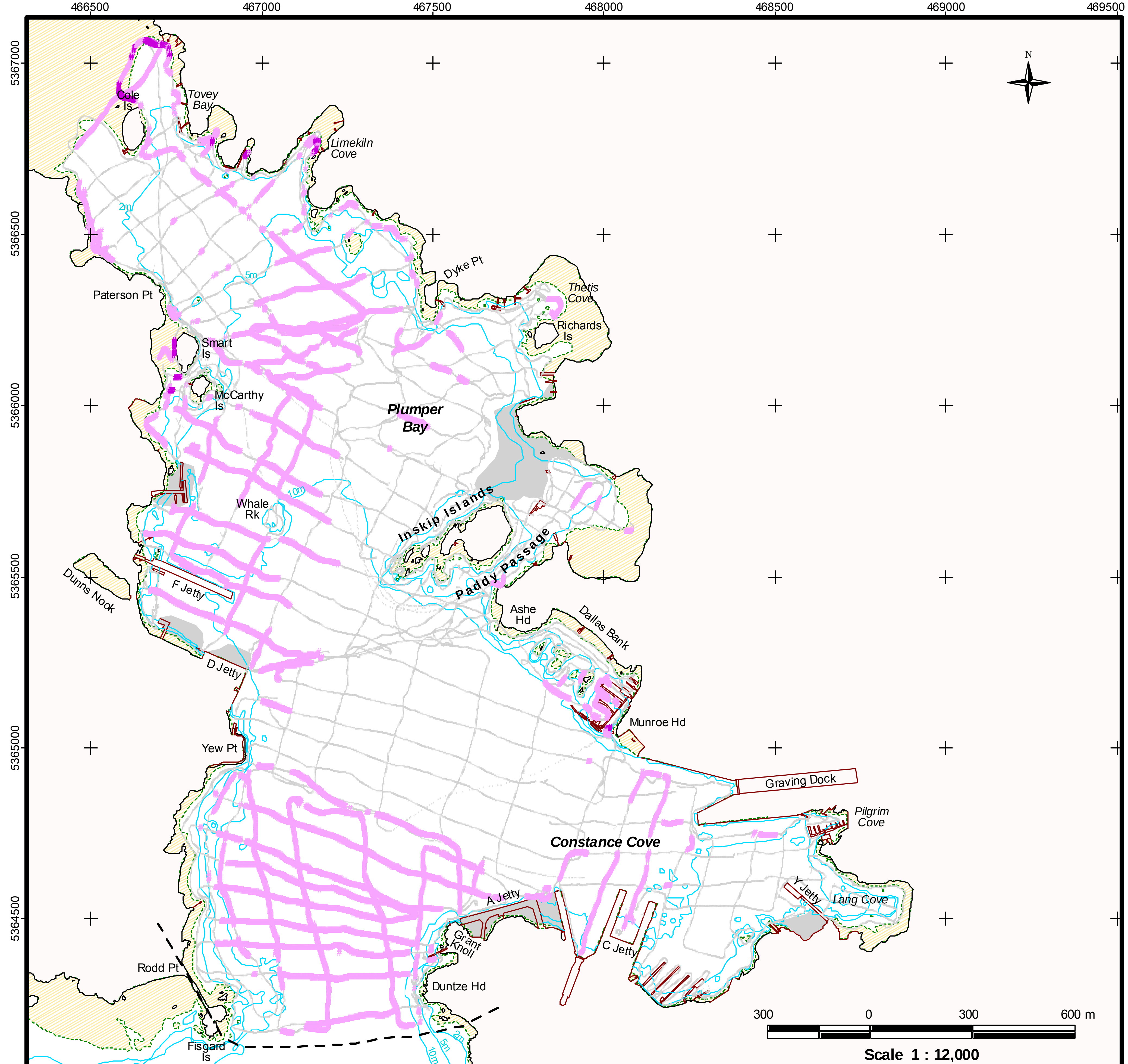
Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 18. Infaunal Burrows

Distribution

Few/Patchy

Continuous

Shoreline

Pier/Wharf/Jetty/Dock

0m Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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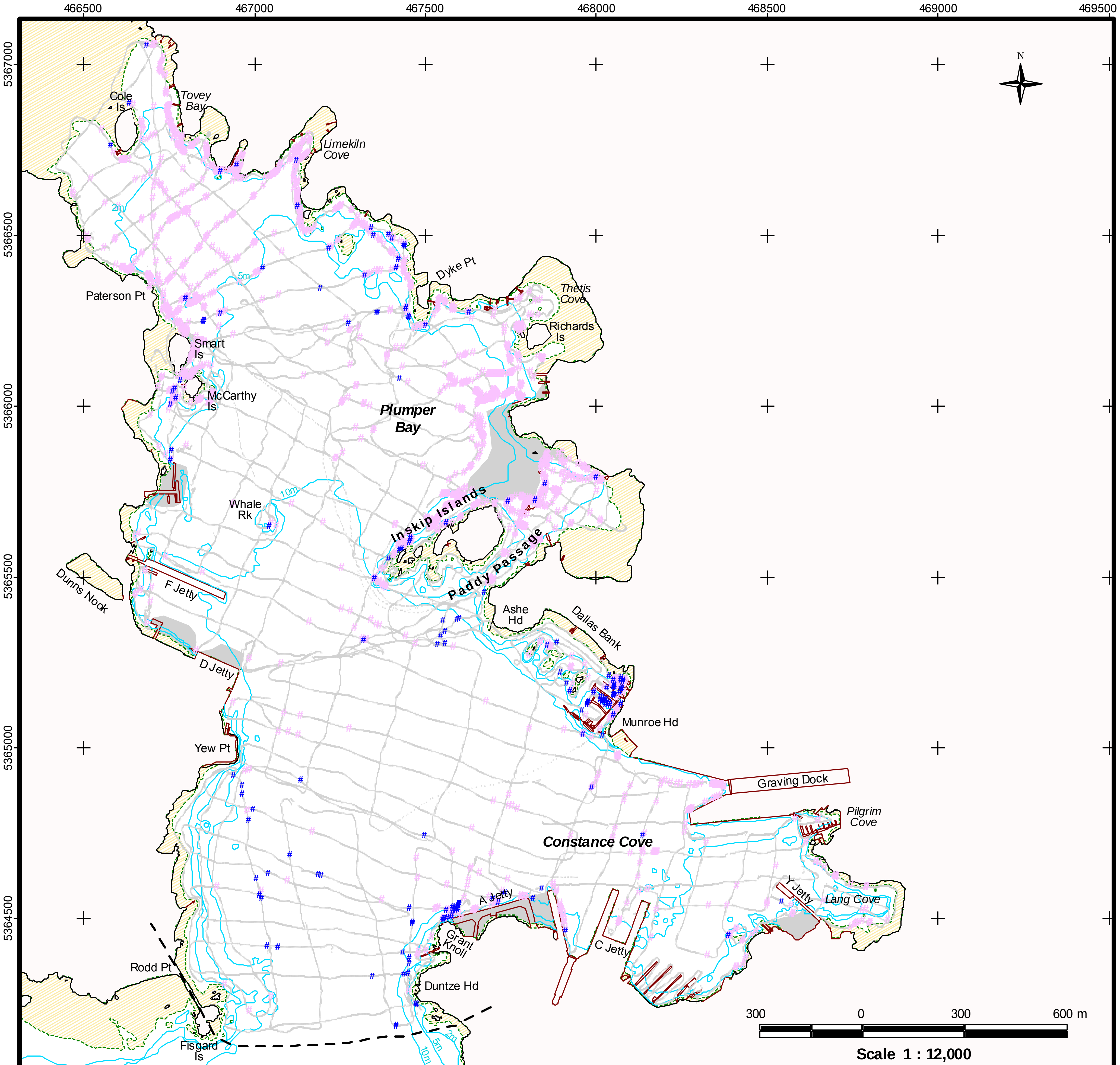

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 19. Anemones

Metridium

\# *Urticina sp. (Tealia)*

Shoreline

Pier/Wharf/Jetty/Dock

0m Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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Survey Dates:
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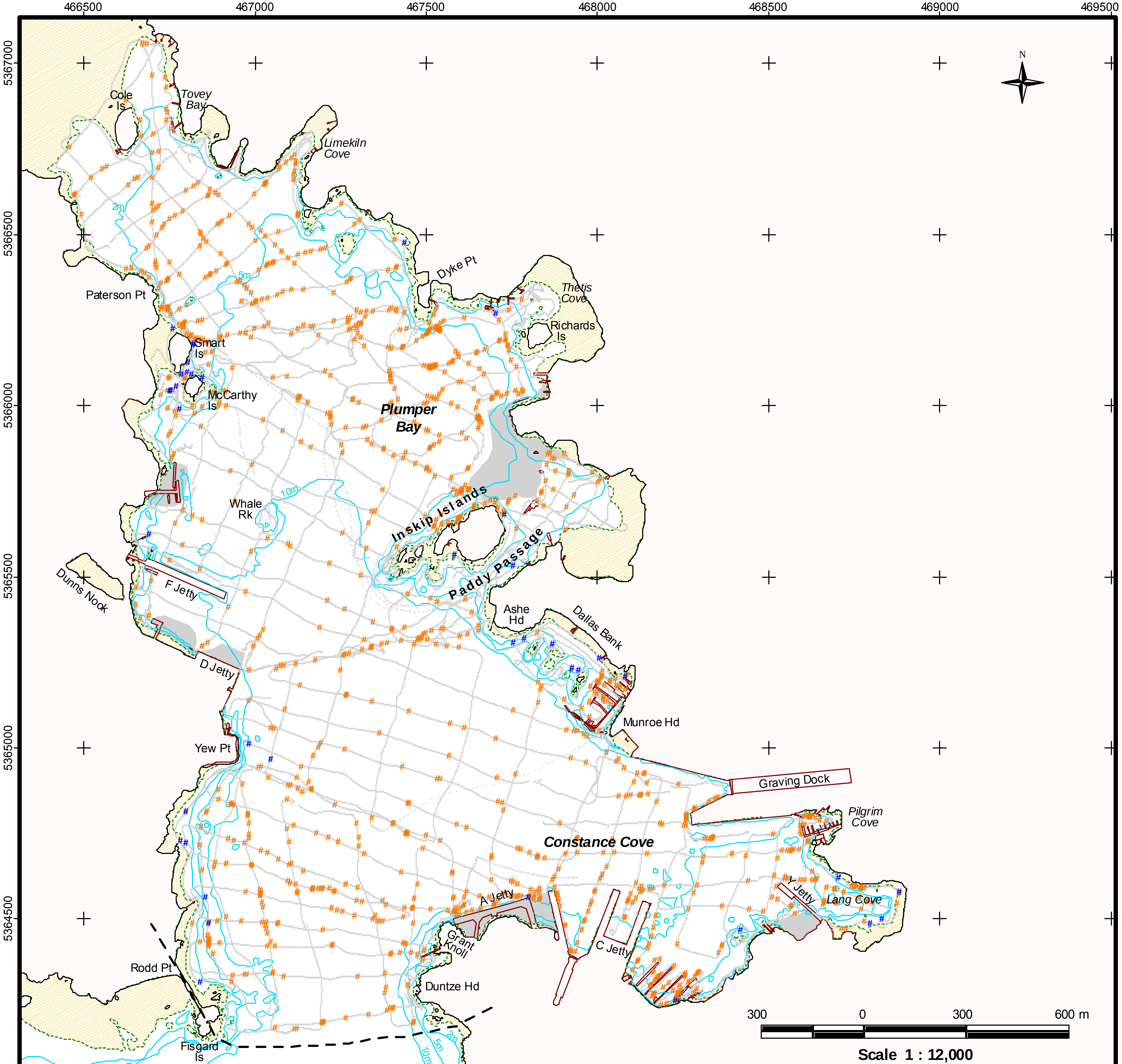

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 20. Crabs

\# *Cancer sp. (C. magister, C. gracilis)*

\# **Red Rock Crabs** *(Cancer productus)*

Shoreline

Pier/Wharf/Jetty/Dock

0m Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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Survey Dates:
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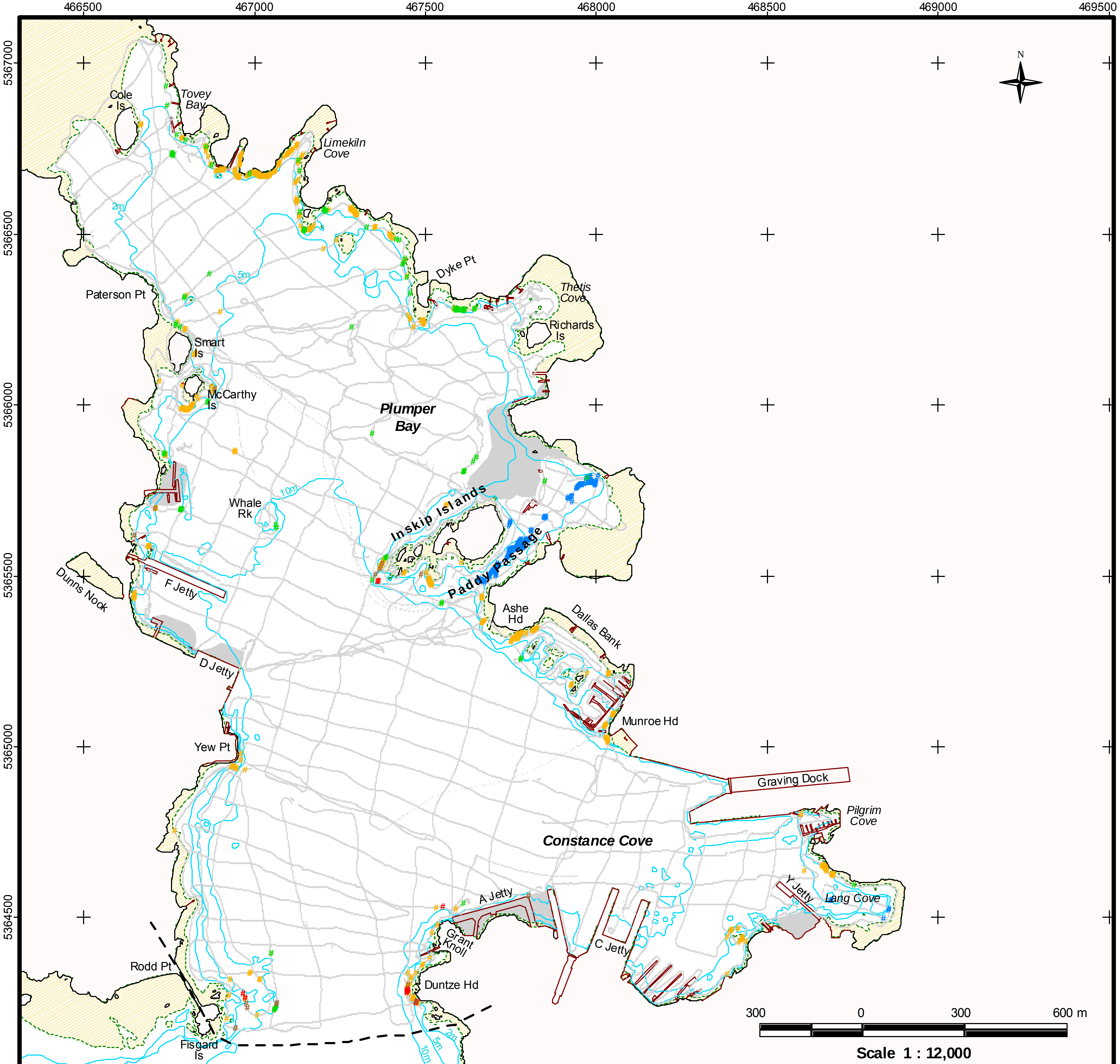

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 21. Other Invertebrates

- # **Red Sea Urchins** *(Strongylocentrotus franciscanus)*
- # **California Sea Cucumbers** *(Parastichopus californicus)*
- # **Burrowing Sea Cumbers** *(Cucumaria miniata)*
- # **Piddock Clams** *(Zirfaea pilsbryi)*
- # **Bryozoans**

Shoreline
Pier/Wharf/Jetty/Dock
Om Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
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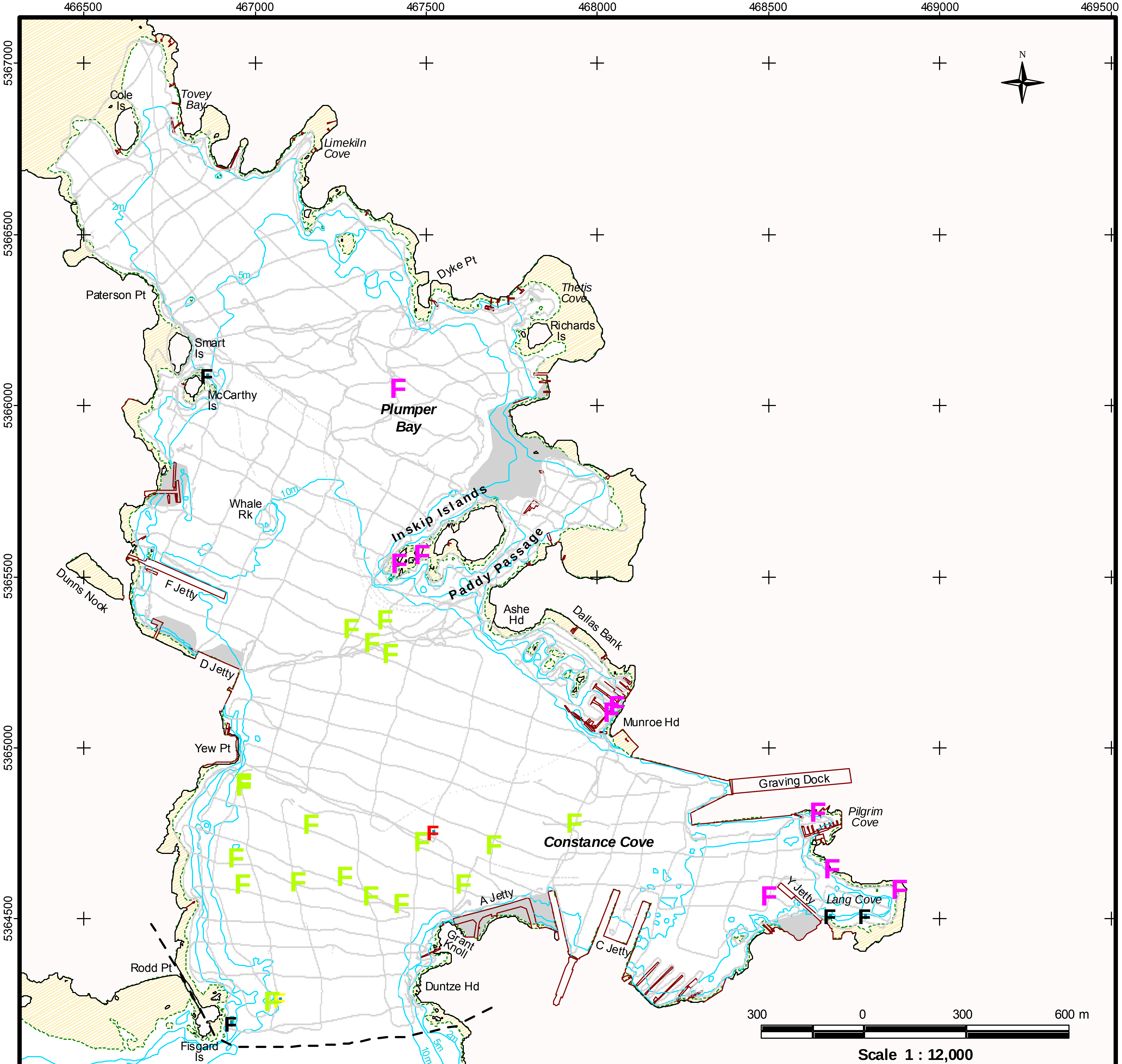

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 22. Fish Observations

F Greenling
F Perch
F Sculpin
F Sole
F Unidentified Fish

Shoreline
Pier/Wharf/Jetty/Dock
0m Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
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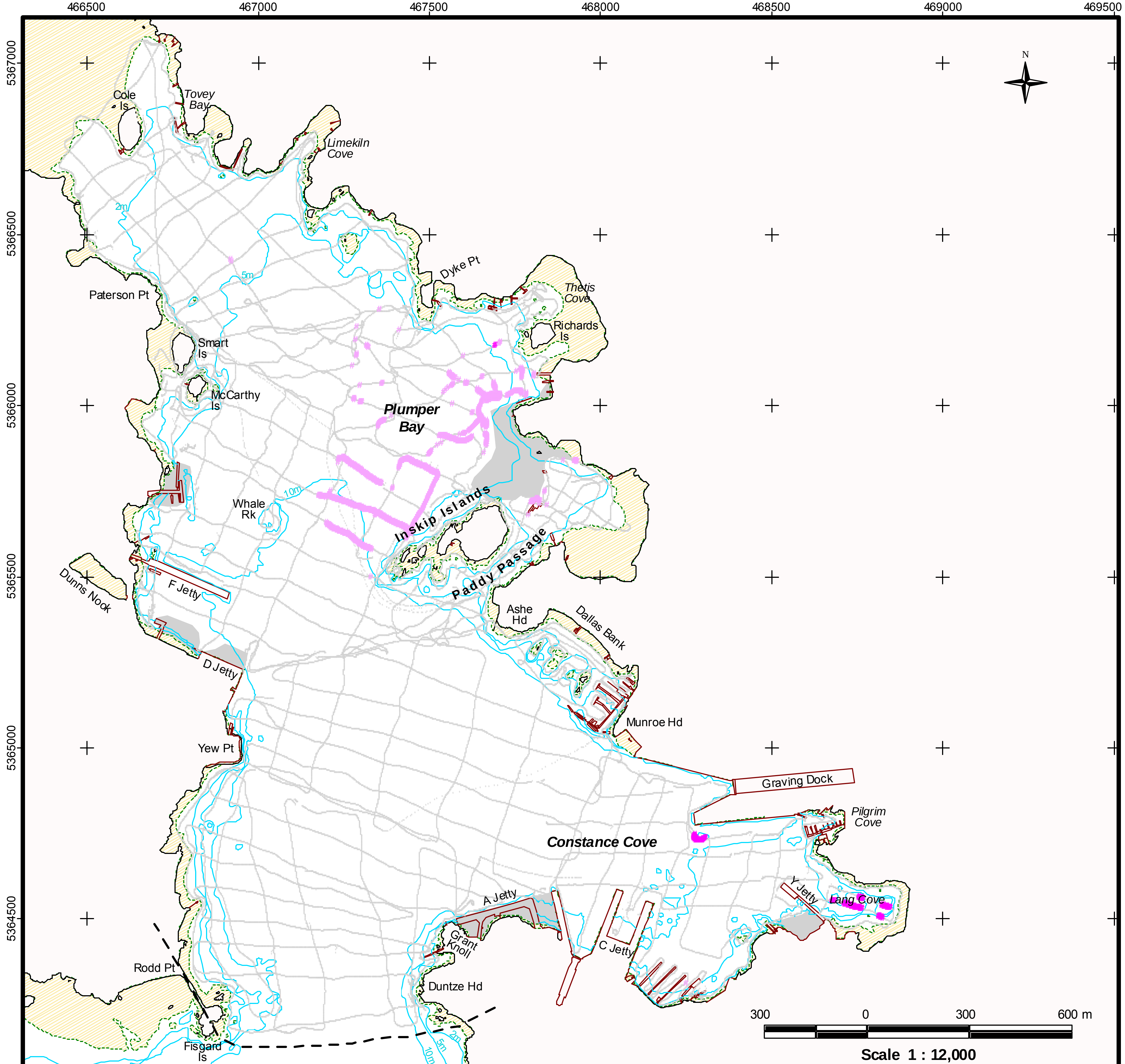

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 23. Bacterial Mats

Distribution

- Few/Patchy
- Uniform

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

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SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004

APPENDIX F
Side Scan Sonar Results

NOTES

1. ON 30 AUGUST 2016, TERRA REMOTE SENSING INC (TRSI) CONDUCTED A SIDE SCAN SONAR SURVEY OF THE ESQUIMALT HARBOUR. DATA WERE COLLECTED FROM FROM ASH HEAD NORTH TO COLE I. THE AREA NORTH OF COLE ISLAND DRIES AT LOW TIDE AND WAS TOO SHALLOW TO COLLECT REASONABLE SIDE SCAN DATA, PARTICULARLY WHEN THE SEABED IS VISIBLE AT LOW TIDE.
2. POSITION AND HEADING DATA WERE COLLECTED USING A HEMISPHERE VS-111 GPS. DIFFERENTIAL CORRECTORS WERE RECEIVED FROM RICHMOND COAST GUARD BEACON. GPS DATA WERE RECORDED AT ONE SECOND INTERVALS TO TRSI's PROPRIETARY NAVIGATION AND DATA LOGGING SOFTWARE *RTC*.
3. SIDE SCAN SONAR DATA WERE COLLECTED USING AN EDGETECH 4200 DUAL FREQUENCY SYSTEM TOWED NEAR THE WATER SURFACE. THE DATA WERE COLLECTED AT 50 METRE HORIZONTAL SCAN RANGE (100 METRE SWATH) AT BOTH 300 AND 900 KHZ. DATA WERE LOGGED TO JSF AND XTF FORMAT USING DISCOVER SOFTWARE AND PROCESSED USING SONAR WIZ. WHERE SHOWN, SIDE SCAN IMAGERY (900 KHZ) DEPICTS HIGHER SEABED REFLECTIVITY AS LIGHTER (WHITE), AND LOWER SEABED REFLECTIVITY (IE. ACOUSTIC SHADOWS) AS DARKER (BLACK).
4. BATHYMETRIC DATA WERE COLLECTED ALONG THE SIDE SCAN LINES USING A KNUDSEN 320M SINGLE BEAM ECHOSOUNDER WITH A 200 KHZ - 6 DEGREE BEAM-WIDTH TRANSDUCER.
5. WATER LEVELS DURING THE BATHYMETRIC DATA COLLECTION WERE COLLECTED USING RTK GPS.
6. THE SHORELINE AND LAND FEATURES SHOWN ON THE DRAWINGS ARE FROM CHS ECN DATA.

LEGEND

S□□B□D D□PTHS □WH□R□ SHOW□□

5 — CONTOURED DEPTHS ARE FOR REFERENCE ONLY AND ARE FROM CHS ECN DATA, ALL REFERENCED TO CHART DATUM

S□□B□D □□□T□R□S □WH□R□ SHOW□□ □□ROM SID□ SC□□ SO□□R D□T□ (30 AUGUST 2016)

ROCK OUTCROP, INCLUDING ADJACENT SUBCROP

WOOD WASTE ZONE (PRIMARILY LOGS)

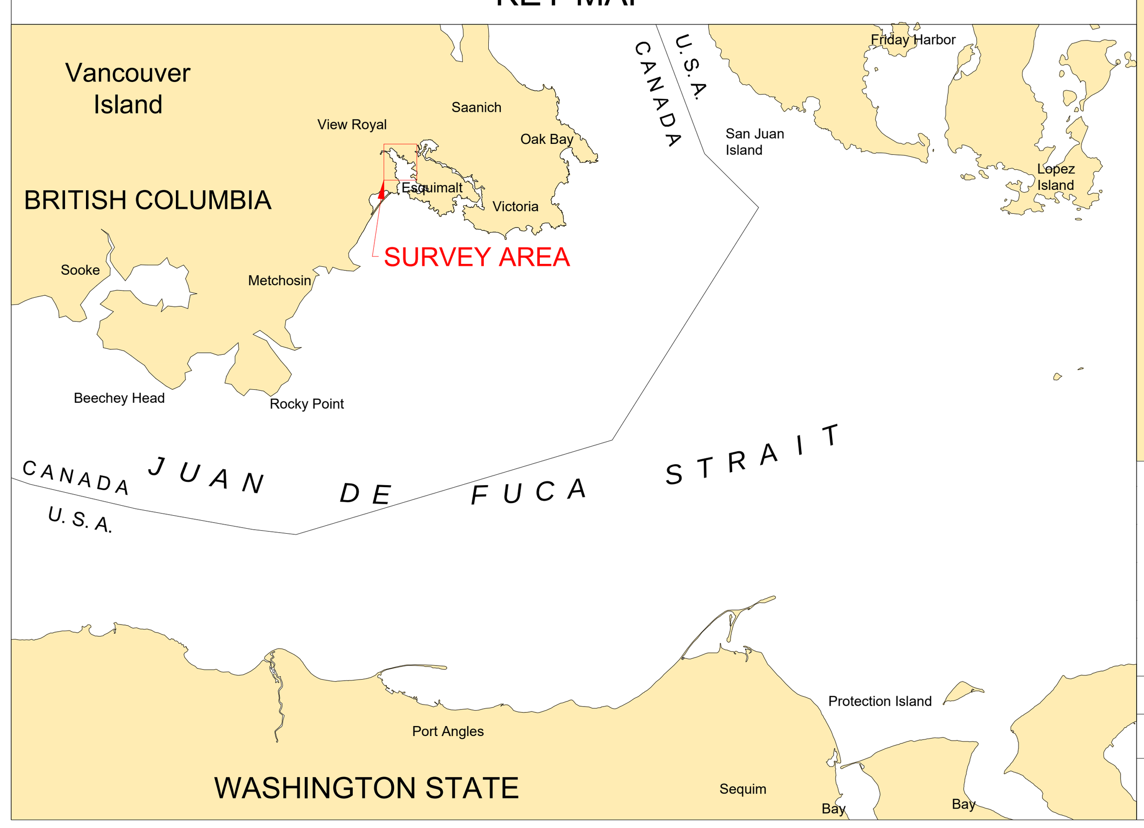
ANCHOR BLOCK (CONCRETE)

UNIDENTIFIED SONAR TARGET (VARIOUS SIZES AND SHAPES)

S□R□□Y TR□C□S □WH□R□ SHOW□□

15:30 15:30 15:30 TRSI SIDE SCAN SURVEY TRACKLINE (30 AUGUST 2016)

KEY MAP



NO	REMARKS	DATE	TRADE	INDEP CHKD	DFTG	DFTG CHKD	INSPD	REV	ACPT
0	Submitted in Final	27 Oct 2016	EXISTING CONDITIONS	KK	KK	MR	client	TA	TA
A	Submitted in draft	16 Sept 2016	EXISTING CONDITIONS	trsi	KK	MR	client	client	client

REVISIONS

SURV	KK,TCB	30Aug2016
PROCD	KK	31Aug2016
DFTG	KK	1Sept2016
CHKD	MR	16Sept2016
INSPD	______	______
REV	______	______
ACPT	______	______

GENERAL NOTES

Equipment
Survey vessel: *Doppler*
Surface Positioning: Hemesphere VS111 GPS
Navigation/Acquisition Software: RTC(TRSI)
Bathymetry: Knudsen 320M, 200kHz - 8° beam
Morphology and Stratigraphy: EdgeTech 4200
Drawing Parameters
Projection: UTM Zone 10N Datum: NAD83
Central Meridian (CM): 123°W
Scale Factor at CM: 0.9996
False Easting: 500000 False Northing: 0
Vertical Datum: LLWLT (Chart Datum)

CLIENT
HEMMERA

TERRA REMOTE SENSING INC.
1962 Mills Road
Sidney, BC Canada
V8L 5Y3
Ph: (250) 656-0931
Fax: (250) 656-4604
Web: www.terraremote.com

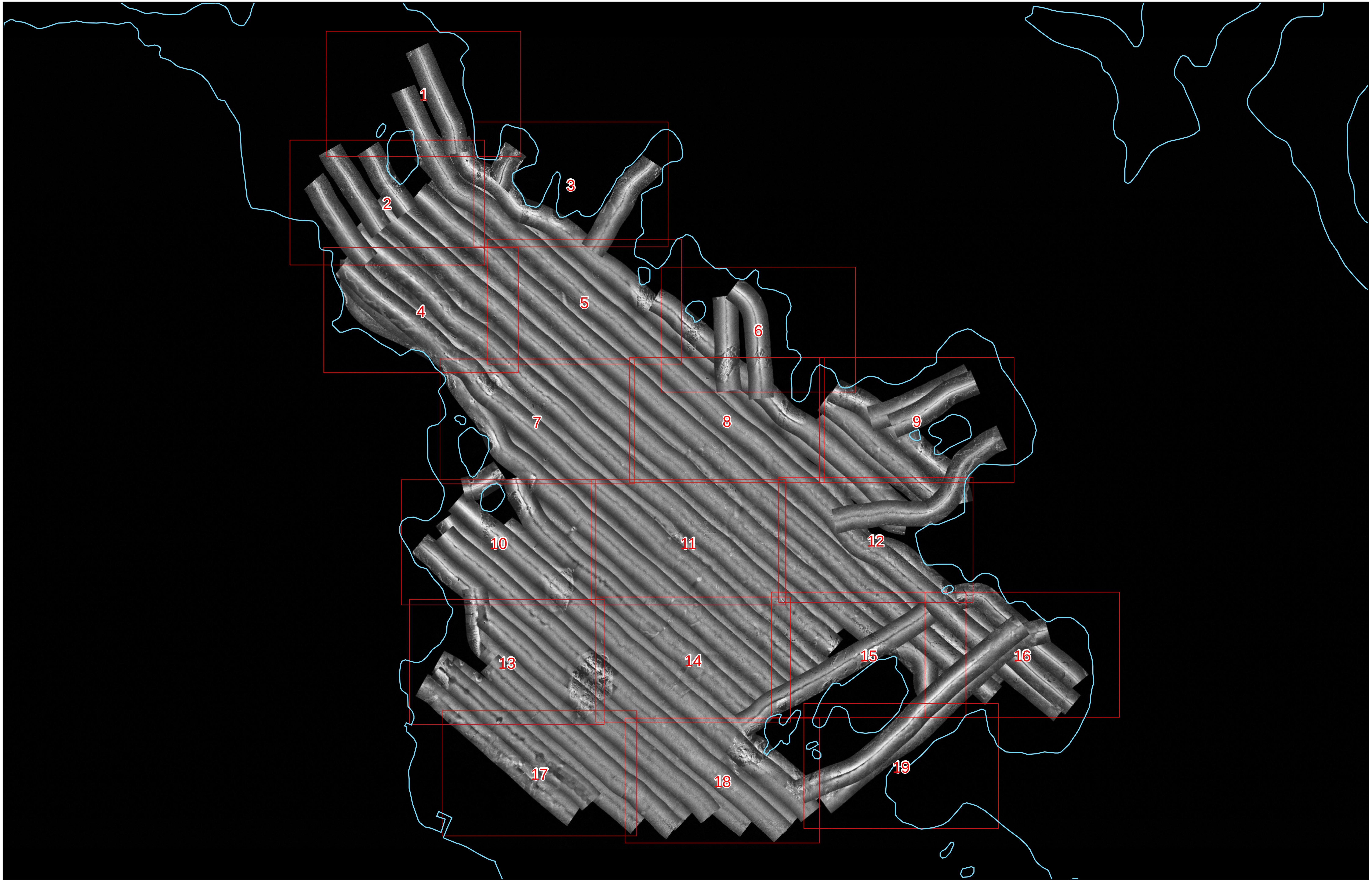
PROJECT
Esquimalt Harbour Side Scan Sonar Survey
Wood Waste Delineation

TITLE
Side Scan Sonar Mosaic

m DWG NO CAD _ R 0 SHT NO. 2 of 3

TRSI PROJECT No.: 000-2795

T:\PROJ-Marine\000-2795 Hemmera - Esquimalt BC\Drawings\2795 Hemmera Esquimalt Harbour.dwg, SSS Mosaic - Sht 2, 27/10/2016 8:56:39 AM, Kelvin.Kopeck



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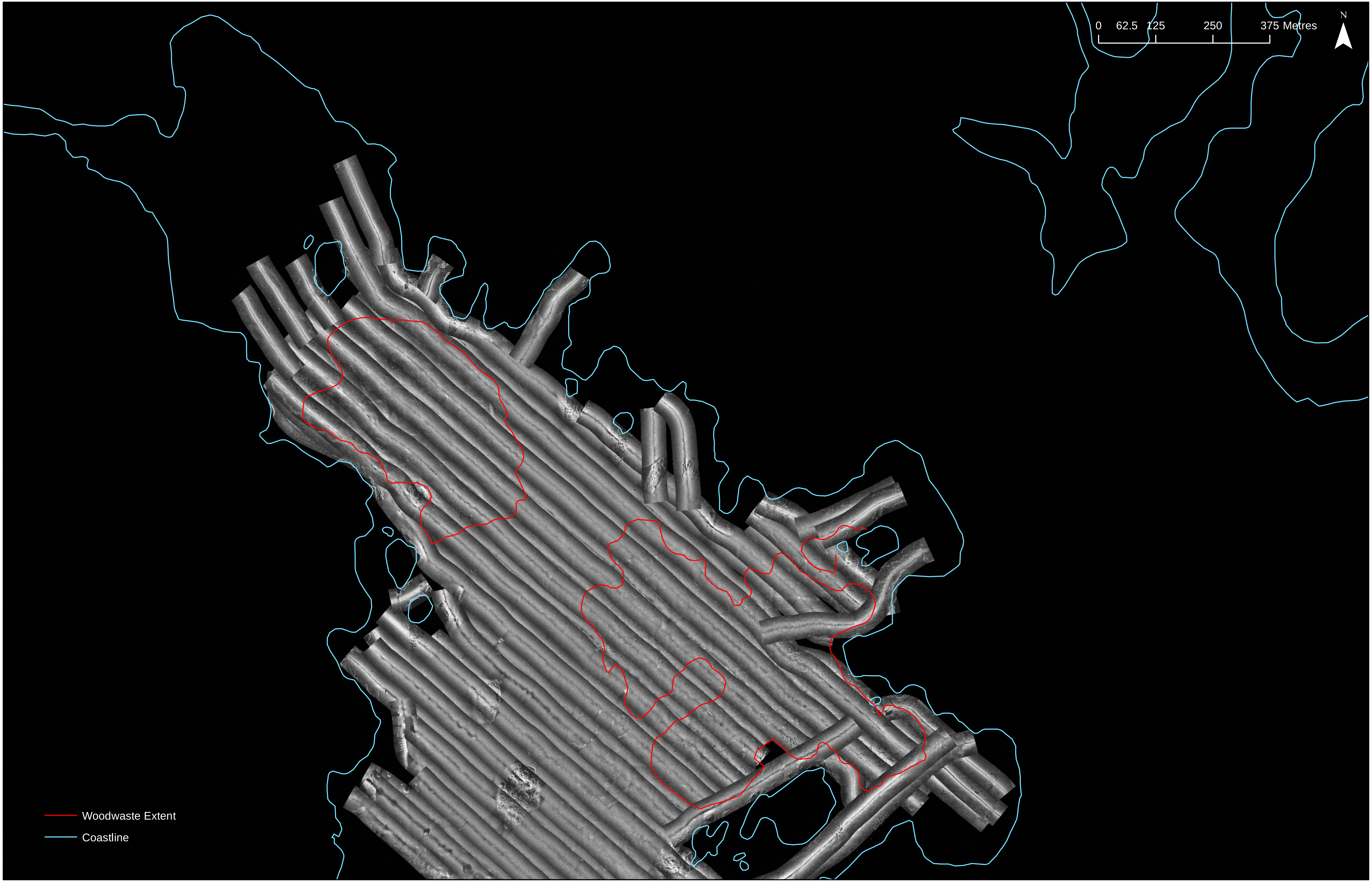
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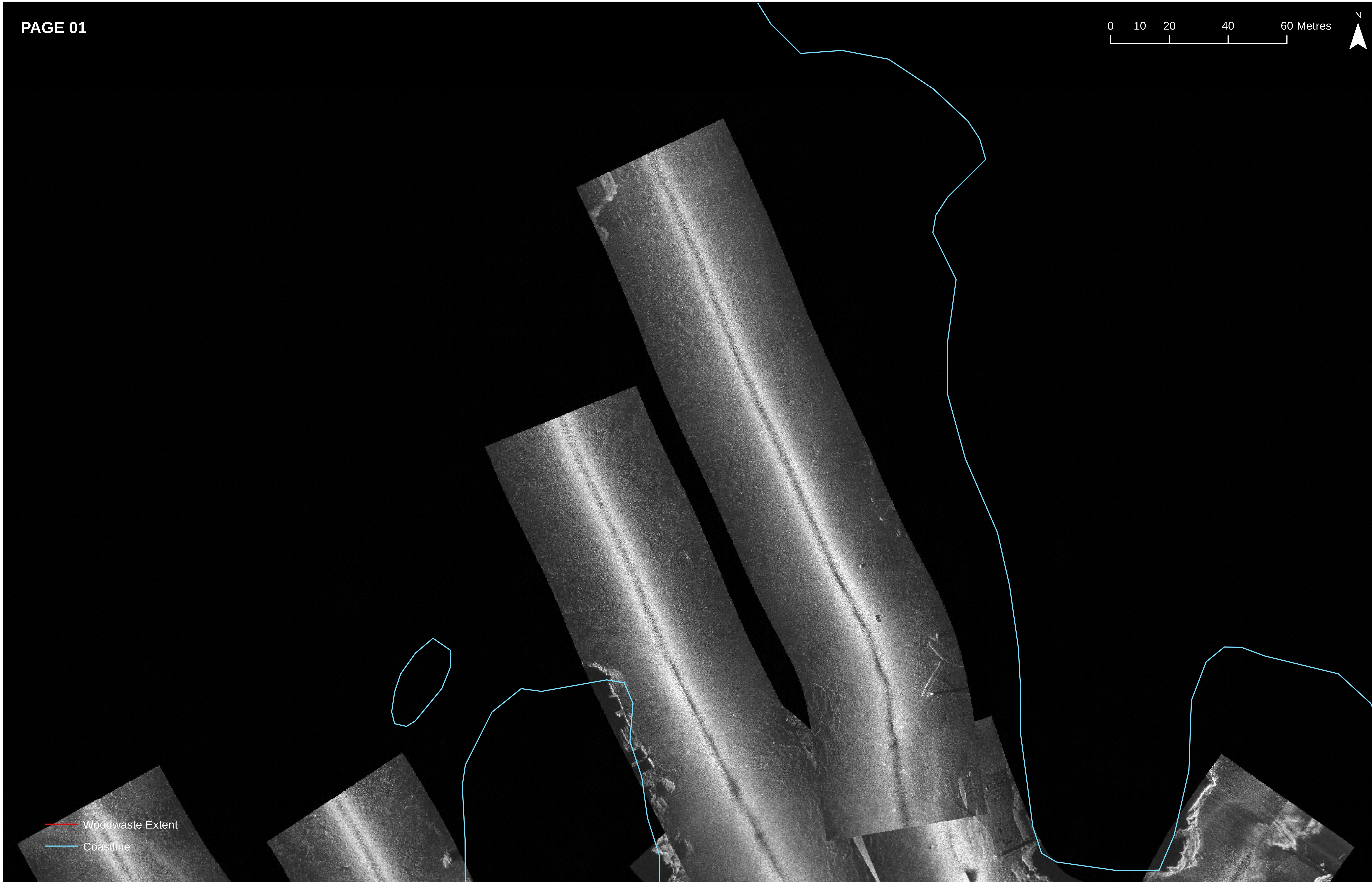
Coastline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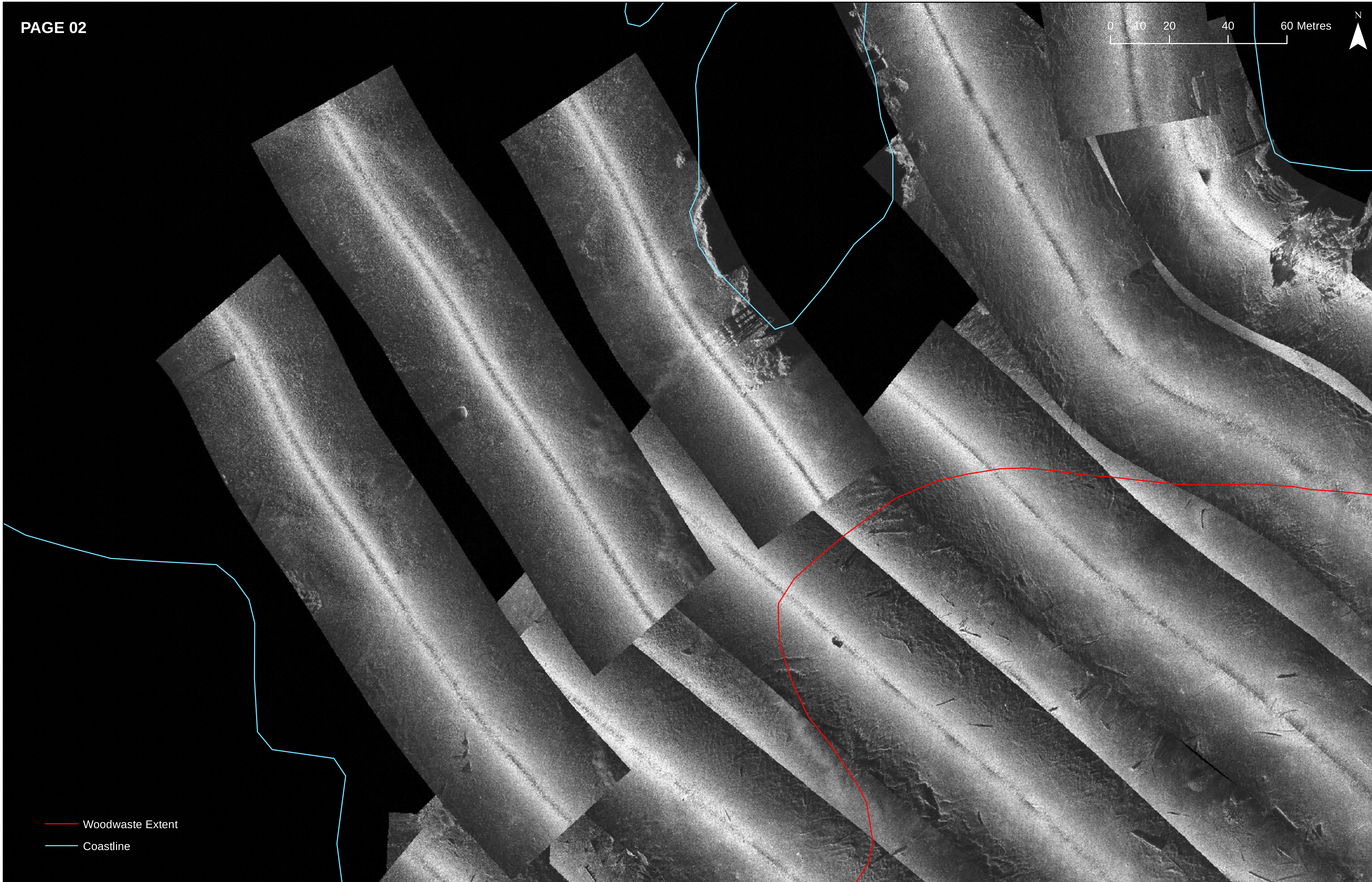
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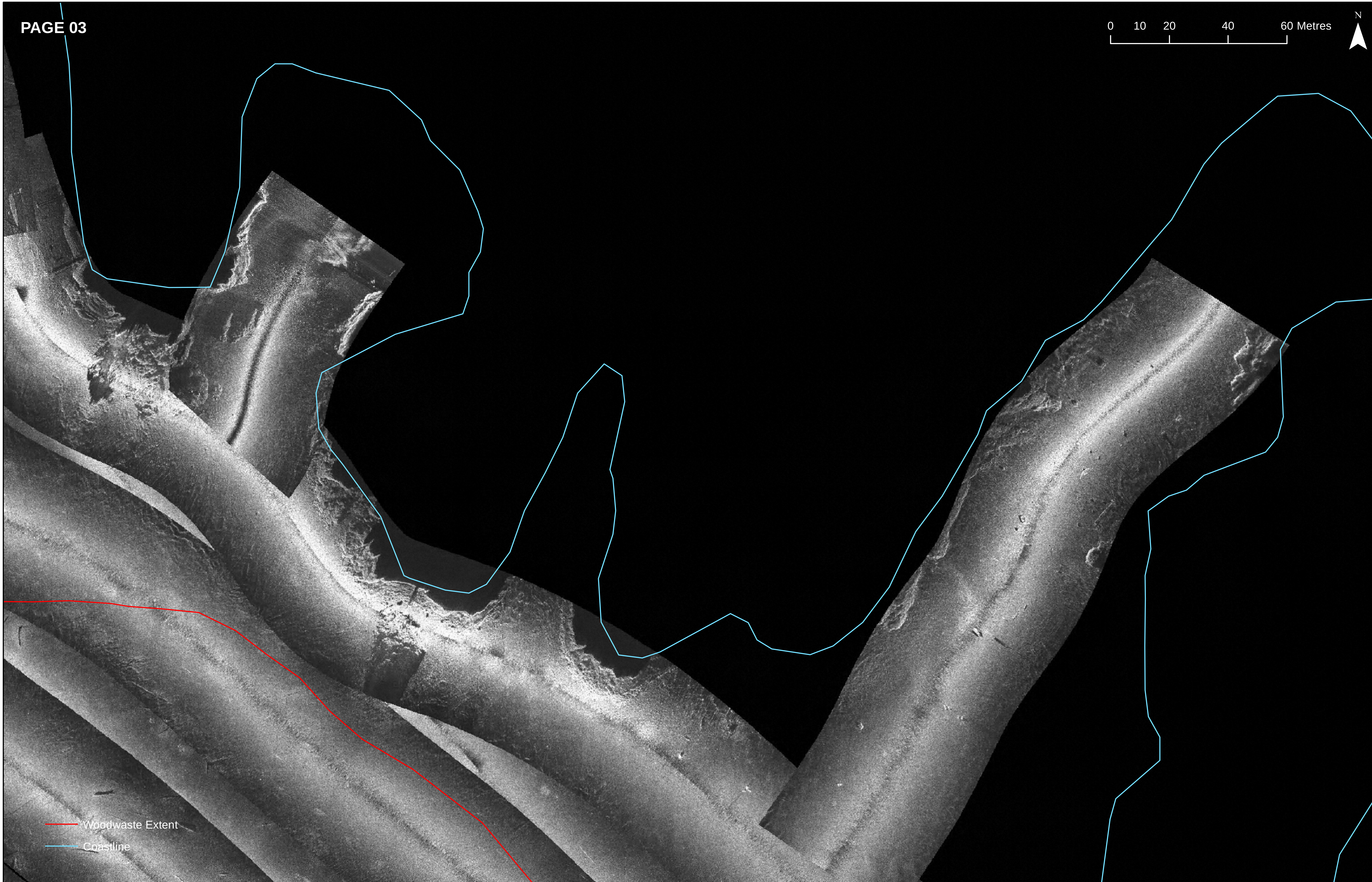
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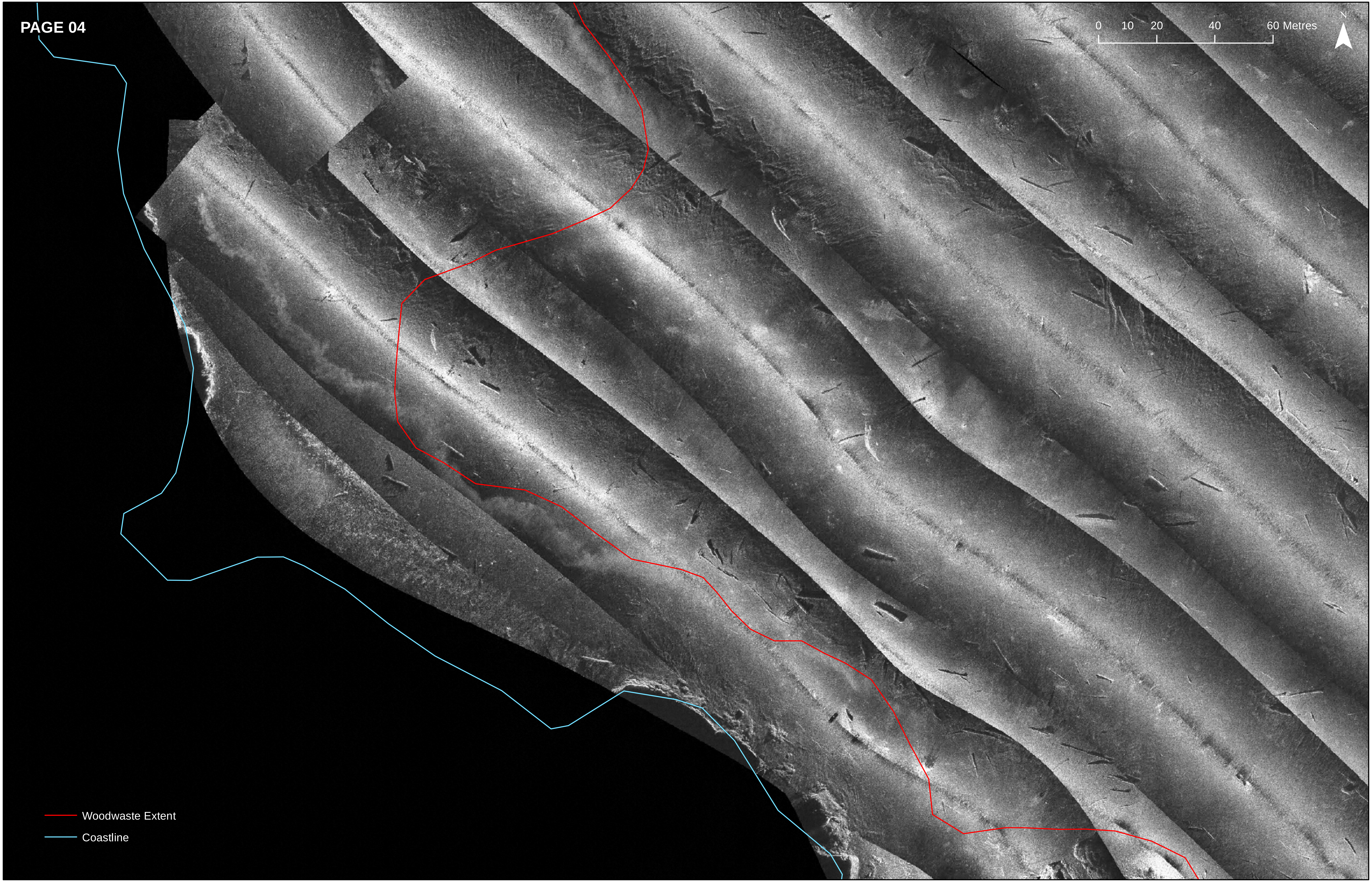
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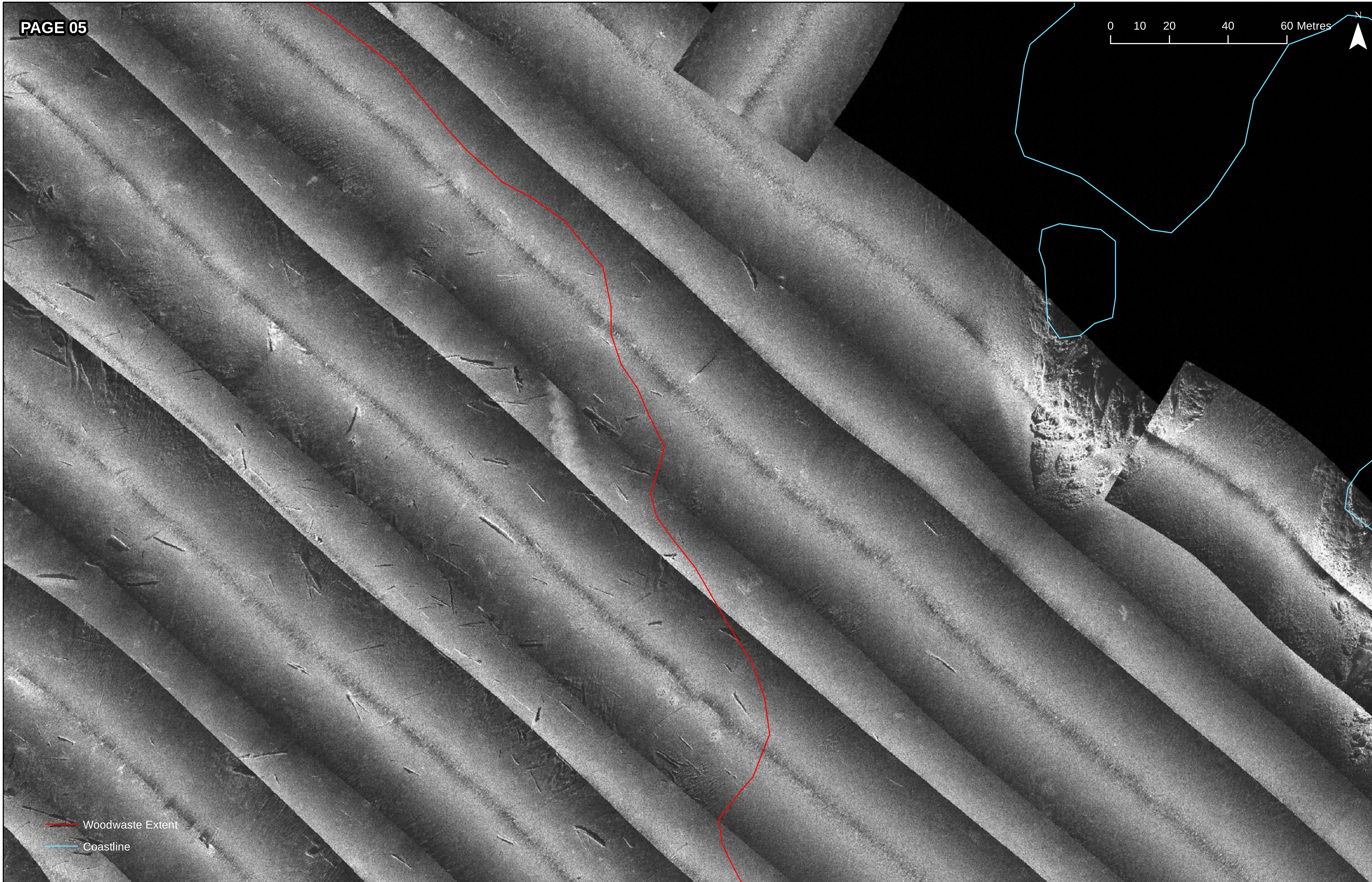
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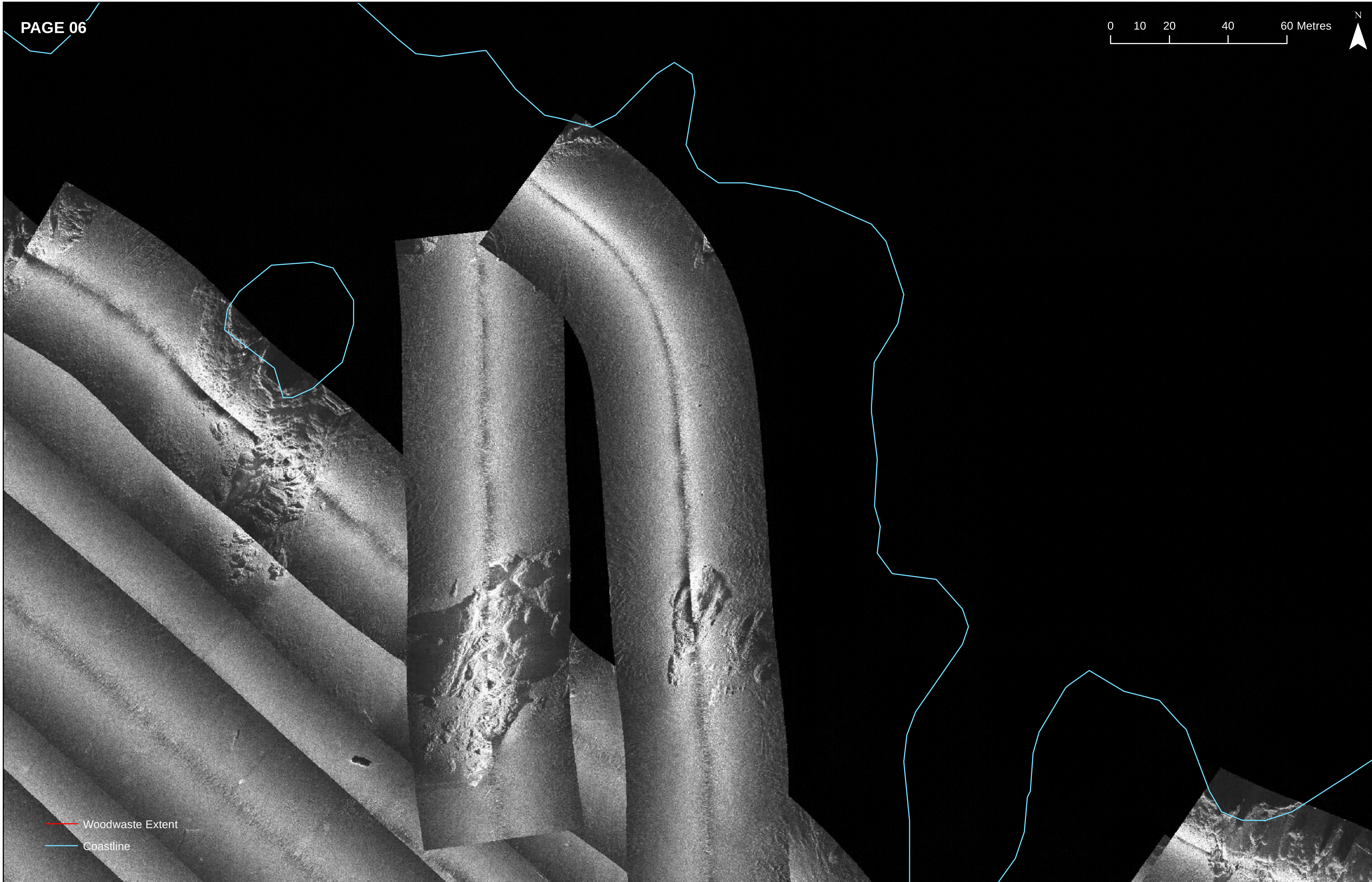

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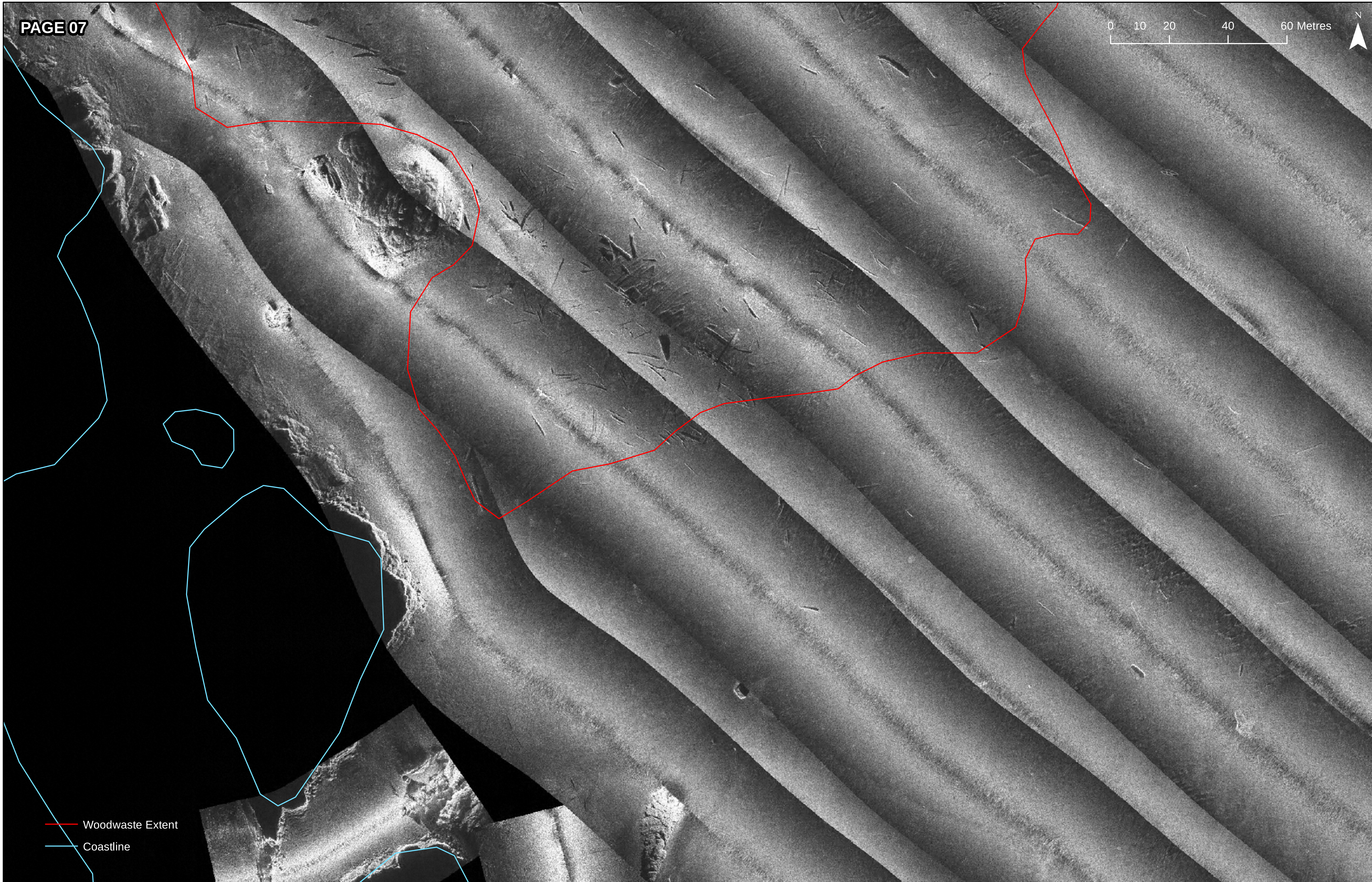
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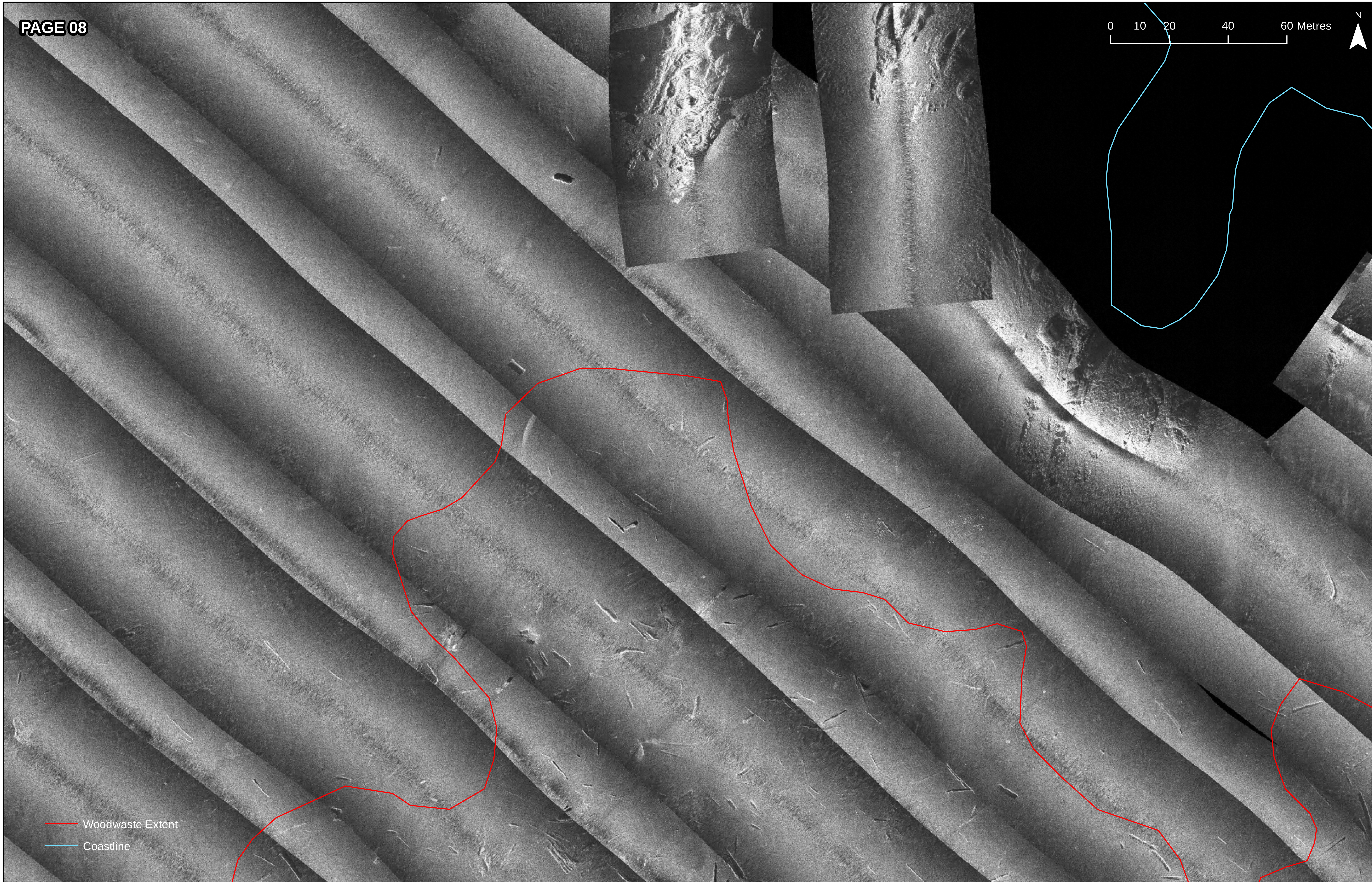
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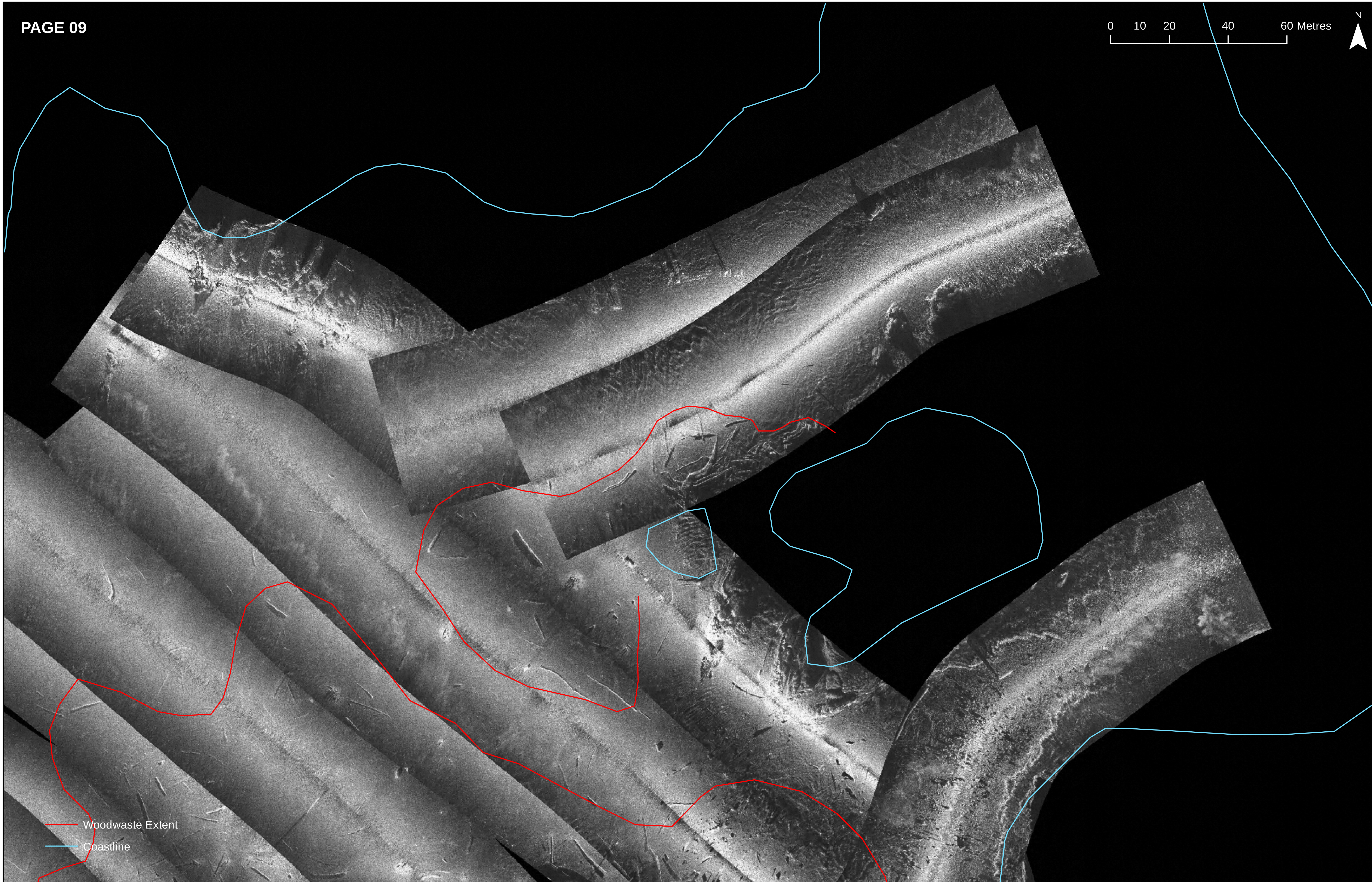
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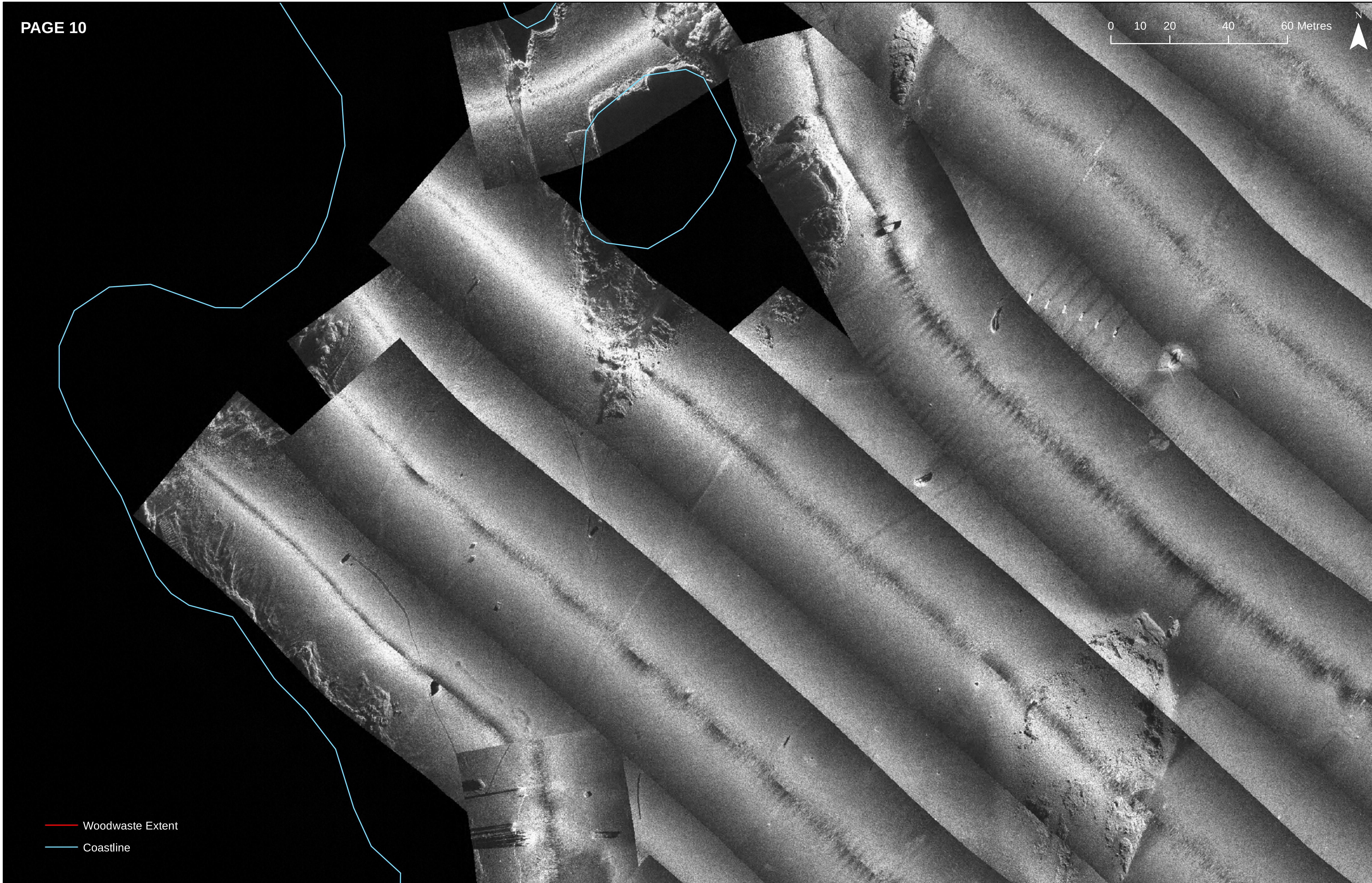
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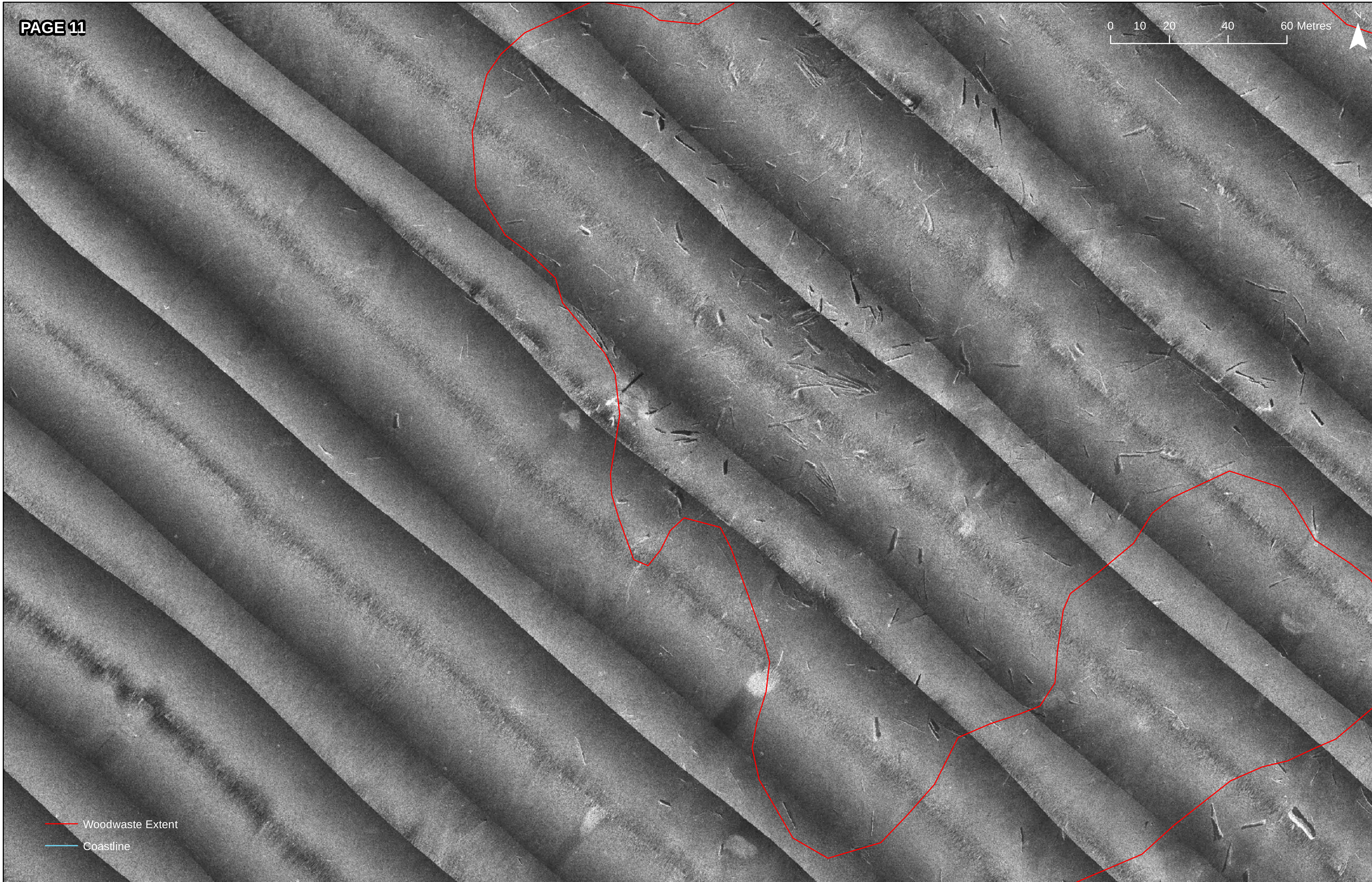
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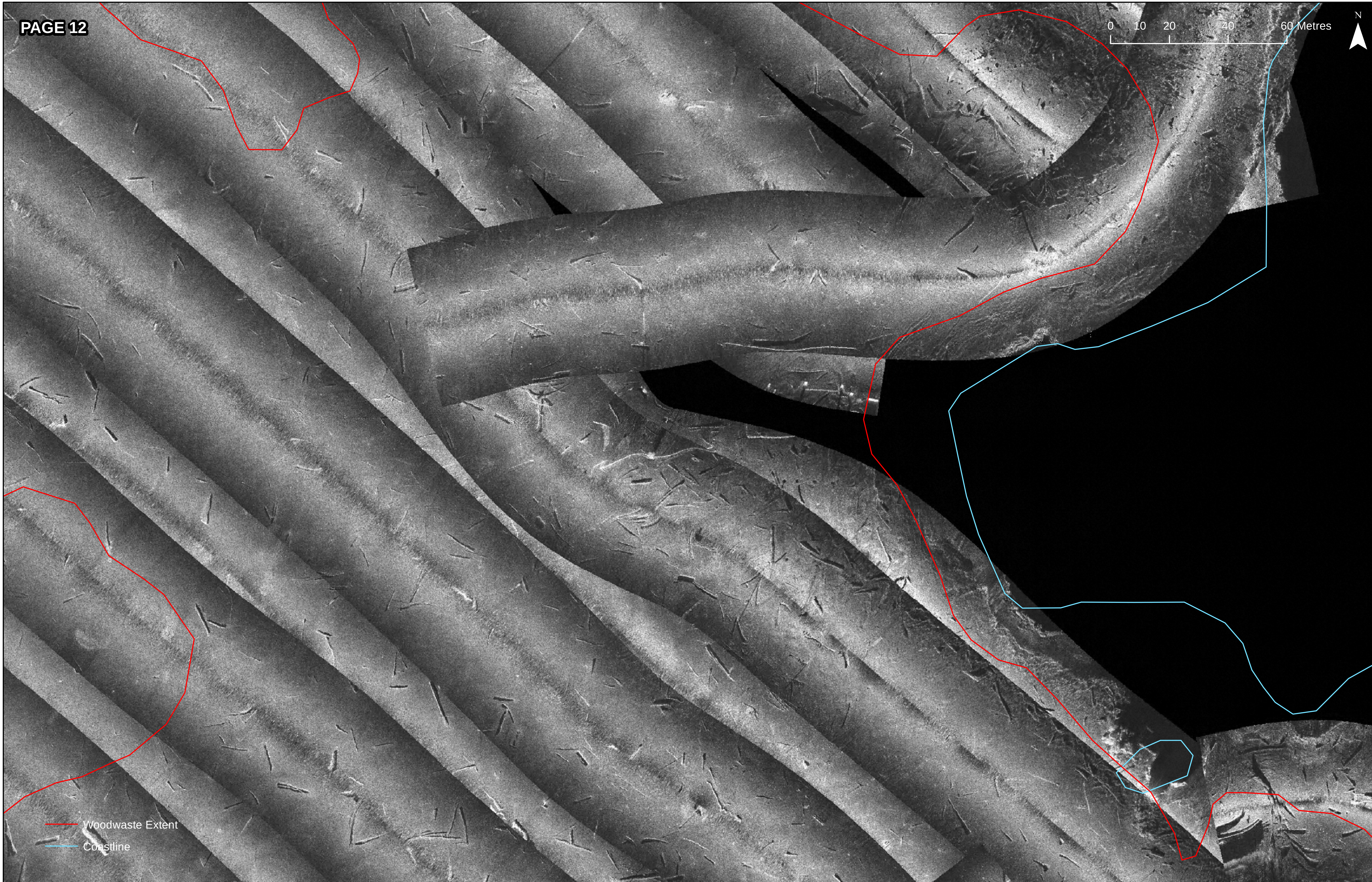
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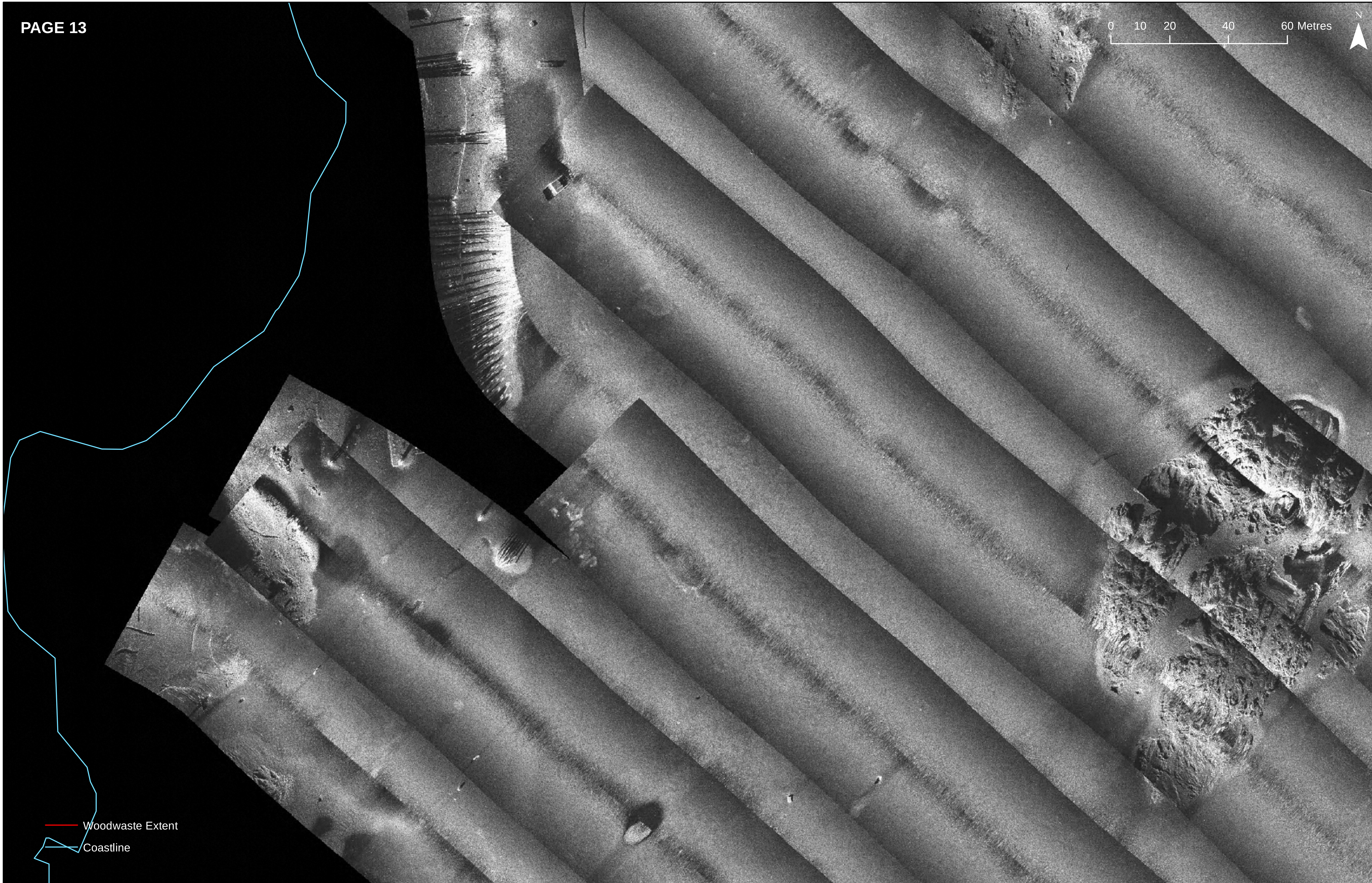
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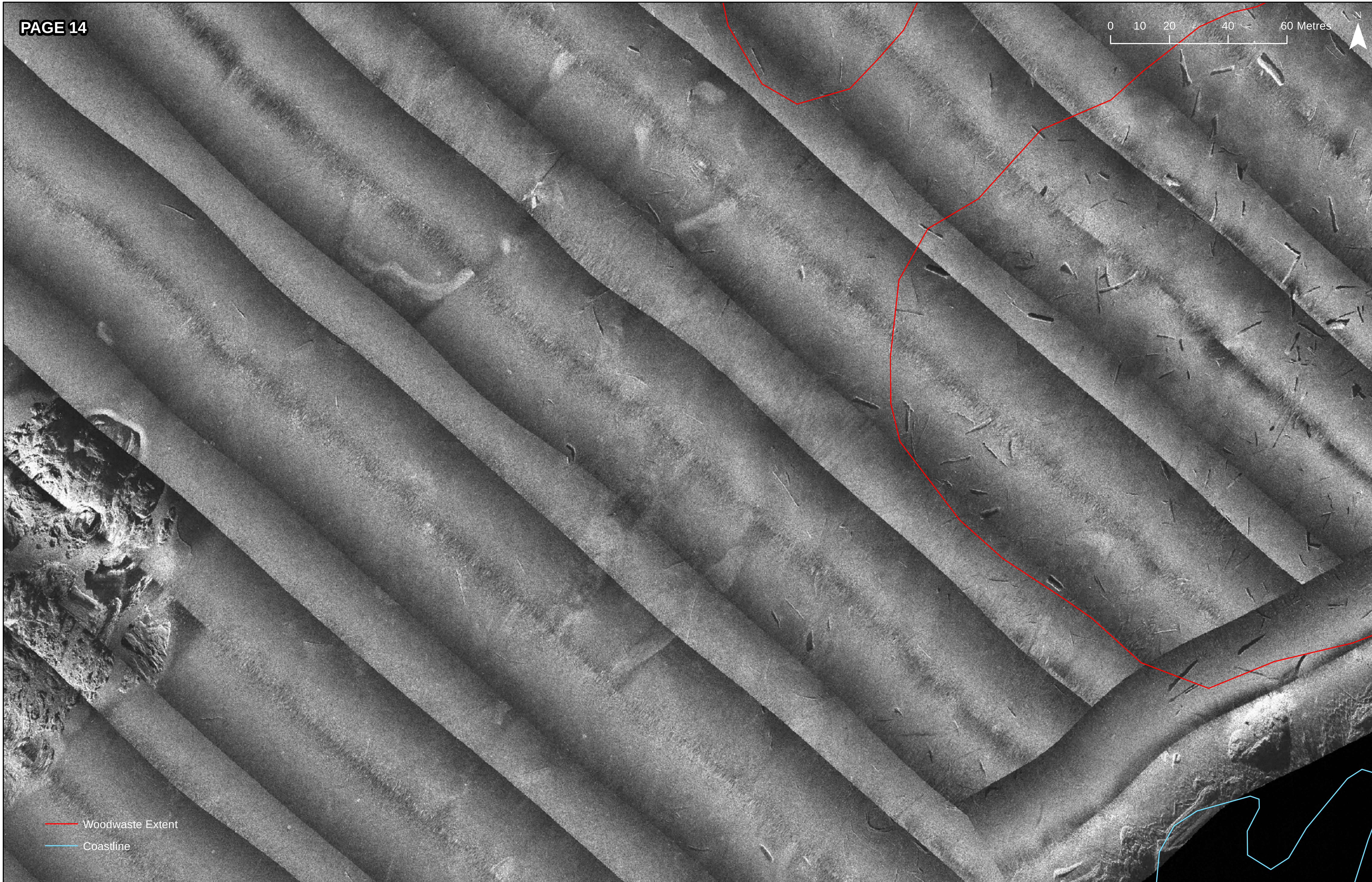
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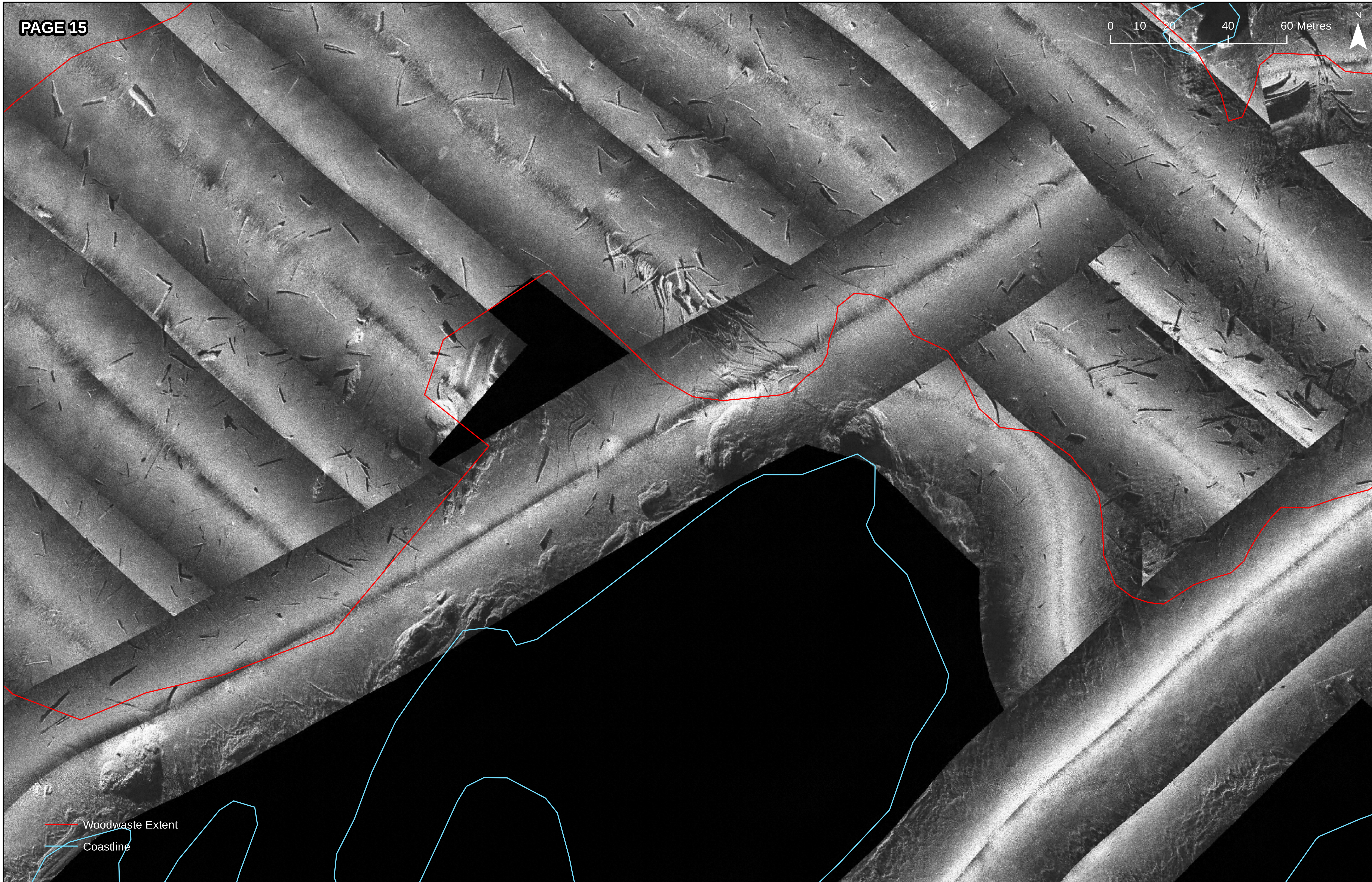
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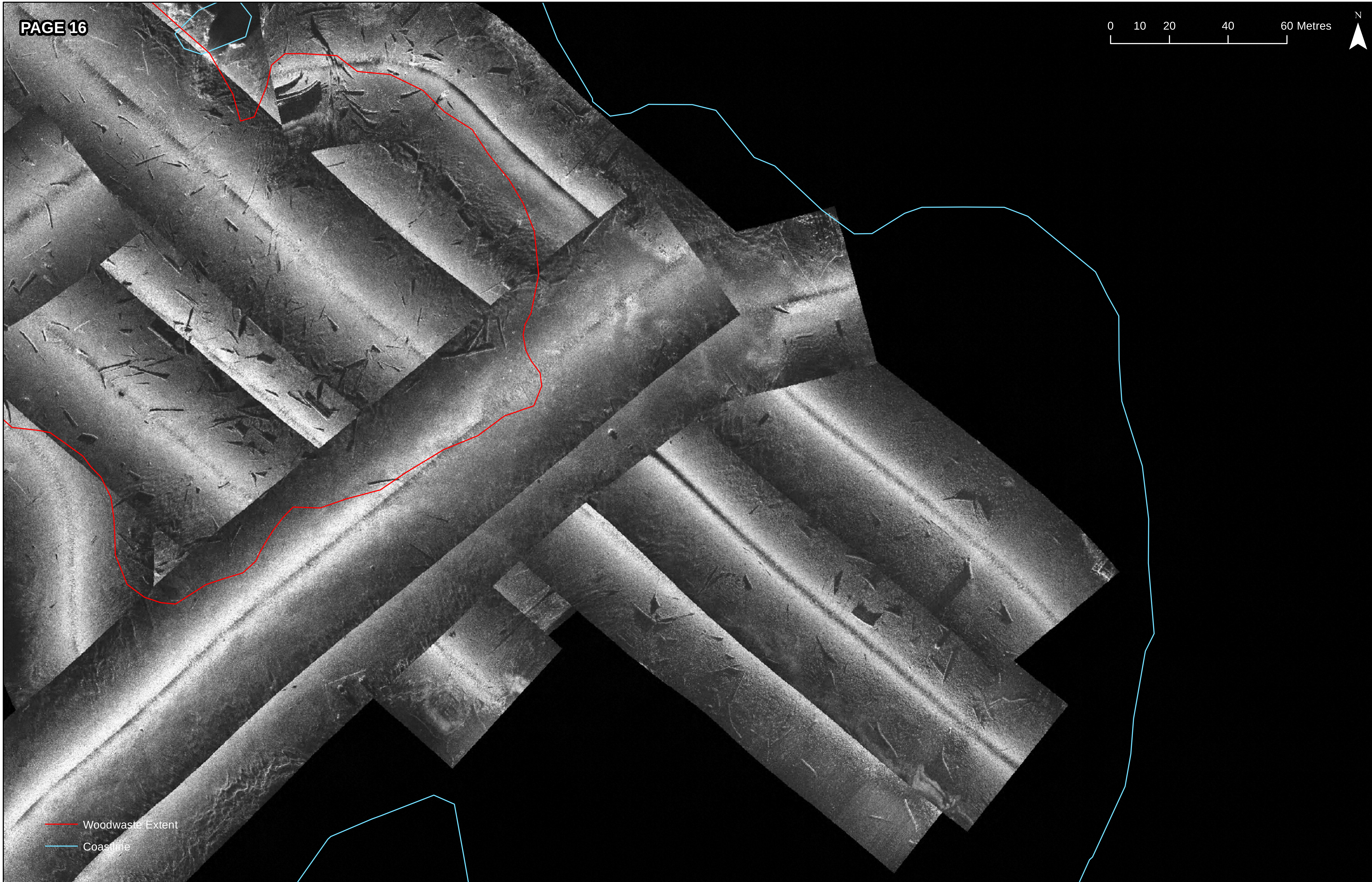
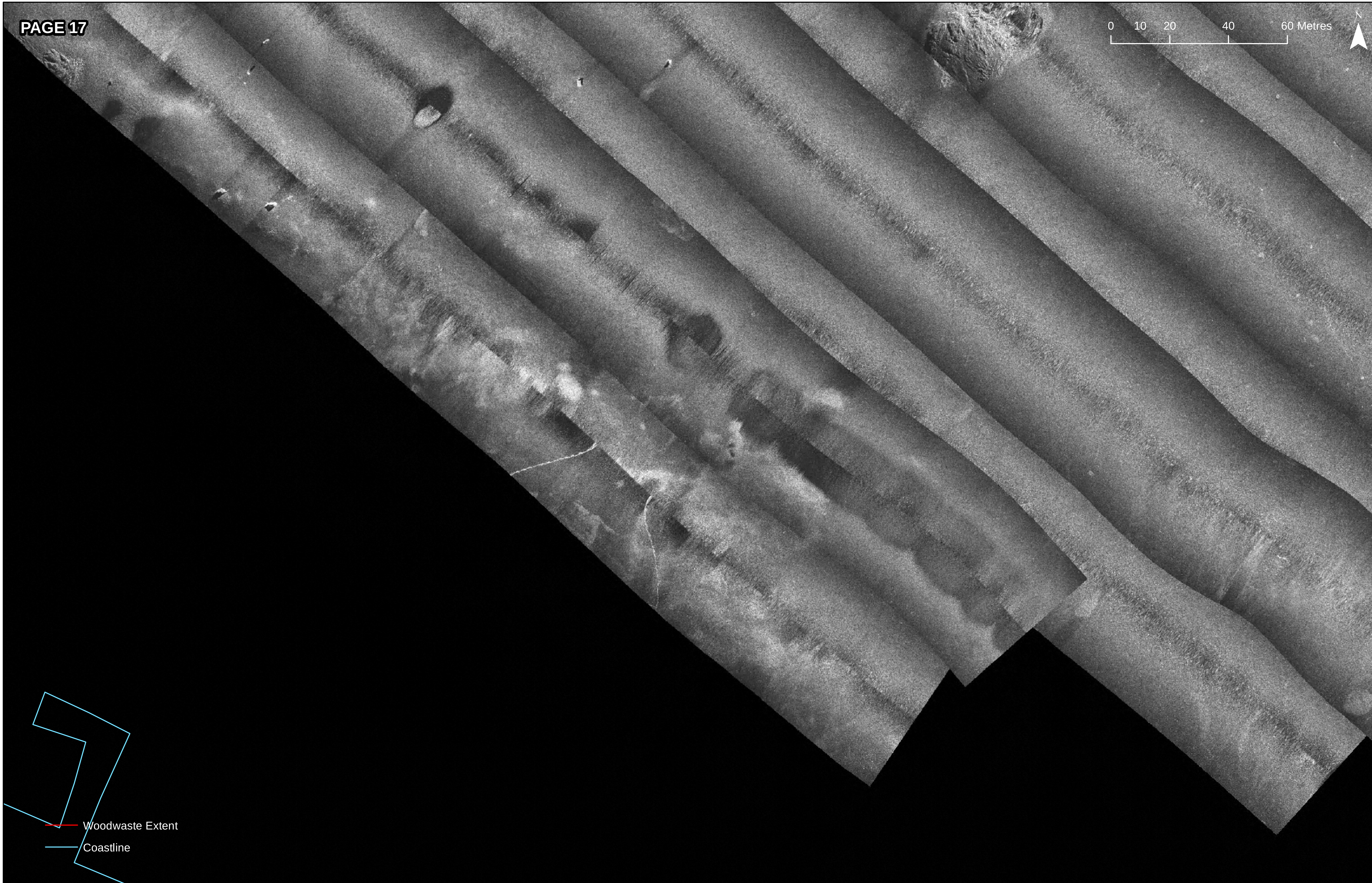
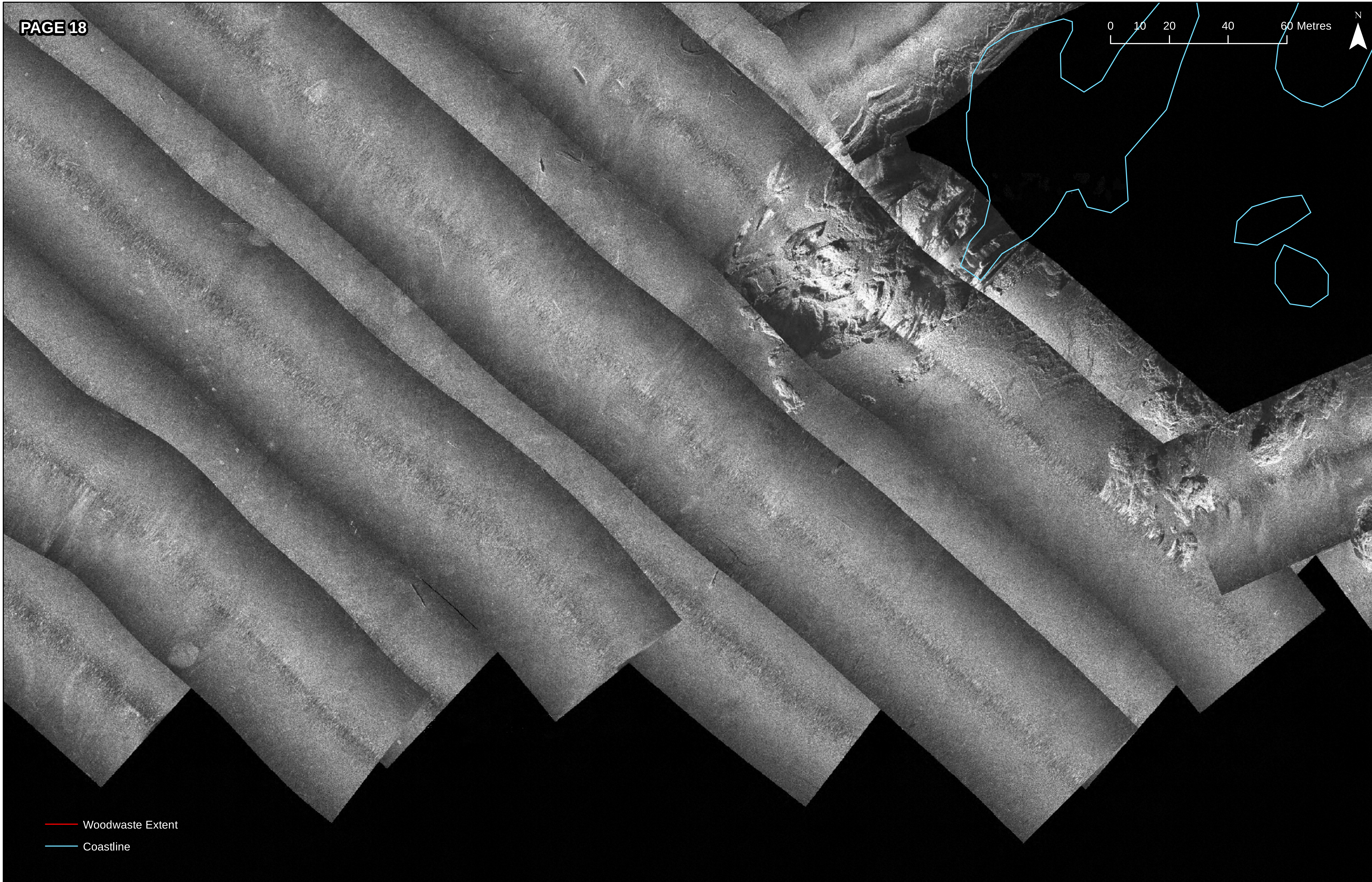
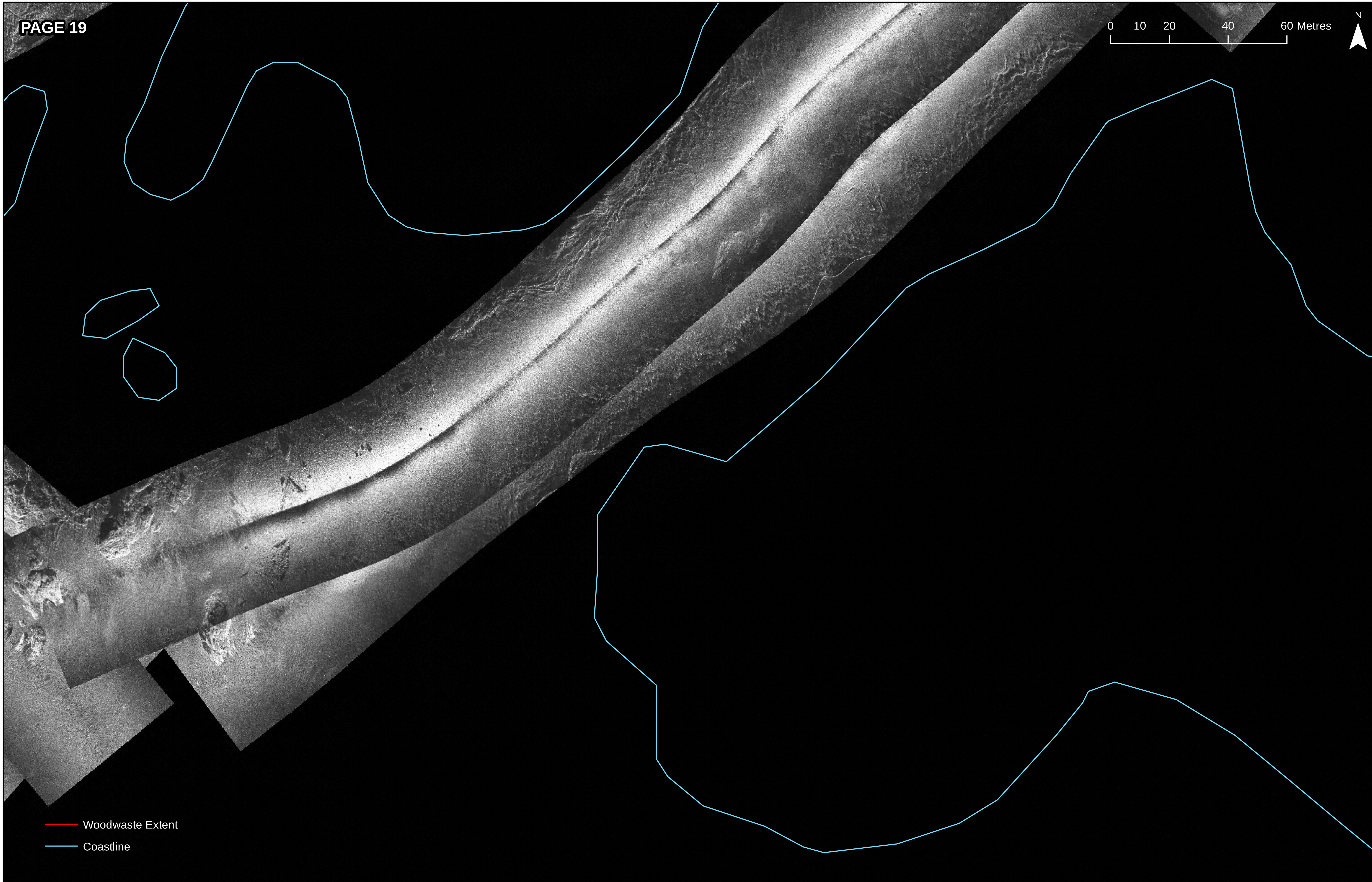
0 10 20 40 60 Metres
N
Woodwaste Extent
Coastline


0
10
20
40
60 Metres
N
Woodwaste Extent
Coastline



PAGE 17
0 10 20 40 60 Metres
N
Woodwaste Extent
Coastline


0
10
20
40
60 Metres
N
Woodwaste Extent
Coastline


0 10 20 40 60 Metres
N
Woodwaste Extent
Coastline

APPENDIX G

Sediment Core Photo Examples

Photo G1: Esquimalt Harbour Borehole T14-01 Sand/silt transitions to sand/silt with shell debris/hash at -0.2m

Photo G2: Esquimalt Harbour Borehole T24-01 Consists entirely of sand/silt and no wood waste

Photo G3: Pedder Bay Borehole T21-01 Consists entirely of coarse sand and no wood waste

Photo G4: Esquimalt Harbour Borehole T31-03 Organic transitions to organic with trace wood fibre/debris (-0.15m) which transitions to silt with trace shell debris/hash at -0.2m

Photo G5: Esquimalt Harbour Borehole T54-03 Organic with wood fibre/debris transitions to silt with trace wood fibre/debris at -0.2m

Photo G6: Esquimalt Harbour Borehole T27-03 Organic with trace wood fibre/debris transitions to organic with wood fibre/debris at -0.3m, which transitions to silt with trace shell debris/hash at -0.3m

Photo G7: Esquimalt Harbour Borehole T27-05 Organic with trace wood fibre/debris transitions to dense wood fibre/debris at -0.1m

Photo G8: Esquimalt Harbour Borehole T56-01 Organic with wood fibre/debris for the length of the borehole core

Photo G9: Esquimalt Harbour Borehole T11-05 Organic with trace wood fibre/debris transitions to organic with wood fibre/debris at -0.15m, and then to sand/silt at -0.3m

Photo G10: Esquimalt Harbour Borehole T48-01 Organic with wood fibre/debris transitions to silt with shell debris/hash at -0.3m

Photo G11: Esquimalt Harbour Sonic Drill BH15 Organic with wood fibre/debris transitioning to silt/clay with shell debris at -0.254m

Photo G12: Esquimalt Harbour Sonic Drill BH14 Organic with wood fibre/debris transitioning to sand/silt with shell debris at -0.366m

Photo G13: Esquimalt Harbour Sonic Drill BH29 Showing the transition from organic with wood fibre/debris to silt/sand with trace shell debris at -1.74m

Photo G14: Esquimalt Harbour Sonic Drill BH7 Wood fibre/debris transitions to silt/sand with trace shell debris at -1.778m

Photo G15: Esquimalt Harbour Sonic Drill BH20 Wood fibre/debris transitions to sand/silt with trace shell debris at -0.84m

Photo G16: Esquimalt Harbour Sonic Drill BH19 Wood fibre/debris transitions to silt/sand with shell debris at -0.42m

APPENDIX H

Wood Waste Depth Cross Sections

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Overview of Cross Section Locations in Esquimalt Harbour

Legend

- ● Sampling Location (Bottom depth of wood waste was reached during sampling)
- ○ Sampling Location (Bottom depth of wood waste was not reached during sampling)
- 0.6 Sampled Wood Waste Depth (m)
- Completed by Hand Core
- Completed by Sonic Drill Core
- Cross-Section
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:8,000

0 100 200 300 400

Metres

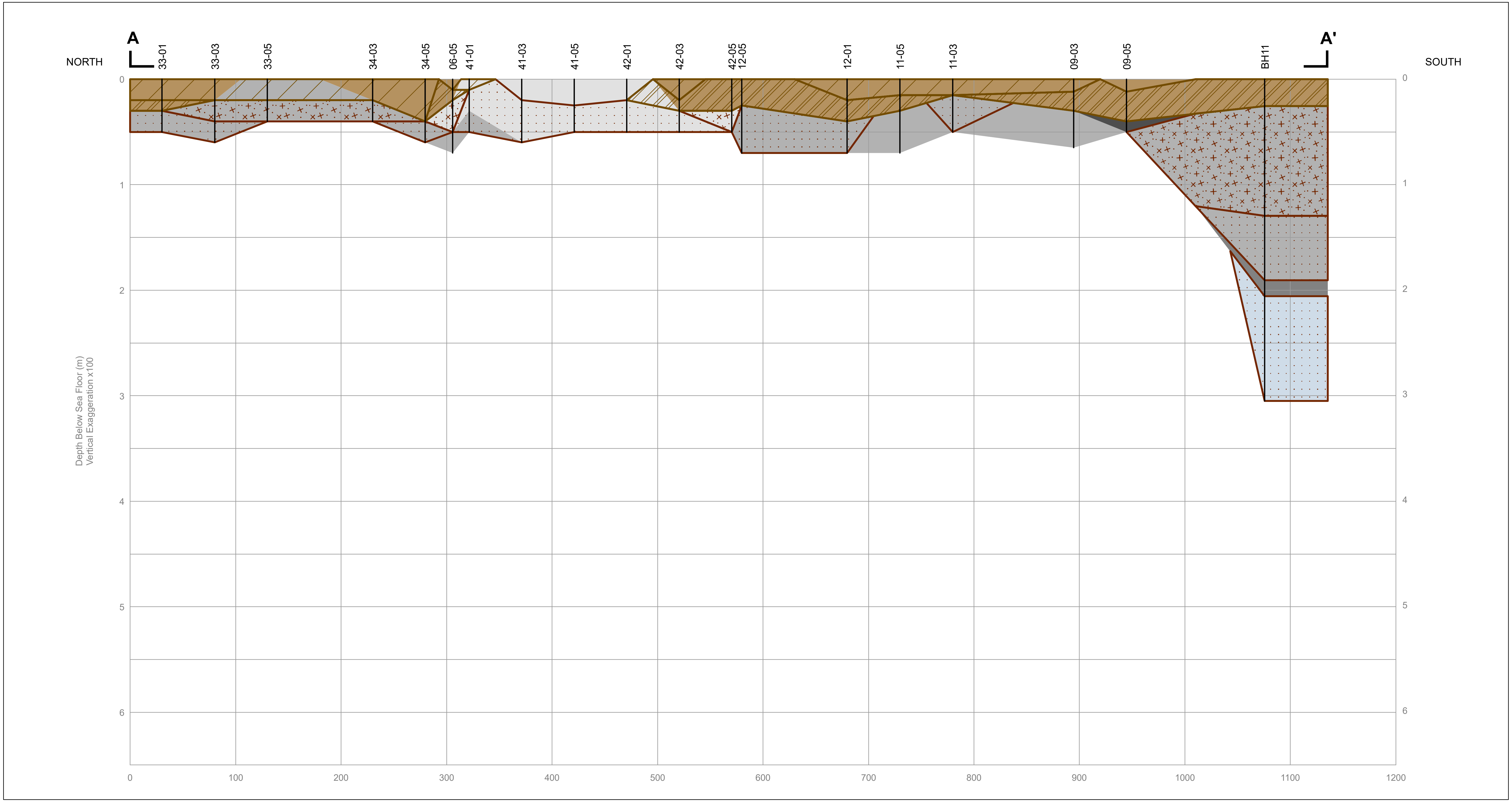
NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure H-1

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Organic
- Sand / Silt / Gravel
- Sand Lens
- Sand / Silt
- Silt
- Silt / Clay / Sand
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:3,500

Vertical Exaggeration x100

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

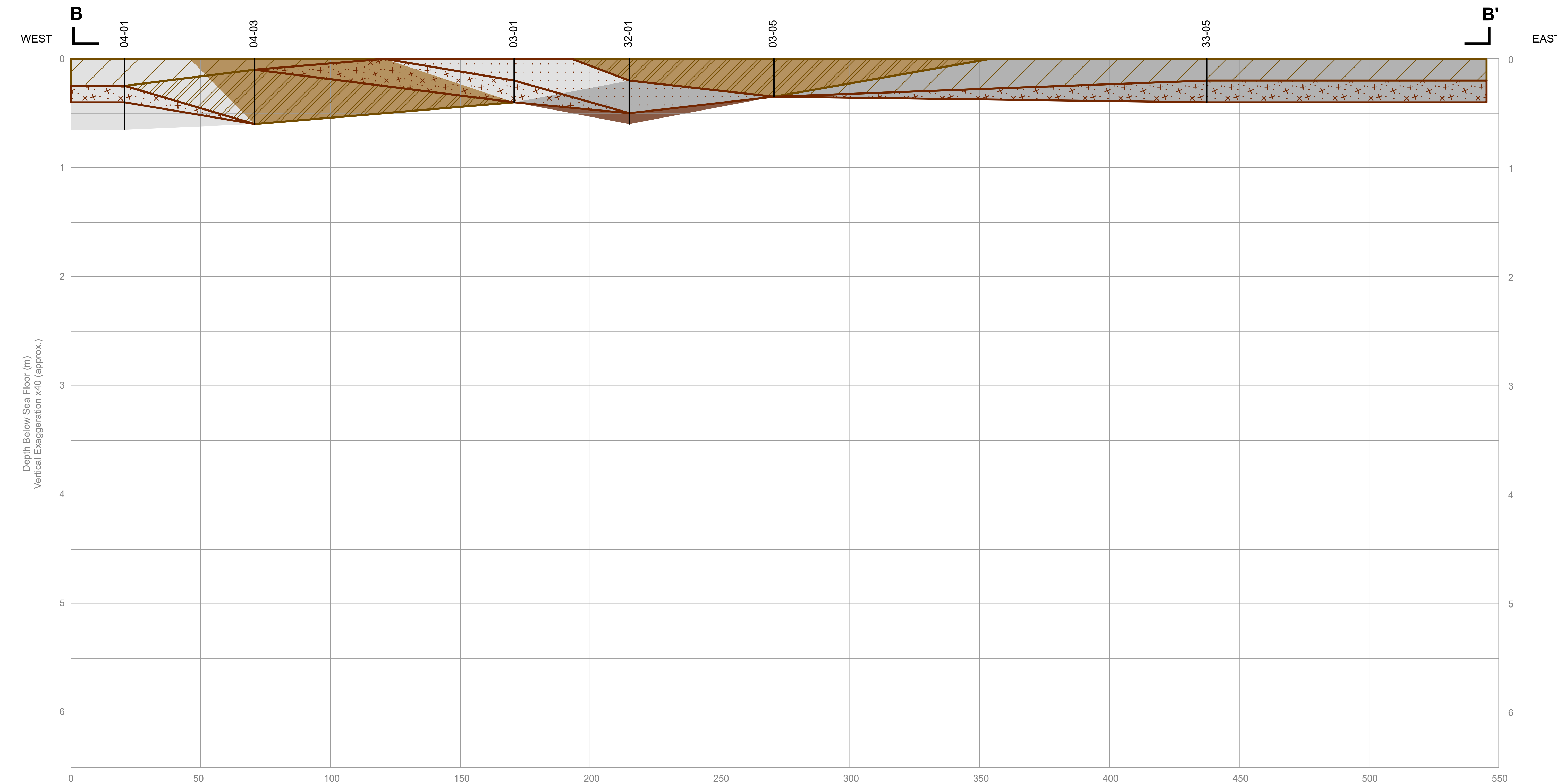
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - A-A'

376-240.08	Production Date: Jan 11, 2019	Figure H-2

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Sand / Silt
- Silt
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:1,500

Vertical Exaggeration x40 (approx.)

0 25 50 75 100

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

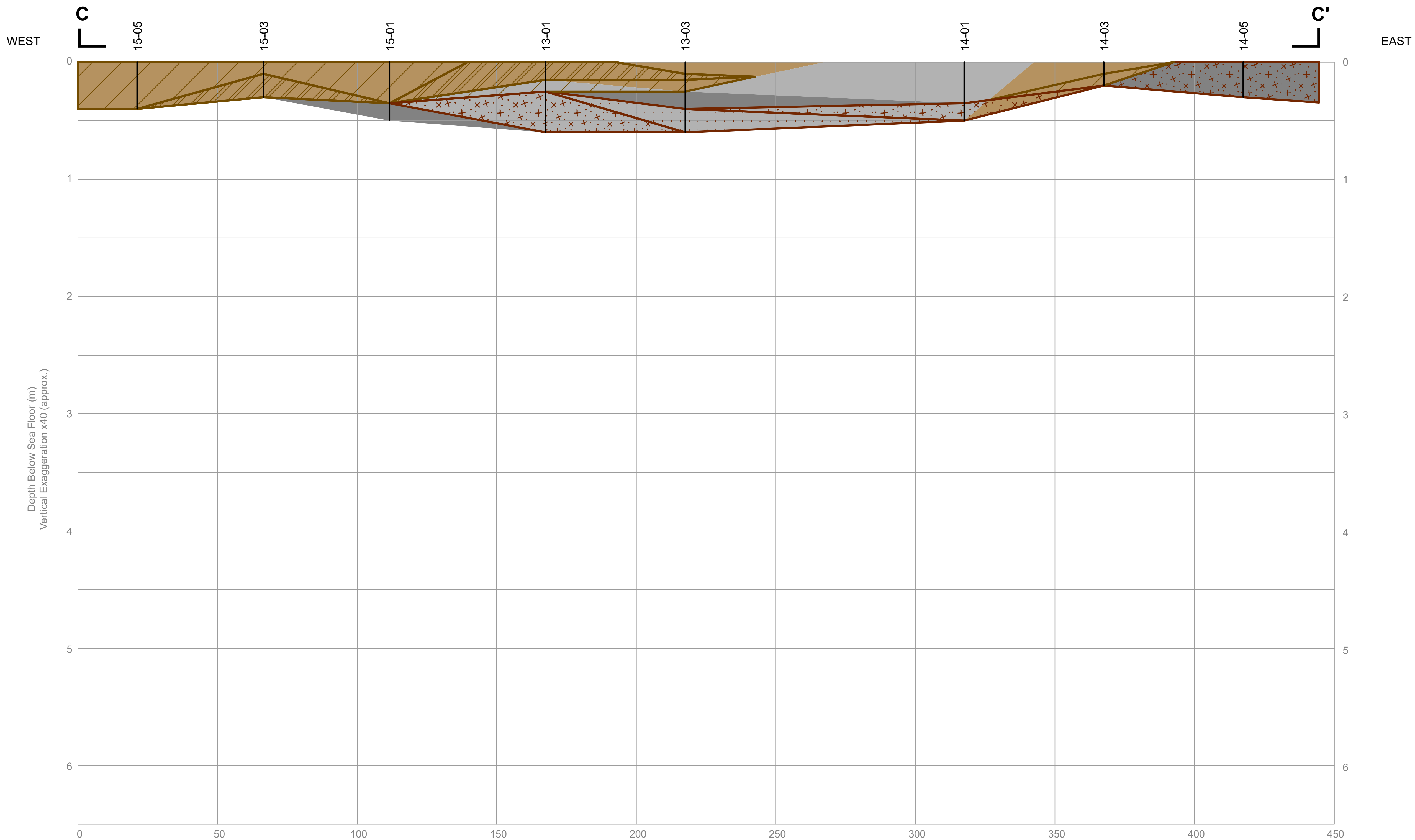
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - B-B'

376-240.08	Production Date: Jan 11, 2019	Figure H-3

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Organic
- Sand
- Sand / Silt
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:1,500

Vertical Exaggeration x40 (approx.)

0 25 50 75 100

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

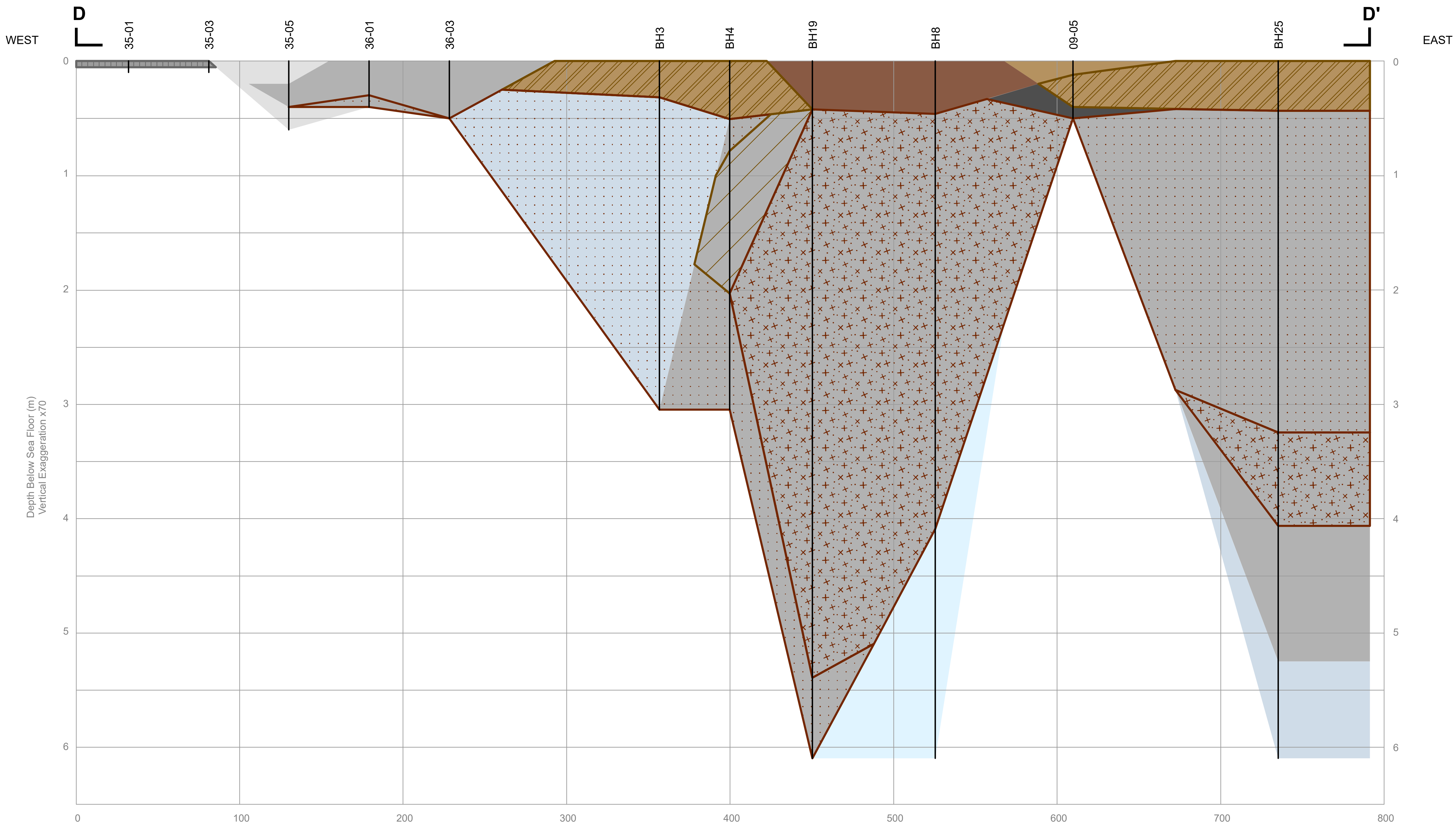
Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - C-C'

376-240.08	Production Date: Jan 11, 2019	Figure H-4

Hemmera An Ausenco Company

Public Works and Government Services Canada

Path: O:\376240\08\mxd\FigH_4__376_240_08_EsquimaltHarbour_CrossSection_CC_190111.mxd



Legend

- Wood Fibre and Wood Debris
- Organic
- Rock
- Sand / Silt / Gravel
- Sand / Silt
- Silt
- Silt / Clay
- Silt / Clay / Sand
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:2,500

Vertical Exaggeration x70

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

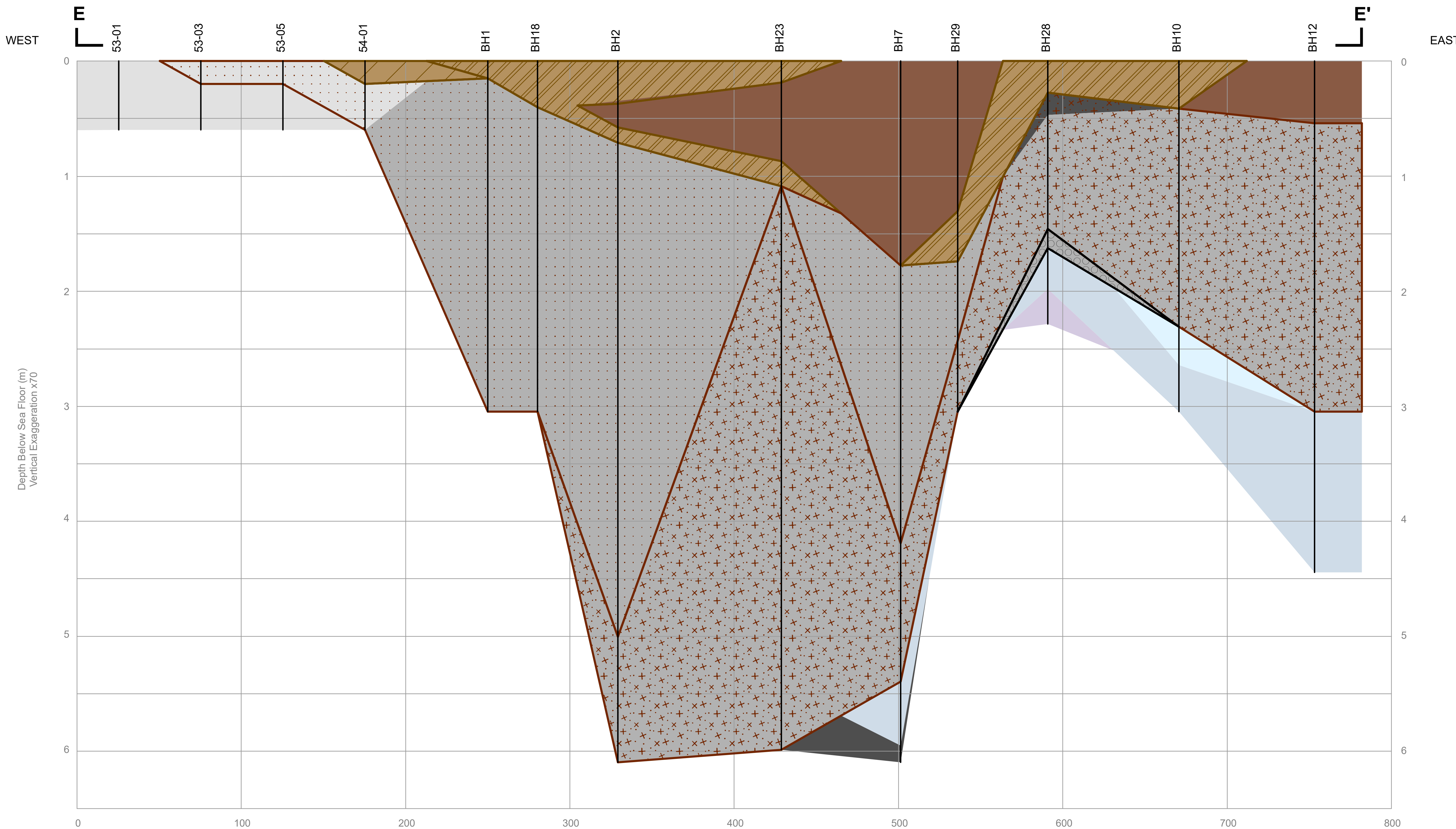
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - D-D'

376-240.08	Production Date: Jan 11, 2019	Figure H-5

Hemmera An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Sand / Silt / Gravel
- Sand / Silt
- Silt
- Silt / Clay
- Silt / Clay / Sand
- Bedrock
- Trace Cobble
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:2,500

Vertical Exaggeration x70

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

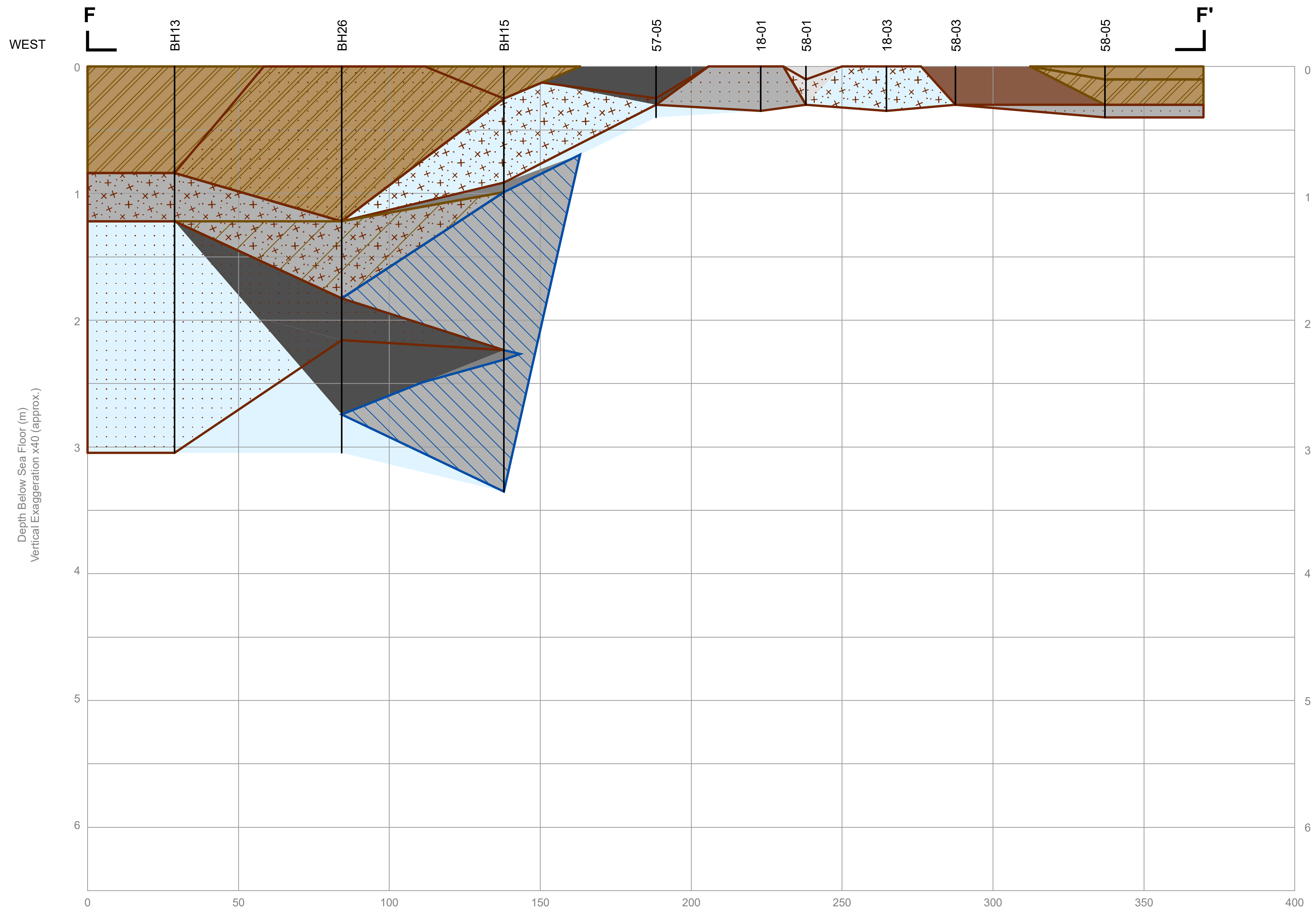
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - E-E'

376-240.08	Production Date: Jan 11, 2019	Figure H-6

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Sand / Silt / Gravel
- Sand Lens
- Sand / Silt
- Silt
- Silt / Clay
- Trace Clay
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:1,500

Vertical Exaggeration x40 (approx.)

0 25 50 75 100

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - F-F'

376-240.08	Production Date: Jan 11, 2019	Figure H-7

Hemmera An Ausenco Company

Public Works and Government Services Canada

APPENDIX I

Biophysical and Sediment Chemistry Data

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	I3	I3	I3	I3	I3	I4	I4	I4	I4	I4	W1	W1	W1	W1	W1
	OLD Sample ID	I3-01	I3-04	I3-02	I3-05	I3-03	I4-01	I4-04	I4-02	I4-05	I4-03	W1-01	W1-04	W1-02	W1-05	W1-03
	NEW Transect ID	01	01	01	01	01	02	02	02	02	02	03	03	03	03	03
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	01-01	01-02	01-03	01-04	01-05	02-01	02-02	02-03	02-04	02-05	03-01	03-02	03-03	03-04	03-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-2.74	-3.66	-4.88	-5.49	-5.79	-7.01	-7.32	-7.62	-7.93	-8.54	-5.49	-6.40	-6.40	-6.40	-6.40
	Depth gauge (ft):	-9	-12	-16	-18	-19	-23	-24	-25	-26	-28	-18	-21	-21	-21	-21
	Tide (m):	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-1.2	-2.2	-3.4	-4.0	-4.3	-5.5	-5.8	-6.1	-6.4	-7.0	-3.4	-4.3	-4.3	-4.3	-4.3
Sediment analyses	Sample Date			Oct-28		Sep-19			Oct-28		Sep-19			Sep-19		Oct-28
	Grab Sample Time			11:33					11:59							10:58
	WP			65					70							63
	Sulphide (as H2S)			21					3.8							24
	Ammonia (N)			10.8					10.4							49.1
	pH			7.92					8.21							7.34
	Total Sulphide			20					3.54							22.1
	TOC (0-10cm)					5400			26000		30000			75000		
	TOC (20-40cm)										12000					
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date			oct 27					oct 27							oct 27
	Sample Time			15:22					15:19							14:52
	WP			046					045							040
	Temp			10.17					10.18							10.2
	Conductivity/salinity			31.84					31.88							31.9
	DO %			82.4					87.8							82.6
	DO mg/L			7.56					8.06							7.57
	pH			7.92					7.9							7.9
Substrate	Silt	90	100	100	100	50	50	25	100	100	100	100	100	100	100	65
	Sand					50	40	25								
	Gravel						10	50								
	Cobble	10														
	Boulder															
	Bedrock															
	Shell			1.5	2	7	20	10	2.5						1	
	Wood waste															35
	Bare															
	WW Depth	0		0		0	0		0		0.2	0		0.55		0.5
	WW State	closed		closed		closed	closed		closed		closed	closed		open		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	I3	I3	I3	I3	I3	I4	I4	I4	I4	I4	W1	W1	W1	W1	W1
		OLD Sample ID	I3-01	I3-04	I3-02	I3-05	I3-03	I4-01	I4-04	I4-02	I4-05	I4-03	W1-01	W1-04	W1-02	W1-05	W1-03
		NEW Transect ID	01	01	01	01	01	02	02	02	02	02	03	03	03	03	03
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	01-01	01-02	01-03	01-04	01-05	02-01	02-02	02-03	02-04	02-05	03-01	03-02	03-03	03-04	03-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-2.74	-3.66	-4.88	-5.49	-5.79	-7.01	-7.32	-7.62	-7.93	-8.54	-5.49	-6.40	-6.40	-6.40	-6.40
		Depth gauge (ft):	-9	-12	-16	-18	-19	-23	-24	-25	-26	-28	-18	-21	-21	-21	-21
		Tide (m):	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-1.2	-2.2	-3.4	-4.0	-4.3	-5.5	-5.8	-6.1	-6.4	-7.0	-3.4	-4.3	-4.3	-4.3	-4.3
		Probe												1.00		1.00	
Biological	Kelp detritus	Kelp detritus						10	1								
	Beggatoa spp.	bacterial mat									95			60	55	55	
	Diatoms	Diatoms	90	95	95	95	75			95			45	40	45	45	60
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp	2.5														
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes					0.5	0.5	2									
	Mounds					0.5	1										
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab	0.5	1	1	1			0.5				0.5		0.5		
	Metacarcinus magister	Dungeness crab						0.5			0.5						
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp						0.5	1.5								
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	W2	W2	W2	W2	W2	I2	I2	I2	I2	I2	I1	I1	I1	I1	I1
	OLD Sample ID	W2-01	W2-04	W2-02	W2-05	W2-03	I2-01	I2-04	I2-02	I2-05	I2-03	I1-01	I1-04	I1-02	I1-05	I1-03
	NEW Transect ID	04	04	04	04	04	05	05	05	05	05	06	06	06	06	06
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	04-01	04-02	04-03	04-04	04-05	05-01	05-02	05-03	05-04	05-05	06-01	06-02	06-03	06-04	06-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.01	-7.01	-7.01	-6.71	-6.40	-7.93	-7.93	-7.93	-7.62	-7.62	-7.01	-7.93	-7.93	-7.93	-7.93
	Depth gauge (ft):	-23	-23	-23	-22	-21	-26	-26	-26	-25	-25	-23	-26	-26	-26	-26
	Tide (m):	2.1	2.1	2.1	2.1	2.1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	Depth m CD:	-4.9	-4.9	-4.9	-4.6	-4.3	-6.1	-6.1	-6.1	-5.8	-5.8	-5.2	-6.1	-6.1	-6.1	-6.1
Sediment analyses	Sample Date					Oct-28			Sep-20		Oct-28	Oct-28		Sep-20		
	Grab Sample Time					10:44					10:00	9:47				
	WP					62					59	58				
	Sulphide (as H2S)					18					120	20				
	Ammonia (N)					57.4					35	20.2				
	pH					7.46					7.65	8.03				
	Total Sulphide					17					111	19.2				
	TOC (0-10cm)					88000			38000					25000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments					WP 060, 061 were too full of wood waste to						piece of large bark and some shell/ shell hash				
YSI Sampling	Sample Date					oct 27					oct 27	oct 27				
	Sample Time					14:48					15:02	14:17				
	WP					039					042	033				
	Temp					10.2					10.19	10.17				
	Conductivity/salinity					31.92					31.85	31.82				
	DO %					82.4					75	87.2				
	DO mg/L					7.56					6.88	8.01				
	pH					7.89					7.88	7.94				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell										1					
	Wood waste				100	100			5							
	Bare															
	WW Depth	0.25		0.45		0.55	0.35		0.25		0.3	0		0.1		0.2
	WW State	closed		closed		open	closed		closed		closed	closed		closed		closed

Transect Sampling Information		**Year**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**
		Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	W2	W2	W2	W2	W2	I2	I2	I2	I2	I2	I1	I1	I1	I1	I1
		OLD Sample ID	W2-01	W2-04	W2-02	W2-05	W2-03	I2-01	I2-04	I2-02	I2-05	I2-03	I1-01	I1-04	I1-02	I1-05	I1-03
		NEW Transect ID	04	04	04	04	04	05	05	05	05	05	06	06	06	06	06
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	04-01	04-02	04-03	04-04	04-05	05-01	05-02	05-03	05-04	05-05	06-01	06-02	06-03	06-04	06-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.01	-7.01	-7.01	-6.71	-6.40	-7.93	-7.93	-7.93	-7.62	-7.62	-7.01	-7.93	-7.93	-7.93	-7.93
		Depth gauge (ft):	-23	-23	-23	-22	-21	-26	-26	-26	-25	-25	-23	-26	-26	-26	-26
		Tide (m):	2.1	2.1	2.1	2.1	2.1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
		Depth m CD:	-4.9	-4.9	-4.9	-4.6	-4.3	-6.1	-6.1	-6.1	-5.8	-5.8	-5.2	-6.1	-6.1	-6.1	-6.1
		Probe		1.00					0.30					0.30		0.70	
Biological	Kelp detritus	Kelp detritus						15									
	Beggatoa spp.	bacterial mat	20	87	37	3		93	95	95	95	95	95	70	95	93	95
	Diatoms	Diatoms	33	10	15												
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																1
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab				0.5	0.5										
	Metridium farcimen	giant plumose anemone				0.5											
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout													2		
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish					50										
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	F1	F1	F1	F1	F1	F2	F2	F2	F2	F2	W5	W5	W5	W5	W5
	OLD Sample ID	F1-01	F1-04	F1-02	F1-05	F1-03	F2-01	F2-04	F2-02	F2-05	F2-03	W5-01	W5-04	W5-02	W5-05	W5-03
	NEW Transect ID	07	07	07	07	07	08	08	08	08	08	09	09	09	09	09
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	07-01	07-02	07-03	07-04	07-05	08-01	08-02	08-03	08-04	08-05	09-01	09-02	09-03	09-04	09-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-2.74	-2.74	-2.74	-3.05	-3.35	-3.96	-4.27	-4.57	-4.57	-4.88	-10.06	-10.06	-10.06	-9.76	-9.76
	Depth gauge (ft):	-9	-9	-9	-10	-11	-13	-14	-15	-15	-16	-33	-33	-33	-32	-32
	Tide (m):	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-1.0	-1.0	-1.0	-1.3	-1.7	-2.3	-2.6	-2.9	-2.9	-3.2	-8.0	-8.0	-8.0	-7.7	-7.7
Sediment analyses	Sample Date	Oct-28		Sep-20			Oct-28		Sep-20					Sep-20		Oct-28
	Grab Sample Time	9:12					9:23									13:55
	WP	55					56									78
	Sulphide (as H2S)	0.029					31									200
	Ammonia (N)	10.9					29.8									50.4
	pH	8.09					7.45									7.79
	Total Sulphide	0.0273					29.5									186
	TOC (0-10cm)			9300					24000					86000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments	shell hash					small amounts of bark									
YSI Sampling	Sample Date	oct 27					oct 27							oct 27		
	Sample Time	14:32					14:35							13:33		
	WP	036					037							024		
	Temp	10.18					10.2							10.16		
	Conductivity/salinity	31.8					31.86							31.87		
	DO %	89.4					85.7							77.3		
	DO mg/L	8.21					7.86							7.09		
	pH	7.93					7.93							7.87		
Substrate	Silt	55	45	40	100	90	90	100	40	100	80	100	95	100	100	100
	Sand	37	55	60		10	10									
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell	8	5	5			2		0.5							
	Wood waste		0.1	20			43	8	60		20		5			
	Bare															
	WW Depth	0		0		0.1	0		0		0.3	0.3		0.3		0.4
	WW State	closed		closed		closed	closed		closed		closed	open		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	F1	F1	F1	F1	F1	F2	F2	F2	F2	F2	W5	W5	W5	W5	W5
		OLD Sample ID	F1-01	F1-04	F1-02	F1-05	F1-03	F2-01	F2-04	F2-02	F2-05	F2-03	W5-01	W5-04	W5-02	W5-05	W5-03
		NEW Transect ID	07	07	07	07	07	08	08	08	08	08	09	09	09	09	09
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	07-01	07-02	07-03	07-04	07-05	08-01	08-02	08-03	08-04	08-05	09-01	09-02	09-03	09-04	09-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-2.74	-2.74	-2.74	-3.05	-3.35	-3.96	-4.27	-4.57	-4.57	-4.88	-10.06	-10.06	-10.06	-9.76	-9.76
		Depth gauge (ft):	-9	-9	-9	-10	-11	-13	-14	-15	-15	-16	-33	-33	-33	-32	-32
		Tide (m):	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-1.0	-1.0	-1.0	-1.3	-1.7	-2.3	-2.6	-2.9	-2.9	-3.2	-8.0	-8.0	-8.0	-7.7	-7.7
		Probe														0.20	
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat											80	80	88	92	100
	Diatoms	Diatoms			50	50	43	75	80	70	73						
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp	30														
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed	1														
	Ulva lactuca	sea lettuce															
	Holes			3													
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab						0.5			0.5	0.5					
	Metacarcinus magister	Dungeness crab		0.5		1											
	Metridium farcimen	giant plumose anemone		0.5			0.5	4		2		4					
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown						0.5									

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
	Field Survey #	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	W6	W6	W6	W6	W6	T2	T2	T2	T2	T2
	OLD Sample ID	W6-01	W6-04	W6-02	W6-05	W6-03	T2-01		T2-02		T2-03
	NEW Transect ID	10	10	10	10	10	11	11	11	11	11
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	10-01	10-02	10-03	10-04	10-05	11-01	11-02	11-03	11-04	11-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-9.76	-9.76	-9.15	-8.54	-7.32	-8.84	-8.84	-8.84	-8.84	-8.84
	Depth gauge (ft):	-32	-32	-30	-28	-24	-29	-29	-29	-29	-29
	Tide (m):	2.1	2.1	2.1	2.1	2.1	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-7.7	-7.7	-7.0	-6.4	-5.2	-6.4	-6.4	-6.4	-6.4	-6.4
Sediment analyses	Sample Date			Sep-20		Oct-28	Oct-28		Sep-20		
	Grab Sample Time					14:09	13:34				
	WP					79	76				
	Sulphide (as H2S)					30	77				
	Ammonia (N)					67.5	33.4				
	pH					7.37	7.41				
	Total Sulphide					27.8	72.8				
	TOC (0-10cm)			110000					70000		
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments					wood waste, bark in larger pieces					
YSI Sampling	Sample Date					oct 27	oct 27				
	Sample Time					13:28	13:36				
	WP					023	025				
	Temp					10.15	10.14				
	Conductivity/salinity					31.8	31.84				
	DO %					84.3	82.3				
	DO mg/L					7.74	7.56				
	pH					7.9	7.89				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100
	Sand										
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste	18	1			1					
	Bare										
	WW Depth	0.6		0.6		0.6	0.6		0.5		0.3
	WW State	open		open		open	open		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
		Field Survey #	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	W6	W6	W6	W6	W6	T2	T2	T2	T2	T2
		OLD Sample ID	W6-01	W6-04	W6-02	W6-05	W6-03	T2-01		T2-02		T2-03
		NEW Transect ID	10	10	10	10	10	11	11	11	11	11
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	10-01	10-02	10-03	10-04	10-05	11-01	11-02	11-03	11-04	11-05
		Point ID	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-9.76	-9.76	-9.15	-8.54	-7.32	-8.84	-8.84	-8.84	-8.84	-8.84
		Depth gauge (ft):	-32	-32	-30	-28	-24	-29	-29	-29	-29	-29
		Tide (m):	2.1	2.1	2.1	2.1	2.1	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-7.7	-7.7	-7.0	-6.4	-5.2	-6.4	-6.4	-6.4	-6.4	-6.4
		Probe						0.60	0.60	0.60	0.60	0.60
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat	100	93	95	85	13	100	100	100	100	100
	Diatoms	Diatoms										
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade										
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp										
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce										
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab					1			1		
	Metacarcinus magister	Dungeness crab										
	Metridium farcimen	giant plumose anemone	2									2
	Metridium senile	short plumose anemone										
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp										
	Pandalus platyceros	spot prawn										
	Pandalus unknown	Pandalus unknown										
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish	15									
	Sculpin unknown	sculpin unknown	0.5									

Section	Parameter															
Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	T2	T2	T2	T2	T2	F3	F3	F3	F3	F3	F4	F4	F4	F4	F4
	OLD Sample ID	T-04		T2-05		T2-06	F3-01	F3-04	F3-02	F3-05	F3-03	F4-01	F4-04	F4-02	F4-05	F4-03
	NEW Transect ID	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	12-01	12-02	12-03	12-04	12-05	13-01	13-02	13-03	13-04	13-05	14-01	14-02	14-03	14-04	14-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-8.84	-8.84	-8.84	-8.84	-8.84	-7.93	-7.32	-7.01	-6.71	-6.71	-5.79	-5.18	-4.27	-3.35	-3.05
	Depth gauge (ft):	-29	-29	-29	-29	-29	-26	-24	-23	-22	-22	-19	-17	-14	-11	-10
	Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-6.4	-6.4	-6.4	-6.4	-6.4	-5.5	-4.9	-4.6	-4.3	-4.3	-3.4	-2.8	-1.9	-1.0	-0.6
Sediment analyses	Sample Date	Oct-28		Sep-20			Oct-28				Sep-21			Sep-21		Oct-28
	Grab Sample Time	13:14					12:53									12:21
	WP	75					73									71
	Sulphide (as H2S)	47					230									6.4
	Ammonia (N)	36.4					39.7									8.22
	pH	7.37					7.52									8.06
	Total Sulphide	44					219									6
	TOC (0-10cm)			72000			58000				68000			5800		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	oct 27					oct 27									oct 27
	Sample Time	13:40					13:59									13:53
	WP	026					030									029
	Temp	10.15					10.18									10.27
	Conductivity/salinity	31.87					29.3									31.75
	DO %	78.1					81.2									82.9
	DO mg/L	7.17					7.57									7.6
	pH	7.89					7.9									7.9
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	30	5	5	3
	Sand												70	90	95	90
	Gravel													5		
	Cobble															
	Boulder															
	Bedrock															
	Shell											5		7	3	7
	Wood waste						0.1	0.1	0.1	0.1	0.1		10		33	
	Bare															
	WW Depth	0.4		0.65		0.25	0.35		0.6		0.4	0		0.2		0
	WW State	closed		open		closed	closed		closed		open	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	T2	T2	T2	T2	T2	F3	F3	F3	F3	F3	F4	F4	F4	F4	F4
		OLD Sample ID	T-04		T2-05		T2-06	F3-01	F3-04	F3-02	F3-05	F3-03	F4-01	F4-04	F4-02	F4-05	F4-03
		NEW Transect ID	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	12-01	12-02	12-03	12-04	12-05	13-01	13-02	13-03	13-04	13-05	14-01	14-02	14-03	14-04	14-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-8.84	-8.84	-8.84	-8.84	-8.84	-7.93	-7.32	-7.01	-6.71	-6.71	-5.79	-5.18	-4.27	-3.35	-3.05
		Depth gauge (ft):	-29	-29	-29	-29	-29	-26	-24	-23	-22	-22	-19	-17	-14	-11	-10
		Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-6.4	-6.4	-6.4	-6.4	-6.4	-5.5	-4.9	-4.6	-4.3	-4.3	-3.4	-2.8	-1.9	-1.0	-0.6
		Probe	0.60	0.60	0.60	0.60	0.60		0.20		0.40			0.17			
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	100	100	100	100	100	70	95	100	99	97	75				
	Diatoms	Diatoms												58	80	80	60
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched													1		
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp											2				
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes															2	
	Mounds															1	
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab												1	1		1
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone			5			1					2			0.5	
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab											1				
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	W4	W4	W4	W4	W4	W3	W3	W3	W3	W3	T4	T4	T4	T4	T4
	OLD Sample ID	W4-01	W4-04	W4-02	W4-05	W4-03	W3-01	W3-04	W3-02	W3-05	W3-03	T4-01		T4-02		T4-03
	NEW Transect ID	15	15	15	15	15	16	16	16	16	16	17	17	17	17	17
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	15-01	15-02	15-03	15-04	15-05	16-01	16-02	16-03	16-04	16-05	17-01	17-02	17-03	17-04	17-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.32	-7.32	-7.01	-6.71	-5.79	-8.84	-8.84	-8.54	-8.23	-7.93	-5.18	-5.18	-5.18	-5.18	-5.18
	Depth gauge (ft):	-24	-24	-23	-22	-19	-29	-29	-28	-27	-26	-17	-17	-17	-17	-17
	Tide (m):	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9
	Depth m CD:	-5.3	-5.3	-5.0	-4.7	-3.8	-6.8	-6.8	-6.5	-6.2	-5.9	-3.3	-3.3	-3.3	-3.3	-3.3
Sediment analyses	Sample Date	Sep-21		Oct-28			Oct-28		Sep-21					Oct-28		Sep-21
	Grab Sample Time			13:03			12:37							15:24		
	WP			74			72							86		
	Sulphide (as H2S)			24			12							4.1		
	Ammonia (N)			53.9			64.4							25.3		
	pH			7.23			7.25							7.77		
	Total Sulphide			22.5			11.6							3.83		
	TOC (0-10cm)	98000							72000					60000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture			75			68									49
	Available (KCl) Ammonia (N) (AVS)			19.6			19.2									6.99
	Soluble (2:1) pH (AVS)			7.63			7.76									7.95
	Sulphide (AVS)			2700			352									492
	Grab Sampling Comments						pieces of bark in sampler							wood waste at waypoints 084 and 085 made it		
YSI Sampling	Sample Date			oct 27			oct 27									Oct 27
	Sample Time			13:44			13:48									13:19
	WP			027			028									021
	Temp			10.19			10.2									10:16
	Conductivity/salinity			31.84			31.81									31.79
	DO %			83.4			85									82.8
	DO mg/L			7.65			7.79									7.6
	pH			7.89			7.91									7.9
Substrate	Silt	100	100	100	100	100	100	100	100	50	100	75	75	75	75	75
	Sand											25	25	25	25	25
	Gravel															
	Cobble														10	
	Boulder															
	Bedrock															
	Shell													80		80
	Wood waste	0.1	0.1	0.1	0.1	0.1		0.1	0.1	50			100		100	
	Bare															
	WW Depth	0.35		0.3		0.4	0.2		0.2		0.35	0.35		0.3		0.4
	WW State	closed		closed		closed	closed		closed		closed	open		open		open

Transect Sampling Information		**Year**	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	W4	W4	W4	W4	W4	W3	W3	W3	W3	W3	T4	T4	T4	T4	T4
		OLD Sample ID	W4-01	W4-04	W4-02	W4-05	W4-03	W3-01	W3-04	W3-02	W3-05	W3-03	T4-01		T4-02		T4-03
		NEW Transect ID	15	15	15	15	15	16	16	16	16	16	17	17	17	17	17
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	15-01	15-02	15-03	15-04	15-05	16-01	16-02	16-03	16-04	16-05	17-01	17-02	17-03	17-04	17-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.32	-7.32	-7.01	-6.71	-5.79	-8.84	-8.84	-8.54	-8.23	-7.93	-5.18	-5.18	-5.18	-5.18	-5.18
		Depth gauge (ft):	-24	-24	-23	-22	-19	-29	-29	-28	-27	-26	-17	-17	-17	-17	-17
		Tide (m):	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9
		Depth m CD:	-5.3	-5.3	-5.0	-4.7	-3.8	-6.8	-6.8	-6.5	-6.2	-5.9	-3.3	-3.3	-3.3	-3.3	-3.3
		Probe		0.20		0.30			0.50				0.50	0.50	0.40	0.20	0.20
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	83	88	99	99	90	83	80	80	48	83					
	Diatoms	Diatoms															
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp											80			80	40
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab										0.5					
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone									1	0.5					
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp														10	
	Pandalus platyceros	spot prawn														10	
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
	Field Survey #	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	T4	T4	T4	T4	T4	F6	F6	F6	F6	F6
	OLD Sample ID	T4-04		T4-05		T4-06	F6-01	F6-04	F6-02	F6-05	F6-03
	NEW Transect ID	18	18	18	18	18	19	19	19	19	19
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	18-01	18-02	18-03	18-04	18-05	19-01	19-02	19-03	19-04	19-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-5.18	-5.18	-5.18	-5.18	-5.18	-12.20	-12.20	-11.89	-11.28	-9.76
	Depth gauge (ft):	-17	-17	-17	-17	-17	-40	-40	-39	-37	-32
	Tide (m):	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0
	Depth m CD:	-3.3	-3.3	-3.3	-3.3	-3.3	-10.2	-10.2	-9.9	-9.3	-7.8
Sediment analyses	Sample Date	Sep-21		Oct-28			Oct-27		Sep-21		
	Grab Sample Time			15:07			14:26				
	WP			83			52				
	Sulphide (as H2S)			0.035			0.05				
	Ammonia (N)			9.17			39.6				
	pH			8.06			7.73				
	Total Sulphide			0.0329			0.0467				
	TOC (0-10cm)	39000							50000		
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture			32			53				
	Available (KCl) Ammonia (N) (AVS)			2.96			9.74				
	Soluble (2:1) pH (AVS)			8.42			7.61				
	Sulphide (AVS)			58.2			225				
	Grab Sampling Comments			lots of whole shells made sampling			bark wood waste, 2inch chunks				
YSI Sampling	Sample Date			oct 27			oct 27				
	Sample Time			13:23			13:03				
	WP			022			019				
	Temp			10.23			10.14				
	Conductivity/salinity			31.8			31.82				
	DO %			82.5			78.1				
	DO mg/L			7.57			7.18				
	pH			7.88			7.88				
Substrate	Silt	75	75	75	75	40	70	60	65	70	40
	Sand	25	25	25	25	60	30	40	35	30	50
	Gravel										10
	Cobble										
	Boulder										
	Bedrock										
	Shell	40	40		50		1	2			
	Wood waste	40					10	10	15	43	
	Bare										
	WW Depth	0		0		0	0.1		0.2		0.15
	WW State	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
		Field Survey #	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	T4	T4	T4	T4	T4	F6	F6	F6	F6	F6
		OLD Sample ID	T4-04		T4-05		T4-06	F6-01	F6-04	F6-02	F6-05	F6-03
		NEW Transect ID	18	18	18	18	18	19	19	19	19	19
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	18-01	18-02	18-03	18-04	18-05	19-01	19-02	19-03	19-04	19-05
		Point ID	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-5.18	-5.18	-5.18	-5.18	-5.18	-12.20	-12.20	-11.89	-11.28	-9.76
		Depth gauge (ft):	-17	-17	-17	-17	-17	-40	-40	-39	-37	-32
		Tide (m):	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0
		Depth m CD:	-3.3	-3.3	-3.3	-3.3	-3.3	-10.2	-10.2	-9.9	-9.3	-7.8
		Probe	0.20	0.50	0.60	0.40	0.30					
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat										
	Diatoms	Diatoms			80	50		55	50	35		
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade							1		1	
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp		30			20				15	100
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce					20					
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab		1			2		1	1		
	Metacarcinus magister	Dungeness crab									0.5	
	Metridium farcimen	giant plumose anemone										
	Metridium senile	short plumose anemone										
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp							3			
	Pandalus platyceros	spot prawn										2
	Pandalus unknown	Pandalus unknown							5			
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate						4				
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown								1		
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish										2
	Sculpin unknown	sculpin unknown						1	1			

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	F5	F5	F5	F5	F5	O1	O1	O1	O1	O1	O2	O2	O2	O2	O2
	OLD Sample ID	F5-01	F5-04	F5-02	F5-05	F5-03	O1-01	O1-04	O1-02	O1-05	O1-03	O2-01	O2-04	O2-02	O2-05	O2-03
	NEW Transect ID	20	20	20	20	20	21	21	21	21	21	22	22	22	22	22
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	20-01	20-02	20-03	20-04	20-05	21-01	21-02	21-03	21-04	21-05	22-01	22-02	22-03	22-04	22-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-12.50	-12.50	-12.50	-12.50	-12.50	-4.88	-5.79	-6.40	-7.01	-7.32	-7.62	-8.23	-7.93	-8.54	-8.84
	Depth gauge (ft):	-41	-41	-41	-41	-41	-16	-19	-21	-23	-24	-25	-27	-26	-28	-29
	Tide (m):	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-10.5	-10.5	-10.5	-10.5	-10.5	-2.8	-3.7	-4.3	-4.9	-5.2	-5.5	-6.1	-5.8	-6.4	-6.7
Sediment analyses	Sample Date	Sep-21		Oct-27					Sep-22		Oct-21	Oct-21				Sep-22
	Grab Sample Time			16:08												
	WP			51												
	Sulphide (as H2S)			0.099							5.7	0.017				
	Ammonia (N)			30							7.26	9.64				
	pH			7.75							8.1	7.92				
	Total Sulphide			0.0928							5.4	0.0163				
	TOC (0-10cm)	35000							1600							8700
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture			57							28	34				
	Available (KCl) Ammonia (N) (AVS)			13.8							7.26	9.64				
	Soluble (2:1) pH (AVS)			7.73							8.1	7.92				
	Sulphide (AVS)			323							44	85.5				
	Grab Sampling Comments			bark wood waste, 2inch chunks												
YSI Sampling	Sample Date			oct 27							oct 27	oct 27				oc t27
	Sample Time			12:58							10:00	10:05				10:05
	WP			018							005	006				007
	Temp			10.16							10.21	10.29				10.3
	Conductivity/salinity			31.92							31.86	31.89				31.97
	DO %			68.1							80.3	76.7				73.4
	DO mg/L			6.25							7.35	7.05				6.77
	pH			7.81							7.78	7.81				7.78
Substrate	Silt	55	70	70	70	70	10	10	10	20	20	40	50	50	60	60
	Sand	45	30	30	30	30	90	90	90	80	80	60	50	50	40	40
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell		1										0.5	1		
	Wood waste	30	7.5	40	20	13										
	Bare															
	WW Depth	0.25		0.2		0.2	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	F5	F5	F5	F5	F5	O1	O1	O1	O1	O1	O2	O2	O2	O2	O2
		OLD Sample ID	F5-01	F5-04	F5-02	F5-05	F5-03	O1-01	O1-04	O1-02	O1-05	O1-03	O2-01	O2-04	O2-02	O2-05	O2-03
		NEW Transect ID	20	20	20	20	20	21	21	21	21	21	22	22	22	22	22
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	20-01	20-02	20-03	20-04	20-05	21-01	21-02	21-03	21-04	21-05	22-01	22-02	22-03	22-04	22-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-12.50	-12.50	-12.50	-12.50	-12.50	-4.88	-5.79	-6.40	-7.01	-7.32	-7.62	-8.23	-7.93	-8.54	-8.84
		Depth gauge (ft):	-41	-41	-41	-41	-41	-16	-19	-21	-23	-24	-25	-27	-26	-28	-29
		Tide (m):	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-10.5	-10.5	-10.5	-10.5	-10.5	-2.8	-3.7	-4.3	-4.9	-5.2	-5.5	-6.1	-5.8	-6.4	-6.7
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	5	23	43	55	60	63	53	70	73	78	80	78	88	80	80
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp						13	18	13	85	25	5		3		
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed							8			20	10	15	15	15	15
	Ulva lactuca	sea lettuce						63									
	Holes								0.5				7	7	7.5	4.5	5.5
	Mounds														0.5	1	1
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab		1	0.5											0.5	
	Metacarcinus magister	Dungeness crab							0.5					0.5	1	0.5	0.5
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab	1														
	Pandalus danae	coon striped shrimp	0.5				3										
	Pandalus platyceros	spot prawn			0.5												
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species						2.5	0.5		1	1					
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate	0.5		0.5												
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															0.5
	Sebastes spp. YOY	young of the year rockfish											1				
	Sculpin unknown	sculpin unknown												1			

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	O3	O3	O3	O3	O3	O4	O4	O4	O4	O4	O5	O5	O5	O5	O5
	OLD Sample ID	O3-01	O3-04	O3-02	O3-05	O3-03	O4-01	O4-04	O4-02	O4-05	O4-03	O5-01	O5-04	O5-02	O5-05	O5-03
	NEW Transect ID	23	23	23	23	23	24	24	24	24	24	25	25	25	25	25
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	23-01	23-02	23-03	23-04	23-05	24-01	24-02	24-03	24-04	24-05	25-01	25-02	25-03	25-04	25-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.32	-8.23	-8.54	-8.54	-8.84	-8.84	-9.15	-9.15	-9.15	-9.45	-8.84	-8.84	-9.15	-8.84	-9.45
	Depth gauge (ft):	-24	-27	-28	-28	-29	-29	-30	-30	-30	-31	-29	-29	-30	-29	-31
	Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-5.2	-6.1	-6.4	-6.4	-6.7	-6.7	-7.0	-7.0	-7.0	-7.4	-6.7	-6.7	-7.0	-6.7	-7.4
Sediment analyses	Sample Date	Sep-22		Oct-21			Oct-21		Sep-22					Sep-22		Oct-21
	Grab Sample Time															
	WP															
	Sulphide (as H2S)			0.063			0.025									14
	Ammonia (N)			6.96			19.8									16.9
	pH			7.91			8.16									8.24
	Total Sulphide			0.0593			0.0235									13.1
	TOC (0-10cm)	7300							7200					6000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture			37			37									35
	Available (KCl) Ammonia (N) (AVS)			6.96			19.8									16.9
	Soluble (2:1) pH (AVS)			7.91			8.16									8.24
	Sulphide (AVS)			92.5			173									224
	Grab Sampling Comments															
YSI Sampling	Sample Date			oct 27			oct 27		oct 27			oct 27		oct 27		oct 27
	Sample Time			9:50			9:55		9:55			10:10		10:10		10:10
	WP			001			003		004			008		009		010
	Temp			10.14			10.15		10.14			10.16		10.25		10.12
	Conductivity/salinity			31.59			31.92		31.91			31.81		31.91		31.87
	DO %			68.7			74.1		84.3			81.2		78.8		76.8
	DO mg/L			6.24			6.62		7.55			7.43		7.22		7.03
	pH			7.44			7.61		7.7			7.85		7.86		7.87
Substrate	Silt	35	60	50	60	60	60	50	50	50	40	40	40	40	30	40
	Sand	65	40	50	40	40	40	50	50	50	60	60	60	60	70	60
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell						0.5							0.5	0.5	
	Wood waste															
	Bare															
	WW Depth	0.15		0		0	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information		Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	O3	O3	O3	O3	O3	O4	O4	O4	O4	O4	O5	O5	O5	O5	O5
		OLD Sample ID	O3-01	O3-04	O3-02	O3-05	O3-03	O4-01	O4-04	O4-02	O4-05	O4-03	O5-01	O5-04	O5-02	O5-05	O5-03
		NEW Transect ID	23	23	23	23	23	24	24	24	24	24	25	25	25	25	25
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	23-01	23-02	23-03	23-04	23-05	24-01	24-02	24-03	24-04	24-05	25-01	25-02	25-03	25-04	25-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.32	-8.23	-8.54	-8.54	-8.84	-8.84	-9.15	-9.15	-9.15	-9.45	-8.84	-8.84	-9.15	-8.84	-9.45
		Depth gauge (ft):	-24	-27	-28	-28	-29	-29	-30	-30	-30	-31	-29	-29	-30	-29	-31
		Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-5.2	-6.1	-6.4	-6.4	-6.7	-6.7	-7.0	-7.0	-7.0	-7.4	-6.7	-6.7	-7.0	-6.7	-7.4
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	55	80	83	80	83	63	55	78	85	53	70	63	65	70	
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair										18					
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp						83	75						85	83	90
	Sacharina groenlandica	split kelp	50	38	55	58	58			90	78	70	30	53			
	Sarcodietheca gaudichaudii	succulent seaweed											63	18	2.5	0.5	
	Ulva lactuca	sea lettuce										2.5					
	Holes		3									0.5					
	Mounds		1													0.5	
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab														0.5	
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab	2	0.5										0.5			
	Metridium farcimen	giant plumose anemone					0.5										
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp				1		3									
	Pandalus platyceros	spot prawn	0.5										0.5				
	Pandalus unknown	Pandalus unknown	5	2.5	2	5	10.5	3	5	4	8.5	5	3	1.5	1	1	2.5
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab	0.5	0.5		0.5					0.5	1.5					
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback				1											
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish		1	0.5		0.5	1	0.5	0.5							
	Sculpin unknown	sculpin unknown	1														

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
	Field Survey #	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	O6	O6	O6	O6	O6	T3	T3	T3	T3	T3
	OLD Sample ID	O6-01	O6-04	O6-02	O6-05	O6-03	T3-01		T3-02		T3-03
	NEW Transect ID	26	26	26	26	26	27	27	27	27	27
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	26-01	26-02	26-03	26-04	26-05	27-01	27-02	27-03	27-04	27-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-9.15	-9.45	-9.76	-9.45	-9.45	-11.59	-10.98	-10.98	-10.98	-10.67
	Depth gauge (ft):	-30	-31	-32	-31	-31	-38	-36	-36	-36	-35
	Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-7.0	-7.4	-7.7	-7.4	-7.4	-9.5	-8.9	-8.9	-8.9	-8.6
Sediment analyses	Sample Date	Oct-21				Sep-22	Ept-23		Oct-28		
	Grab Sample Time								14:40		
	WP								81		
	Sulphide (as H2S)	0.014							11		
	Ammonia (N)	22.4							31.3		
	pH	8.21							7.3		
	Total Sulphide	0.0127							10.3		
	TOC (0-10cm)					5400	68000				
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture	36									
	Available (KCl) Ammonia (N) (AVS)	22.4									
	Soluble (2:1) pH (AVS)	8.21									
	Sulphide (AVS)	69.4									
	Grab Sampling Comments								wood waste, bark		
YSI Sampling	Sample Date								oc t27		
	Sample Time								15:38		
	WP								049		
	Temp								10.17		
	Conductivity/salinity								31.93		
	DO %								76.3		
	DO mg/L								7		
	pH								7.87		
Substrate	Silt	40	40	40	40	40	100	100	100	100	100
	Sand	60	60	60	60	60					
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste									40	30
	Bare										
	WW Depth	0		0		0	0.6		0.3		0.6
	WW State	closed		closed		closed	open		open		open

Transect Sampling Information		**Year**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**
		Transect Survey Date	**Sep-22**	**Sep-22**	**Sep-22**	**Sep-22**	**Sep-22**	**Sep-23**	**Sep-23**	**Sep-23**	**Sep-23**	**Sep-23**
		Field Survey #	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
		OLD Transect ID	**O6**	**O6**	**O6**	**O6**	**O6**	**T3**	**T3**	**T3**	**T3**	**T3**
		OLD Sample ID	**O6-01**	**O6-04**	**O6-02**	**O6-05**	**O6-03**	**T3-01**		**T3-02**		**T3-03**
		NEW Transect ID	**26**	**26**	**26**	**26**	**26**	**27**	**27**	**27**	**27**	**27**
		Point	**01**	**02**	**03**	**04**	**05**	**01**	**02**	**03**	**04**	**05**
		NEW Sample ID	**26-01**	**26-02**	**26-03**	**26-04**	**26-05**	**27-01**	**27-02**	**27-03**	**27-04**	**27-05**
		Point ID	**1**	**4**	**2**	**5**	**3**	**1**	**4**	**2**	**5**	**3**
		Distance	**0**	**25**	**50**	**75**	**100**	**0**	**25**	**50**	**75**	**100**
		Depth gauge (m):	**-9.15**	**-9.45**	**-9.76**	**-9.45**	**-9.45**	**-11.59**	**-10.98**	**-10.98**	**-10.98**	**-10.67**
		Depth gauge (ft):	**-30**	**-31**	**-32**	**-31**	**-31**	**-38**	**-36**	**-36**	**-36**	**-35**
		Tide (m):	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**
		Depth m CD:	**-7.0**	**-7.4**	**-7.7**	**-7.4**	**-7.4**	**-9.5**	**-8.9**	**-8.9**	**-8.9**	**-8.6**
		Probe						**0.40**	**0.60**	**0.50**	**0.40**	**0.40**
Biological	Kelp detritus	**Kelp detritus**										
	Beggatoa spp.	**bacterial mat**						100	100	50	100	100
	Diatoms	**Diatoms**	55	50	80	75	70			50		
	Agarum fimbriatum	**fringed sieve kelp**										
	Coralline crust spp.	**pink encrusting coralline seaweed**										
	Desmerasria viridis	**Stringy acid hair**										
	Gracilaria											
	Red blade	**red blade**										
	Red branched	**Red branched**										
	Red filamentous	**red filamentous**										
	Sacharina latissima	**sugar kelp**	87	45	82	50	53					
	Sacharina groenlandica	**split kelp**		45		45						
	Sarcodietheca gaudichaudii	**succulent seaweed**										
	Ulva lactuca	**sea lettuce**										
	Holes					1	0.5					
	Mounds					0.5						
	Balanus glandula	**acorn barnacle**										
	Cancer productus	**red rock crab**										
	Dirona											
	Metacarcinus gracilis	**graceful rock crab**									3	
	Metacarcinus magister	**Dungeness crab**										
	Metridium farcimen	**giant plumose anemone**							4	8	4	12
	Metridium senile	**short plumose anemone**										
	Pagurus sp.	**hermit crab**										
	Pandalus danae	**coon striped shrimp**		0.5			1.5					
	Pandalus platyceros	**spot prawn**	0.5		5							
	Pandalus unknown	**Pandalus unknown**	3.5	4		3.5	8					
	Parastichopus californicus	**red sea cucumber**										
	Pisaster ochraceaus	**Ochre sea star**										
	Pugetia productus	**kelp crab**		1.5								
	shrimp species	**shrimp species**										
	Stronglyocentrotus franciscanus	**red urchin**										
	Styela montereyensis	**stalked tunicate**										
	Tresus sp.	**gaper clams**										
	Urticina unknown	**Anemone unknown**										
		Tunicate										
	Aulorhynchus flavidus	**Tube snout**										
	Citharichthys stigmaeus	**speckled sand dab**										
	Clupea pallasii	**Pacific herring**										
	Lumpenus sagitta	**Smanke prickleback**		1								
	Platichthys stellatus	**starry flounder**									1	
	Pleuronichthys coenosus	**C-O sole**										
	Sebastes spp. YOY	**young of the year rockfish**				2						
	Sculpin unknown	**sculpin unknown**										

Section	Parameter															
Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	T3	T3	T3	T3	T3	I5	I5	I5	I5	I5	I6	I6	I6	I6	I6
	OLD Sample ID	T3-04		T3-05		T3-06	I5-01	I5-04	I5-02	I5-05	I5-03	I6-01	I6-04	I6-02	I6-05	I6-03
	NEW Transect ID	28	28	28	28	28	29	29	29	29	29	30	30	30	30	30
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	28-01	28-02	28-03	28-04	28-05	29-01	29-02	29-03	29-04	29-05	30-01	30-02	30-03	30-04	30-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-10.37	-10.67	-10.37	-10.37	-10.67	-13.11	-12.80	-12.80	-13.11	-12.80	-12.80	-12.50	-12.50	-12.50	-11.59
	Depth gauge (ft):	-34	-35	-34	-34	-35	-43	-42	-42	-43	-42	-42	-41	-41	-41	-38
	Tide (m):	2.2	2.2	2.2	2.2	2.2	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	Depth m CD:	-8.2	-8.5	-8.2	-8.2	-8.5	-11.3	-11.0	-11.0	-11.3	-11.0	-11.0	-10.7	-10.7	-10.7	-9.8
Sediment analyses	Sample Date	Oct-28		Sep-23					oc t27					Oct-27		Sep-23
	Grab Sample Time	14:26							17:12					16:48		
	WP	80							54					53		
	Sulphide (as H2S)	18							0.012					0.027		
	Ammonia (N)	34.9							29.5					28		
	pH	7.21							7.85					7.8		
	Total Sulphide	16.7							0.0112					0.025		
	TOC (0-10cm)			63000												18000
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture								49					52		
	Available (KCl) Ammonia (N) (AVS)								10.3					9.98		
	Soluble (2:1) pH (AVS)								7.92					7.82		
	Sulphide (AVS)								63.4					129		
	Grab Sampling Comments								small amount of wood waste					small amount of wood waste		
YSI Sampling	Sample Date	oct 27							oct 27					oct 27		
	Sample Time	15:43							13:11					14:45		
	WP	050							020					053		
	Temp	10.16							10.15					10.14		
	Conductivity/salinity	31.91							31.71					31.88		
	DO %	78.2							58.2					81		
	DO mg/L	7.17							5.34					7.43		
	pH	7.86							7.87					7.9		
Substrate	Silt	100	100	100	100	100	60	70	70	60	60	70	70	70	70	60
	Sand						40	30	30	40	40	30	30	30	30	30
	Gravel															10
	Cobble															
	Boulder															
	Bedrock															
	Shell						1	1		2	2.5		0.5	0.5		
	Wood waste	20	30							2	2	2.5	0.1	1		
	Bare															
	WW Depth	0.5		0.45			0		0		0	0		0		0
	WW State	open		closed			closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	T3	T3	T3	T3	T3	I5	I5	I5	I5	I5	I6	I6	I6	I6	I6
		OLD Sample ID	T3-04		T3-05		T3-06	I5-01	I5-04	I5-02	I5-05	I5-03	I6-01	I6-04	I6-02	I6-05	I6-03
		NEW Transect ID	28	28	28	28	28	29	29	29	29	29	30	30	30	30	30
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	28-01	28-02	28-03	28-04	28-05	29-01	29-02	29-03	29-04	29-05	30-01	30-02	30-03	30-04	30-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-10.37	-10.67	-10.37	-10.37	-10.67	-13.11	-12.80	-12.80	-13.11	-12.80	-12.80	-12.50	-12.50	-12.50	-11.59
		Depth gauge (ft):	-34	-35	-34	-34	-35	-43	-42	-42	-43	-42	-42	-41	-41	-41	-38
		Tide (m):	2.2	2.2	2.2	2.2	2.2	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
		Depth m CD:	-8.2	-8.5	-8.2	-8.2	-8.5	-11.3	-11.0	-11.0	-11.3	-11.0	-11.0	-10.7	-10.7	-10.7	-9.8
		Probe	0.40	0.40	0.40	0.40	0.40										
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	100	100	100	100	100										
	Diatoms	Diatoms						28	35	23	33	10	23	13	18	10	
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp														8	75
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes							3.5	1.5	1.5	1	1.5			0.5	1.5	
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab						0.5	0.5				0.5				
	Metridium farcimen	giant plumose anemone	6						0.5								
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															1.5
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown											1.5			5	
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															1
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate											1				
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole								0.5							
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	10a	10a	10a	10a	10a	10b	10b	10b	10b	10b	11a	11a	11a	11a	11a
	OLD Sample ID	10a-01	10a-04	10a-02	10a-05	10a-03	10b-01	10b-04	10b-02	10b-05	10b-03	11a-01	11a-04	11a-02	11a-05	11a-03
	NEW Transect ID	31	31	31	31	31	32	32	32	32	32	33	33	33	33	33
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	31-01	31-02	31-03	31-04	31-05	32-01	32-02	32-03	32-04	32-05	33-01	33-02	33-03	33-04	33-05
	Point ID	1	2	3	4	5	1	2	3	4	5	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	5.79	-6.10	-6.10	-6.40	-6.40	-6.40	-6.71	-6.71	-7.01	-7.62	-6.40	-6.40	-6.40	-7.01	-6.40
	Depth gauge (ft):	19	-20	-20	-21	-21	-21	-22	-22	-23	-25	-21	-21	-21	-23	-21
	Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.5	2.5	2.5	2.5	2.5
	Depth m CD:	8.0	-3.9	-3.9	-4.2	-4.2	-4.2	-4.5	-4.5	-4.8	-5.4	-3.9	-3.9	-3.9	-4.5	-3.9
Sediment analyses	Sample Date	Oct-19		Oct-19					Oct-19		Oct-19	Oct-19		Oct-19		
	Grab Sample Time															
	WP															
	Sulphide (as H2S)	60									160	130				
	Ammonia (N)	7.03									13	17.7				
	pH	8.1									7.84	7.68				
	Total Sulphide	56									146	123				
	TOC (0-10cm)			34000					31000					21000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	oct 27									oct 27	oct 27				
	Sample Time	14:43									14:57	14:26				
	WP	038									041	035				
	Temp	10.18									10.2	10.15				
	Conductivity/salinity	31.88									31.91	31.89				
	DO %	85.5									78.6	83.1				
	DO mg/L	7.84									7.2	7.63				
	pH	7.91									7.89	7.92				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste															
	Bare															
	WW Depth	0		0.2		0	0.5		0.4		0.4	0.3		0.4		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	10a	10a	10a	10a	10a	10b	10b	10b	10b	10b	11a	11a	11a	11a	11a
		OLD Sample ID	10a-01	10a-04	10a-02	10a-05	10a-03	10b-01	10b-04	10b-02	10b-05	10b-03	11a-01	11a-04	11a-02	11a-05	11a-03
		NEW Transect ID	31	31	31	31	31	32	32	32	32	32	33	33	33	33	33
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	31-01	31-02	31-03	31-04	31-05	32-01	32-02	32-03	32-04	32-05	33-01	33-02	33-03	33-04	33-05
		Point ID	1	2	3	4	5	1	2	3	4	5	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	5.79	-6.10	-6.10	-6.40	-6.40	-6.40	-6.71	-6.71	-7.01	-7.62	-6.40	-6.40	-6.40	-7.01	-6.40
		Depth gauge (ft):	19	-20	-20	-21	-21	-21	-22	-22	-23	-25	-21	-21	-21	-23	-21
		Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.5	2.5	2.5	2.5	2.5
		Depth m CD:	8.0	-3.9	-3.9	-4.2	-4.2	-4.2	-4.5	-4.5	-4.8	-5.4	-3.9	-3.9	-3.9	-4.5	-3.9
		Probe	70.00	70.00	70.00	50.00	30.00	40.00	40.00	30.00	20.00	20.00	20.00	20.00	30.00	20.00	40.00
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat				5		30	20	10	50	80				5	5
	Diatoms	Diatoms	80	80	80	50	80	70	60	80	50	10	90	90	90	80	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp					1										
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone			1	1											
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
	Field Survey #	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	11b	11b	11b	11b	11b	14a	14a	14a	14a	14a
	OLD Sample ID	11b-01	11b-04	11b-02	11b-05	11b-03	14a-01	14a-04	14a-02	14a-05	14a-03
	NEW Transect ID	34	34	34	34	34	35	35	35	35	35
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	34-01	34-02	34-03	34-04	34-05	35-01	35-02	35-03	35-04	35-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.32	-7.32	-7.32	-7.93	-7.32	-7.80	-6.20	-6.90	-11.90	-12.60
	Depth gauge (ft):	-24	-24	-24	-26	-24	-7.8				
	Tide (m):	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-4.8	-4.8	-4.8	-5.4	-4.8	-5.4	-3.8	-4.5	-9.5	-10.2
Sediment analyses	Sample Date	Oct-19		Oct-19							Oct-19
	Grab Sample Time										
	WP										
	Sulphide (as H2S)	26									
	Ammonia (N)	9.64									41.2
	pH	7.83									8.25
	Total Sulphide	24.3									
	TOC (0-10cm)			33000							32000
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments										
YSI Sampling	Sample Date	oct 27					oct 27				
	Sample Time	14:22					15:31				
	WP	034					047				
	Temp	10.17					10.16				
	Conductivity/salinity	31.85					31.87				
	DO %	84					90.6				
	DO mg/L	7.71					8.31				
	pH	7.94					7.91				
Substrate	Silt	100	100	100	100	100					100
	Sand										
	Gravel										
	Cobble							40			
	Boulder							50			
	Bedrock						100		100	100	
	Shell							10			
	Wood waste										
	Bare										
	WW Depth	0.4		0		0.4	0		0		0
	WW State	open		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
		Field Survey #	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	11b	11b	11b	11b	11b	14a	14a	14a	14a	14a
		OLD Sample ID	11b-01	11b-04	11b-02	11b-05	11b-03	14a-01	14a-04	14a-02	14a-05	14a-03
		NEW Transect ID	34	34	34	34	34	35	35	35	35	35
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	34-01	34-02	34-03	34-04	34-05	35-01	35-02	35-03	35-04	35-05
		Point ID	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.32	-7.32	-7.32	-7.93	-7.32	-7.80	-6.20	-6.90	-11.90	-12.60
		Depth gauge (ft):	-24	-24	-24	-26	-24	-7.8				
		Tide (m):	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-4.8	-4.8	-4.8	-5.4	-4.8	-5.4	-3.8	-4.5	-9.5	-10.2
		Probe	40.00	30.00	20.00	20.00	20.00					
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat	20	50	50	30	30					
	Diatoms	Diatoms	80	50	50	50	30			80		10
	Agarum fimbriatum	fringed sieve kelp						60				
	Coralline crust spp.	pink encrusting coralline seaweed								10		
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade							5			
	Red branched	Red branched										
	Red filamentous	red filamentous							10			
	Sacharina latissima	sugar kelp				30	30	5				
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce										
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle						10			40	
	Cancer productus	red rock crab	1						1		1	
	Dirona							1				
	Metacarcinus gracilis	graceful rock crab									1	
	Metacarcinus magister	Dungeness crab										
	Metridium farcimen	giant plumose anemone										
	Metridium senile	short plumose anemone							2		2	
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp										
	Pandalus platyceros	spot prawn							5		22	
	Pandalus unknown	Pandalus unknown										
	Parastichopus californicus	red sea cucumber								2		
	Pisaster ochraceaus	Ochre sea star						1				
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin								2	2	
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring			30							
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish						8			50	
	Sculpin unknown	sculpin unknown						1	1	1		

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	14b	14b	14b	14b	14b	16a	16a	16a	16a	16a	16b	16b	16b	16b	16b
	OLD Sample ID	14b-01	14b-04	14b-02	14b-05	14b-03	16a-01	16a-04	16a-02	16a-05	16a-03	16b-01	16b-04	16b-02	16b-05	16b-03
	NEW Transect ID	36	36	36	36	36	37	37	37	37	37	38	38	38	38	38
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	36-01	36-02	36-03	36-04	36-05	37-01	37-02	37-03	37-04	37-05	38-01	38-02	38-03	38-04	38-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-11.90	-11.80	-11.40	-11.60	-11.50	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-12.80	-12.50	-12.50
	Depth gauge (ft):						-43	-43	-43	-43	-43	-43	-43	-42	-41	-41
	Tide (m):	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Depth m CD:	-9.5	-9.4	-9.0	-9.2	-9.1	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.3	-10.0	-10.0
Sediment analyses	Sample Date	Oct-19		Oct-19			Oct-20		Oct-20			Oct-20		Oct-20		
	Grab Sample Time															
	WP															
	Sulphide (as H2S)	7.3					0.04					62				
	Ammonia (N)	8.16					5.88					11.7				
	pH	7.83					7.81					7.88				
	Total Sulphide	6.84					0.038					58				
	TOC (0-10cm)			35000					23000					25000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	oct 27					oct 27					oct 27				
	Sample Time	15:34					12:53					12:49				
	WP	048					017					016				
	Temp	10.19					10.15					10.16				
	Conductivity/salinity	31.85					31.91					31.91				
	DO %	78.5					77.4					66.9				
	DO mg/L	7.2					7.1					6.14				
	pH	7.86					7.87					7.84				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	10														
	Bare															
	WW Depth	0		0		0	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	14b	14b	14b	14b	14b	16a	16a	16a	16a	16a	16b	16b	16b	16b	16b
		OLD Sample ID	14b-01	14b-04	14b-02	14b-05	14b-03	16a-01	16a-04	16a-02	16a-05	16a-03	16b-01	16b-04	16b-02	16b-05	16b-03
		NEW Transect ID	36	36	36	36	36	37	37	37	37	37	38	38	38	38	38
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	36-01	36-02	36-03	36-04	36-05	37-01	37-02	37-03	37-04	37-05	38-01	38-02	38-03	38-04	38-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-11.90	-11.80	-11.40	-11.60	-11.50	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-12.80	-12.50	-12.50
		Depth gauge (ft):						-43	-43	-43	-43	-43	-43	-43	-42	-41	-41
		Tide (m):	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
		Depth m CD:	-9.5	-9.4	-9.0	-9.2	-9.1	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.3	-10.0	-10.0
		Probe	30.00	60.00	60.00	10.00	20.00	20.00	0.00	20.00	20.00	20.00	0.00	50.00	20.00	0.00	50.00
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat			10	5	5										
	Diatoms	Diatoms	5	5					80	40	90	90	50	80	30	90	80
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab									1						
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	12a	12a	12a	12a	12a	12b	12b	12b	12b	12b	13a	13a	13a	13a	13a
	OLD Sample ID	12a-01	12a-04	12a-02	12a-05	12a-03	12b-01	12b-04	12b-02	12b-05	12b-03	13a-01	13a-04	13a-02	13a-05	13a-03
	NEW Transect ID	39	39	39	39	39	40	40	40	40	40	41	41	41	41	41
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	39-01	39-02	39-03	39-04	39-05	40-01	40-02	40-03	40-04	40-05	41-01	41-02	41-03	41-04	41-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-8.84	-9.15	-8.84	-8.84	-8.84	-8.84	-8.84	-8.84	-8.54	-8.54	-8.54	-8.54	-8.54	-7.93	-8.54
	Depth gauge (ft):	-29	-30	-29	-29	-29	-29	-29	-29	-28	-28	-28	-28	-28	-26	-28
	Tide (m):	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
	Depth m CD:	-6.5	-6.8	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.2	-6.2	-6.2	-6.2	-6.2	-5.6	-6.2
Sediment analyses	Sample Date			Oct-20		Oct-20			Oct-20		Oct-20	Oct-20		Oct-20		
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					79					66	31				
	Ammonia (N)					11.7					12.3	19.3				
	pH					7.78					7.77	7.67				
	Total Sulphide					74.7					62	28.9				
	TOC (0-10cm)			25000					27000					28000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date					oct 27					oct 27	oct 27				
	Sample Time					15:14					15:10	14:14				
	WP					044					043	032				
	Temp					10.19					10.19	10.15				
	Conductivity/salinity					31.48					29.97	31.85				
	DO %					79.3					82.8	83				
	DO mg/L					7.29					7.69	7.62				
	pH					7.88					7.89	7.91				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste															
	Bare															
	WW Depth	0		0		0	0		0		0	0.1		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	12a	12a	12a	12a	12a	12b	12b	12b	12b	12b	13a	13a	13a	13a	13a
		OLD Sample ID	12a-01	12a-04	12a-02	12a-05	12a-03	12b-01	12b-04	12b-02	12b-05	12b-03	13a-01	13a-04	13a-02	13a-05	13a-03
		NEW Transect ID	39	39	39	39	39	40	40	40	40	40	41	41	41	41	41
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	39-01	39-02	39-03	39-04	39-05	40-01	40-02	40-03	40-04	40-05	41-01	41-02	41-03	41-04	41-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-8.84	-9.15	-8.84	-8.84	-8.84	-8.84	-8.84	-8.84	-8.54	-8.54	-8.54	-8.54	-8.54	-7.93	-8.54
		Depth gauge (ft):	-29	-30	-29	-29	-29	-29	-29	-29	-28	-28	-28	-28	-28	-26	-28
		Tide (m):	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
		Depth m CD:	-6.5	-6.8	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.2	-6.2	-6.2	-6.2	-6.2	-5.6	-6.2
		Probe	30.00	20.00	40.00	30.00	40.00	50.00	30.00	30.00	40.00	40.00					
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	60	70	60	60	60	60	70	70	50	50	50	50	50	50	50
	Diatoms	Diatoms	40	30	40	40	40	40	30	30	50	50	50	50	50	50	50
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab			1											1	
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
	Field Survey #	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	13b	13b	13b	13b	13b	17a	17a	17a	17a	17a
	OLD Sample ID	13b-01	13b-04	13b-02	13b-05	13b-03	17a-01	17a-04	17a-02	17a-05	17a-03
	NEW Transect ID	42	42	42	42	42	43	43	43	43	43
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	42-01	42-02	42-03	42-04	42-05	43-01	43-02	43-03	43-04	43-05
	Point ID	1	4	2	5	3					
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-8.54	-85.28	-9.45	-98.40	-9.45	-12.80	-13.72	-13.11	-13.41	-12.80
	Depth gauge (ft):	-28	-26	-31	-30	-31	-42	-45	-43	-44	-42
	Tide (m):	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-6.2	-83.0	-7.2	-96.1	-7.2	-10.4	-11.3	-10.7	-11.0	-10.4
Sediment analyses	Sample Date	Oct-20		Oct-20			Oct-21				Oct-21
	Grab Sample Time										
	WP										
	Sulphide (as H2S)	23					11				
	Ammonia (N)	18.7					20.1				
	pH	7.7					7.75				
	Total Sulphide	21.4					10.2				
	TOC (0-10cm)			33000							22000
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments										
YSI Sampling	Sample Date	oct 27					Oct 27				
	Sample Time	14:09					12:44				
	WP	031					015				
	Temp	10.16					10.15				
	Conductivity/salinity	31.9					30.88				
	DO %	58.7					68.9				
	DO mg/L	5.39					6.37				
	pH	7.86					7.85				
Substrate	Silt	100	100	100	100	100	100	90	100	90	90
	Sand										
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste							10		10	10
	Bare										
	WW Depth	0		0.3		0.3	0.2		0		0
	WW State	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
		Field Survey #	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	13b	13b	13b	13b	13b	17a	17a	17a	17a	17a
		OLD Sample ID	13b-01	13b-04	13b-02	13b-05	13b-03	17a-01	17a-04	17a-02	17a-05	17a-03
		NEW Transect ID	42	42	42	42	42	43	43	43	43	43
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	42-01	42-02	42-03	42-04	42-05	43-01	43-02	43-03	43-04	43-05
		Point ID	1	4	2	5	3					
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-8.54	-85.28	-9.45	-98.40	-9.45	-12.80	-13.72	-13.11	-13.41	-12.80
		Depth gauge (ft):	-28	-26	-31	-30	-31	-42	-45	-43	-44	-42
		Tide (m):	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-6.2	-83.0	-7.2	-96.1	-7.2	-10.4	-11.3	-10.7	-11.0	-10.4
		Probe						0.00	0.00	0.00	0.00	0.00
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat	50	50	50	50	50					
	Diatoms	Diatoms	50	50	50	50	50	80	80	90	80	80
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade										
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp		30				10	10			
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce						10		10		
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab										
	Metacarcinus magister	Dungeness crab								1		
	Metridium farcimen	giant plumose anemone										
	Metridium senile	short plumose anemone				2						
	Pagurus sp.	hermit crab						1		1		
	Pandalus danae	coon striped shrimp				3				1	15	
	Pandalus platyceros	spot prawn										
	Pandalus unknown	Pandalus unknown										
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish										
	Sculpin unknown	sculpin unknown										

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	17b	17b	17b	17b	17b	18a	18a	18a	18a	18a	18b	18b	18b	18b	18b
	OLD Sample ID	17b-01	17b-04	17b-02	17b-05	17b-03	18a-01	18a-04	18a-02	18a-05	18a-03	18b-01	18b-04	18b-02	18b-05	18b-03
	NEW Transect ID	44	44	44	44	44	45	45	45	45	45	46	46	46	46	46
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	44-01	44-02	44-03	44-04	44-05	45-01	45-02	45-03	45-04	45-05	46-01	46-02	46-03	46-04	46-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-13.41	-13.11	-13.41	-13.11	-13.41	-5.49	-7.62	-11.59	-11.89	-12.80	-13.72	-14.02	-14.02	-13.72	-13.72
	Depth gauge (ft):	-44	-43	-44	-43	-44	-18	-25	-38	-39	-42	-45	-46	-46	-45	-45
	Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-11.0	-10.7	-11.0	-10.7	-11.0	-3.1	-5.2	-9.2	-9.5	-10.4	-11.3	-11.6	-11.6	-11.3	-11.3
Sediment analyses	Sample Date	Oct-21				Oct-21			Oct-21		Oct-21			Oct-21		Oct-21
	Grab Sample Time															
	WP															
	Sulphide (as H2S)	0.22									1.1					0.021
	Ammonia (N)	8.63									5.95					10
	pH	7.83									7.97					7.88
	Total Sulphide	0.211									1.05					0.02
	TOC (0-10cm)					15000			13000					18000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	Oct 27		Oct 27					Oct 27					Oct 27		
	Sample Time	12:39		12:34					12:24					12:27		
	WP	014		013					011					012		
	Temp	10.13		10.16					10.13					10.13		
	Conductivity/salinity	31.86		31.92					31.88					31.9		
	DO %	77.9		73.3					73					74.9		
	DO mg/L	7.16		6.72					6.67					6.87		
	pH	7.88		7.85					7.84					7.87		
Substrate	Silt	90	90	100	100	100			80	100	100		100	100	100	100
	Sand						20									
	Gravel						50	20	20							
	Cobble						30	30								
	Boulder															
	Bedrock							50								
	Shell															
	Wood waste	10	10													
	Bare															
	WW Depth	0		0		0	0		0.3		0	0		0		0
	WW State	closed		closed		closed	closed		open		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	17b	17b	17b	17b	17b	18a	18a	18a	18a	18a	18b	18b	18b	18b	18b
		OLD Sample ID	17b-01	17b-04	17b-02	17b-05	17b-03	18a-01	18a-04	18a-02	18a-05	18a-03	18b-01	18b-04	18b-02	18b-05	18b-03
		NEW Transect ID	44	44	44	44	44	45	45	45	45	45	46	46	46	46	46
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	44-01	44-02	44-03	44-04	44-05	45-01	45-02	45-03	45-04	45-05	46-01	46-02	46-03	46-04	46-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-13.41	-13.11	-13.41	-13.11	-13.41	-5.49	-7.62	-11.59	-11.89	-12.80	-13.72	-14.02	-14.02	-13.72	-13.72
		Depth gauge (ft):	-44	-43	-44	-43	-44	-18	-25	-38	-39	-42	-45	-46	-46	-45	-45
		Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-11.0	-10.7	-11.0	-10.7	-11.0	-3.1	-5.2	-9.2	-9.5	-10.4	-11.3	-11.6	-11.6	-11.3	-11.3
		Probe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	50.00	60.00	50.00	0.00	0.00	0.00	0.00
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	80	80	80	80	70					30	40	40	40	40	40
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria							30	10								
	Red blade	red blade									5						
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp							10		20		20		10		
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed								20							
	Ulva lactuca	sea lettuce							10	10							
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab						1	1								
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab										2					
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn		4	5			12	25	12				5			
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams									3						
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout								1							
	Citharichthys stigmaeus	speckled sand dab												1			
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish								4							
	Sculpin unknown	sculpin unknown															

	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
Transect Sampling Information	Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24
	Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	47	47	47	47	47	48	48	48	48	48	49	49	49	49	49
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	47-01	47-02	47-03	47-04	47-05	48-01	48-02	48-03	48-04	48-05	49-01	49-02	49-03	49-04	49-05
	Point ID															
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-4.88	-5.18	-5.49	-5.49	-5.18	-5.18	-5.18	-5.49	-5.49	-5.49	-12.20	-11.59	-10.98	-10.98	-10.98
	Depth gauge (ft):	-16	-17	-18	-18	-17	-17	-17	-18	-18	-18	-40	-38	-36	-36	-36
	Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.8	2.8	2.8	2.8	2.8
	Depth m CD:	-2.7	-3.0	-3.3	-3.3	-3.0	-3.0	-3.0	-3.3	-3.3	-3.3	-9.4	-8.8	-8.2	-8.2	-8.2
Sediment analyses	Sample Date	Jan-24		Jan-24		Jan-24	Jan-24		Jan-24		Jan-24	Jan-24		Jan-24		Jan-24
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					0.13					0.008					0.007
	Ammonia (N)					16.1					12.4					11.2
	pH					7.42					7.58					7.59
	Total Sulphide					0.122					0.0078					0.0067
	TOC (0-10cm)	44000		19000			58000		61000			26000		14000		
	TOC (20-40cm)															
	TOC (30-40cm)	17000		11000		9200	26000		12000		12000	13000		10000		11000
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date															
	Sample Time															
	WP															
	Temp															
	Conductivity/salinity															
	DO %															
	DO mg/L															
	pH															
Substrate	Silt	50	80	100	100	100	100	70	80	70	90	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	50	20					30	20	30	10					
	Bare															
	WW Depth	0		0.1		0	0.3		0.3		0.2	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
		Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24
		Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	47	47	47	47	47	48	48	48	48	48	49	49	49	49	49
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	47-01	47-02	47-03	47-04	47-05	48-01	48-02	48-03	48-04	48-05	49-01	49-02	49-03	49-04	49-05
		Point ID															
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-4.88	-5.18	-5.49	-5.49	-5.18	-5.18	-5.18	-5.49	-5.49	-5.49	-12.20	-11.59	-10.98	-10.98	-10.98
		Depth gauge (ft):	-16	-17	-18	-18	-17	-17	-17	-18	-18	-18	-40	-38	-36	-36	-36
		Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.8	2.8	2.8	2.8	2.8
		Depth m CD:	-2.7	-3.0	-3.3	-3.3	-3.0	-3.0	-3.0	-3.3	-3.3	-3.3	-9.4	-8.8	-8.2	-8.2	-8.2
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	90	90	90	95	95	20	20	20	10	10	90	90	90	90	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp		10													
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes												7				
	Mounds																
	Balanus glandula	acorn barnacle											5				
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone								3							
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown												2	3	4	
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
	Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
	Field Survey #	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	50	50	50	50	50	51	51	51	51	51
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	50-01	50-02	50-03	50-04	50-05	51-01	51-02	51-03	51-04	51-05
	Point ID										
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-11.28	-11.28	-10.98	-11.28	-11.28	-10.37	-10.98	-10.98	-10.98	-10.98
	Depth gauge (ft):	-37	-37	-36	-37	-37	-34	-36	-36	-36	-36
	Tide (m):	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
	Depth m CD:	-8.5	-8.5	-8.2	-8.5	-8.5	-7.6	-8.2	-8.2	-8.2	-8.2
Sediment analyses	Sample Date	Jan-24		Jan-24		Jan-24	Jan-25		Jan-25		Jan-25
	Grab Sample Time										
	WP										
	Sulphide (as H2S)					0.011					0.048
	Ammonia (N)					14					15.5
	pH					7.56					7.75
	Total Sulphide					0.01					0.0449
	TOC (0-10cm)	24000		24000			24000		28000		
	TOC (20-40cm)										
	TOC (30-40cm)	14000		14000		17000	18000		16000		16000
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments										
YSI Sampling	Sample Date										
	Sample Time										
	WP										
	Temp										
	Conductivity/salinity										
	DO %										
	DO mg/L										
	pH										
Substrate	Silt	100	100	100	100	100	100	100	100	100	100
	Sand										
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste										
	Bare										
	WW Depth	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
		Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
		Field Survey #	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	50	50	50	50	50	51	51	51	51	51
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	50-01	50-02	50-03	50-04	50-05	51-01	51-02	51-03	51-04	51-05
		Point ID										
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-11.28	-11.28	-10.98	-11.28	-11.28	-10.37	-10.98	-10.98	-10.98	-10.98
		Depth gauge (ft):	-37	-37	-36	-37	-37	-34	-36	-36	-36	-36
		Tide (m):	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
		Depth m CD:	-8.5	-8.5	-8.2	-8.5	-8.5	-7.6	-8.2	-8.2	-8.2	-8.2
		Probe										
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat										
	Diatoms	Diatoms	90	90	90	80	90	90	90	80	80	80
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade										
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp										
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce										
	Holes										2	2
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab										
	Metacarcinus magister	Dungeness crab										
	Metridium farcimen	giant plumose anemone										
	Metridium senile	short plumose anemone										
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp										
	Pandalus platyceros	spot prawn										
	Pandalus unknown	Pandalus unknown			12	2					1	
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish										
	Sculpin unknown	sculpin unknown										

Transect Sampling Information	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
	Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23
	Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	52	52	52	52	52	53	53	53	53	53	54	54	54	54	54
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	52-01	52-02	52-03	52-04	52-05	53-01	53-02	53-03	53-04	53-05	54-01	54-02	54-03	54-04	54-05
	Point ID															
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-10.67	-10.67	-10.67	-10.67	-10.37	-12.20	-12.20	-12.20	-12.20	-12.20	-12.20	-12.80	-12.20	-12.20	-11.89
	Depth gauge (ft):	-35	-35	-35	-35	-34	-40	-40	-40	-40	-40	-40	-42	-40	-40	-39
	Tide (m):	2.8	2.8	2.8	2.8	2.8	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	Depth m CD:	-7.9	-7.9	-7.9	-7.9	-7.6	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.6	-10.0	-10.0	-9.7
Sediment analyses	Sample Date	Jan-25		Jan-25		Jan-25	Jan-23		Jan-23		Jan-23	Jan-23		Jan-23		Jan-23
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					0.008					0.011					0.008
	Ammonia (N)					14.8					11.6					12.5
	pH					7.48					7.57					7.12
	Total Sulphide					0.0075					0.01					0.0077
	TOC (0-10cm)	55000		64000			25000		30000			38000		53000		
	TOC (20-40cm)															
	TOC (30-40cm)	19000		16000		19000	14000		18000		17000	16000		24000		140000
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date															
	Sample Time															
	WP															
	Temp															
	Conductivity/salinity															
	DO %															
	DO mg/L															
	pH															
Substrate	Silt	70	90	60	20	90	100	70	100	1000	100	90	70	90	80	70
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	30	10	40	80	10		30				10	30	10	20	30
	Bare															
	WW Depth	0.2		0.2		0.3	0		0		0	0.2		0.5		0.5
	WW State	closed		closed		closed	closed		closed		closed	closed		open		open

Transect Sampling Information		Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
		Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23
		Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	52	52	52	52	52	53	53	53	53	53	54	54	54	54	54
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	52-01	52-02	52-03	52-04	52-05	53-01	53-02	53-03	53-04	53-05	54-01	54-02	54-03	54-04	54-05
		Point ID															
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-10.67	-10.67	-10.67	-10.67	-10.37	-12.20	-12.20	-12.20	-12.20	-12.20	-12.20	-12.80	-12.20	-12.20	-11.89
		Depth gauge (ft):	-35	-35	-35	-35	-34	-40	-40	-40	-40	-40	-40	-42	-40	-40	-39
		Tide (m):	2.8	2.8	2.8	2.8	2.8	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
		Depth m CD:	-7.9	-7.9	-7.9	-7.9	-7.6	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.6	-10.0	-10.0	-9.7
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat			5	5											
	Diatoms	Diatoms	50	70	80	50	80	90	90	90	90	90	90	90	80	90	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab														1	
	Metacarcinus magister	Dungeness crab		1													
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															1
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
	Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
	Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	55	55	55	55	55	56	56	56	56	56	57	57	57	57	57
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	55-01	55-02	55-03	55-04	55-05	56-01	56-02	56-03	56-04	56-05	57-01	57-02	57-03	57-04	57-05
	Point ID															
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-10.06	-9.76	8.84	-8.84	-9.15	-9.45	-10.06	-9.76	-9.45	-9.15	-4.88	-4.57	-3.96	-4.88	-5.18
	Depth gauge (ft):	-33	-32	29	-29	-30	-31	-33	-32	-31	-30	-16	-15	-13	-16	-17
	Tide (m):	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.8
	Depth m CD:	-7.4	-7.1	11.5	-6.1	-6.4	-6.8	-7.4	-7.1	-6.8	-6.4	-2.1	-1.8	-1.2	-2.1	-2.4
Sediment analyses	Sample Date	Jan-24		Jan-24		Jan-24	Jan-24		Jan-24		Jan-24	Jan-25		Jan-25		Jan-25
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					1.5					0.042					0.006
	Ammonia (N)					25.8					23.9					12.1
	pH					7.3					7.15					7.83
	Total Sulphide					1.38					0.0399					0.0095
	TOC (0-10cm)	140000		120000			140000		120000			190000		150000		
	TOC (20-40cm)															
	TOC (30-40cm)	160000					170000		75000		140000					1500
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date															
	Sample Time															
	WP															
	Temp															
	Conductivity/salinity															
	DO %															
	DO mg/L															
	pH															
Substrate	Silt		40	10	30	10	100	100	100	60	20					20
	Sand															40
	Gravel															40
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	100	60	90	70	90				40	80	100	100	90	90	
	Bare															
	WW Depth	0.5		0.1		0.1	0.4		0.4		0.4	0.3		0.3		0
	WW State	open		open		open	open		open		open	open		open		closed

		Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
Transect Sampling Information		Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
		Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	55	55	55	55	55	56	56	56	56	56	57	57	57	57	57
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	55-01	55-02	55-03	55-04	55-05	56-01	56-02	56-03	56-04	56-05	57-01	57-02	57-03	57-04	57-05
		Point ID															
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-10.06	-9.76	8.84	-8.84	-9.15	-9.45	-10.06	-9.76	-9.45	-9.15	-4.88	-4.57	-3.96	-4.88	-5.18
		Depth gauge (ft):	-33	-32	29	-29	-30	-31	-33	-32	-31	-30	-16	-15	-13	-16	-17
		Tide (m):	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.8
		Depth m CD:	-7.4	-7.1	11.5	-6.1	-6.4	-6.8	-7.4	-7.1	-6.8	-6.4	-2.1	-1.8	-1.2	-2.1	-2.4
		Probe															

			55-01	55-02	55-03	55-04	55-05	56-01	56-02	56-03	56-04	56-05	57-01	57-02	57-03	57-04	57-05
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat		10			5		30	50				30			
	Diatoms	Diatoms	90	90	80	90	80	90	60	50	70	60	60	50	50	70	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade				5											
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes							2									
	Mounds																
	Balanus glandula	acorn barnacle												10			
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab			1												
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone											3		8		
	Pagurus sp.	hermit crab											1				
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2017	2017	2017	2017	2017	error check
	Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	1
	Field Survey #	4	4	4	4	4	1
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	1
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	1
	NEW Transect ID	58	58	58	58	58	1
	Point	01	02	03	04	05	1
	NEW Sample ID	58-01	58-02	58-03	58-04	58-05	1
	Point ID						
	Distance	0	25	50	75	100	1
	Depth gauge (m):	-3.66	-2.44	-1.83	-2.13	-2.44	1.00
	Depth gauge (ft):	-12	-8	-6	-7	-8	1
	Tide (m):	2.8	2.8	2.8	2.8	2.8	1.0
	Depth m CD:	-0.9	0.4	1.0	0.7	0.4	1
Sediment analyses	Sample Date	Jan-25		Jan-25		Jan-25	1.00
	Grab Sample Time						1.00
	WP						1.00
	Sulphide (as H2S)					0.01	1.00
	Ammonia (N)					3.6	1.00
	pH					7.37	1.00
	Total Sulphide					0.0095	1.00
	TOC (0-10cm)	49000		37000			1.00
	TOC (20-40cm)						
	TOC (30-40cm)			22000		17000	
	Moisture						1.00
	Available (KCl) Ammonia (N) (AVS)						1.00
	Soluble (2:1) pH (AVS)						1.00
	Sulphide (AVS)						1.00
	Grab Sampling Comments						1.00
YSI Sampling	Sample Date						1.00
	Sample Time						1.00
	WP						1.00
	Temp						1.00
	Conductivity/salinity						1.00
	DO %						1.00
	DO mg/L						1.00
	pH						1.00
Substrate	Silt	100			40	100	1.00
	Sand		50	50			1.00
	Gravel		50	50			1.00
	Cobble						1.00
	Boulder						1.00
	Bedrock						1.00
	Shell						1.00
	Wood waste				60		1.00
	Bare						1.00
	WW Depth	0		0.4		0.35	
	WW State	closed		closed		closed	

Transect Sampling Information		Year	2017	2017	2017	2017	2017	error check
		Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	1
		Field Survey #	4	4	4	4	4	1
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	1
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	1
		NEW Transect ID	58	58	58	58	58	1
		Point	01	02	03	04	05	1
		NEW Sample ID	58-01	58-02	58-03	58-04	58-05	1
		Point ID						
		Distance	0	25	50	75	100	1
		Depth gauge (m):	-3.66	-2.44	-1.83	-2.13	-2.44	1.00
		Depth gauge (ft):	-12	-8	-6	-7	-8	1
		Tide (m):	2.8	2.8	2.8	2.8	2.8	1.0
		Depth m CD:	-0.9	0.4	1.0	0.7	0.4	1
		Probe						1.00
Biological	Kelp detritus	Kelp detritus						1.00
	Beggatoa spp.	bacterial mat						7128
	Diatoms	Diatoms	90	70	30	90	90	12277
	Agarum fimbriatum	fringed sieve kelp						60
	Coralline crust spp.	pink encrusting coralline seaweed						10
	Desmerasria viridis	Stringy acid hair						18
	Gracilaria							40
	Red blade	red blade						17
	Red branched	Red branched						1
	Red filamentous	red filamentous						10
	Sacharina latissima	sugar kelp						1549
	Sacharina groenlandica	split kelp						682
	Sarcodietheca gaudichaudii	succulent seaweed						203
	Ulva lactuca	sea lettuce						125.5
	Holes							66
	Mounds							6.5
	Balanus glandula	acorn barnacle						65
	Cancer productus	red rock crab		1				7.5
	Dirona							1
	Metacarcinus gracilis	graceful rock crab						23
	Metacarcinus magister	Dungeness crab						13
	Metridium farcimen	giant plumose anemone						60.5
	Metridium senile	short plumose anemone						22
	Pagurus sp.	hermit crab						7
	Pandalus danae	coon striped shrimp						43
	Pandalus platyceros	spot prawn						109
	Pandalus unknown	Pandalus unknown						114
	Parastichopus californicus	red sea cucumber						2
	Pisaster ochraceaus	Ochre sea star						1
	Pugetia productus	kelp crab						7
	shrimp species	shrimp species						5
	Stronglyocentrotus franciscanus	red urchin						4
	Styela montereyensis	stalked tunicate						5
	Tresus sp.	gaper clams					1	4
	Urticina unknown	Anemone unknown						1
		Tunicate						1
	Aulorhynchus flavidus	Tube snout						3
	Citharichthys stigmaeus	speckled sand dab						1
	Clupea pallasii	Pacific herring						30
	Lumpenus sagitta	Smanke prickleback						2
	Platichthys stellatus	starry flounder						1
	Pleuronichthys coenosus	C-O sole						1
	Sebastes spp. YOY	young of the year rockfish						136
	Sculpin unknown	sculpin unknown						8

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Abundance data in matrix format, including total taxa (species richness) count per sample, and total abundance per sample for Hemmera Esquimalt Harbour 2017.

Biologica Sample #				Grand Total	17-033-001	17-033-002	17-033-003	17-033-004	17-033-005	17-033-006	17-033-011	17-033-012	17-033-013	17-033-014	17-033-015	17-033-016	17-033-017	17-033-018
Client Sample #					04-05	04-05	07-03	07-03	12-03	12-03	15-01	15-01	41-03	41-03	43-05	43-05	45-03	45-03
Replicate					Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02
Date Sampled					07/03/2017								08/03/2017	08/03/2017				
Debris Volume					High	High	High	High	Standard	High	Standard	Standard	Standard	Standard	Standard	Standard	High	High
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	ANOL	Naididae	Paranais litoralis	2												1		
ANNE	ANOL	Naididae	Tectidrilus sp.	389	16	106	96	122										46
ANNE	POER	Dorvilleidae	Schistomeringos annulata	11	4	2	4							1				
ANNE	POER	Dorvilleidae	Schistomeringos longicornis	11				3		2								
ANNE	POER	Dorvilleidae	Schistomeringos sp.	24		18											6	
ANNE	POER	Glyceridae	Glycera americana	1											1			
ANNE	POER	Goniadidae	Glycinde picta	84	5	3	2	3	2	2	3	1		2	4	8	8	4
ANNE	POER	Goniadidae	Glycinde sp.	49		4		5		2				2	4	6		
ANNE	POER	Hesionidae	Micropodarke dubia	4		2	2											
ANNE	POER	Hesionidae	Oxydromus pugettensis	6	4												2	
ANNE	POER	Hesionidae	Podarkeopsis glabrus	63	2	16	10	8						2	1	1		
ANNE	POER	Hesionidae	Podarkeopsis perkinsi	1									1					
ANNE	POER	Hesionidae	Podarkeopsis sp.	2						2								
ANNE	POER	Lumbrineridae	Lumbrineridae indet.	2			2											
ANNE	POER	Lumbrineridae	Lumbrineris californiensis	8														8
ANNE	POER	Lumbrineridae	Scoletoma tetraura complex	1,016		2									181	237		4
ANNE	POER	Nephtyidae	Bipalponephtys cornuta	11									1		1			
ANNE	POER	Nephtyidae	Nephtys punctata	1												1		
ANNE	POER	Nereididae	Alitta virens	1				1										
ANNE	POER	Nereididae	Nereis procera	13			8	4										
ANNE	POER	Nereididae	Platynereis bicanaliculata	127	2		24	38									58	3
ANNE	POER	Onuphidae	Onuphidae indet.	1				1										
ANNE	POER	Onuphidae	Onuphis sp.	2														2
ANNE	POER	Pholoidae	Pholoe minuta	1														
ANNE	POER	Phyllodocidae	Eteone californica	1				1										
ANNE	POER	Phyllodocidae	Eteone longa complex	1														
ANNE	POER	Phyllodocidae	Eteone sp.	1				1										
ANNE	POER	Phyllodocidae	Eteone tuberculata	6				1		2								
ANNE	POER	Phyllodocidae	Eumida longicornuta	2	2													
ANNE	POER	Phyllodocidae	Phyllodoce hartmanae	1											1			
ANNE	POER	Polynoidae	Gattyana cirrhosa	1														
ANNE	POER	Polynoidae	Harmothoe imbricata	1				1										
ANNE	POER	Polynoidae	Hesperonoe adventor	1		1												
ANNE	POER	Polynoidae	Tenonia priops	2														
ANNE	POER	Sphaerodoridae	Sphaerodoropsis sphaerulifer	2														
ANNE	POER	Syllidae	Brania sp.	1				1										
ANNE	POER	Syllidae	Exogone dwisula	32	2	22	2	2								2		
ANNE	POER	Syllidae	Syllis cornuta	1											1			
ANNE	POSE	Ampharetidae	Ampharete labrops	390	8	18	148	186			4	4	1	3	1		4	8
ANNE	POSE	Ampharetidae	Ampharete lineata	1														
ANNE	POSE	Ampharetidae	Ampharetidae indet.	1												1		
ANNE	POSE	Capitellidae	Capitella capitata complex	132		2	2		16	14	1	3	11	9			14	14
ANNE	POSE	Capitellidae	Heteromastus filobranchus	31											9	8		
ANNE	POSE	Capitellidae	Mediomastus ambiseta	2														2
ANNE	POSE	Capitellidae	Mediomastus californiensis	36		4	4	8									4	16
ANNE	POSE	Chaetopteridae	Spiochaetopterus costarum complex	6														2
ANNE	POSE	Cirratulidae	Aphelochaeta glandaria complex	2,088				1		2	1				431	440		20
ANNE	POSE	Cirratulidae	Aphelochaeta monilaris	330		2									45	66		
ANNE	POSE	Cirratulidae	Aphelochaeta sp.	59								1						
ANNE	POSE	Cirratulidae	Chaetozone setosa complex	205								1			42	42		47
ANNE	POSE	Cirratulidae	Cirratulidae indet.	2										2				
ANNE	POSE	Cirratulidae	Kirkegaardia sp.	4		4												
ANNE	POSE	Cossuridae	Cossura pygodactylata	19											1	8		
ANNE	POSE	Magelonidae	Magelona longicornis	2														
ANNE	POSE	Maldanidae	Euclymene sp. nr. zonalis	59											6	16		2
ANNE	POSE	Maldanidae	Praxillella pacifica	2														

Biologica Sample #				Grand Total	17-033-001	17-033-002	17-033-003	17-033-004	17-033-005	17-033-006	17-033-011	17-033-012	17-033-013	17-033-014	17-033-015	17-033-016	17-033-017	17-033-018
Client Sample #					04-05	04-05	07-03	07-03	12-03	12-03	15-01	15-01	41-03	41-03	43-05	43-05	45-03	45-03
Replicate					Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02
Date Sampled					07/03/2017								08/03/2017	08/03/2017				
Debris Volume					High	High	High	High	Standard	High	Standard	Standard	Standard	Standard	Standard	Standard	High	High
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	POSE	Opheliidae	Armandia brevis	2,646	102	28	18	16	168	348	65	32	206	136	1	1	52	32
ANNE	POSE	Opheliidae	Ophelina acuminata	3											1	1		
ANNE	POSE	Orbiniidae	Leitoscoloplos pugettensis	1											1			
ANNE	POSE	Orbiniidae	Scoloplos acmeceps	6													2	4
ANNE	POSE	Oweniidae	Galathowenia oculata	1														
ANNE	POSE	Oweniidae	Owenia fusiformis	86			34	52										
ANNE	POSE	Sabellidae	Euchone incolor	22											2	3		
ANNE	POSE	Spionidae	Dipolydora cardalia	2											1			
ANNE	POSE	Spionidae	Dipolydora sp.	6											2			2
ANNE	POSE	Spionidae	Paraprionospio alata	12						2					2			
ANNE	POSE	Spionidae	Polydora sp. complex	10				5							3	2		
ANNE	POSE	Spionidae	Prionospio (Minuspio) lighti	1,140	74	346	66	187		28	34	19	8	32	19	17	30	18
ANNE	POSE	Spionidae	Prionospio (Prionospio) sp.	1											1			
ANNE	POSE	Spionidae	Pseudopolydora paucibranchiata	5			2	2							1			
ANNE	POSE	Spionidae	Spiophanes berkeleyorum	2												1		
ANNE	POSE	Sternaspidae	Sternaspis affinis	2											2			
ANNE	POSE	Terebellidae	Lanassa venusta venusta	4									1					
ANNE	POSE	Terebellidae	Polycirrus sp. complex	1				1										
ANNE	POSE	Trichobranchidae	Terebellides sp.	1												1		
ARTH	CRAM	Aoridae	Aoroides intermedia	230													200	30
ARTH	CRAM	Aoridae	Aoroides sp.	46		40									1	1		
ARTH	CRAM	Aoridae	Aoroides spinosa	18	14													4
ARTH	CRAM	Caprellidae	Caprella kennerlyi	2														2
ARTH	CRAM	Caprellidae	Caprella mendax	6													6	
ARTH	CRAM	Caprellidae	Caprellidae indet.	2														2
ARTH	CRAM	Isaeidae	Gammaropsis spinosa	1														
ARTH	CRAM	Isaeidae	Isaeidae indet.	1														
ARTH	CRAM	Isaeidae	Photis brevipes	14		2											2	
ARTH	CRAM	Isaeidae	Photis sp.	8	4	4												
ARTH	CRAM	Isaeidae	Protomedeia prudens	2														
ARTH	CRAM	Melitidae	Desdimelita desdichada	13				1							1	3		
ARTH	CRAM	Oedicerotidae	Deflexilodes sp.	6												3		
ARTH	CRAM	Oedicerotidae	Oedicerotidae indet.	1								1						
ARTH	CRAM	Oedicerotidae	Westwoodilla tone	9											1	2	2	4
ARTH	CRAM	Phoxocephalidae	Eobrolgus chumashi	10													4	6
ARTH	CRAM	Phoxocephalidae	Heterophoxus affinis	2														
ARTH	CRAM	Phoxocephalidae	Heterophoxus sp.	1												1		
ARTH	CRAM		Amphipoda indet.	8	8													
ARTH	CRCI		Balanomorpha indet.	17	6		6	1				1						
ARTH	CRCU	Leuconidae	Eudorella pacifica	1														
ARTH	CRCU	Leuconidae	Eudorella sp.	2														
ARTH	CRCU	Leuconidae	Leucon sp.	4														
ARTH	CRDE	Callianassidae	Neotrypaea gigas	5								2					1	
ARTH	CRDE	Cancridae	Cancridae indet.	1													1	
ARTH	CRDE	Crangonidae	Crangon alaskensis	3			1								1			
ARTH	CRDE	Hippolytidae	Lebbeus sp.	1														1
ARTH	CRDE	Pinnotheridae	Pinnixa schmitti	20							1							
ARTH	CRDE	Pinnotheridae	Pinnixa sp.	8		2									1	2		
ARTH	CRIS	Limnoriidae	Limnoria lignorum	4														
ARTH	CRLE	Nebaliidae	Nebalia pugettensis complex	206													202	2
ARTH	CRTA	Leptocheliidae	Leptochelia dubia complex	7	4											2		
MISC	BRYO	Vesiculariidae	Bowerbankia gracilis	2														
MISC	CNHY	Corynidae	Corynidae indet.	2														2
MISC	CNHY	Corynidae	Sarsia tubulosa	1				1										
MISC	CNHY	Corynidae	Slabberia sp.	1				1										
MISC	CNHY	Pandeidae	Amphinema dinema	1				1										
MISC	NTEA	Amphiporidae	Amphiporus imparispinosus	1				1										
MISC	NTEA	Emplectonematidae	Paranemertes californica	6			2	4										
MISC	NTEA	Lineidae	Cerebratulus californiensis	52		4	16	18										
MISC	NTEA	Lineidae	Micrura sp.	1										1				
MISC	NTEA	Tubulanidae	Tubulanus polymorphus	15			6	9										

Biologica Sample #				Grand Total	17-033-001	17-033-002	17-033-003	17-033-004	17-033-005	17-033-006	17-033-011	17-033-012	17-033-013	17-033-014	17-033-015	17-033-016	17-033-017	17-033-018
Client Sample #					04-05	04-05	07-03	07-03	12-03	12-03	15-01	15-01	41-03	41-03	43-05	43-05	45-03	45-03
Replicate					Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02
Date Sampled					07/03/2017								08/03/2017	08/03/2017				
Debris Volume					High	High	High	High	Standard	High	Standard	Standard	Standard	Standard	Standard	Standard	High	High
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
MISC	NTEA	Tubulanidae	Tubulanus sp.	2														2
MISC	NTEA		Anopla indet.	1														
MISC	URAS		Stolidobranchiata indet.	1				1										
MOLL	MOBI	Cardiidae	Clinocardiinae indet.	19			4	8			1					1		
MOLL	MOBI	Cardiidae	Clinocardium nuttallii	18				18										
MOLL	MOBI	Lasaeidae	Kurtiella tumida	43			6	3							11	3	4	
MOLL	MOBI	Lucinidae	Lucinoma annulatum	2														2
MOLL	MOBI	Lucinidae	Parvilucina tenuisculpta	3											1	1		
MOLL	MOBI	Nuculidae	Acila castrensis	54											16	18		
MOLL	MOBI	Nuculidae	Ennucula tenuis	5												1		
MOLL	MOBI	Tellinidae	Macoma carlottensis	26											3	2		
MOLL	MOBI	Tellinidae	Macoma nasuta	103	2	1					14	3	1	4	4	4	4	3
MOLL	MOBI	Tellinidae	Macoma sp.	105	4	6	6	13	1	4	3			1		1		6
MOLL	MOBI	Tellinidae	Tellina modesta	1														
MOLL	MOBI	Tellinidae	Tellina sp.	26			8	5									2	4
MOLL	MOBI	Thyasiridae	Axinopsida serricata	76											6	15	4	
MOLL	MOBI	Veneridae	Leukoma staminea	5														
MOLL	MOBI	Veneridae	Nutricola sp.	54											6	15		
MOLL	MOBI	Veneridae	Veneridae indet.	7							1					2		
MOLL	MOBI		Bivalvia indet.	56	2	18	8	16						1				
MOLL	MOGA	Columbellidae	Astyris gausapata	3													2	
MOLL	MOGA	Littorinidae	Lacuna vincta	4													2	2
MOLL	MOGA	Onchidorididae	Loy thompsoni	1												1		
MOLL	MOGA	Pyramidellidae	Odostomia sp.	27												4		
MOLL	MOGA	Pyramidellidae	Turbonilla sp.	9														
MOLL	MOGA	Rissoidae	Alvania compacta	131			16	50								6	44	2
MOLL	MOGA	Rissoidae	Alvania sp.	22				16									4	2
MOLL	MOGA		Cephalaspidea indet.	4														
MOLL	MOGA		Gastropoda indet.	50	2	2	10	27								1	4	
			Total Abundance	**10,802**	**267**	**659**	**513**	**844**	**187**	**408**	**128**	**68**	**230**	**196**	**817**	**952**	**668**	**310**
			Total Unique Taxa (species richness)	**117**	**17**	**21**	**26**	**37**	**4**	**10**	**10**	**11**	**8**	**10**	**36**	**39**	**26**	**31**

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Abundance data in matrix format, including total taxa (species richness) count per s

Biologica Sample #				17-033-019	17-033-020	17-033-021	17-033-022	17-033-023	17-033-024	17-033-025	17-033-026	17-033-027	17-033-028	17-033-029	17-033-030	17-033-031	17-033-032
Client Sample #				46-03	46-03	50-01	50-01	53-01	53-01	54-03	54-03	59-01	59-02	61-01	61-01	60-01	60-02
Replicate				Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02			Rep 01	Rep 02		
Date Sampled												07/03/2017	07/03/2017	10/03/2017	10/03/2017	09/03/2017	09/03/2017
Debris Volume				Standard	Standard	Standard	Standard	Standard	Standard	High	High	High	High	Standard	High	Standard	Standard
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	ANOL	Naididae	Paranais litoralis														1
ANNE	ANOL	Naididae	Tectidrilus sp.													3	
ANNE	POER	Dorvilleidae	Schistomeringos annulata														
ANNE	POER	Dorvilleidae	Schistomeringos longicornis									2				1	3
ANNE	POER	Dorvilleidae	Schistomeringos sp.														
ANNE	POER	Glyceridae	Glycera americana														
ANNE	POER	Goniadidae	Glycinde picta	1	3	1			2	4	6		4	4	6	6	
ANNE	POER	Goniadidae	Glycinde sp.		6	3			1		2	2	2	4	6		
ANNE	POER	Hesionidae	Micropodarke dubia														
ANNE	POER	Hesionidae	Oxydromus pugettensis														
ANNE	POER	Hesionidae	Podarkeopsis glabrus		4			1		2	2	2		7		2	3
ANNE	POER	Hesionidae	Podarkeopsis perkinsi														
ANNE	POER	Hesionidae	Podarkeopsis sp.														
ANNE	POER	Lumbrineridae	Lumbrineridae indet.														
ANNE	POER	Lumbrineridae	Lumbrineris californiensis														
ANNE	POER	Lumbrineridae	Scoletoma tetraura complex	236	268	1	1	4	1	28	44			1	8		
ANNE	POER	Nephtyidae	Bipalponephtys cornuta						1	2	4				2		
ANNE	POER	Nephtyidae	Nephtys punctata														
ANNE	POER	Nereididae	Alitta virens														
ANNE	POER	Nereididae	Nereis procera		1												
ANNE	POER	Nereididae	Platynereis bicanaliculata													2	
ANNE	POER	Onuphidae	Onuphidae indet.														
ANNE	POER	Onuphidae	Onuphis sp.														
ANNE	POER	Pholoidae	Pholoe minuta		1												
ANNE	POER	Phyllodocidae	Eteone californica														
ANNE	POER	Phyllodocidae	Eteone longa complex	1													
ANNE	POER	Phyllodocidae	Eteone sp.														
ANNE	POER	Phyllodocidae	Eteone tuberculata		2												1
ANNE	POER	Phyllodocidae	Eumida longicornuta														
ANNE	POER	Phyllodocidae	Phyllodoce hartmanae														
ANNE	POER	Polynoidae	Gattyana cirrhosa											1			
ANNE	POER	Polynoidae	Harmothoe imbricata														
ANNE	POER	Polynoidae	Hesperonoe adventor														
ANNE	POER	Polynoidae	Tenonia priops							2							
ANNE	POER	Sphaerodoridae	Sphaerodoropsis sphaerulifer		2												
ANNE	POER	Syllidae	Brania sp.														
ANNE	POER	Syllidae	Exogone dwisula												2		
ANNE	POER	Syllidae	Syllis cornuta														
ANNE	POSE	Ampharetidae	Ampharete labrops			1					4						
ANNE	POSE	Ampharetidae	Ampharete lineata	1													
ANNE	POSE	Ampharetidae	Ampharetidae indet.														
ANNE	POSE	Capitellidae	Capitella capitata complex					1			2	30	6	4	2		1
ANNE	POSE	Capitellidae	Heteromastus filobranchus	6	6						2						
ANNE	POSE	Capitellidae	Mediomastus ambiseta														
ANNE	POSE	Capitellidae	Mediomastus californiensis														
ANNE	POSE	Chaetopteridae	Spiochaetopterus costarum complex	1						2					1		
ANNE	POSE	Cirratulidae	Aphelochaeta glandaria complex	546	633			1		6		2		3	2		
ANNE	POSE	Cirratulidae	Aphelochaeta monilaris	87	130												
ANNE	POSE	Cirratulidae	Aphelochaeta sp.								58						
ANNE	POSE	Cirratulidae	Chaetozone setosa complex	13	59									1			
ANNE	POSE	Cirratulidae	Cirratulidae indet.														
ANNE	POSE	Cirratulidae	Kirkegaardia sp.														
ANNE	POSE	Cossuridae	Cossura pygodactylata	3	7												
ANNE	POSE	Magelonidae	Magelona longicornis		2												
ANNE	POSE	Maldanidae	Euclymene sp. nr. zonalis	12	23												
ANNE	POSE	Maldanidae	Praxillella pacifica		2												

Biologica Sample #				17-033-019	17-033-020	17-033-021	17-033-022	17-033-023	17-033-024	17-033-025	17-033-026	17-033-027	17-033-028	17-033-029	17-033-030	17-033-031	17-033-032
Client Sample #				46-03	46-03	50-01	50-01	53-01	53-01	54-03	54-03	59-01	59-02	61-01	61-01	60-01	60-02
Replicate				Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02			Rep 01	Rep 02		
Date Sampled												07/03/2017	07/03/2017	10/03/2017	10/03/2017	09/03/2017	09/03/2017
Debris Volume				Standard	Standard	Standard	Standard	Standard	Standard	High	High	High	High	Standard	High	Standard	Standard
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	POSE	Opheliidae	Armandia brevis			5	11	50	19	152	52	458	343	154	102	66	29
ANNE	POSE	Opheliidae	Ophelina acuminata		1												
ANNE	POSE	Orbiniidae	Leitoscoloplos pugettensis														
ANNE	POSE	Orbiniidae	Scoloplos acmeceps														
ANNE	POSE	Oweniidae	Galathowenia oculata		1												
ANNE	POSE	Oweniidae	Owenia fusiformis														
ANNE	POSE	Sabellidae	Euchone incolor	6	11												
ANNE	POSE	Spionidae	Dipolydora cardalia		1												
ANNE	POSE	Spionidae	Dipolydora sp.												2		
ANNE	POSE	Spionidae	Paraprionospio alata	3	1						4						
ANNE	POSE	Spionidae	Polydora sp. complex														
ANNE	POSE	Spionidae	Prionospio (Minuspio) lighti	1	21	4		1	30	10	64	6	20	54	28	13	10
ANNE	POSE	Spionidae	Prionospio (Prionospio) sp.														
ANNE	POSE	Spionidae	Pseudopolydora paucibranchiata														
ANNE	POSE	Spionidae	Spiophanes berkeleyorum		1												
ANNE	POSE	Sternaspidae	Sternaspis affinis														
ANNE	POSE	Terebellidae	Lanassa venusta venusta		1						2						
ANNE	POSE	Terebellidae	Polycirrus sp. complex														
ANNE	POSE	Trichobranchidae	Terebellides sp.														
ARTH	CRAM	Aoridae	Aoroides intermedia														
ARTH	CRAM	Aoridae	Aoroides sp.											1	2	1	
ARTH	CRAM	Aoridae	Aoroides spinosa														
ARTH	CRAM	Caprellidae	Caprella kennerlyi														
ARTH	CRAM	Caprellidae	Caprella mendax														
ARTH	CRAM	Caprellidae	Caprellidae indet.														
ARTH	CRAM	Isaeidae	Gammaropsis spinosa	1													
ARTH	CRAM	Isaeidae	Isaeidae indet.		1												
ARTH	CRAM	Isaeidae	Photis brevipes													5	5
ARTH	CRAM	Isaeidae	Photis sp.														
ARTH	CRAM	Isaeidae	Protomedeia prudens	2													
ARTH	CRAM	Melitidae	Desdimelita desdichada	1	1										6		
ARTH	CRAM	Oedicerotidae	Deflexilodes sp.	1	1									1			
ARTH	CRAM	Oedicerotidae	Oedicerotidae indet.														
ARTH	CRAM	Oedicerotidae	Westwoodilla tone														
ARTH	CRAM	Phoxocephalidae	Eobrolgus chumashi														
ARTH	CRAM	Phoxocephalidae	Heterophoxus affinis	1	1												
ARTH	CRAM	Phoxocephalidae	Heterophoxus sp.														
ARTH	CRAM		Amphipoda indet.														
ARTH	CRCI		Balanomorpha indet.					3									
ARTH	CRCU	Leuconidae	Eudorella pacifica		1												
ARTH	CRCU	Leuconidae	Eudorella sp.								2						
ARTH	CRCU	Leuconidae	Leucon sp.								4						
ARTH	CRDE	Callianassidae	Neotrypaea gigas			2											
ARTH	CRDE	Cancridae	Cancridae indet.														
ARTH	CRDE	Crangonidae	Crangon alaskensis			1											
ARTH	CRDE	Hippolytidae	Lebbeus sp.														
ARTH	CRDE	Pinnotheridae	Pinnixa schmitti	1	15			2	1								
ARTH	CRDE	Pinnotheridae	Pinnixa sp.									2					1
ARTH	CRIS	Limnoriidae	Limnoria lignorum												4		
ARTH	CRLE	Nebaliidae	Nebalia pugettensis complex									2					
ARTH	CRTA	Leptocheliidae	Leptochelia dubia complex														1
MISC	BRYO	Vesiculariidae	Bowerbankia gracilis												2		
MISC	CNHY	Corynidae	Corynidae indet.														
MISC	CNHY	Corynidae	Sarsia tubulosa														
MISC	CNHY	Corynidae	Slabberia sp.														
MISC	CNHY	Pandeidae	Amphinema dinema														
MISC	NTEA	Amphiporidae	Amphiporus imparispinosus														
MISC	NTEA	Emplectonematidae	Paranemertes californica														
MISC	NTEA	Lineidae	Cerebratulus californiensis													5	9
MISC	NTEA	Lineidae	Micrura sp.														
MISC	NTEA	Tubulanidae	Tubulanus polymorphus														

Biologica Sample #				17-033-019	17-033-020	17-033-021	17-033-022	17-033-023	17-033-024	17-033-025	17-033-026	17-033-027	17-033-028	17-033-029	17-033-030	17-033-031	17-033-032
Client Sample #				46-03	46-03	50-01	50-01	53-01	53-01	54-03	54-03	59-01	59-02	61-01	61-01	60-01	60-02
Replicate				Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02			Rep 01	Rep 02		
Date Sampled												07/03/2017	07/03/2017	10/03/2017	10/03/2017	09/03/2017	09/03/2017
Debris Volume				Standard	Standard	Standard	Standard	Standard	Standard	High	High	High	High	Standard	High	Standard	Standard
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
MISC	NTEA	Tubulanidae	Tubulanus sp.														
MISC	NTEA		Anopla indet.						1								
MISC	URAS		Stolidobranchiata indet.														
MOLL	MOBI	Cardiidae	Clinocardiinae indet.	1						2	2						
MOLL	MOBI	Cardiidae	Clinocardium nuttallii														
MOLL	MOBI	Lasaeidae	Kurtiella tumida	1	5		1			2	2					3	2
MOLL	MOBI	Lucinidae	Lucinoma annulatum														
MOLL	MOBI	Lucinidae	Parvilucina tenuisculpta		1												
MOLL	MOBI	Nuculidae	Acila castrensis	11	7			2									
MOLL	MOBI	Nuculidae	Ennucula tenuis	1	2			1									
MOLL	MOBI	Tellinidae	Macoma carlottensis	2	12				3					1	2	1	
MOLL	MOBI	Tellinidae	Macoma nasuta	5	9	1		5	7	6	3	1		8	6	2	10
MOLL	MOBI	Tellinidae	Macoma sp.							8	18	3		4		14	13
MOLL	MOBI	Tellinidae	Tellina modesta		1												
MOLL	MOBI	Tellinidae	Tellina sp.	1							6						
MOLL	MOBI	Thyasiridae	Axinopsida serricata	18	33												
MOLL	MOBI	Veneridae	Leukoma staminea	5													
MOLL	MOBI	Veneridae	Nutricola sp.	10	23												
MOLL	MOBI	Veneridae	Veneridae indet.		1				1		2						
MOLL	MOBI		Bivalvia indet.							4	4					1	2
MOLL	MOGA	Columbellidae	Astyris gausapata		1												
MOLL	MOGA	Littorinidae	Lacuna vincta														
MOLL	MOGA	Onchidorididae	Loy thompsoni														
MOLL	MOGA	Pyramidellidae	Odostomia sp.	8	6			1	4	4							
MOLL	MOGA	Pyramidellidae	Turbonilla sp.	2	7												
MOLL	MOGA	Rissoidae	Alvania compacta	2	6									1			4
MOLL	MOGA	Rissoidae	Alvania sp.														
MOLL	MOGA		Cephalaspidea indet.									4					
MOLL	MOGA		Gastropoda indet.								2	2					
			Total Abundance	**991**	**1,321**	**19**	**13**	**72**	**71**	**234**	**291**	**516**	**375**	**249**	**183**	**125**	**95**
			Total Unique Taxa (species richness)	**33**	**42**	**8**	**3**	**12**	**11**	**13**	**19**	**11**	**4**	**14**	**16**	**13**	**14**

biologica

Benthic report of quality control and quality assurance for Hemmera Esquimalt Harbour 2017.

Biologica Sample ID	Client Sample ID	Replicate	Debris Volume	Subsample	Sorting Efficiency QC: Spotcheck	Subsampling Accuracy
17-033-001	04-05	Rep 01	High	1/2	95.83%	
17-033-002	04-05	Rep 02	High	1/2		
17-033-003	07-03	Rep 01	High	1/2		
17-033-004	07-03	Rep 02	High	Whole		95.30%
17-033-005	12-03	Rep 01	Standard	Whole		
17-033-006	12-03	Rep 02	High	1/2	100.00%	
17-033-007	14-03	Rep 01-A	Not analyzing	na		
17-033-008	14-03	Rep 01-B	Not analyzing	na		
17-033-009	14-03	Rep 02-A	Not analyzing	na		
17-033-010	14-03	Rep 02-B	Not analyzing	na		
17-033-011	15-01	Rep 01	Standard	Whole		
17-033-012	15-01	Rep 02	Standard	Whole		
17-033-013	41-03	Rep 01	Standard	Whole	100.00%	
17-033-014	41-03	Rep 02	Standard	Whole		
17-033-015	43-05	Rep 01	Standard	Whole		
17-033-016	43-05	Rep 02	Standard	Whole		
17-033-017	45-03	Rep 01	High	1/2	96.91%	97.80%
17-033-018	45-03	Rep 02	High	1/2		
17-033-019	46-03	Rep 01	Standard	Whole		
17-033-020	46-03	Rep 02	Standard	Whole	99.39%	
17-033-021	50-01	Rep 01	Standard	Whole		
17-033-022	50-01	Rep 02	Standard	Whole		
17-033-023	53-01	Rep 01	Standard	Whole		
17-033-024	53-01	Rep 02	Standard	Whole		
17-033-025	54-03	Rep 01	High	1/2	100.00%	
17-033-026	54-03	Rep 02	High	1/2		
17-033-027	59-01		High	1/2		
17-033-028	59-02		High	1/2		
17-033-029	61-01	Rep 01	Standard	Whole		
17-033-030	61-01	Rep 02	High	1/2		
17-033-031	60-01		Standard	Whole		
17-033-032	60-02		Standard	Whole		
				Average:	98.69%	96.55%

Quality Control

Sorting efficiency: [(total count – organisms recovered in spot check and/or re-sort) / total count] x 100%

Spot Check: 25% of sample debris resorted for 19% of samples

Sediment Chemistry Test		Units	EQL	BCCSR Sed. Marine Sensitive	BCCSR Sed. Marine Typical	CCME Sediment Aquatic Life (Marine, ISGQ)	CCME Sediment Aquatic Life (Marine, PEL)	DAS reference Criterion	BH3		BH5		BH8	
									Surficial	>30cm	Surficial	>30cm	Surficial	>30cm
Grain Size	Silt (<0.0625mm and >0.0039mm)	%	0.01	-	-	-	-	-	96.59	95.99	94.87	97.96	67.66	71.02
	Clay (<0.0039mm)	%	0.01	-	-	-	-	-	-	-	-	-	21.82	21.84
	Sand (<2.00mm & >0.063mm)	%	0.01	-	-	-	-	-	3.2	3.56	3.99	1.84	9.94	6.42
	Gravel (>2.00mm)	%	0.01	-	-	-	-	-	0.2	0.45	1.13	0.2	0.58	0.72
Inorganics	Moisture	%	0.3	-	-	-	-	-	44	39	42	40	39	39
	Percent Saturation	%		-	-	-	-	-	89.8	79.1	87.1	85.5	82.3	75.5
	Ammonia	mg/kg	2	-	-	-	-	-	-	-	-	-	-	-
	Chloride	mg/kg	48	-	-	-	-	-	11,900	9060	11,900	9980	10,300	9010
	pH (Initial)	pH_Units		-	-	-	-	-	8.52	8.9	8.56	8.94	8.76	8.77
	Phosphorus	mg/kg	10	-	-	-	-	-	-	-	955	790	919	886
Metals	Soluble Chloride	mg/L	100	-	-	-	-	-	13,300	11,500	13,600	11,700	12,600	11,900
	Sodium ion (1+)	mg/kg	2.4	-	-	-	-	-	6680	5170	6710	5820	5950	5210
	Aluminium	mg/kg	100	-	-	-	-	-	-	-	16,600	16,700	14,100	15,400
	Antimony	mg/kg	0.1	-	-	-	-	-	-	-	0.21	0.2	0.15	0.16
	Arsenic	mg/kg	0.5	26	50	7.24	41.6	7.24	-	-	7.69	8.18	6.53	7.17
	Barium	mg/kg	0.1	-	-	-	-	-	-	-	46	36.1	35.4	34.6
	Beryllium	mg/kg	0.2	-	-	-	-	-	-	-	0.32	0.31	0.26	0.29
	Bismuth	mg/kg	0.1	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1
	Cadmium	mg/kg	0.05	2.6	5	0.7	4.2	0.6	-	-	3.31	2.2	3.05	2.73
	Calcium	mg/kg	100	-	-	-	-	-	-	-	12,000	6960	13,800	8450
	Chromium (III+VI)	mg/kg	1	99	190	52.3	160	52.3	-	-	34.7	34.8	29	31.2
	Cobalt	mg/kg	0.3	-	-	-	-	-	-	-	6.13	6.72	5.32	5.96
	Copper	mg/kg	0.5	67	130	18.7	108	18.7	-	-	22.2	22.4	16.7	20
	Iron	mg/kg	100	-	-	-	-	-	-	-	24,400	25,800	21,100	23,000
	Lead	mg/kg	0.1	69	130	30.2	112	30.2	-	-	13.3	4.47	3.68	3.84
	Lithium	mg/kg	5	-	-	-	-	-	-	-	19	22.5	16.1	16.4
	Magnesium	mg/kg	100	-	-	-	-	-	-	-	8200	8160	6880	7510
	Manganese	mg/kg	0.2	-	-	-	-	-	-	-	205	222	182	203
	Mercury	mg/kg	0.05	0.43	0.84	0.13	0.7	0.75	-	-	0.236	<0.05	<0.05	<0.05
	Molybdenum	mg/kg	0.1	-	-	-	-	-	-	-	3.98	4.09	3.42	3.08
	Nickel	mg/kg	0.8	-	-	-	-	-	-	-	21.7	23.3	18.5	20.3
	Potassium	mg/kg	100	-	-	-	-	-	-	-	2520	2590	2160	2280
	Selenium	mg/kg	0.5	-	-	-	-	-	-	-	0.8	0.79	0.75	0.75
	Silver	mg/kg	0.05	-	-	-	-	-	-	-	0.115	0.101	0.09	0.1
	Sodium	mg/kg	100	-	-	-	-	-	-	-	10,200	9790	8630	8910
	Strontium	mg/kg	0.1	-	-	-	-	-	-	-	86.7	48.9	90.9	57.4
	Thallium	mg/kg	0.05	-	-	-	-	-	-	-	0.361	0.308	0.364	0.379
	Tin	mg/kg	0.1	-	-	-	-	-	-	-	1.74	0.47	0.38	0.4
	Titanium	mg/kg	1	-	-	-	-	-	-	-	1160	1160	1080	1140
	Uranium	mg/kg	0.05	-	-	-	-	-	-	-	2.05	1.86	1.74	1.58
	Vanadium	mg/kg	2	-	-	-	-	-	-	-	51.5	53.5	45.9	49.9
	Zinc	mg/kg	1	170	330	124	271	124	-	-	72	64.9	54.9	56.8
	Zirconium	mg/kg	0.5	-	-	-	-	-	-	-	9.39	9.32	8.02	8.76
PAH	2-methylnaphthalene	mg/kg	0.001	0.12	0.24	0.0202	0.201	-	0.038	0.008	0.012	0.0097	0.0077	0.0063
	Acenaphthene	mg/kg	0.0005	0.055	0.11	0.00671	0.0889	-	0.066	<0.0005	0.0014	0.00083	<0.0005	<0.0005
	Acenaphthylene	mg/kg	0.0005	0.079	0.15	0.00587	0.128	-	0.067	<0.0005	0.0012	<0.0005	<0.0005	<0.0005
	Anthracene	mg/kg	0.001	0.15	0.29	0.0469	0.245	-	0.43	0.0013	0.0056	0.001	<0.001	<0.001
	Benzo(a)anthracene	mg/kg	0.001	0.43	0.83	0.0748	0.693	-	1.2	0.002	0.012	0.0015	0.0015	<0.001
	Benzo(a) pyrene	mg/kg	0.001	0.47	0.92	0.0888	0.763	-	0.76	0.0015	0.0087	<0.001	0.0012	<0.001
	Benzo(b)fluoranthene	mg/kg	0.001	-	-	-	-	-	0.81	0.0025	0.015	0.002	0.0026	0.0016
	Benzo(b+j)fluoranthene	mg/kg	0.001	-	-	-	-	-	1.2	0.0025	0.023	0.002	0.0026	0.0016
	Benzo(g,h,i)perylene	mg/kg	0.05	-	-	-	-	-	-	-	-	-	-	-
	Benzo(k)fluoranthene	mg/kg	0.001	-	-	-	-	-	0.4	<0.001	0.0073	<0.001	<0.001	<0.001
	Chrysene	mg/kg	0.001	0.52	1	0.108	0.846	-	1.2	0.0028	0.014	0.0033	0.0021	0.0021
	Dibenz(a,h)anthracene	mg/kg	0.0005	0.084	0.16	0.00622	0.135	-	0.11	<0.0005	0.0019	<0.0005	<0.0005	<0.0005
	Fluoranthene	mg/kg	0.001	0.93	1.8	0.113	1.494	-	2	0.0036	0.022	0.0032	0.0035	0.0018
	Fluorene	mg/kg	0.001	0.089	0.17	0.0212	0.144	-	0.16	0.0026	0.0042	0.0027	0.0021	0.0015
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.002	-	-	-	-	-	0.32	<0.002	0.0054	<0.002	<0.002	<0.002
	Naphthalene	mg/kg	0.001	0.24	0.47	0.0346	0.391	-	0.05	0.0015	0.0038	0.002	0.0015	<0.001
	High Molecular Weight PAHs	mg/kg	0.001	-	-	-	-	-	6.9	0.013	0.082	0.012	0.012	0.0063
	Total PAHs	mg/kg	0.001	10	20			2.5	9	0.036	0.13	0.037	0.031	0.019
	Phenanthrene	mg/kg	0.001	0.34	0.65	0.0867	0.544	-	1.3	0.0096	0.018	0.0092	0.0069	0.005
	Low Molecular Weight PAHs	mg/kg	0.001	-	-	-	-	-	2.1	0.023	0.046	0.025	0.018	0.013
	Pyrene	mg/kg	0.001	0.87	1.7	0.153	1.398	-	1.7	0.0036	0.024	0.004	0.0041	0.0024
	B(a)P Total Potency Equivalent	mg/kg	0.01	-	-	-	-	-	1.2	<0.01	0.016	<0.01	<0.01	<0.01
PCB	PCBs (Sum of total)	mg/kg	0.01	0.12	0.23	0.0215	0.189	0.1	<0.1	<0.01	<0.25	<0.1	<0.1	<0.1

APPENDIX I: Biophysical and Sediment Chemistry Data

Sediment Chemistry Test		Units	EQL	BCCSR Sed. Marine Sensitive	BH10			BH15		BH16		BH18	BH20		BH27		BH28		BH29	
					Surficial	>30cm	>30 dup	Surficial	>30cm	Surficial	>30cm	Surficial	Surficial	>30cm	Surficial	>30cm	Surficial	>30cm	Surficial	>30cm
Grain Size	Silt (<0.0625mm and >0.0039mm)	%	0.01	-	-	56.62	59.85	-	67.98	56.11	50.71	94.91	-	37.64	22.31	75.34	-	-	37.3	80.99
	Clay (<0.0039mm)	%	0.01	-	-	18.05	20.88	-	-	-	-	-	-	23.43	-	-	-	-	-	-
	Sand (<2.00mm & >0.063mm)	%	0.01	-	-	23.88	17.1	-	28.72	38.29	34.18	4.64	-	34.14	58.86	22.91	-	-	36.67	16.16
	Gravel (>2.00mm)	%	0.01	-	-	1.45	2.17	-	3.3	5.6	15.11	0.45	-	4.8	18.84	1.75	-	-	26.03	5.5
Inorganics	Moisture	%	0.3	-	69	34	40	65	20	60	19	43	81	45	42	20	59	22	74	64
	Percent Saturation	%		-	176	67.9	85.4	-	75.9	130	48.1	84.7	269	95.2	52.8	70.6	124	50	336	145
	Ammonia	mg/kg	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chloride	mg/kg	48	-	35,600	8030	10,700	-	5390	22,400	3680	12,700	56,400	12,600	6270	4000	23,300	4530	37,900	24,400
	pH (Initial)	pH_Units		-	7.95	8.24	8.71	8.59	7.97	8.24	9.07	8.64	8.07	8.8	8.98	8.12	8.45	9.15	7.65	8.36
	Phosphorus	mg/kg	10	-	955	833	876	750	818	734	575	792	528	1080	904	777	737	372	503	953
Metals	Soluble Chloride	mg/L	100	-	20,200	11,800	12,500	-	7110	17,300	7640	14,900	21,000	13,300	11,900	5660	18,800	9050	11,300	16,800
	Sodium ion (1+)	mg/kg	2.4	-	19,900	4640	6340	-	3510	12,800	2360	7200	30,100	6840	3640	2620	13,300	2600	21,300	13,300
	Aluminium	mg/kg	100	-	17,000	11,600	14,300	8510	31,400	10,800	13,600	16,900	6180	16,700	9130	22,300	13,100	8220	6210	18,700
	Antimony	mg/kg	0.1	-	1.12	0.16	0.16	0.41	0.34	0.36	0.21	0.28	0.21	0.4	0.24	0.28	0.49	0.15	0.3	0.65
	Arsenic	mg/kg	0.5	26	14.7	6.33	7.87	7.6	9.4	5.27	3.74	7.08	4.16	9.06	5.69	5.93	7.97	5.06	3.15	13.3
	Barium	mg/kg	0.1	-	58.9	25.6	32.1	23.9	92.3	28.2	37.5	41.1	17.6	47.7	26.3	76.1	41.8	14	22.2	55.8
	Beryllium	mg/kg	0.2	-	0.31	0.21	0.26	<0.2	0.47	<0.2	0.22	0.31	<0.2	0.34	<0.2	0.36	0.23	<0.2	<0.2	0.35
	Bismuth	mg/kg	0.1	-	0.16	<0.1	<0.1	<0.1	0.13	<0.1	<0.1	<0.1	<0.1	0.14	<0.1	0.11	0.11	<0.1	<0.1	0.2
	Cadmium	mg/kg	0.05	2.6	3.32	2.91	3.13	1.81	0.093	2.48	0.285	2.04	1.4	2.43	1.39	0.132	2.18	0.619	1.45	2.65
	Calcium	mg/kg	100	-	8980	10,300	7520	16,000	7700	7090	9840	7060	8350	30,600	49,800	9070	36,000	17,300	8270	11,900
	Chromium (III+VI)	mg/kg	1	99	44.7	23.5	30.2	18.3	60.8	23.3	27.5	33.5	18.4	33.5	18.3	43.5	26.8	15.4	17	40.6
	Cobalt	mg/kg	0.3	-	7.32	4.66	5.64	4.66	21.5	5.38	8.54	6.12	2.51	6.43	5.36	15.1	5.28	5.52	2.8	7.33
	Copper	mg/kg	0.5	67	76.2	15.2	18.9	32.1	70.1	39.3	22.5	24.7	29.7	35	16.5	46.7	37.2	10.8	31.6	59.5
	Iron	mg/kg	100	-	32,800	17,400	21,300	15,000	48,500	16,600	22,600	24,700	11,200	25,100	16,000	36,500	19,500	13,400	17,300	29,300
	Lead	mg/kg	0.1	69	40.5	3.27	3.84	12.1	6.52	21.8	3.36	24.6	16.5	56.3	6.12	5.23	37.3	1.76	17.3	60.8
	Lithium	mg/kg	5	-	20	13.5	15.8	7.1	24.9	10.1	13.8	20.7	6.5	18.4	8.7	18.9	13.9	7.8	7	21.7
	Magnesium	mg/kg	100	-	11,100	5630	7090	6030	14,700	6740	7040	8180	8860	8310	4650	10,900	7450	4190	7170	10,400
	Manganese	mg/kg	0.2	-	227	165	191	165	721	178	347	200	106	210	185	514	171	142	164	242
	Mercury	mg/kg	0.05	0.43	0.44	<0.05	<0.05	0.12	0.054	0.198	<0.05	0.35	0.19	0.902	0.067	<0.05	0.605	<0.05	0.206	1.13
	Molybdenum	mg/kg	0.1	-	26.9	2.57	4.21	11.1	0.84	10.8	1.32	3.75	18	5.7	4.22	0.55	10.2	3.12	22.7	11.7
	Nickel	mg/kg	0.8	-	26.6	15.8	19.9	13.2	52	16.4	24.4	21.5	10.4	23.2	14.2	40.7	18.2	11.2	10.9	26.9
	Potassium	mg/kg	100	-	3280	1690	2180	1350	3420	1880	2200	2520	2500	2620	1150	2590	2180	798	1840	3110
	Selenium	mg/kg	0.5	-	2.04	0.63	0.82	0.79	<0.5	0.85	<0.5	0.68	1.19	1.08	<0.5	<0.5	1.14	<0.5	1.05	1.36
	Silver	mg/kg	0.05	-	0.308	0.079	0.098	0.085	0.108	0.141	<0.05	0.121	0.12	0.18	0.067	0.068	0.228	<0.05	0.128	0.419
	Sodium	mg/kg	100	-	28,500	6510	8620	13,500	6400	15,700	4060	10,100	42,400	13,300	5440	4970	17,000	2850	26,200	20,900
	Strontium	mg/kg	0.1	-	87.1	66.4	50.2	109	51.1	56.4	53.9	53.7	90.8	184	333	58.6	231	106	87.5	99.4
	Thallium	mg/kg	0.05	-	0.528	0.484	0.398	0.34	0.074	0.443	0.14	0.243	0.195	0.434	0.335	0.073	0.421	0.268	0.197	0.349
	Tin	mg/kg	0.1	-	9.02	0.41	0.39	2.31	0.51	4.19	0.29	1.94	3.46	11.8	1.31	0.41	7.8	0.19	2.46	12.2
	Titanium	mg/kg	1	-	937	923	1060	589	1410	777	965	1010	363	1090	732	1080	890	803	373	1170
	Uranium	mg/kg	0.05	-	8.04	1.27	1.89	3.53	0.407	2.69	0.701	1.89	5.21	2.55	1.96	0.364	3.34	1.05	5.67	3.96
	Vanadium	mg/kg	2	-	71.6	38.3	47.1	36.1	111	45.5	52.2	49.6	38	55.8	36.2	83.4	50	35.2	40.8	66.6
	Zinc	mg/kg	1	170	141	44.6	54.8	61.6	86.7	95	40.9	71.8	64.9	88.9	96	66.8	85.2	22.6	158	124
	Zirconium	mg/kg	0.5	-	9.36	6.21	7.86	4.53	7.24	5.45	6.7	8.2	4.67	4.8	4.91	7.02	7.05	4.48	4.36	10.4
PAH	2-methylnaphthalene	mg/kg	0.001	0.12	0.027	0.0056	0.0064	<0.054	<0.02	<0.048	<0.02	0.019	0.017	0.02	<0.02	<0.02	0.019	0.001	0.0089	0.043
	Acenaphthene	mg/kg	0.0005	0.055	0.0091	<0.0005	<0.0005	<0.014	<0.005	0.028	<0.005	0.0018	0.016	0.0077	<0.005	<0.005	0.0089	<0.0005	0.012	0.018
	Acenaphthylene	mg/kg	0.0005	0.079	0.015	<0.0005	<0.0005	0.015	<0.005	0.017	<0.005	0.0016	0.008	0.015	<0.005	<0.005	0.014	<0.0005	0.0081	0.023
	Anthracene	mg/kg	0.001	0.15	0.063	0.0015	<0.001	0.034	<0.004	0.055	<0.004	0.0058	0.056	0.039	0.013	<0.004	0.049	<0.001	0.035	0.093
	Benzo(a)anthracene	mg/kg	0.001	0.43	0.096	0.002	0.0013	0.081	<0.02	0.094	<0.02	0.013	0.063	0.076	0.025	<0.02	0.078	<0.001	0.038	0.13
	Benzo(a) pyrene	mg/kg	0.001	0.47	0.13	0.0023	<0.001	0.093	<0.02	0.067	<0.02	0.018	0.048	0.087	0.023	<0.02	0.079	<0.001	0.04	0.14
	Benzo(b)fluoranthene	mg/kg	0.001	-	0.14	0.0024	0.0029	0.12	<0.02	0.094	<0.02	0.021	0.049	0.07	0.032	<0.02	0.11	<0.001	0.037	0.19
	Benzo(b+j)fluoranthene	mg/kg	0.001	-	0.2	0.0035	0.0029	0.19	<0.02	0.14	<0.02	0.031	0.074	0.11	0.032	<0.02	0.17	<0.001	0.056	0.28
	Benzo(g,h,i)perylene	mg/kg	0.05	-	-	-	-	<0.14	<0.05	<0.12	<0.05	-	-	-	<0.05	<0.05	-	-	-	-
	Benzo(k)fluoranthene	mg/kg	0.001	-	0.065	0.0011	<0.001	0.063	<0.02	0.048	<0.02	0.01	0.024	0.035	<0.02	<0.02	0.057	<0.001	0.017	0.085
	Chrysene	mg/kg	0.001	0.52	0.15	0.0039	0.0037	0.13	<0.02	0.12	<0.02	0.017	0.098	0.097	0.045	<0.02	0.13	<0.001	0.071	0.2
	Dibenz(a,h)anthracene	mg/kg	0.0005	0.084	0.02	<0.0005	0.00067	<0.054	<0.02	<0.048	<0.02	0.0028	0.0096	0.016	<0.02	<0.02	0.013	<0.0005	0.005	0.019
	Fluoranthene	mg/kg	0.001	0.93	0.26	0.005	0.0019	0.21	<0.02	0.44	<0.02	0.028	0.27	0.2	0.088	<0.02	0.27	<0.001	0.18	0.37
	Fluorene	mg/kg	0.001	0.089	0.016	0.0014	0.0017	<0.054	<0.02	<0.048	<0.02	0.0062	0.024	0.014	<0.02	<0.02	0.014	<0.001	0.019	0.027
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.002	-	0.073	<0.002	<0.002	0.057	<0.02	<0.048	<0.02	0.0086	0.035	0.062	<0.02	<0.02	0.044	<0.002	0.024	0.083
	Naphthalene	mg/kg	0.001	0.24	0.023	0.0012	<0.001	<0.027	<0.01	0.038	<0.01	0.0067	0.026	0.026	0.01	<0.01	0.032	<0.001	0.017	0.059
	High Molecular Weight PAHs	mg/kg	0.001	-	1	0.021	0.01	0.8	<0.02	1.1	<0.02	0.11	0.7	0.69	0.27	<0.02	0.89	<0.001	0.47	1.4
	Total PAHs	mg/kg	0.001	10	1.3	0.036	0.024	0.92	<0.02	1.3	<0.02	0.18	0.96	0.91	0.32	<0.02	1.1	0.001	0.63	1.8
	Phenanthrene	mg/kg	0.001	0.34	0.093	0.0047	0.0055	0.072	<0.01	0.095	<0.01	0.023	0.11	0.095	0.025	<0.01	0.1	<0.001	0.068	0.16
	Low Molecular Weight PAHs	mg/kg	0.001	-	0.25	0.014	0.014	0.12	<0.02	0.23	<0.02	0.065	0.26	0.22	0.048	<0.02	0.24	0.001	0.17	0.43
	Pyrene	mg/kg	0.001	0.87	0.39	0.0079	0.0029	0.29	<0.02	0.34	<0.02	0.035	0.21	0.22	0.089	<0.02	0.32	<0.001	0.14	0.49
	B(a)P Total Potency Equivalent	mg/kg	0.01	-	0.2	<0.01	<0.01	-	-	-	-	0.027	0.079	0.13	-	-	0.13	<0.01	0.059	0.22
PCB	PCBs (Sum of total)	mg/kg	0.01	0.12	<0.75	<0.1	<0.02	<0.6	<0.01	<0.13	<0.01	<0.5	<0.5	<0.5	<0.1	<0.01	<0.13	<0.01	<2	<0.75

APPENDIX J

Detailed Pilot Study Project Cost Estimate

Fiscal Year	Task Description	Project Manager	Biologist 1 (Marine Biology)	Biologist 2 (Sediment Chemistry)	Technician 1 (Biologist/ Diver)	Technician 2 (Biologist/ Diver)	Technician 3 (Diver)	Technician 4 (Sediment Chemistry)	GIS Specialist	Total Hours	Subtotal Labour Fees	Disbursements		Subconsultant Fees	Notes/assumptions
												Travel/Living	Direct Expenses		
1	**Finalized Site Selection and Regulatory Requirements**									**155**	**$17,636.00**	**$1,245.00**	**$200.00**	**$2,500.00**	
	Planning and Logistics	2	2	2	2			2		10	$1,204.00				Kickoff meeting
	Finalized selection of Pilot Study site and reference site		2		5					7	$810.00				Analysis and Decision on Final site selection and reference
	Navigation Protection Act - Notice of Works		2		5				2	9	$990.00				Notice of Works, engagement with TC
	Disposal at Sea - Beneficial Use Exemption for Use of Clean Fill	2	2	6	10			60	2	82	$9,276.00	$1,245.00	$200.00		Project Description, Sample Plan, Sediment Characterization Report, Engagement with ECCC
	Fisheries Act - Serious Harm Assessment	2	8		35				2	47	$5,356.00				Serious harm assessment, Request for Review, engagement with DFO
	Clean fill Sediment Chemistry Analysis													$2,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, 7 samples
2	**Pilot Study Setup and Characterization of Baseline Conditions**									**302**	**$33,636.00**	**$4,000.00**	**$3,400.00**	**$151,000.00**	
	Fieldwork Planning and Logistics	2	2		20	10	10		5	49	$5,436.00				Sample plan, HASP, Fieldwork coordination
	Fieldwork	2			50	50	50			152	$17,056.00	$4,000.00	$3,400.00		Labour: pilot project setup, 4 days of sampling, mob and demob. Disbursements: 4 nights accomodation, 4.5 days per diem, vehicle rental, ferry fares, pilot study setup supplies (buoys, rope, cement cinder blocks, dive safety gea
	Data entry and Analysis				10	10	10	10	10	50	$5,380.00				Entry of field data, compilation of laboratory results, figure creation
	Reporting	2	5	5	12	12		10	5	51	$5,764.00				Letter style report on baseline conditions
	Sediment Chemistry Analysis													$16,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, ammonia, sulphides, dioxins/furans, 33 samples
	Nautilus Bioassay Analysis													$112,000.00	Analysis: 1 acute and 1 chronic per sample, 33 samples = 66 tests
	Biologica Benthic Invertebrate Analysis													$18,000.00	Biologica technician labour, supplies, lab analysis of 11 samples
	Dive Boat Operator													$4,500.00	4 days, plus SCUBA tank rentals and air fills
	Application of Pilot Study Treatments									**275**	**$30,787.00**	**$5,900.00**	**$3,000.00**	**$2,480,800.00**	
	Fieldwork Planning and Logistics	2	6		20	10	10		5	53	$5,936.00				Implementation Plan, HASP, Fieldwork coordination
	Fieldwork				60	60	60			180	$20,160.00	$5,900.00	$3,000.00		Labour: 5 days of dive support for pilot implementation, mob and demob. Disbursements: 5 nights accomodation, 5.5 days per diem, vehicle rental, ferry fares, equipment (dive safety gear, etc)
	Reporting	2	5		10	10	10		5	42	$4,691.00				Treatment Application Memo, EM Summary Report
	Dredgeate Sediment Chemistry Analysis													$8,000.00	Analysis: TCLP Metals, LEPH/HEPH/PAH, PCB, TOC, BTEX, Grain Size, % Moisture, Na/Cl, 9 composites
	Dredge Contractor													$899,100.00	Dredge to scow, transport of dredgeate to barge ramp
	Transport of Dredged Materials													$80,000.00	Transport of dreadgeate by dump truck to upland facility
	Upland Facility Disposal of Dredgeate													$1,488,000.00	Cost of disposal at upland facility (assumed weight of 2000kg/m3, and disposal cost of $1.86/kg based on disposal of drill cuttings from November 2017)
	Dive Boat Operator													$5,700.00	5 days, plus SCUBA tank rentals and air fills
3	**Effectiveness Monitoring - Year 1**									**248**	**$27,698.00**	**$3,000.00**	**$1,800.00**	**$131,800.00**	
	Fieldwork Planning and Logistics	2	2		10	5	5		5	29	$3,196.00				Sample plan, HASP, Fieldwork coordination
	Fieldwork	2			40	40	40			122	$13,696.00	$3,000.00	$1,800.00		Labour: 3 days of sampling, mob and demob. Disbursements: 3 nights accomodation, 3.5 days per diem, ferry fare, vehicle rental, equipment (dive safety)
	Data entry and Analysis				5	10	10	10	5	40	$4,370.00				Entry of field data, compilation of laboratory results, figure creation
	Reporting	2	5	5	10	10	10	10	5	57	$6,436.00				Letter style report on Year 1 conditions compared with baseline
	Sediment Chemistry Analysis													$16,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, ammonia, sulphides, dioxins/furans, 33 samples
	Nautilus Bioassay Analysis													$112,000.00	Analysis: 1 acute and 1 chronic per sample, 33 samples = 66 tests
	Dive Boat Operator													$3,300.00	3 days, plus SCUBA tank rentals and air fills
4	**Effectiveness Monitoring - Year 2**									**271**	**$30,358.00**	**$4,000.00**	**$1,800.00**	**$151,000.00**	
	Fieldwork Planning and Logistics	2			10	5	5			22	$2,496.00				Sample plan, HASP, Fieldwork coordination
	Fieldwork	2			50	50	50			152	$17,056.00	$4,000.00	$1,800.00		labour: 4 days of sampling, mob and demob, and pilot project takedown. Disbursements: 4 nights accomodation, 4.5 days per diem, vehicle rental, ferry fares, equipment (dive safety gear, etc)
	Data entry and Analysis				5	10	10	10	5	40	$4,370.00				Entry of field data, compilation of laboratory results, figure creation
	Reporting	2	5	5	10	10	10	10	5	57	$6,436.00				Letter style report on Year 1 and 2 conditions compared with baseline
	Sediment Chemistry Analysis													$16,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, ammonia, sulphides, dioxins/furans, 33 samples
	Nautilus Bioassay Analysis													$112,000.00	Analysis: 1 acute and 1 chronic per sample, 33 samples = 66 tests
	Biologica Benthic Invertebrate Analysis													$18,000.00	Biologica technician labour, supplies, lab analysis of 11 samples
	Dive Boat Operator													$4,500.00	4 days, plus SCUBA tank rentals and air fills
	Determination of Pilot Study Effectiveness Report									**327**	**$36,460.00**	**$0.00**	**$0.00**	**$10,000.00**	
	Data and Analysis		2	10	60	60		30	20	182	$20,100.00				Detailed statistical and community analsyes, interpolative mapping, figure creation
	Final Report	5	10	10	60	10	10	30	10	145	$16,360.00				Final reporting, determination of effectiveness and remedial recommendations
	Biologica Benthic Invertebrate Consulting Services													$10,000.00	Data processing and interpretation consultation
	Subtotal Hours	33	58	43	499	372	300	182	91	1578					
	Rate	$128.00	$125.00	$125.00	$112.00	$112.00	$112.00	$112.00	$90.00						
	Sub-total Fees	$4,224.00	$7,250.00	$5,375.00	$55,888.00	$41,664.00	$33,600.00	$20,384.00	$8,190.00		$176,575.00	$18,145.00	$10,200.00	$2,927,100.00	

Total Labour Fees	**$ 176,575**
Total Disbursements	**$ 28,345**
Total Subconsultant Fees	**$ 2,927,100**
Total Estimated Pilot Scope	**$ 3,132,020**

Category	Cost
Year 1	**$ 21,581**
Year 2	**$ 2,712,523**
Year 3	**$ 164,298**
Year 4	**$ 233,618**
Total Estimated Pilot Scope	**$ 3,132,020**

Appendix B
Environmental Requirements

Appendix B-1
Due Diligence Environmental Effects Determination

Establishment File Number: R.089382.001
EIA Number: 2019-21-102311

Department of National Defence (DND)

Due Diligence Environmental Effects Determination (DD EED) Report

Physical Activity: DND Wood Waste Remediation Pilot Project

Prepared by: Hemmera Envirochem

Date: 2019/07/23

Version: v2

Executive Summary

The Department of National Defence (DND) and Contracting Authority Public Services and Procurement Canada (PSPC) proposes to conduct the DND Wood Waste Remediation Pilot Project (the Project) located adjacent to CFB Esquimalt within the marine waters of northern Esquimalt Harbour, British Columbia (Latitude 40^{O} 26’ 44.04” N, Longitude: 123^{O} 26’ 33.48” W). The northern area of the Harbour has a long history of log booming, log storage and sawmill operations which have contributed to a large amount of persistent subtidal wood debris deposited on the northern Harbour floor. Large volumes of wood waste can overwhelm the assimilative capacity of subtidal benthic communities, impairing otherwise productive fish habitats. Previous assessment work by both Hemmera and Anchor QEA have determined that a total area of 640,000m^2 of subtidal fish habitat in northern Esquimalt Harbour contains wood waste impacted sediments that pose an environmental risk to benthic fish habitat and warrants remediation consistent with the objectives of Esquimalt Harbour Remediation Project.

Anchor QEA, working on behalf of PSPC, has retained Hemmera Envirochem Inc. (Hemmera), a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), to review the potential significant adverse effects of the Project on the environment and fish/fish habitat resources, to conduct an EED and a *Fisheries Act* serious harm assessment and, if necessary, to prepare an offsetting plan in support of the *Fisheries Act*.

The Project involves the implementation of an on-site wood waste remediation pilot project with the objectives of assessing:

- The site-specific effectiveness of the two potential remedial techniques for remediating wood waste-impacted sediments that pose an environmental risk to benthic fish habitat and enhancing subtidal benthic fish habitat conditions within northern Esquimalt Harbour
- The site-specific constructability of placing the sand material in areas with unique physical and geotechnical characteristics.
- The effect of placing rock mounds over enhanced natural recovery (ENR) treated sediments to assess the suitability for kelp establishment.

Results of the pilot project will be used to determine the efficacy of the In Situ Amendment for use in the remediation of degraded wood waste habitat and inform the selection of remedial actions for the sediments impacted by wood waste in Esquimalt Harbour. Any future remediation work will be evaluated through a separate Environmental Effects Determination.

For the purposes of this Environmental Effects Determination (EED) report, the project was divided into the following components:

1. Construction Activities
2. Post-Construction Monitoring

Potential significant adverse effects of these activities were assessed, and avoidance and mitigation measures have been identified to minimize or eliminate these effects to Valued Environmental Components (VECs).

On the basis of this EED report, it has been determined that the Project activities are not likely to cause significant adverse environmental effects. Therefore, the Project can proceed with application of the mitigation measures specified in the interaction tables in this report.

Table of Contents

Figures

Appendices

Part 1. Physical Activity Information

1.1 Title of Proposed Physical Activity

Department of National Defence (DND) Wood Waste Remediation Pilot Project (Project)

1.2 Originating Directorate, Base, or Unit

The originating Establishment is: Department of National Defence (DND), Canadian Forces Base Esquimalt (CFB Esquimalt)

1.3 Location of Proposed Physical Activity

Latitude: 40^{O} 26’ 44.04” N Longitude: 123^{O} 26’ 33.48” W

The Project site is located within the marine waters of northern Esquimalt Harbour, at the south end of Vancouver Island, British Columbia. Esquimalt Harbour is bounded to the east by the municipality of Esquimalt, to the south by CFB Esquimalt Dockyard, to the north and northeast by the town of View Royal, and to the west by the City of Colwood, as shown in **Figure 1**.

The harbour is a Federal Harbour (established by the 1924 Six Harbour Agreement) that is administered by the Department of National Defence (DND) and is governed by the Canada Marine Act, Transport Canada’s (TC) Natural and Man-made Harbour Regulations, and local practices and procedures. The harbour authority is CFB Esquimalt Queen’s Harbour Master.

The Songhees and Esquimalt First Nations jointly hold a waterlot lease with DND that is located north of Inskip Island and West of Plumper Bay (see **Figure 2** for location). The Esquimalt and Songhees First Nations reserves are located to the north of the Esquimalt Graving Dock (EGD) and are administered by Aboriginal Affairs and Northern Development Canada. Parks Canada administers Fort Rodd Hill and Fisgard Lighthouse National Historic Sites. View Royal, the area to the northeast of Esquimalt Harbour, is largely private residential.

1.4 Project Summary

Project Overview and History

The DND and Contracting Authority Public Services and Procurement Canada (PSPC) propose to conduct a wood waste remediation pilot project (the Project) in the northern portion of Esquimalt Harbour (the Harbour) on Vancouver Island, British Columbia (**Figure 1**).

Esquimalt Harbour has been home to numerous industrial activities since the mid-1800s, including civilian and military shipbuilding and repair, commercial and military ship operations, and private logging and milling. These historical activities have generated a wide variety of organic and inorganic pollutants, which have made their way into the harbour and have become part of the underlying sediments. Contaminated sediments within Esquimalt Harbour (FCSAP site ESQ-1) are being remediated in a phased approach under the Esquimalt Harbour Remediation Project (EHRP).

In particular, the northern area of the Harbour has a long history of log booming, log storage and sawmill operations. Water leaseholds used for log booming/log storage have contributed to a large amount of persistent subtidal wood debris deposited on the northern Harbour floor. Large volumes of wood waste overwhelm the assimilative capacity of benthic communities and lead to an anthropogenic increase in organic content in the sediments of nearshore marine habitats (Breems and Goodman 2009, Washington State 2013). Therefore, wood waste deposits can negatively affect the productivity of marine benthic communities through both the physical alteration of sediments (i.e. build-up of wood waste deposits isolating sediments and breaking down the exchange of oxygen and nutrients) and the accumulation of toxic by-products from the anaerobic decomposition of wood waste, especially porewater sulphides (e.g. H_2S). Wood waste-associated impacts to nearshore benthic communities can result in impairing otherwise productive habitats, which form the foundation of nearshore marine food webs, and are integral to recycling nutrients between the SWI (Washington State 2013).

In 2016 - 2018 Hemmera assessed the northern portion of the Harbour and determined that widespread areas are negatively impacted by the presence of persistent wood waste accumulations and decomposition by-products (Hemmera 2018). The type of wood waste varies by location by historical use but includes logs, bark, wood chips, and fibres (e.g. sawdust), and in some locations occurs in deposits that are more than 2 m thick. Subsequent studies by Anchor QEA and Hemmera further characterized and defined these areas and measured high levels of sulphides in sediments within northern Esquimalt Harbour (Anchor QEA 2019a, 2019b). As such, sediments containing wood waste in the Harbour pose an environmental risk to benthic fish habitat and warrant remediation consistent with the objectives of EHRP.

Based on previous assessment work, two larger areas of wood waste, totaling 640,000m^2, in northern Esquimalt Harbour have been identified for potential sediment remediation under the Esquimalt Harbour Wood Waste Remediation project (WWRP; Anchor QEA 2019b). The objective of the WWRP is to develop and implement a risk management and remediation strategy that effectively reduces the ecological impacts associated with wood waste impacted sediments and enhances the quality of existing subtidal fish habitat in northern Esquimalt Harbour.

The potential remediation area was delineated into five Wood Waste Management Areas (WWMAs) based on historical wood sources, physical conditions, geochemical conditions, and site use (Anchor QEA 2019b; **Figure 2**). The northern-most area of wood waste is composed of one WWMA, while the area of wood waste in the south is composed of 4 WWMAs. The applicability (effectiveness and ability to implement) of available remedial technologies for wood waste were then assessed for each WWMA (Anchor QEA 2019b). However, further site-specific studies are required to determine the effectiveness of implementing two potential remedial options that are cost-effective and less-invasive remedial techniques: Enhanced Natural Recovery (ENR) and In Situ Amendment (outlined further below).

Project Objectives

The Project proposes to implement an on-site wood waste remediation pilot project in December 2019, to investigate:

- The site-specific effectiveness of two potential remedial techniques for remediating wood waste-impacted sediments that pose an environmental risk to benthic fish habitat and enhancing subtidal benthic fish habitat conditions within northern Esquimalt Harbour:
    - ENR (clean sand cover)
    - In Situ Amendment treatment (clean sand cover mixed with siderite)
- The site-specific constructability of placing the sand material in areas with unique physical and geotechnical characteristics.
- The effect of placing rock mounds over ENR treated sediments to assess the suitability for kelp establishment.

The Project will include placement of ENR, In Situ Amendment Treatment, and rock mounds at Test Areas within two defined work areas (Work Area 1 within DND marine waters, and Work Area 2 within the Esquimalt and Songhees Leased Waterlot) and subsequent post-construction monitoring. The specific Project activities covered by the EED are described in further detail in **Section 2.1 Description of Physical Activities**.

Results of the pilot project will be used to determine the efficacy of the In Situ Amendment for use in the remediation of degraded wood waste habitat and inform the selection of remedial actions for the sediments impacted by wood waste in Esquimalt Harbour as part of the WWRP.

Site Selection and Pilot Project Design

Site Selection Criteria

The Pilot Project locations were selected based on thickness of wood debris deposits estimated from surface grab samples and sediment cores, geotechnical properties of surface sediments, and surface sediment conditions (i.e., images) identified from diver surveys (Anchor QEA 2019a), using the following specific selection criteria:

- To target subtidal marine areas that:
    - Have significant thickness of wood debris (i.e., a thickness that adversely affects benthic community composition, typically greater than 20 cm).
    - Show visual evidence of wood debris on the surface
- To select one work area that has firm surface sediments and one work area that has soft surface sediments to assess a range of geotechnical conditions
- Based on geotechnical conditions (e.g. bathymetry)
- To avoid areas:
    - That show evidence of significant propwash scour due to vessel operations or may be subject to prop wash scour due to known vessel operations
    - Within or directly adjacent to the Jones Marine Lease area (to minimize impacts on Jones Marine business activities in lease areas)
    - That show evidence of bedrock outcrops (to focus on benthic soft sediments impacted by wood waste)

Based on these criteria, two Work Areas within the marine subtidal waters of northern Esquimalt Harbour were selected for use in the pilot project, one within Esquimalt Harbour North WWMA and one within Inskip Island West WWMA (**Figure 3**).

<u>Pilot Project Treatments</u>

Two potential remedial techniques for remediating wood waste-impacted sediments and enhancing subtidal benthic fish habitat conditions were selected:

- ENR (clean sand cover)
- In Situ Amendment treatment (clean sand cover mixed with siderite)
- Control (no action)

Enhanced Natural Recovery

Refers to the placement of a layer of clean material (usually sand) on top of wood waste impacted sediments to increase the rate of the natural recovery process. While ENR does not reduce the mass of wood debris or eliminate wood debris by-products (i.e., sulphides), the ENR layer immediately replaces the biologically active zone with clean sediment in order to provide an oxygenated layer to promote benthic infauna community recruitment and establishment of a productive benthic community (Breems and Goodman 2009, Washington State 2013). As benthic communities develop, bioturbators will naturally mix the clean material with underlying wood waste over time, diluting wood waste and accelerating aerobic decomposition.

Sand material to be placed during the pilot project will consist of clean sand that meets the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) sediment quality guidelines. Laboratory tests of samples taken from Fraser River sand, for previous use as clean fill, indicate that all measurable metals were below the lowest value for sediment quality guidelines established by the Canadian Council of Ministers of the Environment (CCME) and are representative of the type of fill material that would be used, (**Appendix A: Sediment Chemistry**).

In Situ Amendment

This treatment involves the mixing of a naturally-occurring mineral-based chemical compound with clean sand material and placing in a thin layer over sediment (similar to ENR). In addition to replacing the biologically active zone with clean sediment (to provide an oxygenated layer to promote benthic infauna community recruitment and establishment of a productive benthic community), the mineral-based compound will also bind porewater sulphides (e.g. H_2S), which are a toxic by-product of organic decomposition, so they are no longer biologically available thereby reducing H_2S concentrations and ultimately reducing benthic toxicity.

In Situ Amendment has not been previously used to remediate wood waste-impacted sediments; however, to ensure the In Situ Amendment will not pose a risk to fish or fish habitat in Esquimalt Harbour, an appropriate compound was selected through: (i) desktop-based technical literature review, (ii) geochemical transport modeling, and (iii) laboratory bench-scale tests using sediment from Esquimalt Harbour (Anchor QEA 2019c). Based on this work, Siderite, a natural earth mineral consisting of ferrous carbonate ($FeCO_3$), was selected to be mixed with clean sand in order to bind with H_2S.

Upon placement in the marine environment, Siderite will slowly dissolve in water to produce carbonate and ferrous iron (Fe(II)) ions, the latter of which will bind with toxic H_2S to precipitate iron sulphides. In anoxic environments, the reaction of sulphide with the Fe(II) ion will form a stable compound of either mackinawite (FeS) or pyrite (FeS_2). Over time mackinawite can also transform to pyrite. Fe(II) released from siderite may also be oxidized to ferric iron (Fe(III)) and precipitated in the form of iron oxides and oxyhydroxides, which can abiotically oxidize dissolved sulphide. The resulting effect is the permanent reduction of toxic H_2S in the impacted benthic environment.

Siderite is an odourless non-toxic material that does not present a hazard to human or animal health and is not a controlled substance (**Appendix B: Siderite SDS Information Sheet**). Applications have included the use in food as a nutrient supplement in food and possibly infant formula (U.S. Food and Drug Administration: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=184.1307b), as well as use in the agricultural industry for livestock feed supplements.

Previously, siderite has been used successfully as a cap amendment in an aquatic environment in order to aid with pH control (**Appendix C: Onondaga Lake Final Design**). With this project, testing was conducted to evaluate potential water quality impacts during and after placement of siderite as part of an amended sediment cap, including batch leach testing to evaluate leaching of constituents from siderite in upwelling porewater. Results show there were no exceedances of New York State Department of Environmental Conservation (NYSDEC) surface water criteria, and leach testing results verify that the majority of analytes (metals, semivolatiles, total cyanide, pH and total suspended solids) were not detected or actually showed decreased concentrations in the leachate, and there would be no significant long-term impacts resulting from porewater migration through the siderite.

Rigorous laboratory bench-scale treatability testing was also conducted on wood waste sediment collected from norther Esquimalt Harbour to assess the effectiveness of sand cover mixed with different mineral-based reactive amendments to reduce bioavailable toxic porewater sulphide concentrations at the sediment-water interface (**Appendix D: Supplemental Treatability Recommendations Report**). Dissolved sulphide concentrations in overlying water was measured 10, 20 and 40 days following the application of the amendments. The tests demonstrated that sand mixed with siderite suppressed dissolved sulphide concentrations not only in overlying water and porewater but also in underlying sediment porewater over the 40-day test duration. Dissolved sulphide concentrations in overlying water were also close to or less than the method detection limit (MDL) of the iodine method (0.1 mg/L), indicating that siderite is effective at suppressing sulphide species. Testing was conducted with powdered siderite due to faster reaction kinetics than granular forms in short testing durations; however, granular forms of these amendments are expected to be just as effective as the powder forms in the long term. Granular forms are also expected to be better suited for In Situ application, particularly for mixing and placement effectiveness.

Based on this information, it has been concluded that the In Situ Amendment Treatment of clean sand (95%) blended with siderite material (5%) does not constitute a risk to fish or fish habitat from a change in sediment concentrations or the introduction of deleterious materials. The In Situ Amendment is expected to act similar to sand, and provide a clean substrate for benthic colonization following the pilot project implementation.

Control

The control treatment will not include any placement of material or change to the marine environment. This will act as a comparison treatment to the ENR and In Situ Amendment in the determination of effectiveness over the duration of the pilot project.

<u>Project Design</u>
Two Work Areas were selected for use in the pilot project, the design of each as outlined below:

Work Area 1

Work Area 1 (dimensions 190 by 110 m) is located in an area characterized by soft surface sediments with water depths ranging from between -4.0 m to -6.0 m Chart Datum (CD; **Figure 3**). The objectives in this Work Area are to:

- Evaluate the performance of ENR (clean sand) and In Situ Amendment (clean sand mixed with siderite) treatment types for remediation of soft surface wood waste-impacted sediments
- To examine the viability of different placement methods on the softer surface sediments in this area.
    - Placed materials in Work Area 1 are more likely to mix with the softer surface sediments, which could make the placement of a well-defined layer of ENR or In Situ Treatment more difficult.

This Work Area contains six Test Areas (each Test Area is 30 m by 30m or 900m^2) spaced 50m apart (**Figure 4**). Five of the Test Areas will have material placed in varying combinations of thickness (0.3 m to 0.6 m) and treatment type (i.e. ENR or In Situ Amendment), while Test Area 6 will serve as a control plot (i.e. no construction impacts; see **Table 1**).

The total construction footprint below the high water mark within Work Area 1 will be 4500 m^2 (5 Test Areas x 900m^2). Further details are provided in Component 1: Construction Activities in **Section 2.1** and **Table 1**.

Work Area 2

Work Area 2 (dimensions 200 m by 110 m) is located in an area characterized by firm surface sediments and high density of coarser wood waste, with water depths ranging from between -4.0 m to -9.0 m CD (**Figure 5**). The objective of this Work Area is to:

- Practice the placement of materials at the start of construction in the Practice Area
- Evaluate the performance of ENR (clean sand) and In Situ Amendment (clean sand mixed with siderite) treatment types for remediation of firm surface wood waste-impacted sediments
- Investigate the effectiveness of rock mounds (6 m diameter) placed over ENR (clean plots) to investigate kelp restoration activities.

This Work Area contains three Test Areas (each Test Area is 30 m by 30 m or 900m^2) spaced 50m apart, and one Practice Area (dimensions 40 m by 110 m or 4,400 m^2; **Figure 5**).

Prior to the placement of treatment materials in any of the Test Areas, the Contractor will conduct a ‘practice placement’ of ENR (clean sand) within the Practice Area. The intent of a ‘practice placement’ is to demonstrate that the Contractor’s means and methods are adequate to meet the Targeted Placement Thickness and Vertical Placement Tolerances required. This placement will occur within 10 m by 10 m practice plots located in the designated Practice Area in Work Area 2, as few times as required to refine the placement technique. As such, the ‘practice placement’ is anticipated to only use a subset of the entire 4,400 m^2 Practice Area; however, to be conservative, the entire Practice Area was included in the calculation of total project footprint.

The placement of two rock mounds will also occur within the Practice Area, overlying two ENR (clean sand) practice plots. Rip rap/boulder will be placed to create two circular Rock Mounds with a maximum center height of 1.5 – 2.0 m and maximum diameter of 6 m. Location of the Rock mounds within the Practice Area will be determined following completion of practice placement work. Two of the Test Areas will have material placed, both with the same thickness (0.3 m) but varying in treatment type (i.e. ENR or In Situ Amendment), while the third Test Area will serve as a control plot (i.e. no construction impacts; see **Table 1**).

The total footprint below the high water mark within Work Area 2 will be 6200 m^2 ((2 Test Areas x 900m^2)+(1 Practice Area x 4,400 m^2)). Further details are provided in Component 1: Construction Activities in **Section 2.1**) and **Table 1**.

The total Project footprint for both Work Areas combined is conservatively estimated to be a 10,700 m^2 of enhanced subtidal marine fish habitat.

Table 1: Summary of Work Area, Treatment Types, Construction footprint, Material Composition and Volumes, and Placement Thickness

Work Area	Treatment Area	Treatment Type	Construction Footprint (m^2)	Material Composition and Volume (m^3)			Total Volume (m^3)	Targeted Placement Thickness (m)
				Type 1: Clean Sand	Type 2: Granular Siderite	Type 3: Rock		
Work Area 1	Test Area 1	In Situ Amendment	900	391	14	-	405	0.3
	Test Area 2	In Situ Amendment	900	391	14	-	405	0.3
	Test Area 3	In Situ Amendment	900	391	14	-	405	0.3
	Test Area 4	ENR	900	405	-	-	405	0.3
	Test Area 5	ENR	900	675	-	-	675	0.6
	Test Area 6	Control	N/A	-	-	-	-	-
	Sub-Total Work Area 1		***4,500***	***2,253***	***42***		***2,295***	***-***
Work Area 2	Test Area 7	In Situ Amendment	900	391	14	-	405	0.3
	Test Area 8	ENR	900	405	-	-	405	0.3
	Test Area 9	Control	-	-	-	-	-	-
	Practice Area	ENR / Rock Mounds	*4,400****	270******	-	38	38	0.3 (clean sand), 1.5 (Rock mound)
	Sub-Total Work Area 2		***6, 200***	***1066***	***14***	***38***	***848***	***-***
Project Total			**10, 700**	**3,319**	**56**	**38**	**3,143**	**-**

*****Only a subset of the entire 4,400 m^2 Practice Area is anticipated to be used in 10 m x 10 m plots; however, to be conservative, the entire Practice Area was included in the calculation of total project footprint.

******270m^3 of sand is estimated as a maximum for Practice Plots.

1.5 Applicability of DND EIA Directive

This Physical Activity does not meet the definition of a project in Section 66 of the *CEAA* 2012 and therefore Section 67/68 is not applicable. However, according to the DND Environmental Impact Assessment Directive a determination on the likelihood of adverse environmental effects is required as an exercise of due diligence before the Physical Activity can proceed.

1.6 DD EED Start Date

Start date of the effects determination process: 2019-04-17

1.7 EIA number

EIA Number: 2019-21-102311

1.8 Provincial and Municipal Government Involvement

N/A

1.9 Other Federal Departments or Third-Party Groups

A Request for Review will be submitted to Fisheries and Oceans Canada (DFO). If DFO determines that the project will cause serious harm to fish or fish habitat, an authorization will be obtained from the Minister of Fisheries, Oceans and the Canadian Coast Guard as per Paragraph 35(2)(b) of the Fisheries Act Regulations.

A Notice of Works, under the *Navigation Protection Act*, will also be submitted to Transport Canada.

1.10 Contacts

1.10.1 Establishment Point of Contact

a) Name: Jennifer Holder, MARPAC ESS

b) E-mail Address: jennifer.holder@forces.gc.ca

1.10.2 Physical Activity Project OPI

a) Name: Mike Waters, MARPAC FSE Environment Officer

b) E-mail Address: Michael.Waters@forces.gc.ca

1.11 Relevant Environmental Legislation

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Project Pilot Project	Approval/Permit OR Requirements Met
Federal			
Canadian Environmental Assessment Act, 2012	Section 67 specifies that Federal Authorities must not make a decision about a proposed "project" on federal lands unless the proposed "project" is determined to be unlikely to cause significant adverse environmental effects, or the Governor in Council decides that those effects are justified. Section 5 provides protections against adverse project effects to 'any structure, site or thing that is of historical, archaeological, paleontological or architectural significance'.	The proposed Project meets the definition of a "project" under the Act, and an Environmental Effects report has been prepared.	No formal approval required. The Environmental Effects Determination indicates that the Project is unlikely to cause significant adverse environmental effects with mitigation measures that have been recommended.
Fisheries Act	Section 35 prohibits causing serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery unless authorized under the Act.	Project involved work in water which has the potential to cause serious harm to fish.	Serious harm to fish is not anticipated for the scope of work as outlined in Anchor 2018. A Request for Review will be submitted by Department of National Defence to Fisheries and Oceans Canada.
	Section 36 prohibits the deposit of a deleterious substance in water frequented by fish.	Project activities require work in and around water that could cause a release of deleterious substances. Placement of siderite (iron carbonate) is not a deleterious substance, as described in the Environmental Effects Determination.	Water quality performance objectives have been developed in the Water Quality Monitoring Plan to help meet the intent of this section. Contractor also to prepare and implement a Spill Prevention and Response Plan, Water Quality Protection Plan and a Sediment and Erosion Control Plan.
	Section 38 specifies a duty to notify and take corrective measures when serious harm to fish or deposit of a deleterious substances occurs, or when there is a serious and imminent danger of such an occurrence	Project involves work in and around water that contains fish and fish habitat.	Reporting requirements are to be considered in the development of the Contractor's communications and spill response plans.
Deposit out of the Normal Course of Events Notification Regulations under the Fisheries Act	The regulations identify the "prescribed person" for notifications under Section 38 of the Fisheries Act	The BC Provincial Emergency Program, now called Emergency Management BC, is the 24-hour emergency telephone service for spill reporting and spill notification to relevant provincial and federal agencies.	Spill reporting requirements are to be considered in the development of the Contractor's spill response plan.

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Project Pilot Project	Approval/Permit OR Requirements Met
Marine Mammal Regulations under the Fisheries Act	Section 7 prohibits the disturbance of marine mammals except when fishing for marine mammals under the authority of these Regulations. Subsections 7(3) to 7(4) of the Marine Mammal Regulations (amended in June 2018) identify the following approach distances for marine mammals: - 100 metres for whale, dolphin and porpoise - 200 metres for killer whale populations in BC and the Pacific Ocean	Marine mammals may occur in and adjacent to the Wood Waste Remediation Project Work Site.	Mitigation measures will be implemented to avoid disturbing marine mammals.
Aquatic Invasive Species RegulationsUnder the Fisheries Act	Prohibitions on import, transport, possession and/or release for species listed in Part 2 of the Schedule in the Regulations.	Vessels used for the Wood Waste Remediation Project project have the potential to unintentionally transport invasive species.	Mitigation measures will be implemented to avoid the introduction of invasive species.
Species at Risk Act (S.C. 2002, c. 29)	The Species at Risk Act contains prohibitions that make it an offence to: - kill, harm, harass, capture, or take an individual of a species listed in Schedule 1 of the Species at Risk Act as endangered, threatened or extirpated; - possess, collect, buy, sell or trade an individual of a species listed in Schedule 1 of the Species at Risk Act as endangered, threatened or extirpated; - damage or destroy the residence (e.g., nest or den) of one or more individuals of a species listed in Schedule 1 of the Species at Risk Act as endangered, threatened or extirpated	Several marine mammal species at risk have some potential to occur in the in-water project areas including harbour porpoise, killer whales, and Steller sea lions. Common Nighthawk, a Species at Risk Act Schedule 1 threatened species, may nest on the gravel at Yew Point.	Mitigation measures will be followed to avoid contravening the Act.
Migratory Birds Convention Act	Section 5.1/ 5.2 prohibits the deposit of a substance that is harmful to migratory birds.	Migratory birds may occur in the Wood Waste Remediation Project Work Site, and deposition of a substance such as fuel may harm migratory birds.	Mitigation measures will be implemented to avoid depositing harmful substances.
Migratory Birds Regulations (pursuant to the Migratory Birds Convention Act)	Section 6 – Prohibits the disturbance, destruction or removal of a nest or related shelter, or egg of a migratory bird, or possession of a live migratory bird, or a carcass, nest or egg of a migratory bird.	No land-based staging areas will be used in Esquimalt Harbour for this project.	General prohibition – no authorization issued.
Navigation Protection Act	Regulates and protects navigable waters in Canada including Esquimalt Harbour. No work will be built or placed in, on, over, under, through or across any navigable water unless approved or exempted under this Act.	Project works meet the assessment criteria for the Minor Works Order and are classified as “designated works” under the Act.	A Notice to the Minister is not required under the Act for works classified as “designated works” as long as all legal requirements are met.

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Project Pilot Project	Approval/Permit OR Requirements Met
Canada Marine Act	The Act establishes the means of management of ports and harbour facilities such as through the establishment of ports and harbour authorities. The Queen's Harbour Master is the designated Authority for Esquimalt Harbour. Esquimalt Harbour Practices and Procedures are made pursuant to the Act. Procedures include marine spill response and reporting.	The Project will be undertaken in Esquimalt Harbour.	Esquimalt Harbour Practices and Procedures shall be followed by all harbour users associated with the Project.
Canada Shipping Act	The Act promotes safety in marine transportation and recreational boating; protects the marine environment from damage due to navigation and shipping activities; prohibits the discharge of pollutants and contains reporting requirements; and prescribes regulations for vessels on or in any Canadian waterway through the "Collision Regulations".	Project involves work in a waterway.	All vessels used by the Contractor will comply with the relevant orders and regulations of the Canada Shipping Act including pollution prevention and reporting.
Transportation of Dangerous Goods Act	Regulates the transport of dangerous goods in Canada, whether by rail, road, air, or water, and establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with prescribed safety marks. The Act also establishes requirements regarding emergency response assistance plans.	Dangerous goods may be transported during this Project.	Hazardous materials associated with the Project will be transported in accordance with this Act.
Provincial			
Environmental Management Act	Prohibition against the introduction of waste into the environment in such a manner or quantity as to cause pollution, unless the introduction of that waste is conducted in accordance with a permit, approval, order, or regulation. The Act also prohibits causing pollution which is defined in the Act as "…the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment."	This general prohibition is addressed by the water quality protection measures developed for the Project as outlined in the Water Quality Monitoring Plan.	No wastes will be introduced into the environment.
Hazardous Waste Regulation (pursuant to Environmental Management Act)	Hazardous wastes are wastes that could harm human health or the environment if not properly handled and disposed of. The Hazardous Waste Regulation includes the identification, handling, transport, disposal and treatment of hazardous wastes.	No hazardous wastes will be generated during this Project.	General provisions – no authorization issued.

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Project Pilot Project	Approval/Permit OR Requirements Met
Contaminated Sites Regulation (pursuant to Environmental Management Act)	The Contaminated Sites Regulation provides a process for identifying and tracking the movement and deposition of soils from contaminated sites. Previously (prior to November 2017), the Contaminated Sites Regulation Schedule 7 was applicable to the assessment of soils/sediments being relocated or disposed on provincial land. The Stage 10 amendments allow use of the soil standards as applicable to the receiving site, in determining when a Contaminated Soil Relocation Agreement might be required to relocate soil to a receiving site. The Contaminated Sites Regulation is also relevant to the characterization, transportation and disposal of the dredged materials to provincial lands.	No dredging or removal of contaminated sediment will occur during this project.	General provisions – no authorization issued.
Spill Reporting Regulation (pursuant to Environmental Management Act)	The regulation defines a "spill" as: (a) an unauthorized release of a listed substance that enters, or is likely to enter a body of water, or (b) the release or discharge of listed substance into the environment in an amount exceeding the listed quantity. The regulation identifies to whom spills are to be reported and the reporting requirements.	Listed substances might be used during the Project. Emergency Program, now called Emergency Management BC is the 24-hour emergency telephone service for notification and follow up reporting.	The requirements of the Regulation are to be considered in the development of a spill response plan.
Wildlife Act	<u>Section 34</u> – A person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys: (c) a bird or its egg (d) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl (e) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg	No nesting is anticipated during this project as the work is all water-based without any staging areas in Esquimalt Harbour.	General prohibition – no authorization issued. Mitigation measures will be followed to avoid contravening the Act.
Transportation of Dangerous Goods Act	Regulates the transport of all dangerous goods in British Columbia on provincial highways and ferry routes. The Act establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with prescribed safety marks.	Dangerous goods may need to be transported for this Project.	General provisions – no authorization issued. Any hazardous materials associated with the Project will require be transported with a manifest.

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Project Pilot Project	Approval/Permit OR Requirements Met
Municipal			
Town of View Royal Bylaw No. 523 (2003)	Outlines noise disturbance in the Town.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
City of Colwood Noise Bylaw, No. 1594 (2016)	Outlines noise disturbance during certain hours and days of the week.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
City of Colwood Traffic and Highway Regulation Bylaw, No. 1134 (2010)	Designates truck routes for heavy trucks (over 8,600 kilograms).	If over-land transportation is undertaken, specific truck routes may need to be used.	A Traffic Management Plan will be prepared by the contractor if over-land transport is undertaken.
Township of Esquimalt Maintenance of Property and Nuisance Regulation Bylaw No. 2826 (2014)	Regulates the maintenance of property, unsightly property, and nuisance, including noise.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
Township of Esquimalt Bylaw No. 2898 (2017)	The Bylaw identifies roads that are not acceptable for trucks over 10,000 kilograms within Esquimalt.	If over-land transportation is undertaken, specific truck routes may need to be used.	A Traffic Management Plan will be prepared by the contractor if over-land transport is undertaken.
Capital Regional District Bylaw No. 2922 (Consolidated) (2016)	Regulate the discharge of waste into sewers connected to a sewage discharge facility operated by the Capital Regional District	Potential for Contractor to want to discharge waste into sewers.	In the event that the Contractor wishes to discharge waste such as barge stormwater, into the Capital Regional District sewer system, the Contractor will apply for permits/authorizations for such a discharge.

Part 2. Environmental Effects Discussion

2.1 Description of Physical Activity Components, Schedule and Site

The Project is comprised of the following components: 1) Construction Activities (placement of material) and 2) Post-Construction Monitoring. Project details are based on 100% design specifications and drawings provided by Anchor QEA. Future design changes, if deemed necessary, may require additional assessment and an amendment to this EED report may be necessary.

Component 1: Construction Activities

Construction is targeted to commence in December 2019, within the DFO least risk winter timing window for Area 19 Victoria (December 1 – February 15). Construction activities will occur over a two-week period and include:

- Mobilization and pre-construction survey
- Placement of the materials within each Work Area and post-construction surveys
    - Placement of materials will occur from a barge located above the Work Area into the Practice Area and each of the Test Areas (**Table 1**)
    - Post-construction surveys will be completed for each Test Area and the Practice Area once placement is complete in that area
    - Placement of materials is anticipated to occur over an eight-day period, with materials being placed at approximately 420 m^3 / day.
- Demobilization

No upland area within Esquimalt Harbour will be used for staging or loading/offloading equipment and material as part of this work. All work activities associated with this project, including temporary construction facilities (i.e., trailer, restrooms), materials and equipment staging will be conducted on the water using barges or other floating platforms or vessels. During the placement of materials into the Work Areas, grounding of barges and equipment will not occur, and reduced power will be used during transport in shallow areas to minimize disturbance to newly placed materials. Barges will spud in place for storage purposes.

In Test Areas where In Situ Amendments (clean sand and granular siderite) are applied, the sand and siderite will be uniformly blended on the barge prior to placement in the marine environment and will be blended by proportioning the fined-grained sand and siderite (5% of Siderite by dry weight).

Prior to the placement of treatment materials in the Test Areas, the Contractor will conduct a ‘practice placement’ of clean sand. The intent of a ‘practice placement’ is to demonstrate that the Contractor’s means and methods are adequate to meet the Targeted Placement Thickness and Vertical Placement Tolerances required. This placement will occur within 10 m by 10 m practice plots located in the designated Practice Area in Work Area 2, and will occur as few times as possible (**Figure 4**). As such, the ‘practice placement’ is anticipated to only use a subset of the entire 4,400 m^2 Practice Area; however, to be conservative, the entire Practice Area was included in the calculation of total project footprint.

Placement of Material in Work Area 2

Following the material placement in the practice area, placement will continue within Work Area 2 in the following order (**Figure 4**):

- Practice Area - ENR Practice Plots and 2 Rock mounds
- Test Area 7 - In Situ Amendment
- Test Area 8 - ENR

All work will be completed in one test area before moving on to the next test area. No placement will occur in Test Area 9 as this is a Control Treatment.

The placement of the two rock mounds will occur within the Practice Area, overlying two ENR (clean sand) practice plots, to create two circular Rock Mounds with a maximum center height of 1.5 – 2.0 m in the center and maximum diameter of 6 m. Location of the Rock mounds within the Practice Area will be determined following completion of Practice Placement work.

Placement of ENR and In Situ Amendment in Test Areas 7 and 8 will occur using any of the acceptable placement methods listed below for Work Area 1 or other methods proposed by the contractor (and accepted by PSPC) as an alternate placement method.

Placement of Material In Work Area 1

Following the placement of material in Work Area 2, placement will occur in the following order within Work Area 1 (**Figure 3**):

- Test Area 1 - In Situ Amendment
- Test Area 2 - In Situ Amendment
- Test Area 3 - In Situ Amendment
- Test Area 4 - ENR
- Test Area 5 - ENR

All work will be completed in one test area before moving on to the next test area. No placement will occur in Test Area 6 as this is a Control Treatment.

One of the purposes of the pilot project is to evaluate the effectiveness of using different placement methods to place material in the Test Areas of Work Area 1, which contains soft bed sediments. The contractor will select two or three different placement methods to use within Work Area 1, for the placement of the In Situ Amendment (clean sand mixed with granular siderite) within Test Areas 1, 2, and 3 as follows:

- Placement method 1: Controlled placement above the water surface
    - The contractor will place the In Situ material from a material barge using a clamshell or re-handling bucket to lay down material over the specified test area. This will occur by cracking the bucket open slightly and swinging the bucket in an arc above the water surface.
    - As long as the placement method meets water quality criteria and other requirements in the Specifications, drop distance above the water surface may vary and is not restricted.

- Placement method 2: Controlled placement above the water surface
    - The contractor will place the In Situ material from a material barge using a high-speed conveyor, skip box, or similar from above the water surface.
    - As long as the placement method meets water quality criteria and other requirements in the Specifications, drop distance may vary and is not restricted.
- Placement method 3: Controlled placement below the water surface
    - The contractor will place the In Situ material from a material barge directly near the sea bed floor using a clamshell bucket (or similar) before releasing
    - The contractor will limit the drop distance from bucket to sea bed bottom (i.e., less than approximately 2-m drop).

The contractor will place ENR materials (clean sand) in Test Areas 4 and 5 using any of the acceptable placement methods listed above or other methods proposed by the contractor (and accepted by the Departmental Representative) as an alternate placement method

Component 2: Post-Construction Monitoring

Following Component 1, post-construction monitoring will be conducted in each Test Area to evaluate effectiveness of ENR (clean sand cover) and In Situ Amendment (clean sand cover amended with siderite) treatment types, in comparison to the control treatments, for remediating wood waste-impacted sediments.

Baseline monitoring will begin immediately following material placement for comparison against monitoring approximately 1 month after construction, and subsequently every 3 months for up to 12 months post construction. Planned monitoring activities will include the following:

- Sediment profile imaging (SPI) – will be conducted immediately following placement to assess the thickness of placed material and identify target monitoring locations. SPI is an underwater technique for photographing the sediment-water interface in order to measure or estimate biological, chemical or physical processes that occur in the top 20 cm. It utilizes a camera on a small platform, lowered to the seafloor, and the camera pushed into the sediment. SPI will be employed at multiple locations within each Test Area and could be employed during later monitoring phases to assess redox potential discontinuity (i.e., thickness of oxidized sediment layer) and benthic colonization.

- Diver surveys – will record bottom conditions along transects in the Test Areas documenting condition of placed sediments, evidence of benthic invertebrates, presence of wood waste, and other conditions that can be visually documented. Surveys will be conducted up to 12 months following construction. Divers may also collect samples of the placed material near the end of the 1-year monitoring period for benthic invertebrate enumeration to assess the rate of recolonization in the cover material.

- Porewater sulphide testing – will be conducted at the locations identified during the original post-construction SPI survey. Divers will deploy diffusive gradients in thin films (DGTs) spears to collect porewater sulphide profiles within the test areas. DGTs will be shipped to the laboratory for analysis immediately following construction and at several monitoring events within 12 months following construction.

- Multi-beam bathymetric surveys – will be conducted twice during the first year within the extent of each Work Area to assess changes to the placement areas from scour, deposition, or settlement over time.

The monitoring plan for the pilot project will be developed during final design. The plan will provide specific information regarding number and locations of diver survey transects and SPI locations. The monitoring plan will also describe sampling and testing means, methods, and quality assurance/quality control procedures.

2.2 Identification of Valued Ecosystem Components (VECs)

Table 2. Environmental Effects Matrix

PHYSICAL ACTIVITY COMPONENTS	VALUED ECOSYSTEM COMPONENTS (VEC)													
	PHYSICAL				BIOLOGICAL				SOCIAL AND CULTURAL					
	Atmosphere	Surface Water	Marine Substrate	Ambient Noise	Marine Vegetation and Fish Habitat	Marine Invertebrates, Fish, and Mammals	Seabirds, shorebirds and Waterfowl	Species at Risk	Commercially, Recreationally, Aboriginally Important (CRA) Fish	Water/Land Use	Recreational Use	Cultural Resources	Aboriginal / Traditional Activities	Health and Safety
1) Construction Activities • Mobilization • Placement of material • Demobilization	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2) Post Construction Monitoring	x	x	x	x		x	x	x			x		x	x

Legend: [*Blank*] = No Effect **|** [X] = Potential Significant Adverse Effect

2.3 Identification of Valued Ecosystem Components

The following Valued Ecosystem Components have been identified for the Project and are evaluated in the following section.

- Physical Components
    - Atmosphere
    - Surface Water
    - Marine Substrate
    - Ambient Noise
- Biological Components
    - Marine Vegetation and Fish Habitat
    - Marine Invertebrates, Fish, and Mammals
    - Seabirds, Shorebirds, and Waterfowl
    - Marine Species at Risk
- Social and Cultural Components
    - Commercially, Recreationally, and Aboriginally (CRA) Important Fish
    - Water/Land Use
    - Recreational Use
    - Cultural Resources
    - Aboriginal/Traditional Activities
    - Health and Safety

General Description

Esquimalt Harbour is located along the southeastern end of Vancouver Island, off the Strait of Juan de Fuca and comprises several smaller bays and coves with many small rocky islets (**Figure 1**). In its entirety, the harbour encompasses approximately 354 hectares (50 hectares of intertidal area and 304 hectares of subtidal area) and 20 kilometres of shoreline (excluding islands), with the federal Department of National Defence (DND) portion of the harbour encompasses an area of 343 hectares.

Esquimalt Harbour and the surrounding area has been heavily industrialized since 1848 with a long history of sawmilling and ship building and repairing activities. Historically, a number of industries have operated within the harbour and reportedly discharged wastes into Esquimalt Harbour. These industries include a saw and grist mill, carpenter shop, blacksmith shop, slaughterhouse, flour mill, ship building, and repair of non-naval vessels (Golder 2006). Leaseholds within the harbour used for log booming have resulted in a large amount of wood debris being deposited on the harbour floor along with other contaminants resulting from infilling of the foreshore and historic operations and infrastructure within upland properties. While many contaminants have been studied extensively in the harbour, the assessment of wood waste and its associated physical impacts have not been examined historically. Based on the review in Hemmera 2018, the last observable date for log booming was in 1997, and the sources of wood waste to sediment have been controlled since that time.

Within Esquimalt Harbour, the shorelines are mixed between natural and anthropogenic conditions. The natural shoreline, ranges from sand and gravel beaches to rocky shores, which has largely been maintained along the west and northeast sides of the harbour. Shoreline in the southwest and much in the southeast has been altered by dredging, infilling, and hardening to support industrial and naval activities (i.e. Esquimalt Graving Dock, Canadian Forces Base Esquimalt, and the Canadian Forces Sailing Association). The Harbour is relatively quiescent, with semi-protected to protected shoreline exposure (i.e. relative exposure to the elements, primarily waves) classification. The harbour is not influenced by strong tidal currents to the same extent as Victoria Harbour or Gorge Waterway; therefore, the shoreline along the harbour is classified as semi-protected to protected and experiences very low tidal currents (0.001 to 0.045 metres per second). However, Paddy Passage and the channel between Smart and McCarthy islands are subject to stronger currents due to their narrow nature.

The harbour is relatively shallow, ranging from 5 to 12 m CD in depth within the limits of the harbour, and a maximum depth of 16 m CD at the harbour entrance. The dominant subtidal substrate type within the harbour has been classified as 87% granular materials (gravel, sand, and mud) with a few subtidal bedrock outcrops. Sediment in the upper or northern portion of the harbour and around Plumper Bay is mainly silt, with large areas of organic cover, while the southern areas have higher proportions of sand.

Further details outlining the physical, biological and social VEC components of the Project are provided below.

2.3.1 Physical Components

i) Atmosphere

The climate in the Project area is characterized by mild, damp winters, and warm, dry summers. The mean annual temperature ranges from 9.2^{oC} to 10.5^{oC}. Mean annual precipitation varies from 647 to 1263 mm with very little falling as snow in winter.

The proposed Project location is situated near the existing CFB Esquimalt, and Esquimalt Graving Dock, both large scale industrial operations and contributors to the ambient atmospheric conditions at the site.

ii) Surface Water

There are a number of natural and engineered freshwater inputs into the harbour. Millstream Creek flows into the head of the harbour, draining a watershed of approximately 2,800 hectares (including a storm drain network), with a stream length of approximately 17 kilometres terminating in a large intertidal mudflat (extending as far out as Cole Island during some low tides). Flooding and erosion of the lower Millstream Creek watershed streambanks can deliver large quantities of fines to the harbour. A small, mapped watercourse commonly named Joe Creek flows from the Juan de Fuca golf course approximately 886 m northwest, through CFB Esquimalt Property Colwood before discharging into the harbour. Joe Creek provides poor quality fish habitat due to barriers, poor water quality, and poor riparian cover throughout the watercourse (D.R. Clough Consulting 2016). The watercourse likely provides drainage to the golf course and surface drainage to nearby properties. Additionally, an unidentified stream (approximately 1 km long) is present in the View Royal area, at the north end of the harbour, outside of the federal harbour limit, that discharges the Price Creek Watershed. In addition, 97 stormwater drains discharge directly into the harbour (CRD 2016).

iii) Marine Substrate

Water quality near the sediment water interface in northern Esquimalt Harbour had dissolved oxygen and pH characterized as being moderate (DO % mean = 78.9, SD = 6.8; pH mean = 7.9, SD = 0.08).

<u>Work Area 1</u>

Work Area 1 is located in WWMA-1 Esquimalt Harbour North (**Figure 2** and **Figure 3**). This WWMA covers an area of 176,000 m^2 with water depths ranging from 1.0 to -6.0 m CD (Anchor QEA 2019). Sediment in this area has previously been characterized as mud/sand, this area has been reported to contain a very soft layer of fine-grained, flocculent suspended sediments that appears to have a high fraction of organics and accumulates just above the more competent sediment surface (Anchor QEA 2019). This sediment was hard to sample using traditional sediment sampling equipment, but was noted by divers during SCUBA assessments as a layer similar to fluidized mud. No evidence of vessel scour; area considered low potential for propwash in the Esquimalt Harbour Natural Recovery Analysis (Anchor QEA 2018).

Surficial wood waste cover of >10% occurs across 65,000 m^2 of WWMA-1 but occurs up to 100% coverage at two survey locations. WWMA-1 is generally characterized by relatively thin deposits of wood waste (average thickness is 0.4 m, up to 0.6 m) compared to other WWMAs, with an area of 106,000 m2 containing >0.2 m thick wood waste deposits. The historical source of wood waste in this area is log rafting, with wood fragments and bark primarily present and sunken logs scattered throughout the WWMA (Anchor QEA 2019).

WWMA-1 has a TOC concentration up to 12%, with an average of 6%, and higher levels of porewater sulphides compared with other WWMAs (Seasonal sulphide concentrations exceeding 10 mg/L in the entire WWMA with more than half of the samples exceeding 50 mg/L). Impairments to benthic communities have been documented at TOC levels as low as 1 – 3%. The area is documented as having low impacts from non-wood-related contaminants, with no chemical contaminants exceed 6x Probable Effects Level (PEL) and only cadmium exceeding 1x PEL (Anchor QEA 2019).

The presence of Beggiatoa spp., multicellular filamentous chemosynthetic bacteria that oxidize sulphides, are an indicator of organic enrichment (i.e. TOC) from anthropogenic activities such as aquaculture or wood-processing and form dense white bacterial mats in some areas. While the detection of the bacteria presence can be seasonal (fewer areas with white bacterial mats were observed during surveys conducted in winter months, likely due to increased levels of oxygen at the SWI, or the first few centimeters of the sediment, allowing for the bacteria to migrate into the sediment with the change in the oxygen-sulphide transition); however, *Beggiatoa* spp. mats from 50% to 96% coverage have been observed in the southern portion of this WWMA and none in the northern portion.

Work Area 2

Work Area 2 is located within WWMA-4 Inskip Island West, which is situated adjacent to the north side of Inskip Island (**Figure 2** and **Figure 3**). The WWMA is 136,000 m^2 with water depth ranging from high water down to -11 m CD (Anchor QEA 2019). Sediment in this area has previously been characterized as mud/sand; however, no layer of soft fine-grained, flocculent sediment with high organics was observed (Anchor QEA 2019). The area is considered medium potential for propwash in the Esquimalt Harbour Natural Recovery Analysis (Anchor QEA 2018).

Surficial wood waste of >10% cover occurs across approximately 111,000 m2 of the area but occurs up to 100% surface cover at four survey locations (out of 57 survey points).

Relatively thick deposits of wood waste impacted sediment are found within this WWMA, (average thickness of 0.7 m, up to 2.0 m) and a high density of sunken logs are present. Historical sources of wood waste are from log rafting, with bark and wood fragments primarily observed.

Only one TOC sample was taken from this area, measuring 16%. Seasonal sulphide concentrations are high but slightly lower than WWMAs 1 through 3 with values up to 37 mg/L and 18 percent exceeding 30 mg/L. Low impacts from non-wood related contaminants; no chemical contaminants exceed 6x PEL, only dioxins/furans exceed 1x PEL.

While the detection of *Beggiatoa* spp. mats presence can be impacted by seasonal conditions, they have been observed for much of this WWMA, ranging from 13% to 100% coverage.

v) Ambient Noise

The Project is located nearby CFB Esquimalt operational activities along the west shore of Esquimalt Harbour, currently inaccessible to the general public. Operation of heavy machinery and general harbour operations in Constance Cove, due to on-going works at CFB Esquimalt, contributes to ambient noise conditions in the area. Based on imagery from Google Earth, no residents are located within at least 200m of Work Area 1 and 400 m of Work Area 2.

2.3.2 Biological Components

Recent biophysical desktop and field survey assessments were conducted by Hemmera (Hemmera 2018; **Appendix E: Department of National Defence Esquimalt Harbour Wood Waste Assessment, Characterization and Management Plan**) to assess the extent and impacts of wood waste on the benthic communities in Esquimalt Harbour. A summary of both the desktop and field survey results pertinent to the Project Work Areas are broken down by VEC sub-sections below.

The desktop review is consistent with guidance from Breems and Goodman (2009) around information required to assess impacts from wood waste and includes both current and historical data within the harbour. Sources of information reviewed include:

- Duffus, H.J, J.W. Madill, W.t. MacFarlane, and P.J. Schurer. 1978. First Report on Bottom Studies of Esquimalt Harbour. Royal Roads Military College, Coastal Marine Science Laboratory Manuscript Report No 78-3. 23pp.
- Schurer, P.J., W.T. MacFarlane, and H.J. Duffus. 1979. Sub-bottom Survey of Harbours Near Victoria, B.C. 17pp
- Bright. 1995. An Environmental Survey of Esquimalt Harbour: Part I. Historical Inputs, Marine Sediment Contamination, and Biological Uptake. Report prepared for the Director General Environment, Department of National Defence by the Environmental Sciences Group, Royal Roads Military College.
- Hemmera. 2004. Victoria & Esquimalt Harbours Environmental Baseline Study. Volume 18 (Addendum#3) Lot A. Lot 18. Prepared for Transport Canada, Victoria & Esquimalt Harbours Environmental Program.
- Archipelago. 2004. Subtidal survey of Physical and Biological Features of Esquimalt Harbour. Prepared for Transport Canada, Victoria and Esquimalt Harbours Environmental Program.
- SLR Consulting Ltd. 2016. Detailed Quantitative Ecological Risk Assessment to Support Environmental Risk Management, Esquimalt Harbour, BC, Esquimalt Harbour Remediation Project (EHRP), Draft #3.

The following databases and information systems were also used:

- Capital Regional District online mapping application (CRD Atlas) and harbours information website;
- Ecosystems of British Columbia;
- Sensitive Habitat Inventory and Mapping (SHIM);
- iMapBC;
- BC Coastal Resource Information Management System (CRIMS database);
- British Columbia Marine Conservation Analysis (BCMCA);
- BC Conservation Data Centre (CDC) Species and Ecosystem Explorer;
- DFO Aquatic Species at Risk Map;
- North Coast Watershed Atlas (NCWA), Community Mapping Network; and
- Pacific Coastal Resources Atlas (PCRA), Community Mapping Network.

Biological field survey assessments were conducted by SUBA biophysical transect surveys, and benthic infauna sampling (Hemmera 2018; refer to **Appendix E** for further methodology). Survey and sample design were chosen to safely assess areas of wood waste deposits (initially delineated using the side scan sonar results), transition zones, and areas without wood waste within the Harbour. Over the course of three field surveys, a total of fifty-two 100 m long transects were surveyed by SCUBA (**Figure 6**):

- Field Survey 1: September 19 - 23, 2016
- Field Survey 2: October 19 - 21, 2016
- Field Survey 4: January 23 - 25, 2017

i) Marine Vegetation and Fish Habitat

Desktop Review

The Project Work Areas are located in marine subtidal areas and do not contain any upland riparian or intertidal habitat.

Within the Project Work Areas, fish habitat was identified to consist of fine mud-sand flats as described in **Section 2.3.1**, iii) Marine Substrate above (Archipelago 2004).

In general, vegetative cover has not been previously found on mud-sand sediments in the Project Work Areas (Archipelago 2004). In the areas of >30% wood waste (% organic cover) vegetation was primarily sparse to negligible. In 2004, native eelgrass (*Zostera marina*) was present in some nearshore areas of the Harbour; however, dredging, infilling, and wood waste may have impacted the distribution, and the bathymetry of the Project Work Areas is deeper than the abiotic requirements of eelgrass in Esquimalt Harbour (+0.5 to -0.9 m CD; Archipelago 2004).

Field Assessment

Field surveys confirmed that within the Project Work Areas, fish habitat consists of fine mud-sand flats, with areas of surficial wood waste as described in Section 2.3.1, iii) Marine Substrate above (**Photo 1** and **Photo 2**; Hemmera 2018).

White bacterial mats (e.g. *Beggiatoa spp.*) are common throughout the inner harbour area (**Photo 1**), while diatomaceous mats are more common in the mid- to outer harbour area. The two are inversely distributed, and overlap is rare. Fewer areas with white bacterial mats were observed during surveys conducted in winter months, likely due to increased levels of oxygen at the SWI, or the first few centimeters of the sediment, allowing for the bacteria to migrate into the sediment with the change in the oxygen-sulphide transition.

Similar to Archipelago (2004), the field assessment verified that attached or rooted marine vegetation was sparse to absent in the Project Work Areas and, where present, consisted solely of drift senescent understory kelps (e.g. *Saccharina latissima* and *S. groenlandica*). Although eelgrass (*Zostera marina*) beds have been previously noted to occur in the Harbour (Archipelago 2004), known locations are >300 m from the Project Work Areas and no eelgrass was observed during field assessments in the Project Work Areas.

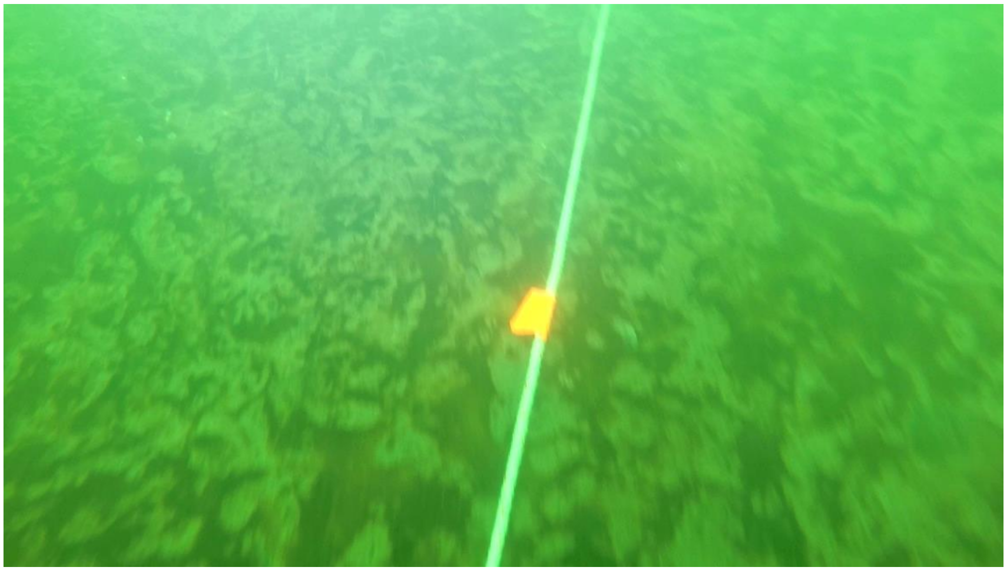

Photo 1 Representative view of Work Area 1 in northern Esquimalt Harbour with fine wood fibres intermixed with silt and *Beggiatoa* spp. bacterial mat

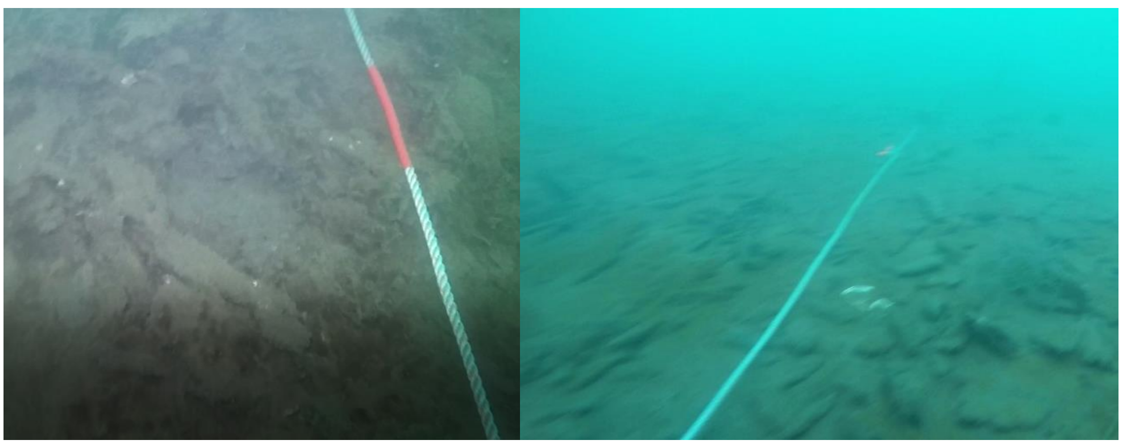

Photo 2 Representative view of Work Area 2 in northern Esquimalt Harbour with bark wood debris covered with a thin layer of fine silt

ii) Marine Invertebrates, Fish, and Mammals

<u>Desktop Review</u>

Both Dungeness (*Metacarcinus magister*) and graceful crabs (*Cancer gracilis*) were observed throughout the subtidal habitats of the northern Harbour on mud-sand and gravelly mud - sand substrates. Plumose anemones were frequently attached to logs and larger pieces of wood debris with crabs relatively abundant (Archipelago 2004). Additionally, Archipelago (2004) documented patchy occurrences of infaunal burrows in areas outside of known wood waste deposits and an absence of holes and mounds in wood waste areas.

As with larger invertebrate macrofauna, fish that have been previously identified in the subtidal environment throughout the Harbour varied in their distributions by habitat type. In 2004, flatfish were the most commonly identified fish species off Inskip Islands (Archipelago 2004). Other fish such as perch and rockfish were associated mainly with the kelp beds in rocky areas adjacent to the islands, outside of the Project Work Areas (Archipelago 2004). North of Cole Island, Millstream Creek is recognized as coho spawning habitat (SHIM Atlas 2016). Other fish species in the stream include: brown bullhead (Ameiurus nebulosus), cutthroat trout (*Oncorhynchus clarkii)*, prickly sculpin (*Cottus asper*), pumpkinseed (*Lepomis gibbosus*), smallmouth bass (*Micropterus dolomieu*) and threespine stickleback (*Gasterosteus aculeatus*).

Marine mammals including Steller sea lion (*Eumetopias jubatus*) and harbour seal (*Phoca vitulina*) have been observed within Esquimalt harbour, but the Project area does not provide any important habitat for any species of marine mammal (Archipelago 2004, Hemmera 2018).

Field Assessment

Epibenthic Community

The epibenthic community in the Project Work Areas within northern Esquimalt Harbour has been documented as relatively sparse, with several common soft bottom species observed throughout survey areas, such as: Dungeness crabs (*Metacarcinus magister*), graceful crab (*Metacarcinus gracilis*), shrimp (*Pandalus spp*.), and hermit crabs (*Pagurus spp*.). White bacterial mats (e.g. *Beggiatoa spp.*) appear common (**Photo 1**) and inversely distributed with diatomaceous mats, which were more common in the mid- to outer Harbour area. Within the Project Work Areas scattered exposed logs were partially colonized by typical encrusting and hard substrate organisms, such as plumose anemones (*Metridium senile)*, hydroids (Phylum Cnidaria, Class Hydrozoa) and tunicates (subphylum Tunicata; **Photo 3**).

Photo 3 Representative view of a subtidal area in northern Esquimalt Harbour with *Beggiatoa* spp overlying fine sediments, and a scattered log providing hard substrate for colonization by plumose anemones

Infauna Observations

Infauna holes and mounds, generally indicative of burrowing shrimps, worms and bivalves, were relatively absent from most transects within the Project Work Areas. Occasionally *Macoma* sp. clams and mud bay shrimp were encountered during sediment sampling efforts.

Benthic infauna data was collected during field surveys in 2018 from fourteen paired benthic invertebrate sample locations within Esquimalt Harbour and summarized to examine variation among sample locations (Hemmera 2018). Both abundance, diversity, and composition varied across sample locations. Most stations dominated by a single second-order opportunistic polychaete species (*Armandia brevis*) and two other second-order opportunistic species dominating at the remaining stations (*Prionospio **(**Minuspio**)** lighti* and *Aphelochaeta glandaria* complex. The stations closest to Work Area 1 and 2 were both dominated by *Armandia brevis* and *Prionospio **(**Minuspio**)** lighti*, species known to dominate in polluted or degraded habitats, such as log handling facilities, and indicators of elevated levels of TOC. Sample locations furthest from the Project Work Areas (i.e. sample locations closer to the mouth of the harbour and furthest inside the harbour) had higher diversity metrics.

iii) Seabirds, Shorebirds, and Waterfowl

Desktop Review

North of Cole Island at the head of the Harbour is an area of shallow water and mudflats at the mouth of Millstream Creek. This habitat is used by many marine bird species, such as gulls and ducks, for foraging but is located >600 m from Work Area 1.

Esquimalt Lagoon, located near the mouth of Esquimalt Harbour, is considered an important over-wintering ground and feeding area for several bird species (CRD 2016). Again, this area falls well outside of the Project Work Area.

Species previously documented as frequenting Esquimalt Harbour include gulls and terns, swans, geese and dabbling ducks, diving ducks, mergansers and coots, loons and grebes, cormorants, shorebirds and alcids (CRD 2016) In general, many species are migratory, and migratory bird species occur in the highest numbers from August 15 through May 15 (CRD 2016).

Since the Project Work Areas are entirely subtidal, without shallow marine vegetation, they do not offer suitable foraging habitat for the majority of marine bird species that could occur at the Work Areas. However, marine bird species such as Glaucous-winged gulls or cormorant species could occur incidentally within the marine waters overlying the Work Areas.

iv) Marine Species at Risk

A search of the BC CDC *Species and Ecosystems Explorer* and the DFO Aquatic Species at Risk Map showed that there are 13 provincially and/or federally listed marine species or sub-populations that may potentially occur in the Project Work Areas (**Table 3**). However, no critical habitat is designated within the Project Work Areas.

Transient killer whales (*Orcinus orca*), harbour porpoises (*Phocena phocena*), and Steller sea lions (*Eumetopias jubatus)* have also been observed within the Harbour (Mike Waters, Pers. Comm.).

Northern abalone (*Haliotis kamchatcana*) have previously been observed along rocky nearshore habitat of Constance Cove near the C-Jetty work zone within Esquimalt Harbour (Balanced Environmental 2012), along with Duntz Head and ML Floats (Mike Waters, Pers. Comm.). However, no suitable abalone habitat occurrs within the Project Work Areas (e.g., hard rocky substrate, pink encrusting coralline algae, abundant kelp [Lessard and Campbell 2018]), as the harbour seafloor in the Work Areas is comprised of soft sediments.

Table 3. Marine Species at Risk with the Potential to Occur within the Project Work Areas

Listed Species Name	COSEWIC Status	SARA Status	Habitat and Range Description	Likelihood of Occurrence within Project Work Areas
Steller sea lion (*Eumetopias jubatus*)	Special Concern	Schedule 1-Special Concern	Marine habitats include coastal waters near shore and over the continental slope; sometimes rivers are ascended in pursuit of prey. When not on land, the sea lions may congregate at nearshore traditional rafting sites, or move out to the edge of the continental shelf	Steller sea lions have been observed in the Harbour; however, the Project Area is not considered important habitat for the Steller sea lion
Harbour porpoise (*Phocoena phocoena*)	Special Concern	Schedule 1-Special Concern	Coastal waters and adjacent offshore shallows and also inhabits inshore areas such as bays, channels, and rivers. Mothers and young tend to move into sheltered coves and similar sites soon after parturition.	The Project Area is not considered primary habitat for this porpoise but may occur in areas adjacent to the Project area (this species has not been observed in the Project Area during surveys).
Killer whale (NE Pacific Southern resident population) *(Orcinus orca)*	Endangered	Schedule 1-Endangered	The range during spring, summer, and fall includes the waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Little is known about winter movements and range.	The Project Area is not considered primary habitat for killer whales, which are found more frequently in the nearshore waters of Juan de Fuca; however, they are not known to frequent the active harbours of Esquimalt and Victoria. It is considered unlikely that killer whales would enter within or adjacent to the Project Area.
Killer whale (West Coast transient [Bigg's] population) *(Orcinus orca)*	Threatened	Schedule 1-Threatened		
Northern abalone (*Haliotis kamtschatkana)*	Threatened	Schedule 1-Threatened	Found near kelp beds in the shallow subtidal and lower intertidal zones on hard substrates. Prefers areas with high wave action and currents.	No known occurrences within Project area, have been observed in Constance Cove on harder substrates. Low wave action and currents, and lack of hard substrate means occurrence within the Project area is highly unlikely.
Olympia Oyster (*Ostrea conchaphila*)	Special Concern	Schedule 1-Special Concern	Mainly found in the lower intertidal and shallow subtidal of saltwater lagoons/ estuaries. Also found on tidal flats/channels, bays/sounds, or attached to pilings or the undersides of floats. On the outer coast, this oyster species is only found in protected locations. Within suitable habitat, Olympia oysters need hard substrate for settlement.	No known occurrences of Olympia oysters within Project Area. Lack of hard substrate means occurrence of abalone within the Project area is highly unlikely.

Listed Species Name	COSEWIC Status	SARA Status	Habitat and Range Description	Likelihood of Occurrence within Project Work Areas
Yelloweye Rockfish (*Sebastes ruberrimus*)	Special Concern	Schedule 1- Special Concern	Occur in rocky reefs and boulder fields to depths of 600 m, with younger individuals found in shallower regions. Little is known about fine scale movements and distribution.	The Project Area is not considered primary habitat for yelloweye rockfish as they prefer complex habitats with rocky substrates. Juvenile rockfish sp. were occasionally observed in northern Esquimalt harbour during field surveys, solely around colonized hard substrate structures such as logs.
Tope Shark (*Galeorhinus galeus*)	Special Concern	Schedule 1- Special Concern	Mainly demersal on continental and insular shelves, but also on the upper slopes. In BC, observed most on the west coast of Vancouver Island. Occasionally found in pelagic, open ocean ecosystems.	No known occurrences within the Project Area. Unlikely to occur, as tope shark prefer demersal offshore habitats.
Bluntnose Sixgill Shark (*Hexanchus griseus*)	Special Concern	Schedule 1- Special Concern	Wide but patchy distribution in deep, cool waters along the continental slope and Strait of Georgia, down to 2000 m. Diurnal migrations take them to shallower waters at night.	Although possible, the bluntnose sixgill shark is considered highly unlikely to occur in the Project Area, as it prefers deeper, colder waters.
Humpback Whale (*Megaptera novaeangliae*)	Special Concern	Schedule 1- Special Concern	Migrate north from Hawaii or Baja, Mexico in the spring to forage on small pelagic fishes, primarily off the west coast of Vancouver Island. Occasionally seen in the Strait of Georgia.	The Project Area is not considered primary habitat for humpback whales, though they may be found in adjacent habitats, particularly further offshore.
Grey Whale (*Eschrichtius robustus*)	Special Concern	Schedule 1- Special Concern	Occur throughout the coastal waters of the Pacific. Depending on the population, grey whales migrate through or remain in BC waters in the summer, feeding on benthic invertebrates in sandy bays. Mainly found along the west coast of Vancouver Island, particularly during southward migrations.	The Project Area is not considered primary habitat for grey whales, though they may be found in adjacent habitats, particularly further offshore.
Basking shark (*Cetorhinus maximus*)	Endangered	Schedule 1- Endangered	Found along temperate coasts and open ocean environments although they are extremely rare in BC due to directed eradication in the 1960s. Early signs of population recovery in Puget Sound.	No known occurrences of basking sharks in the Project Area and due to their diminished population, it is considered highly unlikely that they would occur near the Project.

Listed Species Name	COSEWIC Status	SARA Status	Habitat and Range Description	Likelihood of Occurrence within Project Work Areas
Leatherback Sea Turtle (*Dermochelys coriacea*)	Endangered	Schedule 1- Endangered	Open ocean, often near edge of continental shelf; also seas, gulfs, bays, and estuaries. Mainly pelagic, foraging in temperate waters. Seldom approaching land except for nesting in tropical locations	Adult leatherback sea turtles have been seen foraging off the coast of BC between July and September and are sometimes seen in inshore waters. No known occurrences within the Project Work Areas. Potential to occur is low

* Red - Extirpated, Endangered, or Threatened, Blue – Special Concern, Yellow - apparently secure and not at risk of extinction

2.3.3 Social and Cultural Components

i) Commercial, Recreational, Aboriginal Fisheries

Esquimalt Harbour is located within DFO Fisheries Management Subarea 19-2. As a precautionary measure, DFO closed Esquimalt Harbour (Subarea 19-2) in 2016 to all fishing, including commercial, recreational, and Aboriginal fisheries, due to a fuel spill in Plumper Bay. According to the QHM, commercial crab fishery activities occurred in Esquimalt Harbour in 2016 prior to the closure by an estimated six or fewer harvesters (Golder 2018). Typically, commercial crab is harvested over approximately two months at the start of the DFO-regulated opening in mid-June. Esquimalt Harbour

has also been closed to all bivalve shellfish harvest due to marine biotoxin and this closure remains in effect (DFO 2018a). If the DFO 2016 fishery closure is lifted, the bivalve shellfish consumption advisory would remain in place for Esquimalt Harbour as would a seafood consumption advisory (DFO 2018b). The seafood consumption advisory provides the recommended maximum weekly intake, in accordance with Health Canada (HC) recommendations for adults and toddlers, of Dungeness crab hepatopancreas and muscle, red rock crab hepatopancreas and muscle, sea urchin roe, and rockfish muscle (DFO 2018b).

In the event that DFO lifts the fishing closures in Esquimalt Harbour, as per the Esquimalt Harbour Practices and Procedures, fishing or crabbing in Esquimalt Harbour requires pre-authorized approval of a harbour official (Royal Canadian Navy 2017). As per the Esquimalt Harbour Practices and Procedures, fishing and crabbing is prohibited in the entrance to Esquimalt Harbour, and in the area east of McCarthy Island (Royal Canadian Navy 2017). Fishing and crabbing are to be conducted only in areas that minimize impact on marine traffic, harbour use, and in accordance with DFO licensing requirements (Royal Canadian Navy 2017).

Recreationally, finfish and crab fishing was documented as occurring within Esquimalt Harbour in 2006; however, this was mostly near the mouth of the harbour, well outside of the Project Work Areas (Golder 2006).

Before the harbour was industrialized, Indigenous groups harvested large numbers of herring. Cumulative herring spawn habitat index (SHI) data from Fisheries and oceans Canada based on spawn records from 1928-2009 classifies Esquimalt harbour as minor (lowest 25%) to low (next 25%), and herring spawning habitat falls outside of the Project Work Areas (BCMA: Marine Atlas of Pacific Canada).

Under the Douglas Treaty, the Esquimalt and Songhees Nations have fishing and hunting rights, which are practiced in Esquimalt Harbour. In meetings with DND, First Nations representatives have indicated that they have ongoing subsistence and cultural uses in the harbour. Both the Esquimalt and Songhees Nations assert Aboriginal rights and interests within the harbour area.

ii) Water/Land Use

The marine waters within the two Work Areas are outside of areas of regular CFB Esquimalt use; however, these waters are intermittently used for vessel movement and mooring. The Jones Marine Lease Area is adjacent to (west of) Work Area 2 and previlusly used intermittently for log booming/storage activities. However, limited use of this facility is expected during Component 1 and Component 2 activities.

There is no upland portion of this project for land use.

iii) Recreational Use

No national or provincial parks are located adjacent to the Project Work Areas, but there are a number of waterfront parks in Esquimalt Harbour, including two National Historic Sites. Fort Rodd Hill and Fisgard Lighthouse National Historic Site is located on the west side of the entrance to the harbour. Another National Historic Site, Cole Island, is located at the north end of the harbour, approximately 500 m from Work Area 1. Both sites are open to the public for day use recreation.

In addition to recreational fish and seafood harvesting, other water-based recreation in Esquimalt Harbour includes recreational boating, kayaking, and shoreline usage. Pleasure crafts use the harbour year-round (Golder 2018). Ships at anchor must register with QHM Operations and cannot remain at anchor for longer than 2 weeks, there are also strict rules for anchoring and a number of sections in the harbour are off limits. The Canadian Forces Sailing Association is located near Constance Cove within the harbour.

The work will not impede recreational or cultural use of the harbour.

iv) Cultural Resources

The Project falls within the traditional territories of the Songhees and Esquimalt Nations, and the Esquimalt and Songhees First Nations reserves are located to the north of the Esquimalt Graving Dock (EGD). DND has previously completed archaeological overview assessments of proposed remediation areas in Esquimalt Harbour (Golder 2015, 2016a, 2017). From these, no heritage resources, including archaeological sites or areas of archaeological potential, have been identified in the Project Work Areas. The nearest known archaeological site is located >50 m from Work Area 2; however, no ground disturbance is anticipated as part of Project activities.

Information on Indigenous Engagement can be found below in **Section 2.5**.

v) Aboriginal/Traditional Activities

The Project falls within the traditional territories of the Songhees and Esquimalt Nations, and the Esquimalt and Songhees First Nations reserves are located to the north of the Esquimalt Graving Dock (EGD). Work Area 2 is located within the Songhees and Esquimalt First Nations jointly held waterlot lease with DND.

Use of Esquimalt Harbour for the exercise of treaty rights or for other traditional purposes by the Esquimalt Nation and Songhees Nation has decreased since approximately 1960. Current use is related to non-harvesting activities; however, the Esquimalt Nation and Songhees Nation have indicated to DND that this current use does not reflect their past use or desired future use of the harbour for their “food basket,” made up in part by seafood (i.e., ling cod, rockfish or rock cod, clams, mussels, sea urchin, crab, shrimp, and prawns), as well as waterfowl such as ducks and geese.

Information on Indigenous Engagement can be found below in **Section 2.5**.

2.4 Physical Activity Effects and Associated Mitigation Measures

The potential Project-related effects on each of the Valued Ecosystem Components, along with relevant avoidance and mitigation measures are outlined in **Table 4** below. Prior to the commencement of the Project, the Contractor will retain a QP to prepare an EPP that demonstrates how they will satisfy the environmental requirements (mitigation measures and monitoring requirements). The EPP will include the following information:

- Organization chart and names of persons responsible for EPP implementation and compliance
- Training requirements
- Site and activity-specific measures that will be implemented, equipment that will be used, and maintenance that will be undertaken
- Contingency procedures in the event that environmental protection goals are not being met
- Drawings, for example, showing work and storage areas

The EPP will include, at a minimum, procedures for the following:

- Dust and emissions control Plan
- Water quality protection Plan
- Spill prevention and response Plan
- Silt curtain control Plan
- Sediment and erosion control Plan
- Non-hazardous waste storage and disposal
- Monitoring for presence of herring and marine mammals a as well as triggers for modifying work
- Archaeological chance find management

The EPP will be part of submissions by the contractor and will be reviewed by DND/PWGSC and must be accepted prior to construction.

Table 4: Potential effects of the Project on each Valued Ecosystem Component (VEC) with avoidance and mitigation measures

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?
Atmosphere	1) Construction Activities • Use of Industrial Equipment • Stockpiled materials on barge	Air quality will be negatively affected due to the use of construction equipment. Exhaust generated may present a health risk to workers or other people in the immediate area. Dust may be generated by stockpiled materials.	1) A Dust and Emissions Control Plan will be developed by the Contractor's Environmental Specialist and implemented by the Contractor. • Plans will assign implementation and monitoring roles • On-site personnel will review the plans, understand their roles and responsibilities, and be properly trained and equipped to implement the plan. • Plan will include specific measures that will be undertaken to meet prohibitions outlined within relevant municipal bylaws and exposure limits outlined within the Occupational Health and Safety Regulation. 2) DND OPI is responsible for coordinating notification of the affected community of the nature and likely duration of forthcoming project activities that may temporarily degrade local atmospheric conditions. Coordinate notification to individuals and/or organizations/municipalities outside the Department through Base Public Affairs. 3) Vessels and equipment will be well maintained and in good working order. 4) Work will be scheduled to avoid periods of extremely dry or windy conditions. 5) Airborne dust conditions will be monitored daily and additional housekeeping and dust suppression techniques will be employed as required. • Workers nearby will be notified of the potential reduction in air quality. 6) Good housekeeping and dust suppression techniques will be employed to reduce airborne dust and prevent off-site migration. 7) As appropriate, additional dust control measures will be implemented as necessary • All materials will be covered during transport to and from the Site. Dust-producing materials with be covered with 6 mil polyethylene sheeting (at a minimum) • The use of water as a dust suppressant may also be employed 9) Efforts will be made to minimize exhaust emissions: • Vessels, equipment and machinery used on Site will be in good working order and comply with applicable air quality standards. • Equipment and machinery producing excessive exhaust will be replaced or repaired. • The contractor will use clean alternative fuels for vessels and equipment wherever possible. • Idling of vessels, equipment and machinery will be minimized, and turned off when not in use. • Stationary emission sources (such as portable diesel generators, compressors, etc) will only be used if there is not another alternative, and will be turned off when not in use • Equipment and machinery will be operated at optimum rated loads	No
Surface Water	1) Construction Activities • Material Placement	Placement of clean sand material and siderite for remediation and enhancement of degraded marine substrates may temporarily increase turbidity within the vicinity of the Project.	1) Water Quality Protection Plan will be developed by a Qualified Environmental Professional and implemented by the Contractor. • Plan will assign implementation and monitoring roles • On-site personnel will review the plans, understand their roles and responsibilities, and be properly trained and equipped to implement the plan. • The plan will outline water quality monitoring procedures to ensure that water in the Project Work Areas meets applicable guidelines and standards during material placement activities. • Water quality monitoring will be undertaken by a Qualified Professional. • The plan will include, but will not be limited to: proposed water quality monitoring locations and frequency; applicable guidelines and thresholds; permit requirements; engineering controls; best management practices; and mitigation measures to reduce impacts on the marine environment. 2) A Sediment and Erosion Control Plan will be developed by the Contractor's Environmental Specialist and implemented by the Contractor. • Plans will assign implementation and monitoring roles • On-site personnel will review the plans, understand their roles and responsibilities, and be properly trained and equipped to implement the plan. • The plan will include specific measures that will be undertaken, and equipment to be used, to prevent transport and erosion of barge sand during periods of rain and/or wind. Including mitigation measures listed under Atmosphere.	No

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?

			3) A Spill Prevention and Response Plan will be developed by the Contractor's Environmental Specialist and implemented by the Contractor.
			• Plan will assign implementation and monitoring roles.
			• Ensure Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to conduct spill response activities
			• Plan will include a list of spill response equipment that will be present on Site.
			• Plan will include specific measures that will be undertaken to prevent and respond to spills, and will include:
			  ○ Ensure all equipment, machinery, vessels and vehicles brought on Site are clean, free of leaks, excess oil, and grease, and in good working order.
			  ○ Check all equipment, machinery, vessels and vehicles every morning for leaks and ensure they are maintained in good working order.
			  ○ Ensure hydraulic machinery, if required, uses environmentally-sensitive hydraulic fluids that are non-toxic to aquatic life and are readily or inherently biodegradable.
			  ○ Limit refuelling, fuel stockpiling and maintenance of equipment to designated areas on level, impermeable surface areas at least 30 m away from any drainage or surface water features.
			  ○ Ensure all refuelling occurs with funnels, pads and drip pans in place.
			  ○ Store fuels, lubricants and chemicals appropriately on Site, with proper controls to prevent the release of deleterious substances, in a designated area at least 30m away from surface water features or surface water drainage.
			  ○ Place properly sized oil drip pans under all equipment and vehicles left on site.
			  ○ Identify high-risk locations where spills are probable and maintain spill kits, capable of handling the largest potential spill through the duration of the project, at these locations. Locate PPE at the top of the spill kit to ensure easy access for the spill responder. Keep spill kits closed with a safety seal affixed to indicate if the kit has been used or tampered with.
			  ○ Respond immediately to all spills in accordance with plan. Contact the following if a spill cannot be contained and cleaned up and second level response is required:
			    ▪ Port Operations and Emergency Services Queen's Harbour Master/Environmental Protection Office (250-363-2160 (24/7) / VHF Ch 10 (Esquimalt Harbour) / VHF Ch 19 (Nanoose Harbour) / Duty Q 250-889-0044 (silent hours)) for marine spills in Esquimalt and Nanoose Harbours and their approaches;
			    ▪ 911 for land-borne spills. Inform the 911 operator that the spill has occurred on CFB Esquimalt property.
			  ○ Verbally report all spills to DND OPI immediately. If DND OPI is not available, contact the Joint Operations Centre (JOC) (363-2425, 363-5848).
			  ○ Submit the following information to DND OPI within one day of a spill incident:
			    ▪ Date and time of spill (indicate occurrence, discovery and cleanup commencement and Type of material spilled and Transport of Dangerous Goods classification
			    ▪ Spill surface (gravel, water, pavement, shop floor)
			    ▪ Quantity of material spilled and quantity recovered (kg/L)
			    ▪ Source/origin of spill
			    ▪ Cause of spill (description of incident)
			    ▪ Corrective action take and action plan to prevent a subsequent spill
			    ▪ Human impacts
			    ▪ Environmental impacts (ground, water, vegetation, wildlife)
			    ▪ Weather conditions at the time of the incident
			    ▪ Agencies or authorities notified or involved
			    ▪ Media interest
			  ○ DND OPI is responsible for ensuring that all spills are reported to MARPAC FSE in accordance with MARPAC SEMS DSE1: Safety and Environmental Emergency Incident Reporting. If MARPAC FSE personnel are not immediately available, contact the Joint Operations Centre (JOC) (363-2425, 363-5848). If required, MARPAC FSE or the JOC will contact Emergency Management BC directly to ensure that ECCC's notification requirement is met.	

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?
			4) Mitigation measures to protect water quality will include: • Sand cover material must be clean, fine-grained sand material, free of organic material as similar in nature to the native sediment within the Work Site as practical and must conform to specific gradations as indicated in the specifications. Sand material will meets the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) sediment quality guidelines. • Material will be placed in a controlled manner, and not placed by rapid dumping of a barge load • The contractor must describe in its construction work plan what means, methods and procedures will be used to prevent water quality requirement exceedances, and what contingency actions will be taken to restore compliance. • The contractor must employ placement means and methods that will avoid resuspending sea bed sediment during placement activities and prevent excessive mixing of the placed material with the sea bed sediment. • Sediment control measures such as silt curtains will be implemented during material placement if needed to meet water quality criteria outlined in the Water Quality Plan • A Silt Curtain Control Plan will be developed by the Contractor's Environmental Specialist and implemented by the Contractor. The plan will include: how the silt curtain will be installed, maintained and inspected, if required to protect water quality. If required, silt curtain should be inspected daily from the surface of the water. • Refuse and debris related to the Work will be collected and disposed of at approved disposal facilities in compliance with laws and requirements of all authorities having jurisdiction. • The Contractor will not dump, burn, bury, or allow others under its control to dump, burn, or bury construction wastes and refuse associated with the Work. Should refuse or construction wastes related to the Work be dumped, the Contractor will immediately act to clean up and remove the waste material to an approved location. • The Contractor's work area will have a recycling and waste management program in place. Among other things, clearly labelled garbage bins with lids and recycling containers must be made available for food waste and recyclable office waste. The Contractor will arrange for the placement of garbage receptacles and recycling containers at key locations within the Work Site such as in the vicinity of the laydown area. Garbage bins kept outside will have lids sufficient to keep wildlife from accessing the waste inside. • The Contractor will establish regular clean up and disposal programs to prevent the unnecessary accumulation of excessive construction waste and refuse. • Hazardous materials will be disposed of in accordance with law and the requirements of all authorities having jurisdiction. • Should the on-site storage of hazardous materials such as gasoline or oils be required, secondary containment capable of holding at least 110% of all hazardous materials stored within will be in place. • Above ground storage tank areas will be bermed, lined, and have in place appropriate drainage systems for removing accumulated rainwater. • Current Safety Data Sheets (SDS)1 and an inventory will be maintained for all controlled substances used, stored, and handled on-site associated with Project activities. • An area will be designated, as required, for the transfer or temporary storage of hazardous materials and wastes. The area will be clearly labelled and controlled in accordance with Workplace Hazardous Materials Information System and other statutes. • Where construction activities involve the handling, storage, and removal of hazardous waste, the Contractor(s) will maintain the following records: o Inventories of types and quantities of hazardous waste generated, stored, or removed o Manifests identifying hazardous waste haulers and disposal destinations o Disposal certification documents • Personnel will be trained in the handling and transportation of dangerous goods and controlled substances.	

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?
Marine Substrate	1) Construction Activities • Material Placement 2) Post Construction Monitoring	Placement of clean sand and siderite for remediation and enhancement of degraded marine substrates may disturb marine substrates Spudding of barge equipment for placement of materials and storage may disturb marine substrates Propwash may disturb newly placed materials	1) Mitigation measures to protect marine substrate will include: • Sand cover material must be clean, fine-grained sand material, free of organic material as similar in nature to the native sediment within the Work Site as practical and must conform to specific gradations as indicated in the specifications. Sand material will meets the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) sediment quality guidelines. • Material will be placed in a controlled manner, and not placed by rapid dumping of a barge load • The contractor must employ placement means and methods that will avoid resuspending sea bed sediment during placement activities and prevent excessive mixing of the placed material with the sea bed sediment. • Grounding of barges and equipment will be minimized during placement of materials and overnight storage • Reduced power will be used during transport in shallow areas to minimize disturbance to newly placed materials	No
Ambient Noise	1) Construction Activities • Use of Industrial Equipment	Increase in ambient noise during construction.	1) Mitigation measure for ambient noise include: • Comply with Canada Occupational Health and Safety Regulations (DND/CAF personnel) and the BC Occupational Health and Safety Regulations (Contractor personnel) regarding noise regulations and PPE requirements. • The Contractor must comply with local ordinances regarding noise control while conducting activities at the Work Site. • Project activities that have the potential to increase ambient noise levels will comply with time periods identified in applicable municipal noise bylaws. If work is required outside these hours, the DND OPI is responsible for gaining approval as required. Noise restrictions apply between the hours of 7:00 pm and 7:00 am from Monday to Saturday and at all times on Sundays and statutory holidays. The contractor must undertake noisier work activities during daytime hours and modify activities based on noise monitoring and resident feedback. • Coordinate notification of the affected community with DND OPI. Information will include: the nature and likely duration of any particularly noisy operations that may be forthcoming as a part of project activities. Coordinate notification to individuals and/or organizations/municipalities outside the Department through Base Public Affairs. • If noise complaints are reported, DND OPI will complete a noise generation evaluation • Properly maintain equipment and machinery to minimize unnecessary noise pollution. Fit all machinery and equipment with functioning exhaust and muffler systems. Ensure machinery covers and equipment panels are well fitted and remain in place to muffle noise. Ensure bolts and fasteners are tight to avoid rattling. • Placing power-generating equipment in such a way to reduce exposure and minimize disruption to adjacent occupants. • Shielding loud power equipment and turning off equipment when not in use. • The occurrence of multiple noise activities during a single event (cumulative effects) or for prolonged periods will be prevented	No
Marine Vegetation, and Fish Habitat	1) Construction Activities 2) Post Construction Monitoring	Placement of clean sand and siderite for remediation and enhancement of degraded marine substrates may disturb marine substrates Spudding of barge equipment for placement of materials and storage may disturb marine substrates Propwash may disturb newly placed materials Introduction of Invasive Species.	1) Refer to mitigation measures outlined for Marine Substrates and Surface Water 2) Additionally: • Before entering Esquimalt Harbour, remove plants, algae, and animals attached to or inside vessels to help avoid the spread of marine invasive species. • If deemed necessary, the QP will have the authority to halt work to avoid impacts to aquatic animals and/or their habitat. Mitigation methods will be reviewed and corrected.	No

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?
Marine Fish, Invertebrates, and Mammals	1) Construction Activities	Placement of clean sand and siderite for remediation and enhancement of degraded marine substrates may cause the direct Mortality of Fish.	1) Refer to mitigation measures outlined for Marine Substrates and Surface Water 2) Additionally: • If, after project review, DFO determines that the project will cause serious harm to fish and is part of a commercial, recreational or Aboriginal fishery or supports a commercial, recreational or Aboriginal fishery, an authorization will be obtained from the Minister of Fisheries, Oceans and the Canadian Coast Guard as per Paragraph 35(2)(b) of the Fisheries Act Regulations. • Work is scheduled to occur within the DFO least risk winter window for Area 19 (December 1 – February 15) and outside the Pacific herring spawning season (between February 15 and June 1). • If work occurs within the herring spawning season; However; if delays occur and the work window falls between 15 February and June 1, a qualified QP will visually observe from the surface of the water for spawning herring (i.e., schools of herring depositing eggs or releasing milt) and herring eggs within and adjacent to the Project Work Site. Monitoring for spawning herring and herring eggs will be undertaken every day that in-situ water quality monitoring is conducted. If herring spawning is observed within in-water work areas, the PWGSC Representative will be informed and work with potential to affect herring egg masses or emergent larvae will be stopped for 10 to 14 working days. If herring eggs are found on equipment, the PWGSC Representative will be informed, and work will be stopped and will not resume until after eggs have hatched • Material will be placed in such a way as to not increase the risk of mortality and or injury to fish within the Work Site. Material will be placed near the water surface, below the surface or within approximately 1 m of the substrate, as approved by the Contractor and the QP. As long as the placement method meets water quality criteria and other requirements in the Specifications, drop distance above the water surface may vary and is not restricted. • Should silt curtains be employed, contained areas will be monitored for fish presence and marine mammals. If schools of fish or a marine mammal are observed in the enclosed silt curtain, in-water work will be temporarily suspended, and the silt curtain opened to allow organisms to escape. • If deemed necessary, the QP will have the authority to halt work to avoid impacts to aquatic animals and/or their habitat. Mitigation methods will be reviewed and corrected.	No
	1) Construction Activities	Interactions with marine mammals.	1) Marine mammal monitoring will be implemented during all in-water activities by a qualified professional. 2) Visual observations of work within a silt curtain will be made to verify that marine mammals do not become entrapped. If a marine mammal is observed in the enclosed area, the enclosed area opened to allow the mammal to leave. 3) Vessels will follow standard boat operation when in proximity to marine mammals in accordance with the Marine Mammal Regulations and DFO's guidance for watching marine wildlife: • Under no circumstances, other than in the case of an emergency, will vessels approach within 200 m of any killer whale or within 100 m of all other whales, dolphins and porpoises. For all other marine mammal encounters, vessels will avoid approaching within 100 m of a marine mammal in the water or a seal/sea lion haul out. • As safe navigation allows, reduce speed to less than 7 knots when within 400 m of the nearest whale. Avoid abrupt course changes. • If seals or sea lions are encountered, reduce boat speed, minimize wake, wash and noise, and then slowly pass without stopping. Avoid sudden changes in speed and direction. • Pay attention and move away, slowly and cautiously, at the first sign of disturbance or agitation. • Do not disturb, move, feed or touch any marine wildlife, including seal pups. • Emergency collisions with marine mammals, or a sighting of an entangled or injured marine mammal, are to be immediately reported to Coast Guard (VHF Channel 16) or Whale Emergency Network (1-800-465-4336). Additionally, DND Formation Safety and Environment needs to be contacted for all marine mammal issues.	No

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?
Seabirds, shorebirds and Waterfowl	1) Construction Activities • Use of Industrial Equipment	Disturbing nesting birds.	1) Construction activities will be scheduled to avoid sensitive bird periods such as breeding, nesting, roosting, rearing young and staging (migration). The general nesting period for southern BC is February – September. 2) A QP will conduct a bird nest survey on Inskip Island prior to project implementation, if activities will be conducted during the nesting period. If nests are present, a QP will develop a management plan identifying protective measures specific to the species present. Management plan should be developed in accordance with the most recent version of the following documents, as applicable: • Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia, BC Ministry of Environment • Guide for developing Beneficial Management Practices for Migratory Bird Conservation, Environment and Climate Change Canada • Project implementation will not commence until the management plan is approved by DND OPI and MARPAC FSE. DND OPI is responsible for developing contingency plans to modify project activities in accordance with the management plan. A QP, who is provided with authority to modify or halt project activities if it is deemed necessary to do so for the protection of bird species or habitat, will monitor the plan through implementation.	No
Species at Risk	1) Construction Activities	Placement of clean sand and siderite for remediation and enhancement of degraded marine substrates may cause the direct Mortality of Species at Risk	1) Refer to Mitigation measures for Surface Water, Marine Substrates, Marine Vegetation and Fish Habitat, and Marine Fish, Invertebrates, and Mammals 2) Additionally, If a Species at Risk or critical habitat is found, work will be suspended and DND OPI will be notified.	No
CRA	1) Construction Activities	Placement of clean sand and siderite for remediation and enhancement of degraded marine substrates may cause the direct Mortality of CRA species	1) Refer to Mitigation measures for Surface Water, Marine Substrates, Marine Vegetation and Fish Habitat, and Marine Fish, Invertebrates, and Mammals	
Water/Land Use	1) Construction Activities	Vessels may interfere with navigation within Esquimalt Harbour.	1) The Contractor will submit a Navigation Control Plan describing means and methods by which vessel movements and current Esquimalt Harbour practices and control procedures will be completed and monitored. Vessel movements will be coordinated by the Queens Harbour Master (QHM) • Practices and procedures that have been developed pursuant to Section 56 of the Canada Marine Act, which provide guidance to safe use, navigation, and environmental stewardship of the harbour, will be followed 2) All vessels entering the harbour are required to contact the Queen's Harbour Master Operations for a clearance request and provide applicable information. 3) Unless authorized, no project activity is to be conducted that will adversely affect harbour operations, interfere with navigation, or adversely affect sediment, soil, air or water quality. 4) All posted speed limits will be followed or at a safe speed to not exceed 7 knots. Reduce speed to a minimum wake when passing berthed ships. 5) Project vessels will keep 100 m away from stationary vessels and 200 m away from vessels underway. 4) Material transported by barge into, within, and out of Esquimalt Harbour requires the Contractor to coordinate directly with QHM pursuant to the Canada Marine Act. The PWGSC Representative requires 72-hour notification of all material transported by barge into or out of Esquimalt Harbour. Material barge transport movements within Esquimalt Harbour require a 24-hour notification to the QHM. 5) Work will be phased to minimize disruptions to other vessel traffic which includes mitigations in the specifications (i.e., stand-by time). 6) QHM will be consulted for overnight moorage of vessels and provided points of contact for any emergencies involving the vessels. 7) Additional emergency docking and navigation management procedures outlined in the Navigation Control Plan will be followed.	No
Recreational Use	1) Construction Activities 2) Post Construction Monitoring	Project has potential to obstruct small areas of the harbour from recreational boat use over the two week construction period or during Post Construction Monitoring	1) Project Work will be communicated to the QHM and/or Base Public Affairs by the DND OPI to coordinate external notification to recreational users.	No

VEC(s) Affected	Physical Activity Component(s)	Description of Effects	Mitigation Measures	Are residual significant adverse effects likely?
Cultural Resources	1) Construction Activities	Potential to uncover archaeological resources during material placement.	1) Archaeological Chance Find Management procedures will be included in the EPP and Archaeological Chance Find Management Guidelines are to be followed if sediment will be handled (i.e., removal if a test area is overfilled, etc.). • Totes for storage and protection of items will be provided along with a cedar box and blanket for HR if identified. • Monitoring of excavated sediments, if applicable, will include provisions for the collection of observed historically, archaeologically, or paleontologically significant artifacts, features, and faunal materials, as well as human remains	No
Aboriginal/Traditional Activities	1) Construction Activities 2) Post Construction Monitoring	Potential to obstruct traditional activities during construction activities and post construction monitoring.	1) Mitigation measures will be verified during Indigenous Engagement.	No
Health and Safety	1) Construction Activities 2) Post Construction Monitoring	Potential for injury during construction activities and post construction monitoring	1) Develop and implement a Health and Safety Plan to minimize the potential for accidental injury or property damage during all stages of the project. 2) Ensure the plan outlines measures for protecting site workers, visitors, and DND/CAF personnel working adjacent to the Site. Ensure the plan is monitored through project implementation. 3) Ensure all project activities comply with the direction detailed in the Canada Occupational Health and Safety Regulations (DND/CAF personnel) and the BC Occupational Health and Safety Regulations (Contractor personnel) regarding Occupational Health and Safety (OHS). 3) Immediately take measures to rectify unforeseen or peculiar safety related hazards that become evident during project implementation. Verbally advise the DND OPI immediately and provide a written report of the hazard or condition as soon as practical. 4) Conduct regular safety briefings and meetings with on-site workers to encourage safe working procedures are followed. 5) Investigate and report all incidents and accidents as required by: - DND General Safety Program (DND/CAF personnel) - Occupational Health and Safety Regulation, B.C. Reg. 195/2015, Workers Compensation Act (Contractor personnel) 6) DND OPI is responsible for ensuring compliance with BSO 3005-0: Occupational Health and Safety Liaison with Private Contractors. This includes: - ensuring that all hazards associated with the project are identified and assessed and mitigation strategies are developed prior to work commencing - ensuring that a communication plan is developed with the appropriate DND/CAF supervisors for hazards that have the potential to impact adjacent DND/CAF personnel.	

Potential Effects to Fish and Fish Habitat

Potential Project-related effects to fish and fish habitat are estimated prior to the application of any mitigation measures. Project activities with the potential to cause serious harm to fish that are part of a Commercial, Recreational, and Aboriginal (CRA) fishery, to fishes that support such a fishery, and to aquatic Species at Risk were assessed, along with impacts to aquatic habitat (including water and sediment quality). "Serious harm to fish" as defined in Subsection 2(2) of the *Fisheries Act* is: "the death of fish or any permanent alteration to, or destruction of, fish habitat." Project activities and associated potential effects that may result in serious harm to fish are identified in **Table 5** and expanded upon below. Pathways of effects (DFO 2014) were also considered, where applicable.

Table 5. Potential Project-related Effects to Fish and Fish Habitat

Construction Activity	Potential Effect		
	Fish Mortality	Loss of Fish Habitat	Alteration of Fish Habitat
Placement of treatment types on seafloor	✓		✓
Introduction of Siderite to the marine environment			✓
Operation of machinery			

Fish Mortality

Some in-water activities, including the placement of the various treatment types (ENR or In Situ Amendment) in the marine environment, have the potential to cause direct injury or mortality of fish (including eggs, and larvae), due to interaction between fish and the mixed materials, or direct contact with industrial equipment (as identified by DFO's *Pathways of Effects*; DFO 2014). The placement of the material required for the Project may result in entrapment or smothering of adult and juvenile fish, as well as, smothering of eggs, larvae and infaunal invertebrate species. Infilling of marine habitats may lead to direct mortality of low mobility and sessile species (e.g., bivalves).

Temporary changes to surface water quality that may occur during Project construction at the Project Site also have the potential to cause direct injury or mortality of fish, and include:

- Introduction of deleterious substances (e.g., polycyclic aromatic hydrocarbons) to the environment, due to accidental release from on-site heavy machinery (DFO 2014).
- Temporary increase in total suspended solids from infilling works. Increased suspended sediments may disrupt fish feeding and/or predator avoidance.

Permanent Alteration of Fish Habitat

The introduction of the clean sand and clean sand/siderite material to the marine environment has the potential to permanently alter the fish habitat within the Project footprint. The materials may cause a permanent alteration in the substrate available to fish and invertebrates, particularly members of the infaunal (within the sediment) community. However, based on i) desktop-based technical literature review, (ii) geochemical transport modeling, and (iii) laboratory bench-scale tests using sediment from Esquimalt Harbour (as outlined in **Section 1.4**) it has been concluded that the In Situ Amendment Treatment of clean sand (95%) blended with siderite material (5%) does not constitute a risk to fish or fish habitat from a change in sediment concentrations or the introduction of deleterious materials. The application of clean sand enhances fish habitat conditions in the northern Harbour by replacing the biologically active zone with clean sediment in order to provide an oxygenated layer to promote benthic infauna community recruitment and establishment of a productive benthic community (Breems and Goodman 2009, Washington State 2013).

The In Situ Amendment is expected to act similar to clean sand and provide a suitable clean substrate for benthic colonization while restoring degraded conditions (by removing toxic H_2S).

2.5 Indigenous Community Engagement

This section summarizes collected background information on the Aboriginal groups that may be affected by the DND Project. Included is a description of how DND determined which Aboriginal groups needed to be engaged. The Aboriginal groups that will be potentially affected are identified based on guidance from DND and publicly available information from the federal government and the Province of British Columbia. Based on this information, DND concluded that the following groups and organizations have Aboriginal interests in the Esquimalt Harbour remediation area:

- Esquimalt Nation
- Songhees Nation
- Te'mexw Treaty Association, representing the Malahat Nation, Scia'new (Beecher Bay) First Nation, Snaw-naw-as (Nanoose) First Nation, Songhees Nation, and the T'Sou-ke (Sooke) Nation
- Hul'qumi'num Treaty Group, representing the Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, and Penelakut Tribe
- Saanich Nations (Malahat First Nation, Pauquachin First Nation, Tsartlip First Nation, Tsawout First Nation and Tseycum First Nation)
- Stz'uminus (Chemainus) First Nation
- Métis Nation British Columbia
- Métis Nation of Greater Victoria

There are two First Nations communities with Indian Reserves (IRs) on Esquimalt Harbour and thus considered local to the Esquimalt Harbour remediation areas: the Esquimalt Nation on the Esquimalt IR and the Songhees Nation on New Songhees IR 1A. These IRs are located on Plumper Bay on the east shore of the harbour, adjacent to the Esquimalt Graving Dock and approximately 700 m north of CFB Esquimalt.

The Esquimalt and Songhees Nations are Douglas Treaty Nations. The Douglas Treaties include a series of treaties signed in the 1850's by the Crown and Vancouver Island First Nations, including what are now the Esquimalt and Songhees Nations. Use of Esquimalt Harbour for the exercise of treaty rights or for other traditional purposes by the Esquimalt Nation and Songhees Nation has decreased since approximately 1960. Current use is related to non-harvesting activities; however, the Esquimalt Nation and Songhees Nation have indicated to DND that this current use does not reflect their past use or desired future use of the harbour for their "food basket," made up in part by seafood (i.e., ling cod, rockfish or rock cod, clams, mussels, sea urchin, crab, shrimp, and prawns) and waterfowl (i.e., duck and geese).

As part of the Te'mexw Treaty Association (TTA), the Songhees Nation is negotiating a final agreement with Canada and British Columbia through the British Columbia Treaty Commission (BCTC) process. There are five First Nations that form the TTA: Malahat Nation, Scia'new (Beecher Bay) First Nation, Snaw-naw-as (Nanoose) First Nation, Songhees Nation, and the T'Sou-ke (Sooke) Nation. All of these First Nations have IRs located within the Capital Regional District, except for the Snaw-naw-as First Nation who have an IR situated on Nanoose Bay in the Regional District of Nanaimo. The Esquimalt Nation is not participating in the BCTC process.

In addition to the Esquimalt Nation, Songhees Nation and the TTA, the federal Aboriginal and Treaty Rights Information System (ATRIS) maintained by Indigenous and Northern Affairs Canada and the First Nations Consultative Areas Database (accessed online 1 March 2016) maintained by the Province of British Columbia identifies Hul'qumi'num Treaty Group (HTG) member First Nations as having potential interests in Esquimalt Harbour, based on a large asserted marine (non-core) territory. Like the TTA, the First Nations of the HTG are collectively negotiating a final agreement with Canada and British Columbia through the BCTC process; the HTG are currently at Stage 4 of the six-stage BCTC process. The five members of the HTG are Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, and Penelakut Tribe. The Stz'uminus (Chemainus) First Nation was previously part of the HTG but have recently withdrawn from the BCTC process. The closest HTG community to Esquimalt Harbour is located approximately 45 km to the north by the City of Duncan, BC. The HTG have indicated previously to DND that Esquimalt Harbour is a "lower priority" in relation to their interests but have recommended that HTG member communities be notified about DND activities by letter.

In late 2016, ATRIS and the First Nations Consultative Areas Database (both accessed online 5 December 2016) identified the Saanich Nations, including the Malahat First Nation, Pauquachin First Nation, Tsartlip First Nation, Tsawout First Nation and Tseycum First Nation, as having potential interests in Esquimalt Harbour. Each of the five Saanich Nations have their own IRs located within the Capital Regional District. There have been no previous communications between DND and the five Saanich Nations.

It is not known if the Métis use Esquimalt Harbour, including the C3RP Work Site, for harvesting purposes. Métis Nation British Columbia (MNBC) is an Aboriginal organization routinely identified by the Canadian Environmental Assessment Agency for BC-based Projects subject to review under the Canadian Environmental Assessment Act 2012. MNBC represents 34 chartered communities in BC, including the Métis Nation of Greater Victoria (MNGV); MNGV is the Métis local for the Capital Regional District, which includes Esquimalt Harbour. There have been no previous communications between DND and MNBC or other Métis representative groups.

Consultation with the Songhees and Esquimalt Nations has been ongoing since 2006. Between 2006 and 2007, a First Nation Involvement Plan, including a traditional use and knowledge study, was undertaken as part of the Esquimalt Harbour Sediment Quality Project. The following provides a summary of work conducted between 2006 and 2007:

- Planning (August 2006): First Nations with potential interests in Esquimalt Harbour were identified and contacted based on background research and discussions with DND and PSPC.
- Data Collection (September to October 2006): The team worked with local First Nations to understand how and where people currently use the harbour, as well as how and where the harbour was used in the past and how and where First Nations anticipate using the harbour in the future. Data collection methods included formalized interviews with community Elders and expert knowledge holders that documented and mapped traditional use sites, as well as Traditional Ecological Knowledge (TEK), from the harbour. Collected information was entered into a GIS database and the results summarized into a confidential report to PSPC, DND and the Esquimalt and Songhees Nations.
    - The confidential TEK identified a wide range of traditional and recreational use in Esquimalt Harbour as well as concerns regarding contamination and deterioration of the harbour environment and loss of access due to other activities in the harbour. While the TEK report is now over 10 years old, concerns highlighted at recent consultation sessions reiterate the contamination issues highlighted in the TEK.
- Communication (September 2006 to February 2007): The results of the TEK were provided to the community for additional comment, and protocols were put in place for protecting confidential information. In addition, the results of the environmental studies for the Harbour were shared with First Nations. Support to First Nations in the review of the technical environmental studies and the participation in the overall engagement process was offered.
- Evaluation (February to March 2007): The team committed to working with First Nations to monitor the effectiveness of the engagement process and to track relationships as they developed. Progress against the following goals were measured: increased awareness of the harbour environment; increased ability of First Nations to be involved in harbour management; and, improved communication between DND and First Nations.

2.5.1 First Nations Communications for the Project

This section describes the approach, methods and actions that DND has undertaken to engage Aboriginal Groups prior to and during the environmental assessment process. The comments and concerns of Aboriginal groups, and the process for addressing these comments and concerns are summarized.

DND recognizes the importance of effectively engaging Aboriginal groups with Aboriginal interests in the Project Work Areas. The objective was to support positive, productive and long-lasting relationships with affected Aboriginal communities that properly addressed applicable legal and regulatory requirements. DND has committed to providing Aboriginal groups opportunities where appropriate to engage in Esquimalt Harbour remediation projects and to provide meaningful input for consideration.

A First Nations Communications Plan was previously prepared for Esquimalt Harbour remediation projects by Golder (2014), that provided for a communications stream between DND and First Nations that is separate from the Public Communications Plan. This plan details communication activities with First Nations from Fall 2014 through to implementation to support the preliminary draft EA and the necessary permitting for the Esquimalt Harbour remediation projects to proceed, and it provides an outline of recommended activities through to implementation close out (December 2022) to monitor for emerging issues or concerns. The Plan is intended as a living document that can be adjusted as Esquimalt Harbour remediation and DND communications with First Nations evolve.

Through a combination of formal correspondence, face-to-face meetings, and telephone / e-mail communications, the plan (and amendments, as necessary) accomplished the following measurable and tangible outcomes as a result of its implementation:

- Obtained and demonstrated the incorporation of meaningful First Nations feedback on the preliminary draft EA report for the Esquimalt Harbour remediation projects, including mitigation measures, habitat offsetting, and environmental / archaeological management plans
- Produced appropriate documentation of communications activities, First Nations interests and concerns, DND responses, and key outcomes
- Met First Nations communications requirements and expectations of applicable federal / provincial agencies, such as DFO
- Fostered First Nations support for Esquimalt Harbour remediation projects

The plan anticipates that the HTG member First Nations, Saanich Nations and MNBC / MNGV will be formally notified of the Esquimalt Harbour remediation projects, but that the focus of ongoing communications activities is with the Esquimalt Nation and Songhees Nation, in recognition of their unique history, interests, and concerns relative to Esquimalt Harbour.

Esquimalt Nation Communications

Meetings with the Chief of the Esquimalt Nation were held on 25 September and 13 November 2014. Presentations on the Esquimalt Harbour remediation projects were made to the Chief and Council on 7 March 2016, the Band Administrator on 24 January 2017, to the Chief on 19 July 2017, and to the Chief and Council on 9 May 2018.

Songhees Nation Communications

A meeting with the Chief of the Songhees Nation was held on 8 January 2015. Presentations on the Esquimalt Harbour remediation projects were made to the Songhees Chief and Council on 4 February 2015, 4 May 2016, 18 January 2017, to the Songhees Nation Executive Director on 19 July 2017, and to the Chief and Council on 9 May 2018.

Communication Results

Leadership from the Esquimalt Nation and Songhees Nation have been provided Esquimalt Harbour remediation projects-related information for their review and comment, including mapping of the remediation areas. Separate face-to-face meetings on Esquimalt Harbour remediation projects were conducted with Chief and Council from the Esquimalt Nation and Songhees Nation. Draft environmental assessment documents were also provided to the Esquimalt Nation and Songhees Nation for their review and comment. DND has a standing offer with the Chief and Council from both the Esquimalt and Songhees Nations to conduct a site visit to the proposed Esquimalt Harbour remediation project areas.

First Nations expressed considerable support for the Esquimalt Harbour remediation projects. Specific concerns regarding proposed activities include how and where the dredged sediments will be disposed of and whether dredging and shipping activities associated with CFB Esquimalt and Esquimalt Graving Dock will further disturb contaminated sediments, possibly contaminating other locations in the Esquimalt Harbour. DND has committed to sending the contaminated sediments from the remediation areas to a permitted off-site facility for disposal. DND acknowledged that preliminary studies suggest contaminants can move limited distances over time. However, it is unlikely that that the sediments from the Esquimalt Harbour remediation projects will contaminate other areas of Esquimalt Harbour over the next 50 years.

Both the Esquimalt Nation and the Songhees Nation expressed interest in the potential economic opportunities for their First Nations from Esquimalt Harbour remediation projects, including employment and training opportunities. The Esquimalt and Songhees Nations have in-house experience in conducting remediation activities.

DND has indicated that Defence Construction Canada (DCC) has contracting opportunities for the Esquimalt Harbour remediation projects, including potential Aboriginal set-asides. DND will make DCC aware of the First Nation's interest and as new contracting opportunities present themselves, DND will alert the Esquimalt and Songhees Nations.

Both the Esquimalt Nation and the Songhees Nation expressed considerable concern with the implications of Health Canada's Seafood Consumption Advisory for the Esquimalt Harbour, especially as it relates to the consumption of their traditional foods from the harbour. These foods are an important part of the community member's diet, and have a critical role in their traditional ceremonies. Traditional foods include not only those listed in the Seafood Consumption Advisory, but also waterfowl, clams and mussel, as well as several species of fish. There were also concern that the Esquimalt Harbour remediation projects may interfere with fishing at the entrance to the Esquimalt Harbour.

DND acknowledges these concerns and indicated that this is one of the principal reasons for proceeding with the remediation projects. While the Esquimalt Harbour will never be as it once was before industrialization, there should be significant improvements as a result of the remediation projects that include the remediation of six highly contaminated locations within the Esquimalt Harbour, as well as construction of additional habitat for marine life in the Esquimalt Harbour. At their request, DND has also presented the First Nations with a draft poster board on the Seafood Consumption Advisory established by Health Canada. DND has also committed to investigating how to best accommodate fishing activities in Esquimalt harbour, respecting the fact that there are security requirements that will not allow private vessels to come too close to the Jetties; DND will raise this concern with the Queen’s Harbour Master at CFB Esquimalt.

The Songhees Nation has community events that include activities on the Esquimalt Harbour. For instance, there is an annual canoe race from their IR through the entrance to Esquimalt Harbour. DND has indicated that they can accommodate this race if provided with proper notice; DND has alerted the Queen’s Harbour Master at CFB Esquimalt of this issue.

First Nations expressed a concern about the potential for previously unidentified archaeological sites to be impacted by the remediation activities in remediation project areas. DND has completed archaeological overview assessments (Golder 2015, 2016a, 2017), as well as additional overview work undertaken as part of the C-Jetty, ML Floats and Y-jetty, and Lang Cove EED (Golder 2018). Subsequently, an AIA was completed for the upland portion of A/B Jetties in 2014 and at Lang Cove and the F/G Jetty in 2015 (Golder 2016b). Recommended archaeological mitigation was completed at Lang Cove in November 2016.

DND has committed continuing to work with Aboriginal groups to identify potential adverse effects of the Project on Aboriginal interests. The future involvement of identified First Nations will be incorporated into the Project based on the results of the communication process.

Since 2006, engagement for Esquimalt Harbour remediation has been ongoing with the most recent meeting held in March 2018. Communication plans are being updated in 2019 and further meetings are planned for 2019, where information on the Pilot Project activities will be shared with the Songhees Nation and Esquimalt Nation at an upcoming 2019 meeting.

2.6 Public Participation

The assessment and remediation of the harbour has been communicated to the general public through the annual Public Information Sessions over the past four years. The next Public Information Session is July 2019.

2.7 References and Expertise from Other Federal Government Bodies or Third Party Groups

Anchor QEA. 2018. *Esquimalt Harbour Natural Recovery Analysis*. Esquimalt Harbour Remediation Project. Prepared for Public Works and Government Services Canada and Department of National Defence, and Defence Construction Canada.

Anchor QEA. 2019a. Wood Waste Remediation Project: Data Memorandum. Prepared Public Works and Government Services Canada and Department of National Defence.

Anchor QEA. 2019b. Wood Waste Remediation Project: Remedial Options Analysis. Prepared for Public Works and Government Services Canada and Department of National Defence. 62pp

Anchor QEA. 2019c. Supplemental Treatability Recommendations Report. Prepared for Public Works and Government Services Canada and Department of National Defence. 53pp

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Golder. 2016a. Archaeological Impact Assessment of Remedial Dredging Areas at Lang Cove and F & G Jetty in Esquimalt Harbour, Esquimalt BC. 30 June 2016. Non-permit report on file with PSPC, Victoria, BC.

Golder. 2016b. Archaeological Impact Assessment of Remedial Dredging Areas at Lang Cove and F & G Jetty in Esquimalt Harbour, Esquimalt BC. 30 June 2016. Non-permit report on file with PSPC, Victoria, BC.

Golder. 2017. Archaeological Overview Assessment of Proposed Remedial Dredging Area, Munroe Head to Thetis Cove in Esquimalt Harbour.16 March 2017. Non-permit report on file with PSPC, Victoria, BC.

Golder. 2018. Department of National Defence Environmental Effects Determination Report Project: Esquimalt Harbour Remediation Project (C Jetty / ML Floats and Y Jetty / Lang Cove). Prepared by Golder Associates Ltd. 21 August 2018. DGIEGPS EED File #:2017-21-100946.

Lessard, J. and A. Campbell. 2018. Appendix IV : Impact Assessment Protocol for Works and Developments Potentially Affecting Abalone and their Habitat *in* Action Plan for the Northern Abalone (*Haliotis kamtschatkana*) in Canada. Accessed from: https://www.sararegistry.gc.ca/document/doc1742f/p7_e.cfm

State of Washington Department of Ecology (Washington State). 2013. Wood Waste Cleanup: Identifying, Assessing, and Remediating Wood Waste in Marine and Freshwater Environments - Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards Chapter 173-024 WAC. Publication No. 09-09-044. 93pp.

Part 3. Environmental Effects Determination

On the basis of this DND DD EED Report, it has been determined that the impact of this Physical Activity on the environment is as follows:

☒ The Physical Activity is not likely to cause significant adverse environmental effects. The Physical Activity **can** proceed with application of the mitigation measures specified in the interaction tables in this report.

☐ The Physical Activity is likely to cause significant adverse environmental effects that cannot be mitigated. As per the Environmental Impact Assessment Directive, it is recommended that the Physical Activity must not proceed.

For determination of Serious Harm as it relates to the *Fisheries Act,* refer to **Appendix F: DFO *Fisheries Act* Assessment of Serious Harm.**

DND DD EED Report Prepared by:

Name: Mikaela Davis **Title: Biologist, R.P.Bio**

Signature 23-07-2019
Date (dd-mm-yyyy)

DND DD EED Report Reviewed by:

Name: Jenn Holder **Title: MARPAC ESS**

Signature
Date (dd-mm-yyyy)

DND DD EED Report Accepted and Approved by:

The undersigned accepts the determination and recommendations of this environmental effects determination report. The undersigned also accepts the responsibility to incorporate the recommendations of the report into the Physical Activity design and implementation.

Name: Mike Waters **Title: MARPAC FSE Environment Officer**

Signature
Date (dd-mm-yyyy)

FIGURES

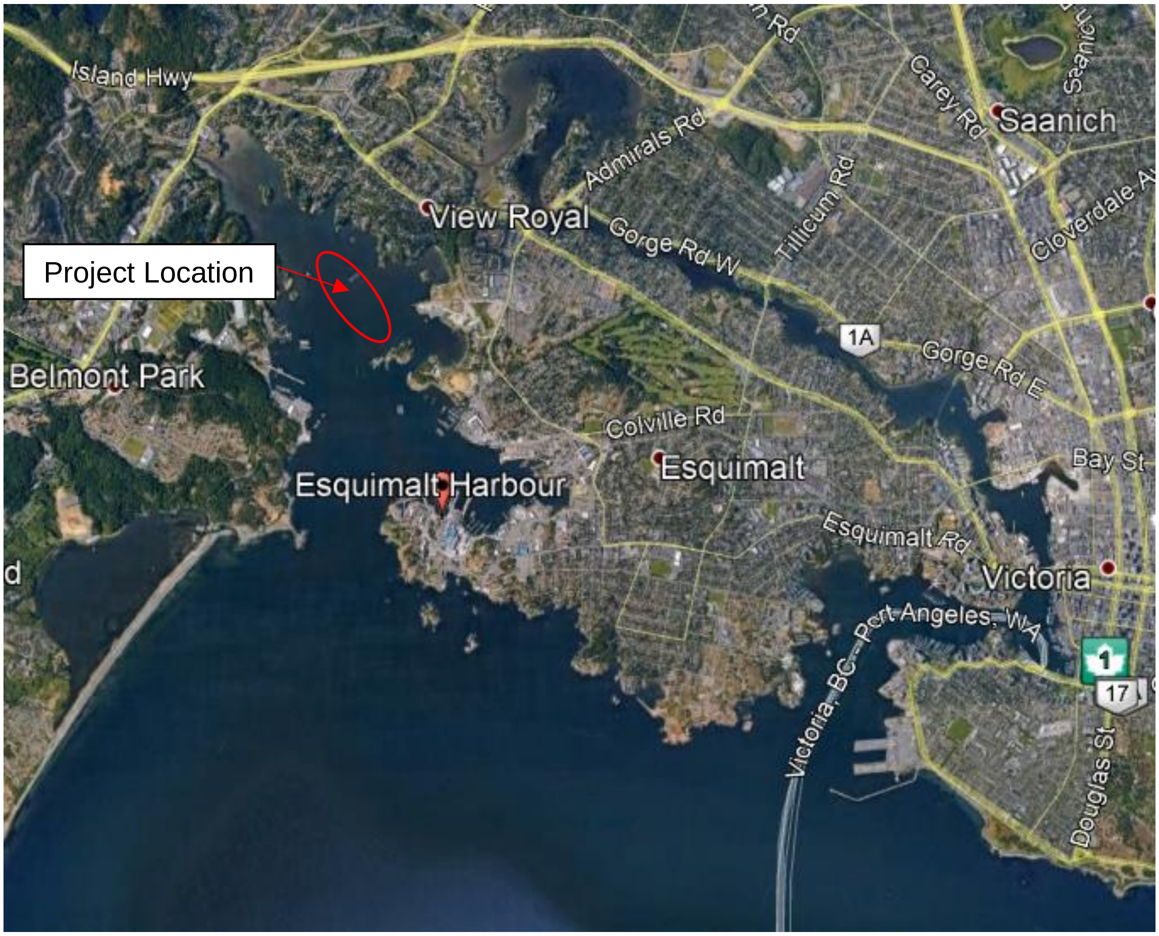
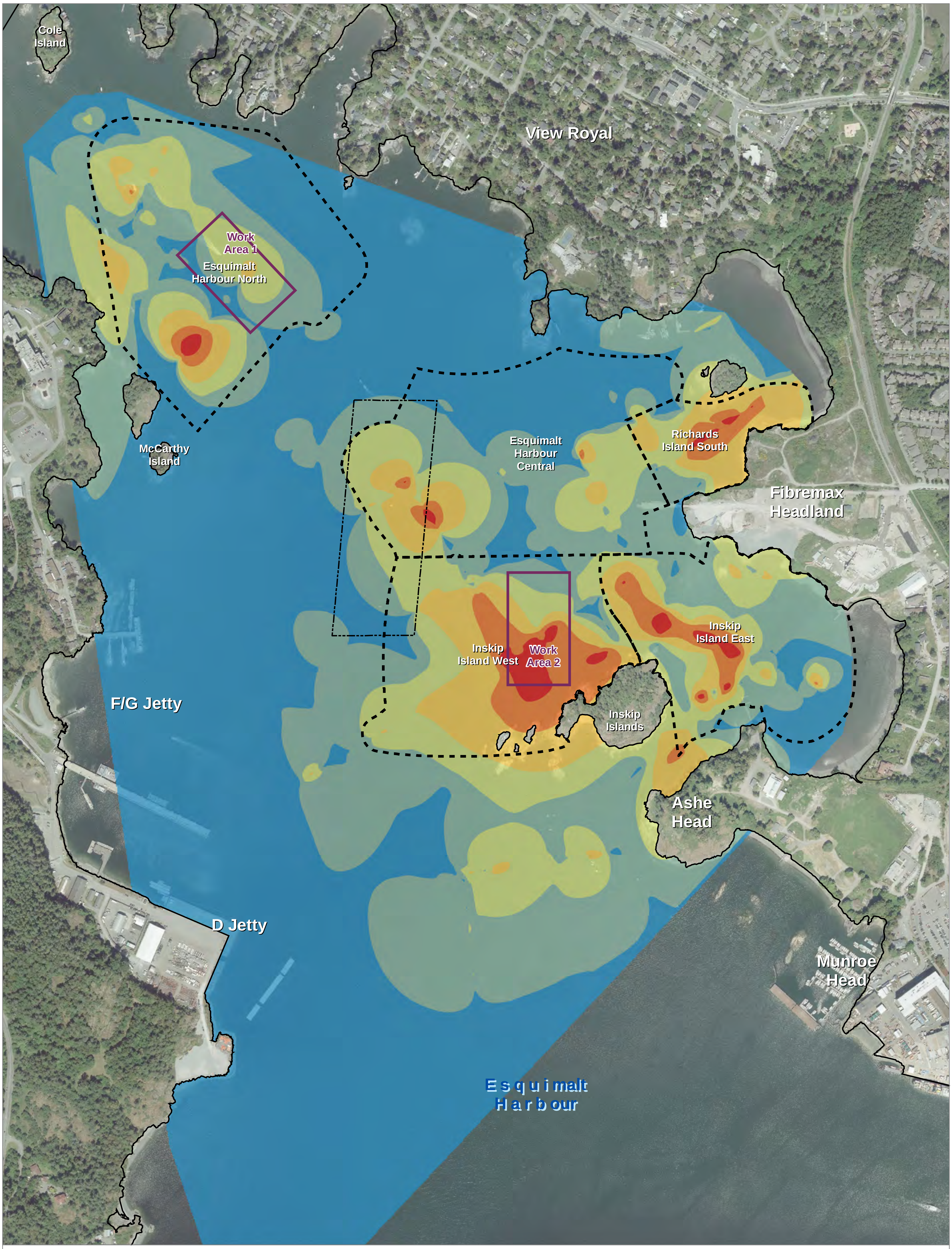


Figure 1. Project Location in relation to Esquimalt Harbour, Esquimalt and View Royal, British Columbia (Source: Google Earth).



LEGEND:

- WWMAs
- Pilot Project Work Areas
- Jones Marine Lease Boundary

Wood Waste (% Cover)

- 0 - 1
- 1.1 - 10
- 10.1 - 25
- 25.1 - 50
- 50.1 - 75
- 75.1 - 100

NOTES:
1. The wood waste percent cover was created using a Natural Neighbor interpolation method.
2. Jones Marine Waterlot Lease boundary corner points coordinates provided by DND.

DND = Department of Defence
WWMA = Wood Waste Management Area

0 200
Metres

Publish Date: 2019/07/17, 10:49 AM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\EMP\Fig3_WoodWaste_PercentCover.mxd

ANCHOR QEA

Figure 2
Pilot Project Work Areas with Wood Waste Cover
Wood Waste Remediation Project - Environmental Management Plan

SITE PLAN
SCALE: 1:5000

LEGEND:

WORK AREA
TEST AREA
BATHYMETRY IN METERS (1m INTERVAL)
JONES MARINE SERVICES LTD SITE
FIRST NATIONS WATERLOT BOUNDARY

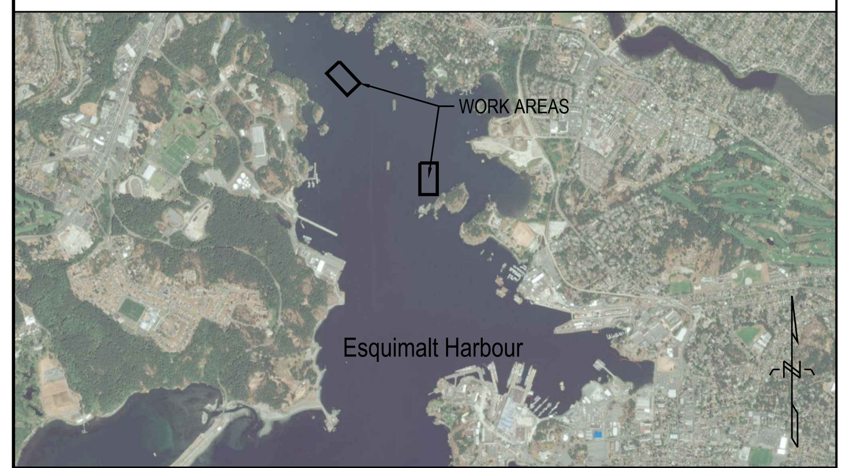
KATHRYN KETTERIDGE
STATE OF WASHINGTON
52805
REGISTERED PROFESSIONAL ENGINEER
2019-07-24

Figure 3. Location of the two work areas in relation to features within northern Esquimalt Harbour

Government of Canada | Gouvernement du Canada

LEVEL OF SECURITY | NIVEAU DE SÉCURITÉ
TO BE REVIEWED | À ÊTRE REVISER

ANCHOR QEA



SOURCE: BATHYMETRY FROM MCCOI, DATED FEBRUARY 2019.
HORIZONTAL DATUM: UTM ZONE 10N, NAD83.
VERTICAL DATUM: CHART DATUM (CD).
NOTES:

1. THE PRE-CONSTRUCTION SURVEY WILL BE COMPLETED BY THE CONTRACTOR'S THIRD-PARTY SURVEYOR (PER SECTION 02 21 13 [SURVEYING AND POSITIONING CONTROL]) TO DOCUMENT BATHYMETRY CONDITIONS WITHIN THE WORK SITE IN ADVANCE OF CONDUCTING WORK. THE CONTRACTOR'S THIRD-PARTY SURVEYOR WILL ALSO PERFORM THE POST-CONSTRUCTION (FINAL) SURVEY FOLLOWING THE DEPARTMENTAL REPRESENTATIVE'S ACCEPTANCE OF THE WORK, BASED ON PROGRESS SURVEY RESULTS. THE PRE- AND POST-CONSTRUCTION SURVEYS WILL BE USED AS THE BASIS FOR MEASUREMENT AND PAYMENT OF CONTRACTOR WORK COMPLETED WITHIN THE WORK AREAS.
2. CONTRACTOR MAY PROPOSE ALTERNATE APPROACH FOR ESTABLISHING SURVEY AND POSITIONING CONTROL (E.G., CAN-NET OR OTHER) IN THE CONTRACTOR'S SURVEY AND POSITIONING CONTROL PLAN.

NO.	DATE	REVISION	APPR.
0	2019/07/24	ISSUED FOR TENDER	

SCALE | ÉCHELLE
1:5000

LOCATION | EMPLACEMENT
ESQUIMALT HARBOUR

PROJECT | PROJET
DND WOOD WASTE REMEDIATION PILOT PROJECT

TRADE | MÉTIER
CIVIL/ENVIRONMENTAL

DATE
2019/07/24

SUBJECT | SUJET
EXISTING CONDITIONS

PRODUCTION	REVIEWED | REVU	
DESIGNED | ÉTUDIÉ K. KETTERIDGE S. RODRIGUEZ	XX | XX X.X.	DES O | AGENT CONC
DRAWN | DESSINÉ C. HEWETT		PROJ MGR | GEST PROJ
CHECKED | VÉRIFIÉ T. WANG		DES MGR | GEST CONC
COORDINATION ----		FIRE | INCENDIE

WBS NO. | NO. OTP
N.000159.11.02

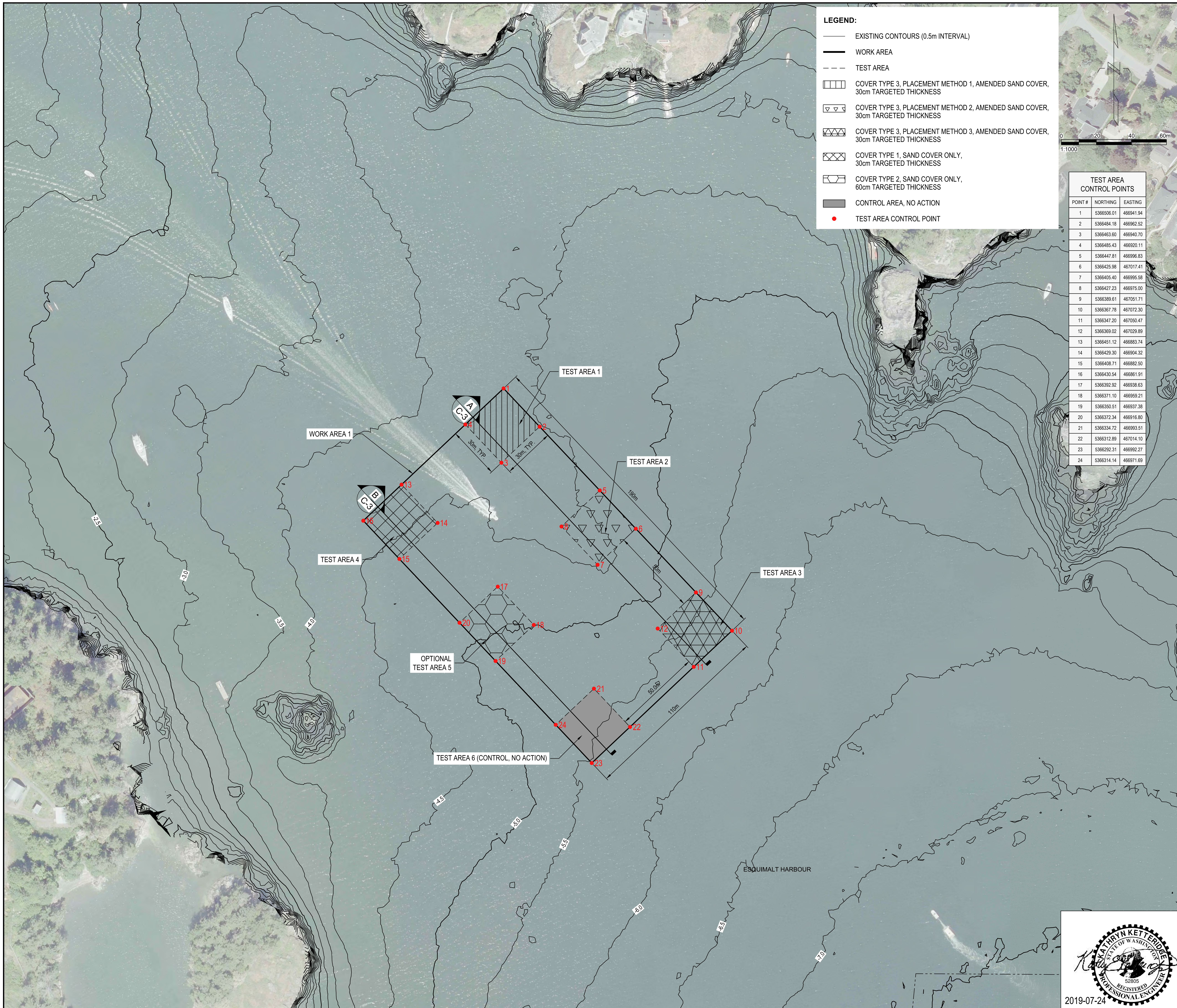
PF NO. | NO. DP
N/A

DWG. NO. | NO. DESSIN
T-3

Canada

BORDER LAST UPDATED 2012-04-01

2019/Jul/18, 9:44am chewett T-3 K:\Projects\0553-Public Works and Government Services Canada\EHRP Definition Phase\Wood Waste Remediation Project\Construction Plans\0553-PL-T_SERIES.dwg



LEGEND:

- EXISTING CONTOURS (0.5m INTERVAL)
- WORK AREA
- TEST AREA
- COVER TYPE 3, PLACEMENT METHOD 1, AMENDED SAND COVER, 30cm TARGETED THICKNESS
- COVER TYPE 3, PLACEMENT METHOD 2, AMENDED SAND COVER, 30cm TARGETED THICKNESS
- COVER TYPE 3, PLACEMENT METHOD 3, AMENDED SAND COVER, 30cm TARGETED THICKNESS
- COVER TYPE 1, SAND COVER ONLY, 30cm TARGETED THICKNESS
- COVER TYPE 2, SAND COVER ONLY, 60cm TARGETED THICKNESS
- CONTROL AREA, NO ACTION
- TEST AREA CONTROL POINT

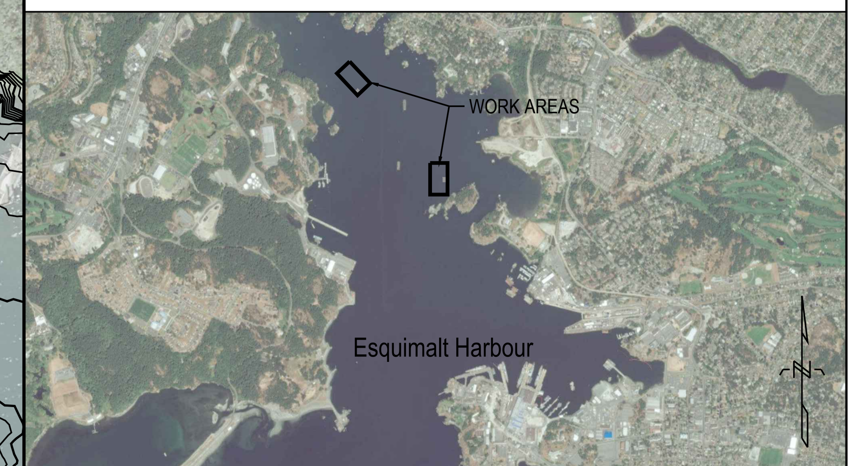
TEST AREA CONTROL POINTS

POINT #	NORTHING	EASTING
1	5366506.01	466941.94
2	5366484.18	466962.52
3	5366463.60	466940.70
4	5366485.43	466920.11
5	5366447.81	466996.83
6	5366425.98	467017.41
7	5366405.40	466995.58
8	5366427.23	466975.00
9	5366389.61	467051.71
10	5366367.78	467072.30
11	5366347.20	467050.47
12	5366369.02	467029.89
13	5366451.12	466883.74
14	5366429.30	466904.32
15	5366408.71	466882.50
16	5366430.54	466861.91
17	5366392.92	466938.63
18	5366371.10	466959.21
19	5366350.51	466937.38
20	5366372.34	466916.80
21	5366334.72	466993.51
22	5366312.89	467014.10
23	5366292.31	466992.27
24	5366314.14	466971.69

Government of Canada | Gouvernement du Canada

LEVEL OF SECURITY | NIVEAU DE SÉCURITÉ
TO BE REVIEWED | À ÊTRE REVISER

ANCHOR QEA



SOURCE: BATHYMETRY FROM MCCOI, DATED FEBRUARY 2019.
HORIZONTAL DATUM: UTM ZONE 10N, NAD83.
VERTICAL DATUM: CHART DATUM (CD).

NOTES:

1. CONTRACTOR MUST CONDUCT PLACEMENT TO THE EXTENTS SHOWN IN EACH TEST AREA AND IN ACCORDANCE WITH DETAILS ON DRAWING C-5.
2. THE CONTRACTOR MUST PLACE COVER TYPE 3 IN TEST AREAS 1, 2 AND 3 USING PLACEMENT METHODS 1, 2, AND 3, RESPECTIVELY, PER THE SPECIFICATIONS AND IN TEST AREAS 4 AND 5 USING ANY OF THE ACCEPTABLE PLACEMENT METHODS LISTED IN THE SPECIFICATIONS, OR OTHER METHODS PROPOSED BY THE CONTRACTOR, AND ACCEPTED BY THE DEPARTMENTAL REPRESENTATIVE AS AN ALTERNATE PLACEMENT METHOD.

NO.	DATE	REVISION	APPR.
0	2019/07/24	ISSUED FOR TENDER	

SCALE | ÉCHELLE
1:1000

LOCATION | EMPLACEMENT
ESQUIMALT HARBOUR

PROJECT | PROJET
DND WOOD WASTE REMEDIATION PILOT PROJECT

TRADE | MÉTIER: CIVIL/ENVIRONMENTAL
DATE: 2019/07/24

SUBJECT | SUJET
REQUIRED MATERIAL PLACEMENT PLAN - WORK AREA 1

PRODUCTION	REVIEWED | REVU	
DESIGNED | ÉTUDIÉ K. KETTERIDGE S. RODRIGUEZ	XX | XX X.X.	DES O | AGENT CONC
DRAWN | DESSINÉ C. HEWETT		PROJ MGR | GEST PROJ
CHECKED | VÉRIFIÉ T. WANG		DES MGR | GEST CONC
COORDINATION ----		FIRE | INCENDIE

WBS NO. | NO. OTP: N.000159.11.02
PF NO. | NO. DP: N/A
DWG. NO. | NO. DESSIN: C-1

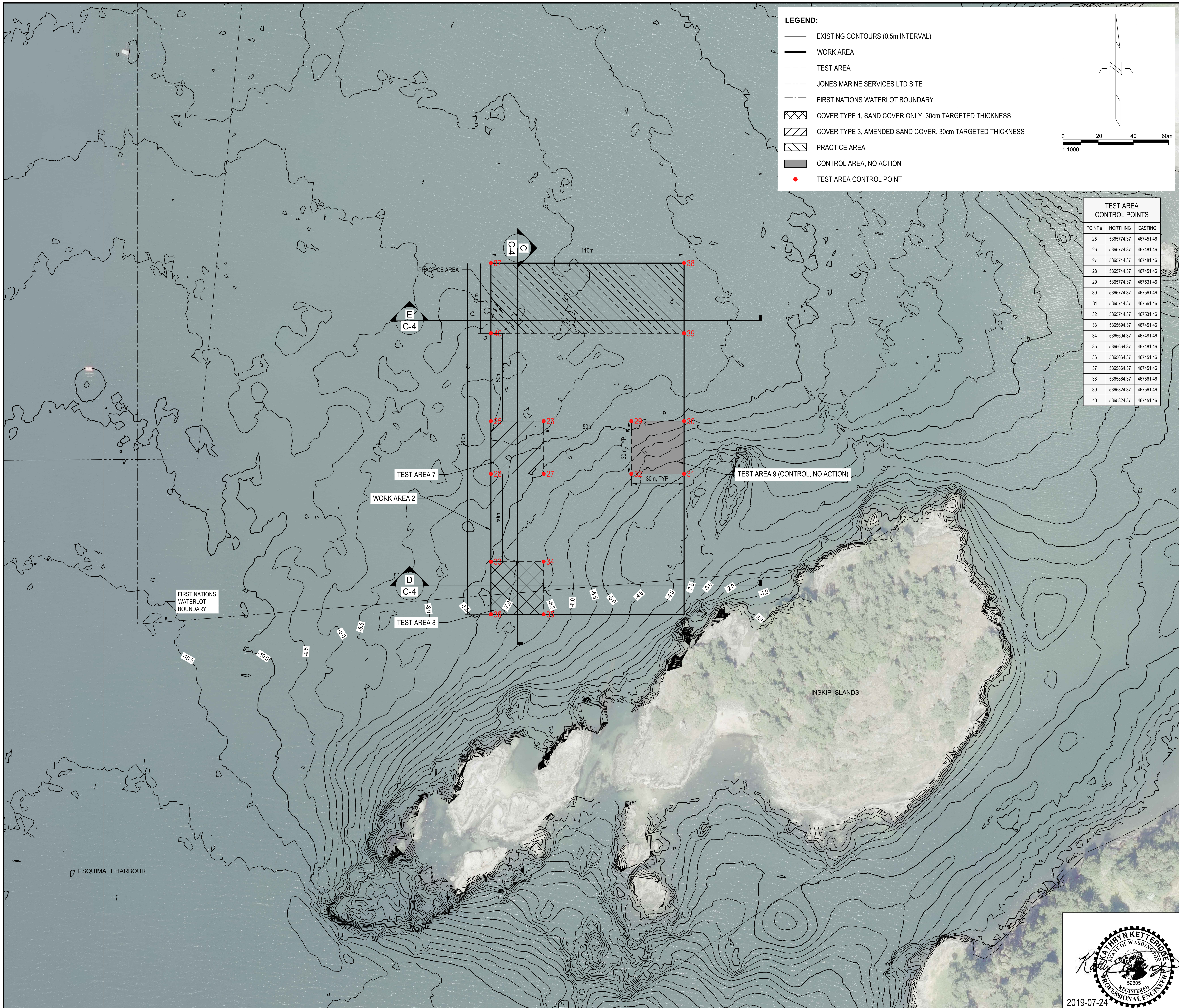
KATHRYN KETTERIDGE
STATE OF WASHINGTON
52805
REGISTERED PROFESSIONAL ENGINEER
2019-07-24

Canadä

BORDER LAST UPDATED 2012-04-01

2019/Jul/18, 9:45am chewett C-1 K:\Projects\0553-Public Works and Government Services Canada\EHRP Definition Phase\Wood Waste Remediation Project\Construction Plans\0553-PL-C_Series.dwg

Figure 4. Design and layout of Work Area 1, the test areas, and the treatments to be applied

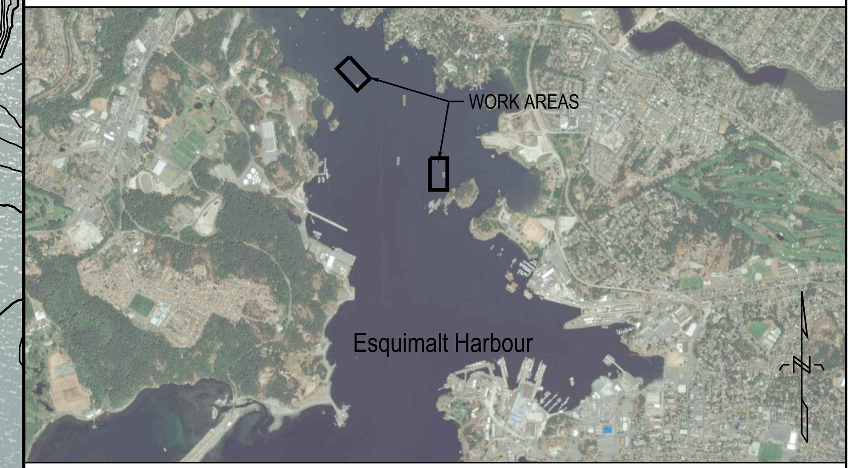


TEST AREA CONTROL POINTS		
POINT #	NORTHING	EASTING
25	5365774.37	467451.46
26	5365774.37	467481.46
27	5365744.37	467481.46
28	5365744.37	467451.46
29	5365774.37	467531.46
30	5365774.37	467561.46
31	5365744.37	467561.46
32	5365744.37	467531.46
33	5365694.37	467451.46
34	5365694.37	467481.46
35	5365664.37	467481.46
36	5365664.37	467451.46
37	5365864.37	467451.46
38	5365864.37	467561.46
39	5365824.37	467561.46
40	5365824.37	467451.46

Government of Canada
Gouvernement du Canada

LEVEL OF SECURITY | NIVEAU DE SÉCURITÉ
TO BE REVIEWED | À ÊTRE REVISER

ANCHOR QEA



SOURCE: BATHYMETRY FROM MCCOI, DATED FEBRUARY 2019.
HORIZONTAL DATUM: UTM ZONE 10N, NAD83.
VERTICAL DATUM: CHART DATUM (CD).

NOTES:
1. CONTRACTOR MUST CONDUCT PLACEMENT TO THE EXTENTS SHOWN IN EACH TEST AREA AND IN ACCORDANCE WITH DETAILS ON DRAWING C-5.
2. THE CONTRACTOR MUST PLACE COVER TYPES 1 AND 3 IN TEST AREAS 7 AND 8, RESPECTIVELY, USING ANY OF THE ACCEPTABLE PLACEMENT METHODS LISTED PER THE SPECIFICATIONS, OR OTHER METHODS PROPOSED BY THE CONTRACTOR, AND ACCEPTED BY THE DEPARTMENTAL REPRESENTATIVE AS AN ALTERNATE PLACEMENT METHOD.
3. ROCK MOUNDS (MATERIAL TYPE 3, WITH A 1.5-METRE TARGETED PLACEMENT HEIGHT AND 5-METRE TARGETED PLACEMENT DIAMETER) ARE REQUIRED TO BE PLACED IN TWO DISCRETE LOCATIONS WITHIN THE PRACTICE AREA (IN WORK AREA 2).
4. ROCK MOUNDS MUST BE PLACED IN AREAS WITH EXISTING BED ELEVATIONS OF -7m CD OR BELOW.

NO.	DATE	REVISION	APPR.
0	2019/07/24	ISSUED FOR TENDER	

SCALE | ÉCHELLE
1:1000

LOCATION | EMPLACEMENT
ESQUIMALT HARBOUR

PROJECT | PROJET
DND WOOD WASTE REMEDIATION PILOT PROJECT

TRADE | MÉTIER
CIVIL/ENVIRONMENTAL

DATE
2019/07/24

SUBJECT | SUJET
REQUIRED MATERIAL PLACEMENT PLAN - WORK AREA 2

PRODUCTION	REVIEWED | REVU	
DESIGNED | ÉTUDIÉ K. KETTERIDGE S. RODRIGUEZ	XX | XX X.X.	DES O | AGENT CONC
DRAWN | DESSINÉ C. HEWETT		PROJ MGR | GEST PROJ
CHECKED | VÉRIFIÉ T. WANG		DES MGR | GEST CONC
COORDINATION ----		FIRE | INCENDIE

WBS NO. | NO. OTP
N.000159.11.02

PF NO. | NO. DP
N/A

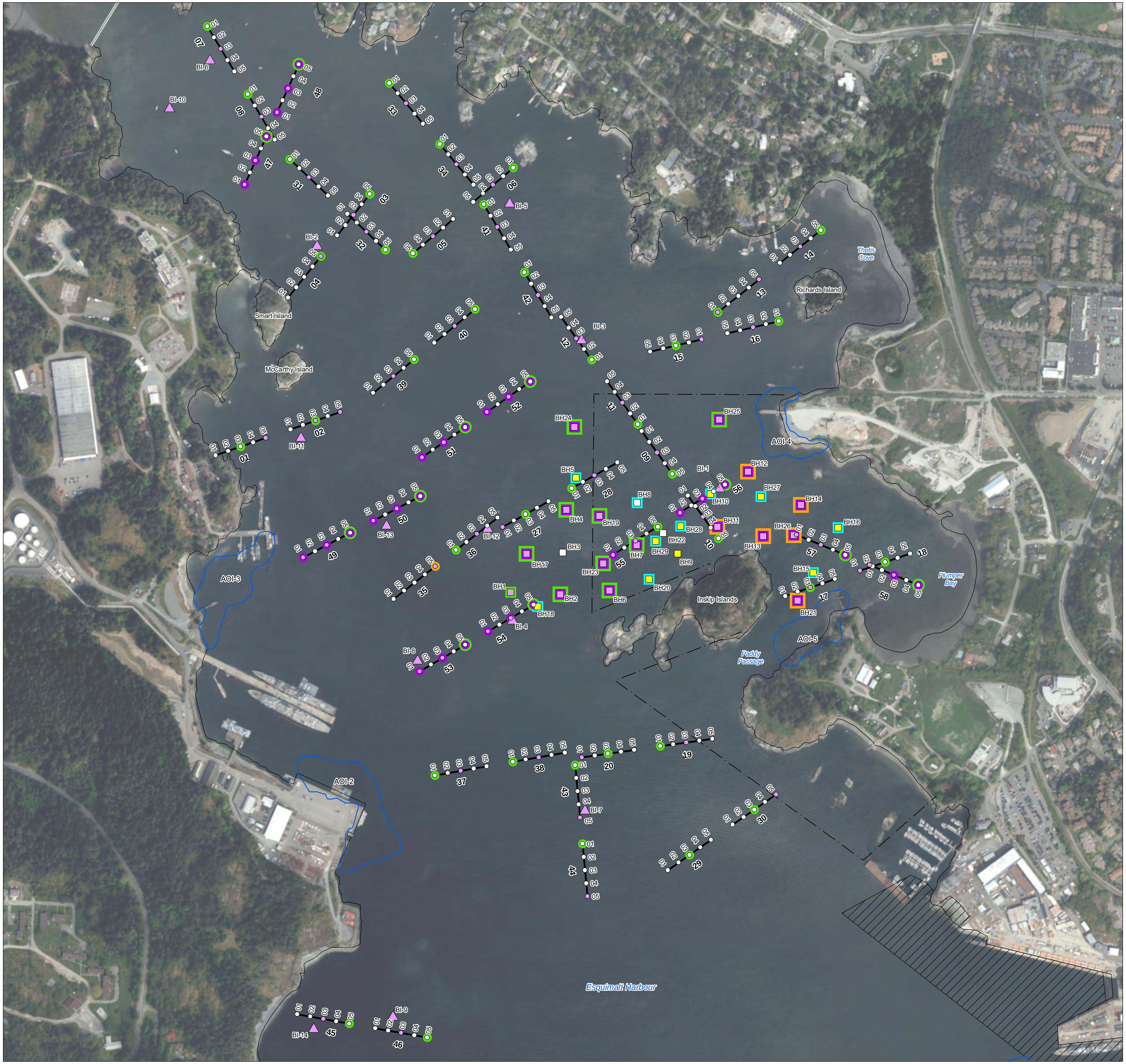
DWG. NO. | NO. DESSIN
C-2

KATHRYN KETTERIDGE
STATE OF WASHINGTON
52805
REGISTERED PROFESSIONAL ENGINEER
2019-07-24

Canadä

K:\Projects\0553-Public Works and Government Services Canada\EHRP Definition Phase\Wood Waste Remediation Project\Construction Plans\0553-PL-C_Series.dwg C-2 chewett 2019/Jul/18, 9:46am

Figure 5. Design and layout of Work Area 2, the test areas and practice area, and the treatments to be applied



Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Field Assessment Sampling Areas (Source: Hemmera 2018)

Legend

- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour

Sampling Location Type

- Benthic Infauna Sample Station
- Drill Borehole
- Biophysical Sample Station
- Dive Transect

Completed Sampling Analysis

- DAS Analytics
- pH
- Ammonia / pH
- Poer Water Sulphide / Ammonia / pH
- Total Organic Carbon - Surficial (0-10cm)
- Total Organic Carbon - Deeper (30-40cm)

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:5,000

0 100 200 300 400

Metres

NAD 1983 UTM Zone 10N

Page Size: 17" x 22"

376-240.08	Production Date: Jul 23, 2019	Figure 6

Hemmera
An Ausenco Company

Public Works and Government Services Canada

APPENDIX A
Sediment Chemistry Results

MILESTONE ENVIRONMENTAL
CONTRACTING WEST INC
ATTN: Vanessa Osorio
4481-232nd Street
Langley BC V2Z 2S2

Date Received: 06-MAY-19
Report Date: 10-MAY-19 18:52 (MT)
Version: FINAL

Client Phone: 778-220-1271

Certificate of Analysis

Lab Work Order #: L2268216

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 17-830008
Legal Site Desc:

Comments: Please note: the water used in the extraction of the Shakeflask analysis was provided by the client. QC with the client supplied water is included in this report.

Carla Fuginski
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2268216-1	L2268216-2	L2268216-3	L2268216-4	L2268216-5
	Description	Grab	Grab	Grab		
	Sampled Date	06-MAY-19	06-MAY-19	06-MAY-19		
	Sampled Time					
	Client ID	RIVER SAND - SAMPLE 1	RIVER SAND - SAMPLE 2	RIVER SAND - SAMPLE 2 DUP	CLIENT SUBMITTED WATER	LCS WITH CLIENT WATER
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	3.08	3.45	3.27	<0.25	<0.25
Leachable Anions & Nutrients	pH (pH)	7.42	7.45	7.45	7.96	8.10
Leachable Metals	Aluminum (Al)-Leachable (mg/L)	<0.25 DLM	<0.25 DLM	<0.25 DLM	<0.25 DLM	<0.25 DLM
	Antimony (Sb)-Leachable (mg/L)	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	0.100
	Arsenic (As)-Leachable (mg/L)	<0.050 DLM	<0.050 DLM	<0.050 DLM	<0.050 DLM	0.101
	Barium (Ba)-Leachable (mg/L)	0.518	0.549	0.607	<0.050 DLM	<0.050 DLM
	Beryllium (Be)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM
	Bismuth (Bi)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	0.088
	Boron (B)-Leachable (mg/L)	3.95	3.68	3.98	4.11	4.16
	Cadmium (Cd)-Leachable (mg/L)	<0.0025 DLM	<0.0025 DLM	<0.0025 DLM	<0.0025 DLM	0.0099
	Calcium (Ca)-Leachable (mg/L)	453	450	465	351	354
	Chromium (Cr)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM
	Cobalt (Co)-Leachable (mg/L)	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	0.0245
	Copper (Cu)-Leachable (mg/L)	<0.050 DLM	<0.050 DLM	<0.050 DLM	<0.050 DLM	<0.050 DLM
	Iron (Fe)-Leachable (mg/L)	<1.5 DLM	<1.5 DLM	<1.5 DLM	<1.5 DLM	<1.5 DLM
	Lead (Pb)-Leachable (mg/L)	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	0.0453
	Lithium (Li)-Leachable (mg/L)	<0.25 DLM	<0.25 DLM	<0.25 DLM	<0.25 DLM	<0.25 DLM
	Magnesium (Mg)-Leachable (mg/L)	1070	1120	1070	1120	1110
	Manganese (Mn)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	0.027
	Mercury (Hg)-Leachable (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000098
	Molybdenum (Mo)-Leachable (mg/L)	0.0059	0.0057	0.0059	0.0095	0.0347
	Nickel (Ni)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	0.046
	Phosphorus (P)-Leachable (mg/L)	<15 DLM	<15 DLM	<15 DLM	<15 DLM	<15 DLM
	Potassium (K)-Leachable (mg/L)	312	320	312	335	342
	Selenium (Se)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	0.097
	Silicon (Si)-Leachable (mg/L)	<2.5 DLM	<2.5 DLM	<2.5 DLM	<2.5 DLM	<2.5 DLM
	Silver (Ag)-Leachable (mg/L)	<0.0025 DLM	<0.0025 DLM	<0.0025 DLM	<0.0025 DLM	0.0087
	Sodium (Na)-Leachable (mg/L)	8550	8950	8720	8830	8750
	Strontium (Sr)-Leachable (mg/L)	6.69	6.70	6.57	6.37	6.41
	Thallium (Tl)-Leachable (mg/L)	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	<0.0050 DLM	0.0918
	Tin (Sn)-Leachable (mg/L)	<0.025 DLM	<0.025 DLM	<0.025 DLM	<0.025 DLM	0.045
	Titanium (Ti)-Leachable (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM
	Uranium (U)-Leachable (mg/L)	0.00271	0.00269	0.00263	0.00258	0.00323
	Vanadium (V)-Leachable (mg/L)	<0.050 DLM	<0.050 DLM	<0.050 DLM	<0.050 DLM	0.054
	Zinc (Zn)-Leachable (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Lead (Pb)-Leachable	B	L2268216-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-SHKFLSK-CVAFS-VA	Soil	Mercury by CVAAS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (MEND Report 1.20.1)" (William A. Price, 2009). In summary, a sample is extracted with deionized water at a 3:1 liquid to solids ratio for 24 hours. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using atomic absorption spectrophotometry (EPA Method 245.7). The Shakeflask extraction is an empirical procedure with pre-defined characteristics. Recovery of some elements (Ag, Bi, Hg, and Sn) by this method can be variable due to the neutral pH of the extraction fluid. LCS QC sample DQOs for these elements have been established at 50-130% for this reason

MET-SHKFLSK-MS-VA	Soil	Metals by ICPMS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (MEND Report 1.20.1)" (William A. Price, 2009). In summary, a sample is extracted with deionized water at a 3:1 liquid to solids ratio for 24 hours. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - mass spectrophotometry (EPA Method 6020A).
The Shakeflask extraction is an empirical procedure with pre-defined characteristics. Recovery of some elements (Ag, Bi, Hg, and Sn) by this method can be variable due to the neutral pH of the extraction fluid. LCS QC sample DQOs for these elements have been established at 50-130% for this reason.

MOISTURE-VA	Soil	Moisture content	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PH-SHKFLSK-PCT-VA	Soil	pH by PCT (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water . The extract is then allowed to settle and subsequently analysed using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-830008

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: MILESTONE ENVIRONMENTAL CONTRACTING WEST INC
4481-232nd Street
Langley BC V2Z 2S2
Contact: Vanessa Osorio

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-SHKFLSK-CVAFS-VA	**Soil**							
Batch R4630750								
WG3045718-2 DUP		**L2268216-2**						
Mercury (Hg)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	10-MAY-19
WG3045718-3 LCS								
Mercury (Hg)-Leachable			90.9		%		50-130	10-MAY-19
WG3045718-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	10-MAY-19
WG3045718-4 MS		**L2268216-3**						
Mercury (Hg)-Leachable			82.1		%		70-130	10-MAY-19
MET-SHKFLSK-MS-VA	**Soil**							
Batch R4630583								
WG3045718-2 DUP		**L2268216-2**						
Aluminum (Al)-Leachable		<0.25	<0.25	RPD-NA	mg/L	N/A	30	10-MAY-19
Antimony (Sb)-Leachable		<0.0050	<0.0050	RPD-NA	mg/L	N/A	30	10-MAY-19
Arsenic (As)-Leachable		<0.050	<0.050	RPD-NA	mg/L	N/A	30	10-MAY-19
Barium (Ba)-Leachable		0.549	0.591		mg/L	7.4	30	10-MAY-19
Beryllium (Be)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Bismuth (Bi)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Boron (B)-Leachable		3.68	3.91		mg/L	6.0	30	10-MAY-19
Cadmium (Cd)-Leachable		<0.0025	<0.0025	RPD-NA	mg/L	N/A	30	10-MAY-19
Calcium (Ca)-Leachable		450	455		mg/L	1.2	30	10-MAY-19
Chromium (Cr)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Cobalt (Co)-Leachable		<0.0050	<0.0050	RPD-NA	mg/L	N/A	30	10-MAY-19
Copper (Cu)-Leachable		<0.050	<0.050	RPD-NA	mg/L	N/A	30	10-MAY-19
Iron (Fe)-Leachable		<1.5	<1.5	RPD-NA	mg/L	N/A	40	10-MAY-19
Lead (Pb)-Leachable		<0.0050	<0.0050	RPD-NA	mg/L	N/A	30	10-MAY-19
Lithium (Li)-Leachable		<0.25	<0.25	RPD-NA	mg/L	N/A	30	10-MAY-19
Magnesium (Mg)-Leachable		1120	1110		mg/L	0.7	30	10-MAY-19
Manganese (Mn)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Molybdenum (Mo)-Leachable		0.0057	0.0056		mg/L	1.5	30	10-MAY-19
Nickel (Ni)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Phosphorus (P)-Leachable		<15	<15	RPD-NA	mg/L	N/A	40	10-MAY-19
Potassium (K)-Leachable		320	309		mg/L	3.5	30	10-MAY-19
Selenium (Se)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Silicon (Si)-Leachable		<2.5	<2.5	RPD-NA	mg/L	N/A	40	10-MAY-19
Silver (Ag)-Leachable		<0.0025	<0.0025	RPD-NA	mg/L	N/A	30	10-MAY-19
Sodium (Na)-Leachable		8950	8670		mg/L	3.2	30	10-MAY-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA	**Soil**							
Batch R4630583								
WG3045718-2 DUP		**L2268216-2**						
Strontium (Sr)-Leachable		6.70	6.79		mg/L	1.3	30	10-MAY-19
Thallium (Tl)-Leachable		<0.0050	<0.0050	RPD-NA	mg/L	N/A	30	10-MAY-19
Tin (Sn)-Leachable		<0.025	<0.025	RPD-NA	mg/L	N/A	30	10-MAY-19
Titanium (Ti)-Leachable		<0.50	<0.50	RPD-NA	mg/L	N/A	40	10-MAY-19
Uranium (U)-Leachable		0.00269	0.00265		mg/L	1.6	30	10-MAY-19
Vanadium (V)-Leachable		<0.050	<0.050	RPD-NA	mg/L	N/A	30	10-MAY-19
Zinc (Zn)-Leachable		<0.50	<0.50	RPD-NA	mg/L	N/A	30	10-MAY-19
WG3045718-3 LCS								
Aluminum (Al)-Leachable			97.2		%		70-130	10-MAY-19
Antimony (Sb)-Leachable			94.2		%		70-130	10-MAY-19
Arsenic (As)-Leachable			93.8		%		70-130	10-MAY-19
Barium (Ba)-Leachable			95.9		%		70-130	10-MAY-19
Beryllium (Be)-Leachable			102.1		%		70-130	10-MAY-19
Bismuth (Bi)-Leachable			94.9		%		50-130	10-MAY-19
Boron (B)-Leachable			102.3		%		70-130	10-MAY-19
Cadmium (Cd)-Leachable			93.8		%		70-130	10-MAY-19
Calcium (Ca)-Leachable			91.6		%		70-130	10-MAY-19
Chromium (Cr)-Leachable			95.5		%		70-130	10-MAY-19
Cobalt (Co)-Leachable			93.9		%		70-130	10-MAY-19
Copper (Cu)-Leachable			92.3		%		70-130	10-MAY-19
Iron (Fe)-Leachable			95.0		%		70-130	10-MAY-19
Lead (Pb)-Leachable			96.4		%		70-130	10-MAY-19
Lithium (Li)-Leachable			101.4		%		70-130	10-MAY-19
Magnesium (Mg)-Leachable			98.0		%		70-130	10-MAY-19
Manganese (Mn)-Leachable			95.9		%		70-130	10-MAY-19
Molybdenum (Mo)-Leachable			95.9		%		70-130	10-MAY-19
Nickel (Ni)-Leachable			93.1		%		70-130	10-MAY-19
Phosphorus (P)-Leachable			103.2		%		70-130	10-MAY-19
Potassium (K)-Leachable			91.4		%		70-130	10-MAY-19
Selenium (Se)-Leachable			91.1		%		70-130	10-MAY-19
Silicon (Si)-Leachable			97.4		%		70-130	10-MAY-19
Silver (Ag)-Leachable			88.0		%		50-130	10-MAY-19
Sodium (Na)-Leachable			93.0		%		70-130	10-MAY-19
Strontium (Sr)-Leachable			93.3		%		70-130	10-MAY-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA	**Soil**							
Batch R4630583								
WG3045718-3 LCS								
Thallium (Tl)-Leachable			86.8		%		70-130	10-MAY-19
Tin (Sn)-Leachable			95.9		%		50-130	10-MAY-19
Titanium (Ti)-Leachable			89.1		%		70-130	10-MAY-19
Uranium (U)-Leachable			98.7		%		70-130	10-MAY-19
Vanadium (V)-Leachable			95.1		%		70-130	10-MAY-19
Zinc (Zn)-Leachable			93.7		%		70-130	10-MAY-19
WG3045718-1 MB								
Aluminum (Al)-Leachable			<0.0050		mg/L		0.005	10-MAY-19
Antimony (Sb)-Leachable			<0.00010		mg/L		0.0001	10-MAY-19
Arsenic (As)-Leachable			<0.0010		mg/L		0.001	10-MAY-19
Barium (Ba)-Leachable			<0.0010		mg/L		0.001	10-MAY-19
Beryllium (Be)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Bismuth (Bi)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Boron (B)-Leachable			<0.010		mg/L		0.01	10-MAY-19
Cadmium (Cd)-Leachable			<0.000050		mg/L		0.00005	10-MAY-19
Calcium (Ca)-Leachable			<0.10		mg/L		0.1	10-MAY-19
Chromium (Cr)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Cobalt (Co)-Leachable			<0.00010		mg/L		0.0001	10-MAY-19
Copper (Cu)-Leachable			<0.0010		mg/L		0.001	10-MAY-19
Iron (Fe)-Leachable			<0.030		mg/L		0.03	10-MAY-19
Lead (Pb)-Leachable			0.00024	B	mg/L		0.0001	10-MAY-19
Lithium (Li)-Leachable			<0.0050		mg/L		0.005	10-MAY-19
Magnesium (Mg)-Leachable			<0.050		mg/L		0.05	10-MAY-19
Manganese (Mn)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Molybdenum (Mo)-Leachable			<0.00010		mg/L		0.0001	10-MAY-19
Nickel (Ni)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Phosphorus (P)-Leachable			<0.30		mg/L		0.3	10-MAY-19
Potassium (K)-Leachable			<0.050		mg/L		0.05	10-MAY-19
Selenium (Se)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Silicon (Si)-Leachable			<0.050		mg/L		0.05	10-MAY-19
Silver (Ag)-Leachable			<0.000050		mg/L		0.00005	10-MAY-19
Sodium (Na)-Leachable			<0.050		mg/L		0.05	10-MAY-19
Strontium (Sr)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Thallium (Tl)-Leachable			<0.00010		mg/L		0.0001	10-MAY-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA	**Soil**							
Batch R4630583								
WG3045718-1 MB								
Tin (Sn)-Leachable			<0.00050		mg/L		0.0005	10-MAY-19
Titanium (Ti)-Leachable			<0.010		mg/L		0.01	10-MAY-19
Uranium (U)-Leachable			<0.000010		mg/L		0.00001	10-MAY-19
Vanadium (V)-Leachable			<0.0010		mg/L		0.001	10-MAY-19
Zinc (Zn)-Leachable			<0.010		mg/L		0.01	10-MAY-19
MOISTURE-VA	**Soil**							
Batch R4627151								
WG3043588-3 DUP		**L2268216-1**						
Moisture		3.08	3.00		%	2.7	20	07-MAY-19
WG3043588-2 LCS								
Moisture			99.9		%		90-110	07-MAY-19
WG3043588-1 MB								
Moisture			<0.25		%		0.25	07-MAY-19
Batch R4630280								
WG3046026-2 LCS								
Moisture			101.2		%		90-110	09-MAY-19
WG3046026-1 MB								
Moisture			<0.25		%		0.25	09-MAY-19
PH-SHKFLSK-PCT-VA	**Soil**							
Batch R4630896								
WG3045718-2 DUP		**L2268216-2**						
pH		7.45	7.47	J	pH	0.02	0.3	10-MAY-19

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2268216-COFC

COC Number: 17 - 830008

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Milestone Env.
Contact:	Calvin Stucket / Vanessa Osorio
Phone:	
Company address below will appear on the final report	
Street:	301 - 202nd St ~~Clayto~~
City/Province:	Langley BC
Postal Code:	V1M 4A6
Invoice To	Same as Report To [X] YES [ ] NO
	Copy of Invoice with Report [ ] YES [ ] NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[ ] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	Calvin@milestoneenv.ca
Email 2	Vanessa@milestoneenv.ca
Email 3	
Invoice Distribution	
Select Invoice Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	
Email 2	

Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [ ]	Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days)	4 day [P4-20%] [ ] 3 day [P3-25%] [ ] 2 day [P2-50%] [ ]
EMERGENCY	1 Business day [E - 100%] [ ] Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]
Date and Time Required for all E&P TATs:	dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information	
ALS Account # / Quote #:	Y Jetty
Job #:	02180047
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	~~Total Metals~~	~~RAHL L Aff~~	ARA potential (ABA)	ML Potential (ICP-MS)	ML Potential (SFE)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Riversand - Sample 1	06 MAY 19		GRAB	2			X	X	X		
	Riversand - Sample 2	|		|	2			X	X	X		
	Riversand - Sample 2 deep	|		|	2			X	X	X		

Drinking Water (DW) Samples[1] (client use)	
Are samples taken from a Regulated DW System?	[ ] YES [ ] NO
Are samples for human consumption/ use?	[ ] YES [ ] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

*Please let CARLA FUGINSKI know these samples have arrived.
TAT: 2 day leachate rush.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ]		SIF Observations	Yes [ ]	No [ ]
Ice Packs [X]	Ice Cubes [ ]	Custody seal intact	Yes [ ]	No [ ]
Cooling Initiated [X]				
INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	22	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 06 May 19	Time: 1830	Received by:	Date:	Time:	Received by: HA	Date: 5/6	Time: 6:25pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY   JUNE 2016 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

AGAT Laboratories

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING
4481 - 232 STREET
LANGLEY, BC V2Z2S2
(604) 329-5554

ATTENTION TO: Vanessa Osorio

PROJECT: 18-014 C Jetty ML Floats

AGAT WORK ORDER: 19V437506

SOIL ANALYSIS REVIEWED BY: Dana Solari, Lab Reporter

TRACE ORGANICS REVIEWED BY: Dana Solari, Lab Reporter

DATE REPORTED: Feb 19, 2019

PAGES (INCLUDING COVER): 16

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (778) 452-4000

*NOTES
VERSION 1: Sample receipt temperature 1°C.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Unit 120, 8600 Glenlyon Parkway
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CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING

ATTENTION TO: Vanessa Osorio

SAMPLING SITE:

SAMPLED BY:

BC CSR Omnibus Metals in Soil

DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

			SAMPLE DESCRIPTION:	River Sand Sample 1	River Sand Sample 1 DUP	River Sand Sample 2	River Sand Sample 3	River Sand Sample 4	River Sand Sample 5	River Sand Sample 6	River Sand Sample 7
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13
Parameter	Unit	G / S	RDL	9901386	9901393	9901394	9901395	9901396	9901397	9901398	9901399
Aluminum	µg/g	40000	10	9000	8730	8880	9050	8840	8960	8870	8530
Antimony	µg/g	250	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Arsenic	µg/g	10	0.1	3.0	2.8	2.6	2.4	3.2	3.4	3.0	2.3
Barium	µg/g	350	0.5	45.4	47.8	47.6	47.4	50.4	59.7	43.7	41.7
Beryllium	µg/g		0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Bismuth	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Boron	µg/g	8500	0.5	1.9	2.0	2.1	2.3	2.0	2.0	2.3	1.8
Cadmium	µg/g		0.01	0.18	0.18	0.18	0.19	0.19	0.18	0.17	0.17
Chromium	µg/g		1	27	28	25	27	27	26	28	27
Cobalt	µg/g	25	0.1	7.2	7.2	7.1	7.3	7.0	7.4	6.8	7.1
Copper	µg/g		0.2	14.2	13.6	13.6	14.2	14.3	13.9	13.2	14.2
Iron	µg/g	35000	10	18200	18300	18500	18600	18100	18000	17600	17400
Lead	µg/g		0.1	1.9	1.9	2.0	1.8	1.8	2.0	1.9	1.8
Lithium	µg/g	30	0.5	7.3	7.2	7.3	7.6	7.6	7.8	7.4	7.0
Manganese	µg/g	2000	1	302	312	321	306	310	315	309	291
Mercury	µg/g		0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02
Molybdenum	µg/g	15	0.2	0.3	0.3	0.3	0.3	0.5	0.3	0.3	0.3
Nickel	µg/g		0.5	31.8	31.2	31.1	33.3	32.7	33.3	32.7	30.9
Selenium	µg/g	1	0.1	0.3	0.3	0.4	0.2	0.2	0.4	0.2	0.2
Silver	µg/g	200	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Strontium	µg/g	9500	1	23	23	23	24	23	26	21	22
Thallium	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/g	25000	0.2	<0.2	0.2	<0.2	<0.2	0.2	0.2	<0.2	<0.2
Tungsten	µg/g	15	0.05	0.09	0.07	0.06	0.07	0.07	0.07	0.06	0.07
Uranium	µg/g	30	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2
Vanadium	µg/g	100	1	40	40	40	40	40	40	38	37
Zinc	µg/g		1	39	38	38	38	37	39	37	37
Zirconium	µg/g		0.1	4.6	5.0	4.7	4.6	4.8	5.1	4.8	4.3
pH 1:2	pH units		0.05	7.47	7.51	7.63	7.70	7.75	7.76	7.75	7.78

Certified By: D. Solani

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING

ATTENTION TO: Vanessa Osorio

SAMPLING SITE:

SAMPLED BY:

BC CSR Omnibus Metals in Soil

DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

Certified By: D. Solanni

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 19V437506

PROJECT: 18-014 C Jetty ML Floats

Unit 120, 8600 Glenlyon Parkway
Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING

ATTENTION TO: Vanessa Osorio

SAMPLING SITE:

SAMPLED BY:

BC CSR Omnibus Metals in Soil

DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

			SAMPLE DESCRIPTION:	River Sand Sample 8
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2019-02-13
Parameter	Unit	G / S	RDL	9901400
Aluminum	µg/g	40000	10	9000
Antimony	µg/g	250	0.1	0.2
Arsenic	µg/g	10	0.1	2.9
Barium	µg/g	350	0.5	56.8
Beryllium	µg/g		0.1	0.2
Bismuth	µg/g		0.5	<0.5
Boron	µg/g	8500	0.5	2.4
Cadmium	µg/g		0.01	0.19
Chromium	µg/g		1	25
Cobalt	µg/g	25	0.1	7.2
Copper	µg/g		0.2	14.6
Iron	µg/g	35000	10	17900
Lead	µg/g		0.1	1.9
Lithium	µg/g	30	0.5	7.5
Manganese	µg/g	2000	1	313
Mercury	µg/g		0.01	0.02
Molybdenum	µg/g	15	0.2	0.4
Nickel	µg/g		0.5	32.6
Selenium	µg/g	1	0.1	0.3
Silver	µg/g	200	0.5	<0.5
Strontium	µg/g	9500	1	25
Thallium	µg/g		0.1	<0.1
Tin	µg/g	25000	0.2	0.2
Tungsten	µg/g	15	0.05	0.06
Uranium	µg/g	30	0.2	0.3
Vanadium	µg/g	100	1	39
Zinc	µg/g		1	38
Zirconium	µg/g		0.1	4.8
pH 1:2	pH units		0.05	7.80

Certified By: D. Solani

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FAX (778)452-4074
http://www.agatlabs.com

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING

ATTENTION TO: Vanessa Osorio

SAMPLING SITE:

SAMPLED BY:

BC CSR Omnibus Metals in Soil

DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to BC CSR Schedule 3.1 - Residential Low Density (Site-specific factor: Groundwater used for drinking)
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9901386-9901400 Results are based on the dry weight of the sample

Analysis performed at AGAT Vancouver (unless marked by *)

Certified By: D. Solani

AGAT Laboratories

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Burnaby, British Columbia
CANADA V5J 0B6
TEL (778)452-4000
FAX (778)452-4074
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 19V437506

PROJECT: 18-014 C Jetty ML Floats

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING

ATTENTION TO: Vanessa Osorio

SAMPLING SITE:

SAMPLED BY:

LEPH/HEPH Soil

DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

Parameter	Unit	G / S	RDL	River Sand Sample 1	River Sand Sample 1 DUP	River Sand Sample 2	River Sand Sample 3	River Sand Sample 4	River Sand Sample 5	River Sand Sample 6	River Sand Sample 7
			SAMPLE TYPE:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
			DATE SAMPLED:	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13	2019-02-13
				9901386	9901393	9901394	9901395	9901396	9901397	9901398	9901399
Naphthalene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	µg/g	60	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1-Methylnaphthalene	µg/g	250	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	µg/g		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	µg/g	950	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	µg/g	600	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	µg/g	1500	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pyrene	µg/g	1000	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)anthracene	µg/g	50	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chrysene	µg/g	200	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(j)fluoranthene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	µg/g	50	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibenzo(a,h)anthracene	µg/g	5	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g,h,i)perylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Quinoline	µg/g	2.5	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
EPH C10-C19	µg/g		20	<20	<20	<20	<20	<20	<20	<20	<20
EPH C19-C32	µg/g		20	<20	<20	<20	<20	<20	<20	<20	<20
LEPH C10-C19	µg/g	1000	20	<20	<20	<20	<20	<20	<20	<20	<20
HEPH C19-C32	µg/g	1000	20	<20	<20	<20	<20	<20	<20	<20	<20
Benzo(b+j)fluoranthene	µg/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Surrogate	Unit	Acceptable Limits									
Naphthalene - d8	%	50-130		94	92	97	85	94	93	91	94
2-Fluorobiphenyl	%	50-130		99	98	98	90	99	99	96	99
P-Terphenyl - d14	%	60-130		90	89	94	83	89	91	88	89

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CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING

ATTENTION TO: Vanessa Osorio

SAMPLING SITE:

SAMPLED BY:

LEPH/HEPH Soil

DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

Certified By: D. Solanii

Certificate of Analysis

AGAT WORK ORDER: 19V437506

PROJECT: 18-014 C Jetty ML Floats

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DATE RECEIVED: 2019-02-13

DATE REPORTED: 2019-02-19

			SAMPLE DESCRIPTION:	River Sand Sample 8
			SAMPLE TYPE:	Sediment
			DATE SAMPLED:	2019-02-13
Parameter	Unit	G / S	RDL	9901400
Naphthalene	µg/g		0.01	<0.01
2-Methylnaphthalene	µg/g	60	0.01	<0.01
1-Methylnaphthalene	µg/g	250	0.01	<0.01
Acenaphthylene	µg/g		0.01	<0.01
Acenaphthene	µg/g	950	0.01	<0.01
Fluorene	µg/g	600	0.02	<0.02
Phenanthrene	µg/g	1500	0.02	<0.02
Anthracene	µg/g		0.02	<0.02
Fluoranthene	µg/g		0.05	<0.05
Pyrene	µg/g	1000	0.02	<0.02
Benzo(a)anthracene	µg/g	50	0.02	<0.02
Chrysene	µg/g	200	0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.02	<0.02
Benzo(j)fluoranthene	µg/g		0.02	<0.02
Benzo(k)fluoranthene	µg/g	50	0.02	<0.02
Benzo(a)pyrene	µg/g		0.05	<0.05
Indeno(1,2,3-c,d)pyrene	µg/g		0.02	<0.02
Dibenzo(a,h)anthracene	µg/g	5	0.02	<0.02
Benzo(g,h,i)perylene	µg/g		0.05	<0.05
Quinoline	µg/g	2.5	0.05	<0.05
EPH C10-C19	µg/g		20	<20
EPH C19-C32	µg/g		20	<20
LEPH C10-C19	µg/g	1000	20	<20
HEPH C19-C32	µg/g	1000	20	<20
Benzo(b+j)fluoranthene	µg/g		0.03	<0.03
Surrogate	Unit	Acceptable Limits		
Naphthalene - d8	%	50-130		91
2-Fluorobiphenyl	%	50-130		97
P-Terphenyl - d14	%	60-130		88

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LEPH/HEPH Soil

DATE RECEIVED: 2019-02-13
DATE REPORTED: 2019-02-19

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to BC CSR Schedule 3.1 - Residential Low Density (Site-specific factor: Groundwater used for drinking)
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9901386-9901400 Results are based on dry weight of sample.
LEPH & HEPH results have been corrected for PAH contributions.

Analysis performed at AGAT Vancouver (unless marked by *)

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Quality Assurance

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING
PROJECT: 18-014 C Jetty ML Floats
SAMPLING SITE:

AGAT WORK ORDER: 19V437506
ATTENTION TO: Vanessa Osorio
SAMPLED BY:

Soil Analysis

RPT Date: Feb 19, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
BC CSR Omnibus Metals in Soil															
Aluminum	9901386		9000	8940	0.6%	< 10	113%	70%	130%	106%	90%	110%			
Antimony	9901386		0.2	0.2	NA	< 0.1	115%	70%	130%	108%	90%	110%			
Arsenic	9901386		3.0	3.2	6.3%	< 0.1	102%	70%	130%	104%	90%	110%			
Barium	9901386		45.4	43.9	3.4%	< 0.5	105%	70%	130%	99%	90%	110%			
Beryllium	9901386		0.2	0.2	NA	< 0.1	101%	70%	130%	99%	90%	110%			
Bismuth	9901386		<0.5	<0.5	NA	< 0.5				100%	90%	110%			
Boron	9901386		1.9	2.0	NA	< 0.5				105%	90%	110%			
Cadmium	9901386		0.18	0.18	0.9%	< 0.01	115%	70%	130%	100%	90%	110%			
Chromium	9901386		27	26	4.6%	< 1	105%	70%	130%	93%	90%	110%			
Cobalt	9901386		7.2	6.7	7.4%	< 0.1	102%	70%	130%	91%	90%	110%			
Copper	9901386		14.2	13.9	2.2%	< 0.2	100%	70%	130%	93%	90%	110%			
Iron	9901386		18200	17800	2.1%	< 10	111%	70%	130%	104%	90%	110%			
Lead	9901386		1.9	1.8	2.8%	< 0.1	88%	70%	130%	92%	90%	110%			
Lithium	9901386		7.3	7.4	1.2%	< 0.5				100%	90%	110%			
Manganese	9901386		302	306	1.1%	< 1	96%	70%	130%	103%	90%	110%			
Mercury	9901386		0.02	0.02	NA	< 0.01	86%	70%	130%	98%	90%	110%			
Molybdenum	9901386		0.3	0.3	NA	< 0.2	102%	70%	130%	95%	90%	110%			
Nickel	9901386		31.8	30.1	5.3%	< 0.5	107%	70%	130%	95%	90%	110%			
Selenium	9901386		0.3	0.4	NA	< 0.1				101%	90%	110%			
Silver	9901386		<0.5	<0.5	NA	< 0.5	118%	70%	130%	97%	90%	110%			
Strontium	9901386		23	23	0.7%	< 1	112%	70%	130%	103%	90%	110%			
Thallium	9901386		<0.1	<0.1	NA	< 0.1	103%	70%	130%	94%	90%	110%			
Tin	9901386		<0.2	<0.2	NA	< 0.2	95%	70%	130%	99%	90%	110%			
Tungsten	9901386		0.09	0.07	NA	< 0.05				98%	90%	110%			
Uranium	9901386		0.3	0.3	NA	< 0.2	97%	70%	130%	98%	90%	110%			
Vanadium	9901386		40	38	6.0%	< 1	106%	70%	130%	93%	90%	110%			
Zinc	9901386		39	36	8.8%	< 1	106%	70%	130%	109%	90%	110%			
Zirconium	9901386		4.6	4.6	0.5%	< 0.1				95%	90%	110%			
pH 1:2	9901386		7.47	7.51	0.5%		99%	90%	110%	100%	95%	105%			

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

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Quality Assurance

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING | AGAT WORK ORDER: 19V437506
PROJECT: 18-014 C Jetty ML Floats | ATTENTION TO: Vanessa Osorio
SAMPLING SITE: | SAMPLED BY:

Trace Organics Analysis

RPT Date: Feb 19, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
LEPH/HEPH Soil															
Naphthalene	70645	9901400	<0.01	<0.01	NA	< 0.01	101%	80%	120%				106%	50%	130%
2-Methylnaphthalene	70645	9901400	<0.01	<0.01	NA	< 0.01	99%	80%	120%				99%	50%	130%
1-Methylnaphthalene	70645	9901400	<0.01	<0.01	NA	< 0.01	100%	80%	120%				99%	50%	130%
Acenaphthylene	70645	9901400	<0.01	<0.01	NA	< 0.01	100%	80%	120%				91%	50%	130%
Acenaphthene	70645	9901400	<0.01	<0.01	NA	< 0.01	101%	80%	120%				107%	50%	130%
Fluorene	70645	9901400	<0.02	<0.02	NA	< 0.02	100%	80%	120%				97%	50%	130%
Phenanthrene	70645	9901400	<0.02	<0.02	NA	< 0.02	100%	80%	120%				102%	60%	130%
Anthracene	70645	9901400	<0.02	<0.02	NA	< 0.02	97%	80%	120%				89%	60%	130%
Fluoranthene	70645	9901400	<0.05	<0.05	NA	< 0.05	99%	80%	120%				95%	60%	130%
Pyrene	70645	9901400	<0.02	<0.02	NA	< 0.02	98%	80%	120%				98%	60%	130%
Benzo(a)anthracene	70645	9901400	<0.02	<0.02	NA	< 0.02	99%	80%	120%				93%	60%	130%
Chrysene	70645	9901400	<0.05	<0.05	NA	< 0.05	99%	80%	120%				100%	60%	130%
Benzo(b)fluoranthene	70645	9901400	<0.02	<0.02	NA	< 0.02	94%	80%	120%				97%	60%	130%
Benzo(j)fluoranthene	70645	9901400	<0.02	<0.02	NA	< 0.02	97%	80%	120%				103%	60%	130%
Benzo(k)fluoranthene	70645	9901400	<0.02	<0.02	NA	< 0.02	105%	80%	120%				94%	60%	130%
Benzo(a)pyrene	70645	9901400	<0.05	<0.05	NA	< 0.05	99%	80%	120%				92%	60%	130%
Indeno(1,2,3-c,d)pyrene	70645	9901400	<0.02	<0.02	NA	< 0.02	99%	80%	120%				85%	60%	130%
Dibenzo(a,h)anthracene	70645	9901400	<0.02	<0.02	NA	< 0.02	100%	80%	130%				78%	60%	130%
Benzo(g,h,i)perylene	70645	9901400	<0.05	<0.05	NA	< 0.05	100%	80%	120%				104%	60%	130%
Quinoline	70645	9901400	<0.05	<0.05	NA	< 0.05	99%	80%	120%				104%	50%	130%
Naphthalene - d8	70645	9901400	91	90	1.1%		101%	80%	120%				102%	50%	130%
2-Fluorobiphenyl	70645	9901400	97	96	1.0%		101%	80%	120%				108%	50%	130%
P-Terphenyl - d14	70645	9901400	88	88	0.0%		101%	80%	120%				102%	60%	130%
EPH C10-C19	70645	9901400	<20	<20	NA	< 20	99%	70%	130%				115%	65%	120%
EPH C19-C32	70645	9901400	<20	<20	NA	< 20	101%	70%	130%				116%	80%	120%

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Certified By: D. Solani

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Method Summary

CLIENT NAME: MILESTONE ENVIRONMENTAL CONTRACTING
AGAT WORK ORDER: 19V437506
PROJECT: 18-014 C Jetty ML Floats
ATTENTION TO: Vanessa Osorio
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Aluminum	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Antimony	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Arsenic	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Barium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Beryllium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Bismuth	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Boron	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP/MS
Cadmium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Chromium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Cobalt	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Copper	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Iron	MET-181-6106, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP/OES
Lead	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Lithium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Manganese	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Mercury	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Molybdenum	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Nickel	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Selenium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Silver	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Strontium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6010C	ICP-MS
Thallium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Tin	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Tungsten	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Uranium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Vanadium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
Zinc	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Zirconium	MET-181-6102, LAB-181-4008	BC MOE Lab Manual C (SALM) and EPA 6020A	ICP-MS
pH 1:2	INOR-181-6031	BC MOE Lab Manual B (pH, Electrometric, Soil)	PH METER

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
1-Methylnaphthalene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Acenaphthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluorene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Phenanthrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Chrysene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(b)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(j)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(k)fluoranthene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(a)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Indeno(1,2,3-c,d)pyrene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Dibenzo(a,h)anthracene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Benzo(g,h,i)perylene	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Quinoline	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
Naphthalene - d8	ORG-180-5102	Modified from BC MOE Lab Manual Section D (PAH)	GC/MS
2-Fluorobiphenyl	ORG-180-5102	modified from BC MOE Lab Manual Section D (PAH)	GC/MS
P-Terphenyl - d14	ORG-180-5102	modified from BC MOE Lab Manual Section D (PAH)	GC/MS
EPH C10-C19	ORG-180-5101	Modified from BCMOE Lab Manual Section D (EPH)	GC/FID
EPH C19-C32	ORG-180-5101	Modified from BCMOE Lab Manual Section D (EPH)	GC/FID
LEPH C10-C19	ORG-180-5101	Modified from BCMOE Lab Manual Section D (EPH)	GC/FID
HEPH C19-C32	ORG-180-5101	Modified from BCMOE Lab Manual Section D (EPH)	GC/FID

AGAT Laboratories

120 - 8600 Glenlyon Parkway
Burnaby, BC
V5J 0B6

P: 778.452.4000 • F: 778.452.4074

Laboratory Use Only

Arrival Temperature: 1°C

AGAT Job Number: 19V437506

Notes: FEB 15 PM5:05

Chain of Custody Record

Report Information

Company: Milestone Environmental Contracting Inc.
Contact: Vanessa Osorio
Address: 9440-202 St, Unit 301
Langley, BC, V1M 4A6
Phone: 604-283-9292 Fax:
AGAT Quote #:
Client Project #: 18-014 C Jetty ML Floats

Report Information

1. Name: Vanessa Osorio
   Email: vanessao@milestoneenv.ca
2. Name: Bill Morgan
   Email: billm@milestoneenv.ca

Report Format

☐ Single Sample per page
☑ Multiple Samples per page
☑ Excel Format Included

Turnaround Time Required (TAT)

Regular TAT ☐ 5 to 7 working days
Rush TAT ☐ Same Business Day - 200%
☐ 1 Business Day - 100%
☑ 2 Business Days - 50%
☐ 3 Business Days - 25%

Date Required:

PLEASE CONTACT LABORATORY IF RUSH REQUIRED SAMPLE SUBMISSION CUT OFF FOR EFFECTIVE DATE BY 3 PM

Invoice To Same as above Yes ☑ / No ☐

Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:

Requirements *(Please Check)*

☑ BC CSR Soil
☐ AL
☐ IL
☐ PL
☐ CL
☑ RL-LD ☐ RL-HD
☐ WL-N ☐ WL-R

☐ BC CSR - Water
☐ DW
☐ AW
☐ IW
☐ LW

Schedule 3.3 *(Please Specify)*
CCME *(Please Specify)* Sediment Quality Guidelines PEL
Other *(Please Specify)* BCCSR Generic Numerical Sediment Criteria for Typical Site Types

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	SAMPLE MATRIX	DATE/TIME SAMPLED	COMMENTS - SITE SAMPLE INFO. SAMPLE CONTAINMENT	LEPH/HEPH/PAH	CSR Omnibus Metals w/ pH	NUMBER OF CONTAINERS	PRESERVED (Y/N)	HAZARDOUS (Y/N)	Hold for: ☐ 60 DAYS
9901786	River Sand Sample 1	sediment	14:10 02/13/19		☑	☑	2			
93	River Sand Sample 1 DUP	sediment	14:15 02/13/19		☑	☑	2			
94	River Sand Sample 2	sediment	14:20 02/13/19		☑	☑	2			
95	River Sand Sample 3	sediment	14:25 02/13/19		☑	☑	2			
96	River Sand Sample 4	sediment	14:30 02/13/19		☑	☑	2			
97	River Sand Sample 5	sediment	14:35 02/13/19		☑	☑	2			
98	River Sand Sample 6	sediment	14:40 02/13/19		☑	☑	2			
99	River Sand Sample 7	sediment	14:45 02/13/19		☑	☑	2			
400	River Sand Sample 8	sediment	14:50 02/13/19		☑	☑	2			

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Vanessa Osorio		Ann	
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time

Page ____ of ____

V117879

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM - BURNABY

Work Order # 19V427506

RECEIVING BASICS:

Received From: Client   Waybill #: ____

SAMPLE QUANTITIES:

Coolers: Box   Containers: 18

TIME SENSITIVE ISSUES:

Earliest Date Sampled: Feb 17, 2019   ALREADY EXCEEDED? Yes No

NON-CONFORMANCES:

3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's) *use jars when available

(1) 0 + 1 + 1 = 1 °C (2) ___+___+___=____°C (3) ___+___+___=____°C (4) ___+___+___=____°C

Was ice or ice pack present: Yes No

Integrity Issues:

Account Project Manager: ____ have they been notified of the above issues: Yes No

Whom spoken to: ____ Date and Time: ____

ADDITIONAL NOTES:

APPENDIX B
Siderite SDS Information Sheet

SDS INFORMATION SHEET: IRON CARBONATE

Section 1: Product and Company

Other Product Name(s) :
FERROUS CARBONATE
or SIDERITE

Company	SIDCO Minerals, Inc. 2801 Richmond Rd. Box 51 Texarkana, TX 75503 USA
Telephone	903-838-4493
Fax	903-838-0275
Email	sidcomine@aol.com

Section 2: Hazards Identification

Emergency Overview	No unusual fire or spill hazard. Low health risk by inhalation

Potential Health Effects

Eyes	May cause mechanical irritation
Skin	None
Inhalation	Low health risk by inhalation. Treat as nuisance dust.

Section 3: Composition / Information on Ingredients

Product name	Siderite is a natural earth mineral composed mainly of ferrous carbonate
Synonyms	Ferrous Carbonate, Iron (II) Carbonate
Color Index	N/A

SDS INFORMATION SHEET: IRON CARBONATE

Chemical Name: *Chemical Formula*	CAS#	% Composition	OSHA PEL TWA	OSHA PEL STEL	ACGIH TLV TWA	ACGIH TLV STEL	DFG-MAK *(Mg/M3)* TWA	DFG-MAK *(Mg/M3)* STEL
Ferrous Carbonate $FeCO_3$	563-71-3	87-80	N.E.[1]	N.E.	N.E.	N.E.	N.E.	N.E.
Silica Crystalline Quartz (respirable) SiO_2	1309--37-1	5-9 (3-5 ppm)	0.1	N.E.	0.1	N.E.	N.E.	N.E.
Aluminum Oxide (non-fibrous) (respirable fraction) Al_2O_3	1344-28-1	3-5 (<3 ppm)	5	N.E.	5	N.E.	N.E.	N.E.
Calcium Oxide CaO	1305-78-8	1-3 (< 3 ppm)	5	N.E.	5	N.E.	N.E.	N.E.

1) N.E. = none established 2) Respirable fraction

Section 4: First Aid Measures

After Inhalation — Remove to fresh air. If breathing is labored or stopped, give artificial respiration. Get immediate medical attention.

After Skin Contact — Wash area of skin with soap and water

After Eye Contact — Flush eyes with plenty of water for at least 15 minutes. Seek medical attention if irritation develops or persists.

After ingestion — If victim is conscious and alert, give large quantities of water to induce vomiting. Seek medical attention immediately.

Section 5: Fire Fighting Measures

Fire — Not considered to be a fire hazard. Not flammable.

Explosion — Not considered to be an explosion hazard.

Extinguishing Media — This material is not combustable and is not anticipated to react with commercially employed extinguishing media. Use appropriate extinguishing media surrounding fire.

SDS INFORMATION SHEET: IRON CARBONATE

Section 6: Accidental Release Measures

Spill Procedures	Protect against identified hazards through use of prescribed persona; protection equipment, proper work and hygiene practices. Limit foot and vehicular traffic to minimize mechanical agitation and dispersion. Employ a vacuum, equipped with HEPA (High Efficiency Particulate Air) filter, for clean-up of the spill material. If no vacuum is available, use a broom and shovel to collect excess powder in the area. Recover uncontaminated material for use. Vacuum or sweep remaining material keeping dust to a minimum. Residual material should then be cleared, utilizing the process of wet sweeping, to avoid dust generation.
Containment Techniques	This is a solid material and will not travel far from the spill location unless mechanically agitated.
Spill Response Equipment	The following equipment is recommended for spill response: • vacuum, equipped with a HEPA filter • broom, wet mop • dust pan, shovel, scoop • bags, drums or sacks for collection
Personal Protective	All personnel should utilize the following protective equipment when performing spill response activities: • gloves (rubber or leather) • safety glasses or goggles • respiratory equipment as recommended in Section 8

Section 7: Handling and Storage

Storage	A moderately dry, well-ventilated area is considered adequate for handling and storage. Usual precautions for nuisance dust should be followed.
Handling	When handling product, all personnel are directed to: • Wear all specified elements of PPE, as directed by this document, or under location specific requirements, whichever is more conservative • Avoid creating dust, where possible.

Section 8: Exposure Controls / Personal Protection

Engineering Controls	Use with adequate ventilation to meet exposure limits in Section 2.
Respiratory Protection	Use NIOSH-approved dust respirator, if overexposure exists.

SDS INFORMATION SHEET: IRON CARBONATE

Skin Protection	Leather or rubber gloves.
Eye/Face Protection	Safety glasses, goggles or face shield are recommended.
Work Hygiene Practices	• To control potential exposures, avoid creating dust. • Do not eat, drink, smoke, or perform other hand-to-mouth activities in product use or handling area. • Wash thoroughly after handling product.

Section 9: Physical and Chemical Properties

Earths are natural products. Technical data varies or are not measurable.

Appearance	Physical State: Solid Color: Light Brown/ Taupe Form: Powder or granular
Odor	Odorless

Section 10: Stability and Reactivity

Stability	Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products	None
Hazardous Polymerization Products	Will not occur.
Incompatibilities	None known.
Conditions to avoid	None

Section 11: Toxicological Information

Ingestion	Ingestion of mineral compounds may cause abdominal pain and nausea.
Inhalation	May cause irritation of mucous membrane or delayed respiratory disease if dust is inhaled over a prolonged period of time.
Skin Contact	No known dangerous acute or chronic effects.
Eye Contact	If dust intrudes into eyes, eye irritation may occur.

Health Hazards (Acute and Chronic)	Respiratory disease may result from prolonged exposure. Can cause eye irritation. Carcinogenicity: NTP: No IARC Monographs: Yes (Silica) Signs and Symptoms of Exposure: Excessive inhalation of dust may result in shortness of breath and reduced pulmonary function and wheezing. Aggravation of Pre-Existing Conditions: Persons with impaired respiratory function may be more susceptible to the effects of the substance.

Section 12: Ecological Information

No harmful effects known other than those associated with suspended inert solids in water.

Section 13: Disposal Concerns

Recommended Disposal Method	Collect in containers, bags or covered dumpster boxes. Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

Section 14: Transportation Information

U.S. DOT	Not regulated for domestic transport by land, rail or air. Enter the proper freight classification on the shipping documents, “MSDS Number” and “Product Name” for shipping purposes.
Canadian TDG Hazard Class and PIN	Not regulated

Section 15: Regulatory Information

SARA 313 Title III	Section 311/312 Hazardous Categories: None Section 313 Toxic Chemicals: None
OSHA Status	This product is not considered hazardous.
TSCA Status	Components of this product are listed in the TSCA Inventory.
California Proposition 65	Not Listed
CERCLA Reportable Quantity	None

International Regulations	Canadian Ingredient Disclosure List: Components are listed. Canadian WHMIS: This material is not a controlled substance under WHMIS. European Community: This material is not subject to classification according to EEC Directive 67/548/EEC.

Section 16: Other Information

Date 15 FEB 2017	The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. SIDCO Minerals, Inc. shall not be held responsible or liable for any damage resulting from handling or from contact with the product.

APPENDIX C
Onondaga Lake Final Design

APPENDIX I

PH AMENDMENT EVALUATION

1.1 CAP pH MODEL MEMO

1.2 SIDERITE LEACHATE EVALUATION

I.2

SIDERITE LEACHATE EVALUATION

APPENDIX I.2

SIDERITE LEACHATE EVALUATION

Testing was conducted to evaluate potential water quality impacts during and after placement of siderite as part of an amended sediment cap. This included bulk chemical analyses for general characterization, modified elutriate testing (MET), and sequential batch leach testing (SBLT) (Parsons, 2009).

The MET evaluation was completed to evaluate potential impacts during material placement. Siderite was mixed with distilled/deionized water, and water samples were collected and analyzed following a 24-hour settlement period. The supernatant was analyzed for total and dissolved target analyte list (TAL) metals, semivolatiles (EPA Method 8260), total cyanide, hardness, pH, and total suspended solids. For dissolved concentrations, an aliquot of the supernatant was centrifuged prior to analysis.

Results from the MET testing (Parsons, 2009) verify that water quality impacts from siderite during cap placement will not be a concern. As shown in Table I.2-1, there were no exceedances of NYSDEC acute surface water quality criteria. Any impacts to water quality would be minor, localized and dissipate rapidly following material placement.

The SBLT was designed to evaluate leaching of constituents from siderite by upwelling porewater following cap placement. SBLT testing was conducted using porewater from the in-lake waste deposit (ILWD), which is the area where siderite is proposed in the initial design as part of the sediment cap. SBLT testing was completed on powered, pelletized and granular siderite. For each of the three forms of siderite ILWD porewater and siderite amendment were added to a container at a liquid to solid ratio of 4:1 and tumbled for 24 hours. The leachate was then removed by centrifugation and decanting. The porewater was replaced and the mixture placed on the tumbler for another 24 hours, after which the porewater was decanted again. This procedure was repeated for a total of four cycles. The initial porewater and leachates from each cycle were analyzed for TAL metals, semivolatiles, total cyanide, pH, and total suspended solids were also measured. Subsequent design evaluations indicate that the amended cap will use granular siderite. Therefore, the discussion below focuses on the results from the granular siderite testing.

SBLT test results verify that there would be no significant long-term impacts resulting from porewater migration through the siderite. Table I.2-2 compares the SBLT leachate analyte concentrations with the ILWD porewater in order to identify potential contributions from siderite. As shown in Table I.2-2, the majority of analytes were not detected or actually showed decreased concentrations in the leachate, perhaps as a result of precipitation, such as for mercury and vanadium. There were some metals, such as aluminum and zinc, which showed variability, or at most, potentially minor increases in comparison to the ILWD porewater. The only metal which showed consistently elevated concentrations in the leachate was cobalt. However, the average concentration of cobalt in the leachate was approximately 6.4 ug/L, which only slightly exceeds the NYSDEC chronic surface water criteria of 5 ug/L. Any metals contribution to the cap porewater would be minor and would be quickly attenuated by the overlying sediment cap.

Semivolatile organic compounds were also analyzed for in the leachate, primarily to identify any impacts due to the manufacturing process associated with the pelletized siderite, which is no longer under consideration. Bis(2-ethylhexyl)phthalate (BEHP) was detected sporadically at low levels in the leachate from all forms of siderite. BEHP is a common laboratory or sample handling artifact. It is used as a plasticizer and may be derived from materials that the siderite samples were in contact with during shipping or sample processing. It would not be expected to be present in granular siderite.

REFERENCES

Parsons, 2009. Onondaga Lake Pre-Design Investigation: Phase IV Work Plan – Addendum 7 Cap pH Amendment Evaluation Addendum.

Parsons, 2009. Onondaga Lake Pre-Design Investigation: Draft Phase IV Data Summary Report Appendix H Cap pH Amendment Study

http://www.dec.ny.gov/regs/4590.html

Table I.2-1
Modified Elutriate Test Results Compared to NYSDEC Class B/C Water Quality Standards

Parameter	Units	Elutriate Blank[1]	Granular Siderite (Sidco)			Acute Aquatic Standard
			Rep 1	Rep 2	Rep 3	
Metals						
Aluminum (dissolved)	ug/L	23.4 B	212 B	177 B	1,190	NS
Arsenic (dissolved)	ug/L	<2	<2	<2	<2.7	340
Beryllium (total)	ug/L	0.4 B	6.6 B	4.5 B	6.2	NS
Cadmium (dissolved)	ug/L	<0.21	<0.21	<0.21	0.19 J	15.7[2]
Chromium (dissolved)	ug/L	<1.1	<1.1	<1.1	2.1 J	1,580[2]
Cobalt (total)	ug/L	<0.4	173	119	107	NS
Copper (dissolved)	ug/L	<4.6	<4.6	<4.6	<2.7	43.5[2]
Lead (dissolved)	ug/L	<1.7	<1.7	<1.7	<1.3	366[2]
Mercury (dissolved)	ug/L	<0.038	<0.038	<0.038	<0.038	1.4
Nickel (dissolved)	ug/L	<0.78	107 B	88.7 B	40.4 B	1,350[2]
Selenium (dissolved)	ug/L	<2.9	<2.9	<2.9	<1.6	NS
Silver (dissolved)	ug/L	<0.54	<0.54	<0.54	<0.68	NS
Thallium (total)	ug/L	<2.4	4 J	3.4 J	<2.4	NS
Vanadium (total)	ug/L	<1.9	549	353	632	NS
Zinc (dissolved)	ug/L	<3.1	212	183	32.6 B	337[2]
Semivolatiles						
2,4-Dichlorophenol	ug/L	<0.13	<0.13	<0.13	<0.13	NS
2,4-Dimethylphenol	ug/L	<0.077	<0.078	<0.076	<0.077	NS
2,4-Dinitrophenol	ug/L	<5.9	<6	<5.8	<5.8	NS
bis(2-Ethylhexyl) phthalate	ug/L	4.1 B	<0.45	<0.44	3 BJ	NS
Hexachlorobenzene	ug/L	<0.17	<0.18	<0.17	<0.17	NS
Hexachlorobutadiene	ug/L	<0.12	<0.11	<0.11	<0.11	NS
Hexachlorocyclopentadiene	ug/L	<0.11	<0.11	<0.11	<0.11	NS
Hexachloroethane	ug/L	<0.077	<0.074	<0.073	<0.072	NS
Pentachlorophenol	ug/L	<1.8	<1.8	<1.8	<1.8	10.5[2]
Phenol	ug/L	<0.24	<0.23	<0.22	9.8	NS
Other						
Cyanide	ug/L	<1.5	<1.5	<1.5	<1.5	22
pH	su	5	5.3	5.4	5.7	NS

Notes:
1: Elutriate blank is DI water with a pH of 5
2: Water quality standard is pH and/or hardness dependent. Standard calculated using the lowest reported hardness (348 mg/L) and pH (7.18) from 2006 monitoring data, Onondaga Lake Ambient Monitoring Program
< - result is non-detect at the reported method detection limit (MDL)
J - estimated value, result is less than the reporting limit (RL) but greater than the MDL
B - analyte detected in associated laboratory blank
NS - no standard

Table I.2-2

Sequential Batch Leach Test Results for Granular Siderite (Sidco)

			Rep 1				Rep 2			
Parameter	**Units**	**SBLT Solution[1]**	**Leach Cycle 1**	**Leach Cycle 2**	**Leach Cycle 3**	**Leach Cycle 4**	**Leach Cycle 1**	**Leach Cycle 2**	**Leach Cycle 3**	**Leach Cycle 4**
Metals										
Aluminum (dissolved)	ug/L	23.1 BJ	33.4 BJ	26.3 BJ	<9.7	20.6 J	46.6 BJ	26.3 BJ	<9.7	13 J
Arsenic (dissolved)	ug/L	13.6	6.2 J	7.4 J	5 J	8 J	5.8 J	7.4 J	8.7 J	5.8 J
Beryllium (total)	ug/L	0.8 J	0.75 J	1.1 J	0.83 J	0.65 J	0.75 J	1.1 J	0.89 J	0.69 J
Cadmium (dissolved)	ug/L	<0.13	<0.13	<0.13	<0.13	<0.13	1.1 J	<0.13	<0.13	<0.13
Chromium (dissolved)	ug/L	<0.57	0.67 J	1.6 J	1.6 J	5.3	1.3 J	0.94 J	1.2 J	2.6 J
Cobalt (total)	ug/L	1.5 J	15.9 J	4.6 J	2.7 J	3.2 J	13.2 J	4.6 J	3.5 J	3.4 J
Copper (dissolved)	ug/L	<2.7	3.8 J	4.8 J	<2.7	12.3 J	5.7 J	4.8 J	<2.7	<2.7
Lead (dissolved)	ug/L	<6.3	<6.3	<6.3	<6.3	<6.3	<6.3	<6.3	<6.3	<6.3
Mercury (dissolved)	ug/L	26.2	<0.038	<0.038	0.046 J	0.095 J	<0.038	<0.038	0.048 J	0.076 J
Nickel (dissolved)	ug/L	167	245	248	200	185	268	243	206	181
Selenium (dissolved)	ug/L	5.7	8.1	8.5	6.1	6.2	7.5	5.2	6.6	3.7 J
Silver (dissolved)	ug/L	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68
Thallium (total)	ug/L	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
Vanadium (total)	ug/L	2.2 J	<1.9	<1.9	<1.9	<1.9	2.9 J	<1.9	<1.9	<1.9
Zinc (dissolved)	ug/L	11.4 BJ	11.7 BJ	24 BJ	30.3 B	41.4 J	22.9 B	13.7 BJ	13.8 BJ	12 BJ
Semivolatiles										
2,4-Dichlorophenol	ug/L	<0.2	<0.24	<0.19	<0.24	<0.21	<0.21	<0.19	<0.24	<0.2
2,4-Dimethylphenol	ug/L	7 J	3.7 J	6.6 J	7.1 J	8 J	3.4 J	6.4 J	0.9 J	8.7 J
2,4-Dinitrophenol	ug/L	<9.1	<11	<8.8	<11	<9.8	<9.5	<8.8	<11	<9
bis(2-Ethylhexyl) phthalate	ug/L	<0.69	7.1 J	5.6 J	<0.81	6.6 J	6.3 J	5.6 J	<0.81	5.6 J
Hexachlorobenzene	ug/L	<0.27	<0.32	<0.26	<0.32	<0.29	<0.28	<0.26	<0.32	<0.27
Hexachlorobutadiene	ug/L	<0.18	<0.21	<0.17	<0.21	<0.21	<0.19	<0.17	<0.21	<0.21
Hexachlorocyclopentadiene	ug/L	<0.17	<0.2	<0.16	<0.2	<0.18	<0.18	<0.16	<0.2	<0.17
Hexachloroethane	ug/L	<0.11	<0.13	<0.11	<0.13	<0.12	<0.12	<0.11	<0.13	<0.11
Pentachlorophenol	ug/L	<2.8	<2.9	<2.7	<3.3	<3	<2.8	<2.7	<3.3	<2.8
Phenol	ug/L	520	420	570 J*	520	580	410	540	71	650
Other										
Total Cyanide	ug/L	696	135	28.7	22.8	36	136	19.4	11.5	32.6
pH	s.u.	11.8	8.1	7.1	6.8	7.4	8.2	7.2	7.4	7.1

Notes:

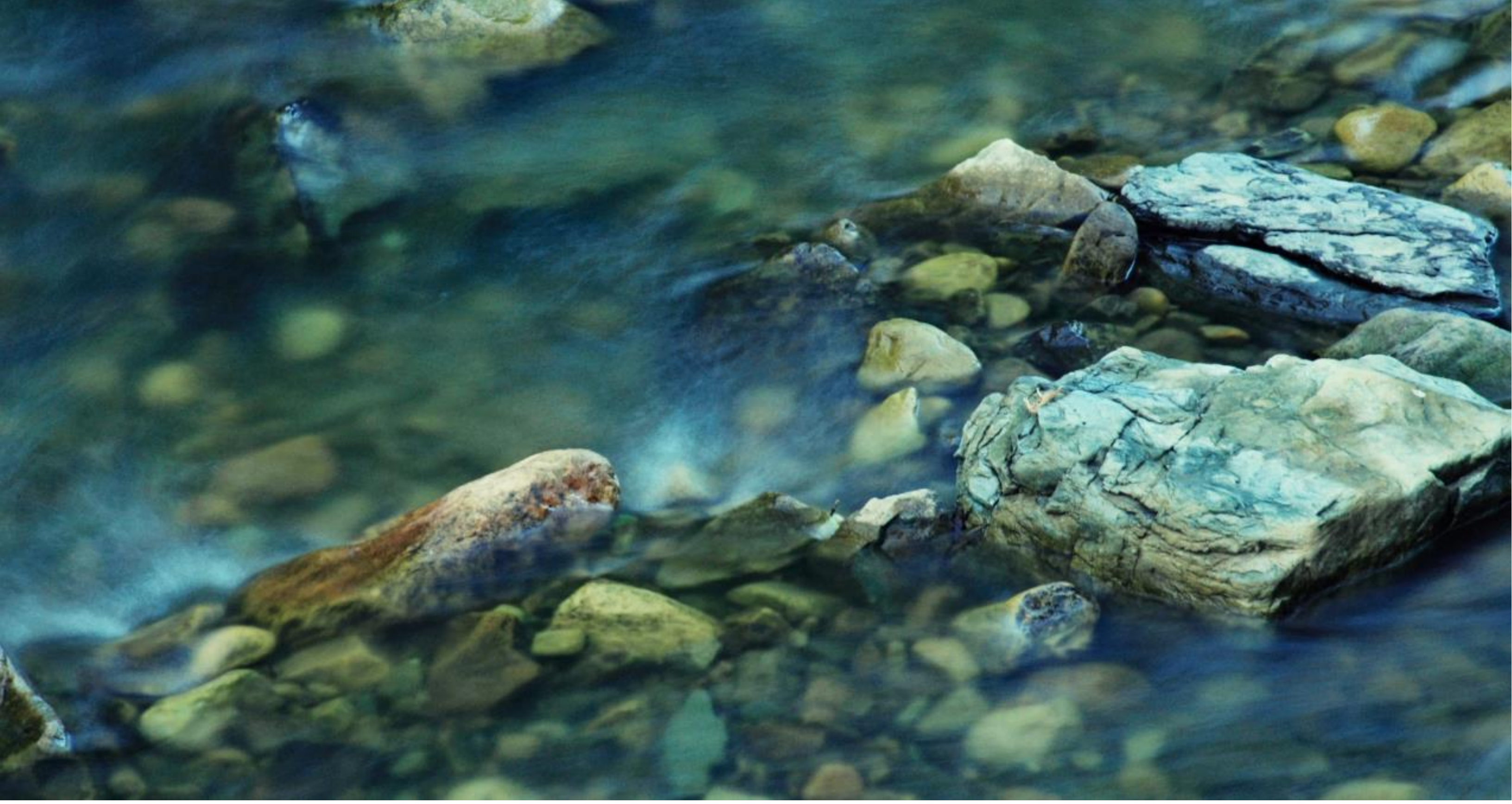
1: SBLT blank solution is porewater collected from location TR-03A.

< - result is non-detect at the reported method detection limit (MDL)

J - estimated value, result is less than the reporting limit (RL) but greater than the MDL

B - analyte detected in associated laboratory blank

APPENDIX D
Supplemental Treatability Recommendations Report



March 2019
Wood Waste Remediation Project

Supplemental Treatability Recommendations Report

Prepared for Public Works and Government Services Canada

March 2019
Wood Waste Remediation Project

Supplemental Treatability Recommendations Report

Prepared for
Public Works and Government Services Canada

Prepared by
Anchor QEA, LLC
1201 3rd Avenue, Suite 2600
Seattle, Washington, 98101

Project Number: 170553-11.05
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TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX

ABBREVIATIONS

µm	micrometre
µS/cm	microsiemens per centimetre
Au/Hg	gold/mercury
AVS	acid volatile sulphide
cm	centimetre
CV	cyclic voltammetry
DGT	diffusive gradients in thin films
DO	dissolved oxygen
EGL	Environmental Geochemistry Laboratory
Fe	iron
Fe(II)	ferrous iron
Fe(III)	ferric iron
$FeCO_3$	siderite
FeS	mackinawite
FeS(aq)	iron complexed sulphide
FeS_2	pyrite
GFH	granular ferric hydroxide
H_2S	hydrogen sulphide
ICP-AES	inductively coupled plasma atomic emission spectroscopy
L	litre
M	moles per litre
MDL	method detection limit
mg/L	milligrams per litre
mL	millilitre
mm	millimetre
MMO	mixed metal oxide
Mn	manganese
MnO_2	manganese dioxide
ORP	oxidation reduction potential
PTFE	polytetrafluoroethylene
S^0	elemental sulfur
SC	specific conductivity

1 Introduction

This report presents results of bench-scale treatability testing to assess the effectiveness of sand cover mixed with treatment amendments to reduce bioavailable porewater sulphide concentrations in sediment containing wood waste in Esquimalt Harbour, British Columbia, Canada (site). Elevated sulphide concentrations have been measured in sediment porewater in areas where wood waste has accumulated as a result of log booming, log storage, and wood mill operations over the last 70 years at the site. Wood waste deposits can negatively affect marine benthic communities through physical alteration of sediments and increased toxicity from by-products of anaerobic decomposition, especially porewater sulphides.

Bench-scale treatability testing was conducted to assess the effectiveness of sand cover mixed with different mineral-based reactive amendments to reduce bioavailable porewater sulphide concentrations at the sediment-water interface for protection of sediment and surface water quality at the site. Several reactive amendments were evaluated in laboratory mesocosms to assess their effectiveness for potential use for future remediation, including for use in a pilot study anticipated to be conducted in fiscal year 2019/2010. Amendments are ranked based on their ability to reduce sulphide concentrations in sediment porewater, cost, and any potential secondary water quality impacts. Appendix A contains modeled predictions to assess the effectiveness of sand and the treatment amendments used in the bench-scale testing at reducing porewater sulphide concentrations, both to compare modeled results to the bench-scale testing findings and to evaluate long-term effectiveness of the recommended amendment.

Sulphides are generated in sediment under anaerobic conditions in the presence of organic matter by bacteria that use chemicals other than oxygen. An excess amount of organic matter can result in excess amounts of hydrogen sulphide to accumulate in porewater, causing toxicity in the sediment and in the water column close to the sediment (Podger 2013). The amount of hydrogen sulphide as a component of total porewater sulphides can vary depending on pH (Rearick et al. 2005). Site-specific benchmarks developed for porewater sulphide in Esquimalt Harbour were 0.0157 milligram per litre (mg/L; threshold effects benchmark) and 0.617 mg/L (probable effects benchmark; SLR 2016). These are similar to literature reference values, which found that larval development tests of bay mussels (*Mytilus edulis*) had a half-maximal effective concentration (EC_{50}) for total sulphide of 0.1 mg/L (Knezovich 1996).

Reduced dissolved sulphide concentrations in sediment porewater may occur through the following processes:

- Precipitation of iron sulphide minerals such as mackinawite (FeS) or pyrite (FeS_2) under reducing conditions
- Abiotic oxidation by iron oxides and manganese (Mn) oxides

- Manipulating sediment redox conditions to regulate the activity of the sulphate-reducing bacteria

In anoxic environments, mackinawite or pyrite can be formed by the reaction of sulphide with ferrous iron (Fe(II)) ion (Lennie et al. 1997). Over time mackinawite can transform to thermodynamically more stable pyrite. Siderite ($FeCO_3$) is a potential treatment amendment that dissolves in water and produces carbonate and Fe(II) ions, the latter of which can combine with sulphide to precipitate iron sulphides. Fe(II) released from siderite may also be oxidized to ferric iron (Fe(III)) and precipitated in the form of iron oxides and oxyhydroxides, which can abiotically oxidize dissolved sulphide.

Other potential treatment amendments include Fe(III) and manganese oxides (Mn(IV)), which can also abiotically oxidize dissolved sulphide into sulphate. The Fe(II) ions produced may also sequester dissolved sulphide by precipitation of Fe(II) sulphide. Mn(IV) oxide (e.g., pyrolusite, birnessite) mineral amendments can suppress dissolved sulphide concentration in sediment porewater by inhibiting microbial sulphate reduction (Vlassopoulos et al. 2018).

Redox manipulation by addition of an electron acceptor that is more oxidizing than sulphate (e.g., oxygen, nitrate, Mn, and Fe) can result in redox levels that inhibit sulphate reduction, which can have the effect of suppressing the production of dissolved sulphide. This strategy has been demonstrated to be successful on sediment cleanup in Onondaga Lake, New York, where the addition of nitrate to the lake's bottom waters prevents the development of sulphate-reducing conditions (Todorova et al. 2009). Like nitrate, Mn(IV)-reducing conditions and Fe(III)-reducing conditions contribute to a more oxidizing redox potential than those under which sulphate reduction takes place, thus amendment of sediments with Mn(IV) oxide or Fe(III) oxide can inhibit reduction of sulphate into sulphides.

Reactive amendments selected for the bench-scale treatability testing were siderite (iron carbonate), manganese oxide, and mixed metal oxide following preliminary screening. This report presents the materials, methods. and testing results of several mesocosms to simulate field conditions and evaluate effectiveness of the amendments. The objective of the treatability study is to provide bench-scale performance data for the reactive media tested to aid in selection of a suitable amendment and dose for pilot testing that could also be evaluated as part of a larger cleanup of the wood waste areas in Esquimalt Harbour. Treatability testing was performed in Anchor QEA's Environmental Geochemistry Laboratory (EGL) in Portland, Oregon.

2 Materials and Methods

2.1 Sample Collection

In December 2018, sediment cores and surface water were collected from the site for use in the bench-scale treatability testing (Anchor QEA 2019a). Table 1 presents the locations and core length of each sediment core, which were 7.5-centimetre (cm) in diameter. The sediment cores were shipped upright and on ice to EGL in Portland, Oregon. Surface water samples were collected in 20-litre (L) plastic cubitainers. The sediment cores were frozen at -20°C, and the surface water samples were stored at 4°C until use. Two different sediment composite samples were prepared by homogenizing sediment cores collected from different areas (Table 1). EHWW-16 is located in the northern area of Esquimalt Harbour, which contains considerable wood waste deposits, much of which comprise finer/less coarse wood than other areas of the harbour. EHWW-3, EHWW-55, and EHWW-57 are located in the area north of Inskip Islands in areas known to contain thick wood deposits that tend to contain more coarse wood waste. These two areas are candidates for remediation and are generally located in the area where pilot study testing is planned. The sediment cores collected from the central area (EHWW-39 and EHWW-59) were saved and stored for potential future testing or characterization.

Sediments from EHWW-16 were homogenized for one set of testing (Sediment Composite A), and sediments from EHWW-3, EHWW-55, and EHWW-57 were homogenized for a second set of testing (Sediment Composite B). The homogenized sediments were subsampled in duplicate and analyzed for iron and manganese (digestion/inductively coupled plasma atomic emission spectroscopy [ICP-AES]), sulphide (distillation/methylene blue method), total organic carbon (high temperature oxidation and coulometric detection), and total solids.

On receipt of the site surface water samples at EGL, pH, oxidation reduction potential (ORP), specific conductance, and dissolved oxygen (DO) were measured at room temperature. Surface water was analyzed in duplicate for cations and metals (sodium, potassium, calcium, magnesium, iron, and manganese by ICP-AES), anions (chloride, sulphate, and nitrate by ion chromatography), sulphide, dissolved organic carbon, and alkalinity.

2.2 Preliminary Reactive Amendment Screening

Reactive amendments to be used in the bench-scale treatability testing program were first subjected to preliminary batch screening testing. Reaction batch tests were performed to determine removal efficiency of dissolved sulphide in water by several reactive amendments. Table 2 lists the reactive amendments tested in the preliminary batch screening tests. The reaction rate batch tests were set up in 500 millilitre (mL) polyethylene bottles at a liquid/solid mass ratio (mass of test solution to dry mass of amendment) of 250. Test solution was prepared using deoxygenated deionized water.

Sodium sulphide nonahydrate ($Na_2S·9H_2O$) was dissolved to target initial dissolved sulphide concentration at approximately 100 mg/L as hydrogen sulphide (H_2S). Sodium chloride (NaCl) and sodium bicarbonate ($NaHCO_3$) were dissolved in test solution at 0.7 moles per litre (M) and 0.01 M to maintain ionic strength and pH, respectively. In one test bottle, test solution and reactive amendment was prepared and sealed under nitrogen atmosphere. Test bottles were kept in a heat-sealed, nitrogen-filled Mylar bag and gently agitated on a shaker table for 3 days to ensure proper mixing. Solutions in the test bottles were sampled after 1 and 3 days of reaction. Water samples were filtered by 0.45-micrometre (µm) syringe filter and immediately analyzed for dissolved sulphide by the iodine method (Standard Method 4500-S2-F; APHA 2005). Results are presented in Section 3.2.

2.3 Mesocosm Setup

Sediment cores were thawed, sediment was extruded from the core tubes and homogenized under a nitrogen atmosphere to produce two representative sediment composite samples for testing. Large wood debris, rocks, and large shell fragments were removed by hand. Smaller wood debris were not removed to maintain the carbon source for microbial activity. Sediment mesocosms were prepared in acrylic columns (10 cm diameter by 50 cm tall) with polytetrafluoroethylene (PTFE) end caps held in place by rubber O-rings. Five mesocosms were prepared for each of the two sediment composites (10 mesocosms; Table 3), including three reactive amendments mixed with sand, a sediment control (sediment only), and a sand control (sediment overlain by sand only).

Approximately 1.6 kilograms of wet homogenized sediment composite was placed in each column to achieve a sediment depth of 15 cm. The three reactive amendments were mixed with sand at a dose of 5% on a dry-weight basis. A 10-cm layer consisting of sand with or without reactive amendment was placed on top of the previously loaded sediment for a total depth of 25 cm. Site water was then slowly added to the mesocosms on top of the sediment to provide an overlying water column depth of 15 cm. Figure 1 provides a schematic of the sediment mesocosm apparatus, and Figure 2 presents images of a sediment control mesocosm (2a) and a mesocosm with the siderite-amended sand layer (2b). After adding surface water to the mesocosms, they were sealed with a PTFE cap. The mesocosms were then connected to a N_2 gas distribution manifold, and the overlying water was purged with high-purity nitrogen for several hours to remove DO and promote establishment of anaerobic conditions (Figure 3). Mesocosms were kept in the dark except during sampling. Overlying water was periodically topped off as needed to maintain the water depth in the mesocosms. The mesocosms were allowed to stabilize for approximately 1 week prior to sampling.

2.4 Mesocosm Monitoring

2.4.1 Overlying Water

Approximately 50 mL of overlying water was periodically collected from each mesocosm to detect the onset of sulphate-reducing conditions. Water samples were immediately filtered (0.45-µm polyethersulfone membranes) and analyzed for dissolved sulphide concentrations by the iodine method (SW-846 Test Method 9034). The method detection limit (MDL) of the iodine method was 0.1 mg/L as S. General water quality parameters including pH, ORP, specific conductivity (SC), and DO were also measured using a multi-probe flowblock monitoring system (Geotech Environmental Equipment, Inc), which allows simultaneous measurement on a small volume of water without contacting air.

2.4.2 Sulphide Concentration Profiles

Diffusive gradients in thin films (DGT) devices were used to monitor dissolved sulphide concentration profiles across the sediment/(amended) sand/water interface. This method, developed over the last two decades (Teasdale et al. 1999; Rearick et al. 2005), is becoming increasingly common as a reliable in situ technique for quantifying sulphide levels in sediment porewater. The method is based on the reaction of silver iodide (AgI), a white powder impregnated into a gel, with sulphide to produce silver sulphide (Ag_2S), a black solid. The gray-scale intensity of the colour developed is proportional to the amount of sulphide accumulated in the gel.

Flat-probe DGT assemblies preloaded for sulphide measurement were purchased from DGT Research (http://www.dgtresearch.com). The DGT sampler consist of a DGT holder containing a 0.6-millimetre (mm)-thick silver iodide (AgI)-impregnated binding gel layer, overlain by a 0.78-mm thick polyacrylamide diffusive gel, and held in place by a 0.45-µm cellulose nitrate membrane filter. The window size of the DGT sampler is 1.8 by 15 cm (Figure 4). Prior to use, the DGT assemblies were deoxygenated by immersion in 0.3 M sodium chloride purged with high-purity nitrogen gas for at least 2 days to remove any residual oxygen.

Dissolved sulphide concentration profiles across the sediment/(amended) sand/water interface were measured by manually deploying and retrieving the flat-probe DGT assemblies from the top of the mesocosms. Exposure time of the DGT assemblies ranged between 6 and 48 hours as discussed below. On retrieval, the DGT assemblies were immediately rinsed with deionized water to remove residual sulphide and fines to stop the reaction of sulphide with AgI in the binding gels. Then, the binding gels were immediately recovered and placed on blotting paper. The binding gels were then laid on a thin cellophane sheet (Bio-Rad), and covered with a second cellophane sheet. The sheet assembly was then placed in a vacuum gel dryer (Bio-Rad, Model 583) and dried for 2 hours at 80°C. The dried sheet was digitally scanned (Konica Minolta BizHub-C364) and saved as a grey-scale image file. Gel analysis software (UN-SCAN-IT Gel Version 7.1) was used to measure and analyze the grey-scale intensity of the images.

Dissolved sulphide concentrations were determined from grey-scale intensity data and exposure time according to Equation 1. This equation is based on the standard DGT equations proposed by Teasdale et al. (1999), which involves plotting the gray-scale intensity to dissolved sulphide concentrations and fitting the data to a function relating gray-scale intensity to dissolved sulphide concentrations. The data were obtained with different exposure times to confirm the equation is valid for each exposure time. As shown in Figure 5, the data fit well to an exponential function (Equation 1) over the entire range of sulphide concentrations tested (0.1 to 195 mg/L as H_2S) for each exposure time.

Equation 1
DGT Calibration Curve for Sulphide Concentration Using Optical Densitometry

$$\mathrm{C} = \frac{2.993 \times exp\ (0.018 \times I)}{t}$$

$$R^2 = 0.963$$

where:

C	=	sulphide concentration (mg/L as H_2S)
I	=	grey-scale intensity of binding gel image
t	=	exposure time (hours)

2.4.3 Sediment Porewater Sulphide Speciation by Microelectrode Voltammetry

Gold/mercury (Au/Hg) microelectrode voltammetry is used to determine various reduced sulfur compounds and ions in situ without sample manipulation (Luther et al. 2001). In this study, Au/Hg microelectrode voltammetry was used to identify sulphide speciation in sediment porewater from selected sediment cores and the composites. A DLK-70 potentiostat (AIS Inc., New Jersey) with an Au/Hg working electrode mounted on a micromanipulator and Ag/AgCl reference and platinum (Pt) counter electrodes was used for voltammetry measurements. The Au/Hg microelectrodes were fabricated, conditioned, and calibrated following published procedures (Luther et al. 1998, 2008, 2013). Cyclic voltammetry (CV) scans were collected from −0.1 to −1.8 volts at different depths and the working electrode was conditioned before advancing to the next measurement.

3 Results

3.1 Initial Sample Characterization

Characterization results for the sediment composites and surface water are presented in Tables 4 and 5, respectively.

3.2 Preliminary Reactive Amendment Screening

In the preliminary batch screening tests, reactive amendments were compared and evaluated in terms of their efficiency to remove dissolved sulphide from water (Figure 6). Overall, powder reactive amendments removed dissolved sulphide from the test solution faster than granular reactive amendments probably because of a larger surface area. Among all reactive media, powder mixed metal oxide (MMO) achieved the best performance to remove dissolved sulphide. Granular MMO also removed dissolved sulphide approximately 50% within 3 days. The powder manganese dioxide (MnO_2) amendment performed the second best to remove dissolved sulphide. The granular ferric hydroxide (GFH) amendment achieved approximately 25% removal. Although dissolved sulphide removed by granular siderite was kinetically not fast, powder siderite removed dissolved sulphide efficiently. The iron-oxide slag and basic oxygen furnace slag amendments sequestered dissolved sulphide to some extent, but they were not as effective as the siderite amendment. Sand and oyster shell did not reduce dissolved sulphide concentration at all.

Based on the results of the preliminary batch screening test and cost of each amendment (i.e., material and shipping costs), three reactive amendments (siderite, MnO_2, and MMO) were selected for bench-scale treatability testing (Table 2). Although GFH efficiently removed dissolved sulphide, it is relatively expensive material compared to the three reactive amendments. The three amendments selected for testing are commercially available in bulk quantity.

Powder form of the selected reactive amendments was used for mesocosms because their reaction kinetics are faster than those in granular form. This enables evaluation and comparison of their performance within the relatively short bench-scale testing duration.

3.3 Mesocosm Monitoring

3.3.1 Dissolved Sulphide and Water Quality Monitoring in Overlying Water

Overlying water in the mesocosms was sampled at 7, 14, 28, and 40 days after setup, and the water samples were analyzed for dissolved sulphide (the iodine method), pH, ORP, SC, and DO (Table 6 and 7). By 28 days, dissolved sulphide concentrations of 0.9 to 1.2 mg/L as H_2S were detected in the control mesocosms, while the amendment mesocosms were all close to or less than the MDL of the iodine method (0.1 mg/L). After 40 days, however, dissolved sulphide was detected in the sand-only amended mesocosms, while the mesocosms with the reactive media-amended sand layers were all close to or less than the MDL. The low ORP and DO levels indicate that anaerobic conditions were established in the mesocosms. ORP and DO levels were lowest in the control mesocosms, slightly higher in the sand-only mesocosms, and highest in the amended sand mesocosms. ORP was slightly higher in the MnO_2 and MMO amended sand mesocosms than in the siderite amended sand mesocosms. SC and pH remained relatively stable in each mesocosm.

These results indicate that 1) reactive amendments within the sand layer can buffer redox condition and reduce sulphide transport from the underlying sediment layer to overlying water, and 2) a sand-only layer can be temporarily effective, but not effective over time in isolating reduced sediment from overlying water compared to an amended sand layer.

3.3.2 Porewater Sulphide Concentration Profiles

Sulphide concentration profiles in the mesocosms were monitored using flat-probe DGTs deployed at 10, 20, and 40 days. Deployment times and vertical deployment depths of the DGT assemblies were adjusted for each mesocosm and sampling event to account for expected sulphide levels (Table 8).

Sulphide concentration profiles in the mesocosms are presented in Figure 7 for sediment composite A and Figure 8 for sediment composite B. In the control mesocosms, the binding gels were saturated below 4 to 6 cm depth for a 12-hour exposure time, and the deeper portions of the profiles represent minimum sulphide concentrations (i.e., sulphide concentrations as H_2S were greater than 12 mg/L). The DGT results confirmed that sulfate-reducing conditions were maintained in the control mesocosms throughout the testing (~20 mg/L as H_2S in sediment porewater). Sulphide concentrations varied slightly at different depths in the control mesocosm within sediment composite B, probably because of the presence of small wood debris, rocks, and shell fragments. Overlying water had sulphide odour in the control mesocosms after 7 days. Figure 9 shows images of the control mesocosm after 10 and 40 days of incubation. After 40 days, black precipitate, likely mackinawite (FeS(s)), was observed in overlying water and the sediment surface in the control mesocosms.

Dissolved sulphide was not detected by DGT in overlying water or in sand layer porewater in the sand-only mesocosms throughout the testing, which suggests that the sand layer itself has some effectiveness in mitigating sulphide concentrations in overlying water (Figure 7 and 8). However, dissolved sulphide was detected in overlying water after 40 days by the iodine method (but not the DGT method). As discussed in Section 3.4, several different sulphide species were identified in sediment porewater, and it is likely that dissolved sulphide species that cannot be detected by DGT diffused into overlying water through the sand layer over time. In the sand-only mesocosms, dissolved sulphide concentrations were measured by DGT in sediment porewater below the sand over time (Figure 7 and 8), indicating that a sand layer is not effective at reducing sulphide concentration in underlying sediment. After 40 days, black precipitate, likely FeS(s), was observed at the overlying water/sand interface and at the sediment/sand interface in the sand-only mesocosms. Figure 10 shows images of the sand-only amended mesocosm after 40 days of incubation. This observation at the sand surface indicates iron complexed sulphide (FeS(aq)) and other sulphide species, which cannot be detected by DGT, diffused into overlying water through the sand layer and precipitate as FeS(s).

In the mesocosms with the siderite-amended sand layer, dissolved sulphide concentrations were not detected in siderite-sand porewater and overlying water by DGT during the testing (Figure 7 and 8). Dissolved sulphide concentrations in overlying water were also close to or less than the MDL of the iodine method (0.1 mg/L). In contrast to the sand-only mesocosms, dissolved sulphide concentrations in sediment porewater measured by DGT decreased over time in the mesocosms with the siderite-amended sand layer. This clearly indicates that siderite is effective in mitigating dissolved sulphide not only in overlying water and amended sand layer porewater, but also for a few cm into the underlying sediment porewater. In contrast to the sand-only mesocosms, black precipitates were not observed on top of the siderite-amended sand layer after 40 days (Figure 11). Black precipitates were formed at the amended sand/sediment interface, indicating siderite reacted with sulphide in sediment porewater, likely as a result of siderite dissolving to Fe(II) and carbonate ions, and Fe(II) ion reacting with dissolved sulphide to form FeS(s).

In the mesocosms with the MnO_2-amended and MMO-amended sand layers, dissolved sulphide concentrations were not detected in amended sand layer porewater and overlying water by DGT during the testing (Figure 7 and 8). Dissolved sulphide concentrations in overlying water were also close to or less than the MDL of the iodine method (0.1 mg/L). The mesocosms with the MnO_2-amended and MMO-amended sand layers showed reduced dissolved sulphide concentrations not only in overlying water and amended sand layer porewater but also for a few cm into the underlying sediment porewater. The MnO_2-amended and MMO-amended sand layers exhibited better effects to suppress dissolved sulphide concentrations in sediment porewater than the siderite-amended sand layer. This may be due to abiotic oxidation of dissolved sulphide and/or redox manipulation by MnO_2 and MMO. Images show MnO_2 and MMO reacted with dissolved sulphide at the amended sand/sediment interface after 40 days (Figure 12), likely because MMO contains iron oxides, which might reduce to Fe(II) ion and react with dissolved sulphide to form FeS(s).

3.4 Sulphide Speciation by Microelectrode Voltammetry

Prior to homogenizing the sediment cores, microelectrode voltammetry measurements were collected to identify sulphide species present in sediment porewater. The Au/Hg working electrode, Ag/AgCl reference, and Pt counter electrode were inserted into the sediment cores from the top. Vertical profiles could not be obtained due to large wood debris, rocks, and shell fragments, which made it difficult to advance the Au/Hg working electrode deeper into the sediment. In addition, the extremely high sulphide concentrations in the sediment porewater poisoned the Ag/AgCl reference electrode which had to be frequently reconditioned. Therefore only a few voltammetry scans could be obtained from the upper 5 cm of selected cores.

Figure 13 shows cyclic voltammograms obtained from sediment core EHWW-16-SC-2. Dissolved H_2S concentration was high enough to saturate the Au/Hg working electrode. The voltammograms indicate the presence of free H_2S, acid-volatile sulphide (AVS), and a trace of iron complexed sulphide (FeS(aq)). AVS is defined as the pool of sulfur compounds that is released as H_2S gas when a sample is reacted with acid. AVS may include larger molecular clusters of FeS(aq) and FeS(s) nanoparticles or colloids, which are generally less bioavailable than free H_2S. The large AVS peak in the cyclic voltammograms indicate that a significant portion of the sulphide in the sediment porewater is present in these less bioavailable forms.

After incubating the mesocosms for about a month, Au/Hg microelectrode voltammetry measurement was conducted to identify sulphide speciation in the sediments in the control mesocosms. The Au/Hg working electrode was slowly inserted into the sediments to conduct CV at different depths. Ag/AgCl reference and Pt counter electrode were submerged into overlying water. During the measurement, nitrogen gas was slowly filled above overlying water to maintain low DO concentrations. Figure 14 shows cyclic voltammograms obtained from the sediments in the control mesocosms. The cyclic voltammograms also indicate the presence of several different sulphide species such as free H_2S, AVS, FeS(aq), and a trace of elemental sulfur (S^0). High FeS(aq) peaks were observed in the cyclic voltammograms, which indicates sediment porewater is rich in FeS(aq) and may correspond to the observation of black spots, probably FeS(s), in the sediment layer in the mesocosms (Figure 11 and 12). It should be noted that most of the porewater sulphide is not present as free H_2S species based on the microelectrode voltammetry results. Peak sizes of sulphide species in the cyclic voltammograms are different between the sediment core EHWW-16 (Figure 13) and the sediments of the control mesocosms (Figure 14). This is likely because the sediment composites were prepared by mixing and homogenizing the different cores, and then incubated with surface water under anoxic conditions for about a month (Table 1). In situ, sulphide speciation can be variable vertically within a single sediment profile and at different locations, depending on the amount of sulphide production by sulfate-reducing bacteria, which is linked to the amount of bioavailable organic carbon (which can vary by wood type and age of wood), water temperature, and other site-specific conditions.

4 Summary and Recommendations

Bench-scale mesocosms were prepared in the laboratory using sediment and surface water collected from the site. The effectiveness of a sand layer with three different reactive amendments (i.e., siderite, MnO_2, and MMO) was studied to assess effectiveness at suppressing sulphide concentrations in the mesocosms. Dissolved sulphide concentration profiles in mesocosms were measured by DGT after 10, 20, and 40 days of incubation. Dissolved sulphide concentrations in overlying water in mesocosms were also periodically measured by the iodine method.

The DGT results confirmed that sulfate-reducing conditions were maintained in sediment in the control mesocosms throughout the testing (~20 mg/L as H_2S in sediment porewater). ORP and DO levels were maintained at low levels in all mesocosms. These results suggest that field conditions were effectively simulated, which is necessary to accurately evaluate the performance of the selected reactive amendments in the testing.

The following conclusions can be drawn from the bench-scale testing:

- **Sand-only layer effectiveness.** The testing demonstrated that a sand layer can decrease the diffusion of dissolved sulphide from the sediment layer. While dissolved sulphide in sand layer porewater was not detected by DGT in the sand-only mesocosms, dissolved sulphide was detected in overlying water after 40 days by the iodine method. This suggests that sulphide species that cannot be detected by DGT diffused into overlying water through the sand layer. The microelectrode voltammetry results indicate that several different sulphide species are present in sediment porewater in the sediment composites. Although those may not be bioavailable sulphide species, a sand-only layer is not completely effective at maintaining low sulphide concentrations. The dissolved sulphide concentrations measured by the iodine method confirmed a sand layer is not effective at reducing dissolved sulphide concentration in underlying sediment.
- **Siderite-amendment effectiveness.** Siderite-amended sand suppressed dissolved sulphide concentrations not only in overlying water and amended sand porewater but also in underlying sediment porewater over the 40-day test duration. This is likely the result of siderite dissolving into Fe(II) ion, which reacts with dissolved sulphide to precipitate FeS(s) in the sediment layer. Dissolved sulphide concentrations in overlying water were also close to or less than the MDL of the iodine method (0.1 mg/L), indicating that siderite is effective at suppressing sulphide species that cannot be detected by DGT.
- **MnO_2 and MMO-amendment effectiveness.** MnO_2-amended sand and MMO-amended sand significantly suppressed dissolved sulphide concentration in sediment porewater. The MnO_2-amended and MMO-amended sand layers exhibited better effects to suppress dissolved sulphide concentrations in sediment porewater than the siderite-amended sand layer. The mechanism is likely a result of 1) manganese oxides and iron oxides abiotically oxidizing

dissolved sulphide and 2) an elevated redox condition that is inhibiting sulfate reducing conditions.

- **Sulphide species.** Microelectrode voltammetry measurement was conducted to identify sulphide speciation in the sediment cores collected from the site. Cyclic voltammograms collected from the core indicated the presence of different sulphide species such as free H_2S, AVS, FeS(aq), and S^0 in site sediment and sediment composites, which are less bioavailable forms. Free H_2S is reactive to AgI and can be measured by DGT, but DGT may not be able to measure AVS, FeS(aq), and S^0.

The results of this study support the use of reactive amendments mixed with sand as part of an in situ pilot study to assess the effectiveness in wood waste areas of Esquimalt Harbour. Bench-scale test results indicate that sand amended with siderite, MnO_2, or MMO are each expected to be effective at reducing dissolved porewater sulphide concentrations. The results of the bench-scale testing were consistent with modeled predictions of sulphide concentrations (Appendix A). The following findings from this study and Appendix A should be considered during design of the in situ pilot study and for consideration as part of a potential larger-scale remediation of wood waste areas in Esquimalt Harbour:

- **Powder versus granular treatment amendments.** Testing was conducted with powder reactive amendments because their reaction kinetics are faster than those in granular form, which was required to evaluate and compare its performance within the relatively short bench-scale testing duration. However, granular forms of these amendments are expected to be just as effective as the powder forms in the long term. Granular forms are also expected to be better suited for in situ application, particularly for mixing and placement effectiveness.
- **Amendment dosage.** The dosage of the amendment (5% on a dry-weight basis) was shown to be effective at reducing dissolved porewater sulphide concentrations for both bench-scale testing and modeled predictions. Additional literature review of the potential effects of these amendments on benthic invertebrate and aquatic communities are summarized in the Remedial Options Analysis Report (Anchor QEA 2019b). Kinetic modeling in Appendix A indicates that siderite is expected to be a more effective amendment in the long-term. These modeling results support the use of siderite at 5% by weight in a 1-foot-thick amended sand layer for the pilot study. Modeled results also suggest that siderite is expected to be effective at suppressing porewater sulphide concentrations in the long term (i.e., greater than 30 years). Long-term model simulations and the associated effectiveness of the dose of siderite should be refined following additional testing (i.e., labile organic carbon component of wood waste) and monitoring from the pilot study planned for next fiscal year to inform the effectiveness and permanence of this cleanup technology on a larger scale as part of future remediation activities.

- **Availability and cost.** Siderite, MnO_2, and MMO are all commercially available in granular form; however, siderite tends to be less expensive. Granular siderite is planned for the pilot study, and the supplier indicated that the cost is the same for powdered and granular forms. Additional evaluation on cost and supply factors should be conducted to assess the use of siderite as a treatment amendment for the pilot study and potentially as part of larger-scale remediation activities in the future.

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Tables

Table 1
Sediment Cores Collected for the Bench-Scale Treatability Testing

Sediment Composite	Area	Sample Location	Core ID	Core Length (centimetres)
A	Northern Area	EHWW-16	EHWW-16-SC-1	76
			EHWW-16-SC-2	69
			EHWW-16-SC-3	70
B	Inskip Island	EHWW-3	EHWW-03-SC-2	40
			EHWW-03-SC-3	73
			EHWW-03-SC-4	70
		EHWW-55	EHWW-55-SC-1	19
			EHWW-55-SC-2	13
		EHWW-57	EHWW-57-SC-1	22
			EHWW-57-SC-2	50
			EHWW-57-SC-3	53
C[1]	Central Area	EHWW-39	EHWW-39-SC-1	75
			EHWW-39-SC-2	70
			EHWW-39-SC-3	69
		EHWW-59	EHWW-59-SC-1	64
			EHWW-59-SC-2	67
			EHWW-59-SC-3	67

Note:
1. Composite C was archived.

Table 2
Media Tested in the Preliminary Reactive Amendment Screening Tests and the Bench-Scale Treatability Testing

Media	Source	Selected for Bench-Scale Treatability Testing
Sand	Target Products Ltd. (https://www.targetproducts.com/)	
Oyster shell (Granular)	Myco Supply (https://mycosupply.com/)	
Iron-oxide slag (Granular)	Copperhill Industries, LLC (https://www.mineralsandores.com/)	
Iron-oxide slag (Powder)		
Basic oxygen furnace slag (Granular)	Stein, Inc. (http://www.steininc.com/)	
Siderite (Granular)	Sidco Minerals (https://sidcominerals.com/)	
Siderite (Powder)		○
Mixed metal oxide (Granular)	Carus Corporation (http://www.caruscorporation.com/)	
Mixed metal oxide (Powder)		○
Granular ferric hydroxide	Evoqua Water Technologies, LLC (https://www.evoqua.com)	
Manganese dioxide (Powder)	Laguna Clay Co. (http://www.lagunaclay.com/)	○

Table 3
Mesocosm Setup

Mesocosm	Sediment Composite	Cap Layer	Sediment Layer Thickness (cm)	Sand/ Amended Sand Layer Thickness (cm)	Overlying Water Depth (cm)
1	A	None	15	0	25
2		Sand	15	10	20
3		Siderite (5%) + Sand	15	10	20
4		Manganese dioxide (5%) + Sand	15	10	20
5		MMO (5%) + Sand	15	10	20
6	B	None	15	0	25
7		Sand	15	10	20
8		Siderite (5%) + Sand	15	10	20
9		Manganese dioxide (5%) + Sand	15	10	20
10		MMO (5%) + Sand	15	10	20

Table 4
Results of Initial Sediment Composite Characterization

Parameter	Result[1]		Units
	Sediment Composite A	Sediment Composite B	
Sulphide	23.2	610	mg/kg
Iron	14,900	12,700	mg/kg
Manganese	150	132	mg/kg
Total Organic Carbon	11,000	33,000	mg/kg
Total Solids	61.0	53.3	wt%

Note:

1. Average of two replicate samples. Standard deviation in parentheses. The samples were field-filtered and filtered at EGL again before subsampling for characterization.

Table 5
Results of Initial Surface Water Characterization

Parameter	Result[1]	Units	Lab
Manganese, total	< 0.02	mg/L	Apex Lab
Manganese, dissolved	< 0.02	mg/L	
Iron, total	< 0.50	mg/L	
Iron, dissolved	< 0.50	mg/L	
Sodium	10,100	mg/L	
Potassium	392	mg/L	
Calcium	433	mg/L	
Magnesium	1,150	mg/L	
Chloride	17,600	mg/L	
Sulphate	2,540	mg/L	
Fluoride	0.795	mg/L	
Nitrate[2]	0.439	mg/L as N	
Ammonia	< 0.01	mg/L as N	
Nitrite[3]	< 0.02	mg/L as N	
Alkalinity	103	mg/L as $CaCO_3$	
Sulphide	< 0.05	mg/L	
Dissolved Organic Carbon	< 1.00	mg/L	
pH	7.31	—	EGL
Oxidation-Reduction Potential	237.4	mV	
Specific Conductivity	32,600	µS/cm	
Dissolved Oxygen	9.76	mg/L	

Notes:

1. Average of two replicate samples. Standard deviation in parentheses. The samples were field-filtered and filtered again prior to analysis.
2. Calculated as: (Nitrogen, Nitrate + Nitrite) – (Nitrogen, Nitrite)
3. Sample received at the lab outside the holding time.

Table 6
Results of Water Quality Measurements in the Mesocosms with Sediment Composite A

Parameter	Units	Sediment composite A (EHWW-16)																			
		No Amendment				Sand Only				Siderite + Sand				MnO_2 + Sand				MMO + Sand			
		7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days
pH	—	6.49	6.72	7.35	7.84	6.78	6.90	7.35	7.95	6.92	6.93	7.49	8.01	6.99	7.00	7.50	8.02	7.40	7.02	7.40	7.89
ORP	mV	-115.2	-118.7	-194.6	-220.6	-48.1	-52.5	-153.8	-170.9	9.8	55.7	-154.7	-89.3	30.9	70.1	-72.2	-68.9	47.4	87.1	-12.8	-32.8
SC	µS/cm	32,600	32,500	32,700	32,500	32,700	32,500	32,600	32,500	32,700	32,600	32,700	32,400	32,600	32,500	32,600	32,400	32,600	32,600	32,600	32,500
DO	mg/L	0.89	0.87	0.57	0.66	1.01	1.05	0.73	0.57	1.68	0.94	0.92	0.69	1.50	0.77	0.95	0.64	1.70	0.87	0.84	0.79
Sulphide	mg/L	1.0	0.9	1.1	1.2	0.2	0.1	0.2	1.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 7
Results of Water Quality Measurements in the Mesocosms with Sediment Composite B

		Sediment composite B (EHWW-3, 55, 57)																			
		No Amendment				Sand Only				Siderite + Sand				MnO_2 + Sand				MMO + Sand			
Parameter	Units	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days	7 days	14 days	28 days	40 days
pH	—	7.22	7.04	7.32	7.48	7.58	7.28	7.57	7.85	7.61	7.27	7.56	7.77	7.46	7.29	7.52	7.80	7.55	7.27	7.54	7.72
ORP	mV	-131.7	-138.5	-225.8	-231.5	-61.7	-135.8	-125.8	-145.0	7.7	3.0	-71.7	-94.5	22.9	23.7	-43.4	-65.1	44.4	37.8	-25.5	-44.7
SC	µS/cm	32,500	32,600	32,700	32,600	32,500	32,500	32,400	32,500	32.600	32,500	32,400	32,500	32,600	32,500	32,400	32,400	32,600	32,600	32,600	32,300
DO	mg/L	0.58	0.89	0.44	0.58	0.84	0.89	0.87	0.79	0.85	0.84	1.02	0.68	0.55	0.64	1.28	0.78	1.56	0.98	1.40	0.63
Sulphide	mg/L	0.9	0.8	1.2	1.3	0.1	0.1	0.1	0.4	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

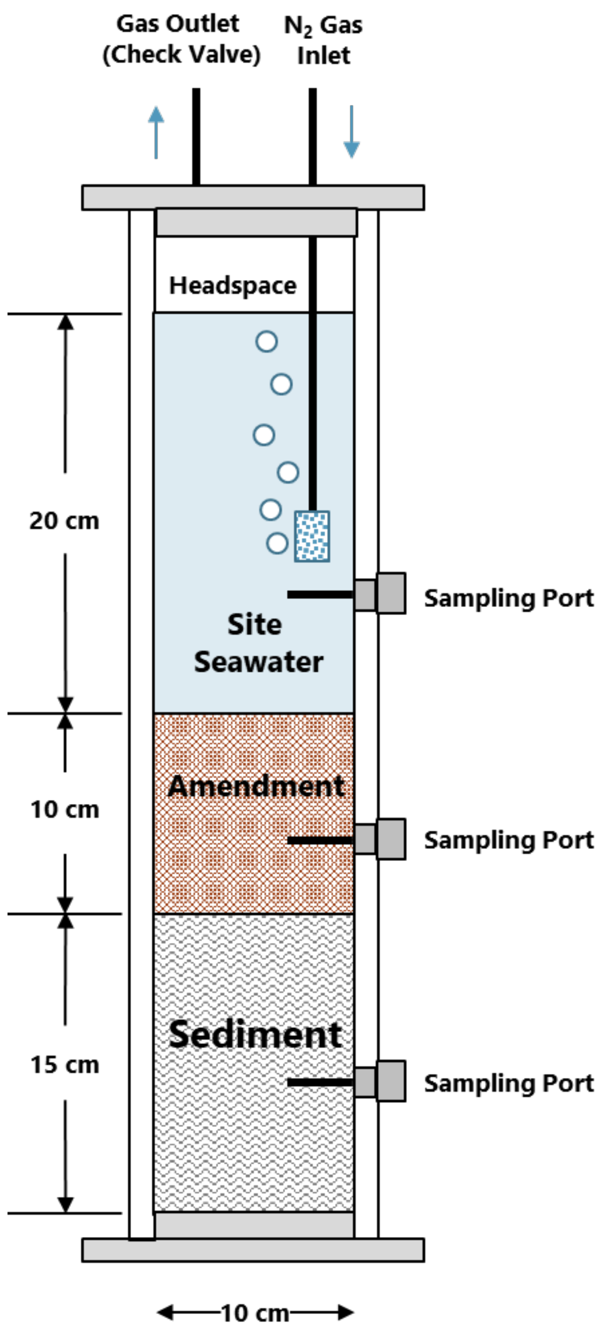
Table 8
DGT Deployment Time and Vertical Position

Mesocosm No.	Sediment Composite	Amended Sand Layer	Incubation (days)	Deployment time (hours)	Vertical position from the top of flat-probe DGT open window (cm)[1]		
					Overlying water	Sand layer	Sediment
1	A	No Amendment	10	12	0–4	—	4–15
			20	6	0–3	—	3–15
			40	6	0–2	—	2–15
2		Sand Only	10	12	0–2	2–12	12–15
			20	12	—	0–10	10–15
			40	48	—	0–10	10–15
3		Siderite + Sand	10	12	0–2	2–12	12–15
			20	48	—	0–10	10–15
			40	48	—	0–10	10–15
4		MnO_2 + Sand	10	12	0–2	2–12	12–15
			20	48	—	0–10	10–15
			40	48	—	0–10	10–15
5		MMO + Sand	10	12	0–2	2–12	12–15
			20	48	—	0–10	10–15
			40	48	—	0–10	10–15
6	B	No Amendment	10	12	0–4	—	4–15
			20	6	0–3	—	3–15
			40	6	0–3	—	3–15
7		Sand Only	10	12	0–2	2–12	12–15
			20	12	—	0–10	10–15
			40	48	—	0–10	10–15
8		Siderite + Sand	10	12	0–2	2–12	12–15
			20	48	—	0–10	10–15
			40	48	0-1	1–11	11–15
9		MnO_2 + Sand	10	12	0–2	2–12	12–15
			20	48	—	0–10	10–15
			40	48	—	0–10	10–15
10		MMO + Sand	10	12	0–2	2–12	12–15
			20	48	—	0–10	10–15
			40	48	—	0–10	10–15

Note:
1. The length of a flat-probe DGT open window is 15 cm.

Figures

Figure 1
Schematic of the Mesocosm Column Setup



Note: Reactive amendment was mixed with quartz sand and applied as a 10 cm layer on top of 15 cm sediment.

Figure 2
Sediment Control Mesocosm (No Amendment) (a) and Siderite + Sand Mesocosm (b)

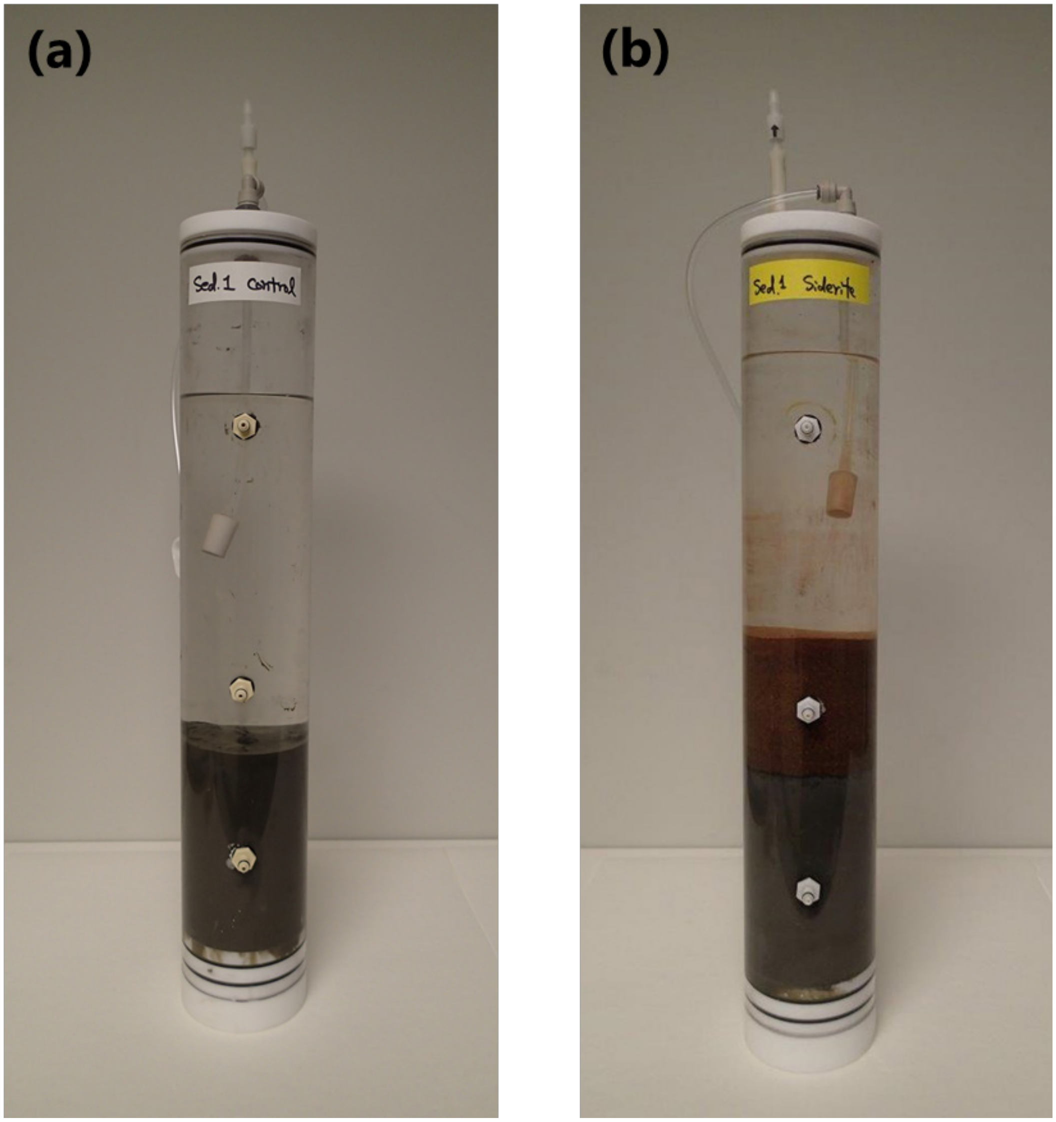


Figure 3
Setup of the Bench-Scale Treatability Testing (Day 1)

Figure 4
Flat-Probe DGT Device

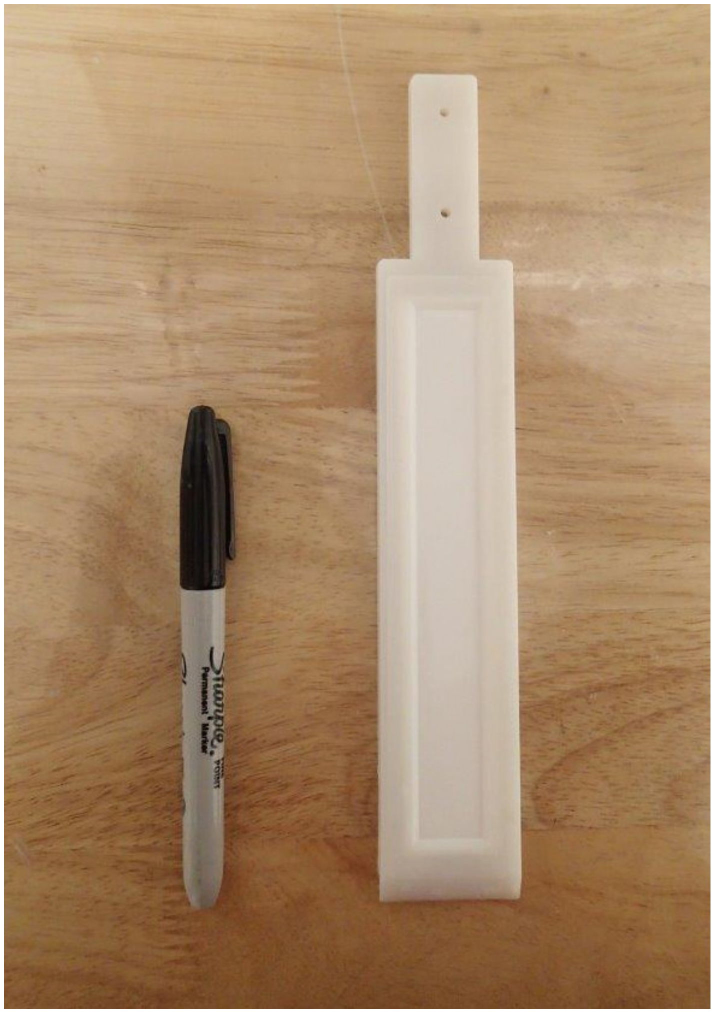


Figure 5
DGT Calibration Curve

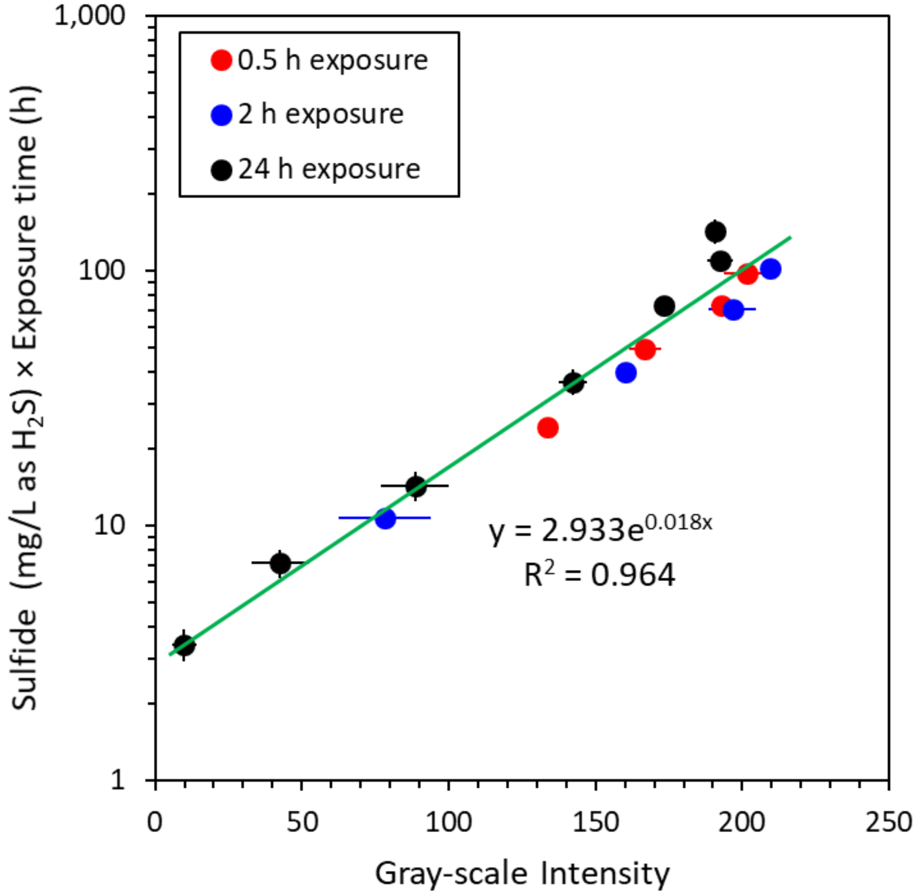


Figure 6
Dissolved Sulphide Concentrations in the Preliminary Batch Screening Tests

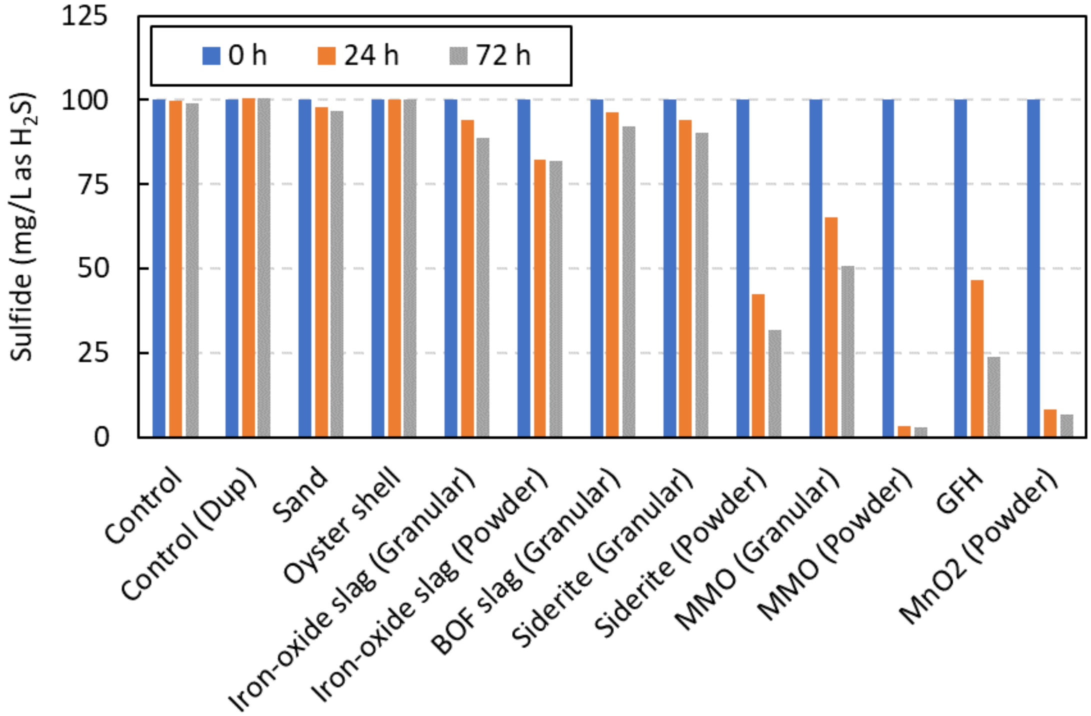
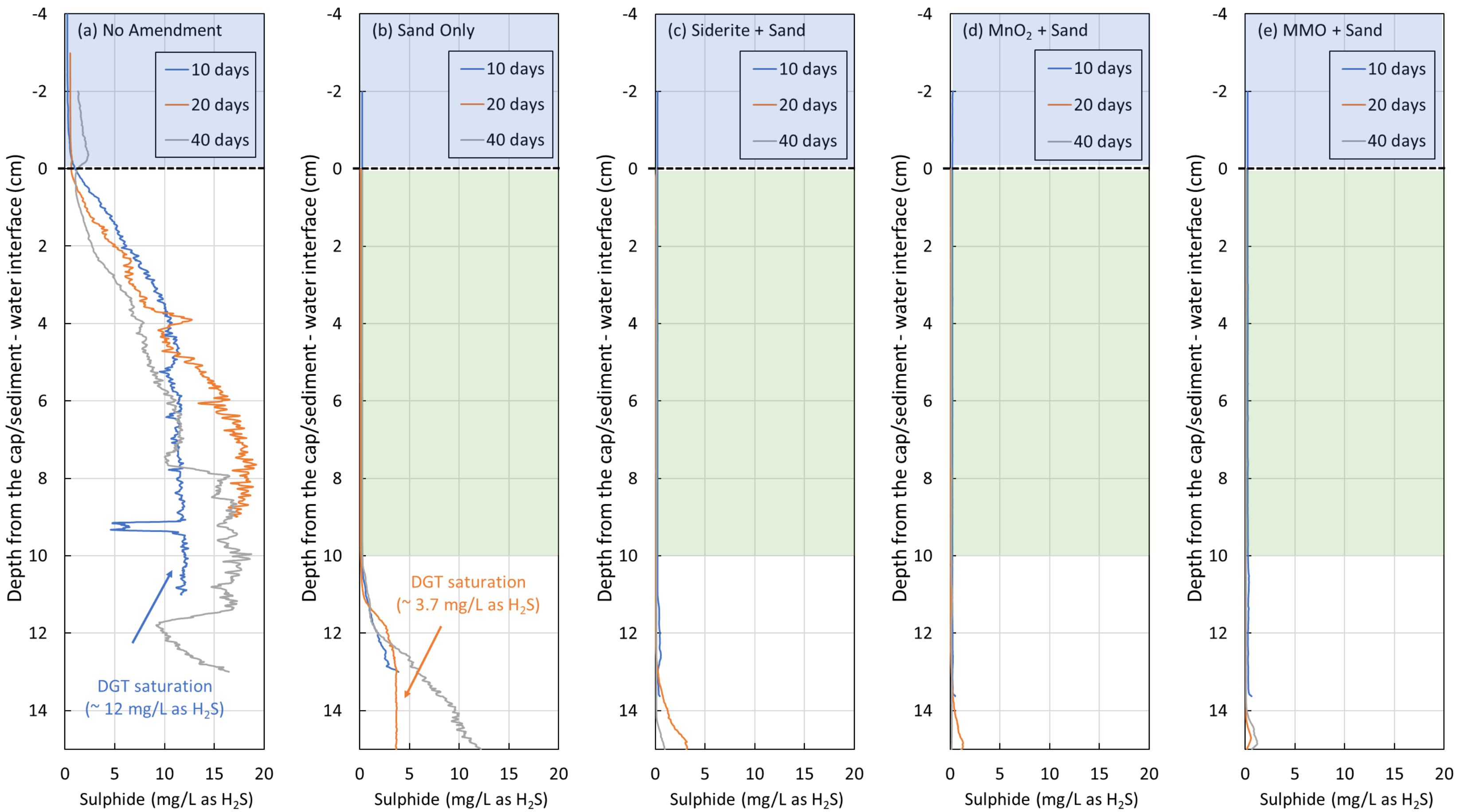
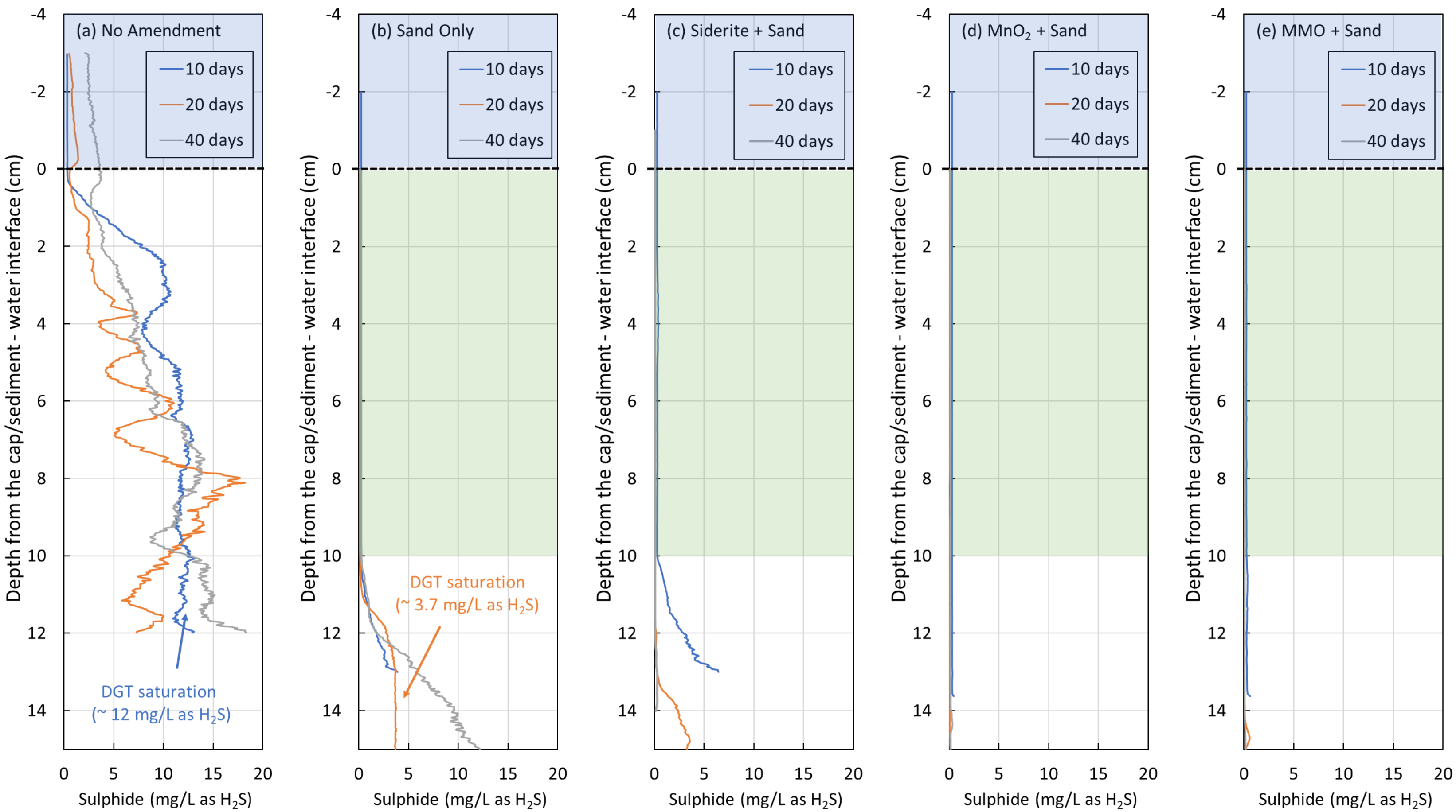


Figure 7
Dissolved Sulphide Concentration Profiles in the Mesocosms with Sediment Composite A



Note: Blue and green transparent colors in background indicate overlying water and sand/amended sand layer, respectively.

Figure 8
Dissolved Sulphide Concentration Profiles in the Mesocosms with Sediment Composite B



Note: Blue and green transparent colors in background indicate overlying water and sand/amended sand layer, respectively.

Figure 9
Sediment Control Mesocosm After 10 Days (a) and After 40 Days of Incubation (b)

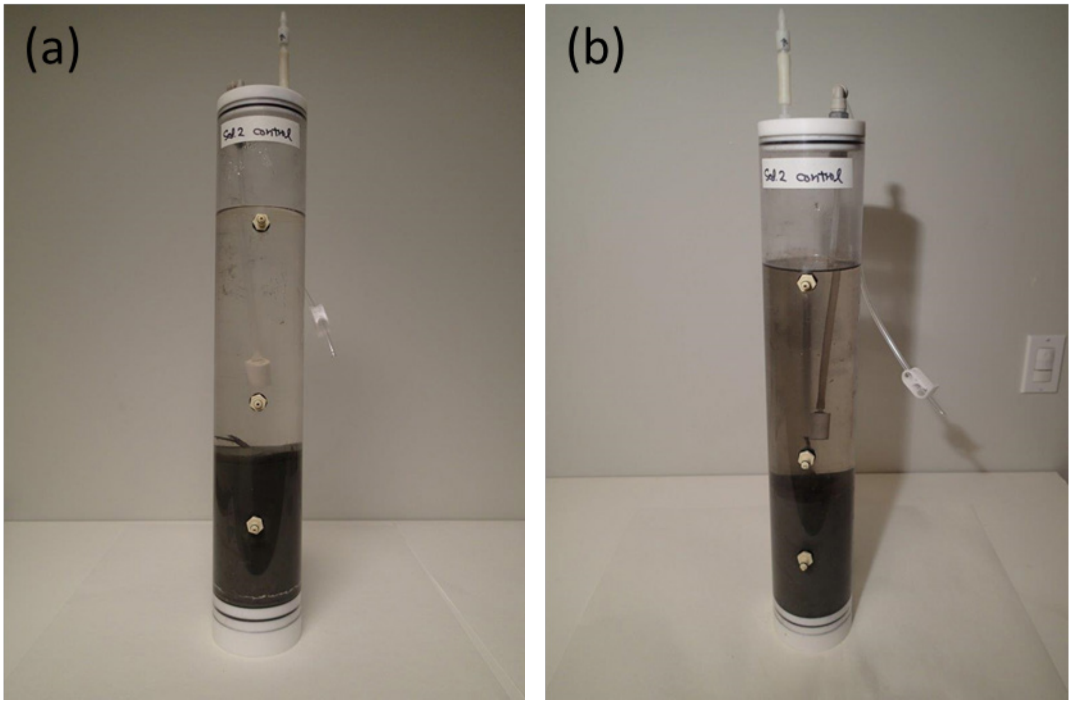
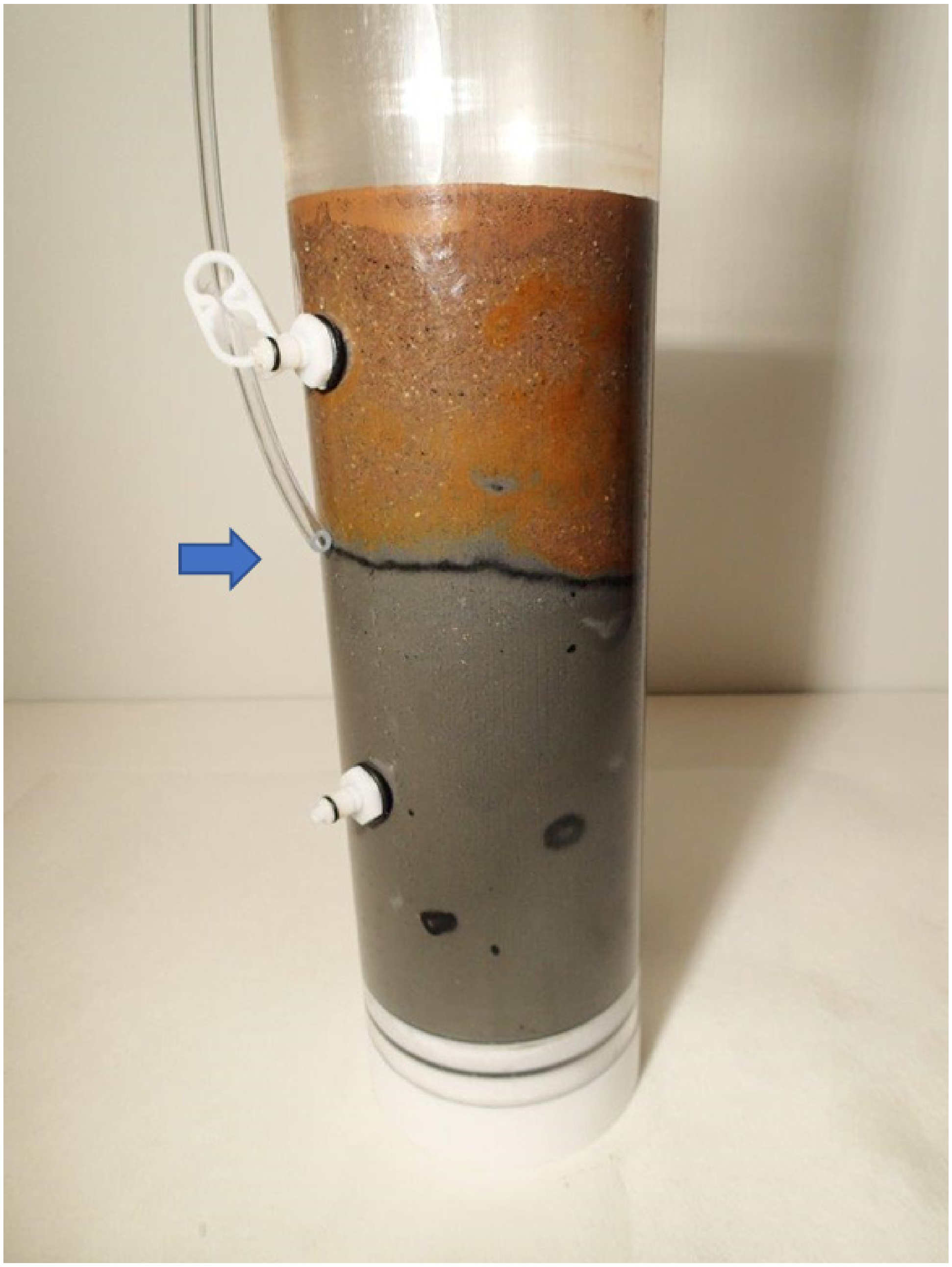


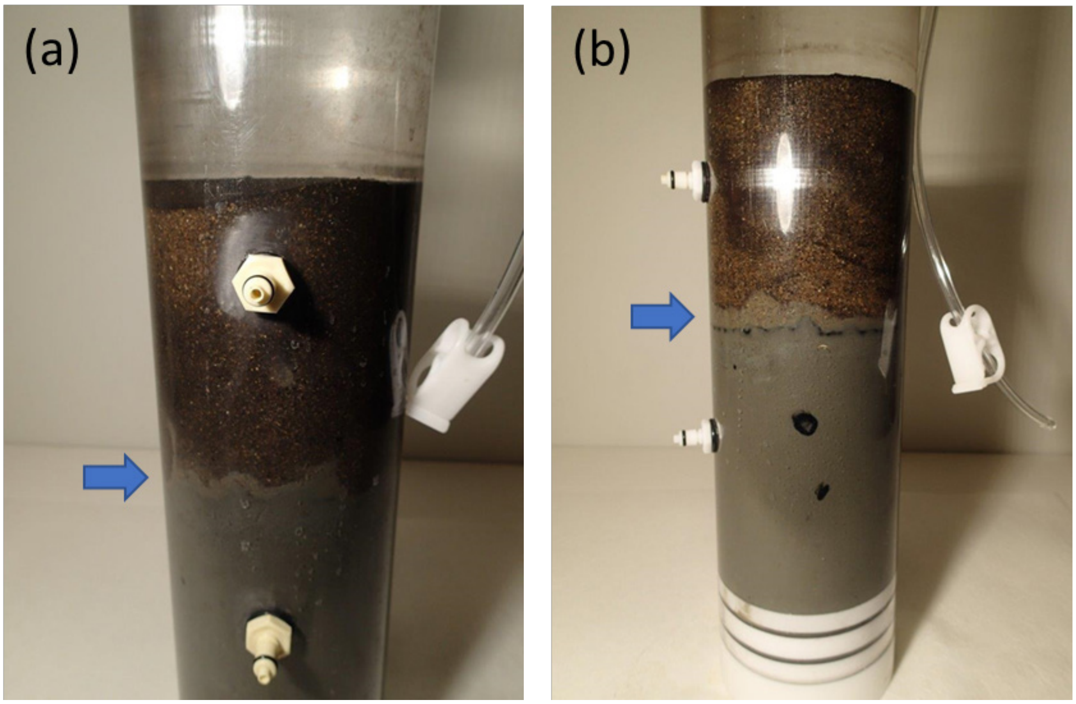
Figure 10
Layer of Black Precipitate Formed at the Overlying Water/Sand and Sediment/Sand Interfaces in the Sand-Only Mesocosm After 40 Days

Figure 11
Layer of Black Precipitate Formed at the Sediment/Amended Sand Interface in the Siderite-Sand Amended Mesocosm



Note: Blue arrow indicates the amended sand/sediment interface.

Figure 12
The MnO_2-Sand Amended Mesocosm (a) and MMO-Sand Amended Mesocosm (b) After 40 Days



Note: Blue arrow indicates the amended sand/sediment interface.

Figure 13
Cyclic Voltammograms Showing the Detection of Various Sulphide Species in Sediment Porewater of Core EHWW-16-SC-2 (Approximately 5 cm from the Top)

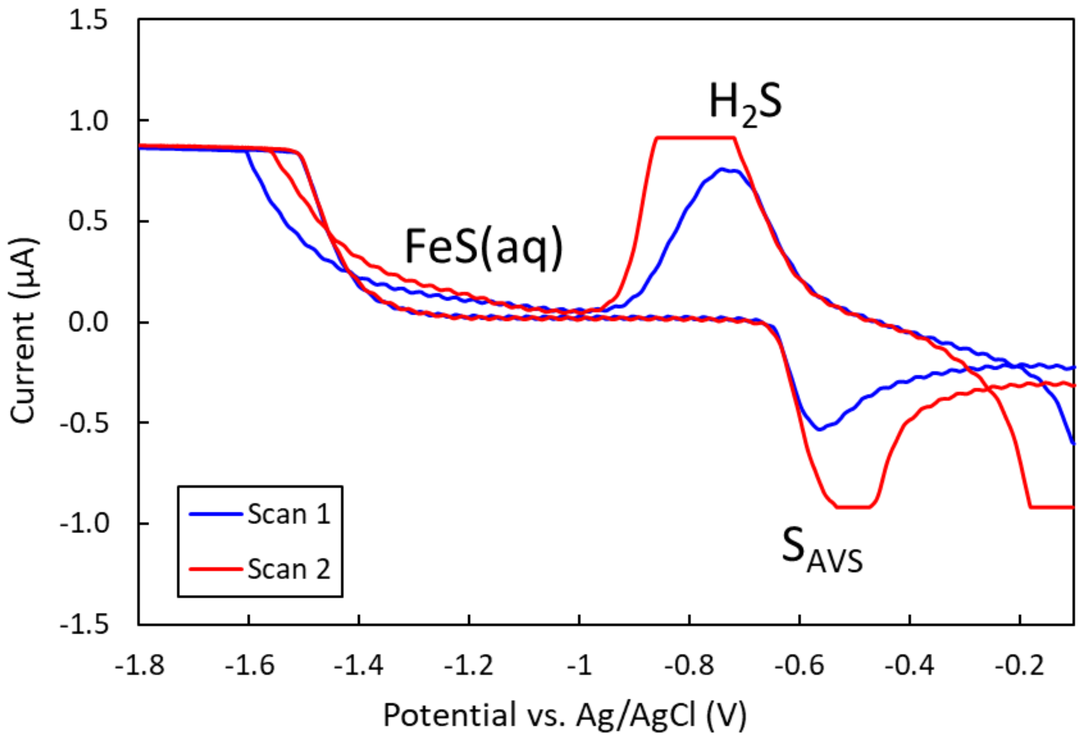
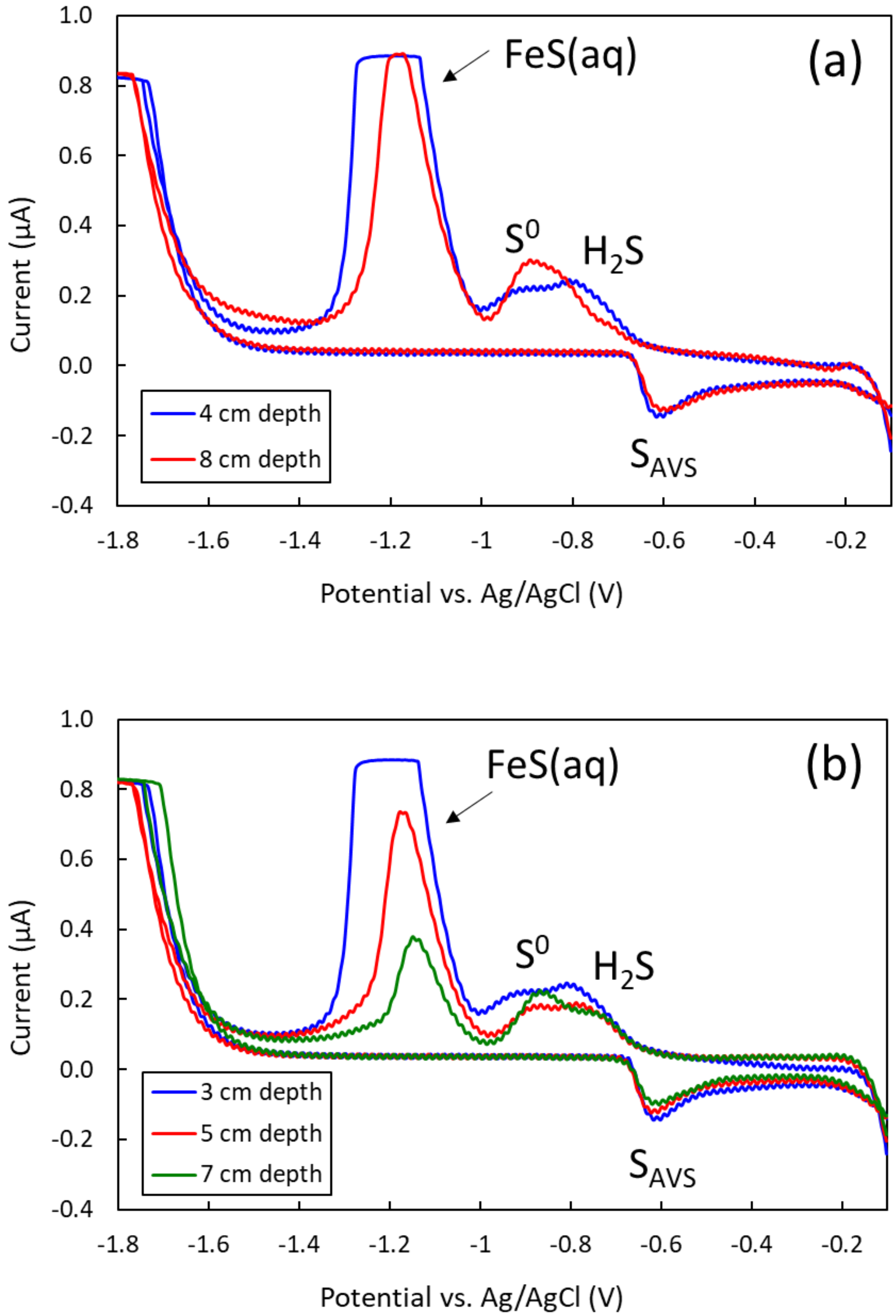


Figure 14
Cyclic Voltammograms Showing the Detection of Various Sulphide Species in Sediment Porewater in the Sediment Control Mesocosms with Sediment Composite A (a) and B (b)



Appendix A
Mesocosm and Pilot Test Modeling

1 Introduction

Laboratory bench-scale sediment mesocosm tests were set up and monitored to evaluate the ability of a thin sand layer with and without reactive amendments to reduce porewater sulphide concentrations. The amendments selected for mesocosm testing included siderite ($FeCO_3$), manganese dioxide (MnO_2), and Carus mixed metal oxide (MMO). These amendments reduce dissolved sulphide by different mechanisms: siderite provides a source of ferrous iron which can react with sulphide to precipitate iron sulphide phases; manganese dioxide and MMO contain oxides that can directly oxidize sulphide to sulphate. The objective of the mesocosm tests was to compare the performance of the three amendments (and unamended sand) in preventing the buildup of dissolved sulphide in the sand layer and overlying water in order to provide a recommendation for an amendment to be incorporated into the pilot study. The bench-scale mesocosms were initially monitored over a period of 40 days; sulphide concentration profiles showed similarly good performance of all three amendments over that time period. Therefore, it is necessary to assess potential differences in performance over a longer timeframe in order to select an amendment for the pilot test. This was accomplished by using a reactive transport model to simulate the evolution of sulphide concentration profiles in the mesocosms over a period of 1 year.

Based on the results of the mesocosm reactive transport model simulations, a hypothetical pilot test model simulation was performed to evaluate porewater sulphide concentrations in the biologically active zone [BAZ] (i.e., upper 10 centimetres [cm]) of a siderite-amended sand layer.

2 Model Setup

2.1 Bench-Scale Mesocosm Models

The mesocosm models were set up using the sediment early diagenesis reactive transport model described in Bessinger et al. 2012. Modelling was implemented in the geochemical reactive transport software PHREEQC Version 3 (Parkhurst and Appelo 2013). The model simulations were set up to reflect the mesocosm setup: a closed system consisting of 15 cm of wood waste/sediment overlain by a 10-cm thick sand layer and 15 cm of seawater. The pore fluid initially present in the sand layer and underlying sediment was also seawater and an effective porosity of 30% was assumed.

Four model scenarios were developed by varying the composition of the sand layer: 1) unamended sand, 2) siderite-amended sand, 3) manganese dioxide-amended sand, and 4) MMO-amended sand. As with the mesocosms, the initial dose of the amendments was 5% by weight. MMO is composed of 23% goethite (FeOOH), 5.5% manganese dioxide, and 12.5% calcite ($CaCO_3$) with the remaining 59% comprising silica, alumina, calcium oxide and proprietary components, considered to be inactive with respect to sulphide. These amounts were scaled for an amendment dose of 5% by weight MMO.

The model simulates biogeochemical processes as kinetically controlled primary and secondary redox reactions. Primary redox reactions include, for example, the microbial oxidation of organic carbon (i.e., wood waste) coupled to the reduction of sulphate to sulphide. Secondary redox reactions include the oxidation of sulphide to sulphate by reductive dissolution of iron and manganese oxides. Dissolution of siderite and precipitation of iron sulphides such as mackinawite (FeS) is treated as an equilibrium process.

Transport of dissolved ions from overlying water into the sediment and vice versa occurs via diffusion and is in response to concentration gradients.

2.2 Pilot Test Model

As with the bench-scale mesocosm models, the pilot test simulation was set up using the sediment early diagenesis model described in Bessinger et al. 2012, and implemented using the geochemical reactive transport software PHREEQC Version 3 (Parkhurst and Appelo 2013). This model simulation was set up to reflect a hypothetical pilot test involving a 30-cm siderite-amended sand layer overlying 100 cm of wood waste and sediment. A constant concentration boundary was implemented at the seawater-sand layer interface, and the pore fluid initially present in the sand layer and underlying sediment was also seawater. An effective porosity of 30% was assumed, and the siderite amendment dose in the sand layer was 5% by weight. The pilot test model simulation was carried out for a period of 30 years.

Also, as with the bench-scale mesocosm models, transport of dissolved ions from overlying seawater into the sediment and vice versa occurs via diffusion and is in response to concentration gradients.

3 Results

3.1 Bench-Scale Mesocosm Models

Figures A–1 through A–4 show the simulated evolution of sulphide concentration profiles in the wood waste/sediment and overlying sand layer for the four mesocosms over a period of 1 year.

Note that the predicted concentrations are a function of the initial conditions assumed and the rate coefficients for the biogeochemical redox reactions used in the model. While the rate coefficients are based on published values taken from the peer-reviewed scientific literature, they are not site-specific and the model was not calibrated to site data as this was beyond the scope of the analysis. Although the predicted absolute concentrations are not necessarily representative of conditions within the mesocosms, the vertical profiles and sulphide breakthrough characteristics of the sand layer in the different mesocosms do provide a basis of comparison to assess the potential long-term effectiveness of the amendments.

The unamended sand mesocosm (Figure A–1) shows a progressive breakthrough of sulphide in the sand layer with the concentration profile approaching steady-state (i.e., linear vertical gradient) by 12 months.

Modelling results indicate that the siderite-amended sand layer (Figure A–2) is effective at preventing dissolved sulphide from breaking through over the course of the simulation. This is due to the precipitation of mackinawite (FeS) at the sand-wood waste interface, which has also been observed in the bench-scale mesocosms. The dissolved sulphide concentrations in the wood waste also decrease over time as sulphur is permanently removed from the solution by this process.

The manganese-dioxide- and MMO-amended sand mesocosms show a breakthrough of sulphide into overlying water albeit at a slower rate than the unamended sand mesocosm. This indicates that the rate of sulphate reduction outpaces the rate of sulphide oxidation by manganese and iron oxides. A limited sensitivity analysis was performed by running an additional simulation in which the rate coefficient for sulphide oxidation by manganese oxide was increased by an order of magnitude. The concentration profiles were diminished, but sulphide breakthrough into the sand layer was still observed to occur by 12 months of simulation time.

These results suggest that although the manganese dioxide and MMO amendments can retard sulphide breakthrough, they would not be as effective as the siderite amendment in the long term.

3.2 Pilot Test Model Simulation

Based on the bench-scale mesocosm model results, siderite was chosen as the amendment for the pilot test model simulation. Figure A–5 shows the average porewater sulphide concentration in the BAZ. Steady state sulphide concentration in BAZ porewater is established after about 6 years, at a concentration of approximately 0.5 milligrams per litre. The model indicates traces of sulphide breakthrough may be observed in the BAZ in a 1- to 2-year timeframe. The simulation results also suggest that the 5% dose will be effective for the duration of the pilot study, and that less than 10% of the siderite will have been expended by the 30-year model timeframe. Long-term model simulations and the associated effectiveness of the dose of siderite could be refined following additional data collection (i.e., labile carbon component of wood waste, porosity) and monitoring from the pilot study planned for next fiscal year.

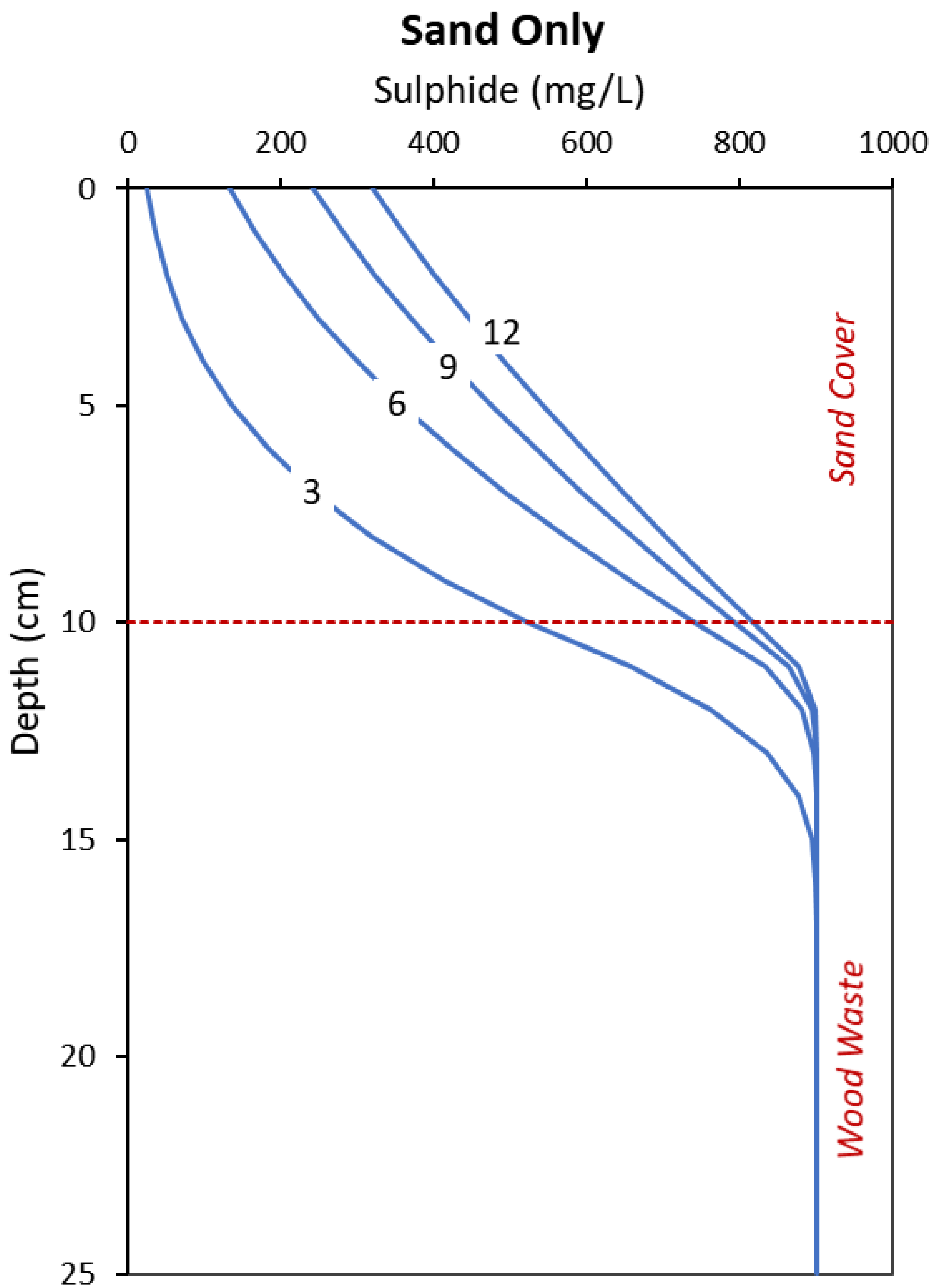


Figure A–1
Simulated Porewater Sulphide Profiles in the Unamended Sand Mesocosm After 3, 6, 9, and 12 Months

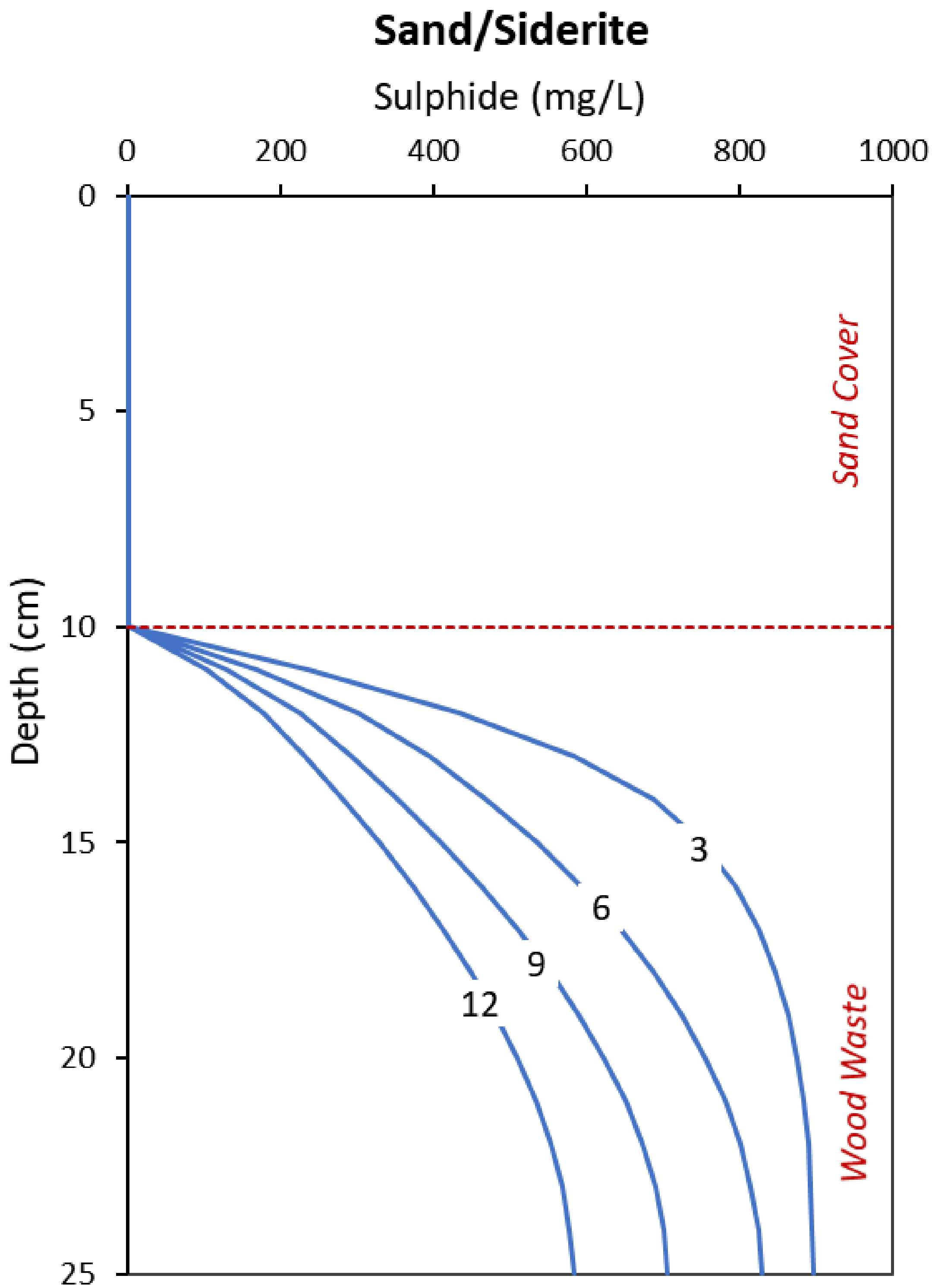


Figure A–2
Simulated Porewater Sulphide Profiles in the Siderite-Amended Sand Mesocosm After 3, 6, 9. and 12 Months

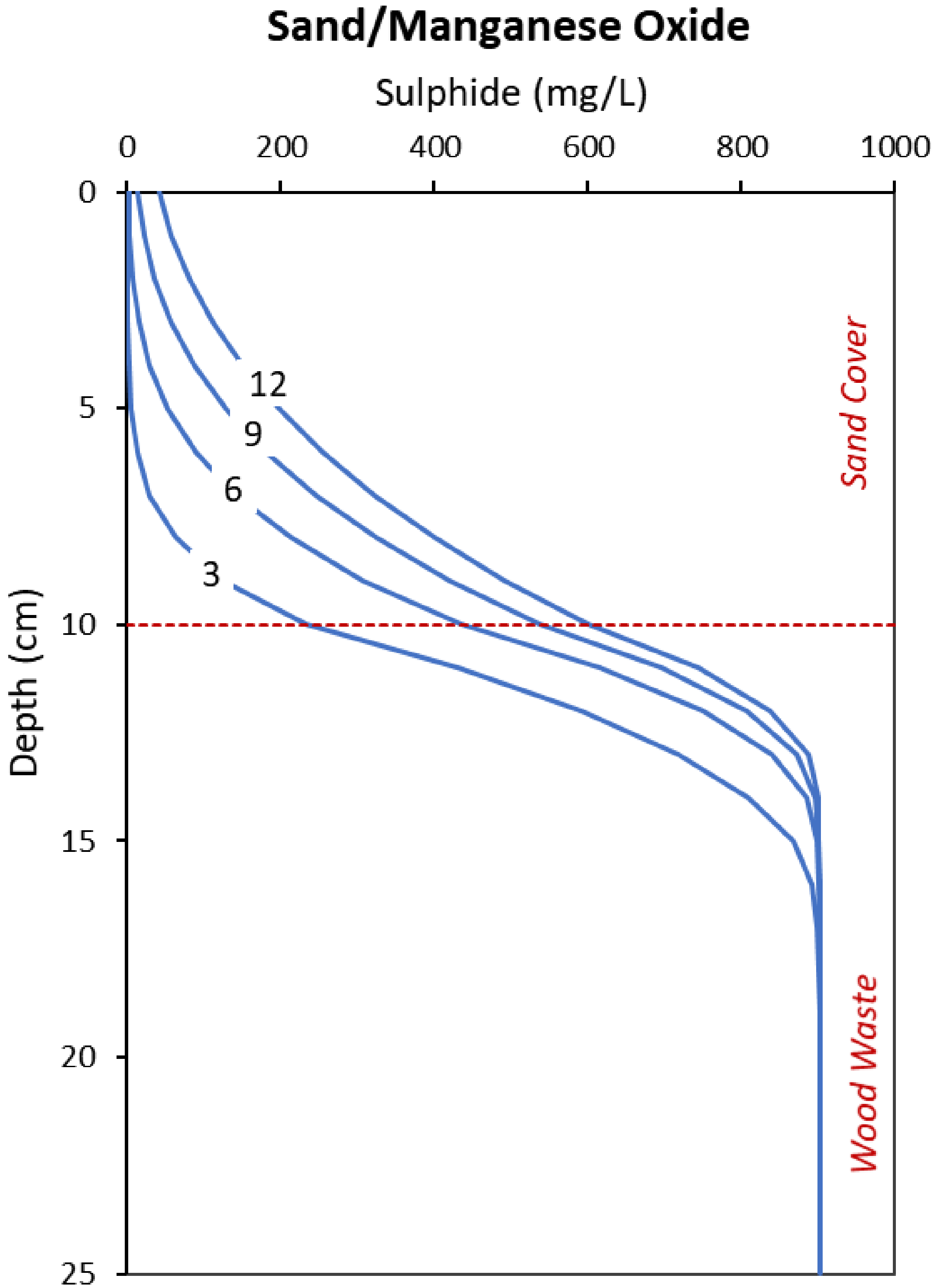


Figure A–3
Simulated Porewater Sulphide Profiles in the Manganese Dioxide-Amended Sand Mesocosm After 3, 6, 9, and 12 Months

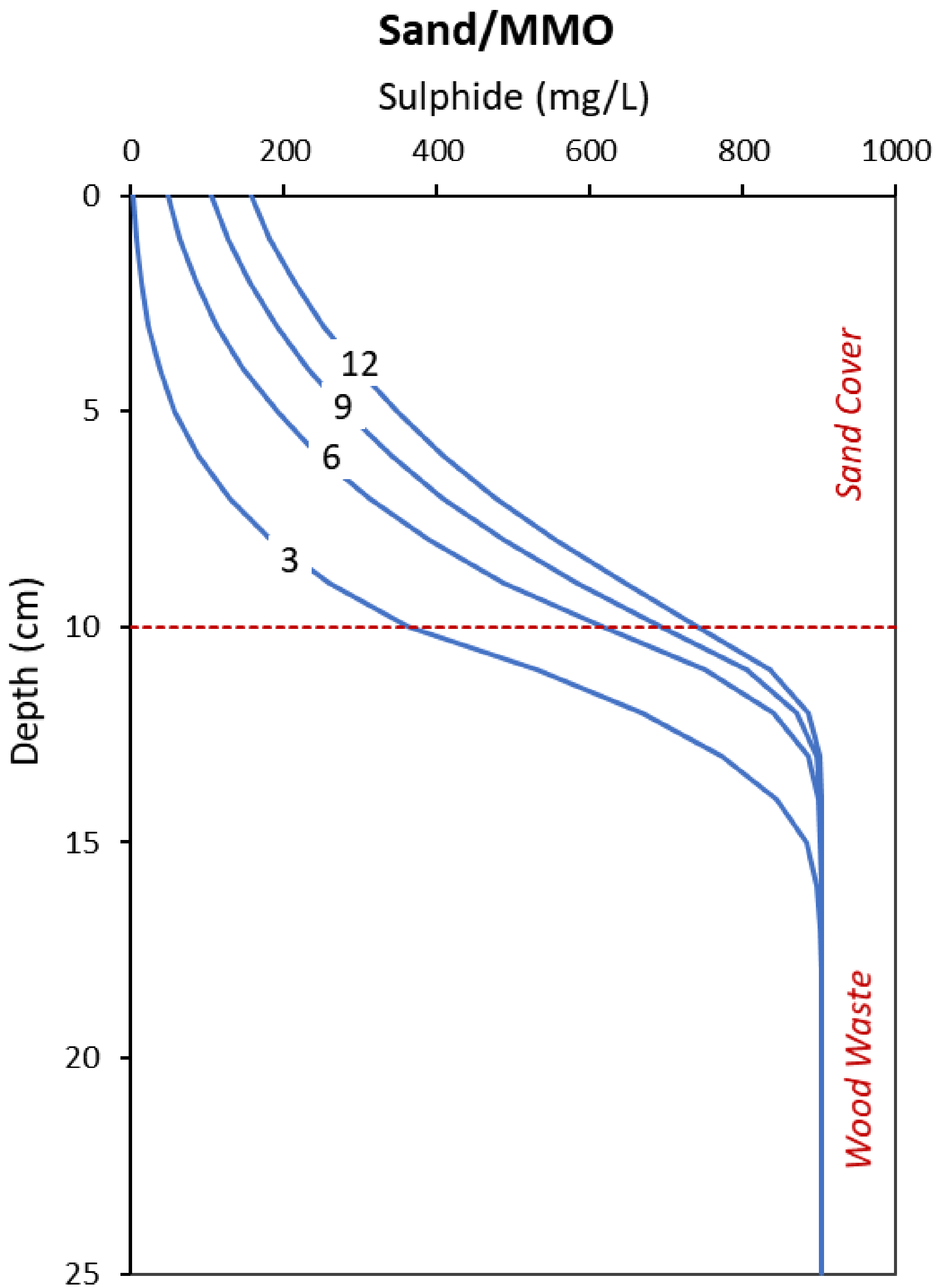


Figure A–4
Simulated Porewater Sulphide Profiles in the MMO-Amended Sand Mesocosm After 3, 6, 9, and 12 Months

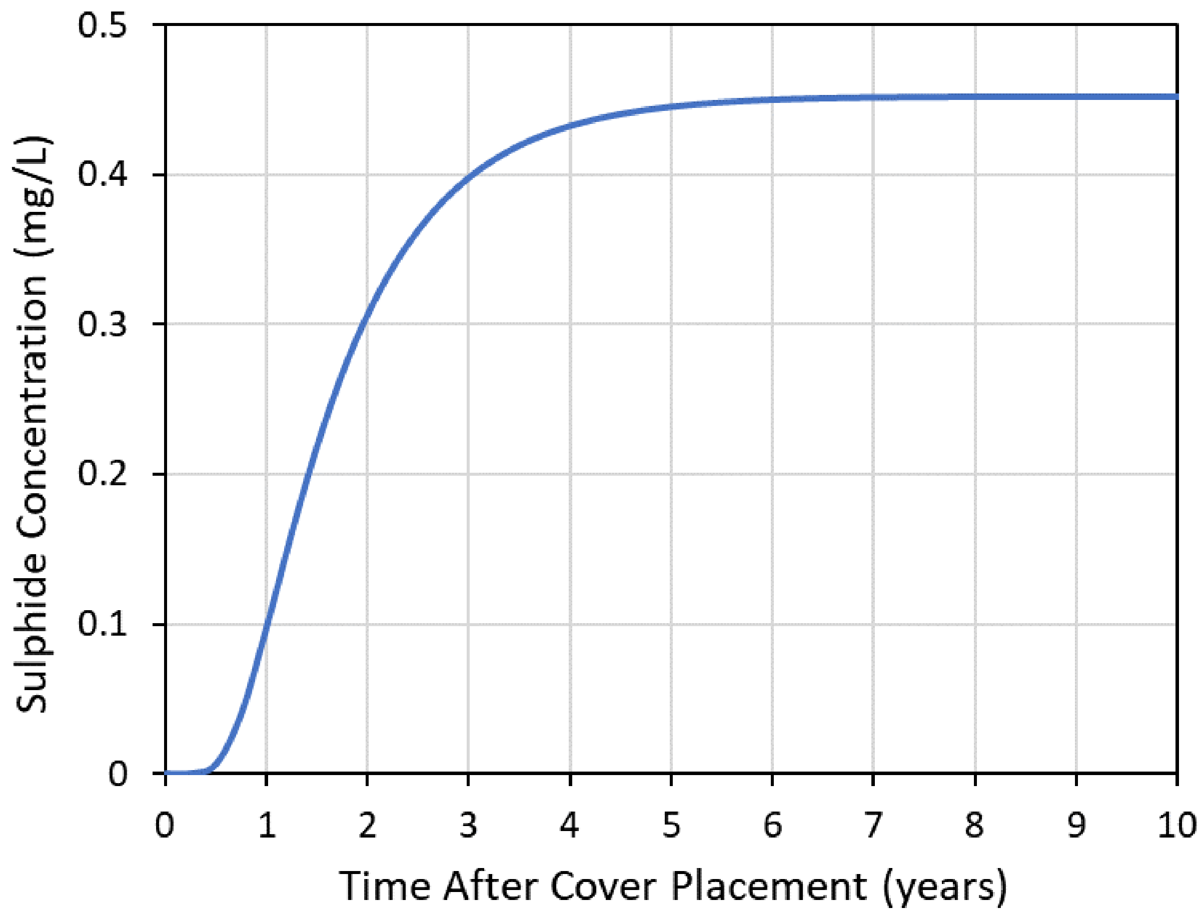


Figure A–5
Simulated Porewater Sulphide Concentration in the BAZ of a 30-cm Siderite-Amended Sand Layer

4 References

Bessinger, B.A., D. Vlassopoulos, S. Serrano, and P.A. O'Day, 2012. "Reactive Transport Modeling of Subaqueous Sediment Caps and Implications for the Long-Term Fate of Arsenic, Mercury, and Methylmercury." *Aquat. Geochem. Online First*™. April 27, 2012.

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APPENDIX E

Department of National Defence Esquimalt harbour Wood Waste Assessment, Characterization and Management Plan

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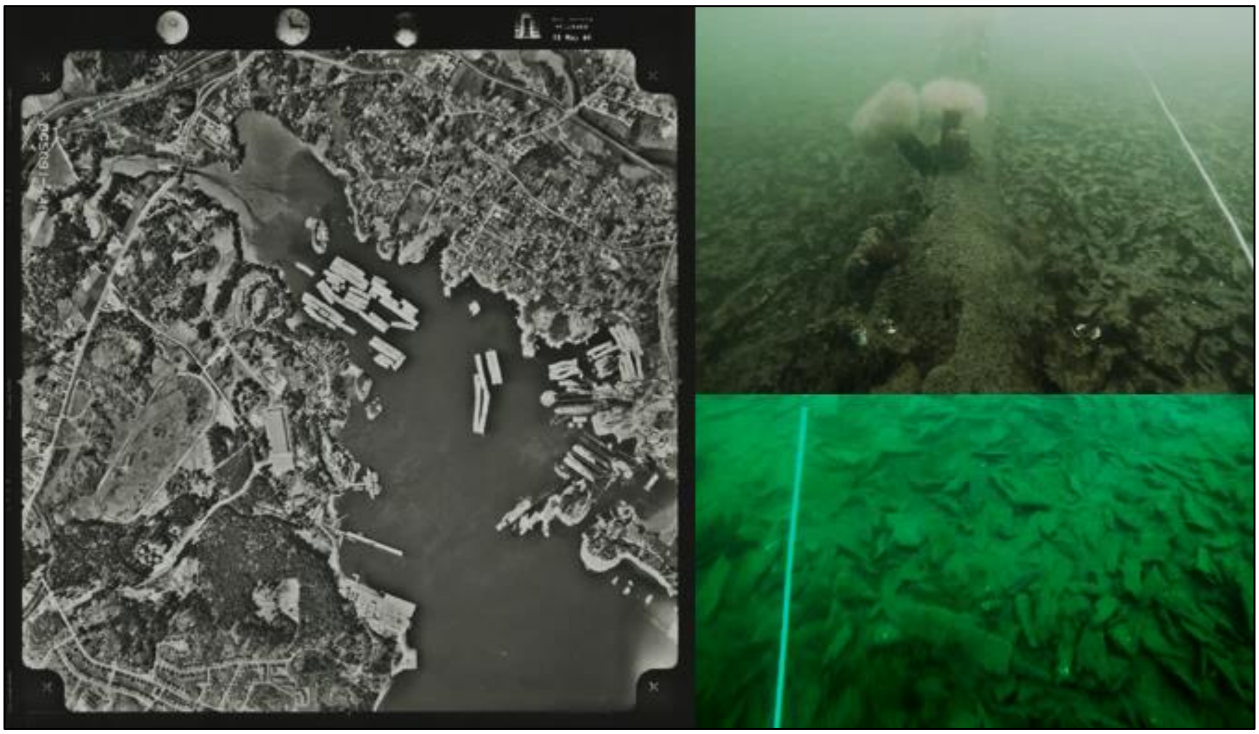
Department of National Defence Esquimalt Harbour Wood Waste Assessment, Characterization and Management Plan



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Project No: R.091121.001

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EXECUTIVE SUMMARY

Esquimalt Harbour has historically been used for log booming, log storage and wood milling operations over the last 70 years. These activities have led to the accumulation of wood and wood debris deposits in the subtidal area of the Harbour. Wood waste deposits can negatively affect marine benthic communities through physical alteration of sediments and increased toxicity through contamination by leachate or the by-products of anaerobic decomposition. An assessment of the effects of wood waste on the subtidal marine environment was conducted on behalf of the Department of National Defence and in support of the Esquimalt Harbour Remediation Project.

This report documents the approach and findings of the assessment including:

- A review of the impacts of wood waste on marine subtidal habitats, a review of Esquimalt Harbour historical industrial activities and existing biophysical studies relating to the Project area, and wood waste delineations in the Harbour (Section 2.0)
- Results from field surveys undertaken to determine the nature and extent (lateral extent and depth) of the wood waste deposits, to document biophysical site conditions, and analyze sediment chemistry results (**Section 3.0**)
- An impact assessment of wood waste on the subtidal benthic community in Esquimalt Harbour (**Section 3.0**)
- Evaluation of remedial options and provide recommendations for next steps (**Section 4.0**)
- Development of a recommended site-specific pilot project to test the effectiveness of proposed remediation measures (**Section 5.0**).

Main findings of the assessment include:

- Wood Waste Delineation

  Wood waste is distributed in two large areas (>100 m wide) north of Inskip Island and reaching into Plumper Bay and south of Cole Island and two smaller areas of wood waste (<50 m wide). The spatial distribution of wood waste deposits was greater than visual observations of the surficial extent of wood waste. The nature of the wood waste was indicative of log storage and log booming areas, primarily small woody debris, composed of bark chips and scattered cut logs and some finer wood pulp/fibre. Wood pulp/fibre could be from historical wood-processing activities that occurred within the harbour (**Section 2.3**) or from the breakdown of small woody debris. The total volume of wood waste and overlying impacted sediments in the Harbour was estimated to be 332,299 m^3.

- Biophysical Conditions

  Esquimalt Harbour epibenthic communities documented for this report were similar to those documented by earlier assessments. In areas of known wood waste deposits epibenthic organisms were sparse with evidence of bacterial mats (Beggiatoa sp.) that are often associated with wood waste impacted sediments. Areas with exposed logs, provided hard substrate for rocky reef organisms to colonize/use as complex habitat structure for refuge. Infauna holes and mounds were relatively absent, indicating the lack of large bioturbators. The abundance and diversity of infauna communities varied across the harbour; however, most stations were dominated by a single second-order opportunistic polychaete species.

- Sediment Chemistry

  Decomposition by-products were assessed to determine drivers of impairment. Total organic carbon (TOC) levels were elevated in comparison to reference locations and had a distribution pattern that was correlated with the assessed extent of wood waste deposits. Pore-water sulphide and Ammonia did not show as tight of a relationship with the delineated area of wood waste.

- Impact Assessment

  Due to its strong correlation with TOC and areas of wood waste deposits, the presence of *Beggiatoa* sp. can be considered an indicator of benthic community impairment from wood waste deposits. Other epibenthic species, such as Dungeness and graceful crabs, were observed in areas of wood waste during surveys but been shown by other studies to use these areas as habitat if the overlying water quality is not impaired.

  Areas of greatest impact on the subtidal benthic community were determined using multivariate analysis and indicated that the sediment chemistry parameter most strongly linked with known areas of wood waste deposits and to differences in benthic infauna community composition and species richness was TOC. Benthic community impairment between 1 – 3% TOC was variable; however, a 3% TOC level has been determined to be a site-specific indicator for the impairment of benthic infauna due to wood waste deposits, with greater impacts observed at TOC levels >5%. The benthic infauna community in Esquimalt Harbour shows general signs of impairment (ranging from somewhat disturbed/impacted to low – moderate impairment) and is dominated by opportunistic polychaete species and the lack of larger bioturbators or species that are pollution-sensitive.

In general, the recommended approach for site-specific remediation of wood waste, and wood waste impacted sediments, is as follows:

- Dredging

  Complete removal of sediment/wood waste in areas where wood waste deposits are > 0.25m deep. Placement of clean fill following dredging to reduce residuals and provide clean substrate for the recruitment and establishment of productive infauna communities. Following the implementation of remediation efforts, a monitoring program will be required to track the recovery of the benthic community and remediated bottom sediments, in order to qualify the remediation for the DND Habitat Bank.

- Pilot Study Project

  Conduct an experimental in-field pilot study within the Harbour to investigate the site-specific effectiveness and feasibility of economical and less invasive remedial options (Monitored Natural and Enhanced Natural Recovery) for areas of discontinuous and/or shallow wood waste deposits (0 – 0.25 m).

ACKNOWLEDGEMENTS

We would like to acknowledge the efforts and valuable input to this Project from both Ashley Rabey, Environmental Specialist, and Kristen Ritchot, Environmental Specialist with Environmental Services, Public Services and Procurement Canada as well as Mike Waters, Environment Officer, Department of National Defence.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Photographs

List of Appendices

ACRONYMS

APEC	Areas of Potential Environmental Concern
AST	Above ground storage tank
BACI	Before After Control Impact
BC	British Columbia
BC MOE	British Columbia Ministry of Environment
BMP	Best Management Practice
BOD	Biological oxygen demand
CCA	Canonical correspondence analysis
CCME	Canadian Council of Ministers of the Environment
CD	Chart datum (where zero metres CD is equal to the average low water level)
CDF	Confined disposal facility
COPC	Contaminant of Potential Concern
DAS	Disposal at sea
DND	Department of National Defence
DQO	Data quality objectives
EMAP	Environmental Monitoring and Assessment Program
ENR	Enhanced natural recovery
EPA	Environmental Protection Agency
FCSI	Federal Contaminated Sites Inventory
FCSAP	Federal Contaminated Sites Action Plan
FPIP	Fisheries Productivity Investment Policy
HWL	High water level (approximately 4.5 m CD)
LWD	Large woody debris
MNR	Monitored Natural Recovery
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
QA/QC	Quality assurance and quality control
RPD	Relative percent differences
SQG	Sediment quality guidelines
SWI	Sediment-water Interface
TOC	Total organic carbon
UST	Underground storage tank
WWI	World War I
WWII	World War II

GLOSSARY

Aerobic Conditions	Presence of dissolved oxygen
Anaerobic Conditions	Depleted of dissolved oxygen
Anaerobic Decomposition	Metabolic functions without oxygen
Benthic Fauna	Organisms within the sediment, in the sediment-water interface, and immediately adjacent overlying water
Biological Oxygen Demand	A process used to determine the rate at which biological organisms use up oxygen in the water. High BOD reduces or removes available dissolved oxygen in the water column and pore water in the sediment.
Cellulolysis	The process of breaking down cellulose
Chemosynthetic	Organisms that use energy released in inorganic chemical reactions to produce sugars and amino acids
Epibenthic	Describes organisms that live on the surface of the sediment on the seafloor
Fibre Blanket	Wood waste not visible to the eye and defined by TOC levels above background levels attributed to wood, wood by-products and wood processing
Heterotrophic	An organism that cannot synthesize its own food and instead depends on organic carbon as a source of energy for growth
Infauna	Organisms that live within the bottom sediment of a body of water
Large Woody Debris	Naturally occurring woody debris that has not been cut or processed in the wood-processing industry, may contain roots or limbs
Methanogenic	Organisms that produce methane as a by-product of anaerobic respiration
Surficial Sediment	The surface layer of sediments (approximately 0-10cm)
Wood Waste	Any wood by-product of the wood processing industry, such as cut logs, bark, wood chips, sawdust or wood fibre

1.0 INTRODUCTION

Forestry and wood product processing has a long and important history in British Columbia (BC), with waterways providing the most efficient and economical way to transport and store timber. As a result, forestry-related activities, such as log booming, log storage and sawmill operations, have resulted in wood waste deposits accumulating in intertidal and subtidal nearshore habitats along the coast of BC. In Esquimalt Harbour (the Harbour), Federal leaseholds have been used for log booming over the last 70 years (most intensively in the 1940s to 1980s), leading to the accumulation of a large amount of wood and wood debris deposited on the Harbour floor.

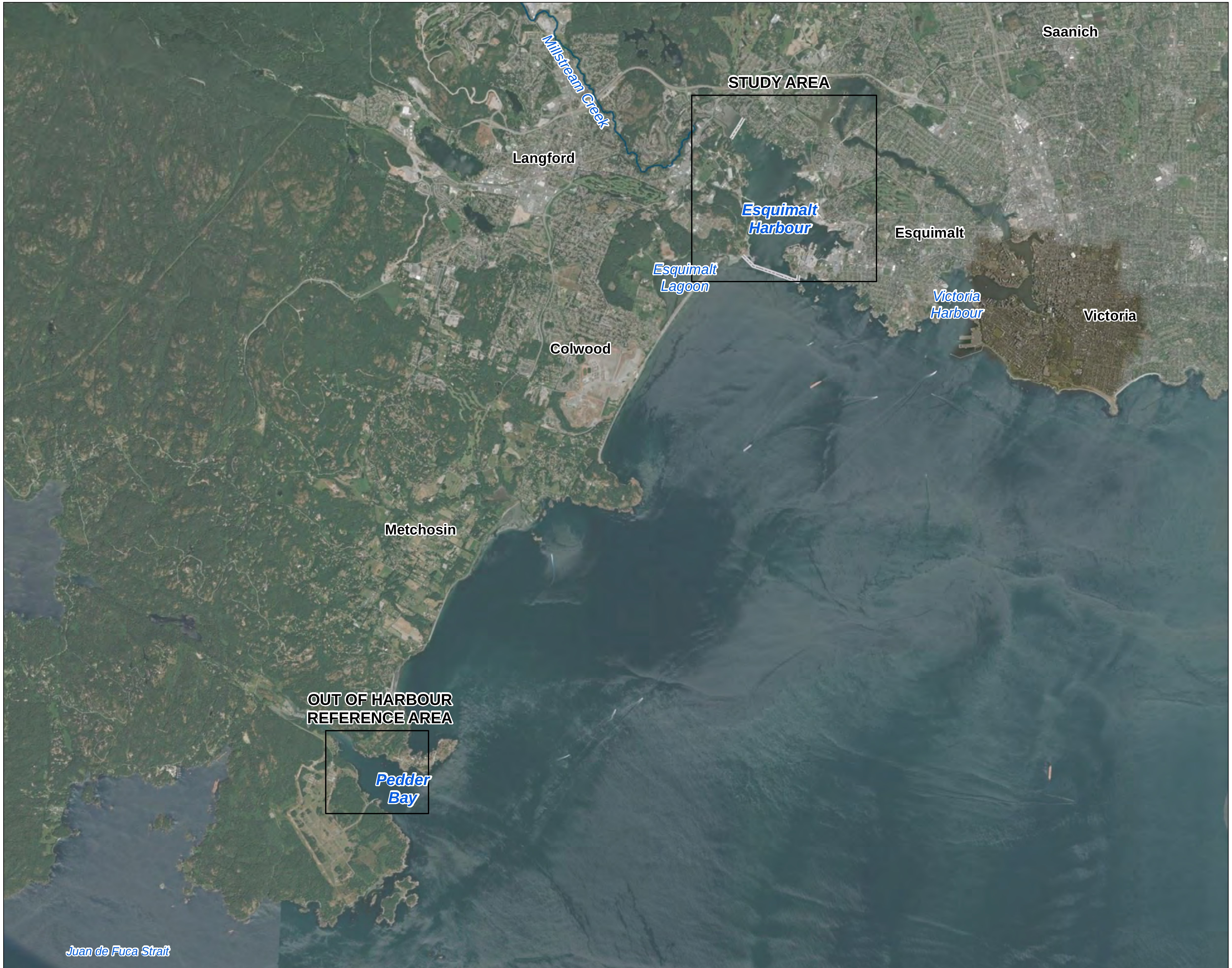
Wood waste deposits can negatively affect marine benthic communities through physical alteration of sediments and increased toxicity through contamination by leachate or the by-products of anaerobic decomposition (i.e., hydrogen sulphide, ammonia and methane). Assessing the effects of wood waste on the marine environment is a priority for the Department of National Defence (DND) in alignment with the Esquimalt Harbour Remediation Project. To address this, the Esquimalt Harbour Wood Waste Assessment, Characterization and Management Plan Project (the Project) was undertaken over two fiscal years, from 2016-2018, by Public Services and Procurement Canada on behalf of DND (see **Figure 1.1** and **Figure 1.2** for Project location).

The objectives of the Project are to:

- Determine the nature (e.g. composition) and extent (lateral coverage and depth) of the wood waste deposits in Esquimalt Harbour
- Characterize the biophysical habitat conditions within areas of known wood waste deposits, transition zones, and areas without wood waste
- Analyze sediment chemistry parameters to determine the distribution of conventional contaminants of concern and conventional sediment chemistry parameters associated with wood waste or wood waste decomposition by-products
- Identify and assess the impacts of wood waste deposits on marine benthic community in Esquimalt Harbour
- Evaluate wood waste remediation options considering the site-specific conditions and results of the impact assessment and provide recommendations for remediation
- Develop a recommended site-specific pilot study project to test the effectiveness of more economical and less invasive remediation measures

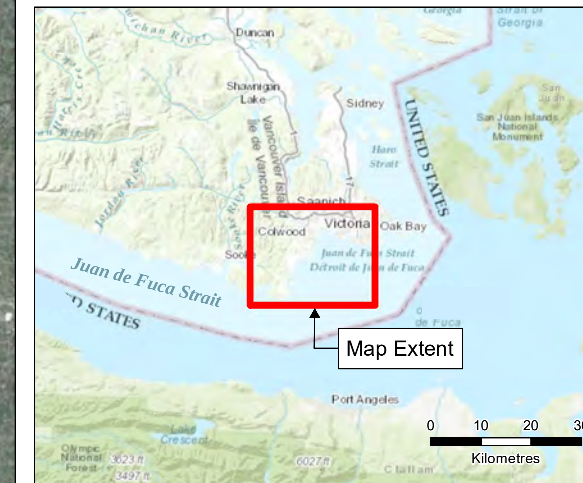
This report documents the approach and findings of the assessment (Project) including:

- A review of the impacts of wood waste on marine subtidal habitats, a review of Esquimalt Harbour historical industrial activities and existing biophysical studies relating to the Project area, and wood waste delineations in the Harbour (**Section 2.0**)
- Results from field surveys undertaken to determine the nature and extent (lateral extent and depth) of the wood waste deposits, and to document biophysical site conditions (**Section 3.0**)
- An impact assessment of wood waste on the subtidal benthic community in Esquimalt Harbour (**Section 3.0**)
- A remedial management options analysis and recommendations for next steps (**Section 4.0**)
- Proposed plan for a remedial pilot project and publication of findings (**Section 5.0**)



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Project Site Locations



Legend

- Limit of Federal Harbour
- Project Site Location

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Limit of Federal Harbour: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: BING Imagery
- Inset Basemap: ESRI World Topographic Map

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Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Project Area

Legend

Limit of Federal Harbour

Notes

1. Locations should be considered approximate.
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- Aerial Image: Capital Regional District, 2015.

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2.0 BACKGROUND INFORMATION REVIEW

This section contains a review of the impacts of wood waste on marine subtidal habitats, a review of Esquimalt Harbour historical industrial activities and existing biophysical studies relating to the Project area, and wood waste delineations in the Harbour.

2.1 OVERVIEW OF THE EFFECTS OF WOOD WASTE ON THE MARINE ENVIRONMENT

The processing of timber and wood products in coastal BC is common within and near aquatic and marine environments due to the ease of transportation; however, these activities result in widespread wood waste deposits on the seafloor. While aquatic ecosystems are adapted to breakdown and store naturally occurring large woody debris (LWD; e.g. Wood debris that has not been processed or cut, may still contain roots or limbs), increased volumes from industrial sources can exceed the natural assimilative capacity of marine ecosystems (Breems and Goodman 2009). The resulting direct and indirect impacts include physical alteration of sediments, the release of leachates, and the generation of toxic by-products during decomposition. Impacts of wood waste on the marine environment are largely site-specific depending on the type or size of wood waste (**Table 2.1**), the species from which it was derived, the degree of incorporation into the sediment, the volume present, local water movement, and the extent of decomposition (Kendall and Michelsen 1997).

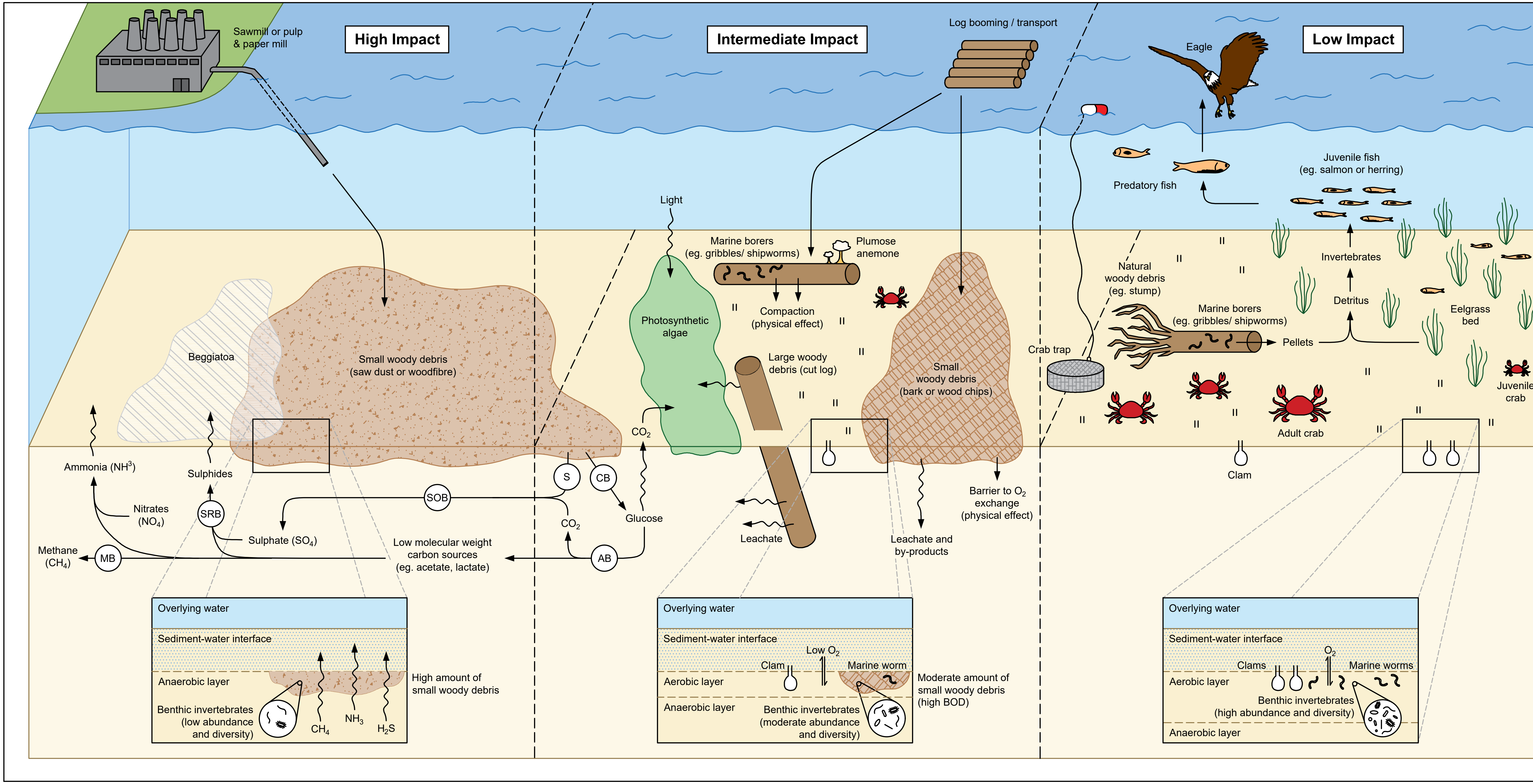
Natural wood debris deposited at the sediment-water interface (SWI) is typically broken down by various marine organisms in the nearshore environment (Maser and Sedell 1994). Large woody debris functions as the primary food source of wood-boring invertebrates, which recycle its nutrients and energy. Wood-boring Crustacea, (e.g. gribbles) and wood-boring bivalve mollusks (e.g. shipworms), colonize LWD before microbial decomposition takes place and ingest the wood through boring (Breems and Goodman 2009). The cellulose portion of the wood is used for nutrition and the remainder excreted as pellets of finely ground wood fibres containing lignin and cellulosic materials (Gonor et al. 1988, Maser and Sedell 1994, Breems and Goodman 2009). While gribbles can use approximately 45 percent of the consumed material, shipworms use approximately 58 percent (Gonor et al. 1988, Maser and Sedell 1994). The fine particulate material of the pellets is easily transported by currents and tides and contributes to the detrital food web that supports species such as forage fish, juvenile salmon and marine birds (Gonor et al 1988, Maser and Sedell 1994, Breems and Goodman 2009; see **Figure 2.1**).

However, small wood waste (e.g. bark, sawdust, or wood fibre) does not meet the habitat requirements of wood-boring invertebrates, wood-borers prefer freshly-deposited wood that has not undergone much decomposition, and industrial wood waste tends to accumulate too rapidly in large volumes, overwhelming the assimilative capacity of benthic communities and leading to an anthropogenic increase in organic content in the sediments of nearshore marine habitats (Breems and Goodman 2009, Washington State 2013). Wood waste-associated impacts to nearshore benthic communities can result in impairing productive habitats, which form the foundation of nearshore marine food webs, and are integral to recycling nutrients between the SWI (Washington State 2013).

Finer-textured wood waste (e.g. wood chips to sawdust) has a greater surface area to volume ration, and my have a greater ecological impact with less coverage (Washington State 2013). Therefore, an understanding of how each type of wood waste reacts in the marine environment is critical to understanding short- and long-term impacts and developing effective site-specific remediation strategies. Each of these impacts are described in detail in the sections below and highlighted in **Figure 2.1**.

Table 2.1 Summary of Subtidal Wood Waste Types, Sources, and Potential Impacts on Marine Ecosystems (Based on Breems and Goodman 2009)

Wood Waste Type	Potential Source	Definition	Potential Impact
Cut logs	Log booming, transport, and storage	Cut timbers of various lengths free of roots and limbs	• Leachate production (slow release rate) • Compaction of sediment • Bark production • Navigational hazard • Can mimic functions of Natural wood
Small woody debris - Bark and small branches	Log booming, log storage, and sawmills, depositional areas	Mainly bark and small wood less than 10 cm in diameter	• Physical barrier/smothering • H_2S, methane, or ammonia production • Leachate production
Small woody debris - Wood chips	Wood chipping and transport facilities	6-10 cm^2	• Physical barrier/smothering • H_2S, methane, or ammonia production • Leachate production
Small woody debris - Sawdust	Sawmills	10 mm^2	• Physical barrier/smothering • H_2S, methane, or ammonia production • Leachate production (rapidly depleted)
Wood fibre	Pulp and Paper mills	< 10 mm^2	• Physical barrier/smothering • H_2S, methane, or ammonia production



Legend

- Beggiatoa
- Photosynthetic algae
- **Small Woody Debris**
- Bark / wood chips
- Sawdust or wood fibre

- AB Aerobic heterotrophic bacteria
- CB Cellulolytic bacteria
- S Elemental sulphur (S)
- MB Methanogenic Bacteria
- SOB Sulphur oxidizing bacteria
- SRB Sulphide reducing bacteria

Notes

1. This figure is not intended to be a "stand-alone" document, but a visual aid to the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Figure not to scale.

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Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Conceptual Site Model

376-240.08	Production Date: Jan 11, 2019	Figure 2.1

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2.1.1 Physical Effects

Wood waste can have a physical effect on marine benthic habitat conditions and benthic fauna. The thickness and composition of wood waste can physically isolate the sediment surface, acting as a barrier to the movement and colonization of benthic invertebrates by limiting their ability to settle on the appropriate substrate type and/or burrow into sediments (e.g. Samis et al. 1999). Wood waste accumulations as shallow as 1 cm can lead to a decline in the abundance of suspension feeders, while deposits up 15 cm can greatly reduce invertebrate biomass and diversity (Conlan and Ellis 1979). Similarly, Jackson (1986) demonstrated that bark accumulations >2.5 cm may eliminate mollusks and several polychaete worm species.

Many benthic species rely on the nutrients and oxygen supplied by an adequately flushed sediment column. A breakdown in the exchange of nutrients and oxygen alters the composition and distribution of the benthic invertebrate population. Accumulated wood waste can form a physical barrier to the transfer of nutrients and oxygen between the SWI and the sediment interstitial spaces (**Figure 2.1**). Critically, accumulation of wood waste at the SWI results in the smothering of any present biota, which in turn reduces mixing of the upper sediment layer by burrowing invertebrates and results in a reduction in the presence of oxygen and ultimately produces an anaerobic environment. Full coverage of benthic sediments with bark, in depths of up to 10 cm, can decrease the dissolved oxygen concentration at the sediment surface from 10 mg/L to 2.5 mg/L (Pentec 1997). The alteration of the upper sediment layer from an aerobic to an anaerobic environment is a key driver in reducing species diversity and the production of toxic by-products from the breakdown of total organic carbon (TOC).

Finally, the texture, size and potential mobility of smaller wood waste may limit the attachment of species requiring immobile rocky substrates such as kelps; however, larger logs can provide a source of attachment or cover for marine borers and some species of algae, anemone, crab and fish (Breems and Goodman 2009; **Figure 2.1**). The natural nearshore environment is a highly productive ecosystem and the decline or loss of habitat and biological communities from physical impacts can have a significant impact on the overall ecosystem. For effective recovery, sediments require the elimination of wood waste and sources, improved dissolved oxygen at the SWI and within surficial sediments through flushing and bioturbation by benthic invertebrates within the surficial sediments (ie. Benthic infauna).

2.1.2 Leachate Production

When wood waste is in contact with water, chemical compounds that are toxic to a range of benthic invertebrates and fish species, leach into the surrounding environment (Pearse 1974, Peters et al. 1976, Buchanan et al. 1976, Samis et al. 1999). The composition of compounds and their concentrations in the leachate vary depending upon the tree species, size, and age, but may include: tropolones, lignins, fatty acids and resin acids (Samis et al. 1999). Although the amount of leachate released from wood waste is reduced as the wood becomes saturated and sinks, it can still be toxic to marine organisms. However, toxins may not accumulate to lethal concentrations in areas with sufficient water exchange (Samis et al. 1999). Larger logs tend to slowly release leachate over a longer duration as the inner, unsaturated wood contains higher concentrations of contaminants that remain available to the environment as they degrade (Yücel et al 2012). Daily tidal movement may further reduce the impacts of leachate through flushing; although this likely has little effect on contaminants accumulated in the pore water sediment adjacent to and beneath wood waste deposits (Breems and Goodman 2009).

2.1.3 By-Products from the Breakdown of Wood Waste

The breakdown of smaller wood waste is largely the result of the microbial metabolism, where bacteria feed on the wood, break it down, and create decomposition by-products under either aerobic or anaerobic conditions. Under aerobic conditions, heterotrophic bacteria assist in the breakdown of wood waste by metabolizing sugars (i.e., glucose; generated during the degradation of cellulose by cellulolytic bacteria) and producing carbon dioxide and simple carbon-based compounds (lower molecular weight carbon sources as by-products (i.e. acetate; Maser and Sedell 1994; see **Figure 2.1**). However, the consumption of oxygen by bacteria, known as biological oxygen demand (BOD), further decreases the availability of dissolved oxygen in the interstitial pore water and at the SWI (Samis et al. 1999). In marine systems, the renewal of dissolved oxygen at the SWI is normally rapid, unless wood waste accumulations are excessively high, blocking circulation or flushing (Pearson et al. 1980; **Figure 2.1**).

Under anaerobic conditions, wood waste decomposition can still occur through anaerobic decomposition, whereby bacteria use chemicals other than oxygen (Pearson 1980). There are various types of anaerobic heterotrophs that breakdown cellulose (via cellulolysis) into low molecular weight organic acid metabolites (e.g. acetate, lactate, succinate and other organic acids; Pearson 1980). In the absence of oxygen, bacteria preferentially use commonly found nitrates (NO_4), along with a low molecular weight organic carbon source, producing ammonia (NH_3) as a by-product (**Figure 2.1**; Pearson 1980). Ammonia, exists in equilibrium between the un-ionized (NH_3) and ionized form (NH_4^+) and is typically found in higher concentrations within sediment porewater than the overlying water column, but can diffuse in stagnant conditions (**Figure 2.1**; Pearson 1980, Gray et al. 2002). At low concentrations ammonia can be acutely toxic to fish and other marine organisms, in particular un-ionized ammonia (Gray et al. 2002).

Once nitrates have been depleted, sulphate reducing bacteria, particularly *Desulfovibrio*, use the low molecular weight carbon sources and the abundance of sulfate (SO_4^{2-}) in marine sediments as an electron receptor to produce sulphide (HS^-), generally in the form of hydrogen sulphide (H_2S; **Figure 2.1;** Pearson 1980, Goodman et al. 1995, Samis et al. 1999 Wang and Chapman 1999, Hyland et al. 2005). The sulphide gradient is often characterized by a black iron sulphide precipitate and a distinct rotten egg odour (Podger unpublished). Within sediments and porewater, the hydrogen sulphide may become trapped and remain acutely toxic to benthic infaunal invertebrates for extended periods of time. However, at the SWI, H_2S readily converts to the non-toxic SO_4 in the presence of oxygen (Podger unpublished), with a short half-life (approximately 20 minutes, Östlund and Alexander 1963). Hydrogen sulphide can have a toxic effect on benthic marine invertebrates, fish and marine vegetation such as eelgrass (e.g. Goodman et al. 1995, Wang and Chapman 1999, Pederson et al. 2004, Hyland et al. 2005, Elliott et al. 2006, Podger Unpublished). The ability to mix oxygen into the upper sediment layers that contain wood waste may help to reduce H_2S production.

Sulphides in the sediment can also be oxidized to the non-toxic SO_4 by species of the multicellular filamentous chemosynthetic bacteria, *Beggiatoa* (Pearson 1980). *Beggiatoa* spp. are widely distributed in coastal sediments with a high organic load (Amend et al. 2004) and are limited to the zone of transition between aerobic and anaerobic environments. Dense white bacterial mats (between 0.5 – 3.0 cm thick) form when the oxygen-sulphide transition zone exists at the SWI (**Figure 2.1**; Podger unpublished, Pearson 1980, Jørgensen 1977, Muβmann et al. 2003). *Beggiatoa* spp. will continue to use hydrogen sulphides, keeping the underlying sediment anaerobic by creating a membrane of dense bacterial mats over the sediment, and obstructing the recovery of degraded sediments. In these conditions fish prey species occur in extremely low abundances and the resulting low dissolved oxygen conditions can become uninhabitable to many fish species (SAIC 1999). The presence of *Beggiatoa* mats can therefore be a good indicator of organic enrichment (i.e. TOC) from anthropogenic activities such as aquaculture or wood-processing (Fenchel and Bernard 1995, Elliott et al. 2006). However, the presence of the dense white mats is dependent on site-specific conditions, namely the presence of the oxygen-sulphide transition zone at the SWI. When the aerobic-anaerobic boundary falls below the sediment surface, large numbers of inconspicuous *Beggiatoa* spp. may occur in the top few centimeters of the sediment (predominantly 0.5 – 2.5 cm), often as the dominant organism, without forming large white mats on the surface (Jørgensen 1977, Muβmann et al. 2003). *Beggiatoa* spp. are classified by their gliding motility and have been shown to vertically migrate in sediment with a rapid change in the depth of the oxygen-sulphide transition zone (Jørgensen 1977, Muβmann et al. 2003). The presence of oxygen at the SWI, or within the first few centimeters of the sediment, can be both temporal (influenced by season) or spatial (influenced by wave action transporting oxygen into the SWI, by the bioturbation of benthic marine invertebrates in the surficial sediment layers, or by heterogenous distribution of wood waste in surfical sediments) (Podger unpublished, Jørgensen 1977, Fenchel and Bernard 1995, Elliott et al. 2006). For example, a study by Jørgensen (1977) found that the mats were only visible for short periods of the summer when bottom waters became stagnant and partially or totally depleted of oxygen.

In addition to nitrate and sulphate, bacteria in anaerobic marine sediments can also produce methane (CH_4) (see **Figure 2.1**). In this process, the lower molecular weight organic forms, such as lactate and acetate, are fermented by anaerobic methanogenic bacteria to produce methane (CH_4; **Figure 2.1**; Pearson 1980). In marine sediments, methane production does not normally occur, with the exception of pockets of decaying material (Pearson 1980), possibly due to reduced activity at temperatures below 10°C (Samis et al. 1999) As with hydrogen sulphide, methane may remain in the interstitial spaces of the sediment until it migrates up to the water column.

2.1.4 Impacts to Benthic Communities

Benthic infauna are important components of nearshore marine ecosystems, driving detrital decomposition and nutrient cycling and providing a food source for higher trophic level organisms. Since these organisms live in close association with the surface sediment, and are often sedentary, they are influenced by the direct and indirect effects of wood waste (see **Section 2.1.1** to **Section 2.1.3**). A small amount of natural organic matter in nearshore marine benthic ecosystems provides an important source of food to benthic communities; however, high levels of organic matter lead to oxygen depletion, a build-up of toxic by-products, and decreases in abundance, biomass and species richness of benthic infauna community organisms (e.g. Hyland et al. 2005; **Figure 2.1** and **Figure 2.2**).

If wood waste is thinly deposited, sedimentation over the wood waste may allow for the natural recovery of the benthic infauna community over longer time periods. However, if wood waste accumulations are deep, sedimentation will not allow for recovery, since sulphides, ammonia, and to a lesser extent methane, will permeate through recently deposited materials (**Figure 2.1**; Washington State Ecology 2013).

2.1.5 Indicators of Impact

The impacts of wood waste on an area depend on the nature and extent of the wood waste in combination with site-specific biophysical conditions (Washington State 2013). Therefore, universal thresholds of impact do not exist and must be developed for a site based on the results of the impact assessment. However, certain indicators can be used in the assessment of impacts from wood waste on the benthic community.

2.1.5.1 Wood Waste Surficial Cover

Assessments of wood waste impacted sites in Washington state have used Kendall and Michelsen's (1997) findings to develop initial screening guidelines to target potential areas of wood waste impacts (Washington State 2013). Under these guidelines, surficial cover of 5 – 25% wood waste indicates a possible need for further investigation, while >25% should be investigated further due to the adverse impacts to the benthic community. However, wood waste assessments in Washington State have found that areas with finer wood waste accumulations (such as small chips or sawdust) have a greater impact with less surficial coverage, and propose using a visual surficial cover of 5%, as opposed to 25%, to screen for potential biological impacts (Washington State 2013).

2.1.5.2 Bacterial Mats

While the presence of white bacterial (*Beggiatoa* sp) mats are indicative of high organic content (i.e. high TOC concentrations), they can be variable and indistinguishable under certain conditions, particularly seasonally with differences in oxygen at the SWI (outlined in **Section 2.1.3**). In combination with bacterial mats, several sediment chemistry analyses can also be used as indicators of degraded sediment conditions and deleterious effects on benthic fauna; however, natural baseline levels for sediment chemistry analyses vary between habitat types and should be considered in the interpretation of habitat quality impacts.

2.1.5.3 Total Organic Carbon

Naturally elevated levels of organic carbon are found associated with productive habitats in nearshore coastal ecosystems that generate high levels of detrital organic material, such as estuaries, eelgrass beds and kelp beds. Aside from these habitats, marine sediments generally have a low organic composition, measured as total organic carbon (Phillips 1984, Libes 1992). Therefore, elevated organic matter can result from accumulation of organic material derived from the detrital food chain or from organic enrichment by anthropogenic activities (e.g. aquaculture industry, sewage outfalls, and wood waste deposits). While naturally-derived organic matter forms an important food source for benthic fauna, an overabundance in surficial sediments will lead to a depletion of oxygen, the production of toxic by-products (e.g. sulphides and ammonia) and the subsequent impairment of benthic communities (decreases in species abundance, species richness, and biomass; F**igure 2.2**, **Section 2.1.3**; Hyland et al 2005). As a result, total organic carbon (TOC) can be used to help identify degraded habitat quality and the presence of wood waste deposits.

The Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines (SQG) for the Protection of Aquatic Life and the environmental quality standards set by BC Contaminated Sites Regulation (BC CSR) do not have a developed marine sediment TOC potential level of concern. However, the US Environmental Protection Agency (EPA) was evaluating threshold effect levels for TOC based on data from the Environmental Monitoring and Assessment Program (EMAP) which demonstrated that impaired benthic communities in estuarine systems were associated with muddy sediment (>80% silt-clay) with moderate TOC content (1 – 3%) while unimpacted communities were associated with sandy sediment (<20% silt-clay) and low TOC content (<1% ; US EPA 1999). Similarly, a global meta-analysis conducted by Hyland et al. (2005) for coastal marine ecosystems proposes that TOC levels can be used as a general screening-level indicator for evaluating the likelihood of reduced sediment quality and associated impairment of the benthic community (low ≤1%, intermediate 1 – 3.5%, and high ≥3.5 %).

While most benthic communities will decrease in species abundance and diversity (measured as species richness) with increasing TOC, there are some Polychaete species that are dominant in polluted or degraded habitats (e.g. log handling facilities) and are good biological indicator species of elevated TOC, including (Reish and Barnard 1960, Rosenberg 1972, Conlan 1977, Kathman et al. 1984, Borja et al. 2000, Teixera et al. 2012):

- *Capitella capitata*;
- *Armandia brevis*; and,
- *Prionospio cirrifera*.

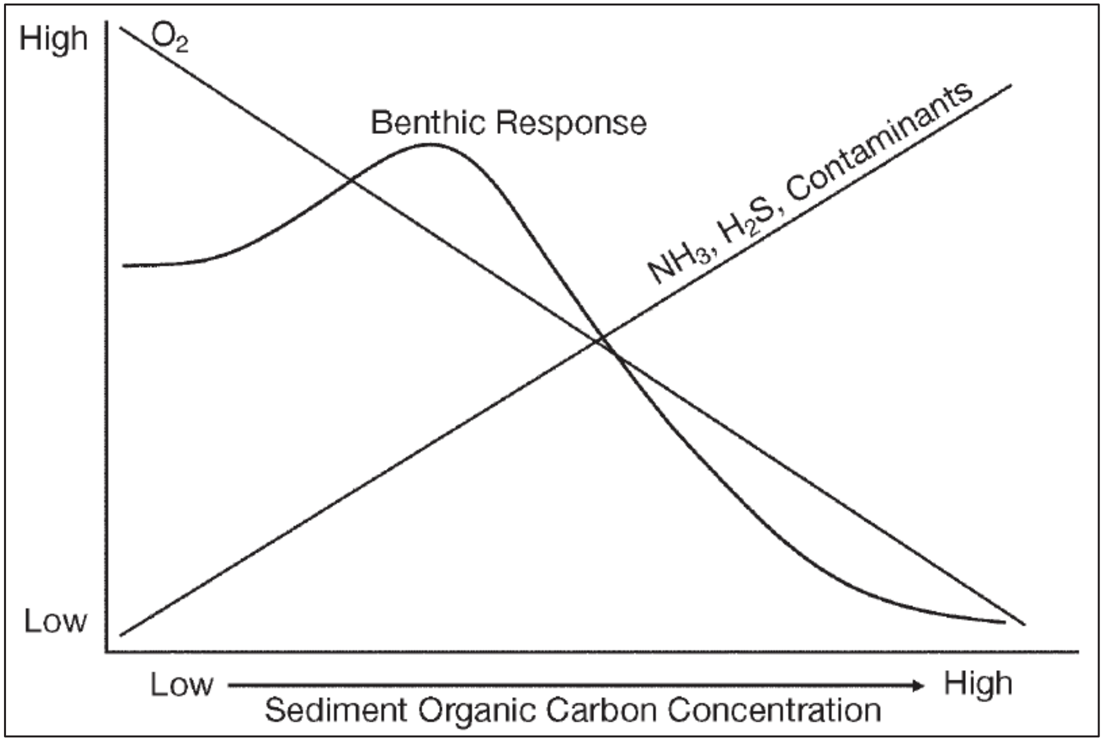


Figure 2.2 **Conceptual Model of the Relationship between Increasing Sediment Organic Carbon, Benthic Community Response, and other Related Environmental Factors, including Oxygen Depletion and Presence of other Co-varying, Sediment-associated Stressors (Hyland et al. 2005)**

2.1.5.4 Hydrogen Sulphide

Hydrogen sulphide is an indicator of sediment health since higher concentrations are directly correlated with increasing TOC and impacted benthic communities (**Figure 2.2**). Sulphide influences sediment toxicity in three ways: (i) increasing sediment toxicity, (ii) decreasing metal toxicity by binding with free metals and forming precipitates and/or complexes, and (iii) by affecting animal behavior (Wang and Chapman 1999). Hydrogen sulfide toxicity varies with pH and by species and life history stage; therefore, threshold levels are developed for a specific organism (Podger Unpublished, Wang and Chapman 1999). In sediment pore-water, sulphide occurs in two forms, as un-ionized hydrogen sulphide (H_2S) and as a sulphide ion (HS^-). Since H_2S can readily diffuse across the cell membranes of organisms, it has a higher toxicity and, at lower pH levels (i.e. more acidic conditions), a greater proportion of H_2S is present in the water (Wang and Chapman 1999).

Community-level effects can also occur indirectly, or as a cascading effect, when dominant or structural species such as eelgrass (*Zostera marina*) or horse clams (*Tresus* spp.) are negatively impacted. For example, hydrogen sulfide can reduce the distribution and health of native eelgrass beds, which normally provide cover for invertebrates and fish that feed sea birds and marine mammals (Pederson et al. 2004, Elliott et al. 2006). Hydrogen sulfide has also been shown to reduce the diversity of benthic invertebrate communities that aerate the sediment through bioturbation and are a large source of food for higher trophic species including crab, river otters and sea birds (Goodman et al. 1995, Wang and Chapman 1999, Hyland et al. 2005).

The CCME SQG for the Protection of Aquatic Life and the US EPA Marine Sediment Screening Benchmarks have not developed a marine sulphide (as H_2S) potential level of concern. However, the US EPA saltwater quality criterion for hydrogen sulphide is 2 µg/L (US EPA 1986), which can be used as a general indicator of water quality.

2.1.5.5 Ammonia

High levels of ammonia are difficult for marine organisms to excrete, leading to a buildup in the tissues and potentially death. Ammonia toxicity can change with environmental factors, such as pH and temperature, as this influences the equilibrium between un-ionized (NH_3) and ionized ammonia (NH_4^+) (Wang and Chapman 1999). An increase in one pH unit will increase the concentration of the more toxic un-ionized form tenfold, while a 5^o C increase in temperature can increase this form 40-50% (CCME 2010). CCME SQG for the Protection of Aquatic Life and the US EPA Marine Sediment Screening Benchmarks have not developed a total ammonia potential level of concern for marine ecosystems; however, the US EPA saltwater quality criterion for un-ionized ammonia is 35 µg/L, which can be used as a general indicator of water quality. Ammonia is easily diluted and flushed in the water column and not likely to be as critical an indicator as H_2S.

2.1.5.6 PH

CCME water quality guidelines for the Protection of Aquatic Life outline an acceptable range of pH 7.0 – 8.7 for marine and estuarine environments based on the pH range observed in Canadian coastal water, unless it can be demonstrated that pH is a result of natural processes (CCME 2010).

2.2 STUDY LOCATION AND SITE DESCRIPTIONS

2.2.1 Esquimalt Harbour Marine Environment

Esquimalt Harbour is located along the southeastern end of Vancouver Island off the Strait of Juan de Fuca and comprises several smaller bays and coves with many small rocky islets (**Figure 1.2**; BCMCA 2016). In its entirety, the Harbour encompasses approximately 354 hectares (50 hectares of intertidal area and 304 hectares of subtidal area) and 20.0 km of shoreline (excluding islands; Archipelago 2004), with the federal DND portion of the Harbour encompassing an area of 343 hectares.

The natural shoreline, ranges from sand and gravel beaches to rocky shores, which has largely been maintained along the west and northeast sides of the Harbour. Shoreline in the southwest and much in the southeast (i.e. Constance Cove) has been altered by dredging, infilling, and hardening to support industrial and naval activities (CRD 2016). The Harbour is relatively quiescent, with semi-protected to protected shoreline exposure (i.e. relative exposure to the elements, primarily waves) classification and very low tidal currents (0.001 – 0.045 m/s) (BCMCA 2016). Research investigating the sediment transport pathways in the harbour indicates that the harbour is in a dynamic equilibrium with little net sediment transport. Two major transport regimes are present and converge around the mouth of Constance Cove and the DND Jetties at Colwood - one moving from the Harbour mouth and one down from the head of the Harbour (Hemmera 2002).

The Harbour is relatively shallow, ranging from five to 12 m Chart Datum (CD) in depth within the limits of the Federal Harbour, and a maximum depth of 16 m CD at the Harbour entrance (CRD 2016; **Figure 1.2**). The subtidal benthic substrate is dominated by 87% fines (gravel, sand, and mud) with a few subtidal bedrock outcrops (CRD 2016). Sediment in the upper portion of the Harbour and around Plumper Bay is mainly silt, with large areas of organic wood waste cover, while the southern areas have higher proportions of sand.

There are several natural and manmade freshwater inputs into the Harbour. Millstream Creek flows into the head of the Harbour, draining a watershed of 2,842 hectares (including a storm drain network), with a stream length of 16.5 km terminating in a large intertidal mudflat (extending as far out as Cole Island during some low tides) (CRD 2016; **Figure 1.1**). Flooding and erosion of the lower watershed streambanks have been identified as a main environmental concern for the Millstream Creek Watershed, which can deliver large quantities of fines to the Harbour. Additionally, there is an unidentified stream in the View Royal area, at the north end of the harbour, outside of the federal harbour limit, that discharges the Price Creek Watershed (CRD 2016). The stream is approximately one kilometre long. There are 97 storm water drains that discharge directly into the Harbour (CRD 2016). The Capital Regional District (CRD) completes an annual stormwater quality sampling program for Victoria and Esquimalt harbours which include fecal coliform (human health) levels for the stormwater discharges and an evaluation of contaminants of concern in stormwater sediments (Hemmera 2002).

2.2.2 Pedder Bay Marine Environment

Pedder Bay is located approximately twelve kilometers to the southwest of Esquimalt Harbour, in the Strait of Juan de Fuca, and was chosen as an out-of-Harbour reference location (**Figure 1.2**) due to its proximity to Esquimalt Harbour, similarities in bathymetry, in shoreline and subtidal substrates, and in wind and wave exposure, and its use in previous studies as a reference location not anticipated to have contamination that substantially affects the environmental conditions (studies summarized in SLR 2016).

The natural shoreline primarily consists primarily of rocky intertidal shores, with a mudflat located at the back of Pedder Bay at the terminus of Pedder and Cripple Creeks (BCMCA 2016). Minimal infrastructure are present within the harbour; however, the shoreline along the southwest has undergone some alterations to support Canadian Forces activities at Rocky Point. Like Esquimalt Harbour, the tidal currents are very low (0.001 – 0.045 m/s; BCMCA 2016) and shoreline exposure is categorized primarily as semi-protected to very protected; however, the southwest shoreline is semi-exposed to waves generated locally within the Juan de Fuca Strait (Baird and Associates Coastal Engineering Ltd 1991, BCMCA 2016). No information is available on the sediment transport pathways within Pedder Bay.

Similar to Esquimalt Harbour, Pedder Bay is also relatively shallow, ranging from 5-10 m CD in depth; although depths do exceed 20 m at the entrance to the Bay (Baird and Associates Coastal Engineering Ltd 1991). Subtidal benthic substrates are classified as a mixture of flats and depressions with a mudflat extending into the subtidal at the back of the Bay. Freshwater input to Pedder Bay is received from both Pedder Creek (107.0 ha watershed including storm drain areas, 1.5 km main stream length) and Cripple Creek (296.7 ha watershed including storm drain areas, 3.5 km main stream length) drains (CRD 2016).

2.3 HISTORICAL ACTIVITIES AND CONTAMINATION

The objective of this section is to document historical use of the Harbour and associated upland properties, to review previously identified Areas of Potential Environmental Concern (APECs) and Contaminants of Potential Concern (COPCs) associated with on and off-site activities and that may have impacted sediment quality in the Harbour. Additionally, this review was also used to identify the sources of wood waste deposition that may be affecting benthic sediment quality and communities. For the purposes of this historical review, the area from the high water level (HWL) seaward, including the subtidal zones within the Federal limits of the Harbour, was investigated (see **Figures 1.1** and **1.2**). Lands above the HWL were classified as being out of the study area or offsite.

2.3.1 Activities and Contamination Review Methods

The review is consistent with guidance from Breems and Goodman (2009) and Washington State (2013) and includes both current and historical operations within the Harbour, as well as concerns associated with the historical use of adjacent and up-gradient properties. Sources of information reviewed included:

1. Previous environmental reports;
2. Aerial photographs review;
3. Search of the Federal Contaminated Sites Inventory (FCSI);
4. Search of the British Columbia Ministry of Environment (BC MOE) Environmental Violations and Management Authorization databases; and,
5. Search of the CRD Online Harbours Atlas for any reliable data/background.

The background review relied on the information presented in past environmental reports of the Harbour to compile relevant information on the history of property development and land use in and along the shore of the Harbour. Reports summarizing environmental investigations included significant information on historic operations that may have affected the seafloor in the study area, including:

- Bright 1993. An Environmental Survey of Esquimalt Harbour: Part I. Historical Inputs, Marine Sediment Contamination, and Biological Uptake. Report prepared for the Director General Environment, Department of National Defence by the Environmental Sciences Group, Royal Roads Military College;
- Hemmera 2002. Esquimalt Harbour Environmental Baseline Study. Esquimalt Harbour, British Columbia. Prepared for Transport Canada; and,
- Golder 2006a. Phase I Environmental Site Assessment and Supplemental Sediment and Crab Sampling Investigation, Esquimalt Harbour. Volume I of III. Prepared for Public Services and Procurement Canada Project. Victoria, British Columbia.

Previous investigations have focused on contamination issues resulting from ship repair activities, filling of Harbour areas and poor handling of chemicals. The sections following provide additional information by identifying the nature of historic land use and site development activities on the properties and tracing the lease history.

As the Project Area is comprised mainly of the Harbour floor, the review of historical activities and contamination was focused on the potential environmental impact on the federal harbour resulting from operations within the Harbour as well as, at neighbouring and surrounding properties. The review covers nine (9) areas that have been placed into 6 headings based on their location (**Figure 2.3**), and covers the following properties:

Esquimalt (Including the Township of Esquimalt and the Department of National Defence Facilities; Areas 1-4)

- DND - CFB Esquimalt Dockyard
- Former Yarrow's Shipyard
- Lang Cove / DND - Naden
- Public Services and Procurement Canada – Graving Dock
- Public Services and Procurement Canada – Munroe Head

Esquimalt First Nations Reserve (Area 5)

- Former West Isle Site
- Former Fibremax Site
- A & M Auto Site
- Fill Sites

Songhees First Nation Reserve (Area 5)

- Ashe Head
- Dallas Bank
- Fill Sites

View Royal (Area 6)

- Residential Properties
- Former Victoria Plywood Site

Colwood (Areas 7 & 8)

- CFB Esquimalt Colwood – North and Central, including:
  - Colwood Supply Depot
  - Fire Fighting Training Area (FFTA)
  - Fleet Diving Unit
  - Fuel Depot
  - Belmont Park

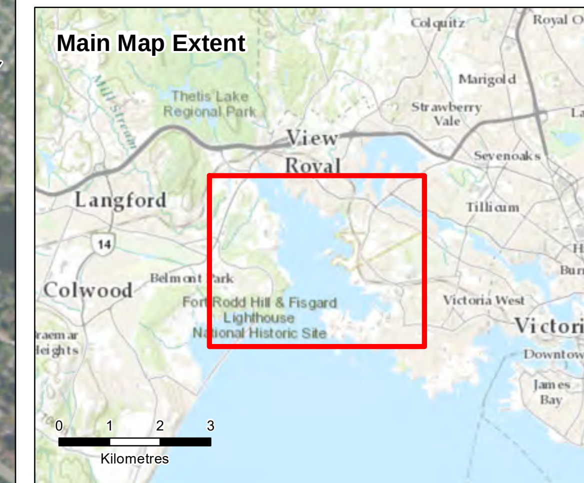
Harbour Floor (Area 9)

- Leased Areas, Un-leased Areas and Water Lots
- Inskip Island
- Macarthy Island
- Smart Island

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Overview and Areas

Main Map Extent



Legend

Federal Harbour Limit

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- APECs: Golder, 2006
- Organic Cover, Un-surveyed Seafloor: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Hemmera
An Ausenco Company

Public Works and Government Services Canada

2.3.2 Aerial Photograph Review

A summary of aerial photographs provides general information with regards to site configurations and activities (**Table 2.2**). A review of aerial photographs dated 1932, 1946, 1954, 1964, 1975, 1980, 1992 and 1997 (**Appendix A**) have been incorporated into the analysis of land use history presented in **Section 2.3.4**.

Aerial photograph review of the Harbour floor and related to the deposition of wood waste are summarized in the following table**.** Based on the review, the last observable date for large-scale log booming was in 1997; however, occasional log booming still occurs infrequently in the harbour within the Jones marine Lease Area.

Table 2.2 Aerial Photograph Review Summary

Chronology	Land Use
1932	Log booms are present near the entrance to Thetis Cove. Four wharves extend from a cannery operation at the location of the Fibremax log sort operation and from the former location of the Victoria Plywood Site.
1946	No log booms are present, otherwise the harbour looks unchanged.
1954	Sawmills appear to be active on the West Isle and the Victoria Plywood sites. Approximately 60-70% of Plumper Bay and Thetis Cove are covered with log booms supplying these operations. Log booms are present on the west side of Inskip Islands and in Paddy Passage.
1964	A sawmill is in operation on the West Isle site. Approximately 20-30% of Plumper Bay and 50-60 % of Thetis Cove are covered with log booms supplying logs to this and the neighbouring Victoria Plywood operations. Log booms are now empty in Paddy Passage.
1975	Sawmills are in operation on the West Isle and Victoria Plywood sites. Approximately 50-60% of Plumper Bay and Thetis Cove are covered with log booms supplying logs to these operations.
1980	Sawmills are in operation on the West Isle and Victoria Plywood sites. Approximately 70-80% of Plumper Bay is covered with log booms supplying logs to these operations. Large log booms are present north of the Inskip Islands.
1992	Sawmills are no longer in operation on the West Isle and Victoria Plywood sites. There is a large reduction of log boom activity with booms only present west of the Fibremax site. Empty log booms remain in Plumper Bay and Thetis Cove. Log booms, which appear to be associated with the log sort facility on the Fibremax site.
1997	There are no log booms on the west side of Esquimalt harbour, in Thetis Cove, or Plumper Bay. Limited log boom activity appears to be associated with the log sort facility on the Fibremax site.

Additional aerial photographs from 2003, 2010, 2011, 2012, 2013, 2014, 2015 and 2016 have been reviewed using Google Earth Pro. While minor changes have occurred between 2003 and 2016, there does not appear to be any significant industrial or infilling changes within the Harbour.

2.3.3 Regulatory Information

2.3.3.1 Federal Contaminated Site Search

The FCSI includes information on all known federal contaminated sites under the custodianship of departments, agencies and consolidated Crown corporations as well as those that are being or have been investigated to determine whether they have contamination arising from past use that could pose a risk to human health or the environment. The inventory also includes non-federal contaminated sites for which the Government of Canada has accepted some or all financial responsibility.

A search of the Online FCSI was conducted on September 8, 2016 and generated greater than 100 federal contaminated sites within Esquimalt Harbour or close proximity. The results of the federal contaminated sites search are located in **Appendix B: Regulatory Information**. It should be noted that Esquimalt harbour was assessed under the Federal Contaminated Sites Action Plan (FCSAP) as one FCSI number and assigned as a Level 1 site.

2.3.3.2 BC MOE Environmental Violations Database

The Environmental Violations Database reports non-compliance orders, administrative sanctions, tickets and court convictions against twenty-four acts regulated by BC MOE since 2006. A search was completed for violations on September 6, 2016 and no environmental violations were listed within proximity to Esquimalt Harbour.

2.3.3.3 BC MOE Environmental Management Authorization Database

A search was conducted of the Environmental Management Authorization Database on November 9, 2016 for approved and permitted waste discharges within the vicinity of the Site. Twenty-one authorizations were on file for Victoria. None of these authorizations were within the vicinity of Esquimalt Harbour. Select details of these authorizations are provided in **Appendix B**.

2.3.3.4 Other Historical Information

Bright (1993) provided a series of tables in Appendix B-1 of the report, which provide a chronological listing of the Esquimalt Harbour occupants as of 1873, 1896, 1925, 1967, and current users as of the report date (1993). Copies of these tables are provided in **Appendix C: Harbour Occupants**.

Additionally, Hemmera (2004) reported current and historic leases of the harbour. These lease agreements are summarized in the following **Table 2.3**.

Table 2.3 Summary of Current and Historical Leasehold Properties

Leaseholder	Lease #	Status	Lease Use	UTM Northing	UTM Easting
Plumper Bay Log Booming	W0306609	Current[1]	Log Booming	5365622.75	467813.067
Plumper Bay Log Booming	W9596354	Former	Log Booming	5365622.75	467813.067
Plumper Bay Sawmills Ltd.	104899	Former	Log Booming	5365608.057	468115.159
Greater Victoria Mill Operators Association (GVMOA)	89482 102058	Former	Log Booming	5366263.803 5365709.496	466872.966 467626.289
Avenor Inc. (Victoria Plywood site)	W8691194	Former	Log booming	5365931.808	467955.718

2.3.4 Site and Surrounding Land Use History

The following historical description of the Harbour is summarized from the Royal Roads Military College (RRMC) report “An Environmental Study of Esquimalt Harbour” (1993).

Prior to the British occupation of the Harbour, Lekwungen-speaking people, ancestors of present day Esquimalt Nation people, were the sole users of the Harbour. Hudson’s Bay Company Chief Factor James Douglas (later Governor of the Crown Colonies of Vancouver Island and British Columbia) visited the Harbour in 1843 on a mission to seek a new site for the HBC’s operations north of the 49th parallel. Although Douglas established the new fort on the shore of Victoria Harbour, he evidently saw the agricultural potential of the land that is now Esquimalt. After signing a series of treaties with local native people to acquire the area for the HBC, Douglas established three farms here to supply Fort Victoria and other HBC forts in the northwest with agricultural products. Farms were established at Colwood, in Constance Cove and in Plumper Bay with the exclusion of the First Nations Reserve at Plumper Bay.

In 1848-49 the first industrial sites were developed; a sawmill and gristmill at Mill Stream Falls. Additional infrastructure was built on the Constance Cove farm including a sawmill, flour mill and trades shops. During this period (1840s), the Royal Navy also had a presence within the Harbour and they conducted the first hydrographic survey. In 1855, the start of the first naval base was seen in the form of hospitals constructed to prepare for a potential battle with the Americans. As tensions mounted, increased construction of the naval base was seen in the Harbour. In 1860, two structures on Cole Island were built for use as powder magazines. In the early 1860’s two large wooden coal sheds (1,500 ton capacity) and the Fisgard Island Lighthouse were built. The construction of the Esquimalt Naval Base was started in 1867 at Signal Hill in Constance Cove.

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1 Current at the time of reporting (2002).

By 1883 the Navel Base had expanded onto the Duntze Head area and included approximately 58 buildings. The base was transferred from the Royal Navy to the Royal Canadian Navy in 1910. Pressure for a graving dock in Esquimalt Harbour increased as the base size grew. Shipbuilding and repair was already taking place by this time within the Harbour. In 1867, the construction of a graving dock was started on the southern shore of Constance Cove. By 1887, the dock was finished and began to service naval and commercial ships. Over the next 40 years the dock would service 855 ships until it was transferred to Esquimalt Naval Base.

2.3.4.1 Esquimalt (Areas 1-4)

In the late 1890s an additional shipyard was constructed in Constance Cove and in 1914 the shipyard was purchased by Alfred Yarrow. The village of Esquimalt was incorporated into the area in 1912 and began construction of a sewer system. The area of Grant Knoll was chosen for the construction of a marine railway (building 116) for the Naval Dockyard. Buildings just east of the railway (buildings 115 and 120) were built for boat maintenance. The “Factory” building (built in the mid 1860s) was the site of an engine shop, smelter and smith shop and during WWI was busy galvanizing ship parts and equipment.

Public Services and Procurement Canada began construction in 1921 on a new graving dock in Skinner’s Cove, just east of Munroe Head, which disappeared as a result. By 1926 the Public Works Graving Dock was receiving ships (see **Figure 2.3**). Continued construction of facilities occurred following WWI. In 1925 fire destroyed the torpedo building, the old boat shed and the rigging loft, but they were replaced immediately (building 115). With the onset of World War II (WWII), increased demand in the base’s facility meant increased expansion. In 1939 construction included a close-range weapons workshop, an indoor testing range building, an electroplating and chemical cleaning facility and a new gun mounting shop. The jetties were referred to as the “Dockyard Jetty” (A-Jetty), the “Refitting Jetty” (B-Jetty) and a “Naval Ordnance Jetty” (C-Jetty, the old coal wharf) (see **Figure 2.3**).

In the early 1940s Yarrows constructed an additional shipyard, situated just north of Munroe Head, to handle the large workload brought on by the war. Approximately 500,000 m^3 of rock was blasted and used as fill in the area. Facilities at the new shipyard (Yarrows 2 Yard) included a marine railway, two building berths, lumber racks, an aluminum storage building, a finishing and paint shop, a compressor and boiler house, a winch house, an electrical shop, a joiner and pattern shop, sheet metal shop, shipwrights, riggers, plate shop/mold loft over, a pre-fabrication shop, an acetylene plant, a blacksmith shop, steel stock storage, rail and spur lines, two wharves, docking space and two cranes. Both the Yarrows shipyards and the Public Works Graving Dock saw many ships during WWII. At the end of the war the old Esquimalt Dry Dock was taken over and renovated by HMC Dockyard. In the mid-1900s shops were split and moved and new ones were built. Of note was the sheet metal workshop, which was constructed in the corner of the coal shed.

Following WWII, the Yarrows #2 Shipyard was shut down. A portion of the yard was a crown lease, which expired in June, 1948. The Yarrows owned portion of the property was sold to Manning Timber Products for use in their sawmill operation. The mill included a drying kiln, a spur line from the Esquimalt and Nanaimo (E & N) Railway, a transformer station and an electrical substation. The mill was in operation for only a short period and in 1959, DND acquired the property and presently has storage areas and facilities on the site. West of this area is the current Canadian Forces Sailing Association. During the 1960s, Yarrows became Versatile Shipyards (later changed back to Yarrows) and Public Works constructed E-Jetty adjacent to the Graving Dock. The Yarrows shipyard shut down in 1992 and the property was acquired by DND. Since then the site has undergone extensive environmental investigation. DND's C-Jetty, a ship repair facility, was closed in 1987, the area was dredged and a new concrete twin C-jetty was constructed.

2.3.4.2 Esquimalt and Songhees First Nations Reserves (Area 5)

In 1886 the E & N Railway was built and the Esquimalt station was located near the boundary between Esquimalt First Nations Reserve and the View Royal. Todd's Cannery (1896) in the Plumper Bay area used the rail facility to export fish. In 1912, a large fuel storage tank was installed as a result of the switch to oil from coal. A machine shop was noted on the 1918 hydrographic chart. During WWII, an oil wharf, ferry slip and oil tank operated by E & N Railway were present in Plumper Bay. The Cannery (now called Empire Cannery) was replaced in 1960 with a sawmill (West Isle Forest Products, later renamed Futura Forest Products). During this time, extensive log booming occurred at the mouth of Plumper Bay.

The 1970s and 1980s saw West Isle Forest Products (Futura Forest Products), Pacific Forest Products, Fibremax Timber Corp. and Victoria Plywood occupy the land south of Plumper Bay. All but the Fibremax site became inactive in the 1990s and clean-up/decommissioning of the sites has either been completed or is ongoing.

2.3.4.3 View Royal (Area 6)

In the 1930s, a floatplane base was located in Limekiln Cove. There was also additional industrial activity in the northern end of the harbour. In the mid-1900s, a masons yard existed in the Parsons Bridge area (over Mill Stream) as did a blacksmith shop and brass foundry. A high voltage electrical transmission line was routed to Dyke Point in 1947 for the harbour (see **Figure 2.3**). Extensive log Booming continued in the 1960s in the northern end of the harbour. During the 1970s and 1980s, the View Royal section of the Harbour (northern section) experienced a residential development boom. Questions exist however, about effectiveness of the septic systems of the older residences.

2.3.4.4 Colwood (Areas 7 & 8)

In 1926, Frank Wilfert built a sawmill where the F-Jetty site is today (see **Figure 2.3**). A Former employee (Paul Cox) stated that the mill didn't use any chemical wood treatment and there were two booming sites, one directly in front of the mill site and the other across the harbour near the First Nations Reserve. Additional communications with residents indicated that log booming was present from Paterson Point to Dyke Point (see **Figure 2.3**), all the way up to Cole Island. Additional industrial activity during this time included a limekiln opposite Limekiln Cove (Patterson Point). The Cole Island magazines were moved to Patterson Point in the late 1930s, due to the requirement for fresh water access. In 1943, a "Magazine Jetty" (G-Jetty), associated with existing magazines, was present and by 1947, the "Fuel Oil Jetty" (F-Jetty) was in service (see **Figure 2.3**). The DND magazines were moved again, this time from Patterson Point to Rocky Point, which is southwest of Victoria (1955). The Naval Supply Depot was built in 1958, using the existing F-jetty. Later Fisgard Island was connected to Rodd Point through the addition of coarse fill material (see **Figure 2.3**). Little change occurred in the Colwood area during the 1960s, 1970s and 1980s. Further development of the area by DND, brought the Naval Fleet School (Pacific), the Fleet Diving Unit (Pacific), and storage space.

2.3.4.5 Harbour Floor (Area 90)

During World War I (WWI), the Royal Navy, the Royal Canadian Navy, and the Army used the magazines on Cole Island. The magazines were later moved to Patterson Point (1930s) and ownership of the island was transferred to the provincial government. Cole Island is currently under the jurisdiction of the provincial government's Heritage Properties Branch (see **Figure 2.3**).

With the exception of log booming in the northern portion of the Harbour from the 1940s to the 1980s and booming in the mouth of Plumper Bay to 1997[2], there has been little to no marine activity, with the exception of navigation, within the federal harbour historically. Influences are linked to the activities of the adjacent lots. These influences include the infilling of portions of the Harbour.

Marine sediments in Esquimalt Harbour have been contaminated by historical and current operations within and adjacent to the harbour (Golder 2006).

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2 As identified in Table 2.4, Section 2.3.3.4, a lease for log booming was current in 2005. However, no log booming was observed on aerial footage review after 1997.

2.3.5 Summary of Areas of Potential Environmental Concern

Golder (2006) included an extensive review of historical literature relating to Esquimalt Harbour and surrounding areas, which was used to identify APECs for the Harbour and adjacent properties. No additional APECs were identified as part of this background review. Golder identified these APECs, in part, to develop a risk management strategy for the harbour.

In total, 104 APECs were identified which are summarized in **Appendix D: Areas of Potential Environmental Concern** (Table and Figures). The APECs were divided into seven categories by Golder, as follows:

- APEC Group A – Fill;
- APEC Group B – ASTs, USTs, other hydrocarbons;
- APEC Group C – Operational activities (including historical operations);
- APEC Group D – Treated timber piles;
- APEC Group E – Polychlorinated Biphenyls (PCBs);
- APEC Group F – Spills; and,
- APEC Group H – Stormwater outfalls.

Typically, a Phase I Environmental Site Assessment would link the APEC sources with areas of identified contamination. However, owing to the long, complex and varied nature of the historical activities at the Site, varied migration of contamination into sediments, and the potential for sediment transport, the source of the contaminants associated with each of the APEC was not always clear and, in most cases, could not be identified without being highly speculative. This process also does not target leachate from wood waste, or the physical impacts of wood waste.

The APECs deemed more relevant to the wood waste assessment, are excerpted from the complete table included in **Appendix D** and are outlined in **Table 2.**4.

Table 2.4 Related Areas of Potential Environmental Concern

APEC ID	Location	Issue(s) / Activity(ies)	Media Type	COPC
C7	West Isle Site, Plumper Bay	Historical operational activities associated with mill	Soil, Groundwater	Unknown
C8	Fibremax, Plumper Bay	Historical activities associated with mill	Soil, Groundwater Sediment	Unknown
C9	Victoria Plywood, Thetis Cove	Former mill activities	Soil, Groundwater, Sediment	Hydrocarbons, metals, PCBs, phenols, PAHs
C15	Cole Island	Potential waste materials from historical operational activities	Soil	Metals, hydrocarbons Possible Organics
C26	Victoria Plywood, Thetis Cove	Pollution Control Permit for discharge into harbour	Sediment	Phenols, hydrocarbons Metals
C27	Northern part of Esquimalt Harbour	Log booming causing accumulation of wood waste on sea floor	Sediments, Aquatic life	Organic material
C31	Upland area to the north and west of F-Jetty, Colwood	Historical presence of a limestone handling facility, historical presence of a sawmill and booming grounds.	Soil, Groundwater, Sediment	Not known
C32	Shoreline of View Royal	Historical commercial activities in the area	Sediment, Aquatic life	Not known
C34	Esquimalt Harbour	Cable ties from log booming activities in the harbour	Sediment, Aquatic life	Metals
F1	West Isle Site, Plumper Bay	Chlorophenols from spill	Soil, Groundwater	Chlorophenols
G1	Harbour wide stormwater outfalls	Discharge of contaminated sediments from upland sources	Sediment, Aquatic life	Metals, PAHs
G2	Esquimalt Graving Dock stormwater outfalls	Stormwater outfalls	Sediment	Metals TBT

2.3.6 Background Review Conclusion

Esquimalt Harbour, and the surrounding area, have been heavily industrialized since 1848 with a long history of sawmilling and federal maritime activities. Leaseholds within the harbour used for log booming, have resulted in a large amount of wood debris being deposited on the harbour floor along with other contaminants resulting from infilling of the foreshore and historic operations and infrastructure within upland properties. While many COPCs have been studied extensively in the harbour, the assessment of wood waste and its associated physical impacts have not been examined historically.

2.4 HISTORICAL BIOPHYSICAL INFORMATION REVIEW

This section summarizes the historical biophysical information collected for the Study Area (i.e. subtidal sea floor within the Federal limits of Esquimalt Harbour, 'Harbour Floor' on **Figure 2.3**) and to fill any gaps through a review of pertinent existing databases to ultimately inform the current site characterization, impact assessment and future management options.

2.4.1 Biophysical Review Methods

The background review is consistent with guidance from Breems and Goodman (2009) and includes both current and historical data within the Harbour and Pedder Bay. Sources of information reviewed include:

- Duffus, H.J, J.W. Madill, W.t. MacFarlane, and P.J. Schurer. 1978. First Report on Bottom Studies of Esquimalt Harbour. Royal Roads Military College, Coastal Marine Science Laboratory Manuscript Report No 78-3. 23pp.
- Schurer, P.J., W.T. MacFarlane, and H.J. Duffus. 1979. Sub-bottom Survey of Harbours Near Victoria, B.C. 17pp
- Bright. 1995. An Environmental Survey of Esquimalt Harbour: Part I. Historical Inputs, Marine Sediment Contamination, and Biological Uptake. Report prepared for the Director General Environment, Department of National Defence by the Environmental Sciences Group, Royal Roads Military College.
- Hemmera. 2004. Victoria & Esquimalt Harbours Environmental Baseline Study. Volume 18 (Addendum#3) Lot A. Lot 18. Prepared for Transport Canada, Victoria & Esquimalt Harbours Environmental Program.
- Archipelago. 2004. Subtidal survey of Physical and Biological Features of Esquimalt Harbour. Prepared for Transport Canada, Victoria and Esquimalt Harbours Environmental Program.
- SLR Consulting Ltd. 2016. Detailed Quantitative Ecological Risk Assessment to Support Environmental Risk Management, Esquimalt Harbour, BC, Esquimalt Harbour Remediation Project (EHRP), Draft #3.

The following databases and information systems were also used:

- Capital Regional District online mapping application (CRD Atlas) and harbours information website;
- Ecosystems of British Columbia;
- Sensitive Habitat Inventory and Mapping (SHIM);
- iMapBC;
- BC Coastal Resource Information Management System (CRIMS database);
- British Columbia Marine Conservation Analysis (BCMCA);
- BC Conservation Data Centre (CDC) Species and Ecosystem Explorer;
- North Coast Watershed Atlas (NCWA), Community Mapping Network; and
- Pacific Coastal Resources Atlas (PCRA), Community Mapping Network.

2.4.2 Regional Overview

The upland areas of both Esquimalt Harbour and Pedder Bay lie within the Eastern Vancouver Island Ecoregion and the Leeward Island Mountains Ecosection and are classified as a Coastal Douglas-fir Moist Maritime Biogeoclimatic Zone (CDFmm). The CDFmm occurs along the southeastern Vancouver Island, on several Gulf Islands, and a small strip of the mainland and is limited to elevations below 150 m. Lying in the rain shadow of Vancouver Island and the Olympic mountains, it is characterized by warm, dry summers and mild, wet winters with mean annual temperature from 9.2 - 10.5 ^{o}C. The most common tree species in upland forest is the coastal variety of Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) which is frequently found with western redcedar (*Thuja plicata*), grand fir (*Abies grandis*), arbutus (*Arbutus menziesii*), Garry oak (*Quercus garryana*), and red alder (*Alnus rubra*), depending on site moisture and nutrient regime (Nuszdorfer et al. 1991).

The marine waters of both Esquimalt Harbour and Pedder Bay fall within the Georgia-Puget Basin Ecoregion, within the Strait of Juan de Fuca Marine Ecosection. Marine ecosections are defined according to physical, oceanographic and biological characteristics, with the Strait of Juan de Fuca Ecosection described as a deep trough marine area with semi-protected coastal waters and a strong “estuarine-like” outflow current (BCMCA 2016, BCMEC 2002). It is the major water exchange conduit between the Georgia - Puget Basin Ecoregion and the open Pacific Ocean (BCMEC 2002). Except for a few islets, such as Race Rocks, most of the ecosection is comprised of warm (i.e. 9 – 15 ^{o}C) nearshore marine waters (BCMEC 2002). Surface waters (0 – 25 m) within the Juan de Fuca Straight are characterized by an average winter temperature of approximately 8.2^{o}C and average summer temperature of 10.0 ^{o}C (Davenne and Masson 2001). The area of Juan de Fuca Strait surrounding Esquimalt Harbour and Pedder Bay is characterized as more marine than the Strait of Georgia and has an average surface salinity of 16 – 33 ppt (BCMEC 2002).

2.4.3 Historic Distribution of Habitats and Species in Esquimalt Harbour

2.4.3.1 Substrate

The majority (87%) of subtidal surficial substrates in the Federal portion of the Harbour is classified as mud, sand or gravel (**Table 2.5**). By grain size, most of the sediments were silt and sand (33% of total subtidal area) or gravelly mud and sand (40% of total subtidal area) (Hemmera 2004, Archipelago 2004). Some isolated bedrock outcrops are present, along with rocky seafloor adjoining rocky islands, but this only comprises 2% of subtidal area surveyed (Hemmera 2004, Archipelago 2004). Wood and bark debris were documented as mainly covering areas associated with log booming operations (**Appendix E: Subtidal Survey of the Physical and Biological Features of Esquimalt**, **Figure 5**; see **Section 2.1** for a review of wood waste in Esquimalt Harbour; Hemmera 2004, Archipelago 2004).

Table 2.5 Subtidal Sediment Breakdown from Subtidal Habitat Survey of Esquimalt Harbour (Archipelago 2004)

Sediment Size	Subtidal Area	
	Area (ha)	%
Gravel (>30%)	41.0	15.3
Gravelly Mud and Sand (trace – 30% gravel)	122.5	45.8
Sand	3.5	1.3
Silt and Sand	100.5	37.6
Silt	0	0
Total	**267.5**	**100**

2.4.3.2 Marine Vegetation

In 2004, vegetation, consisting of macroalgae or eelgrass, covered approximately 30% of the subtidal Harbour seafloor (**Appendix E, Figure 11**; Archipelago 2004). Similar to Victoria Harbour, less than 10% of the total subtidal area in the Harbour had moderate to dense vegetative cover. In general, vegetative cover was not found on mud-sand sediments and was sparse to absent on gravel-sand-mud substrates. In the areas of >30% wood waste (% organic cover) vegetation was primarily sparse to negligible, with the exception of Paddy Passage, north of Inskip Islands (Archipelago 2004). In Paddy Passage macroalgae cover was moderate to dense consisting of broad kelp, green algae, or eelgrass, while sparse cover consisted primarily of filamentous red algae (Archipelago 2004).

Since depositional sediments throughout most of the Harbour are suitable for native eelgrass (*Zostera marina*), it was likely that the total area of native eelgrass was historically larger than today. However, dredging, infilling, and wood waste including bark and wood debris may have impacted the distribution. In 2004, a total area of 0.5 ha of eelgrass was mapped in the Harbour, split between eight small beds, ranging in size from 60 m^2 to 1,630 m^2, in depths of +0.5 to -0.9 m CD (Archipelago 2004). Substrates where eelgrass occurred was mainly a mix of mud and sand with gravel and shell content (barnacle hash). Of the beds identified, three had sparse to low cover (<25%; **Table 2.6**, **Appendix E, Figure 12)**. Epiphytic red algae *(Smithora naiadum*) and diatoms were found on eelgrass blades, and other species co-occurred including: *Laminaria* sp., *Ulva* sp., *Sargassum muticum*, *Alaria* sp. and *Neoagardhiella* sp.

Table 2.6 Estimate of Eelgrass Bed Areas within Esquimalt Harbour in 2004

Bed Number	Location	Area (m^2)
1	Grant Knoll	60
2	Lang Cove South	810
3	Lang Cove North	620
4	Munroe Head North	900
5	Ashe Head South	120
6	Thetis Cove	700
7	Limekiln Cove	1,320
8	Smart Island	820
Total	-	**5,350**

Source: Archipelago 2004

2.4.3.3 Benthic Invertebrate Fauna

Benthic invertebrate fauna is a broad grouping of species that live within (infauna) and on (epibenthic) the surficial substrates of the seafloor. Infauna are divided into two size classes based on body size: meiofauna (63 to 500 µm) and macrofauna (>500 µm in length).

Infauna

Two previous environmental investigations conducted in Esquimalt Harbour have enumerated the macroinvertebrate infauna communities:

- Bright 1995 – 17 stations (17 in September 1993); and,
- SLR 2015 – 56 stations (12 in February 2013, 46 in July 2015).

However, these studies largely avoided areas of known wood waste debris. A subset of results from these studies are presented later in the report (**Section 3.0**).

Larger infauna within the Harbour has also previously been enumerated by using observations of infaunal burrows to indicate the presence of burrowing shrimp, worms, and bivalves (Archipelago 2004). Burrows were primarily found with the gravelly mud - sand substrates along the harbour entrance and western side of the upper harbour, and were not apparent in areas of wood and bark debris (Archipelago 2004). Of all the observations of fauna that Archipelago (2004) made from video surveys, the majority (81%) were made up of unmounded and mounded infaunal burrows.

Epibenthic

Both Dungeness (*Metacarcinus magister*) and graceful crabs (*Cancer gracilis*) have been observed to be distributed throughout the subtidal habitats of the Harbour on mud-sand and gravelly mud - sand substrates, while red rock crab (*C. productus*) are associated with coarser gravel and rocky substrates. Within eelgrass beds, Dungeness crab, graceful crab, helmet crab (*Telmessus cheiragonus*), and horse clams (*Tresus capax*) were the most common invertebrate species (Archipelago 2004). Plumose anemones were frequently attached to logs and larger pieces of wood debris with crabs relatively abundant (Archipelago 2004). Echinoderms such as the California sea cucumber (*Parastichopus californicus*) and red sea urchin (*Strongylocentrotus franciscanus*) were noted in rocky substrates at the harbour entrance and Inskip Islands (Archipelago 2004). For observations refer to **Appendix E**, **Figure 18-21**.

Observations of Northern Abalone (*Haliotis kamchatcana*) have been documented within the harbour, refer to **Section 2.4.4.1** below.

2.4.3.4 Fish and Fisheries

As with larger invertebrate macrofauna, fish that have been previously been identified in the subtidal environment throughout the Harbour varied in their distributions by habitat type. Fish commonly found in eelgrass beds, include: striped (*Embiotoca lateralis*) and pile perch (*Rhacochilus vacca*), threespine stickleback (*Gasterosteus aculeatus*), bay pipefish (*Syngnathus griseolineatus*), Northern ronquil (*Ronquilus jordani*) and gunnels (Archipelago 2004). In 2004, flatfish were the most commonly identified fish species in the outer area of the Harbour and off Inskip Islands (Archipelago 2004). Other fish such as perch and rockfish were associated mainly with the kelp beds adjacent to the islands (Archipelago 2004). For observations of fish during 2004 surveys refer to **Appendix E**, **Figure 22**).

The entirety of the Harbour and surrounding waters of the Greater Victoria area (DFO Are 19-1) are subject to a permanent bivalve sanitary closure due to concerns around potential presence of fecal coliform bacteria and other contaminants resulting from domestic sewage discharge from outfalls, docks, wharves, live-aboard boats and other sources (Golder 2006). In 2006, commercial fisheries within the Harbour were very limited. A commercial crab fishery consisting of only two licences was active in Esquimalt Harbour but restricted to specific areas due to DND security concerns, and red and green commercial sea urchin harvesting were generally conducted well outside of the harbour limits (Golder 2006). Recreationally, finfish and crab fishing was documented as occurring within Esquimalt Harbour in 2006; however, this was mostly near the mouth of the harbour and near Fisgard Island (Golder 2006).

2.4.4 Esquimalt Harbour Environmentally Sensitive Areas

North of Cole Island at the head of the Harbour is an area of shallow water and mudlfats. This habitat is used by many marine species, such as gulls and ducks, for foraging and occurs at the mouth of Millstream Creek, which is recognized as a coho spawning stream (SHIM Atlas 2016). Other fish species in the stream include: brown bullhead (Ameiurus nebulosus), cutthroat trout (*Oncorhynchus clarkia)*, prickly sculpin (*Cottus asper*), pumpkinseed (*Lepomis gibbosus*), smallmouth bass (*Micropterus dolomieu*) and threespine stickleback (*Gasterosteus aculeatus*). Eelgrass habitat has been documented as providing critical rearing habitat for juvenile fish, such as salmon and herring, and aides in erosion control by trapping the sediment in the marine and estuarine environments. Before the harbour was industrialized, first nations harvested large numbers of herring. Cumulative herring spawn habitat index (SHI) data from Fisheries and oceans Canada based on spawn records from 1928-2009 classifies Esquimalt harbour as minor (lowest 25%) to low (next 25%) (BCMA: Marine Atlas of Pacific Canada).

2.4.4.1 SARA Species

A search of the BC CDC *Species and Ecosystems Explorer* showed that there are 7 provincially and/or federally listed marine species or sub-populations that may potentially occur in the Project area (**Table 2.7**, BC CDC, 2016).

Northern abalone (*Haliotis kamchatcana*) have previously been observed within Esquimalt Harbour associated with rocky nearshore habitat in the Esquimalt Harbour Remediation Project of C-Jetty work zone (Balance 2012), along with Duntz Head and ML Floats (Mike Waters, Pers. Comm.). There is little suitable habitat occurring within the present Project area, as much of the harbour seafloor is comprised of soft sediments (see **Section 2.4.3.1** above)

Transient killer whales (*Orcinus orca*), harbour porpoises (*Phocena phocena*), and Steller sea lions (*Eumetopias jubatus)* have also been observed within the harbour (Mike Waters, Pers. Comm.).

Table 2.7 Marine Species at Risk with the Potential to Occur within the Project Area

Listed Species Name	COSEWIC Status	SARA Status	BC Status*	Habitat and Range Description	Likelihood of Occurrence
Steller sea lion (*Eumetopias jubatus*)	Special Concern	Schedule 1- Special Concern	Blue	Marine habitats include coastal waters near shore and over the continental slope; sometimes rivers are ascended in pursuit of prey. When not on land, the sea lions may congregate at nearshore traditional rafting sites, or move out to the edge of the continental shelf	Steller sea lions have been observed in the Project Area; however, the Project Area is not considered important habitat for the Steller sea lion
Harbour porpoise (*Phocoena phocoena*)	Special Concern	Schedule 1- Special Concern	Blue	Coastal waters and adjacent offshore shallows and also inhabits inshore areas such as bays, channels, and rivers. Mothers and young tend to move into sheltered coves and similar sites soon after parturition.	The Project Area is not considered primary habitat for this porpoise but may occur in areas adjacent to the Project area (this species has not been observed in the Project Area during surveys).
Killer whale (NE Pacific Southern resident population) *(Orcinus orca)*	Endangered	Schedule 1- Endangered	Red	The range during spring, summer, and fall includes the waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Little is known about winter movements and range.	The Project Area is not considered primary habitat for killer whales, which are found more frequently in the nearshore waters of Juan de Fuca; however, they are not known to frequent the active harbours of Esquimalt and Victoria. It is considered unlikely that killer whales would enter within or adjacent to the Project Area.
Killer whale (West Coast transient [Bigg's] population) *(Orcinus orca)*	Threatened	Schedule 1- Threatened	Red		

Listed Species Name	COSEWIC Status	SARA Status	BC Status*	Habitat and Range Description	Likelihood of Occurrence
Cutthroat trout (*Oncorhynchus clarkii clarkii*)	Not at risk	Not at risk	Blue	Preferred habitats are eelgrass meadows and kelp beds. Travels from streams to estuaries remaining close to shore.	The last recorded cutthroat trout in Mill Stream (flows into northeast Esquimalt Harbour) was in 1977; therefore, it is unknown if they still exist in the area (BCMOE, 2010). Cutthroat trout have not been observed in the Project Area to date.
Northern abalone (*Haliotis kamtschatkana)*	Threatened	Schedule 1- Threatened	Red	Found near kelp beds in the shallow subtidal and lower intertidal zones on hard substrates. Prefers areas with high wave action and currents.	There are some characteristics of the Project Area that would be favourable for abalone; however, the low wave action and currents and contaminated sediments are unfavourable. abalone were observed at the in the C jetty adjacent to the Project Area (Balanced 2012).
Olympia Oyster (*Ostrea conchaphila*)	Special Concern	Schedule 1- Special Concern	Blue	Mainly found in the lower intertidal and shallow subtidal zones of saltwater lagoons and estuaries. They have also been found on tidal flats, tidal channels, bays and sounds, in splash pools, near freshwater seepage, or attached to pilings or the undersides of floats. On the outer coast, this oyster species is only found in protected locations. Within suitable habitat, Olympia oysters need hard substrate for settlement.	No known occurrences of Olympia oysters within the Project Area.

* Red - Extirpated, Endangered, or Threatened, Blue – Special Concern, Yellow - apparently secure and not at risk of extinction

3.0 SITE CHARACTERIZATION AND IMPACT ASSESSMENT

Wood waste impacts to nearshore benthic communities are site-specific, depending on site conditions (e.g. bathymetry, currents, sedimentation rates) and the nature of wood waste, and require a detailed site assessment and determination of site-specific impacts (Washington State 2013).

3.1 METHODS

Site characterization methods were informed by wood waste assessment and remediation procedures developed by Breems and Goodman (2009) and Washington State Department of Ecology (2013), and included:

- Delineation of the nature (composition, see **Table 2.1**) and extent (lateral percent coverage and depth) of wood waste deposits in Esquimalt Harbour
- Characterization of existing biophysical conditions, within areas of known wood waste deposits, transition zones, and areas without wood waste including: substrate type, spatial distribution, and abundance of epibenthic and infauna biological communities
- Analysis of sediment chemistry to determine the distribution of COPCs and conventional sediment chemistry parameters associated with wood waste or wood waste decomposition by-products (including total organic carbon (TOC), pore water sulphides, ammonia, and pH).

Site characterization employed of a series of complimentary field methods to develop a comprehensive understanding of existing conditions in the Study area (see **Table 3.1**).

Table 3.1 Summary of Field Survey Methods Used to Determine Existing Conditions in Esquimalt Harbour

Survey Method	Objective		
	Wood Waste Delineation	Biophysical Assessment	Sediment chemistry
Side scan sonar	✓	✓	**N/A**
SCUBA Biophysical surveys	✓	✓	**N/A**
Sediment Collection (Hand cores, 0.65 m) (Van Veen, 0.2 m) (Sonic Drill Boreholes, ~5.0m)	✓	**N/A**	✓
Benthic Infauna sampling (Van Veen, 0.2 m)	**N/A**	✓	**N/A**

Following the site assessment, the data were used to determine any areas of Esquimalt Harbour that were impaired by wood waste, the results of which were used to inform remediation or management options (**Section 4.0**).

3.1.1 Field Sampling

Field sampling methods for side scan sonar, SCUBA biophysical surveys, core sampling and grab sampling are described in the following sub-sections.

3.1.1.1 Side Scan Sonar

Side scan sonar was used initially to collect imagery of the seafloor and provide information about larger features such as the distribution of larger wood waste (e.g. cut logs) and other underwater structures (e.g. debris, pilings), as well as sediment surface profiles and contours (e.g. can inform substrate composition assessment). Results were used to focus biophysical assessments on areas with wood waste deposits, and aid in the determination of the extent of wood waste.

Imaging was conducted on August 30, 2016 by Terra Remote Sensing Inc. using a towed Edge Tech 4200 operated at 300 and 900 kHz. Side scan survey lines were conducted primarily in a north-south direction and separated by 25 and 75 m to ensure adequate coverage of the seafloor. The horizontal scan range was 50 m to each side of the vessel. Mapping operations were conducted at three knots and kept at one metre depth (below the surface) throughout the survey.

3.1.1.2 SCUBA Biophysical Surveys

SCUBA surveys provide detailed information on sediment composition, the distribution of surficial wood waste and its composition, and the epibenthic community, and allow for some sub-surface sediment observations with the use of hand-held cores. While less rapid and less expensive then underwater towed video surveys, they are a more precise visual assessment method (Breems and Goodman 2009, Washington State 2013).

Survey and sample design were chosen to safely assess areas of wood waste deposits (initially delineated using the side scan sonar results), transition zones, and areas without wood waste both within the Harbour and at a nearby reference location, to:

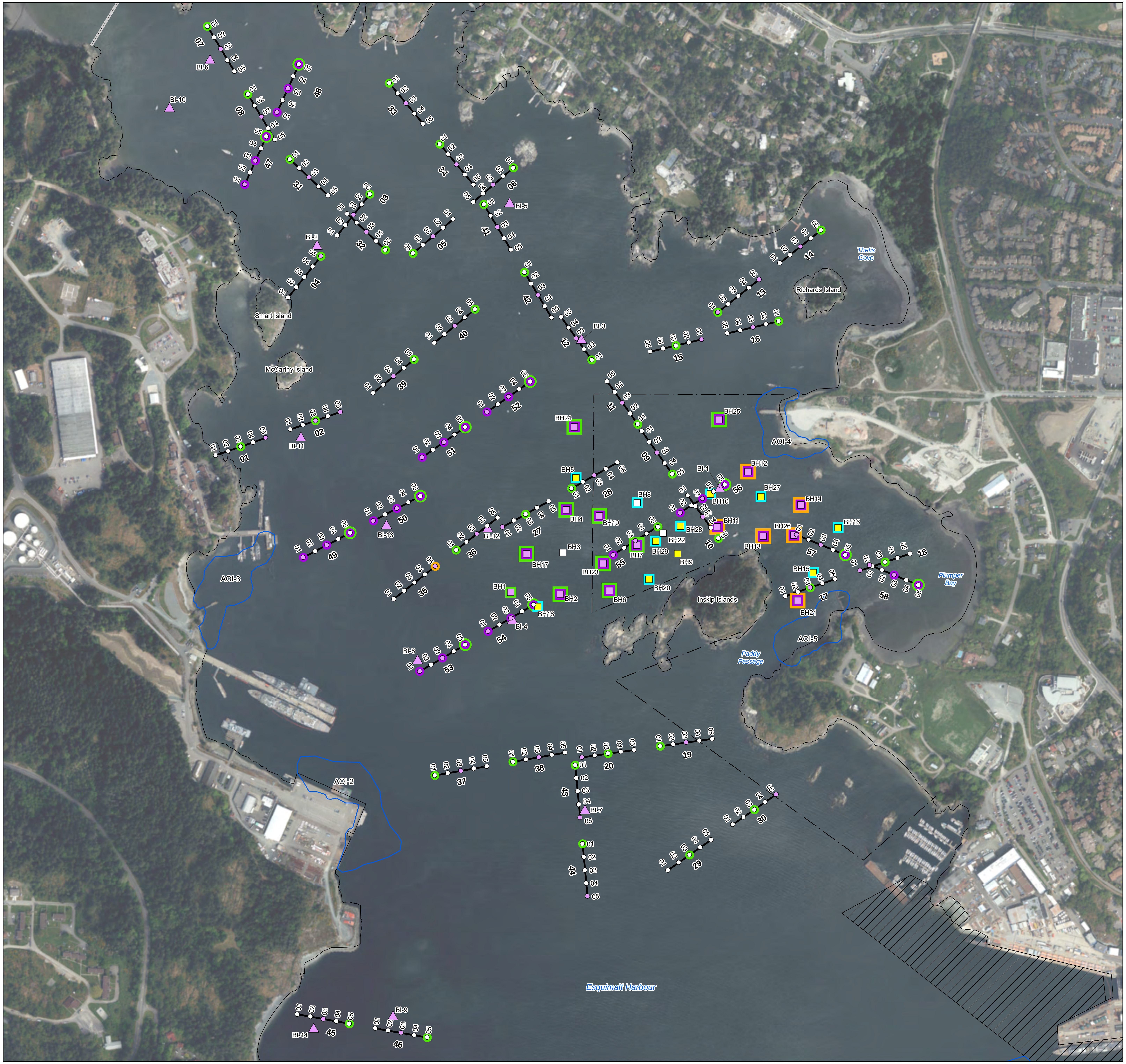
- Visually delineate the extent of surficial wood waste and characterize the composition
- Observe and record biophysical features

Over the course of three field surveys, a total of fifty-eight 100 m long transects were surveyed: 52 within Esquimalt Harbour and six within Pedder Bay (**Figure 3.1** and **Figure 3.2**).

- Field Survey 1: September 19 - 23, 2016
- Field Survey 2: October 19 - 21, 2016
- Field Survey 4: January 23 - 25, 2017

Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Sampling Areas



Legend

- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour

Sampling Location Type

- Benthic Infauna Sample Station
- Drill Borehole
- Biophysical Sample Station
- Dive Transect

Completed Sampling Analysis

- DAS Analytics
- pH
- Ammonia / pH
- Poer Water Sulphide / Ammonia / pH
- Total Organic Carbon - Surficial (0-10cm)
- Total Organic Carbon - Deeper (30-40cm)

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

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Hemmera
An Ausenco Company

Public Works and Government Services Canada

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Pedder Bay Sampling Areas

Legend

Sampling Location Type

- Biophysical Sample Station
- Dive Transect

Completed Sampling Analysis

- Pore Water Sulphide / Ammonia / pH
- Total Organic Carbon - Surficial (0-10cm)

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: Capital Regional District, 2015

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure 3.2

Hemmera An Ausenco Company

Public Works and Government Services Canada

Survey methods followed those outlined in the Marine Foreshore Environmental Assessment Procedure (DFO 2003). Each transect was delineated with a 100 m long lead-weighted line and sampling occurred at stations spaced at 25 m intervals (0, 25, 50, 75, 100m). Transect endpoints were georeferenced using a handheld GPS unit from the surface-support vessel. The 25 m interval sample positions were interpolated using distance along the transect with ArcGIS. At each of the five sampling locations, a 1.0 m x 1.0 m quadrat was used to assess:

- Substrate type (including woody debris; % cover; **Table 3.2**)
- Marine vegetation (% cover)
- Sessile invertebrates (% cover)
- Mobile invertebrates and fish (count)

The abundance of mobile invertebrates and fish were also documented as they were encountered along the transect. All transects were recorded using an underwater video camera for future review, as required.

Table 3.2 Biophysical Assessment Substrate Classification

Substrate Type	Size Range (Diameter)	
Bedrock/ Boulder	>256 mm	
Cobble	64 – 256 mm	
Gravel	2 – 64 mm	
Sand	0.06 – 2 mm	
Silt/Clay/Mud	<0.06 mm	
Other*	N/A*	
Large woody debris	Varies	
Wood waste	Cut Logs	Full size logs
	Small wood debris	<10cm diameter
	Wood chips	6-10cm^2
	Sawdust	10mm^2
	Woodfibre	<10mm^2

Note: *Substrates can also include anthropogenic structures, debris and shell hash etc., all of which were characterized under "substrate – other" during field sampling.

3.1.1.3 Sediment Collection

To delineate the presence and depth of wood waste deposits, and collect sediment samples for chemical analyses, sediment cores were collected throughout the Project area, including the Pedder Bay reference location.

Three sub-surface cores were taken at 50 m intervals (stations 0, 50, and 100 m) along each SCUBA transect (**Section 3.1.1.2**), to a maximum depth of 0.65 m below the sediment surface. The core (0.80 m long by 0.05 m diameter PVC tube) was pushed into the sediments by hand or using a one-kilogram hammer to a depth where it could no longer penetrate. The core was then capped, removed from the sediment, and a second cap placed on the bottom of the core to ensure the contents were not released. The sediment was retained in the corer during removal from the sediment due to suction created by the cap. Aboard the dive vessel, each core was visually inspected, photo-documented, and a borehole log was completed to document the vertical profile of substrate and wood waste stratification (**Table 3.2**). Additional information on the depth of hard substrate below the sediment surface was collected (stations 25 and 75 m) along each SCUBA transect using a one metre long metal probe marked at 10 cm intervals.

Surficial sediment samples (0 – 10 cm) were collected for chemical analyses during the SCUBA surveys using the hand driven cores and during Field Survey 3 (October 26 -27, 2016) using a Ponar grab sampler (~0.15 m by 0.15 m) operated from the waters surface. Analysis of conventional sediment chemistry parameters can aid in the identification of areas affected by wood waste decomposition by-products (Washington State 2013). For each transect, sediment was analyzed for the following parameters (**Figure 3.1** and **Figure 3.2**):

- Total organic carbon (TOC) – one to three samples
- Ammonia (NH_3) and pH – one sample
- Pore-water sulphides – one sample

Total volatile solids and TOC can both provide measures of sediment organic content and are indicators of wood waste in sediments. TOC was analyzed for this Project. Pore water sulphides were chosen over bulk sulphides as they provide a more accurate measure of H_2S; the more toxic form to organisms (see **Section 2.1.4.2**; Breems and Goodman 2009). Biochemical oxygen demand may help evaluate the potential for a reduced oxygen environment but is not considered necessary to determine wood waste impacts (Washington State 2013).

Water quality data were collected during Field Survey 3, within one tidal cycle, using a YSI 600 XL MP Sonde 1.65, with an extended 50 m cord, to record values approximately one metre above the seafloor. Parameters recorded included: water temperature (^{o}C), salinity (g/kg), dissolved oxygen (DO % and mg/L), pH and conductivity (µs).

Following the completion of the first phase of the project (Fiscal Year 2016/2017), it was recommended that further delineation of wood waste depth be conducted in an area immediately north of Inskip Island where hand-held surface cores were not able to determine the maximum depth of wood waste deposits (wood waste deposits were characterized as “open at depth”) during SCUBA surveys. This area was identified during the review of site history as a frequent location for log storage and near the former West Isle Sawmill and Fibremax log sort sites. In November 2017, Field Survey 6 (November 6 – 9th 2017) was initiated to determine the depth of the wood waste in this area using a sonic-drill rig mounted on a spudding barge. A total of 29 boreholes were completed during the survey; a borehole was considered complete if the borehole remained intact during extraction and native sediment was reached below wood waste deposits (**Figure 3.1**). Runs were completed in 5.0 m below ground surface intervals (i.e. below the sea floor), however, in some cases, up to 10.0 m penetration was required to ensure the borehole was complete (i.e. native sediment was reached).

As each run was removed from the water, cores were extruded from the drill into a sealed plastic bag and placed into a core box. Each borehole was visually inspected, photo-documented, and a borehole log was completed to document the vertical profile of substrate and wood waste stratification (**Table 3.2**). Once boreholes were logged and samples collected, drill cuttings were placed into labelled drums prior to characterization using the analytical laboratory results from the samples collected for disposal considerations. Drums were transported to an upland facility that could accept salt-impacted sediments for disposal. As with sediment cores above, sediment chemistry samples were taken from boreholes for the analysis of:

- TOC
- Ammonia
- Pore water sulphides
- pH

To determine the potential for dredged materials to qualify for disposal at sea (DAS), a preliminary investigation was conducted using samples taken from 10 of the boreholes during Field Survey 6 (**Figure 3.1**). Samples were collected from boreholes within the area of wood waste deposits north of Inskip Island and Plumper bay, along the border of, and within, the 5% TOC indicator threshold and analyzed for the DAS Minimum Sample Analytical Requirements[3]:

- Metals
  - Cadmium, mercury, arsenic, chromium, copper, lead, zinc
- Organics
  - Total polychlorinated biphenyls (PCB)
  - Total polycyclic aromatic hydrocarbons (PAH)
- Physical Parameters
  - TOC
  - Moisture (%)
  - Grain Size Distribution (%)

[3] It should be noted that these are the minimum requirements for projects with no contaminant history, and Environment Canada was not contacted to determine needs for additional site-specific analytical requirements.

Sediment chemistry samples from all field surveys (Field Survey 1 – 6) were processed on the support vessel after borehole log entries were completed (**Table 3.3**). Sample jars were identified using labels supplied by Maxxam Analytics (Maxxam) noting the sample number and type of analysis. The sample jars were then temporarily stored in insulated coolers at approximately 4ºC to minimize chemical alteration prior to laboratory analysis. The coolers were transported to Maxxam as soon as possible after sediment sampling was complete (and within acceptable hold times). A site-specific chain-of-custody form accompanied the samples when delivered to Maxxam.

Table 3.3 Surficial Sediment Sample Sizes Analyzed for Sediment Chemistry from Esquimalt Harbour and Pedder Bay

Location	TOC	Porewater Sulphides	NH_3	pH	DAS Analytics (Minimum requirements)
Esquimalt Harbour	95	61	68	78	10
Pedder Bay	6	6	6	6	-

3.1.1.4 Benthic Infauna Sampling

Extensive benthic infauna datasets exist for the Harbour; including a small number at reference stations; however, most sampling has actively avoided areas of known wood waste deposits:

- Bright 1995 – 17 stations (17 in September 1993)
- SLR 2016 – 56 stations (12 in February 2013, 46 in July 2015)

In order to examine the impacts of wood waste on the benthic infauna community, a total of 14 benthic infauna samples were collected during Field Survey 5 (March 7 – 10th 2017), across sediments that exhibited a range of TOC levels in Esquimalt Harbour. Two replicate samples were collected with a Van Veen sediment grab (0.1m^2) at each station and field-screened through a 1.0 mm sieve using unfiltered seawater. Material retained on the screen was transferred to jars and preserved with 10% buffered formalin. Only samples penetrating at least 10cm into the sediment, with no evidence of major washout or slumping, were processed. Sediment in Pedder Bay was very consolidated and grab samples were unsuccessful (i.e. sediment recovery did not meet the required quantities for analysis of benthic infauna community).

3.1.2 Laboratory Analysis

Sediment chemistry analysis and benthic infauna community analysis were performed at independent accredited lab facilities as follows.

3.1.2.1 Sediment Chemistry

All sediment chemistry analysis was performed by Maxxam Analytics.

Quality assurance and quality control (QA/QC) for the sediment samples included collecting a minimum of one duplicate sample for every ten samples analyzed (*i.e.*, 10% field duplicates) and submitting to the lab using a blind sample ID. The relative percent differences (RPDs) between the characterization sample and the field duplicate were calculated and RPDs compared to data quality objectives (DQOs).

RPD = (Absolute Value [A-B] / Average Value ((A+B)/2)) x 100%
where A = field sample and B = duplicate sample

In 2016 the CCME updated their Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 4 Analytical Methods which contains recommended DQOs for laboratory duplicate RPDs (**Table 3.4**; CCME 2016). It is recognized that these DQOs are intended for laboratory duplicates and do not include provisions for additional variability in field duplicates. However, these DQOs are considered a conservative screen for assessing the quality of field duplicates.

Table 3.4 Recommended Data Quality Objectives for Soil, Sediment and Groundwater

Parameter Category	Data Quality Objectives
Organics in Soil and Sediment	
Polycyclic Aromatic Hydrocarbons (PAHs)	50%
Volatile organic Compounds (VOC, including BTEX*)	50%
Hydrocarbon Fractions F1-F4	30%
Metals in Soil and Sediment	
High variability metals: Ag, Al, Ba, Hg, K, Mo, Na, Pb, Sn, Sr, Ti	40%
Other metals	30%
Nutrients in Soil and Sediment	30%
Organics in Water	
VOCs (including BTEX, F1-F4)	30%
PAHs	30%
Metals in Water	20%
Nutrients in Water	20%

*BTEX refers to chemicals benzene, toluene, ethylbenzene and xylene

High RPDs may reflect variability within the sample, which can be present due to the heterogeneity of the media or nature of the contaminant distribution. Values exceeding the above DQOs are examined on a case-by-case basis.

3.1.2.2 Benthic Infauna

Benthic infauna community was analyzed by Biologica Environmental Services Ltd. (Biologica). After a period of fixation, samples were transferred to 70% ethanol and stained with Rose Bengal to aid sorting. All samples and debris retained during field screening were sorted by trained technicians using a dissecting microscope at 10-40x magnification. Samples from high volume wood waste areas were sub-sampled.

Sorting efficiency QA/QC was conducted to ensure sorting efficiency was >95%. QA/QC was performed on 19% of the samples, and any samples below 95% sorting efficiency were re-sorted in their entirety. Subsampling accuracy was assessed by sorting the remaining sample for 10% of all subsampled samples and comparing the fractions to one another to ensure a >95% accuracy.

Organisms were identified to the lowest practicable taxonomic classification level (species wherever possible), using standard taxonomic keys and Biologica's verified reference collections, and enumerated by trained taxonomists.

3.1.3 Data Analysis

To delineate the presence of wood waste and its potential effects within Esquimalt Harbour, the surficial extent and depth of wood waste were mapped and compared with sediment chemistry and existing benthic community data.

3.1.3.1 Wood Waste Delineation

The lateral or surficial extent of the wood waste was documented during SCUBA surveys and mapped as percent cover, while the depth was estimated and mapped using measurements of wood waste collected from the hand-held sediment core and sonic drill data. The sonic drill investigation (Field Survey 6) followed previous field surveys, in order to target an area immediately north of Inskip Island where hand-held surface cores were not able to determine the maximum depth of wood waste deposits (wood waste deposits were characterized as "open at depth") during SCUBA surveys. Wood waste was characterized by size as described in **Table 2.1**. The depth of wood waste was estimated by interpolating the beginning and ending wood waste depths within the core to create top and bottom surfaces and estimating the volume between these two surfaces. In cases where wood waste occurred to the bottom end of the core, the layer was marked as 'open at depth' indicating that the wood waste depth is unknown for this sample location.

Since wood waste surficial cover and depth measurements were based on point observations at sample stations along transects, distribution maps were developed by interpolation using kriging and Surfer v14®. Kriging models the relationships between known sample station values by assuming that the distance or direction between sample points reflects a spatial correlation that can be used to explain changes in the pattern, the resulting figure represents estimates of distribution for each parameter between known sample station values. The interpolated figures were created in ArcGIS 10.5® to visualize the distribution of wood waste coverage and wood waste depth patterns.

The total volume of the wood waste in Esquimalt Harbour was estimated using ArcMap 10.5® to calculate the volume between the sea floor and the bottom of the wood waste deposit, using interpolated results. Wood waste deposits were covered with varying depths of silt in some areas and, in these cases, the overlying surficial sediment was included in the total volume estimated, as it would also need to be dredged during remediation. To visualize the wood waste deposits, information on wood waste depths were also imported into ArcGIS 10.4® from the borehole logs and used to create stratification/cross section profiles at six locations in Esquimalt Harbour.

3.1.3.2 Biophysical Assessment

Epibenthic Observations

Epibenthic communities were recorded during SCUBA surveys as percent cover for each of the sample stations along each transect for vegetation and sessile organisms, and as counts of individuals for mobile organisms. Descriptions of the biophysical environment were summarized qualitatively. Similar to the distribution maps for wood waste surficial coverage and depth, distribution maps were created for both bacterial mats (*Beggiatoa* spp.) and diatoms using percent cover observations and the interpolation method described above (**Section 3.1.2.1**).

Infauna Community

Summary metrics from the results of the benthic infauna sampling were calculated for each sample station to assess the distribution of community composition and included:

- Quantity Indices
  - Abundance (total number of individuals)
- Diversity and Evenness Indices
  - Species Richness (S) – Total number of unique taxonomic groups
  - Shannon-Weiner Diversity Index (H') – Accounts for species richness and evenness
  - Pielou's Evenness (J) – Quantifies distribution of individuals among the taxa
  - Swartz's Dominance Index (SDI) – the number of taxa that account for 75% of the total sample abundance. A lower SDI indicates the sample is dominated by only a few species.

The relative proportion of taxonomic groups was also calculated to highlight the dominant species in each sample.

3.1.3.3 Sediment Chemistry

Sediment chemistry was characterized using TOC, pore water sulphides, ammonia, and pH as indicators of areas impacted by wood waste decomposition by-products (see **Figure 2.1**). Sediment chemistry distribution maps of TOC, pore-water sulphides, ammonia, and pH were created using the interpolation methods described above (see **Section 3.1.2.1**).

Since TOC is a measure of organic content in the sediment, it is assumed that TOC levels are indicative of particulates/wood fibres resulting from historic log boom storage/sorting practices in the Harbour. Pore water sulfides and ammonia provide an additional indication of potential toxic by-products resulting from the anaerobic breakdown of TOC. Finally, pH values influence the toxicity of both sulphides (**Section 2.1.5.4**) and ammonia (**Section 2.1.5.5**) to aquatic life and should be considered in the analysis.

3.1.3.4 Wood waste Impact Assessment

To assess the relationship between the benthic community, the presence of wood waste, and sediment chemistry parameters associated with the breakdown of wood waste in Esquimalt Harbour, multivariate statistical analyses was undertaken to investigate the impact to both infauna and epibenthic communities. Depending on site-specific conditions statistically significant correlations between biological data and sediment chemistry data may or may not be present (Washington State 2013).

Sediment Chemistry

Spatial regression analyses were conducted using GeoDa™ software (Anselin 2003) to determine the relationship between each of the dependent sediment chemistry parameters measured (TOC, pore-water sulphides, ammonia, and pH) and wood waste deposit depths. A stepwise regression comparison approach was used. First, four ordinary least squares regressions were created for each of the dependent variables. Several diagnostics were used to assess for presence and type of spatial dependencies in the data (Anselin et al. 1996), with Moran's I, Lagrange Multiplier, and Robust Lagrange Multiplier tests used to estimate spatial autocorrelation. If autocorrelation was detected, the appropriate spatial model was run (Anselin 2005). Finally, an assessment for heteroskedasticity and non-normality was conducted.

Epibenthic Community

Analysis of the epibenthic community was also conducted using multivariate analyses in PIMER software (v.6.1.2, Primer-E Ltd.). To test for differences among epibenthic species assemblages within varying levels of TOC, a permutational MANOVA (perMANOVA) was conducted using the software package PERMANOVA (Anderson 2001, Andersen et al. 2008). PerMANOVA can determine within group variation, which addresses many common violations of analyzing ecological data. Significant differences among groups of species (*P*) were determined by permutation tests under the null hypothesis of no relationship, termed *pseudo-F*. To test for significant differences among levels of TOC, a one-way perMANOVA was run, which is similar in nature to a one-way ANOVA, except it compares how all the species in each group relate among TOC levels, rather than just a single species or variable.

An analysis of species contribution to the similarity among areas of differing TOC levels was also conducted using SIMPER (similarity percentage analysis) within PRIMER ver.6 (Clarke and Gorley 2006). SIMPER identifies the amount each taxon contributes to the Bray-Curtis similarity within each habitat and the dissimilarity among habitats. In addition, a SIMPER was used to identify key indicator species for each TOC level and how consistently a species contributes to this difference. When the dissimilarity value (δ) is divided by the standard deviation (SD), values greater than approximately 1.4 indicating a strong indicator species (Clarke and Warwick 2001).

A distance-based linear model procedure (DISTLM) in PERMANOVA was used to identify sediment chemistry parameters (TOC, sulphide, ammonia, and pH) explaining variation among the epibenthic community of sample locations. DISTLM is a multivariate multiple regression or distance-based redundancy analysis (dbRDA) technique (McArdle and Anderson 2001) that can fit environmental variables to biotic variables. Marginal tests were conducted to quantify the relationship of each sediment chemistry parameter alone, while conditional tests identify the best combination of sediment chemistry parameters, given the relationship of those previously selected in the model (i.e., the best order of variables to explain the data). The BEST routine within DISTLM was used to identify sediment chemistry parameters that exhibit the greatest correlation with the epibenthic community using model selection criteria. A pseudo-F test statistic was generated using 4999 permutations to allow for a P-value of 0.0002 (Andersen et al. 2008). Results were illustrated using a dbRDA with vector overlay, showing the direction and strength of sediment chemistry parameters with the biotic data summarized by sample locations. The selection criteria R^2 was used to explain the proportion of variation for each of the sediment chemistry parameters.

The stepwise regression comparison approach outlined above for sediment chemistry was also repeated to test for relationships between each of the sediment chemistry parameters as independent variables and bacterial mat coverage (% cover) as a dependent variable.

Infauna Community

Both species composition and species richness were used to test for differences among sample locations as a function of varying levels of sediment chemistry parameters (TOC, pore water sulphides, and ammonia). If sediment chemistry values (TOC, pore-water sulphides, and ammonia) were not co-located with each benthic infauna station, values for the benthic infauna station were extrapolated from the interpolation of sediment chemistry data (**Section 3.1.3.3**). All analysis of the infauna community data was conducted using multivariate analyses in R Statistical software (R Core Team 217).

Differences in species abundance were examined with Canonical Correspondence Analysis (CCA; using the VEGAN community package; Oksanen et al. 2018). The CCA analysis is a multivariate method used to examine the relationships between biological assemblages of species and their environment and was used to identify sediment chemistry parameters driving any variation in community composition between sample locations. Significant differences among species composition at each sample location were determined by permutation tests under the null hypothesis of no relationship. The strength of the fitted sediment chemistry parameter is estimated using the R-squared values and the p-value, the probability that the random permutation of R-squared is larger or equal to the observed value of the fitted value. A p-value < 0.05 was used to determine significant difference from random.

Linear modelling was used to examine differences in species richness. The species richness was rarefied to the minimum sample numbers and a correlation test is performed between the rarefied richness and the environmental variables. The relationship between species richness at each sample location and the sediment chemistry parameters was examined by creating a linear model with all environmental variables and selecting the best model using a stepwise model selectin approach. The best model was then used to examine correlations among species richness and each environmental parameter in the model. Correlations were then tested for significance.

Of the sediment chemistry parameters tested, the parameter identified as the best predictor of changes in community composition and richness was then used to determine the threshold of that parameter that had an impact to infauna community. The summary metrics for each benthic infauna sample locations (**Section 3.1.3.2**) were then plotted against the threshold and used to provide an estimate of threshold impact to species diversity. Finally, to visually display the threshold, bubble plots of summary metrics for each benthic infauna location were overlaid on the interpolated distribution for TOC, and the US EPA TOC threshold.

3.2 RESULTS

3.2.1 Wood Waste Delineation

Side scan sonar results were used to identify the area of wood waste deposits, with a combination of visual assessments (using SCUBA surveys) and sediment coring used to refine the lateral extent and depth of deposits.

3.2.1.1 Side Scan Sonar

Side scan sonar produced 19 high resolution images of the Esquimalt Harbour sea floor (see **Appendix F: Side Scan Sonar Results**). From these images, seafloor features were identified, including (**Figure 3.3**):

- Two large areas (>100 m wide) of wood waste (i.e., sunken logs) north of Inskip Island and into Plumper Bay, and south of Cole Island
- Two smaller areas of wood waste (<50 m wide), one near the mouth of Thetis Cove and one in southeast Plumper Bay
- Subtidal rocky outcrops through the Harbour
- Numerous unidentified targets such as anchor blocks, a wreck, and other anthropomorphic debris
- Bathymetric elevations

Side scan sonar data illustrated that visible surficial wood waste (logs and wood waste debris) are mainly distributed in areas of wood waste previously identified (Archipelago 2004; **Appendix D**, **Figure 8**); however, logs identified on the side scan sonar imagery did not appear as dense as those identified during Archipelago (2004) video tow surveys. Since the majority of log booming and sorting operations ceased in the late 1990’s, and no log removal efforts have occurred, sediment movements within the Harbour may have resulted in the deposition of sediment over the wood waste.

NOTES

1. ON 30 AUGUST 2016, TERRA REMOTE SENSING INC (TRSI) CONDUCTED A SIDE SCAN SONAR SURVEY OF THE ESQUIMALT HARBOUR. DATA WERE COLLECTED FROM FROM ASH HEAD NORTH TO COLE I. THE AREA NORTH OF COLE ISLAND DRIES AT LOW TIDE AND WAS TOO SHALLOW TO COLLECT REASONABLE SIDE SCAN DATA, PARTICULARLY WHEN THE SEABED IS VISIBLE AT LOW TIDE.
2. POSITION AND HEADING DATA WERE COLLECTED USING A HEMISPHERE VS-111 GPS. DIFFERENTIAL CORRECTORS WERE RECEIVED FROM RICHMOND COAST GUARD BEACON. GPS DATA WERE RECORDED AT ONE SECOND INTERVALS TO TRSI's PROPRIETARY NAVIGATION AND DATA LOGGING SOFTWARE *RTC*.
3. SIDE SCAN SONAR DATA WERE COLLECTED USING AN EDGETECH 4200 DUAL FREQUENCY SYSTEM TOWED NEAR THE WATER SURFACE. THE DATA WERE COLLECTED AT 50 METRE HORIZONTAL SCAN RANGE (100 METRE SWATH) AT BOTH 300 AND 900 KHZ. DATA WERE LOGGED TO JSF AND XTF FORMAT USING DISCOVER SOFTWARE AND PROCESSED USING SONAR WIZ. WHERE SHOWN, SIDE SCAN IMAGERY (900 KHZ) DEPICTS HIGHER SEABED REFLECTIVITY AS LIGHTER (WHITE), AND LOWER SEABED REFLECTIVITY (IE. ACOUSTIC SHADOWS) AS DARKER (BLACK).
4. BATHYMETRIC DATA WERE COLLECTED ALONG THE SIDE SCAN LINES USING A KNUDSEN 320M SINGLE BEAM ECHOSOUNDER WITH A 200 KHZ - 6 DEGREE BEAM-WIDTH TRANSDUCER.
5. WATER LEVELS DURING THE BATHYMETRIC DATA COLLECTION WERE COLLECTED USING RTK GPS.
6. THE SHORELINE AND LAND FEATURES SHOWN ON THE DRAWINGS ARE FROM CHS ECN DATA.

REVISIONS

NO	REMARKS	DATE	TRADE	INDEP CHKD	DFTG	DFTG CHKD	INSPD	REV	ACPT
0	Submitted in Final	27 Oct 2016	EXISTING CONDITIONS	KK	KK	MR	client	TA	TA
A	Submitted in draft	16 Sept 2016	EXISTING CONDITIONS	trsi	KK	MR	client	client	client

SURV	KK,TCB	30Aug2016
PROCD	KK	31Aug2016
DFTG	KK	1Sept2016
CHKD	MR	16Sept2016
INSPD		
REV		
ACPT		

GENERAL NOTES

Equipment
Survey vessel: *Doppler*
Surface Positioning: Hemesphere VS111 GPS
Navigation/Acquisition Software: RTC(TRSI)
Bathymetry: Knudsen 320M, 200kHz - 8° beam
Morphology and Stratigraphy: EdgeTech 4200

Drawing Parameters
Projection: UTM Zone 10N Datum: NAD83
Central Meridian (CM): 123°W
Scale Factor at CM: 0.9996
False Easting: 500000 False Northing: 0
Vertical Datum: LLWLT (Chart Datum)

CLIENT
HEMMERA

TERRA REMOTE SENSING INC.
1962 Mills Road
Sidney, BC Canada
V8L 5Y3
Ph: (250) 656-0931
Fax: (250) 656-4604
Web: www.terraremote.com

PROJECT
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

TITLE
Side Scan Sonar Results
- with contoured bathymetry -

DWG NO
CAD
R
SHT NO. 3.3

TRSI PROJECT No.: 000-2795

T:\PROJ-Marine\000-2795 Hemmera - Esquimalt BC\Drawings\2795 Hemmera Esquimalt Harbour.dwg, Surficial Features - Sht 3, 27/10/2016 8:57:28 AM, Kelvin.Kopeck

3.2.1.2 Field Surveys

Surficial Extent

Visual SCUBA surveys within Esquimalt Harbour supported side scan sonar data, with areas of scattered logs (**Photo 1**), at times concentrated, or bark cover (**Photo 2**) observed in two areas: north of Inskip Island and reaching into Plumber Bay, and north of Smart Island (**Figure 3.4**). Areas of Esquimalt Harbour without wood waste were generally characterized by soft sediment with some minor drift marine vegetation (**Photo 3**). In comparison, surficial wood waste cover was not observed during any of the SCUBA surveys conducted in Pedder Bay (**Photo 4**).

The majority of surveyed areas within Esquimalt Harbour are categorized as having little to no visible surficial wood waste (0 – 5%; **Table 3.5**). Although a previous subtidal video survey by Archipelago (2004) covered a greater extent of the harbour (see **Appendix E**, **Figure 3**), due to different study objectives, the surveyed areas that fall outside of the Hemmera towed video and sampling areas (e.g. Constance Cove) were categorized as having little to no wood waste coverage (see **Appendix E**, **Figure 4**). Therefore, surveyed areas of minimal to high wood waste coverage (> 5%) mostly overlapped between the two studies. Since 2004, it appears that the percent cover of extremely high wood waste (>80%) has decreased and the area of moderate wood waste has increased (5 – 30%). Differences between the two studies may be due to variations in study area, but given the side scan sonar observations, are likely due to sedimentation burying wood waste deposits in areas of extremely high wood waste cover (>80%). Since net current velocities and rates of natural sedimentation in Esquimalt Harbour are quite low (< 0.003 m/second tidally averaged current velocities north of Inskip Island; Anchor QEA), burial of wood waste may be attributed to the resuspension and settlement of fine-grained sediments from Harbour activities, such as propeller wash and scour, or from the net influx of sediment from Juan de Fuca Strait (Burd 216, Geosea 2009).

Initial screening guidelines, outlined by Washington State (2013), to target potential areas of wood waste impacts use surficial cover of 5 – 25% wood waste to indicate a possible need for further investigation, while >25% (or 5% where wood waste is finer chips or sawdust) should be investigated further due to the adverse impacts to the benthic community (**Section 2.1.5.1**).

Table 3.5 Estimates of Surficial Wood Waste Cover on the Subtidal Seafloor of Esquimalt Harbour

Wood Waste Coverage (% cover)	Archipelago 2004		Hemmera 2017	
	Subtidal Area (ha)	% of Area Surveyed	Subtidal Area (ha)	% of Area Surveyed
0 – 5	225.7	77	136.53	66
5 - 30	19.5	7	48.91	24
30 - 80	11.0	4	19.19	9
>80	36.9	12	1.49	1
-	**293.10**	**100**	**206.12**	**100**

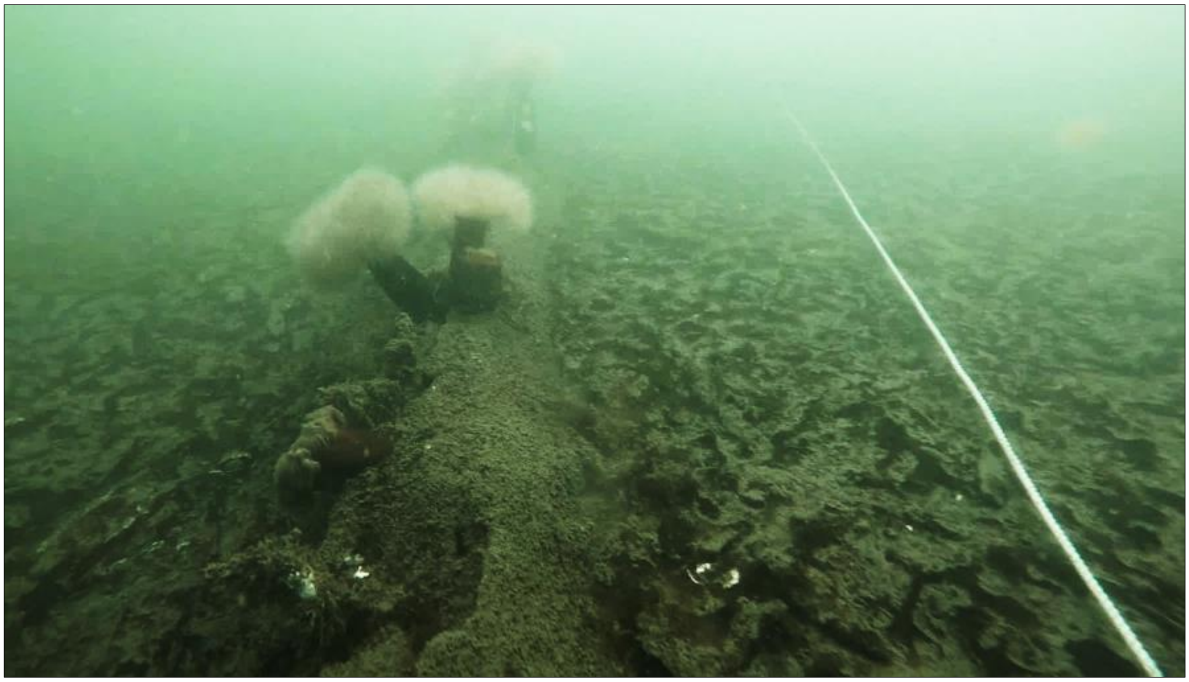
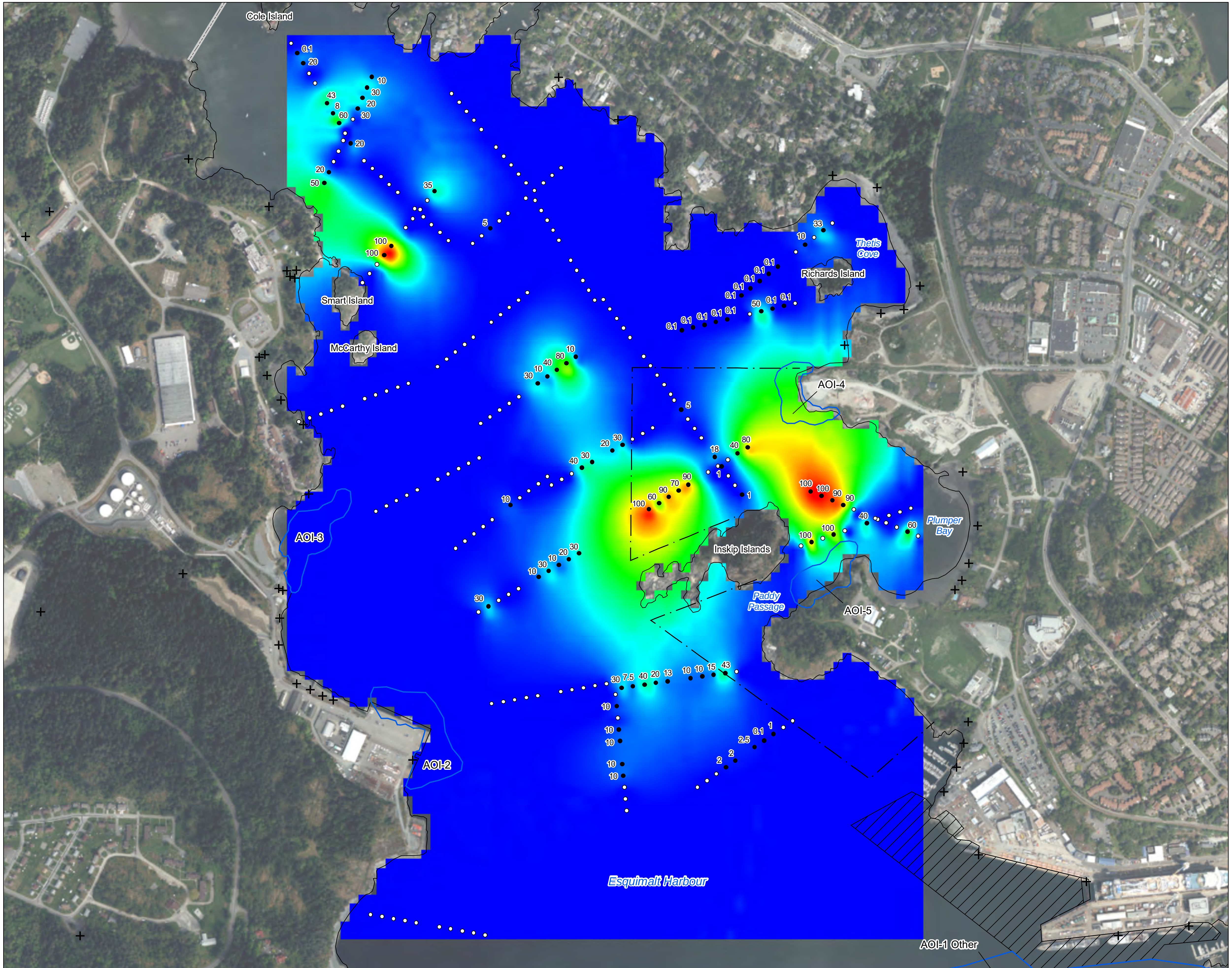


Photo 1 Representative view of a subtidal area in Esquimalt Harbour with scattered logs and fine layer of sediment and fine wood waste surrounded by bacterial mats

Photo 2 Representative view of a subtidal area in Esquimalt Harbour with continuous small woody debris and fine layer of sediment and fine wood waste

Photo 3 **Representative view of a subtidal area in Esquimalt Harbour containing a silty sand substrate with drift understory kelp, shell debris, and only very sparse detritus and small woody debris**

Photo 4 **Representative view of a subtidal area in Pedder Bay containing silty sand substrate, with drift understory kelps, and an active infauna community signified by observable mounds and siphons**



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Surficial Wood Waste Cover from SCUBA Surveys

Legend

- Sampling Location (Surficial Wood Waste Coverage = 0%)
- Sampling Location (Surficial Wood Waste Coverage >0%)
- 0.65 Surficial Wood Waste Coverage (%)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Wood Waste Coverage (%)
100
75
50
25
0

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Wood Waste Depth and Volume

Sediment cores (hand-held and sonic drill) showed variation in the stratification of wood waste and surficial sediment across the Harbour, with no wood waste observed in sediment cores from the Pedder Bay reference location (**Figure 3.5**; **Appendix G: Sediment Core Photo Examples**). To further visualize the distribution of wood waste across the harbour, cross sections were also developed from borehole logs (**Appendix H: Wood Waste Depth Cross Sections**).

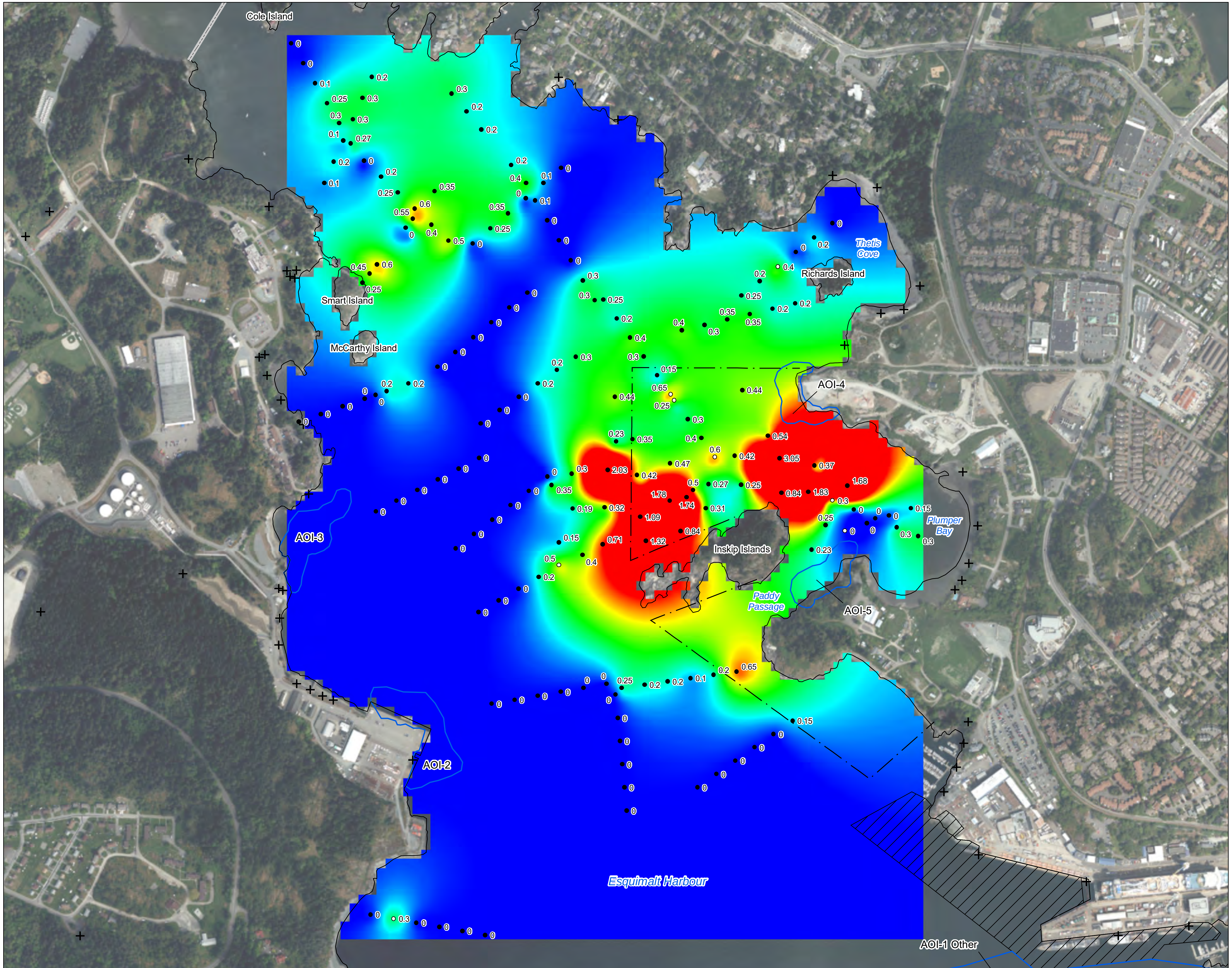
Overall, the wood waste observed below the sediment surface (i.e. not observable during SCUBA surveys) was greater than observable surficial cover (**Figure 3.4**), confirming that wood waste deposits in some areas of the Harbour have become mixed with, or covered by, varying depths of surficial sediments (**Figure 3.5**). The interpolated depth results confirmed that the two large areas of wood waste identified by side scan sonar, north of Inskip Island and south of Cole Island, are the areas with deepest wood waste deposits in Esquimalt Harbour (**Figure 3.5**).

Wood waste deposits in Esquimalt Harbour are characterized by small woody debris, primarily large amounts of bark with some finer wood debris (e.g. sawdust or woodfibre), with interspersed cut logs (**Table 2.1**). While previous studies (Archipelago 2004) and side-scan sonar results show the presence of scattered logs in areas of wood waste, the diameter of the hand-held core was too small to capture this information and logs were only encountered once during the drilling program, north of Inskip Island (Field Survey 6). Decomposition of wood waste was indicated by the presence of dark organic fine sediment in sediment cores containing decomposing wood waste (see examples in **Appendix G**). In areas containing wood waste, a variety of conditions were characterized during borehole logging:

- Organic sediment mixed with high volumes of wood waste (fibre and wood debris)
- Organic sediment mixed with trace to low volumes of wood waste (fibre and wood debris)
- Entirely consisting of small wood waste (fibre and wood debris)

In some boreholes, a mixture of the above conditions was present (e.g. organic sediment mixed with high levels of wood waste overlying a layer entirely consisting of small wood waste before transitioning to native silt/sand sediment). The nature of the wood waste in Esquimalt Harbour is consistent with the extensive log storage activities that occurred until the late 1990's, and the log sort and sawmills located in Thetis Cove and the headland at the Ralmax facility near Plumper Bay (**Section 2.4**). Wood waste deposits transitioned to underlying bedrock or native sediment, which was typically light grey to grey/brown silt/ sand with some shell debris/ shell hash, eventually reaching native clays (in areas where the sonic-drill reached these depths (see examples in **Appendix G**).

The total volume of wood waste and overlying impacted sediments in Esquimalt Harbour is estimated to be 332,299 m^3, with the deeper wood waste deposits (>0.25 m) calculated to be 227,819 m^3 north of Inskip Island and 31,182 m^3 south of Cole Island.



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Wood Waste Depth from Core Samples

Legend

- ● Sampling Location (Bottom depth of wood waste was reached during sampling)
- ○ Sampling Location (Bottom depth of wood waste was not reached during sampling)
- 0.65 Sampled Wood Waste Depth (m)
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Wood Waste Depth (m)

- 0.69 - 2.65
- 0.52
- 0.35
- 0.17
- 0

Notes

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3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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3.2.2 Biophysical Assessment

Biophysical results from all field surveys were summarized to determine impacts of wood waste on the marine benthic community (see **Appendix I: Raw Field Observations and Sediment Chemistry Data).**

3.2.2.1 Physical Characteristics

The subtidal area of Esquimalt Harbour that was surveyed was characterized primarily by unconsolidated soft sediments (mean percent cover silt = 82%, sand = 12%). Small debris wood waste and logs were observed overlying sediments in two areas within the Harbour as identified in **Section 3.2.1** above. Similar to Archipelago's survey in 2004, in shallow surveyed areas outside of the wood waste deposits, sediments were more consolidated and contained higher quantities of gravel/sand: Thetis Cove (Transect 14), immediately adjacent to Cole Island (Transect 7) and in the outer Harbour (Transect 45; Archipelago 2004)). Recent work by Anchor QEA determined that deeper areas of the Harbour are generally characterized by fines, with coarser grained sediment in pockets that may have been stripped of fines by tidal currents and propeller wash. Three small patches of rocky reef habitat, surrounded by soft sediments, were observed in the outer Harbour (Transect 45/46; **Figure 3.1**).

In Pedder Bay sediments were more consolidated and had higher sand content than most of the areas surveyed in Esquimalt.

3.2.2.2 Water Quality Results

Both Esquimalt Harbour and Pedder Bay are tidally driven, with low volume freshwater inputs and low wave exposure (**Section 2.2**). In Esquimalt Harbour, dissolved oxygen and pH near sea bottom was characterized as being moderate (DO % mean = 78.9, SD = 6.8) and (pH mean = 7.9, SD = 0.08), with similar conditions in Pedder Bay (DO % mean = 77.14, SD = 4.68) and (pH mean = 7.7, SD = 0.14). Since conditions are comparable and Pedder Bay did not contain any surficial wood waste, or deposits of wood waste, water quality at or near the SWI in Esquimalt does not appear to be impacted by wood waste.

3.2.2.3 Benthic Community

Epibenthic Community

Esquimalt Harbour epibenthic communities were similar to those documented by Archipelago (2004). The epibenthic community in Esquimalt Harbour was relatively sparse, with several common soft bottom species observed throughout survey areas, such as: Dungeness crabs (*Metacarcinus magister*), graceful crab (*Metacarcinus gracilis*), shrimp (*Pandalus spp*.), and hermit crabs (*Pagurus spp*.). White bacterial mats (e.g. *Beggiatoa spp.*) appear common throughout the inner Harbour area (**Photo 5**, **Figure 3.6**) and are inversely distributed with diatomaceous mats. Diatomaceous mats were observed more commonly from mid-Harbour to the outer Harbour area (**Photo 6**, **Figure 3.7**). Similarly, Archipelago (2004) documented concentrated bacterial mats in areas of highest organic debris, such as Plumper Bay. Bacterial mats are commonly associated with coastal sediments containing high organic content (Amend et al. 2004), such as wood waste, and will outcompete naturally occurring diatom mat communities. Fewer areas with white bacterial mats were observed during surveys conducted in winter months, likely due to increased levels of oxygen at the SWI, or the first few centimeters of the sediment, allowing for the bacteria to migrate into the sediment with the change in the oxygen-sulphide transition zone (for further explanation see **Section 2.1.3**). Similar to Archipelago (2004) marine vegetation was sparse to absent in soft bottomed areas and areas with surficial wood waste cover and consisted solely of drift senescent understory kelps (e.g. *Saccharina latissima* and *S. groenlandica*). Although eelgrass (*Zostera marina*) beds occur in the Harbour, they were not observed in the project area.

Areas with hard structure (e.g. exposed logs and rocky reef habitat) were colonized by typical encrusting and hard substrate organisms. Rocky reef habitat was colonized by coralline algae (*Corallina* spp), ochre stars (*Pisaster ochraceus*), barnacles (*Balanus glandula*), and red sea urchins (*Strongylocentrotus fransicanus*) (**Photo 7**), while exposed logs provided substrate for plumose anemones (*Metridium senile)*, hydroids (Phylum Cnidaria, Class Hydrozoa) and tunicates (subphylum Tunicata; **Photo 1** and **Photo 8**). Areas with high structural complexity also attracted recruiting fish communities of black rockfish (*Sebastes melanops*) (e.g. **Photo 8**).

In comparison, Pedder Bay transects (Transect 21 – 26) had greater presence of shrimp (*Pandalus* sp.) and contained a higher coverage of drift senescent kelps (e.g. *S. latissima* and *S. groenlandica*), *Sarcodietheca gaudichaudii*, and diatoms (**Photo 4**). Bacterial mats were not observed along any of the transects surveyed in Pedder Bay.

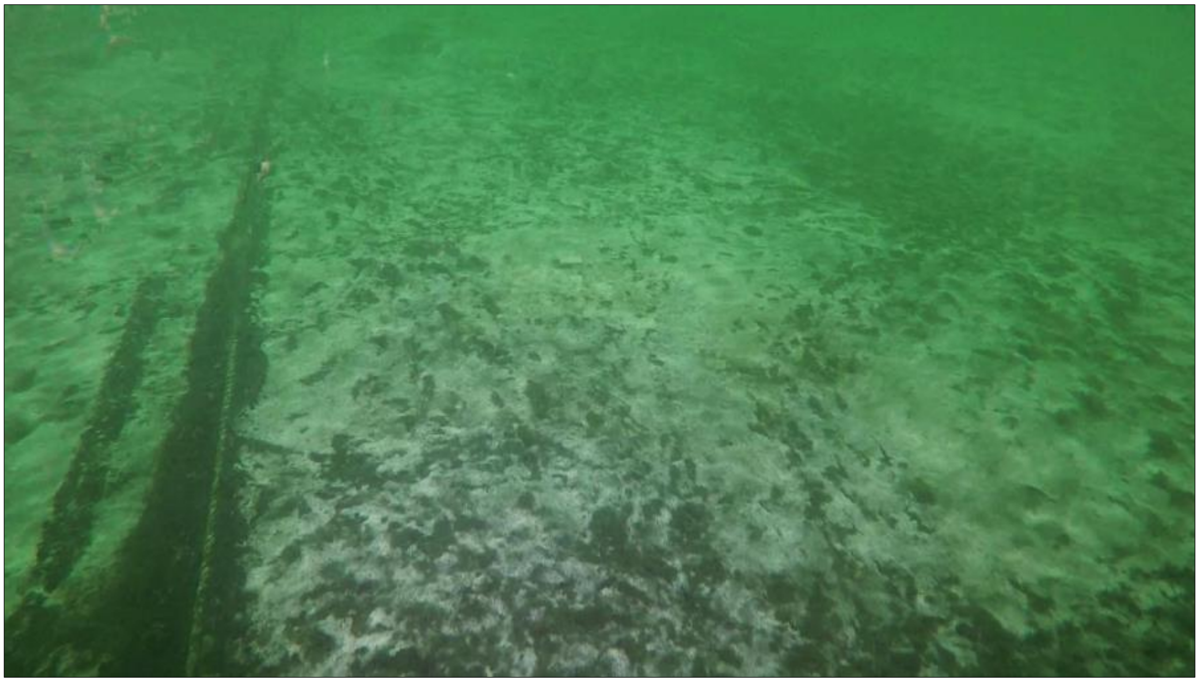


Photo 5 Representative view of a subtidal area in Esquimalt Harbour with fibre mat intermixed with silt and *Beggiatoa* bacterial mat

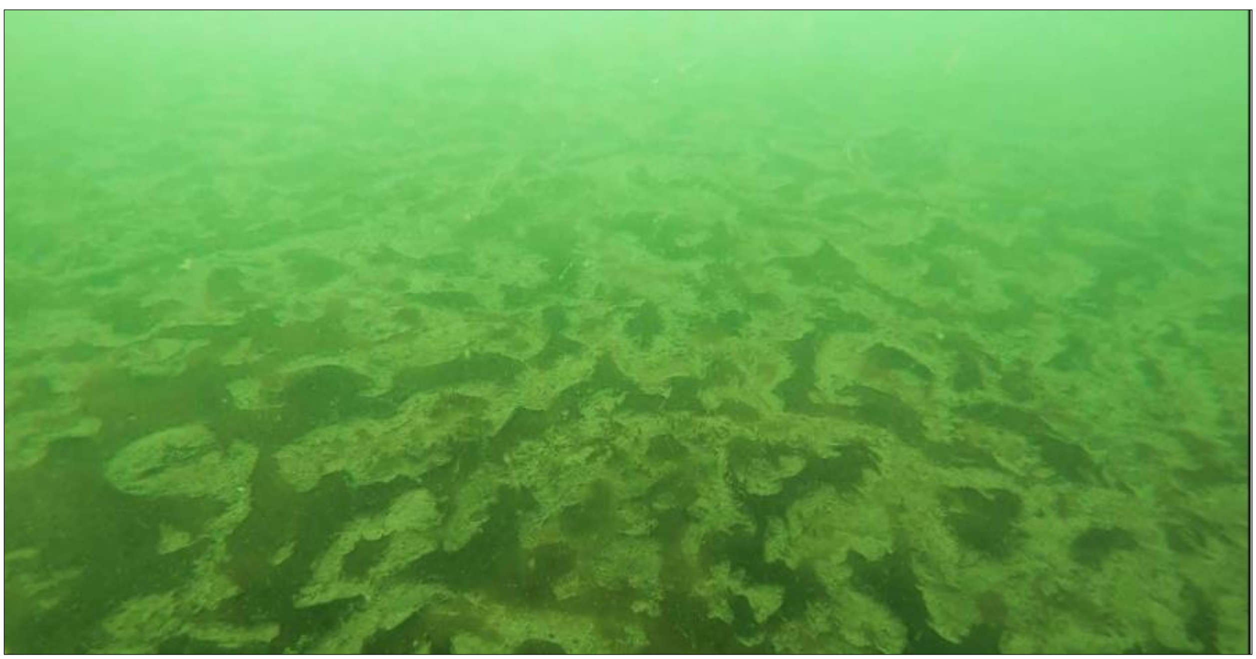


Photo 6 Representative view of a subtidal area in Esquimalt Harbour with silty substrate and a mix of diatoms and *Beggiatoa* bacterial mat

Photo 7 Rocky habitat with encrusting species including a red sea urchin

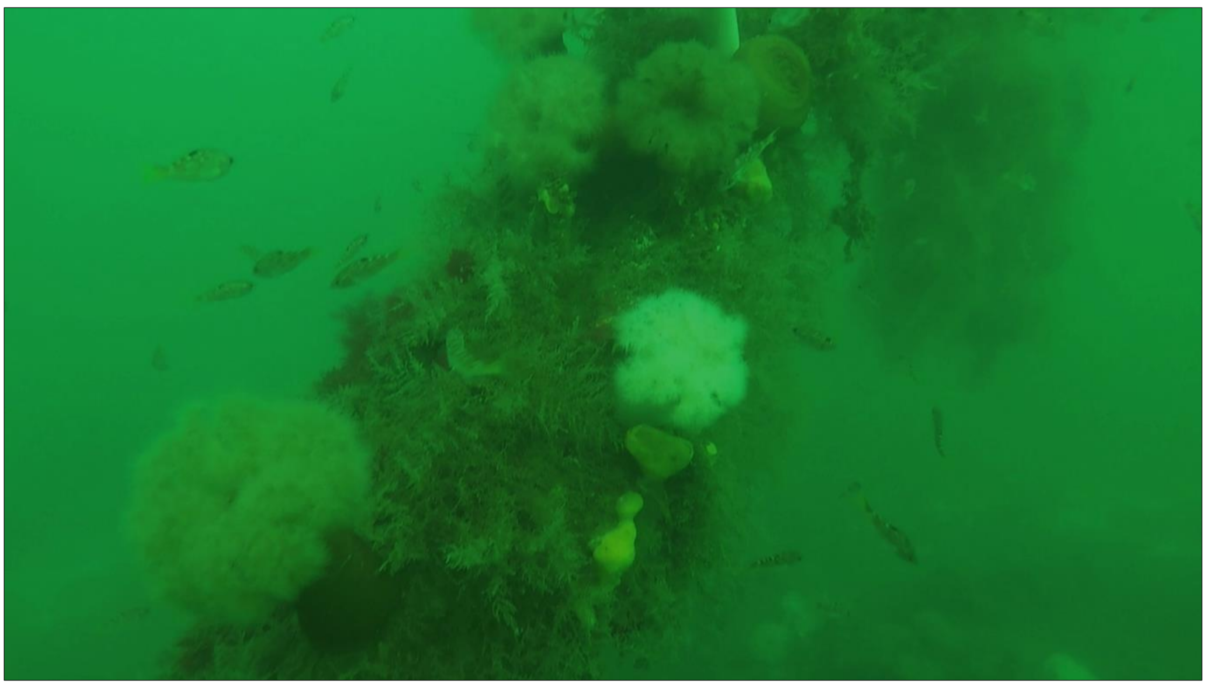
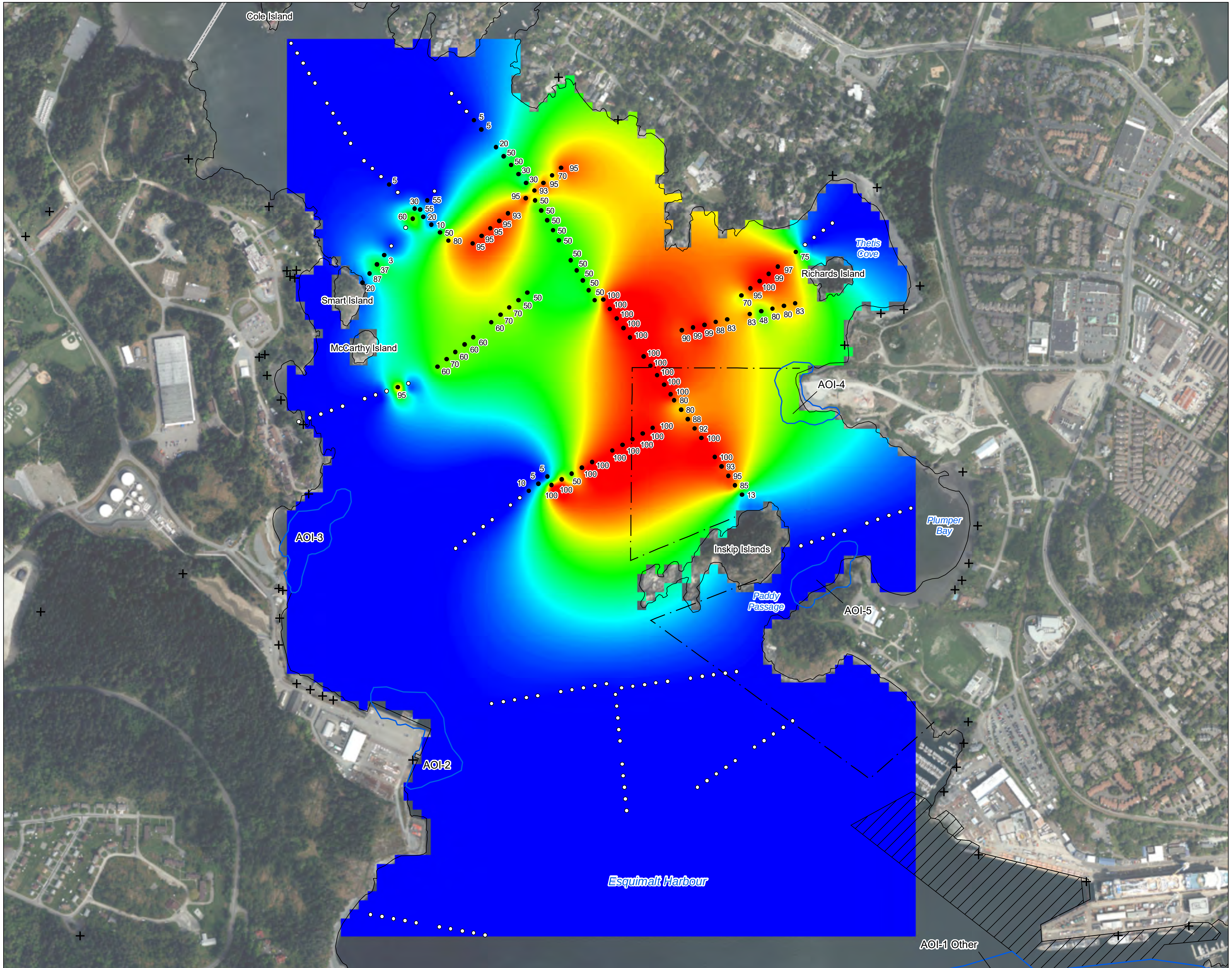


Photo 8 Exposed log covered in plumose anemones and diatoms, surrounded by young of the year black rockfish



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Beggiatoa Coverage

Legend

- ○ Sampling Location (Beggatoea Coverage = 0%)
- ● Sampling Location (Beggiatoa Coverage >0%)
- 75 Sampled Beggiatoa Coverage (%)
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Beggiatoa Coverage (%)
100
75
50
25
0

Notes

1. Locations should be considered approximate.
2. All locations were sampled for beggatoea coverage; however, only sampled coverages greater that 0% have been been labelled.
3. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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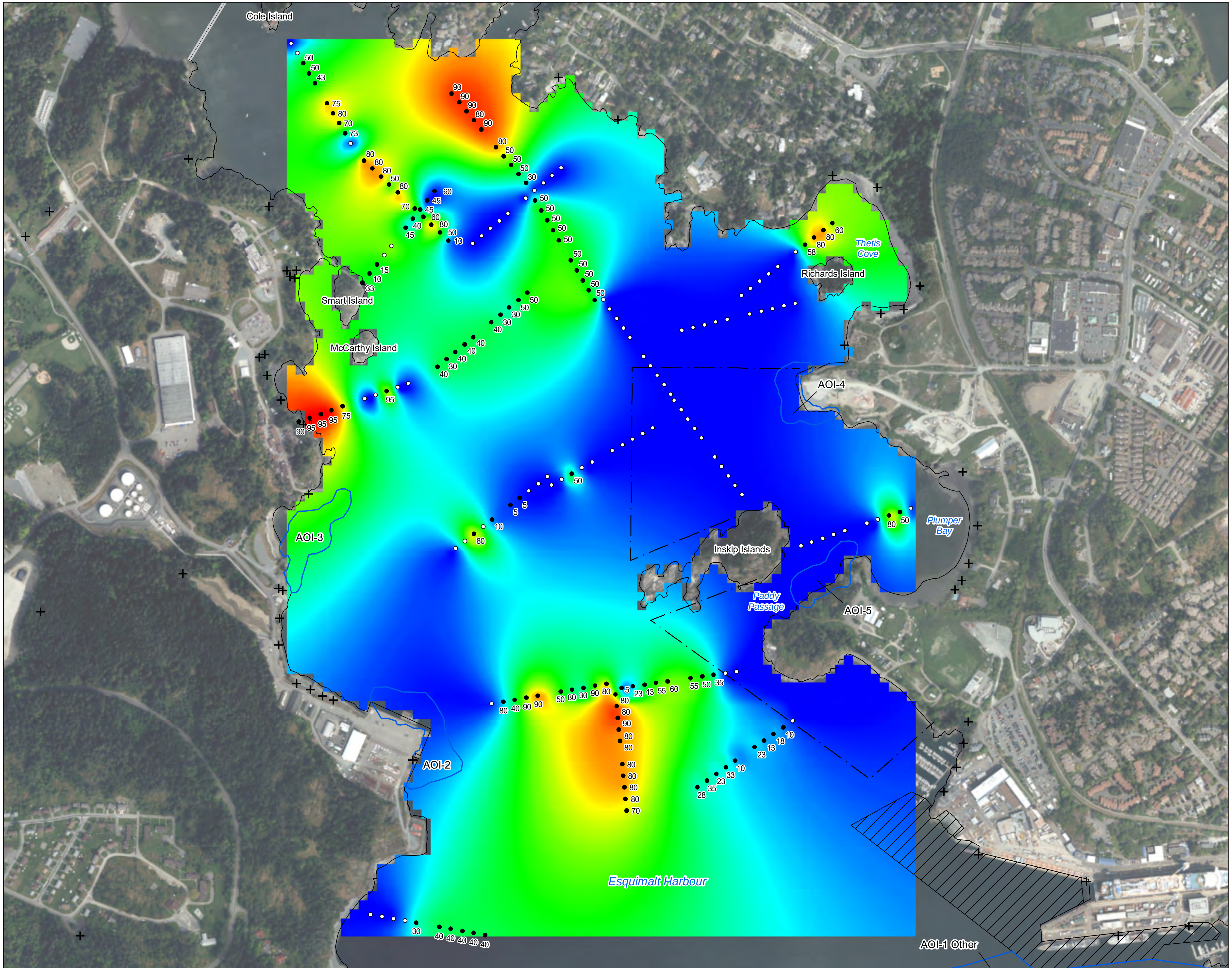

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Diatom Coverage

Legend

- ○ Sampling Location (Diatom Coverage = 0%)
- ● Sampling Location (Diatom Coverage >0%)
- 75 Sampled Diatom Coverage (%)
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Diatom Coverage (%)
95
75
50
25
0

Notes

1. Locations should be considered approximate.
2. All locations were sampled for diatom coverage; however, only sampled coverages greater that 0% have been been labelled.
3. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

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Infauna Observations

Infauna holes and mounds, generally indicative of burrowing shrimps, worms and bivalves, were relatively absent from most transects. Archipelago (2004) documented patchy occurrences of infaunal burrows in areas outside of known wood waste deposits and an absence of holes and mounds in wood waste areas (**Appendix E**, **Figure 18**). In comparison, Pedder Bay had a higher incidence of holes and mounds (**Photo 4**).

Benthic infauna data from fourteen paired benthic invertebrate sample locations within Esquimalt Harbour were summarized to examine variation among sample locations (see Benthic Infauna Stations **Figure 3.1**). The distribution of abundance, species richness, species diversity and evenness indices, and relative abundance of dominant taxa are presented in **Table 3.6** (complete benthic infauna data available in **Appendix I**).

Both abundance and species richness varied across sample locations with a high of 1321 individual organisms and 44 species for location BI-14 Rep 02 and a low of 13 individuals and 3 species at location BI-04 Rep 02 (**Figure 3.1** and **Table 3.6**). The number of species contributing to the 75% total abundance ranged from 1 to 10 across sample stations (**Table 3.6**). Species composition was also variable across sample locations with most stations dominated by a single second-order opportunistic polychaete species (*Armandia brevis*) and two other second-order opportunistic species dominating at the remaining stations (*Prionospio **(**Minuspio**)** lighti* and *Aphelochaeta glandaria* complex; **Table 3.6** and **Figure 3.8**). Sample locations furthest from wood waste deposits (i.e. sample locations closer to the mouth of the harbour and furthest inside the harbour) had higher diversity metrics.

Table 3.6 Benthic Infauna Community Summary Statistics by Sample Location and Level of TOC

Sample ID	Replicate	Wood Debris Indicator	Quantity	Diversity				Dominant Species	Relative Proportion (%)
		TOC	Total Abundance (N)	Species Richness (S)	Shannon Diversity Index (H')	Pielou's Evenness (J')	Swartz's Dominance Index (SDI)		
BI – 1	**01**	85,000	125	15	1.75	0.65	1	*Armandia brevis*	89
	02		95	16	2.24	0.81	1	*Armandia brevis*	91
BI – 2	**01**	63,000	128	11	1.41	0.59	5	*Armandia brevis*	38
	02		68	11	1.57	0.65	4	*Prionospio (Minuspio) lighti*	53
BI – 3	**01**	55,000	249	16	1.31	0.47	1	*Armandia brevis*	90
	02		183	17	1.70	0.60	1	*Armandia brevis*	85
BI – 4	**01**	41,000	19	9	1.98	0.90	2	*Armandia brevis*	65
	02		13	3	0.54	0.49	4	*Prionospio (Minuspio) lighti*	22
BI – 5	**01**	21,000	668	27	2.06	0.62	1	*Armandia brevis*	90
	02		310	35	2.91	0.82	2	*Armandia brevis*	69
BI – 6	**01**	19,000	516	13	0.55	0.22	7	*Ampharete.labrops*	29
	02		375	5	0.38	0.24	6	*Prionospio (Minuspio) lighti*	22
BI – 7	**01**	23,000	267	20	1.99	0.66	2	*Aphelochaeta glandaria* complex	53
	02		659	26	1.82	0.56	3	*Aphelochaeta glandaria* complex	46
BI – 8	**01**	25,000	187	4	0.38	0.28	1	*Armandia brevis*	69
	02		408	11	0.66	0.28	5	*Prionospio (Minuspio) lighti*	42
BI – 9	**01**	18,000	234	15	1.43	0.53	2	*Aphelochaeta glandaria* complex	55
	02		291	23	2.26	0.72	3	*Aphelochaeta glandaria* complex	48
BI – 10	**01**	18,000	230	8	0.48	0.23	4	*Armandia brevis*	53
	02		196	13	1.13	0.44	5	*Armandia brevis*	31
BI – 11	**01**	9,800	513	28	2.43	0.73	2	*Armandia brevis*	51
	02		844	43	2.53	0.67	2	*Armandia brevis*	47
BI – 12	**01**	39,000	817	39	1.70	0.46	2	*Armandia brevis*	62
	02		952	43	1.88	0.50	3	*Armandia brevis*	56
BI – 13	**01**	25,000	72	12	1.29	0.52	5	*Armandia brevis*	26
	02		71	12	1.70	0.68	1	*Armandia brevis*	85
BI – 14	**01**	15,000	991	33	1.50	0.43	5	*Aoroides intermedia*	30
	02		1321	44	1.89	0.50	10	*Tectidrilus.sp.*	15

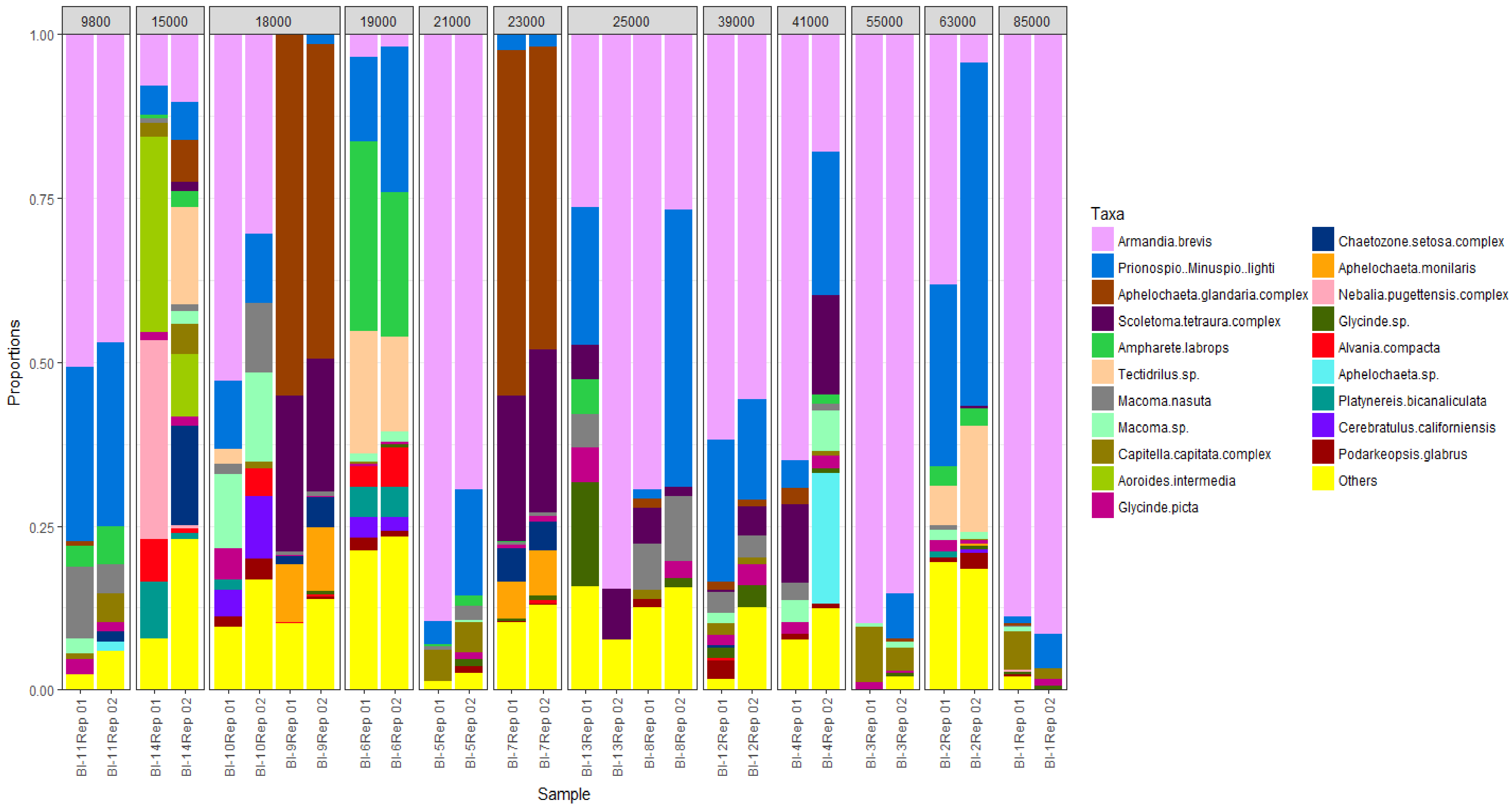


Figure 3.8 **Relative proportion of each Taxonomic Group by Sample Station, Replicate, and TOC Level**

3.2.3 Sediment Chemistry

The analysis of sediment chemistry parameters focussed on wood waste degradation by-products commonly associated with wood waste deposits (TOC, pore water sulphides and ammonia). Raw results by sampling station can be found in **Appendix I.**

3.2.3.1 TOC

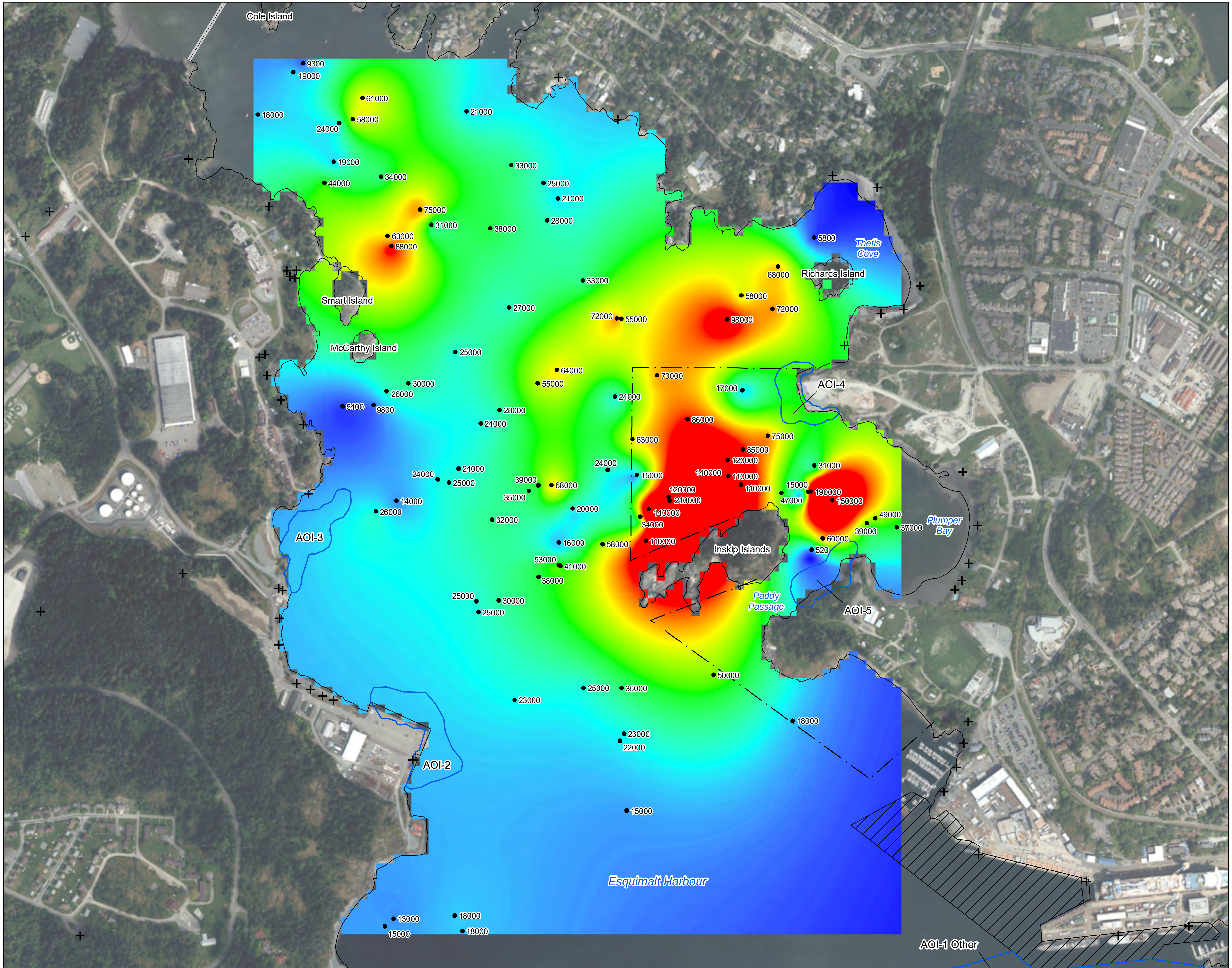
Naturally elevated levels of organic carbon are found associated with productive habitats in nearshore coastal ecosystems that generate high levels of detrital organic material, such as eelgrass beds and kelp beds. However, organic enrichment of nearshore environments also occurs from anthropogenic activities, such as the aquaculture industry, sewage outfalls, and wood waste deposits (**Section 2.1.3**). To interpret TOC measurements, it is necessary to determine if site-specific levels are naturally elevated, using nearby reference locations, or if anthropogenic activities are contributing (e.g. locations of aquaculture tenures, storm water outfall locations, log handling and storage tenures, etc).

TOC measurements within the Harbour ranged from 5,400 to 204,000 mg/L while in Pedder Bay measurements ranged from 1,600 to 8,700 mg/L (**Figure 3.9** and **Figure 3.10**). Elevated TOC measurements within Esquimalt Harbour do not appear correlated with storm-water outfall locations but overlap with the identified areas of wood waste deposits (**Figure 3.5** and **Figure 3.8**). There are no known, or active, log handling/storage tenures or aquaculture facilities in proximity to Pedder Bay or Esquimalt Harbour; however, the Jones Marine Lease Area within the Harbour may occasionally be used to store log booms.

When comparing against TOC screening-level indicators for benthic impairment (**Section 2.1.4**), most of the area covered by the interpolated TOC distribution (200.6 ha) fell within the intermediate (1 – 3%) and high (>3%) impact ranges. In the area of wood waste deposit north of Inskip Island and into Plumper Bay (**Figure 3.**5) TOC values ranged from 33,000 mg/L or 3.3% to 210,000 mg/L or 21% (**Table 3.7**, **Figure 3.9**). TOC values within the wood waste deposit north of Smart Island (**Figure 3.5**) ranged from 21,000 mg/L or 2.1% to 88,00 mg/L or 8.8% (**Table 3.7**, **Figure 3.9**). A few areas in the Harbour were below the 1% TOC screening-level indicator for little to no impairment, including Thetis Cove, adjacent to Cole Island and the western shoreline south of McCarthy Island (**Table 3.7**, **Figure 3.9**). All samples collected at the out-of-Harbour reference location (Pedder Bay) were below 1% or low chance of benthic impairment (**Figure 3.10**).

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Total Organic Carbon



Legend

- Sampling Location
- 5400 Sampled Total Organic Carbon (mg/L)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

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3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Page Size: 11" x 17"

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Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Pedder Bay Interpolated
Total Organic Carbon Concentration

Legend

● Sampling Location

5400 Sampled Total Organic Carbon Concentration (mg/L)

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

- Aerial Image: Capital Regional District, 2015

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Metres

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Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure 3.10

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Table 3.7 Estimates of Subtidal Seafloor Area by TOC Screening-Level Indicators of Benthic Impairment in Esquimalt Harbour

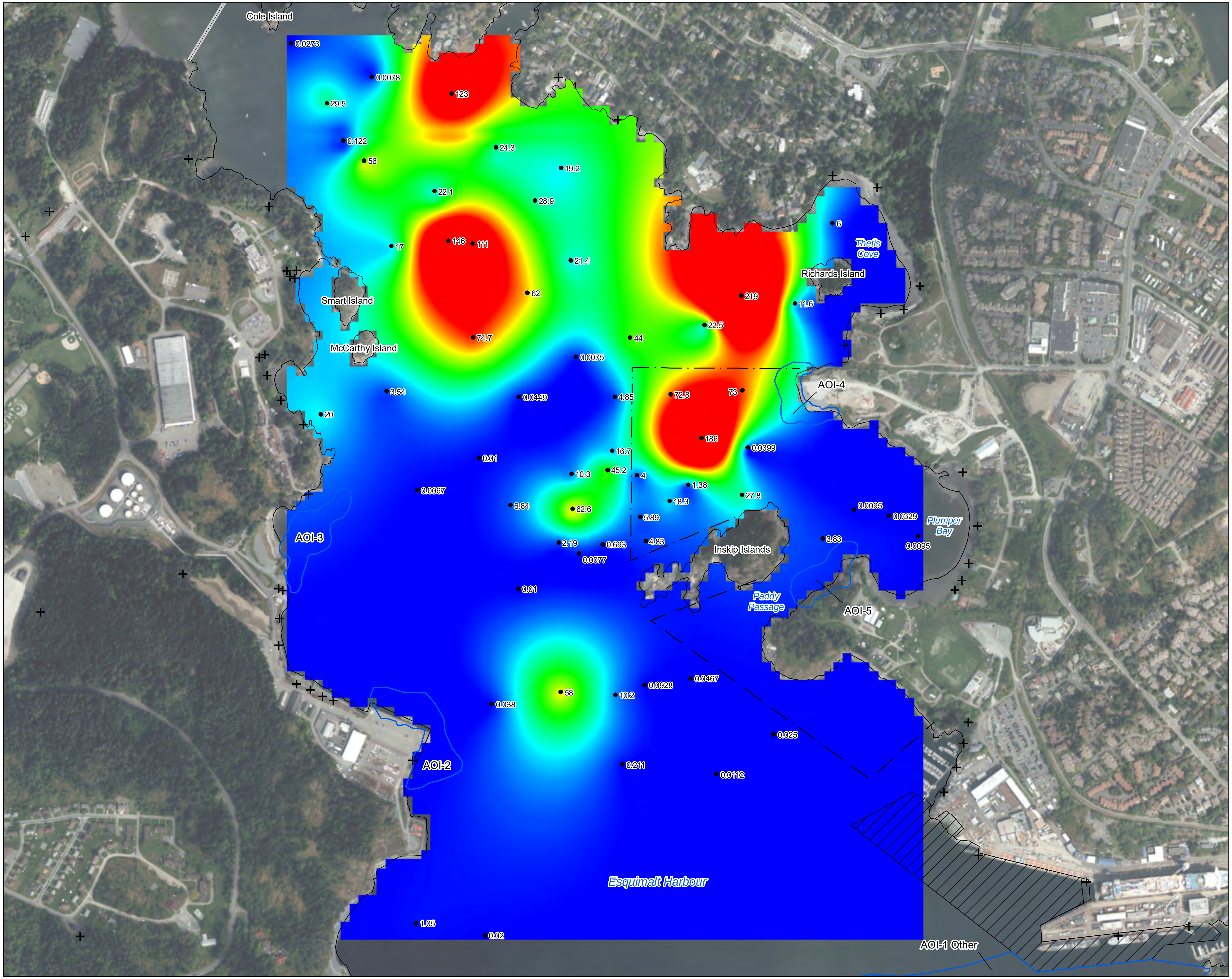
TOC Screening Level (%)	Benthic Impairment	Study Area	
		Area (ha)	% of Area
0 – 1	Low	14.4	7
1 – 3	Intermediate	98.4	49
>3	High	87.9	44
-	-	200.6	100

3.2.3.2 Sulphides

Pore-water sulphides are a by-product of bacterial wood waste decomposition in an anaerobic environment (**Section 2.1.3** and **Figure 2.1**) and may provide an additional indicator of wood waste impacts (Washington State 2013).

Pore-water sulphides in Esquimalt Harbour ranged from 0.01 to 219 mg/L and from 0.01 to 13.1 mg/L at Pedder Bay reference location (**Figure 3.11**). The Detailed Quantitative Ecological Risk Assessment to Support Environmental Risk Management in Esquimalt harbour (SLR 2016) reported pore-water sulphides in a similar range (0.0062 to 161 mg/L) across Esquimalt Harbour sediments and concluded that it may be occurring at concentrations high enough to affect benthic infauna. Results of a bioassay and follow-up study with the amphipod, *Rhepoxynius abronius,* suggested that toxicity (i.e. increased mortality) was observed at pore-water concentrations > 10mg/L and that elevated concentrations of pore-water sulphides are contributing to sediment toxicity in the Harbour.

While there is some overlap of higher sulphide measurements with identified areas of wood waste deposits, some sample locations with higher sulphide measurements are not correlated with known areas of wood waste (**Figure 3.5** and **Figure 3.11**). This may indicate that sulphide levels could be driven by other factors within the harbour. However, accurate pore-water sulphide measurements can also be difficult to obtain as hydrogen sulphide readily oxidizes into less toxic forms when sediment becomes disturbed and volatilization occurs during sampling, transport, and storage (Washington State 2013, Azimuth 2017). Given the pore-water sulphide results, sulphides may not be the best indicator of wood waste-associated impacts to the benthic community.



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Sulphide Concentration

Legend

- Sampling Location
- 22.5 Sampled Sulphide Concentration (mg/L)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Sulphide Concentration (mg/L)

78 - 210
59
39
20
0

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure 3.11

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3.2.3.3 Ammonia

Ammonia is a by-product of bacterial wood waste decomposition in an anaerobic environment (**Section 2.1.3** and **Figure 2.1**) and may provide an additional indicator of wood waste impacts (Washington State 2013).

Ammonia ranged from 2.0 to 67.5 mg/L in Esquimalt Harbour, while at the Pedder Bay reference location it ranged from 7.0 to 19.8 mg/L (**Figure 3.12**). The interpolated distribution of ammonia shows more overlap with the distribution of wood waste and elevated levels of TOC than pore-water sulphides, with two areas of elevated measurements (**Figure 3.5**, **Figure 3.8** and **Figure 3.12**).

3.2.3.4 pH

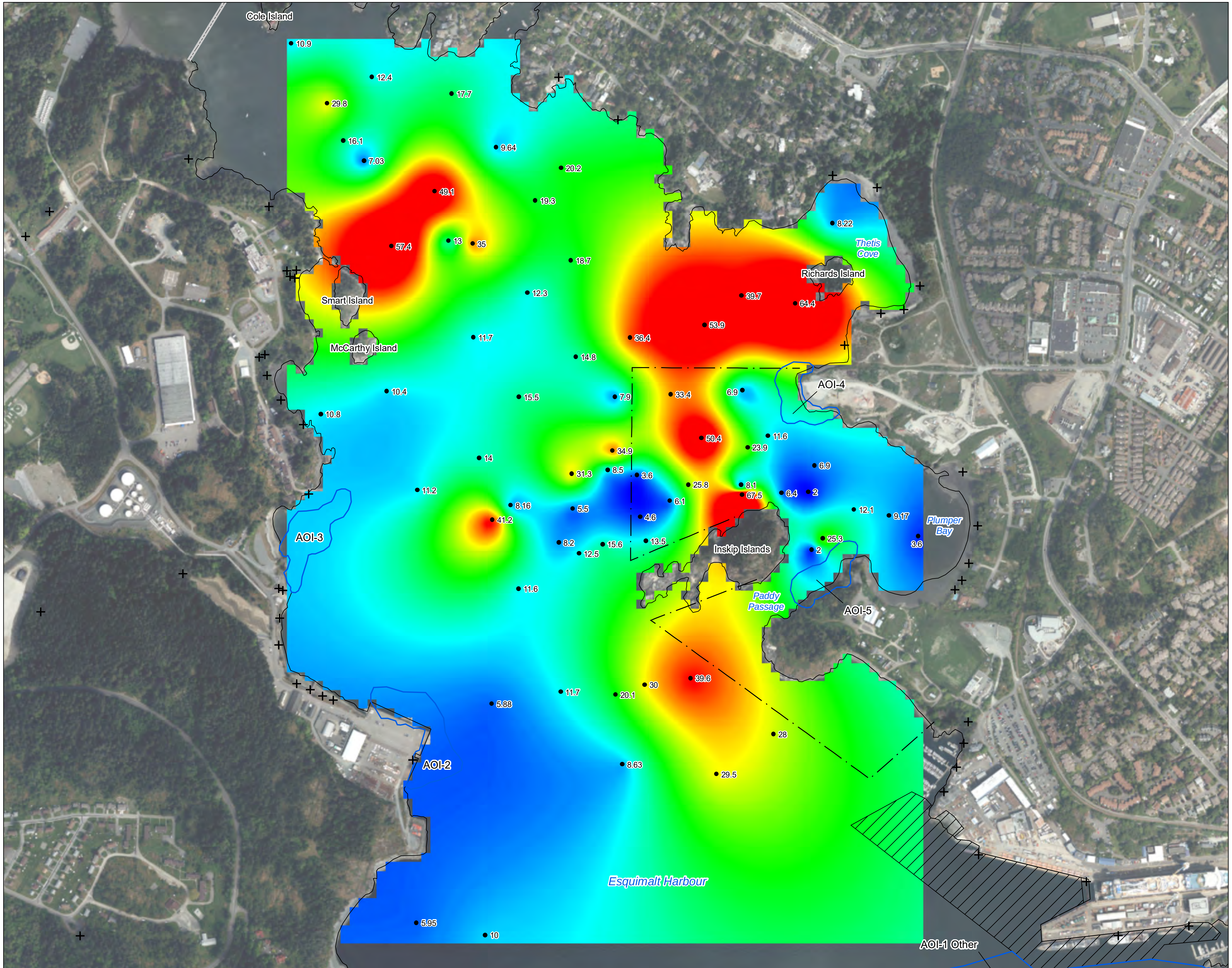
A lower sediment pH will increase the concentration of the more toxic un-ionized forms of sulphide (H2S) and ammonia (NH3) and should be considered in the sediment chemistry analysis when identifying areas impacted by decomposition by-products of wood waste.

Sediment pH in Esquimalt Harbour ranged from 7.02 to 8.27 and from 7.91 to 8.24 at Pedder Bay reference location (**Figure 3.13**). While the range experienced in Esquimalt Harbour sediments is within the range observed in Canadian coastal waters (**Section 2.1.3**), pH was lower (<7.91) in certain areas of Esquimalt Harbour than in all Pedder Bay samples.

While it is variable, the interpolated distribution of sediment pH does show some overlap with the distribution of wood waste, in particular surficial coverage of wood waste (**Figure 3.4** and **Figure 3.13**). The area of deeper wood waste deposits immediately north of the western end of Inskip Islands (**Figure 3.5**) exhibits consistently lower pH values (<7.7).

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated Ammonia Concentration



Legend

- Sampling Location
- 39.7 Sampled Ammonia Concentration (mg/L)
- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Ammonia Concentration (mg/L)

39 - 63
30
21
12
2

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Page Size: 11" x 17"

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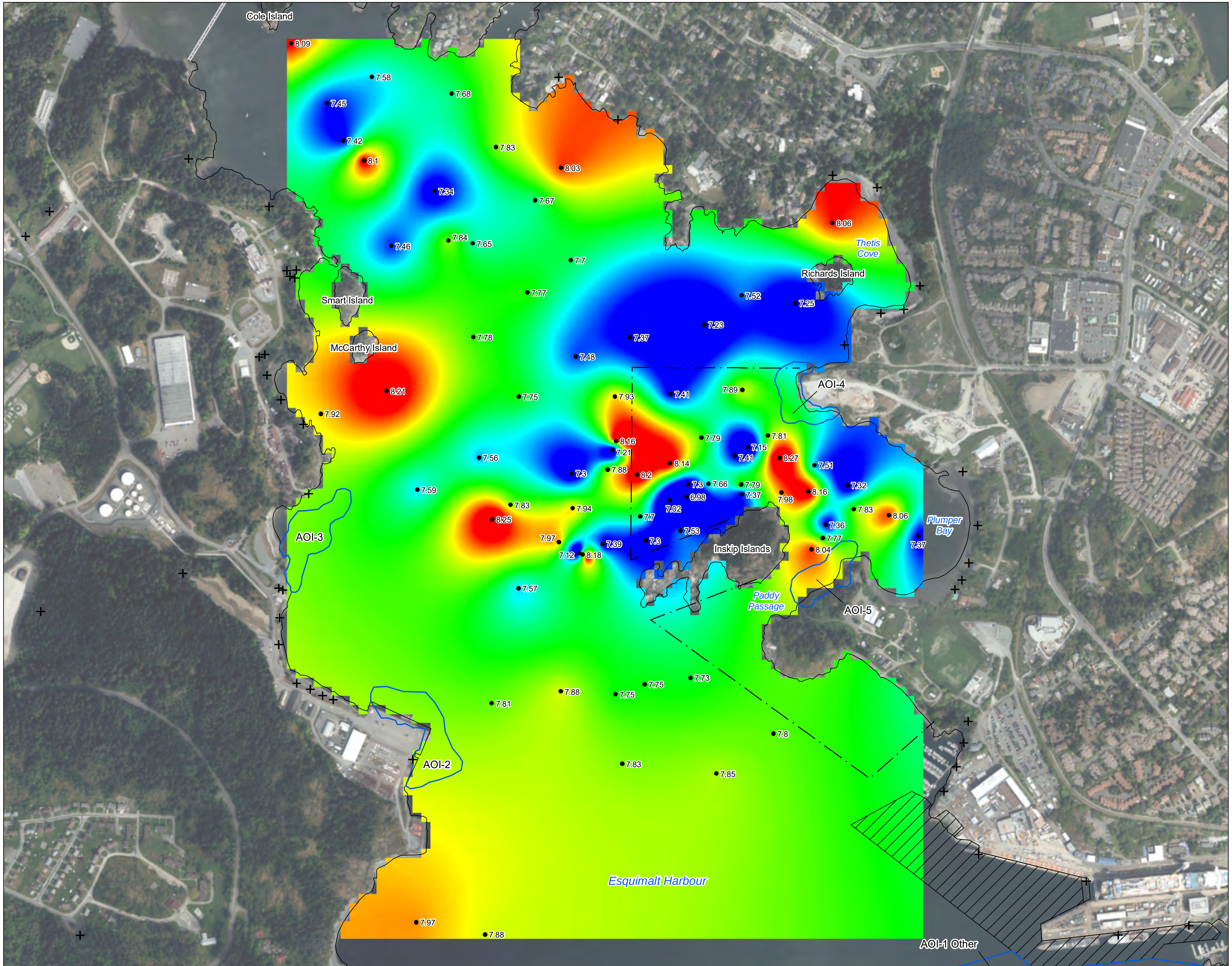

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Interpolated pH Concentration

Legend

- ● Sampling Location
- 7.23 Sampled pH Concentration
- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

pH Concentration

8.06 - 8.20
7.91
7.75
7.60
7.02 - 7.44

Notes

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Metres

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3.3 Wood Waste Impact Analysis

3.3.1 Wood Waste Delineation

Observable surficial wood waste cover ranged from 0 to 100% across surveyed areas of Esquimalt Harbour (**Figure 3.4**). The majority of the surveyed areas of the Harbour (66%; **Table 3.5**) had little to no wood waste cover (0 – 5 %), with 24% of the surveyed area covered by 5 – 30% wood waste, indicating the need for further investigation of impacts (using Washington State's initial screening guidelines, **Section 2.1.5.1**), and 10% of the study area covered by > 30% wood waste, indicating it is likely to have adverse impacts on the benthic community.

The area of wood waste deposits was greater than the observable surficial coverage (**Figure 3.5**), indicating that in some areas wood waste has become mixed with fine sediments or partially covered. However, notable sedimentation overlying wood waste deposits was not observed in most areas of the harbour.

3.3.2 Sediment Chemistry

Wood waste depth was a good predictor of the four sediment chemistry parameters measured (TOC, ammonia, sulphide, and pH). All regression models had significant spatial autocorrelation and required spatial models to best describe the linkages between the predictor variable, wood waste depth, and the dependent chemical variables. TOC exhibited the strongest linkage with wood waste depth (R-squared 0.54 and coefficient value of 75,528; **Table 3.8**). Ammonia and pH were also strongly linked to wood waste depth (R-squared 0.37 and 0.40, and coefficient values of 42.93 and -/082 respectively; **Table 3.8**). Pore-water sulphides had the weakest linkage to wood waste depth (R-squared 0.11 and coefficient value 88.63).

Table 3.8 Spatial Regression Model Combinations and Outputs for Wood Waste Depth as an Independent Variable

Independent Variable	Dependent Variable	Coefficient	Std. Error	z-value	Probability	R-squared	Regression
Wood Waste	TOC	75528.3	16709.7	4.52	<0.001	0.54	Spatial Lag
Wood Waste	Ammonia	42.93	9.38	4.57	<0.001	0.37	Spatial Lag
Wood Waste	pH	-0.82	0.15	-5.24	<0.001	0.40	Spatial Lag
Wood Waste	Sulphide	88.63	34.73	2.55	<0.001	0.11	Spatial Lag

3.3.3 Benthic Community

3.3.3.1 Epibenthic

Although a variety of epibenthic species were observed during field surveys, the epibenthic community in Esquimalt Harbour was dominated by the following groups or organisms: bacterial mats (*Beggiatoa* spp.), diatom mats, and sugar kelp (*Saccharina latissimia*; **Table 3.9**). Given that TOC can be used as an indicator of the percentage of wood waste present in the sediment (Washington 2013), four categories of TOC were used to examine differences in the composition of the epibenthic community. Since there are no developed thresholds of benthic community impact for wood waste, thresholds need to be developed on a site-specific basis. TOC categories were based on the TOC screening-level indicators for benthic impairments (**Section 2.1**): Pedder Bay reference (<1%TOC), in harbour <1% TOC, 1-3% TOC, and >3% TOC). Differences between the categories were identified to be statistically different (P = <0.001) and pairwise tests between each were conducted to determine differences (**Figure 3.14**). The epibenthic community for all three in-harbour TOC categories was significantly different from the Pedder Bay reference location (P = 0.05; **Table 3.9**). Within Esquimalt Harbour no statistical difference was determined between the in-harbour low TOC and intermediate TOC (P = 0.898), indicating the epibenthic community in each was relatively similar and dominated by a high abundance of diatoms (**Table 3.9**). A statistical difference occurred between the in-harbour low TOC and the high TOC areas (P = 0.01) due to the high abundance of *Beggiatoa* sp. bacterial mats associated with areas of wood waste (**Figures 3.5** and **Figure 3.6**; **Table 3.9**) while diatom mat distribution showed an inverse relationship, although slightly less consistent, with bacterial mats (**Figure 3.6 and Figure 3.7**).

Table 3.9 Dominant Epibenthic Species Observed at each of the Four TOC screening-level indicators for benthic impairments

Species	Mean Abundance	Contribution to Group Similarity
Pedder Bay Reference <1% TOC		
Diatoms	68.53	71.56
Drift *Saccharina latissima*	29.83	15.27
Drift *Saccharina groenlandica*	22.33	9.21
In Harbour <1% TOC		
Diatoms	59.55	96.97
In Harbour 1 to 3% TOC		
Diatoms	57.57	94.37
In Harbour >3% TOC		
Beggiatoa spp.	43.04	59.10
Diatoms	27.68	39.19

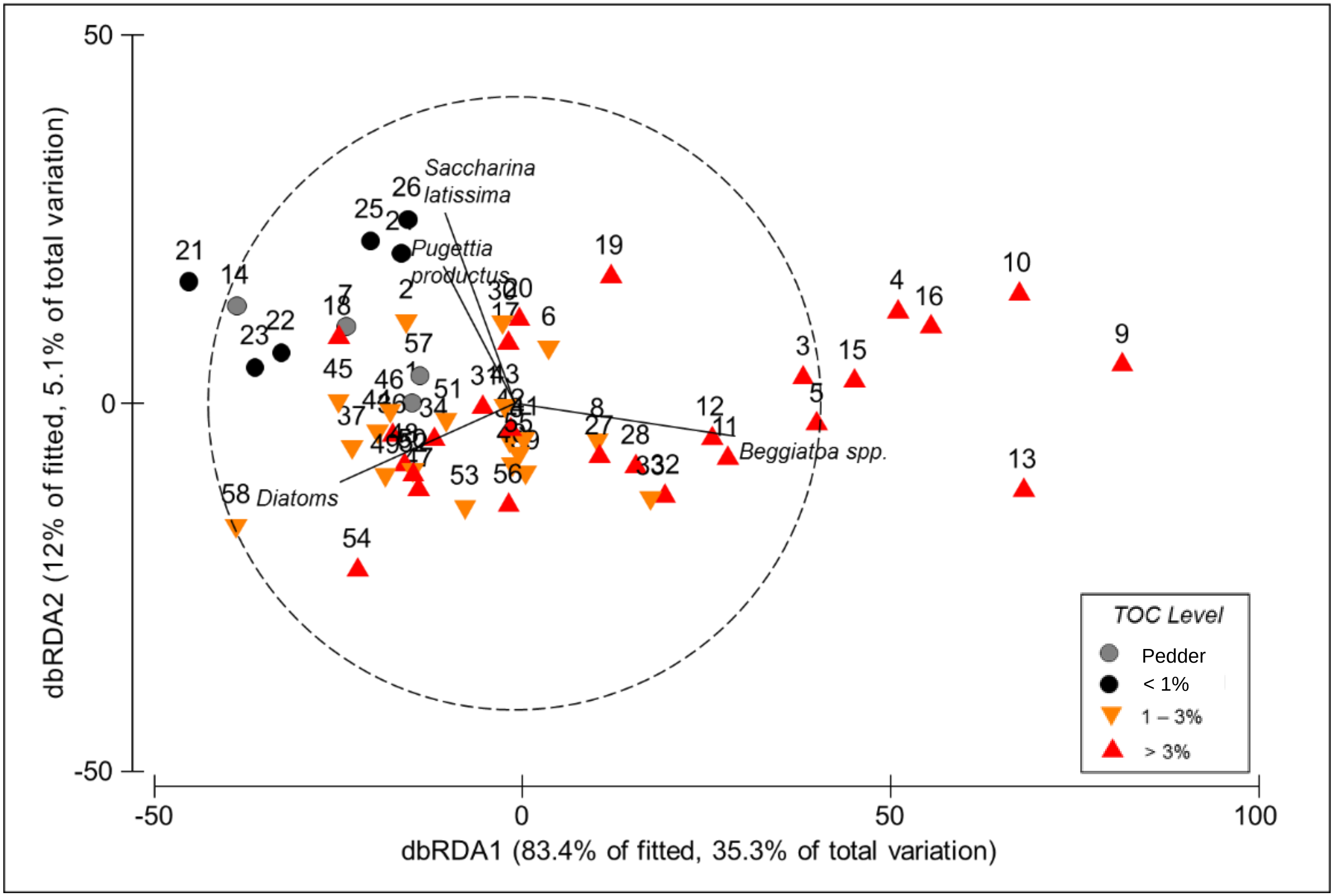


Figure 3.14 **Distance-based redundancy analysis showing the relative similarity among sample locations of differing TOC Screening-level Indicators and the dominant species.**

While all four sediment chemistry parameters were considered predictors of bacterial mat coverage, TOC and sulphide were the strongest predictors (R-squared 0.60 and 0.49 and coefficients 0.0007 and 0.26 respectively; **Table 3.10**). *Beggiatoa* sp. is known to be associated with high levels or organic carbon, requires sulphides to produce energy, and occurs at the oxygen-sulphide transition zone (Amend et al. 2004, Pearson 1980, Jørgensen 1977, Muβmann et al. 2003). Due to its strong correlation with TOC and areas of wood waste deposits, the presence of *Beggiatoa* sp. can be considered an indicator of benthic community impairment from wood waste deposits.

Table 3.10 Spatial Regression Model Combinations and Outputs for Bacterial Mat Coverage as a Dependent Variable

Independent Variable	Dependent Variable	Coefficient	Std. Error	z-value	Probability	R-squared	Regression
TOC	Bacteria	0.0007	0.0002	4.15	<0.001	0.60	Spatial Lag
Sulphide	Bacteria	0.26	0.08	3.17	<0.001	0.49	Spatial Lag
pH	Bacteria	-43.15	18.97	-2.28	0.023	0.41	Spatial Lag
Ammonia	Bacteria	0.49	0.29	1.69	0.091	0.40	Spatial Lag

Other epibenthic species observed during field surveys included Dungeness and graceful crabs and shrimp. A wood waste study in Port Angeles Harbour concluded that areas of sparse, scattered, small wood debris on the sediment surface, offshore of log booming areas, provided habitat for mobile epibenthic organisms such as shrimp, crabs, and fish as long as overlying water quality was not impacted (SAIC 1999).

Large wood debris (e.g. cut log piles) have also previously been shown to function as suitable epi-benthic habitat (SAIC 1999). Both these results and those of SAIC (1999) demonstrate that logs provide hard substrate for the colonization by sessile rocky reef organisms, such as plumose anemones, and rockfish (*Sebastes* spp.) use the logs as habitat. However, the benefits of large woody debris as habitat for epibenthic communities can come at the expense of the benthic infauna community, due to smothering and decomposition creating anaerobic conditions (discussed in **Section 2.1**; SAIC 1999).

Although sparse, epi-benthic species common to nearshore marine ecosystems were present, especially in areas where epibenthic organisms were separated from the sediment-water interface (e.g. log piles). Evidence of extensive *Beggiatoa* sp. bacterial mats indicate some degree of benthic impairment, which requires analysis of the infauna community to determine the nature and extent.

3.3.3.2 Infauna Community

Benthic infauna community composition and species richness were influenced by all three of the wood waste decomposition by-products investigated (TOC, pore-water sulphides, and ammonia). TOC and ammonia were significant drivers (TOC $p = 0.002$, Ammonia $p = 0.008$) of community composition among sample locations while there was greater variation in the relationship between community composition and porewater sulphides (p = 0.18; **Table 3.11**). All three sediment chemistry parameters were significantly correlated with species richness (**Table 3.12**); however, TOC had the strongest relationship with the least variability (correlation -0.63).

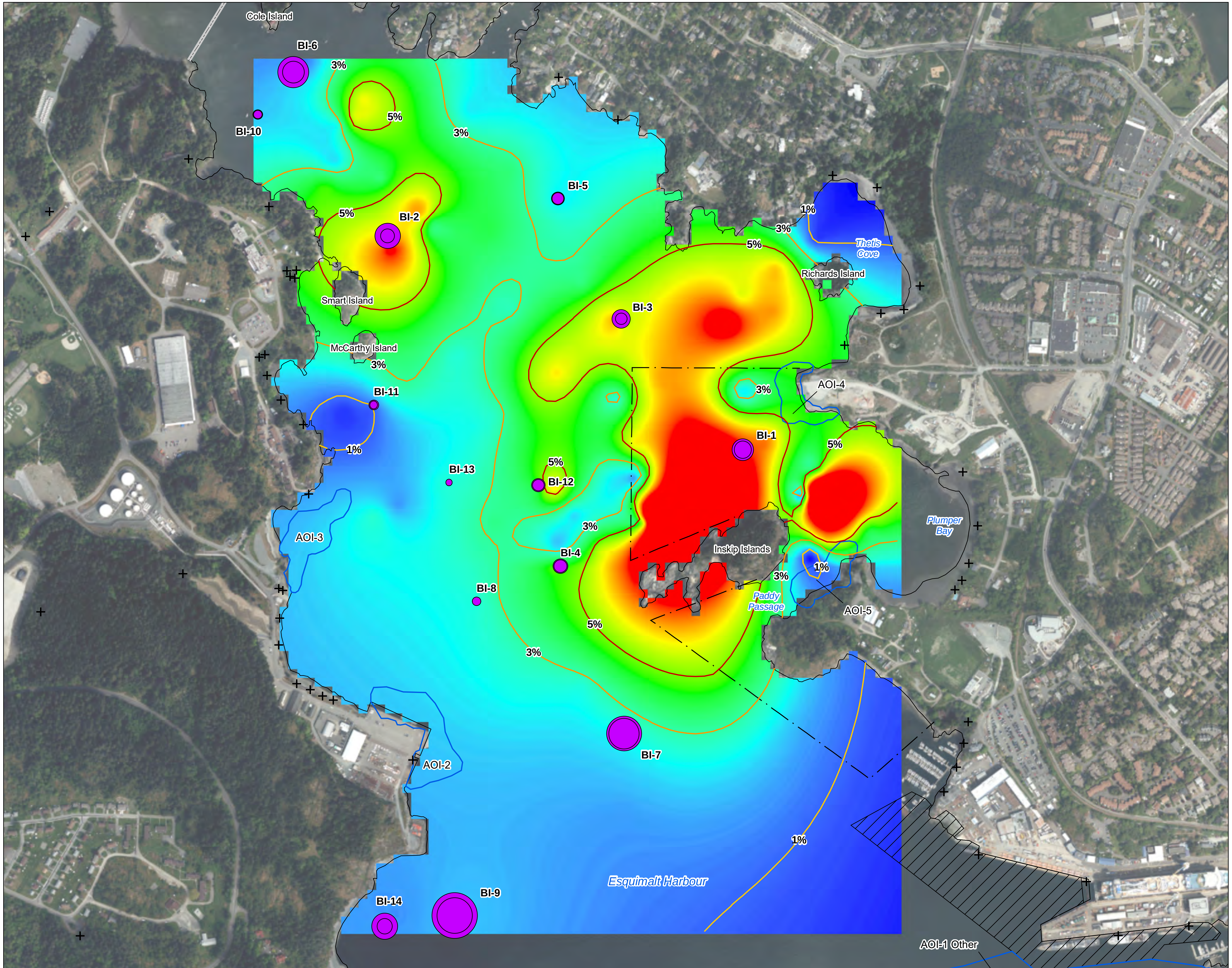
Table 3.11 CCA Model Output of Community Composition as a Function of Wood Waste Decomposition By-products

Sediment Chemistry Parameter	Df	Sum of Squares	R-squared	p-value
TOC	1	0.90	0.11	0.002
Pore-water sulphides	1	0.37	0.04	0.18
Ammonia	1	0.76	0.09	0.008
Residual	24	6.24	0.75	-
Total	27	8.27	1.00	-

Table 3.12 Linear Model Outputs and Correlation Values of Species Richness as a Function of Wood Waste Decomposition By-products

Sediment Chemistry Parameter	Estimate	Standard Error	t-value	p-value	Correlation Value
Intercept	24	2.4	10.3	<0.001	-
TOC	-0.0003	0.0001	-4.5	0.001	-0.63 **
Pore-water sulphides	-4.96E-01	0.2	-2.9	0.01	-0.35
Ammonia	5.17E	0.2	3.0	0.01	-0.22

As described in **Section 2.1**, impacts of wood waste depend on both the nature and extent of the wood waste as well as the site-specific conditions. Therefore, screening-level indicators (**Section 2.1.5.**1) for potential impairment can be used to guide wood waste assessments but site-specific thresholds should be developed to determine impairment and management options. Since TOC is the sediment chemistry parameter most strongly linked with known areas of wood waste deposits (**Figure 3.5** and **Figure 3.9**) and to differences in benthic infauna community composition and species richness, it was chosen as the best decomposition by-product to use for the establishment of site-specific thresholds for areas of impairment of the benthic infauna community. A global meta-analysis conducted by Hyland et al (2005) proposes a screening-level indicator of intermediate benthic infauna impairment between 1 – 3.5% TOC. While results of the benthic infauna analysis show increased variability in the distribution of community composition and species diversity between 1 – 3% TOC in Esquimalt Harbour, the strength of the relationship for these moderate levels of TOC is unclear. A 3% TOC level is more consistent with the distribution of benthic infauna community composition and species diversity among samples stations and is considered the site-specific indicator for determination of impairment of benthic infauna due to wood waste deposits (**Figure 3.15** to **Figure 3.19**).



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Total Abundance by Sample Location

Legend

- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Total Abundance (N)

13 1321

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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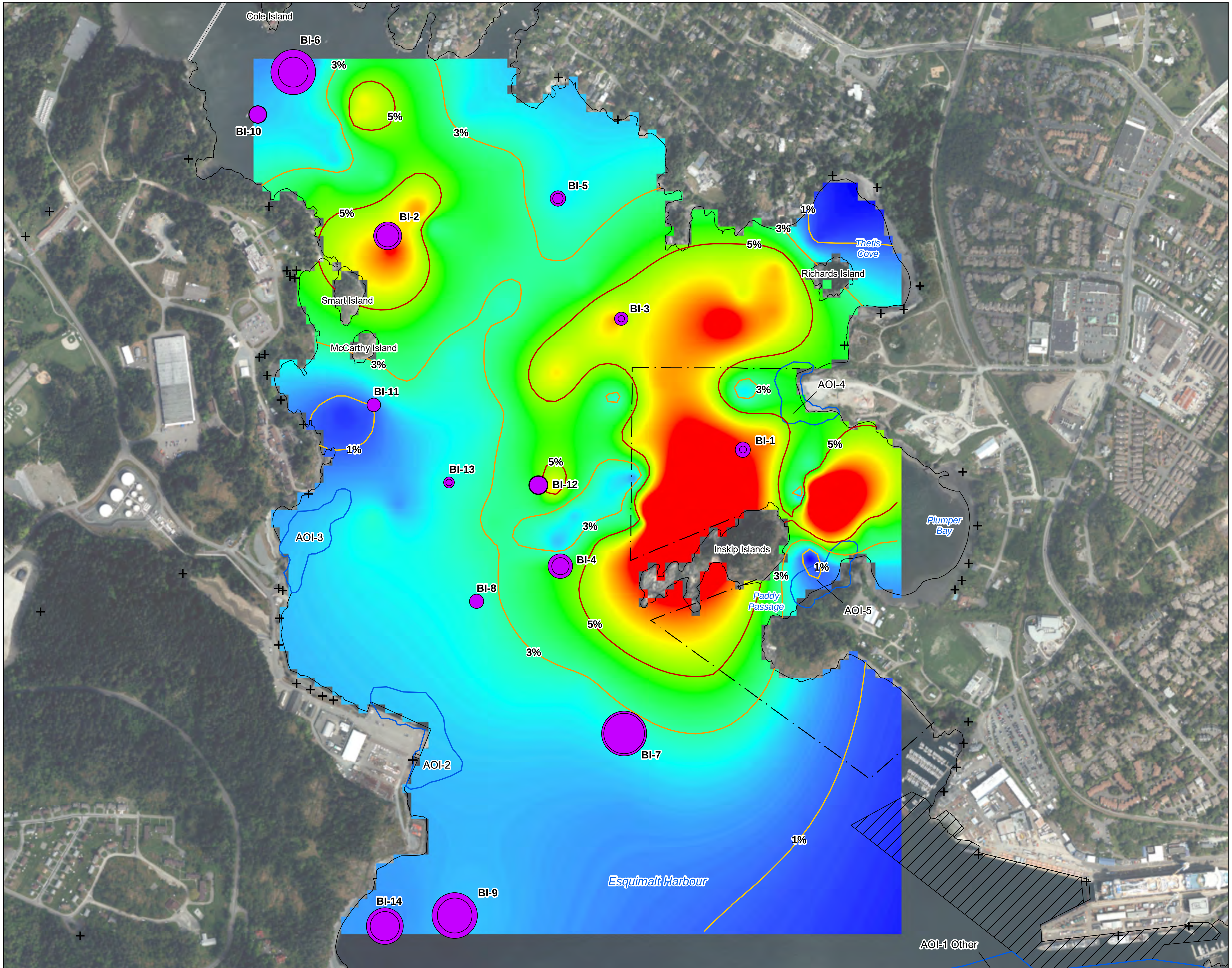
Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Species Richness by Sample Location



Legend

- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Species Richness (S)

3 — 44

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

- 79,700 - 204,000
- 60,200
- 40,700
- 21,100
- 1,600

Notes

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Metres

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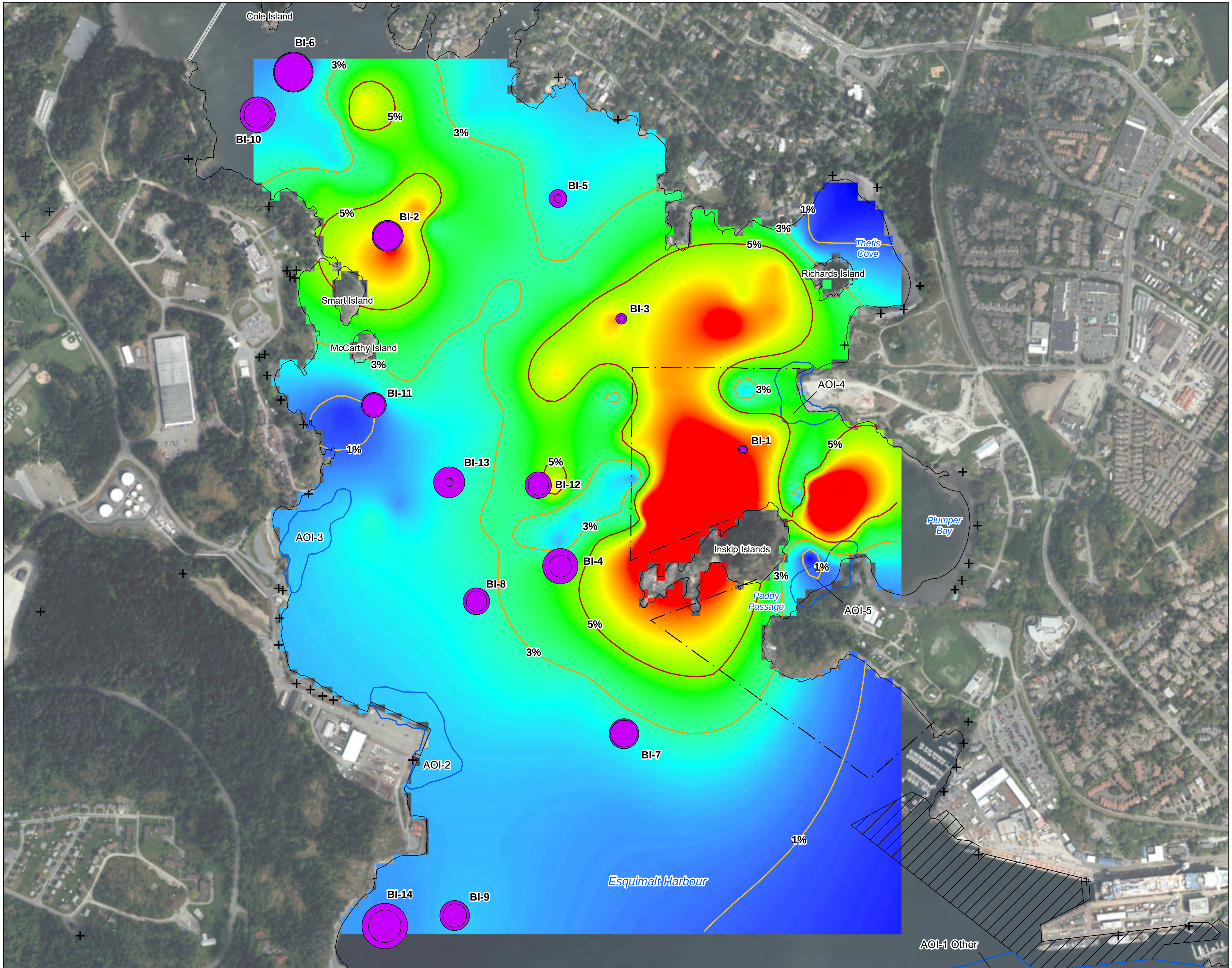
Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Shannon Diversity Index by Sample Location



Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Shannon Diversity Index (H)

0.38
2.91

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

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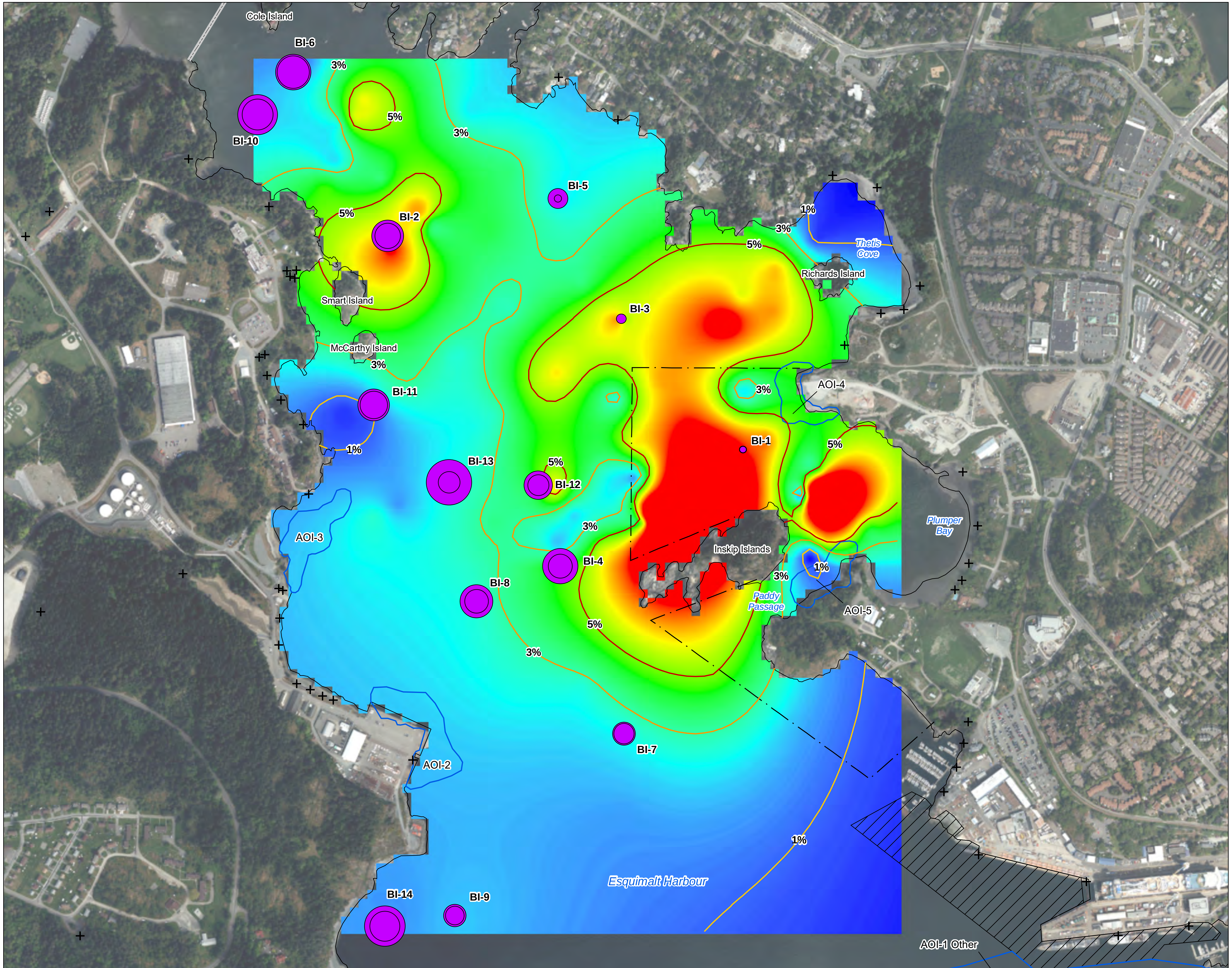
Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Pielou's Evenness Index by Sample Location



Legend

- + Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Pielou's Evenness Index (J)

0.22 — 0.90

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

- 79,700 - 204,000
- 60,200
- 40,700
- 21,100
- 1,600

Notes

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Metres

NAD 1983 UTM Zone 10N

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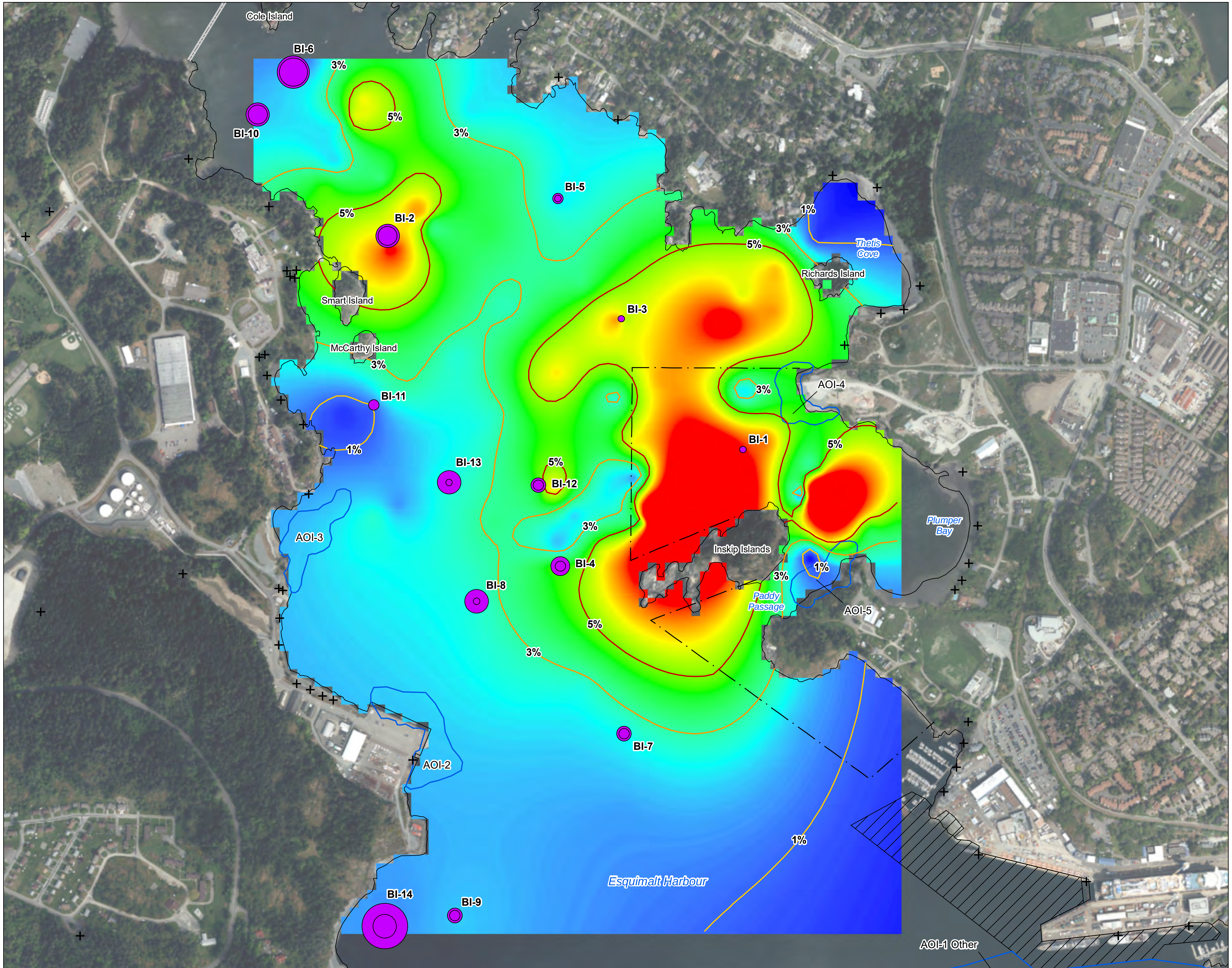

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Benthic Infauna
Swartz's Dominance by Sample Location

Legend

- Stormwater Outflow Drain
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Swartz's Dominance

1
10

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

TOC Concentration (mg/L)

79,700 - 204,000
60,200
40,700
21,100
1,600

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. The interpolated concentration raster shown on this map has been symbolized using a Standard Deviation stretch type, which applies a linear stretch between the values defined by the standard deviation (n=2) value.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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Metres

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These results are consistent with a recent study of benthic infuana in Esquimalt Harbour, which concluded that benthic infauna communities generally show signs of impairment, with stations ranging in their categorization of benthic community health from heavily impacted through to low/moderate impairment with opportunist-dominated areas (i.e. sample areas indicative of slight to pronounced imbalanced situations dominated by subsurface polychaete deposit-feeders; Biologica 2016). However, the sampling effort did not include areas of known wood waste deposits, except for three sample stations that were taken within the Ashe Head Remediation Area in Plumper Bay. The Ashe Head Remediation Area falls within the lower range of TOC values (1 – 3%) and stations were categorized by Biologica (2016) as low/moderate benthic community impairment, due to high summary metrics (e.g. abundance, species richness, diversity) along with the presence of pollution-sensitive taxa, some large bioturbators, and a large number of non-cirratulid opportunistic polychaetes indicative of reduced sediments or organic pollution.

Similar to Biologica (2016), all benthic infauna stations had very few large bioturbators or pollution-sensitive taxa and an elevated abundance of pollution- or disturbance-tolerant, opportunistic taxa. Other studies have documented similar results, for example, in Port Angeles Harbour the infauna community associated with log booming grounds (characterized as having abundant small woody debris such as bark and logs) consisted primarily of small, pioneering organisms that live at or near the SWI (e.g. surface feeding or filtering organisms), with some azoic areas showing no evidence of benthic infauna colonization (SAIC 1999). However, none of the benthic infauna stations sampled for this Project were classified as functionally azoic with minimal microbenthic function; therefore, benthic infauna communities ranged from somewhat disturbed/impacted to low to moderate impairment. Impairment to benthic infaunal communities appears highest north of Inskip Island, where *Beggiatoa* sp. mats were most concentrated and quantities of infauna organisms were moderate to normal but dominated by one opportunist species (SDI = 1).

Annelid Polychaete worms (Spionid Polychaete *Prionospio (Minuspio) lighti* and Opheliid Polychaete *Armandia brevis*) were present at all fourteen benthic infauna stations monitored during this Project, with the majority of stations dominated by one or the other (**Table 6**). Both species inhabit the top surface layer of sediments, deposit-feeding only at the SWI and are categorized as second-order opportunists which thrive under impacted conditions prohibitive to other species (e.g. *P. lighti*) or are associated with high levels of wood waste (*A. brevis*; Borja 2000, Kathman et al 1984, Teixera et a. 2012). Station BI-9 and BI-7, closer to the outer harbour, were dominated by the second-order opportunistic Cirratulid Polychaete complex *Aphelochaeta glandaria*.

The presence of large bioturbators allows for sediment reworking and oxygenation, particularly if they reach mature size, but many are pollution-sensitive or have unknown tolerance to disturbance (Biologica 2016). All benthic infauna stations in Esquimalt Harbour were relatively devoid of commonly-found large bioturbators, with the exception of *Macoma nasuta*, a bivalve Mollusc found at all stations in low numbers and commonly found in organically enriched sediments (Ranasinghe et al. 2013; **Table 3.13**). The occurrences of *M. nasuta* were primarily juveniles, with only a few intermediates and adults noted. Observations of pollution- or organic enrichment-sensitive taxa were limited to stations located between 1 – 3% TOC, with the exception of BI-4 (4.1%) and were almost entirely juveniles (**Table 3.13**).

Table 3.13 Summary of Benthic Infauna Impacts

Sample ID	Quantity*	Diversity*	Proliferating opportunists (>50%)	Stimulated by organic enrichment	Sensitive to Enrichment	large bioturbator
BI – 1	Moderate to Normal	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Macoma nasuta (1 a) Macoma sp (1 a, 2 juv)
BI – 2	Moderately Impoverished	very low	-	Spionidae (*Prionospio (Minuspio) lightii*)	-	Cerebratulus californiensis (4 int) Macoma nasuta (1 a, 2 int Macoma sp (4 int, 2 juv)
BI – 3	Moderate to Normal	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Macoma sp (2 int, 3 juv)
BI – 4	Impoverished	very low	-	Spionidae (*Prionospio (Minuspio) lightii*)	*Lanassa venusta venusta* (2 juv)	Macoma nasuta (1 a, 2 int, 6 juv) Macoma sp (26 juv)
BI – 5	Opportunist Proliferation	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	*Lanassa venusta venusta* (1 int)	Macoma nasuta (5 juv), Macoma sp (5 juv)
BI – 6	Opportunist Proliferation	very low	-	Spionidae (*Prionospio (Minuspio) lightii*)	*Clinocardium nuttalli* (18 juv)	Cerebratulus californiensis (17 a, 11 int, 6 juv), Macoma sp (8 int, 11 juv)
BI – 7	Opportunist Proliferation	opportunist dominated	Cirratulidae (*Aphelochaeta glandaria* complex)	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Glycera americana (1 int), Macoma nasuta (5 int, 3 juv) Macoma sp. (1 juv)
BI – 8	Moderate to Normal	very low/opportunist dominated	-	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (1 a, 2 int, 9 juv)
BI – 9	Moderate to Normal	opportunist dominated	Cirratulidae (*Aphelochaeta glandaria* complex)	Spionidae (*Prionospio (Minuspio) lightii*) very low	*Heterophoxus affinus* (1 a, 1 juv) *Lanassa venusta venusta* (1 int)	Macoma nasuta (3 int, 11 juv)
BI – 10	Moderate to Normal	very low	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Cerebratulus californiensis (3 int, 2 juv), Macoma nasuta (12 juv) Macoma sp (6 int, 21 juv)
BI – 11	Opportunist Proliferation	moderate or opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (17 juv), Macoma sp (3 juv)
BI – 12	Opportunist Proliferation	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (4 int, 10 juv), Macoma sp (4 juv)
BI – 13	Moderately Impoverished	opportunist dominated	Opeliidae (*Armandia brevis*)	Spionidae (*Prionospio (Minuspio) lightii*)	-	Macoma nasuta (1 juv)
BI – 14	Opportunist Proliferation	moderate	-	Spionidae (*Prionospio (Minuspio) lightii*) very low	-	Macoma nasuta (2 a, 3 int, 2 juv) Macoma sp (6 juv)

*Source: Biologica 2016 – Categories of benthic impairment based on calculated indices

4.0 REMEDIAL AND MANAGEMENT OPTIONS

The following sections identify potential remedial options, evaluate the remedial options applicable to Esquimalt Harbour, including the rationale and basis for preferred treatments, provide a preliminary approach to the restoration of wood waste impacted subtidal sediments, and include an analysis of the potential for inclusion of these remediated areas in the DND habitat bank.

4.1 IDENTIFICATION OF POTENTIAL REMEDIAL OPTIONS

Due to the relatively slow decomposition of wood waste by bacteria, accumulations can persist for decades and continue to negatively affect benthic communities and higher trophic level organisms dependent on those communities (Conlan 1977; **Section 2.1**).

Remedial options for wood waste rely on decomposition, isolation and removal mechanisms and may include the use of one treatment or approach, or a combination of approaches for more complex sites (**Table 4.1**). Remediation options include post-remediation monitoring to determine the effectiveness of the chosen approach.

4.1.1 Monitored Natural Recovery

Monitored Natural Recovery (MNR) relies on natural processes such as bioturbation, sedimentation, erosion, and biological decomposition. No physical works are prescribed for MNR. A monitoring program is established to track the progress of natural recovery (e.g. monitoring parameters of concern and biological recovery of infauna through bioassays and/or benthic infauna community analysis).

Site specific physical and biological conditions will determine the feasibility of natural recovery within a reasonable period. If natural recovery is predicted to take greater than 10 years, other, more active, approaches are generally recommended. MNR is generally prescribed for areas where wood waste coverage is discontinuous, deposits are shallow, and impairment of the bottom ecology is minimal. Site-specific conditions required include: adequate dissolved oxygen, flushing and water exchange, high natural sedimentation rates, and sediment turnover (e.g. presence of bioturbators). Washington State Department of Ecology (WSDOE) has determined that natural recovery is unlikely to occur at locations with thick wood waste deposits (e.g. approximately >0.9 m deep), since decomposition by-products will permeate through recently deposited sediment, conditions will remain anaerobic, and few bioturbators will colonize (Washington State 2013). Natural recovery for sites with low sedimentation rates can take decades to return to pre-impact productivity (Picard et al 2003).

MNR is a cost-effective approach for very large sites that meet the above criteria, where other approaches may be cost prohibitive and for areas where seafloor disturbance should be avoided (e.g. existing bivalve shellfish beds).

Table 4.1 Overview of Potential Wood Waste Remediation Options

Remedial Option	Application	Description	Benefits and Constraints
Monitored Natural Recovery	Suitable for sites where wood waste coverage is discontinuous and/or thinly deposited, and only low or moderate impairment	• No modifications or physical works (removal, caps) • Relies on naturally occurring bioturbation and sedimentation • Can take up to 10 years for sites with high bioturbation and natural sedimentation to recover. • Sites with low sedimentation/erosion can take decades to recover.	• Cost effective • Non-invasive • Ineffective at sites with deep accumulations of wood waste, or a lack of dissolved oxygen, flushing and water exchange, and sediment turnover
Enhanced Natural Recovery	Suitable for sites with discontinuous coverage and/ or thin wood waste deposits	• Augments natural recovery with the placement of a thin layer (15cm) of clean sand • Sand provides oxygenated layer that promotes benthic infauna recruitment and establishes a productive benthic community • Bioturbators will mix sand with underlying wood waste overtime, diluting wood waste and accelerating aerobic decomposition	• Cost effective • Minimally invasive • Ineffective at sites with deep accumulations
Dredging	Suitable for sites with continuous coverage and/or deeper wood waste deposits	• Barge platform with clam shell dredge removes wood waste and impacted sediments • Dredge to native sediment and backfill with clean sediment • Variety of disposal options for dredge materials	• Most effective and permanent remedial option • Typically most expensive option
Capping	Suitable for sites with continuous coverage and/or deeper wood waste deposits. May require removal of some wood waste if there are significant volumes	• Thick layer of material placed over wood waste to physically and chemically isolate underlying sediment from contact with marine organisms • Cap thickness is designed by professional engineer for the site-specific conditions but typically one meter, employing medium to fine sand • Typically, sand caps are used in low velocity waterways to protect them from scouring by strong (high energy) currents.	• Least preferred remedial option as the long-term efficacy has not been demonstrated • Expensive, but typically less expensive then dredging • Potential problems include anaerobic off gassing, leaching of soluble by-products, and differential settling • Activities such as prop wash can reduce long-term effectiveness • Raises seafloor by approximately 1 m (before settlement)

Source: Breems and Goodman 2009, Washington State 2013

4.1.2 Enhanced Natural Recovery

Enhanced natural recovery (ENR) augments natural recovery with placement of a thin layer (approximately 15 cm) of unconsolidated clean sand materials that boosts natural recovery processes. The sand layer is not a true engineered cap as wood waste contaminated sediments are not meant to be isolated. Instead, the added thin layer provides oxygenated substrate that promotes benthic infauna recruitment and development of a productive community (Breems and Goodman 2009, Washington State 2013). As benthic communities develop over the long term, the presence of bioturbators will naturally mix or re-work the sand layer with underlying wood waste and accelerate aerobic decomposition.

ENR is only suitable for areas with discontinuous coverage and/or thin wood waste accumulations (< 0.2 m), and for areas that would naturally recover in 10 years or less (Breems and Goodman 2009). The effectiveness of ENR is determined through a post remediation monitoring program.

4.1.3 Dredging

Dredging is the most effective and permanent remedial option for wood waste contaminated sediments, although it is generally the most costly approach. Effective dredging at some locations may require multiple dredging passes. For example, some wood waste is large, and the dredge bucket may not always be able to fully close, dropping material into the water as it is removed. Washington State (2013) recommends that a first pass is conducted with large equipment, followed by a second pass with a smaller, square-faced buckets if required.

Removal of wood waste through dredging exposes native sediments or bedrock. Depending on the depth of wood waste removed, dredging may result in unfavorable bottom depths or the creation of depressions that act as sinks for detritus and other debris and fine wood waste residual material, as much as several inches, can accumulate following dredging. Therefore, backfilling with a layer of clean sand (as with ENR) is a common best management practice (BMP) to fill in depressions, cover any residual material, and promote benthic infauna recolonization.

Dredging is generally performed during least-risk works windows to protect aquatic resources which can affect project scheduling.

Monitoring to ensure wood waste layers have been removed will confirm the efficacy of the dredge operation. Post construction bathymetric surveys will determine the need for additional treatment. Recovery is tracked through a monitoring program that will measure benthic invertebrate community succession.

4.1.3.1 Options for Disposal of Dredge Materials

Disposal at Sea

The most cost-effective means of disposing of dredge materials composed primarily of wood waste is Disposal at Sea (DAS), an activity that is regulated by Environment and Climate Change Canada (ECCC). The distance to established disposal sites is a determining factor in evaluation the cost effectiveness of the DAS option. Wood waste qualifies for DAS if it can be characterized as waste or other matter, as outlined in Schedule 5 *Canadian Environmental Protection Act, 1999*, and is considered clean.

Confined Aquatic Disposal

An alternative to DAS is to engineer a disposal site where dredged material is placed and covered by a cap to ensure long-term isolation and effectiveness. This approach has been utilized in Washington State, but is considered costly, and would require long-term monitoring to ensure effectiveness.

Beneficial Use

As an alternative to DAS, dredged material may be beneficially re-used for nearshore marine projects below the high-water mark so long as there is a demonstrated need or purpose for the use of the sediment, the sediment meets DAS sediment chemistry screening criteria, it can be demonstrated that there is no anticipated marine pollution or deleterious effects from the placement of the fill, and the beneficial use has DFO and local First Nations endorsement. A beneficial use exemption does not require a DAS permit; however, it does require engagement and approval from ECCC regulators with the DAS Program, DFO, and First nations. Similar to the DAS permit-process, a Sediment Sample and Analysis Plan will also need to be prepared and submitted to ECCC for review and input prior to conducting sediment sampling and analysis of the fill and completing a Sediment Characterization Report.

Upland Disposal

If dredgeate does not qualify for DAS or beneficial use, upland disposal at a landfill facility near the project site is feasible but can be costly to transport and to treat, as sediments are categorized as salt-impacted and may contain other forms of contamination (depending on site conditions).

Engineered Nearshore Confined Disposal Facility (CDF)

A second option for contaminated dredged materials is the use to infill a clean berm built along the shoreline and capped with clean sediment. This disposal option requires the determination that tidally driven groundwater exchange will lead to the release of decomposition by-products (e.g. Sulphide and ammonia) into the marine environment. The area on top of the CDF can then potentially be used for port or other water-dependent shoreline development activities. This approach has been used in Washington State at several clean-up sites, but is costly to build and maintain.

Alternative Use

A full review of alternative re-use options has been conducted by Azimuth (2017) and includes alternatives such as: combustion of wood waste can be used to produce power or heat, biomass gasification or pyrolysis to produced power, liquid fuels an/or biochar, and composting. However, **t**he moisture and salt content of dredged wood waste, along with its mixture with sediment, may make its re-use prohibitive from a technical or cost-effectiveness perspective (Azimuth 2017).

4.1.4 In-Situ Capping

A cap is a thicker layer of material, such as sand, placed on top of contaminated sediment which has been engineered to isolate the underlying contaminated sediment. Caps are designed so that the rate of desorption of contaminants in porewater that passes through the cap does not exceed applicable water quality criteria at or near the surface. The cap prevents the contaminated sediment from coming into direct contact with marine organisms; therefore, must be designed to be thick enough that deep-burrowing bioturbators do not come in contact. Caps need to be engineered for the conditions of each site. In Puget Sound, a 1 m thick cap comprised of medium to fine sand is commonly prescribed for wood waste contaminated sediments (Breems and Goodman 2009).

Capping is the least preferred remedial technology for wood waste sites with thick accumulations of wood waste since the long-term efficacy has not been fully demonstrated and potential issues could include anaerobic off-gassing, leaching of soluble by-products, and differential settling, which could compromise the integrity of the cap and prevent the establishment of a healthy and productive benthic community (Breems and Goodman 2009, Washtington 2013). This remedial option is typically expensive, but less expensive then dredging of wood waste. Other constraints of this remedial option include: cap design must provide complete cover of the wood waste (i.e. significant volumes of wood waste may require the removal of some before in-situ capping since capping requirements include limits on the volume of wood waste in the sediment; Washington 2013), and activities such as prop wash can also reduce the long-term effectiveness of the cap. However, this remedial option can be a less complex and less expensive approach to remediation (Washington 2013).

As capping can generate sediment plumes during installation, works should be scheduled to take place during least risk work windows. Proposed capping projects will be subject to a *Fisheries Act* Serious Harm assessment. Recovery is tracked through a monitoring program to demonstrate long-term effectiveness

4.1.5 In-Situ Treatment

In-situ treatments would involve alternate forms of ENR by treating wood waste deposits on-site without movement, in order to facilitate natural in-situ decomposition. To our knowledge, the use of in-situ treatments as a remedial option for benthic communities impaired by wood waste has not been investigated. Previous work on wood waste remediation (Breems and Goodman 2009, Washington State 2013) has not identified any effective in-situ remediation approaches for the treatment of wood waste in the marine environment, only flagged that further research on the rates and mechanisms of decomposition of wood waste components is required to inform other options.

The impacts of wood waste on nearshore benthic communities are similar to those from aquaculture/fish farming (i.e. buildup of organic material on the seafloor, oxygen depletion within and above sediments, increase in sulphides and changes to the benthic community structure, Brooks et al 2003) and research on the impacts to, and potential remediation of, benthic communities beneath aquaculture facilities has been widely explored. Since the impacts of wood waste on nearshore benthic communities are similar to aquaculture, potential approaches to in-situ remediation of wood waste could be drawn from this body of work. However, some differences between impacts of the two activities do exist (e.g. other contaminants, including zinc and copper, accumulate in the sediment below aquaculture pens during the breakdown of aquaculture feed waste, SAG 2011) and remedial approaches used in aquaculture but would require investigation prior to their implementation in Esquimalt Harbour.

Some potential approaches include:

- Oxygenation – Toxic anaerobic by-products of wood waste decomposition (e.g. hydrogen sulphide and ammonia) are oxidized to non-toxic forms when exposed to oxygen. The introduction of oxygen to wood waste deposits may also allow for the aerobic breakdown of wood waste by heterotrophic bacteria, eliminating further production of toxic by-products. This could be conducted by harrowing, or heavy raking of the seafloor, or irrigation with oxygenated surface-water (Keeley et al 2017). However, this has only been explored for remediation of sediments impacted by salmon farm aquaculture in New Zealand and has only been applied to small-scale pilot study field plots (~15m^2) – therefore, may not be feasible for large-scale application.
- Shell hash addition – Low pH can cause a greater proportion of the toxic hydrogen sulphide form to occur in sediment porewater. The addition of a thin layer of crushed bivalve shells (e.g. by-products of shellfish aquaculture) may help to buffer pore-water pH and lower the toxicity of decomposition by-products. This has been used in aquaculture to deal with ocean acidification, in particular addition to the sediment of mudflats on the Atlantic Coast to enhance pore-water pH and clam survival (Green et al 2009, Green et al 2013). Shell hash addition has also proven successful in reducing hydrogen sulphide in organically enriched mudflats in Japan (Yamamoto et al 2012).
- Scavenging sulphides – This approach would include the addition of iron to sediments to precipitate iron-sulphides in order to suppress the sulphate reduction pathways and reduce toxic H_2S by-products. It is used in seagrass systems in the Mediterranean that are impacted by eutrophication (e.g. increases in organic matter, Holmer et al 2005).

4.2 ANALYSIS OF REMEDIAL OPTIONS

Management options for wood waste remediation are developed on a site-specific basis using results of the site assessment (**Section 3.2.3**) and drawing on effective approaches from other wood waste assessment and remediation projects. The evaluation of remedial options for Esquimalt Harbour should also consider remedial objectives, short- and long-term effectiveness, technical feasibility, and cost (including permitting, equipment, mobilization, remedial treatment, monitoring). Further evaluation of a remedial option is generally not warranted if the option is technically unsuitable or cost prohibitive.

Given that wood waste, and its associated decomposition by-products, are not regulated contaminants of concern in the Canadian marine environment, the driver for the remediation of impaired benthic communities in Esquimalt Harbour is to re-establish a balanced and productive benthic community that will restore fish habitats and drive the productivity of upper trophic-level commercial, recreational or Aboriginal (CRA) fisheries species (e.g. Dungeness crabs, fish), so that remediated habitats can be deposited as credits in the DND Habitat Bank.

4.2.1 No Action

Wood waste, in particular bark, is extremely slow to break down and can persist for decades or centuries. Since the cessation of wood-processing activities in the late 1990's (nearly 20 years ago), and the assessment of wood waste by Archipelago (2004; approximately 15 years ago), very little burial of wood waste has occurred, and biophysical conditions within known areas of wood waste appear to have remained unchanged (e.g. relatively sparse epibenthic organisms and very little evidence of infauna activity, such as holes and mounds indicative of burrowing worms and bivalves). Exposed log piles within the Harbour do provide habitat for typical rocky reef species but will not contribute to the recovery of benthic infauna and soft-bottom communities.

Natural sedimentation rates within Esquimalt Harbour are very low and ongoing bottom disturbance occurs in many areas of the Harbour from ship propwash and local dredging resuspending fine sediments creates patchy disturbances to benthic sediments (Burd 2016, Geosea 2009). Without sufficient clean sediment for pollution-sensitive benthic infauna to colonize, an infauna community dominated by low species richness and opportunistic, organic enrichment-tolerant species will continue to prevail. Impacts to benthic infauna can lead to lower food sources for higher trophic organisms, such as Dungeness crabs and juvenile salmonids (**Section 2.1.4**). Due to the presence of *Beggiatoa* sp mats, and without the presence of large infauna bioturbators, oxygen is unlikely to permeate the SWI, and toxic anaerobic by-products will continue to be produced.

Since wood waste decomposition and impacts are site-specific, there is very little information available on the rate of wood waste breakdown and benthic community recovery without remedial action. Conditions in areas containing deeper wood waste deposits (> 0.25 m) within the harbour are expected to persist; however, areas with shallow deposits (0 – 0.25 m) may recover naturally in 10-15 years, depending on sedimentation rates and any disruption to unconsolidated sediments (e.g. propeller wash).

4.2.2 Monitored Natural Recovery

MNR would be implemented in concert with a No Action approach, but monitoring of recovery. In Esquimalt Harbour it is unlikely to lead to the successful recovery of the benthic infauna community in areas containing deeper wood waste deposits (> 0.25 m) in a reasonable time frame. Areas with shallow deposits (0 – 0.25 m) may recover naturally in 10-15 years, depending on sedimentation rates and any disruption to unconsolidated sediments (e.g. propeller wash).

4.2.3 Enhanced Natural Recovery

ENR is generally recommended for areas with continuous coverage and thin wood waste deposits that would naturally recover in 10 years or less. The placement of 15 cm of sand in areas with shallow deposits (0 – 0.25 m), and approximately between 3-5% TOC, may allow for the successful recruitment of a productive benthic infauna community. The presence of some sensitive taxa within the harbour, while patchy, may aid in the establishment of productive infauna communities if physical disturbances (e.g. propeller wash) to unconsolidated benthic environments are minimized Burd (2016).

ENR will not likely be a successful long-term remediation option in areas of deeper wood waste deposits, since anaerobic decomposition will continue to occur below the clean sand layer, decomposition by-products will permeate through recently deposited sediment, and toxic conditions will re-establish preventing recruitment of large bioturbators and other sensitive infauna.

4.2.4 Dredging

Remediation of continuous and/or deeper wood waste deposits in Esquimalt Harbour will require the application of a remedial option that is more intensive then MNR or ENR. Dredging has been proven to be the most effective and permanent approach to removing wood waste accumulations, and often applied in wood waste remediation projects in Washington. However, given the volume of wood waste deposits, and associated impacted sediments, in Esquimalt Harbour this option is logistically complex and very expensive. Site-specific disposal options for dredged materials will, in part, determine the cost and are outlined below.

4.2.4.1 Options for Disposal of Dredge Materials

Should dredging be pursued as a remedial option, Esquimalt Harbour sediments are not likely to be suitable for Beneficial Use (e.g. soft unconsolidated sediments with high quantities of wood are not likely to be structurally suitable fill for nearshore marine construction works, and wood waste could continue decomposing and releasing by-products) and other less common options are costly and their long-term effectiveness is uncertain (e.g. Confined Aquatic Disposal or CDF) or has not been developed to the point of feasible implementation (e.g. Alternative Use) (**Section 4.2.4.1**). Based on this, disposal of dredged materials from Esquimalt Harbour is best done by Disposal at Sea or Upland Disposal.

Disposal at Sea

A preliminary sediment investigation was conducted during Field Survey 6 to characterize the sediment within the wood waste deposit north of Inskip Island, in order to determine if sediment is likely to qualify for a Disposal at Sea Permit and inform site-specific remedial options. Results of the sediment characterization indicate that several contaminant parameters exceed the applicable CCME ISQG and PEL guidelines, as well as the BC CSR sediment standards (Schedule 3.4), including arsenic, cadmium, copper, chromium, lead mercury, zinc, various PAHs, and total PCBs (see **Appendix I**). The sediment characterization data was also screened against the Disposal at Sea Lower Level of the National Action List criteria for cadmium, mercury, total PAHs, and total PCBs, with all four constituents exceeding these criteria in numerous samples. However, detection limits exceed applicable standard criteria (i.e. results were below the laboratory detection limit but above the DAS criteria) and the actual concentrations of metals, PCBs and PAHs cannot be determined. This anomaly may be due to a high water content and level of wood waste organics in the sediment.

Based on Disposal at Sea guidance, and the anticipated exceedances of DAS screening criteria, the sediment associated with the wood waste would be considered by ECCC to have a “high certainty” of future exceedances and indicates that the sediment may not be suitable for DAS. However, DAS permitting requires consultation with ECCC DAS program staff to determine if sediments qualify (https://www.canada.ca/en/environment-climate-change/services/disposal-at-sea/permit-applicant-guide/dredged-material/applicant-guide-permit-dredged-material/chapter-3-1.html). If DAS is a desirable approach to disposing of wood waste, a project description (outlining site history, previous sediment sampling results, etc) and sediment sampling plan will need to be approved by ECCC, sediment sampling conducted, and a sediment and characterization report submitted for review. Sediments determined by ECCC to have a “higher certainty” of exceedance could still qualify for DAS but may be requested to undergo toxicity testing. If DAS is pursued, more finite testing areas should be included in the sediment sampling plan, to focus dredge management units, as sediments from some areas may qualify for DAS even if others do not.

Upland Disposal

Drill cuttings from Field Survey 6 were disposed of at an upland facility located on Vancouver Island that can accept salt-impacted sediments. Should upland disposal of dredged materials be required, it would likely need to be treated for metal stabilization, based on preliminary investigation results (**Appendix I**).

4.2.5 In-Situ Capping

While the long-term efficacy of in-situ capping is uncertain, this remedial option would be likely be a less expensive approach to remediation in Esquimalt Harbour. Given the large spatial extent of deeper wood waste deposits in Esquimalt Harbour (**Figure 3.5**), and that the in-situ cap design would need to completely cover the wood waste, use of this remedial technique in Esquimalt Harbour would likely be logistically complex and require the removal of some wood waste, and irregularly oriented logs in the surface material, to allow for the cap to completely cover. Combined with the uncertainty around long-term effectiveness, this is not considered a feasible option for remediation of wood waste in Esquimalt Harbour at this time.

4.2.6 In-Situ Treatments

To our knowledge, the use of in-situ treatments as a remedial option for benthic communities impaired by wood waste has not been investigated. Research into the impacts to and potential remediation of benthic communities beneath aquaculture facilities has been widely explored. Since the impacts from wood waste are similar to aquaculture, potential approaches to in-situ remediation of wood waste can be drawn from this body of work. However, some differences between impacts of the two activities do exist (e.g. other contaminants, including zinc and copper, accumulate in the sediment below aquaculture pens during the breakdown of aquaculture feed waste, SAG 2011) and remedial approaches used in aquaculture but would require investigation prior to their implementation in Esquimalt Harbour. It is possible that the use of biological or chemical treatments (possible treatments are outline in **Section 4.1.5**) applied to areas of wood waste in Esquimalt Harbour could enhance the natural recovery of the area by increasing the decomposition rate of wood waste or eliminating toxic by-products.

The application of an experimental in-situ approach (such as scavenging sulphides) in the field can lead to un-intended consequences, particularly given the differences in the nature of the organic enrichment between aquaculture and wood waste, and may be challenging to obtain regulatory (ECCC and DFO) support. The oxygenation of sediments does not seem logistically feasible on a larger scale across Esquimalt Harbour. If an in-situ approach were to be pursued, the use of shell hash addition to lower pH and reduce hydrogen sulphide may be the most likely to be logistically feasible and to obtain regulatory support.

4.3 RECOMMENDED OPTIONS AND APPROACHES

After evaluating existing site-specific conditions for Esquimalt Harbour (wood waste distribution and wood waste depth, TOC content, the distribution of *Beggiatoa* sp bacterial mats, and impacts to the benthic infauna community) and remedial options, two wood waste management options are recommended based on the remediation objective:

- To promote recovery of benthic communities and enhancement of fish habitats so that remediated habitats can be deposited as credits to the DND Habitat Bank.

The recommended approach for sediment remediation includes two options, as outlined in **Table 4.2** below, including a field-based pilot study project of cost-effective and less invasive remediation options in areas of shallow wood waste accumulations and the complete removal, through dredging of wood waste, of deeper accumulations (**Figure 4.1**).

Table 4.2 Recommended Options for Remediation of Wood Waste in Esquimalt Harbour

Management Option	Bottom Condition	Area / volume Affected
Dredge with Backfill	• Deep accumulations (>0.25 m) • mostly within the >5% TOC contour	• North Deposit 31,182 m3 • South Deposit 227,819 m3
Field Pilot Study Project	• Shallow accumulations (0-0.25 m) • mostly within the 3-5% TOC contours	-

4.3.1 Dredge and Placement of Clean Fill

MNR and ENR are not considered feasible options for the remediation of deeper wood waste deposits, given the existing information on the impacts and persistence of deeper wood waste deposits, and the low sedimentation rates within the harbour.

Removal of the deeper wood waste deposits and placement of clean fill is considered the most effective and permanent option for remediating the two areas of deeper wood waste deposits (>0.25 m), approximately in areas where TOC is > 5%, that have been determined to impair the function of the benthic community in Esquimalt Harbour (**Figure 4.1**):

- Immediately north of Inskip Island and into Plumper Bay (approximately 227,819 m^3)
- North of Smart Island (approximately 31,182 m^3)

Immediately after dredging and backfilling, confirmatory monitoring is desirable to demonstrate effectiveness (dredge depth and residual wood waste) and backfill thickness. The deposit of remediated habitats to the DND habitat bank would occur after the remediated habitat is proven to be restored back to a productive soft-bottom community. This will entail an effectiveness monitoring program, of sediment chemistry (e.g. wood waste decomposition by-products) and bioassays, to demonstrate benthic infauna recovery (Washington State 2013).

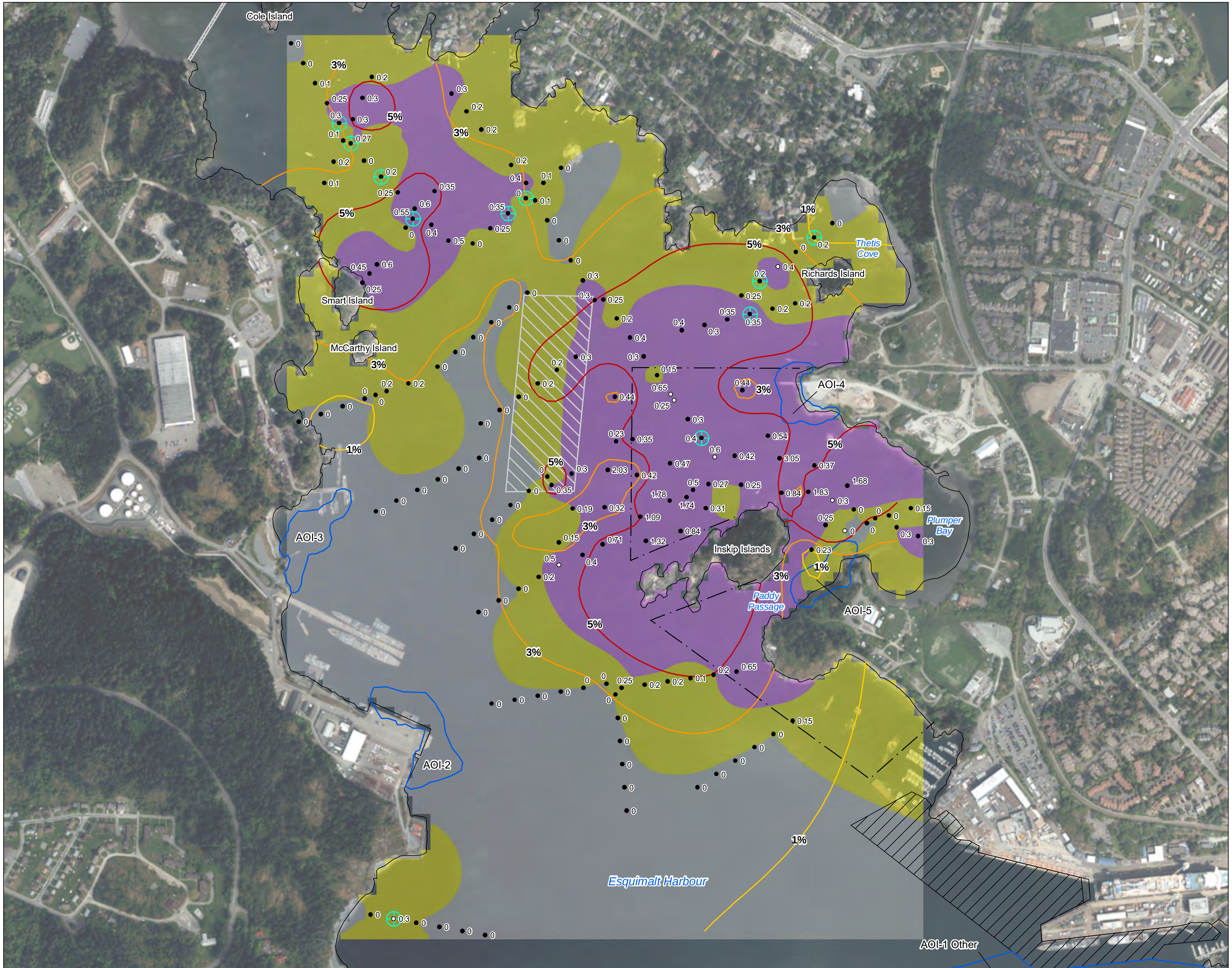
A detailed cost estimate for dredging, including scoping options for disposal of dredge materials, can be provided if DND chooses to pursue this remediation option, once spatial extent and volume have been determined and project design/engineering have occurred. Currently, deep surficial wood waste deposits are mapped based on interpolative distribution modelling around known depths (**Figure 4.1**). The boundaries of deeper deposits should be delineated prior to pursing this as a remediation option, in order to avoid un-necessary dredging and related costs. For example, just south of Inskip Island is categorized as deep based on modelling but should be confirmed. Approximate unit costs for works associated with dredging and capping with sand are presented below (**Table 4.3**).

Table 4.3 Approximate Unit Costs for Remedial Dredge Works in Esquimalt Harbour

Work Description	Unit Cost	Comment
Permitting	$100,000	DAS, Fisheries Act and other permitting processes
Mobilization	$20,000	One-time cost
Dredging	$15,000/day	Clam shell dredge, flat barge, support tug
Sand (clean fill)	$50/tonne	-
Sand Placement	$15,000/day	Clam shell dredge, flat barge, support tug
Disposal fees	$150/tonne	Assumes wood waste qualifies for DAS
Environmental Monitoring	$113/hr	Environmental monitor rate
Demobilization	$20,000	One-time cost
Effectiveness Monitoring	$200,000/year	For a period of three to five years as stipulated by DFO. With sediment chemistry, bioassays, and Scuba surveys

4.3.2 Pilot Study Project

A field-based pilot study project is recommended to determine the site-specific effectiveness and feasibility of economical and less invasive remediation options in areas of shallower wood waste deposits. The details and cost scoping of the recommended pilot study project are provided below in **Section 5.0**.



Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Wood Waste Depths for Remediation Options

Legend

- Sampling Location (Bottom depth of wood waste was reached during sampling)
- Sampling Location (Bottom depth of wood waste was not reached during sampling)
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Jones Marine Group Lease Area
- Study Area

Management Options

- Shallow surficial wood waste deposit (0 - 0.25m)
- Deep surficial wood waste deposit (>0.25m)
- Surficial sediment overlying wood waste deposit
- No wood waste

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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4.4 REGULATORY FRAMEWORK AND REQUIREMENTS

4.4.1 DFO *Fisheries Act* Authorization

Under the *Fisheries Act*, proponents are responsible for avoiding and mitigating serious harm to fish that are part of or support commercial, recreational or Aboriginal (CRA) fisheries:

> *35. (1) No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery (DFO 2012).*

The Fisheries Protection Policy Statement (2013) defines *serious harm to fish* as:

- **The death of a fish;**
- **A permanent alteration of fish habitat** of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursey, rearing, or food supply areas, or a mitigation corridor, or any other area in order to carry out one or more of their life processes;
- **The destruction of fish habitat** of a spatial scale, duration, or intensity that fish can no longer reply upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one of more of their life processes.

On a project-by-project basis, DFO expects proponents, and/or qualified practitioners working on their behalf, to consult DFO's Pathways of Effects and evaluate project-related effects and determine, by way of a serious harm assessment, if the Project will result in Serious Harm. If the proponent cannot avoid or mitigate serious harm to fish (i.e. the Project will result in residual serious harm) then an Authorization under section 35(2)(b) of the *Fisheries Act* is required (DFO 2012).

Prior to the commencement of any physical remediation works in Esquimalt Harbour, a Serious Harm Assessment should be undertaken by a Qualified Environmental Professional. However, the nature of the remediation works is not anticipated to result in residual Serous Harm and not require a *Fisheries Act* Authorization (FAA). A Request for Review form should be completed and submitted to DFO to ensure the avoidance and mitigation measures, along with the determination of no residual serious harm, are considered suitable.

4.4.2 Disposal at Sea Permit

Environment and Climate Change Canada (ECCC) administers the Disposal at Sea (DAS) Program under the *Canadian Environmental Protection Act*. DAS permits may be granted if dredge materials proposed for disposal meet established disposal guidelines. As discussed in **Section 4.2.4.1**, wood waste contaminated sediments may not qualify for DAS and, if DAS is pursued, more finite testing areas should be included in the sediment sampling plan, to focus dredge management units, as sediments from some areas may qualify for DAS even if others do not. ECCC should be consulted prior to finalizing disposal options to determine the feasibility of DAS. Established and active DAS disposal sites may be too distant to achieve cost effective project objectives.

During remediation, placement of clean fill materials will constitute DAS if comprised of dredged sediments; however, the placement of clean materials during remedial works will constitute a beneficial use exemption under the DAS program. This can be applied for through a similar, but less involved process to a DAS permit with ECCC. Regardless of the source of fill material, the proponent will be responsible for ensuring the material is clean, suitable for the intended purpose, and not likely to cause marine pollution.

Esquimalt Harbour is primarily federal crown land and this provincial and local government legislation and statutes do not apply. If dredged material is proposed for upland disposal, provincial waste management regulations may apply.

4.4.3 Navigation Protection Act Notice of Works

Under the *Navigation Protection Act* (formerly the *Navigable Waters Protection Act*), any works that may affect navigation on navigable waters in Canada require approval. Placement of clean fill materials should not greatly alter the bathymetry of the Harbour and will not interfere with navigation in a substantial way. As such, remedial works should fall under permitted works that may proceed without the Minister's approval under the *Navigation Protection Act* (formerly the Navigable Waters Protection Act) administered by the Navigation Protection Program. A Notice of Works Form is required for all work on navigable waters listed on the schedule to the NPA and should be completed and submitted to Transport Canada prior to the commencement of any remediation works.

4.5 Potential Habitat Bank Credit Assessment

The "Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting November 2013" (FPIP 2013) describes a "proponent-led habitat bank" as a formalized approach for creating offsets through habitat creation, enhancement or restoration in advance of projects that result in Serious Harm. The habitat bank is managed to enhance or improve fisheries productivity.

DND maintains a Habitat Bank through a Memorandum of Understanding (MOU) with DFO Pacific Region. The existing habitat banking MOU has expired and a draft Habitat Banking Arrangement between the DND and DFO has been developed to fit modern legislation and policy. The renewed Arrangement will provide up-to-date guidance for management of the habitat bank guided by DFO's "Fisheries Protection Program's Interim Guide to Proponent-led Habitat Banking" (October 2016). The Arrangement, once finalized, will be in effect for 10 years with options to renew.

At present, areas affected by wood waste sustain low quality fish habitat as ecological function is impaired (**Section 3.3**). For a restoration project to be eligible for inclusion in the habitat bank, it must demonstrate an increase in fish habitat productivity over existing conditions. Productive nearshore benthic communities contain unconsolidated fine sediments that support several CRA fishery species and species groups including forage fish, flatfish, Dungeness crabs and bivalve shellfish. The treatments recommended to remediate wood waste in Esquimalt Harbour are designed to promote the re-establishment of a balanced and productive benthic infauna community recovery of the seafloor. Since benthic infauna are important components of nearshore marine ecosystems, driving detrital decomposition and nutrient cycling and providing a food source for higher trophic level organisms, the restoration of unconsolidated subtidal habitats should qualify the area for the DND Habitat Bank. Additionally, while Esquimalt Harbour is included in the DFO Area 19-1 permanent bivalve sanitary closure, it can be argued that bivalves within the harbour provide a source of reproductive larval material that can recruit to harvestable areas.

Temporary physical effects to substrates and benthic organisms will result from ENR and dredging. However, if these areas remain undisturbed following the application of the remedial treatments, they are expected to colonize with opportunistic infauna species relatively rapidly (e.g., six months to one year), and develop into a healthy and productive infauna community (e.g. balanced mix of functions, such as large bioturbators, through the recruitment of annelids, arthropods, and bivalves) over time thus contributing to fish habitat that supports CRA fishery species.

The predicted time to recovery of each remediation approach and the eligibility for inclusion of restored habitat to the habitat bank is presented below in **Table 4.4**. Most remedial treatment types, if they progress as predicted, would be result in productive habitat within a reasonable time frame. The deposit of habitat credits to the bank would be confirmed through monitoring of sediment chemistry (e.g. wood waste decomposition by-products) and bioassays to demonstrate benthic infauna recovery and productive habitat function (Washington State 2013). Effectiveness monitoring would require the establishment of baseline conditions (using sediment chemistry and bioassays) for the targeted areas of remediation immediately prior to restoration treatments being applied in order for comparison to monitoring data in subsequent years.

Table 4.4 Proposed Potential Habitat Banking Bottom Treatments, Restoration Times and Banking Potential

Proposed Treatment	Restoration Period	Habitat Banking Potential
MNR	Unknown (Under 10 years if sedimentation rates are high, sediments are well flushed with dissolved oxygen)	Delayed - dependent on monitoring results
ENR	6 months – 3 years	Yes
Dredging (with backfill)	6 months – 3 years	Yes

DND may also consider value-added habitat enhancement opportunities, such as the creation of subtidal rocky reefs or kelp beds. These enhancements would be constructed over the remediated sediment areas at appropriate depths for productive biological function. An enhancement of this nature is expected to be successful given the results of the impact assessment demonstrating that natural rocky reef areas, and log piles, in Esquimalt Harbour provide functional habitat for invertebrates that require hard substrate (e.g. sea urchins, plumose anemones, coralline algae or understory kelps) and juvenile rockfish (Photo 8). Targeted CRA species for these enhanced habitats would include rockfish (*Sebastes* sp) and lingcod (*Ophiodon elongatus*), forage fish, bivalve shellfish, crabs and urchins. This value-added approach may be the best course of action if operational or future development activities may negatively impact the remediated sediments (e.g. anticipated disturbance of remediated unconsolidated sediments by prop-wash creating patchy disturbances and impacting recruitment and establishment of healthy and productive benthic infauna communities) or, if future DND development will impact nearshore rocky reef habitat and require the offsetting of this type of habitat.

5.0 REMEDIAL PILOT STUDY PROJECT

Given that the remediation of wood waste impacted marine environments is a relatively new objective for water lot managers in British Columbia there are currently no CCME or CSR standards for wood waste remediation. Additionally, dredging and disposal of deeper wood waste deposits is a costly remediation option. Prior to the execution of a larger scale remediation effort, a focused field-based pilot study project has been recommended and designed to fulfill the following objective:

- Determine the site-specific effectiveness and feasibility of economical and less invasive remediation options, MNR and ENR, for areas of discontinuous and/or shallow wood waste deposits in Esquimalt Harbour.

The basic scoping of the pilot study project, including site selection, design, study implementation, and a detailed cost estimate, are provided below for DND to consider implementing in the future. Following the implementation, monitoring, and determination of effectiveness of the pilot project, a full-scale remediation and potential value-added habitat enhancement opportunity can be assessed and implemented.

5.1 SITE SELECTION

The pilot study site(s) should be representative of shallow wood waste deposits, have similar biophysical conditions across the site (and between sites if multiple sites are chosen), and not be affected by DND operational requirements or recontamination by log handling over the duration of the pilot study.

To select suitable sites for the pilot project implementation, areas of the Harbour with shallow (0–0.25 m deep) and deep (> 0.25 m) wood waste deposits were first identified and mapped as follows (**Figure 5.1**):

- 50 m buffer applied to each sample location (wood waste depth was sampled in 50 m intervals)
- Polygons created for shallow and deep deposits
- TOC thresholds (1, 3, and 5%) were overlaid

Following this initial mapping, areas with shallow wood waste deposits, that are approximately within a 3% TOC threshold, were examined to look for locations that possess similar biophysical conditions (e.g. current, bathymetry, biophysical impacts based on sediment chemistry and benthic infauna analysis). Since the pilot project will be conducted in the Harbour, rather than a controlled laboratory setting, it is important to consider other variables that may impact the determination of treatment effectiveness and keep as many of these constant to ensure that the results of the remediation treatments are not influenced by other factors. Based on results, three areas of approximately 100m wide by 170m long have been identified as possible candidate pilot study sites (**Figure 5.1**). The location south of Inskip Islands has been identified as the best candidate for pilot project implementation given that wood waste depths, bathymetry (range from -10.5 to -11.0 m deep), and sediment type (gravelly mud/sand) and sediment chemistry conditions (e.g. TOC) and are relatively equivalent across the location (**Figure 5.1**). Two other areas south of Cole Island are tentatively proposed as back-up or additional locations; however, there is a greater range in bathymetry across the locations (west side of harbour -3.0 to -4.0m; east side of harbour -4.5 to -6.0 m deep), the west location has more variability in wood waste depth, and the sediment characteristics (e.g. unconsolidated almost suspended layer of fine sand/mud bottom sediments) at these two locations may impact the feasibility of pilot study treatments (e.g. placing a sand layer on top of unconsolidated materials could lead to it sinking into the material rather than remaining as a surficial layer).

Additional suitable candidate pilot study sites may exist, but due to the nature of the field assessments (**Section 3.0**), some data gaps remain between transects/sample locations (**Figure 5.1**). Should further field assessments be conducted prior to the selection of a candidate pilot study site(s), the potential site locations should be re-assessed to determine if the boundaries of the identified locations could be expanded and/or to determine if more suitable locations are available.

A reference site location will also be established in the outer Harbour area, ideally in a location that possesses similar bathymetry, sediment type, and current dynamics to the pilot study site.

Prior to finalizing a pilot study and reference site(s), input is required from PWGSC and DND to ensure that operational requirements of the harbour will not impact the site location over the duration of treatment and monitoring.

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Esquimalt Harbour Wood Waste
Proposed Pilot Project Locations

Legend

- Proposed Pilot Project Location
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Management Options

- Shallow surficial wood waste deposit (0 - 0.25m)
- Deep surficial wood waste deposit (>0.25m)
- Surficial sediment overlying wood waste deposit
- No wood waste

Total Organic Carbon Threshold Contours

- < 1
- > 3
- > 5

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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5.2 STUDY DESIGN

The pilot study design can be applied at one site or at multiple sites. The more sites that are included in the study the greater the confidence in the resulting observations. The cost estimate currently includes pricing for the implementation of the pilot study at one study site location (**Section 5.4**).

Regardless off how many sites are chosen, three treatment types are proposed per study site (for a full description of each treatment type refer to **Section 4.1** and **Table 4.1**):

- MNR – no modifications to the treatment area
- ENR – placement of a thin layer of clean fill over existing sediments (approximately 15 cm deep)
- Dredging – dredge wood waste and impacted sediments and backfill with clean fill

The study design includes both spatial and temporal replication following a Before After Control Impact (BACI) design. Replication in experimental design is required to account for natural variation and reduces the influence of measurement error in analyses; therefore, the pilot study has been designed to include three replicates of each treatment type (in approximately 20 m circular plots) at each site (for a total of nine treatment plots), with a minimum of 3-5 sample locations within each treatment plot (for statistical power; see **Figure 5.2**). A circular treatment plot was selected over a square plot due to the difficulty of placing clean fill from a barge and to allow for some spillover into the surrounding area, so that the treatment can be applied up to, and just over, the boundary of the treatment plot.

The pilot study site(s) need to cover a large enough area that the treatment plots can be spaced far enough apart to avoid edge-effects and prevent incidental influence on the results of other treatment plots. Within the pilot site, the placement of treatment plots should be randomized in order to maximize the statistical power, as this helps to ensure any differences found are attributable to the treatment, rather than a confounding variable.

The four corners of the pilot site, and the center point of each circular treatment plot, will be marked with a cement cinder block, and a small float that is suspended off the seafloor by no more than 1 – 2 m, depending on site depth, to allow for easy detection during sampling while not impeding navigation within the Harbour. Each time the treatment plot is sampled, the sample locations should be randomized.

A reference site location, with two plots, will also be established in the outer Harbour area and sampled as described above. No treatments will be applied to the reference location.

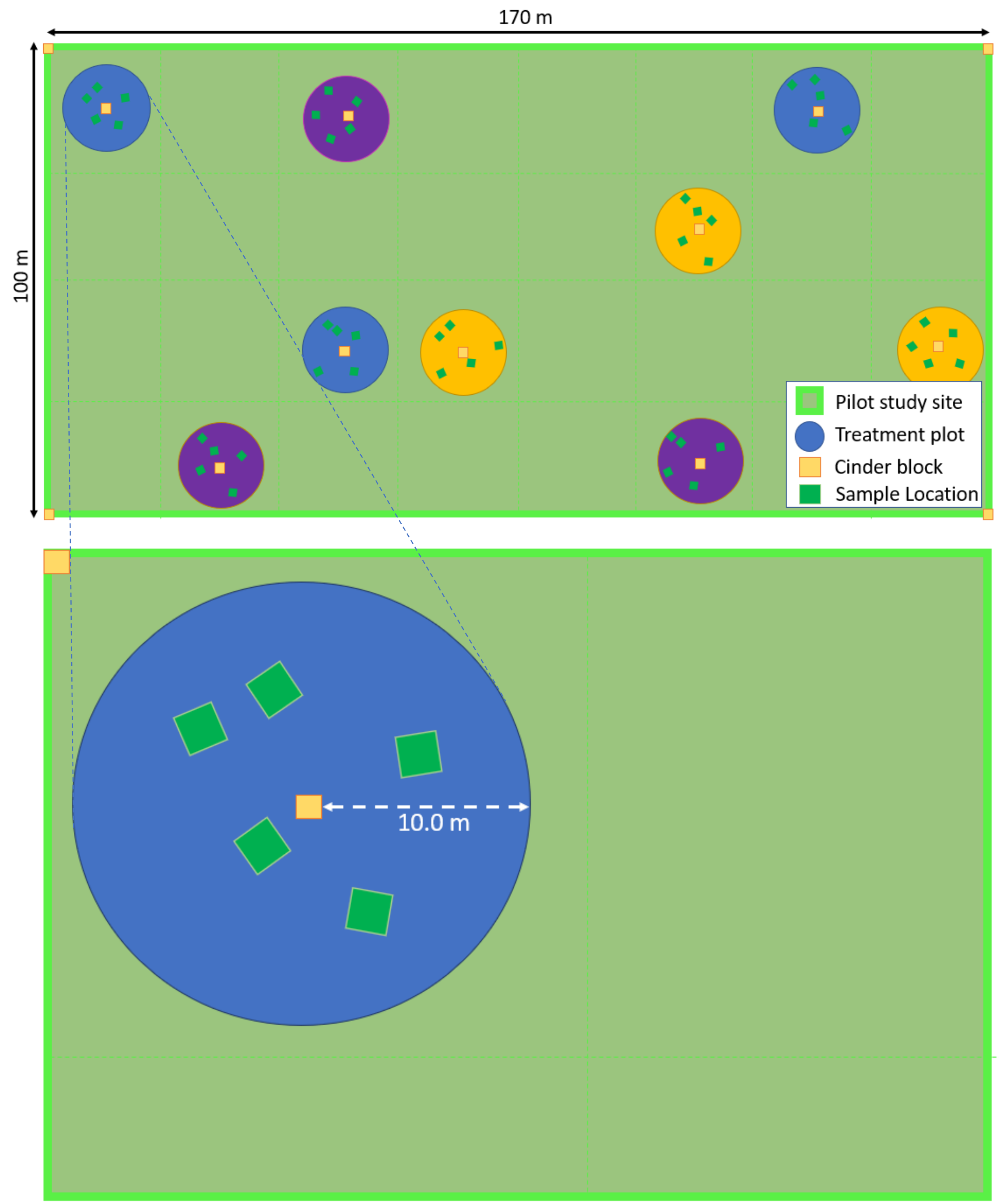

Figure 5.2 Proposed Pilot Project Site Design Includes Three Replicates of each Proposed Treatment Type (MNR, ENR, and Dredge).

5.3 STUDY IMPLEMENTATION

The pilot project implementation has been scoped in a phased approach because it will need to be executed over multiple years. The steps are outlined in the sections below and are proposed to occur with the following timing to coincide with federal government fiscal years:

- Fiscal Year 1 – Completion of regulatory requirements
- Fiscal Year 2 – Baseline conditions (May/June) and application of treatment types (July/August)
- Fiscal Year 3 – Effectiveness monitoring Year 1 (May/June)
- Fiscal Year 4 – Effectiveness monitoring Year 2 (May/June) and final reporting (July – December)

5.3.1 Finalized Site Selection and Pilot Study Regulatory Framework

Regulatory requirements and permitting could be conducted concurrently with **Section 5.3.2 Baseline Conditions**. However, to move forward with the application of the treatment types a few regulatory criteria must be satisfied as outlined below. It is recommended that regulatory requirements be completed well in advance of the application of treatments (Year 1), so that baseline conditions and application of treatments can be completed within the same fiscal year (Year 2), and within the DFO Summer Timing Window for the Protection of Fish and Fish habitat (Area 19 July 1 – October 1).

5.3.1.1 Finalized Site Selection

Before moving forward with regulatory requirements, a final selection of the pilot study site and reference site need to be made in concert with PWGSC and DND.

5.3.1.2 Navigation Protection Act - Notice of Works

Under the *Navigation Protection Act* (formerly the *Navigable Waters Protection Act*), any works that may affect navigation on navigable waters in Canada require approval (**Section 4.4.3**). Because the pilot project will not greatly change the existing bathymetry, or place any obstructions to navigation, a permit approval will not be required. Instead, a *Navigation Protection* Act Notice of Works Form should be completed and submitted to the Transport Canada Navigation Protection Program.

5.3.1.3 Disposal at Sea - Beneficial Use Exemption for Clean Fill

Regardless of the source of fill material, the proponent will be responsible for ensuring the material is clean, suitable for the intended purpose, and not likely to cause marine pollution. The Disposal at Sea Program currently only regulates the placement of dredged material in the marine environment. Therefore, if fill for the ENR and dredge treatments is sourced from an upland quarry, and is comprised of clean construction-grade material, it is Hemmera's understanding that this material will not be required to undergo a DAS beneficial use exemption. Should the clean fill be sourced from dredged marine sediments, the placement of fill from a barge into subtidal areas of Esquimalt Harbour would require a review by the DAS program to determine if it would qualify for a beneficial use exemption.

In order to qualify for beneficial use, there must be a demonstrated need or purpose for the use of the sediment, the sediment must be proven to meet DAS sediment chemistry screening criteria, demonstrate there is no anticipated marine pollution or deleterious effects from the placement of the fill, and have DFO and local First Nations endorsement. After fill has been sourced, a Project Description will be compiled and submitted to DFO and ECCC for consultation and approval. The Project Description will outline:

- Esquimalt Harbour site history and the pilot project objectives (high level overview)
- Fill source location site history/background information
- Dredge area boundary (if fill is dredged) and estimated fill volumes

Depending on the source of dredged materials, a Sediment Sample and Analysis Plan will also need to be prepared and submitted to ECCC for review and input prior to conducting sediment sampling and analysis of the fill and completing a Sediment Characterization Report. If suitable sediment chemistry results already exist, it is possible that ECCC will not require further analysis/reporting. The quantity of fill required for the pilot study will vary based on the dimensions of the final pilot study site location, and treatment plot size, but will be less than 10,000 m^3. Therefore, ECCC will require a minimum of 7 samples (6 samples and 1 duplicate) be analyzed for the minimum analytical requirements, as outlined in **Figure 5.3** below. The Sediment Characterization Report will also be submitted to ECCC to allow for beneficial use signoff. Unlike a full DAS permit application, ECCC does not need sediment chemistry, extended site history information, bathymetric surveys, and dispersion modelling for the receiving pilot study site in Esquimalt Harbour.

5.3.1.4 Disposal at Sea – DAS Permit for Dredged Materials

Before a final pilot study site is selected, and investigatory sediment chemistry conducted to look at DAS Program minimum sample analytical requirements (**Figure 5.3**), it cannot be determined whether sediments from the pilot study site might qualify for a DAS permit. In order to provide a conservative cost estimate, it has been assumed that sediments from the dredge treatment will be disposed of at a permitted upland facility. The DAS permitting process can be lengthy as it must include the compilation of site information and selection of a suitable DAS site, along with First Nations consultation. However, disposal at an upland facility is costly and can have limitations based on the facilities that are able to accept salt-laden waste.

Should PWGSC and DND wish to pursue a DAS permit for dredged materials, ECCC will require detailed Project Description be submitted for review prior to providing input on a Sediment Sampling Plan. Sediment Sampling and a resulting Sediment Characterization Report must be submitted for ECCC to determine whether sediments meet DAS requirements for permitting, at which time, PWGSC and DND could pursue an DAS permit application.

5.3.1.5 **DFO *Fisheries Act – Serious Harm Assessment***

Given the nature and extent of the pilot study design, a serious harm self-assessment is recommended to assess the pilot project-related effects to fish and fish habitat, outline recommended avoidance and mitigation measures for pilot study implementation, and determine residual serious harm. A Request for Review form should be completed and submitted to DFO to ensure the avoidance and mitigation measures, along with the determination of no residual serious harm, are considered suitable. A full *Fisheries Act* Authorization is not expected to be necessary for the implementation of the pilot study.

Disposal at Sea
Minimum Sample Analytical Requirements

The table below outlines minimum analytical requirements for projects with no contaminant history. Prior to sampling, Environment Canada should be consulted to determine the need for additional site-specific analytical requirements.

Metals	Digestion Method	Analytical Method[1]	Target Detection Limit (mg/kg dry weight)	Reference Criterion (mg/kg dry weight)
Cadmium	EPA 3050B	EPA 6020A	0.20	0.60[2]
Mercury	EPA 3050B	EPA 7471	0.05	0.75[2]
Arsenic	EPA 3050B	EPA 6020A	1.00	7.24[3]
Chromium	EPA 3050B	EPA 6020A	1.00	52.3[3]
Copper	EPA 3050B	EPA 6020A	1.00	18.7[3]
Lead	EPA 3050B	EPA 6020A	0.50	30.2[3]
Zinc	EPA 3050B	EPA 6020A	1.00	124[3]
Organics		**Analytical Method[1]**	**Target Detection Limit (mg/kg dry weight)**	**Reference Criterion (mg/kg dry weight)**
Total polychlorinated biphenyls (PCB)		EPA 8080	0.04	0.10[2]
Total polycyclic aromatic hydrocarbons (PAH), [Σ16]		EPA 8270C	0.05	2.50[2]
Acenapthene		EPA 8270C	0.05	
Napthalene		EPA 8270C	0.05	
Acenapthylene		EPA 8270C	0.05	
Anthracene		EPA 8270C	0.05	
Phenanthrene		EPA 8270C	0.05	
Flourene		EPA 8270C	0.05	
Fluoranthene		EPA 8270C	0.05	
Benz[a]anthracene		EPA 8270C	0.05	
Benzo[a]pyrene		EPA 8270C	0.05	
Benzo[b]fluoranthene		EPA 8270C	0.05	
Benzo[k]fluoranthene		EPA 8270C	0.05	
Chrysene		EPA 8270C	0.05	
Benzo[ghi]perylene		EPA 8270C	0.05	
Dibenz[a,h]anthracene		EPA 8270C	0.05	
Indeno[1,2,-cd]pyrene		EPA 8270C	0.05	
Pyrene		EPA 8270C	0.05	
Physical Parameters		**Analytical Method[1]**	**Measurement**	
Total Organic Carbon		EPA 9060A	0.01% dry weight	
Percent Moisture		ASTM D2794-00	1%	
Percent Grain Size Distribution		ASTM D422-63	Sieve and pipette analysis	
Gravel		ASTM D422-63	16 mm – 2 mm	
Sand		ASTM D422-63	2 mm - 0.0625 mm	
Silt		ASTM D422-63	0.0625 mm - 0.0039 mm	
Clay		ASTM D422-63	< 0.0039 mm	

Notes:

[1] An equivalent method certified under the Canadian Association for Laboratory Accreditation that can achieve the specified target detection limit is acceptable.

[2] *Canadian Environmental Protection Act, 1999, Disposal at Sea Regulations*.

[3] Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines, Sediment Quality Guidelines for the Protection of Aquatic Life (Marine).

Figure 5.3 Environment and Climate Change Canada Disposal at Sea Program Minimum Sample Analytical Requirements

5.3.2 Pilot Study Site Setup and Characterization of Baseline Conditions

Once the final pilot study site(s) has been chosen, a pre-treatment determination of baseline conditions should be conducted to allow for the comparison of the effectiveness monitoring results and allow for the determination of remedial standards. Some data will already exist for the pilot study site, based on field assessments conducted as part of this Project (**Section 3.0**); however, further data will need to be collected to fully characterize the entire pilot study site, and include additional metrics that have not been previously sampled.

5.3.2.1 Fieldwork Planning and logistics

Characterization of baseline conditions should be planned for earlier summer months (May/June) in Year 2 of the pilot study so that sampling takes place after the benthic infauna community has had time to flourish (late spring) and, so that the application of treatment types can occur immediately following, within the same fiscal year (July/August), to (i) coincide with the DFO Summer Timing Window for the Protection of Fish and Fish habitat (Area 19 July 1 – October 1) and (ii) allow time for fill to settle and colonization to occur before the effectiveness monitoring begins in the next fiscal year.

A detailed sampling plan will be completed, outlining specifics of the pilot study site(s) setup, sampling of biophysical conditions, and reporting and provided to PWGSC and DND for review. Prior to the commencement of fieldwork, a Health and Safety Plan will also be provided for PWGSC and DND review.

ArcGIS will be used to determine the coordinate locations of the pilot study site boundaries, as well as the center points of each treatment plot and five sample location coordinates within each treatment plot. The sample location coordinates can then be used to determine the compass bearings and distances from the center cinder block.

5.3.2.2 Fieldwork

All fieldwork will be conducted by SCUBA and assisted by a surface-support vessel. For each pilot site and the reference site, the vessel will transit to the pre-determined coordinates for the location and divers will setup the cement cinder blocks at each of the four corners, and at the centre point of each treatment plot (**Figure 5.2**). With diver support, cinder blocks will be slowly lowered from the surface-support vessel on a temporary leadline with a buoy float. Divers will then descend the float line to re-position the cinder block, as necessary, and attach a smaller/shorter marker float for future treatment plot identification (**Figure 5.4**). All cinder block locations will be georeferenced in the field using a handheld GPS unit from the surface-support vessel and the temporary surface buoy as the location.

After setup, and before seafloor sediments are disturbed at each treatment/reference plot by grab sampling and divers, water quality measurements will be assessed using a YSI© handheld multi-parameter meter and the temporary surface buoy as a marker. Parameters will be measured at the surface (-1.0 m) and just above the seafloor, and will include temperature (ºC), dissolved oxygen (%), conductivity (µs/cm), salinity (PPT), pH, and redox potential data was collected.

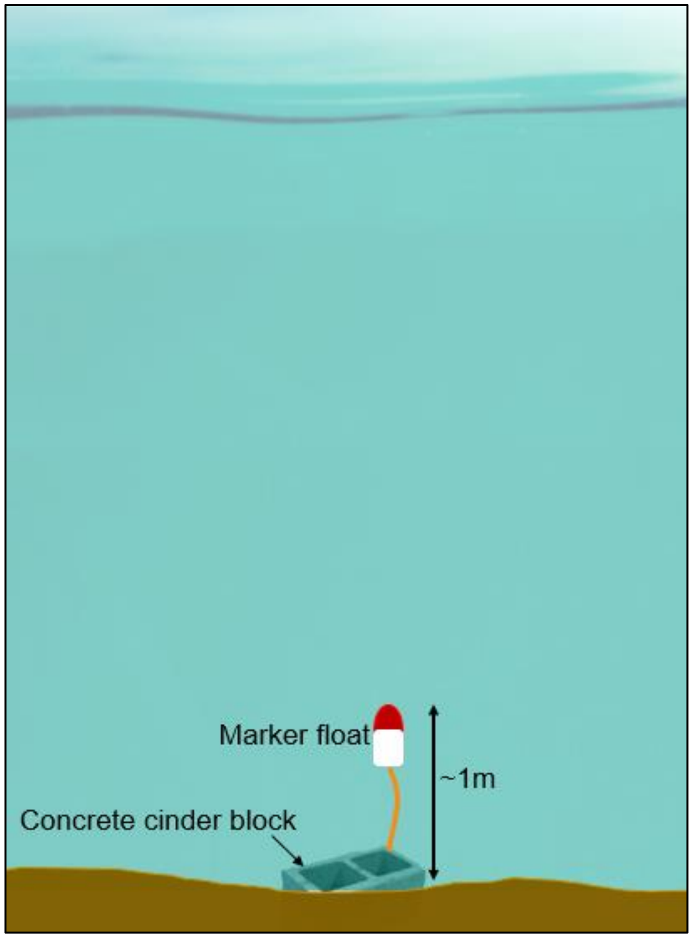

Figure 5.4 Example of Pilot Study Marker Setup

A sediment grab sampler (e.g. Van Veen) will then be deployed at the center point of each treatment plot and reference plot and field-screened by a Biologica technician through a 1.0 mm sieve using unfiltered seawater. Material retained on the screen will be transferred to jars and preserved with 10% buffered formalin for laboratory benthic infauna community analysis. It is recommended that benthic infauna community analysis be conducted during the establishment of baseline conditions, and again at the conclusion of the pilot study, to investigate differences in the benthic infauna community structure, rates of colonization, and determine if larger bioturbators and pollution-sensitive species are present. Benthic infauna communities undergo succession as they reach a mature community, with a greater presence of larger microbenthic and pollution-sensitive species in later stage or healthier productive communities. Larger taxa play a role in the bioturbation of sediments through their burrowing activities, this re-working of the sediments provides oxygenation and can aid in the recovery of wood-waste impacted areas. However, benthic infauna community data for the Harbour currently indicates that pollution-tolerant or opportunistic species dominate, with very few large bioturbators or sensitive species present. The presence of bioturbators will be an integral part of the success of enhanced natural recovery treatments. While this analysis is costly, it would be informative of the likelihood of a healthy and productive mature benthic infuana community developing within the Harbour.

After setup and grab sampling, biophysical conditions within each of the nine treatment plots and two reference plots will be surveyed. At each plot, divers will descend the temporary line to the center cinder block and use the predetermined compass bearings and a transect tape to navigate to the five randomized sample locations. At each of the five sample locations, divers will place a 1.0 m x 1.0 m quadrat, use an underwater camera to take a photo of each sample location quadrat, and record:

- Seafloor depth
- Substrate type (% cover; **Table 3.2**)
- Marine vegetation, bacteria (*Beggiatoa* sp.) and sessile invertebrates (% cover)
- Mobile invertebrates and fish observed within a few metres of the quadrat (abundance)

At three sample locations (i.e. quadrat) within each plot, divers will also collect surficial sediment using push cores, to delineate the depth of wood waste and collect sediment for the analysis of biophysical and chemical parameters as follows:

- One long core (0.80 m long by 0.05 m diameter PVC tube) will be pushed into the sediments by hand or using a one-kilogram hammer to a depth where it could no longer penetrate. The core will be capped, removed from the sediment, and a second cap placed on the bottom of the core to ensure the contents were not released. The sediment is retained in the corer during removal from the sediment due to suction created by the cap.
- Three short squat cores (0.30 m long by 0.10 m diameter PVC tube) will be pushed into the sediments by hand or using a one-kilogram hammer to a depth where it could no longer penetrate and capped as above.
- A one-meter long metal probe, marked with 10cm intervals, could also be used within the transect to collect additional information on the depth of hard substrates, shell hash/debris, and/or wood waste.

Aboard the surface-support vessel, sediment within the long core will be extruded into a core box and visually inspected, photo-documented, and a borehole log completed to document the vertical profile of substrate types and wood waste stratification (**Table 3.2**), along with other sediment observations (e.g. texture, colour, odour, presence of biota).

Sediment from the shorter cores will be used for analysis of physical and chemical sediment parameters, along with bioassays. Water will be decanted from the cores and the sediment immediately placed in clean containers/polyethylene bags, labelled with project information, recorded on a chain-of-custody form, and placed in coolers with ice packs to maintain temperatures below 6 ºC until they can be shipped to the appropriate laboratory facility. Approximately one duplicate for every ten samples will also be selected at random for data QA/QC procedures.

Following the completion of sampling at each of the nine treatment plots and two reference plots, the temporary surface line/buoy used for setup can be untied and reeled back into the surface-support vessel, and the shorter marker buoy left to help with location identification during future phases (**Figure 5.4**).

5.3.2.3 Analysis and Reporting

Benthic infauna community samples collected in the field will be analyzed by Biologica after a period of fixation, similar to that described in **Section 3.1.2.2**. Sediment core samples collected in the field will be sent to an accredited laboratory facility for analysis of physical and sediment chemistry parameters and to Nautilus Environmental for bioassay testing.

Sediment will be analyzed for the following physical and chemical parameters, which includes wood waste by-products along with contaminants which could impact results of the pilot study:

- Grain size distribution
- TOC
- Ammonia (NH_3) and pH
- Pore-water sulphides
- Heavy metals
- PAHs
- PCBs
- Dioxins/furans

Bioassays are an analytical method used to determine the toxicity of the sediment on living animals, they are a confirmatory tool used to demonstrate whether wood waste is adversely impacting benthic community and will be used to determine the short-term effectiveness of selected pilot project treatments by correlating wood waste and wood waste by-products with bioassay results. Provincial ecological risk assessment guidelines and the FCSAP provide guidance on bioassay testing but there are no Canadian criteria. Washington State SMS criteria stipulates the use of 2 acute and 1 chronic bioassay test for marine sediment (Washington 2013). Once the timing of the baseline conditions fieldwork has been confirmed, Nautilus Environmental can be contacted to determine the seasonal availability of species. Nautilus requires a minimum of one week's notice prior to submitting samples; however, samples can be held for up to 6 weeks before conducting bioassay testing. The bioassay toxicity tests outlined in **Table 5.1** have been selected as suitable for the pilot study, based on locally-relevant infauna/epifauna that naturally occur in soft sediment habitats. The cost of one chronic and one acute test have been included in the cost estimate, it is recommended that at least one of the tests include a benthic infauna organism type (**Section 5.4**).

Table 5.1 Locally-relevant Toxicity Tests, Species and their Classification

Toxicity Test (Duration/Endpoint)	Species	Organism Type	Test Classification
48 – 96 h larval development and survival	Sea urchin (*Strongylocentrotus purpuratus*) or sand dollar (*Dendraster excentricus*)	Epibenthic	Chronic
10-minute fertilization	Sea urchin (*Strongylocentrotus purpuratus*) or sand dollar (*Dendraster excentricus*)	Epibenthic	Acute
20-day survival and growth	Polychaete worm (*Neanthes arenaceodentata*)	Benthic Infauna	Chronic
10-day survival	Amphipod (*Rhepoxynius abronius*)	Benthic Infauna	Acute

Site-specific remedial standards will need to be developed based on site-specific conditions. Data analysis results from the pilot study site and outer harbour reference site will be compared to determine remedial endpoint goals. Results of the baseline conditions and remedial standards will be summarized in a short letter-style report for use in determining effectiveness of pilot study treatments in future fiscal years.

5.3.3 Application of Pilot Study Treatments

Following the completion of regulatory requirements and collection of baseline conditions, the various treatment types can be applied to the treatment plots as outlined below.

5.3.3.1 Fieldwork Planning and logistics

Characterization of baseline conditions should be planned for earlier summer months (May/June), after benthic community has had time to flourish, so that the application of treatments can occur immediately following, within the same fiscal year (July/August). The application of treatments to each treatment plot should be conducted within the DFO Summer Timing Window for the Protection of Fish and Fish habitat (Area 19 July 1 – October 1) and follow avoidance and mitigation measures outlined in the Serious Harm Assessment.

Prior to the commencement of fieldwork, a detailed Implementation Plan will be completed, outlining the specific details of implementation. A Health and Safety Plan will also be provided for PWGSC and DND review.

Treatment types applied to each of the nine treatment plots will be randomized and determined in advance of the fieldwork.

5.3.3.2 Fieldwork and Reporting

Application of the various treatment types will commence with the dredging and removal of wood waste and impacted sediments from the three treatment plots assigned to the dredge treatment and wrap up with the placement of clean fill for the ENR and dredge treatments. To assist with the application of treatments (i.e. move/replace treatment plot markers and confirm treatments have been applied appropriately), a dive team will also be onsite with a surface support vessel.

For the dredge treatment plots, a spudding, crane barge (with dredge bucket size approximately 3-4 m^3) will mobilize to site and use previously-marked GPS coordinates to position at each of the three dredge treatment plots. Divers will confirm the treatment plot marker locations and remove them prior to the dredging. As dredgeate is removed it will be placed in a contained barge. Following the completion of dredging at a treatment plot, divers will visually confirm dredging parameters, and place a temporary center marker using a concrete cinder block with leadline and surface buoy.

Total volume of dredgeate is estimated to be approximately 400 m^3, assuming three 20 m diameter treatment plots are dredged to approximately 0.4 m depth. Once the pilot study site has been selected, and baseline conditions collected, the total dredge volume can be more accurately determined.

Sediment samples will be collected from the dredgeate of each of the treatment plots and sent for sediment chemistry analytics to inform upland disposal facilities of contents and cost of disposal. For each of the three dredge treatment plots, 3 composite samples will be created. The sediment samples will be placed in clean containers/polyethylene bags, labelled with project information, recorded on a chain-of-custody form, and placed in coolers with ice packs to maintain temperatures below 6 ºC until they can be shipped to the appropriate laboratory facility. Approximately one duplicate for every ten samples will also be selected at random for data QA/QC procedures. Sediment samples collected in the field will be sent to an accredited laboratory facility for analysis of the following sediment chemistry parameters:

- Grain size distribution and % moisture
- TOC
- TCLP metals (including sulphur)
- LEPH/HEPH/PAH
- PCB
- BTEX
- Na/Cl

Once analytical results are received, the dredgeate can be towed to a location where it can be offloaded to dump trucks and transported to an upland facility that can accept salt-impacted sediments for disposal.

Once dredging is complete, placement of clean fill can commence. A spudding, crane barge will position itself using GPS waypoints for treatment plots, and the temporary surface buoy markers placed by divers, and place fill with the dredge at both the ENR treatment plots and the dredged treatment plots. Before fill is placed, divers will move the treatment plot markers and, following the placement of fill, divers will visually confirm that fill is placed appropriately (i.e. confirm thickness or provide feedback to crane operator on further areas to fill) and replace the treatment plot markers as per **Figure 5.4**. Approximately 600 m^3 of clean fill has been estimated to be required, 190 m^3 to place 15-20 cm of sand across the ENR treatment plots, and 400 m^3 of fill to backfill the dredged treatment plots.

Onsite dive team members can serve as Environmental Monitors, to ensure that avoidance and mitigation measures outlined in the *Fisheries Act* Serious Harm Assessment are being implemented appropriately.

Results of the application of treatment types will be summarized in a short letter-style report. If the application of treatment types is completed within the same fiscal year as the baseline conditions, these results can be included in the same report. An environmental monitoring report will also be submitted at the completion of treatment application, summarizing on-site environmental activities and documenting any issues that arose.

5.3.4 Effectiveness Monitoring

Benthic infauna communities undergo succession as they reach a mature community, with a greater presence of larger microbenthic and pollution-sensitive species in later stage or healthier communities. The colonization and re-establishment of the benthic infauna community could take several years to establish. For example, results from Esquimalt Graving Dock Remediation Project's Year 1 and Year 3 effectiveness monitoring provides an indication of both rates of colonization/re-establishment and community composition following remediation within Esquimalt Harbour (Keystone 2015). Year 1 results indicate that the benthic infauna community was dominated by small, quick colonizers or species known to be pollution-tolerant (Keystone 2015)[4]. Therefore, effectiveness monitoring is recommended to occur annually for a minimum of two consecutive years following the application of treatment types (within pilot study Years 3 and 4). The presence of bioturbators will be an integral part of the success of enhanced natural recovery treatment (as described in **Section 4.1.2**); therefore, time should be allowed for larger bioturbators to colonize and begin bioturbating the clean fill, before the determination of pilot study effectiveness. Effectiveness monitoring must occur at the same time of year as the characterization of baseline conditions (May/June), to avoid any impacts of seasonality on the results, as was observed with the Esquimalt Graving Dock work (Keystone 2015).

[4] Bathymetry at the Esquimalt Graving Docks may differ significantly from wood waste remediation areas, and benthic invertebrate community structure varies with seafloor depth.

Sampling of the treatment and reference plots will follow the exact procedures used for sampling baseline conditions, outlined in **Section 5.3.2** above. In short, SCUBA divers will transit to the pilot study site and reference site using a surface-support vessel. Treatment plots will be located using previously determined GPS coordinates for the center marker of each plot. Before seafloor sediments are disturbed, water quality measurements will be taken at the center point of each plot. Divers will then locate the center cinder block of each plot and use predetermined compass bearings and a transect tape to navigate to five randomized sample locations. At each location a quadrat will be used to record biophysical observations, and push cores will be used to collect sediment at three of the locations. Sediment cores will be processed on the deck of the support vessel and sent to the appropriate laboratory facilities for analysis of physical and chemical parameters, along with bioassay testing.

Benthic infauna community analysis will only be conducted during the second year of effectiveness monitoring. Here, divers can attach temporary surface buoys to the treatment and reference plot center markers so that the sediment grab sampler can be deployed. Methods for field screening and laboratory analysis are as described above (**Section 5.3.2**).

Results of the first year of effectiveness monitoring will be summarized in a short letter-style report, comparing data to baseline conditions, while results of the second year of effectiveness monitoring will be rolled into the final report.

After the second year of effectiveness monitoring is complete, the pilot study and reference site and treatment plot markers can be removed by the divers. However, PWGSC and DND may decide to maintain these for potential future monitoring.

5.3.5 Determination of Pilot Study Effectiveness Report

Once the analytical results for the second year of effectiveness monitoring have been received (approximately 2-3 months following fieldwork), the data for pre-treatment baseline conditions and the two years of effectiveness monitoring can be compiled, analyzed and a final report for the pilot study project compiled.

Results will be used to determine whether there are any significant differences in wood waste by-product levels (i.e. TOC, ammonia, sulphides), bioassay toxicity results, and benthic infauna community structure between the three treatment types and the reference location. This will aid in the determination of which treatment type was most effective for the restoration of a productive benthic community. Based on the outcome, recommendations will be made for the remediation of the discontinuous and/or shallow areas of wood-waste deposits within Esquimalt Harbour.

5.4 COST ESTIMATE

Given the level of information available for basic scoping of the pilot study permitting, phased design implementation, and determination of effectiveness, a detailed, but not definitive, cost estimate is provided. The total estimated cost for the pilot study project implementation is **$3,132,020.00,** plus applicable taxes, with a breakdown of totals by year provided in **Table 5.2** below and the detailed cost estimate breakdown included in **Appendix J: Detailed Pilot Project Cost Estimate**.

Table 5.2 Pilot Study Project Cost Estimate Totals by Year

Category	Cost
Year 1: Finalized Site Selection and Regulatory Requirements	$ 21,581.00
Year 2: Pilot Setup, Baseline Conditions, Application of Treatments	$ 2,712,523.00
Year 3: Effectiveness Monitoring Year 1	$ 164,298.00
Year 4: Effectiveness Monitoring Year 2 and Determination of Effectiveness	$ 233,618.00
Total Pilot Study	**$ 3,132,020.00**

Assumptions and notes on the cost estimate:

- Cost estimate currently includes pricing for the implementation of the pilot study at one study site. It is noted that additional sites would improve the margin of error
- Dredgeate volume is assumed to be approximately 400 m^3 – based on three, 20 m diameter dredge treatment plots are dredged to approximately 0.4 m depth. Once the pilot study site has been selected, and baseline conditions collected, the total dredge volume can be more accurately determined
- Cost estimate is based on disposal of dredgeate at a Vancouver-Island based facility.
- The weight of dredged sediments is assumed to be 2000 kg/1 m^3 and based the cost of upland disposal on the cost of drill cutting sediments disposed of following Field Survey 6 ($1.86/kg). Physical stabilization of sediments may be required, and the upland facility may not accept cut logs within the dredgeate.
- The dredging costs will vary with contractor, equipment type, and study site depths (greater depths will take longer to dredge and backfill)
- Cost estimate assumes that approximately 600 m^3 of clean fill will be required – based on 190 m^3 to place 15-20 cm of sand across the three ENR treatment plots, and 400 m^3 of fill to backfill the dredged treatment plots.

6.0 PUBLICATION RECOMMENDATIONS

The publication of wood waste assessment and remediation case studies contributes to the working knowledge of the success of wood waste remediation and provides valuable information to waterlot managers in British Columbia on the regional impacts of wood waste and success of site-specific designed remediation efforts. Therefore, recommendations for the publication of assessment and remediation results have been included here for PWGSC and DND's consideration.

Given that the site characterization and assessment data is extensive, and the pilot study project has a separate objective, two or three targeted scientific publications are proposed as follows:

1. Assessment of Wood Waste Impacts to Benthic Communities within Esquimalt Harbour
2. Site-specific Effectiveness and Feasibility of Three Wood Waste Remediation Treatments on Areas of Discontinuous or Shallow Wood Waste Deposits in Esquimalt Harbour
3. Remediation of Wood Waste Impacted Sediments in Esquimalt Harbour

An initial list of suggested journals for publications has been provided in **Table 6.1** for consideration.

Table 6.1 Proposed Scientific Journals for Publication of Wood Waste Assessment and Remediation Results

Journal	Journal Scope	Notes
Marine Pollution Bulletin	Concerned with the rational use of maritime and marine resources in estuaries, the seas and oceans, as well as with documenting marine pollution and introducing new forms of measurement and analysis. Topics include effluent disposal and pollution control, but also the management, economic aspects and protection of the marine environment in general. Several different categories of articles are published, including, 'baselines' which document measurements which are expected to have value in the future.	• International • Publication fee • Open Access
Water Quality Research Journal of Canada	The Water Quality Research Journal is a forum for original research dealing with the aquatic environment and reports new and significant findings that advance the understanding of the field. General subject areas can include: Impact of current and emerging contaminants on aquatic ecosystems, Aquatic ecology, Conservation and protection of aquatic environments, Responsible resource development and water quality (mining, forestry, hydropower, oil and gas), wastewater and stormwater treatment technologies and strategies, Industrial water quality, Groundwater quality (management, remediation, fracking, legacy contaminants), Assessment of surface and subsurface water quality, Regulations, economics, strategies and policies related to water quality.	• Canadian journal - more relevant regionally. • No publication fee • Open Access (for a fee) • Easier/faster to get published
Water Environment Research	Water Environment Research is a multidisciplinary water resource management journal for the dissemination of fundamental and applied research in all scientific and technical areas related to water quality and resource recovery. Goal is to foster communication and interdisciplinary research between water sciences and related fields such as environmental toxicology, agriculture, public and occupational health, microbiology, and ecology. In addition to original research articles, short communications, case studies, reviews, and perspectives are encouraged.	• International • Engineering audience

7.0 CONCLUSIONS

We sincerely appreciate the opportunity to have assisted you with this project and if there are any questions, please do not hesitate to contact the undersigned by phone at 604.669.0424.

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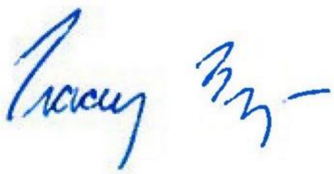

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APPENDIX A
Aerial Photos


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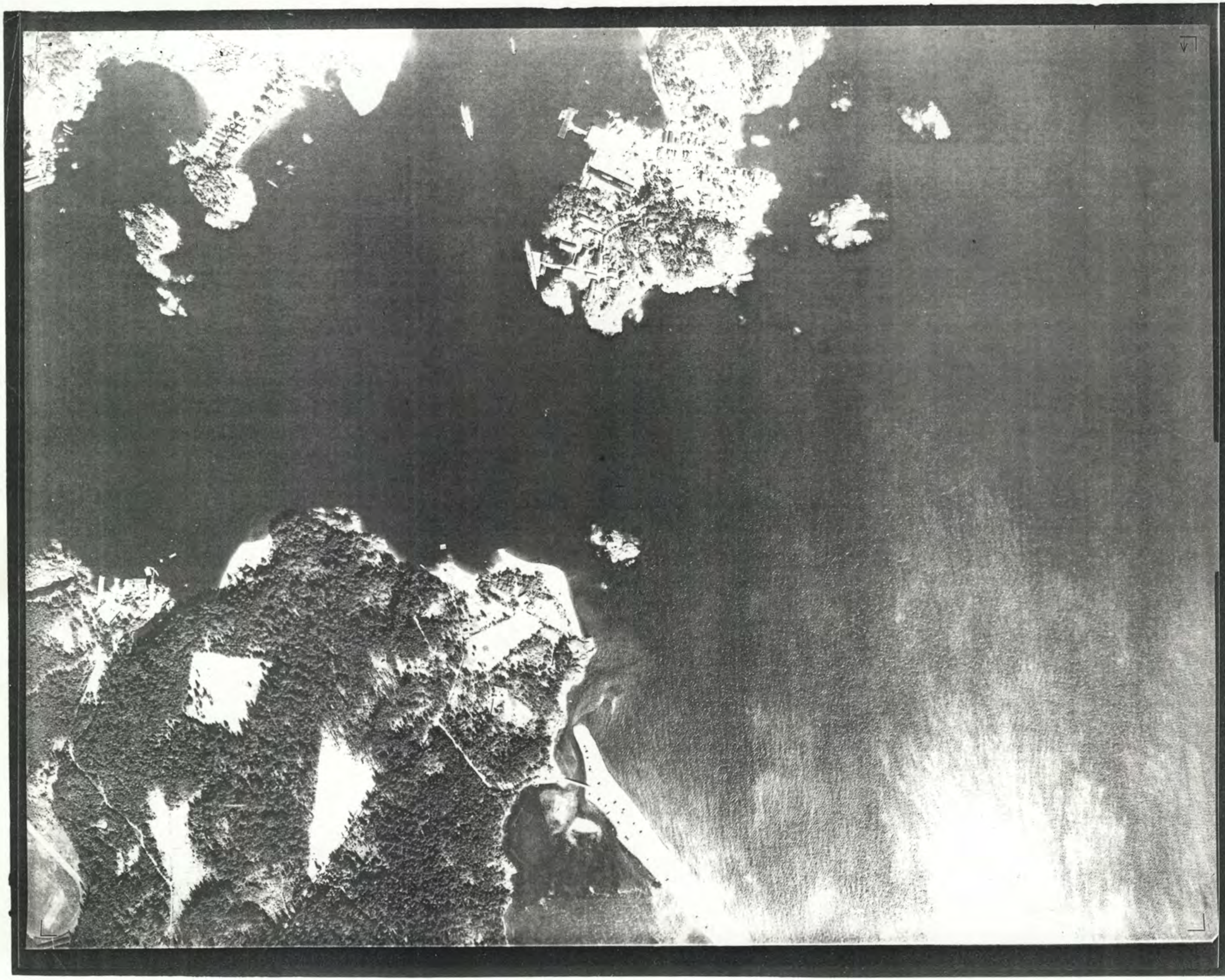


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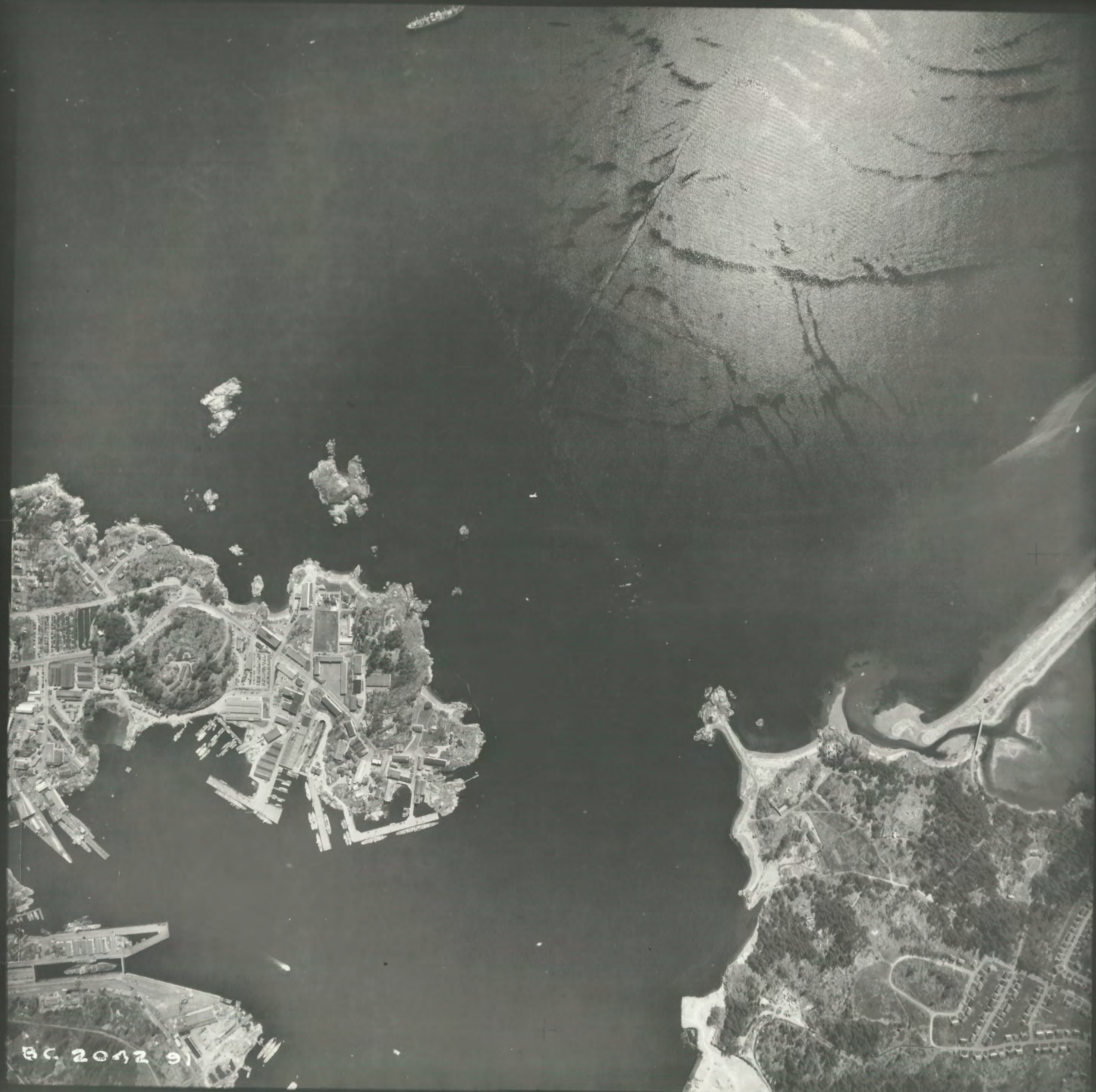
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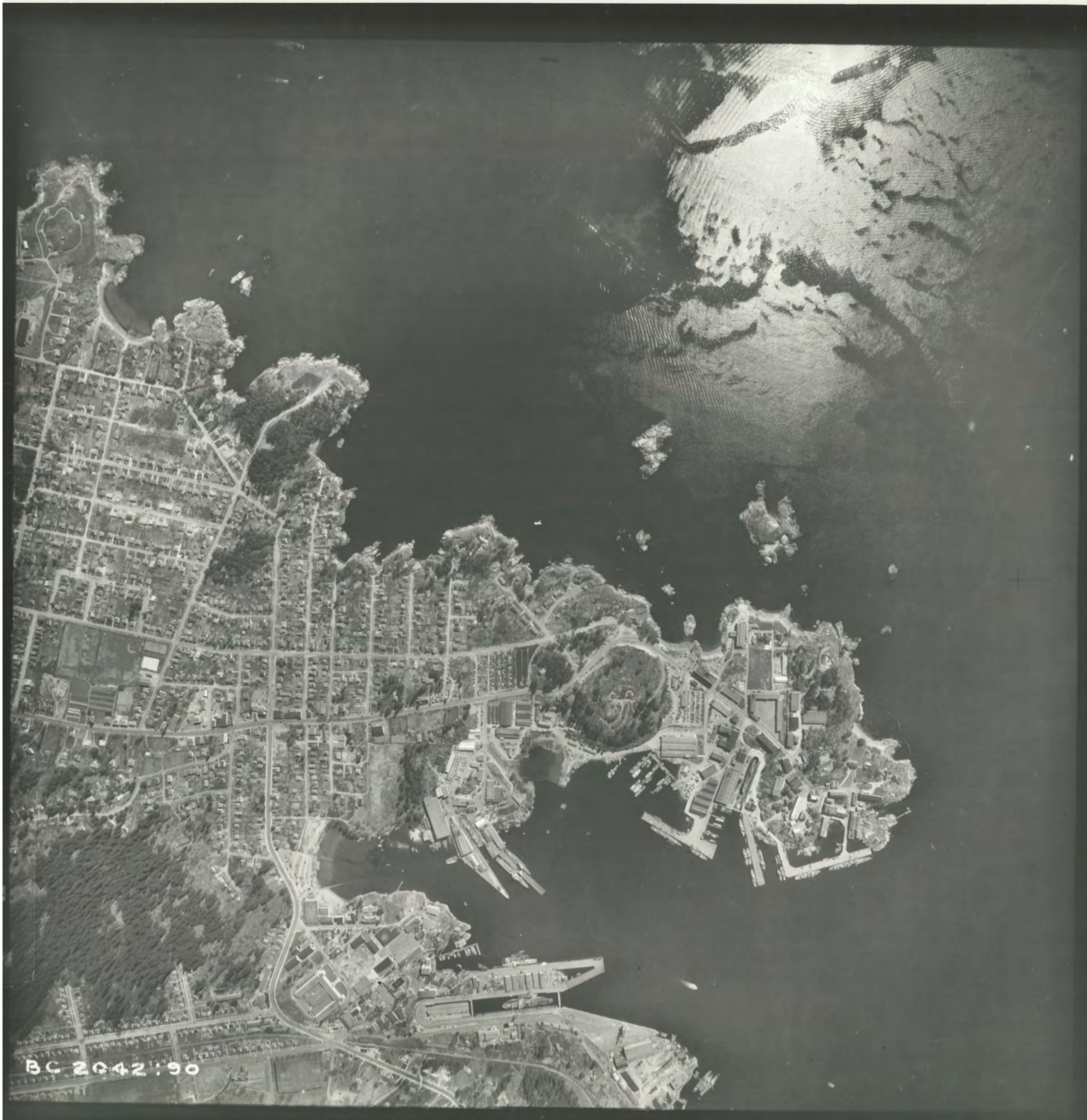
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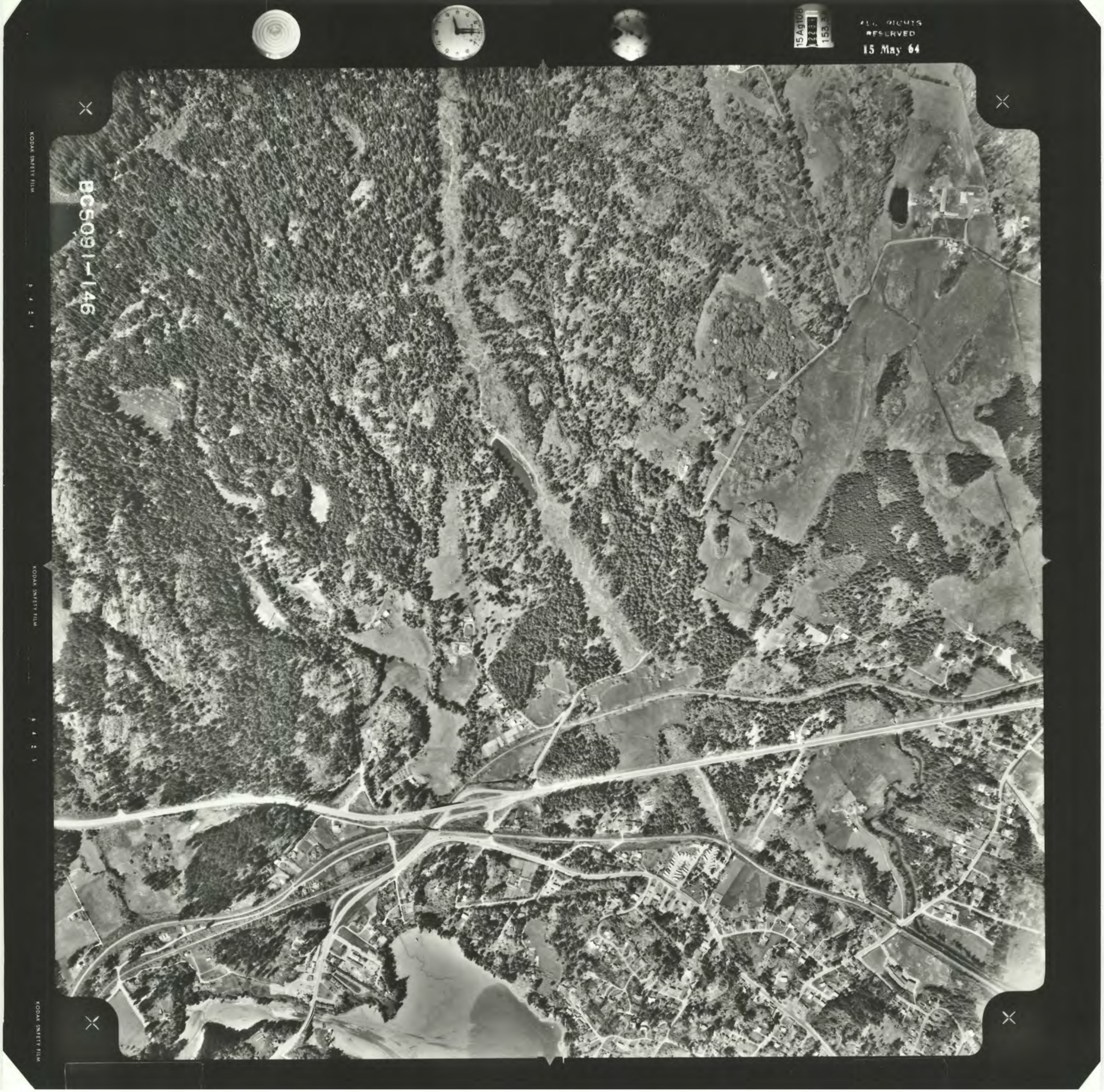
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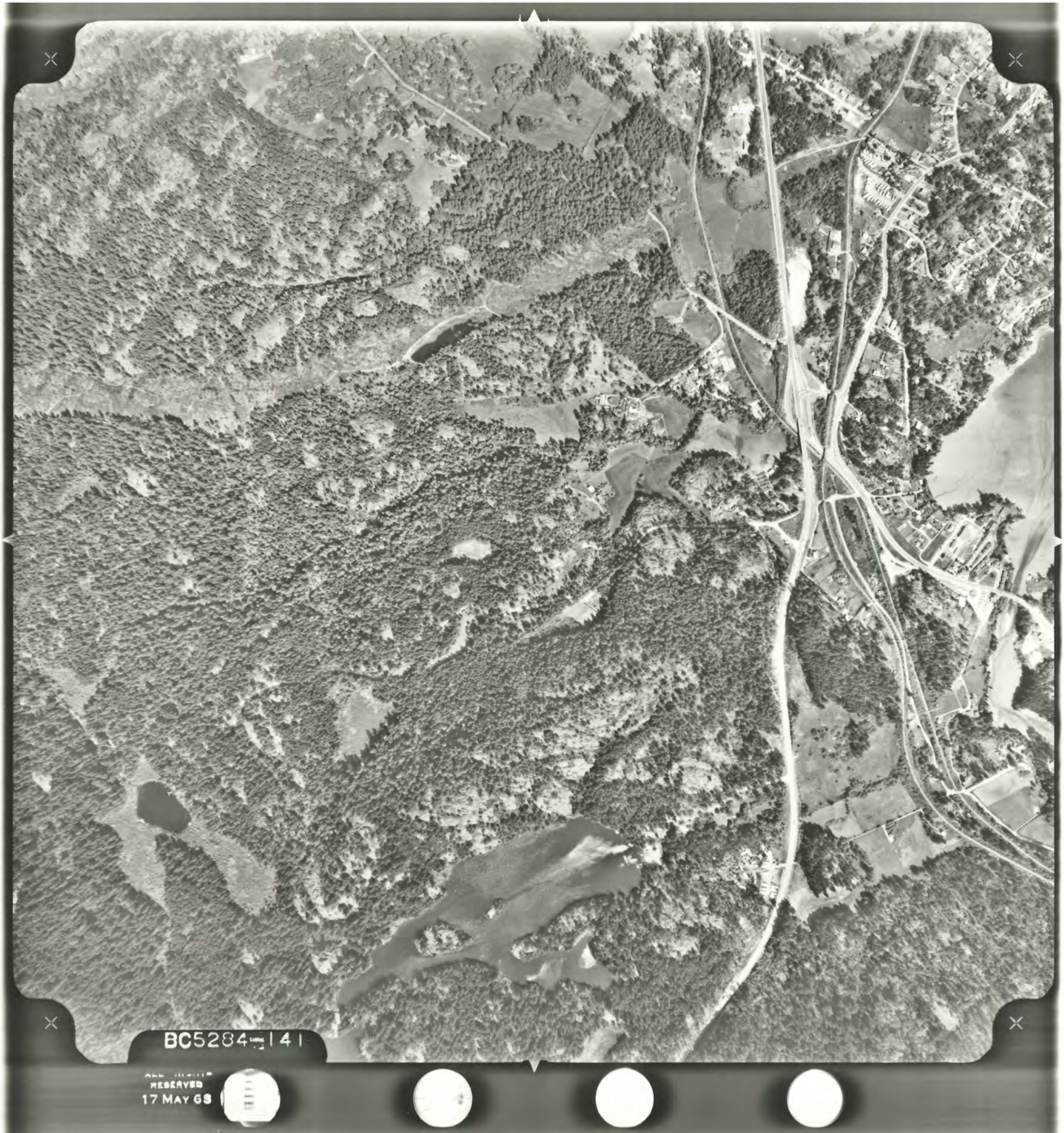
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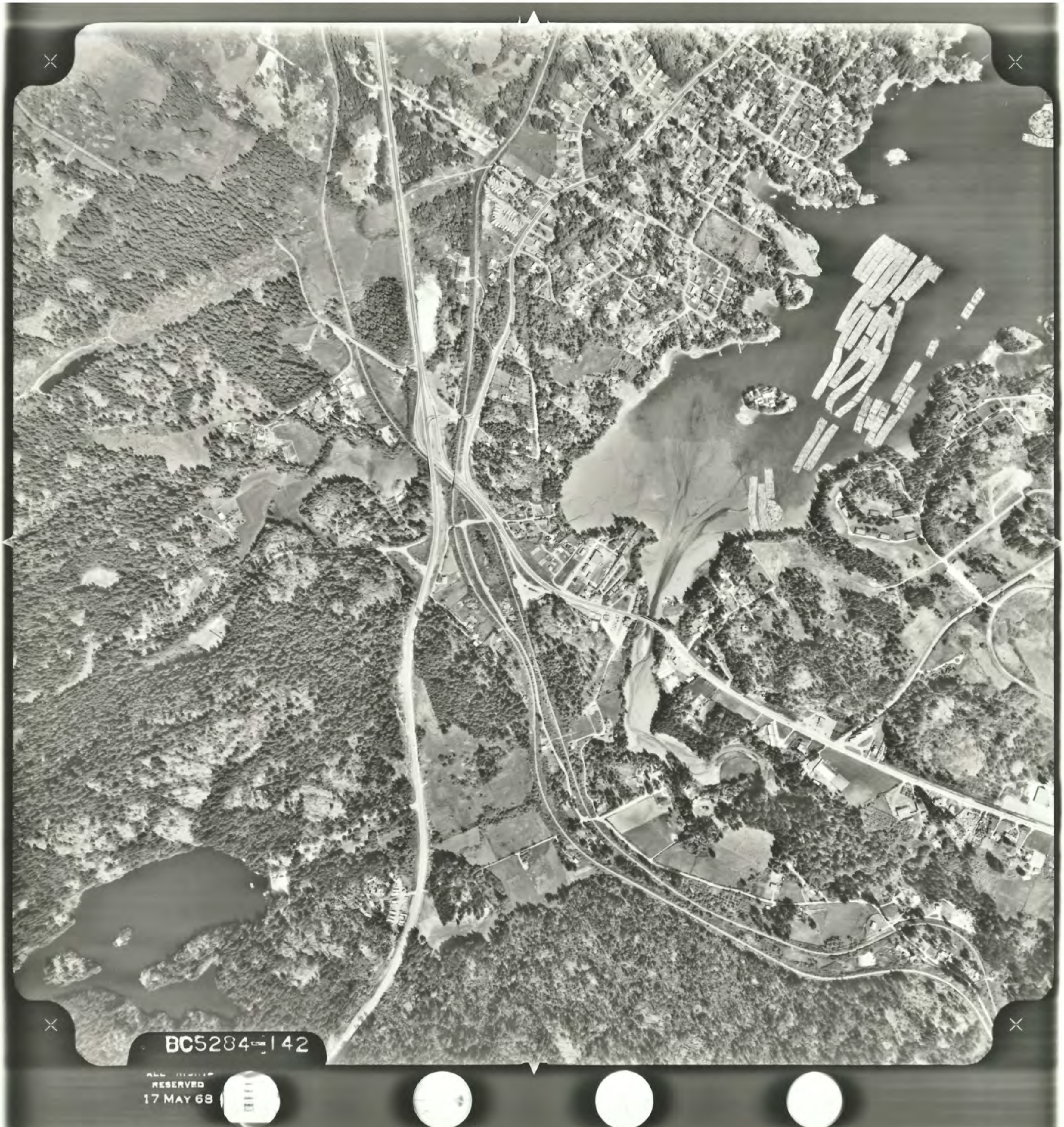
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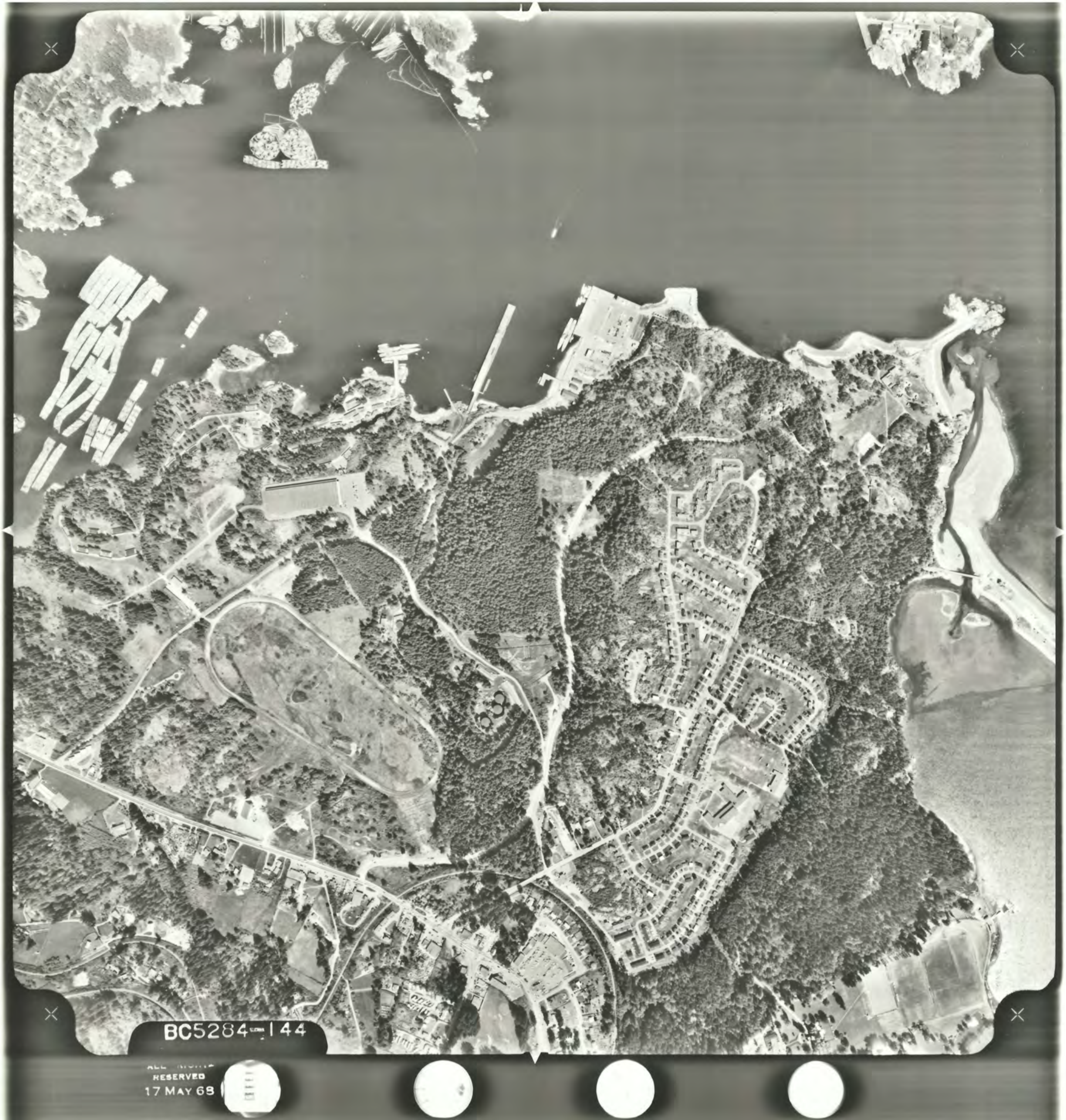
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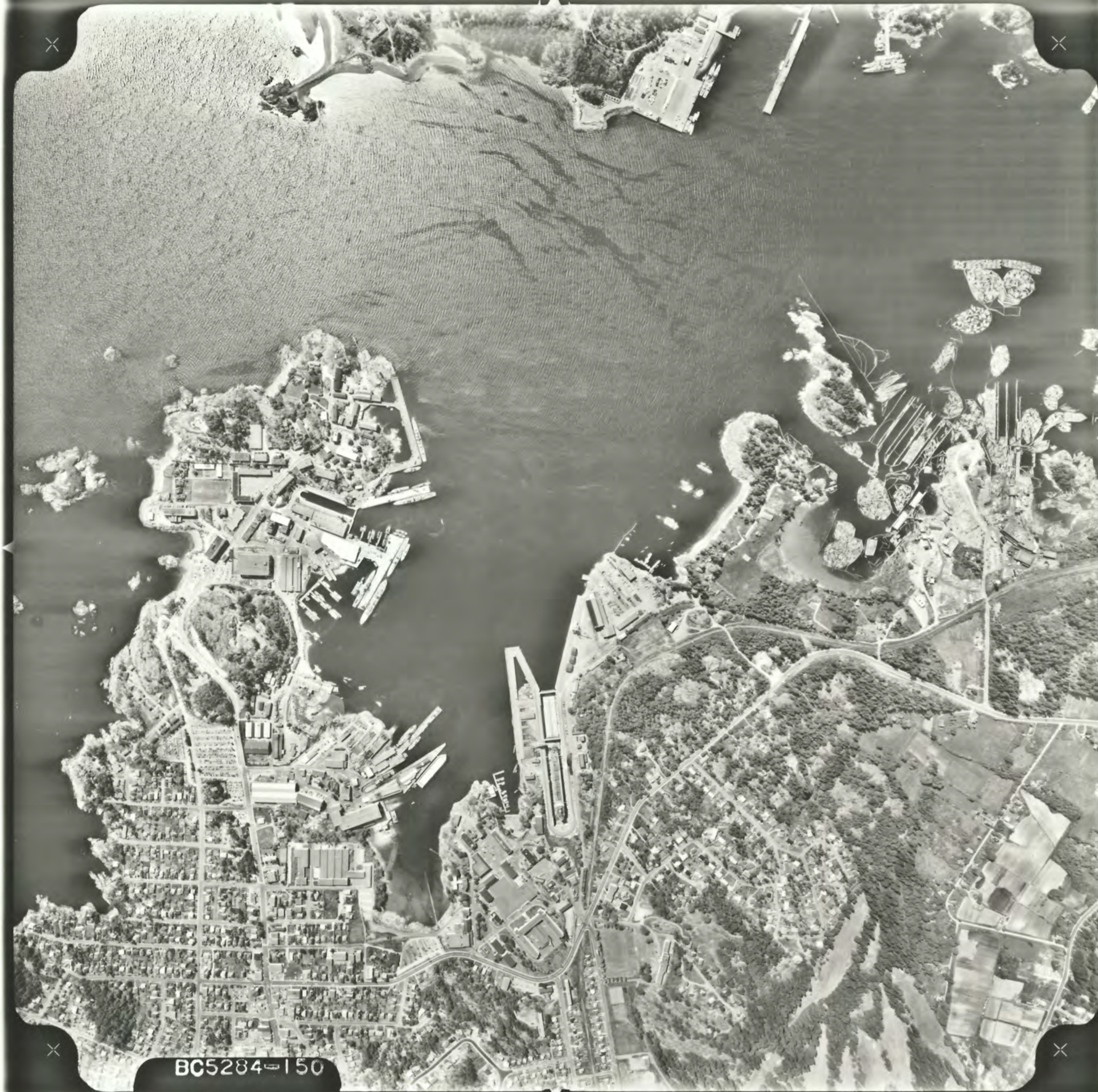

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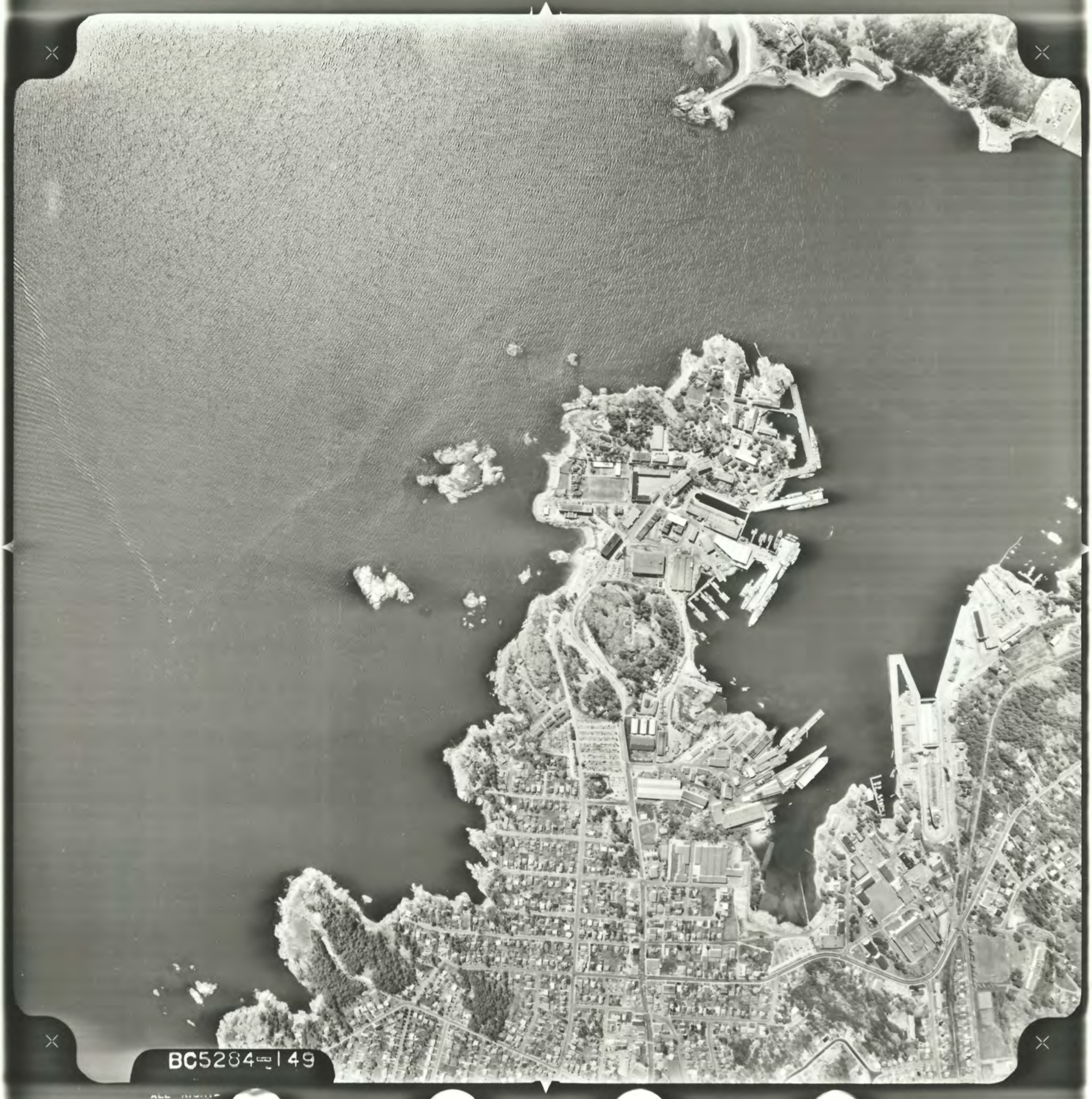
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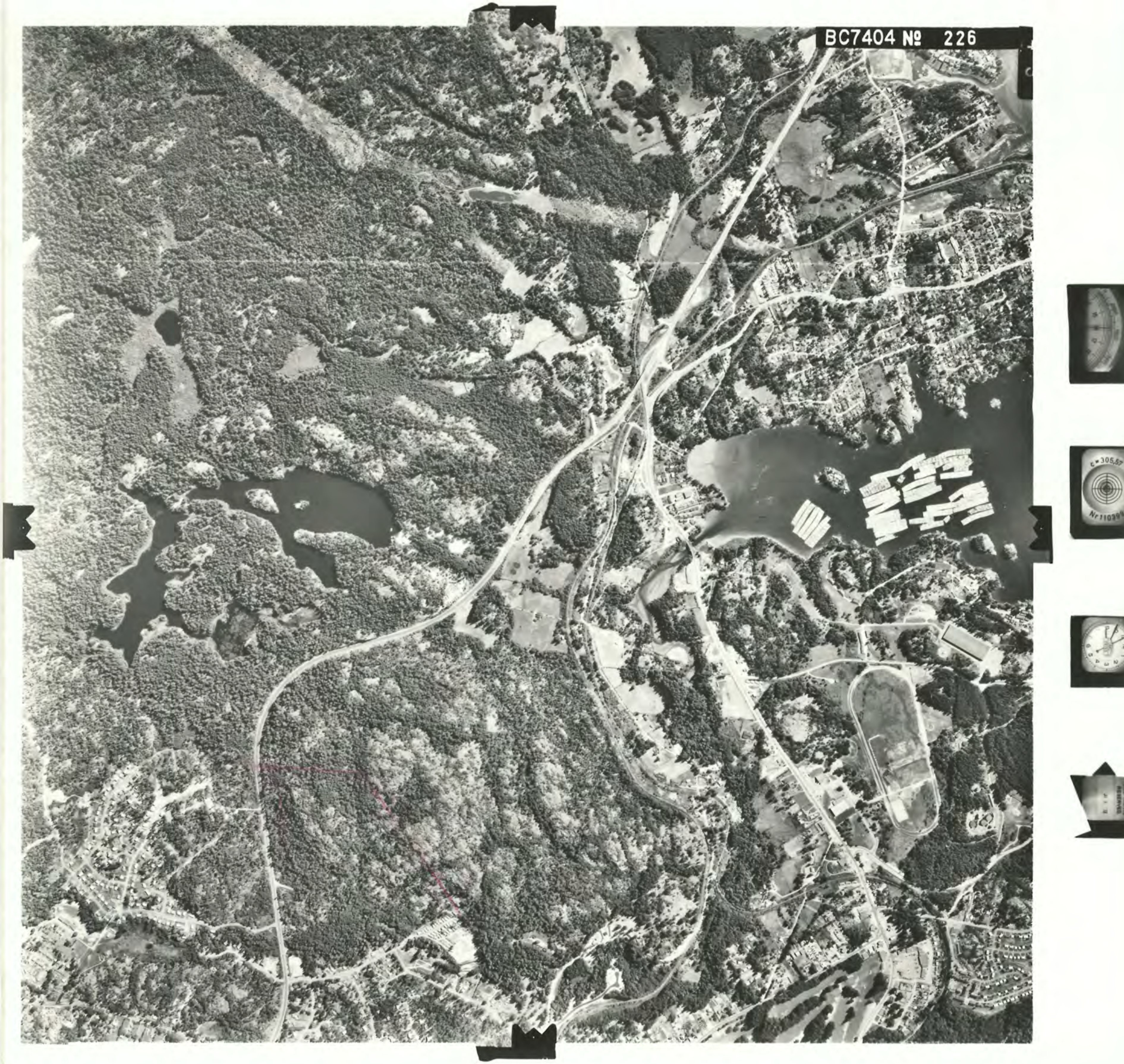
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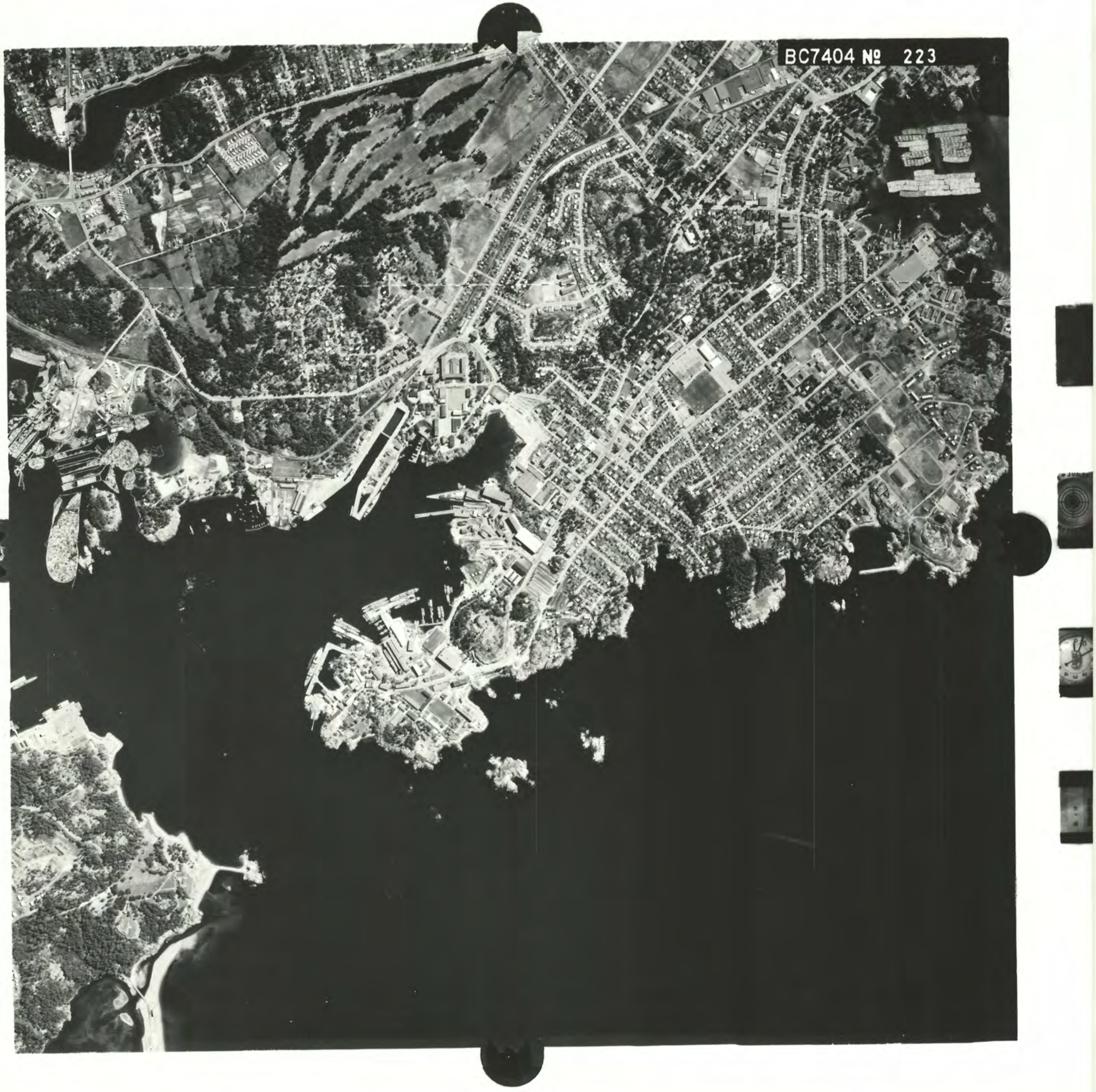
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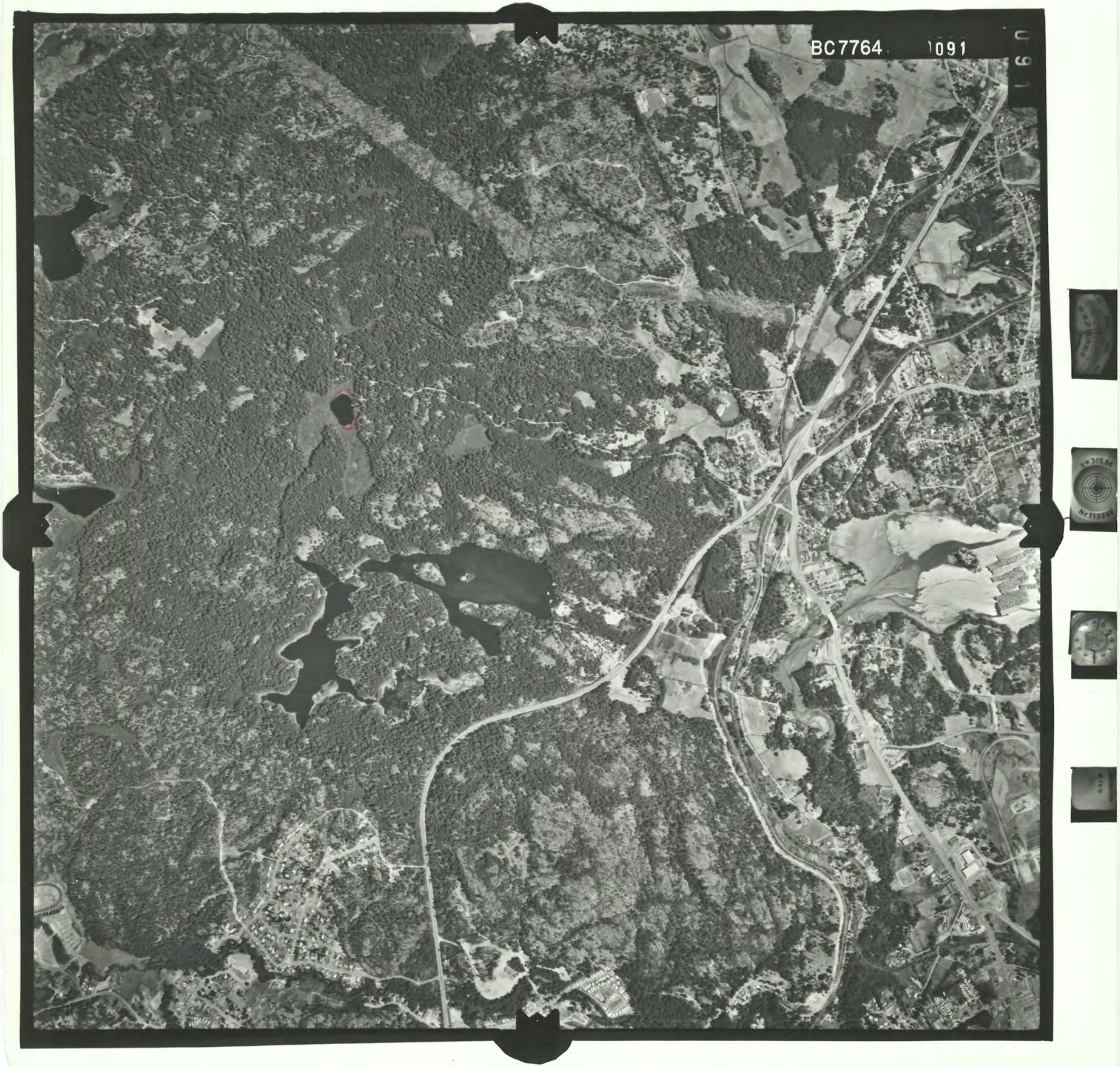
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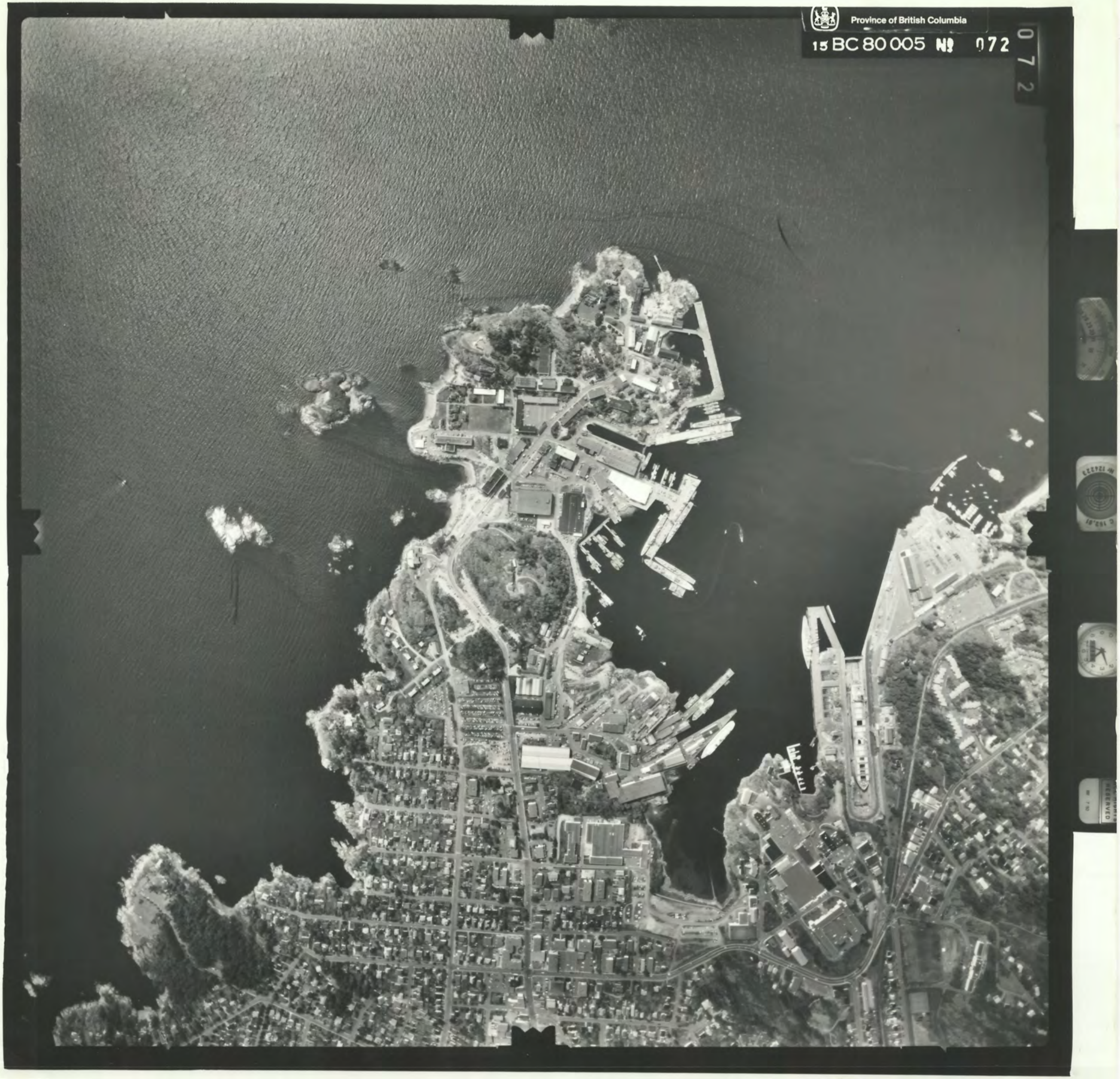
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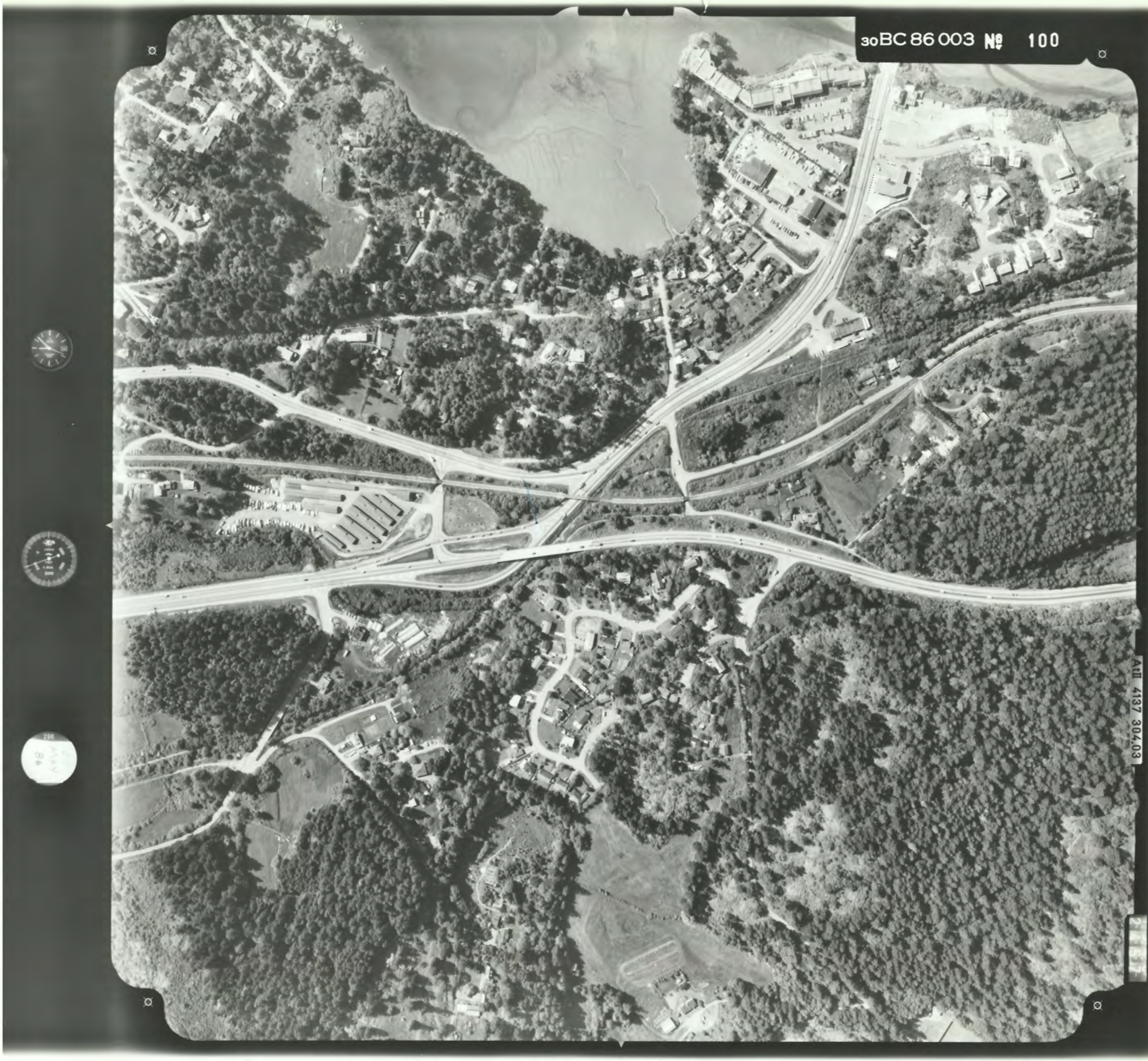
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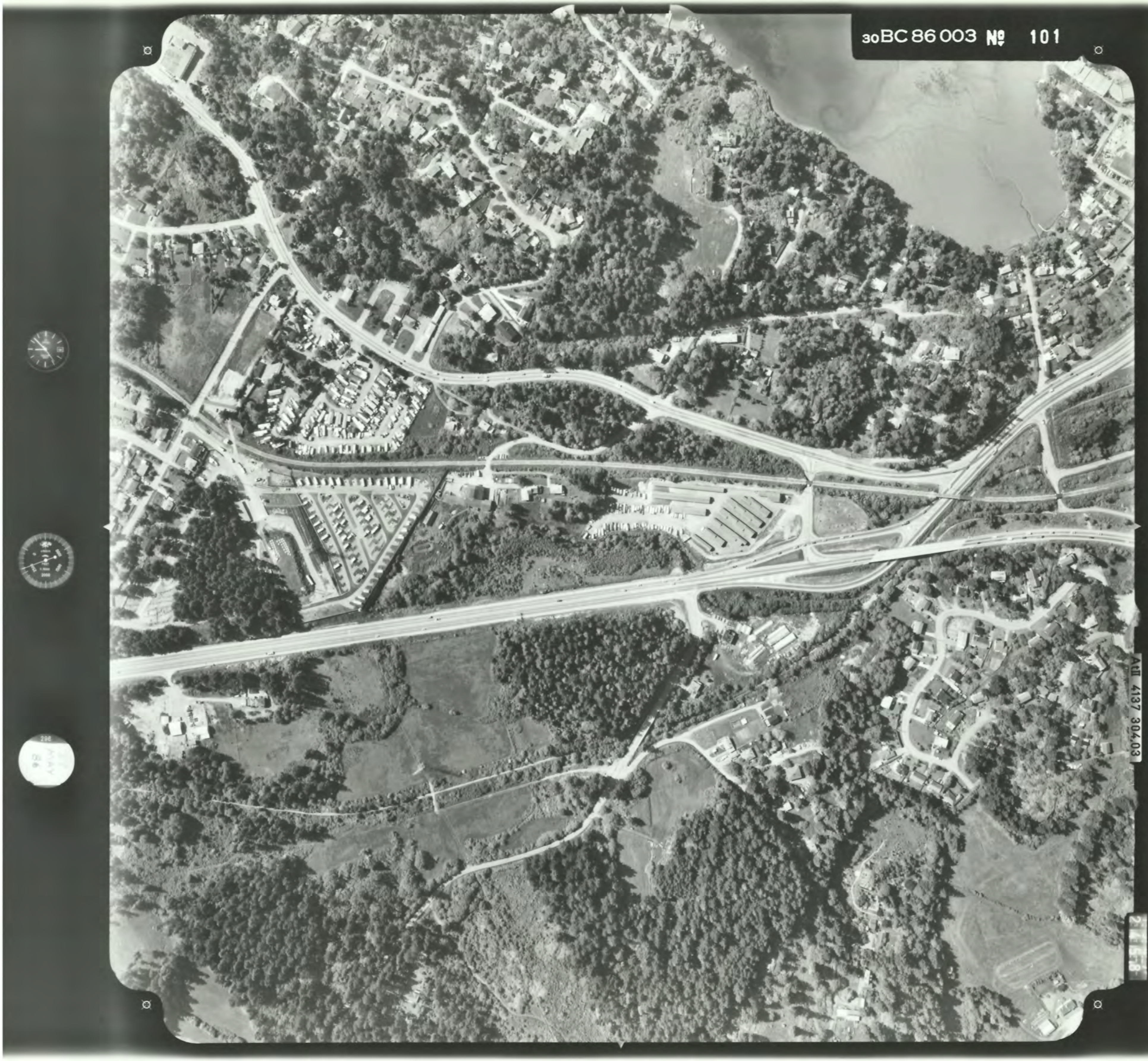

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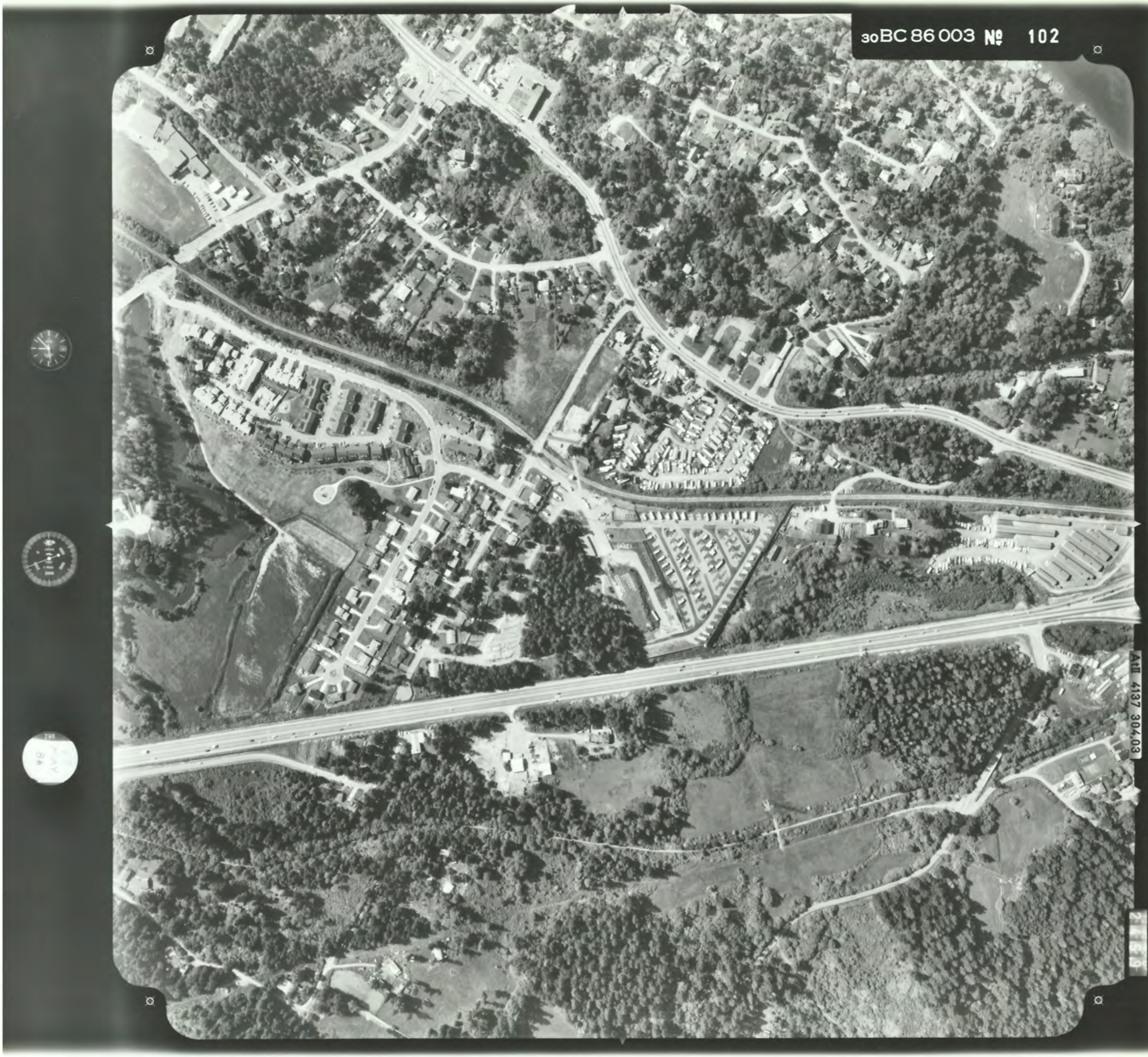
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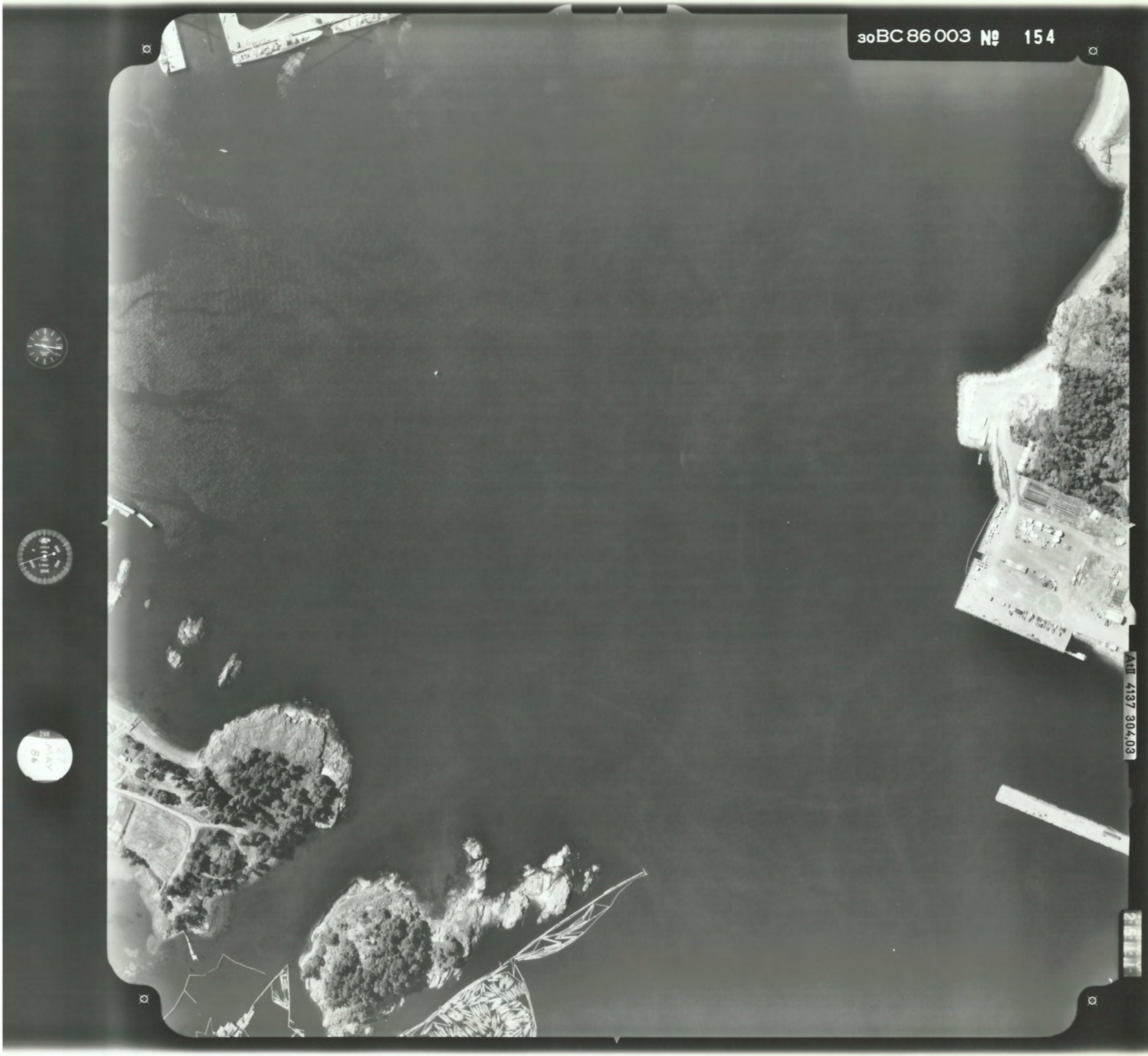
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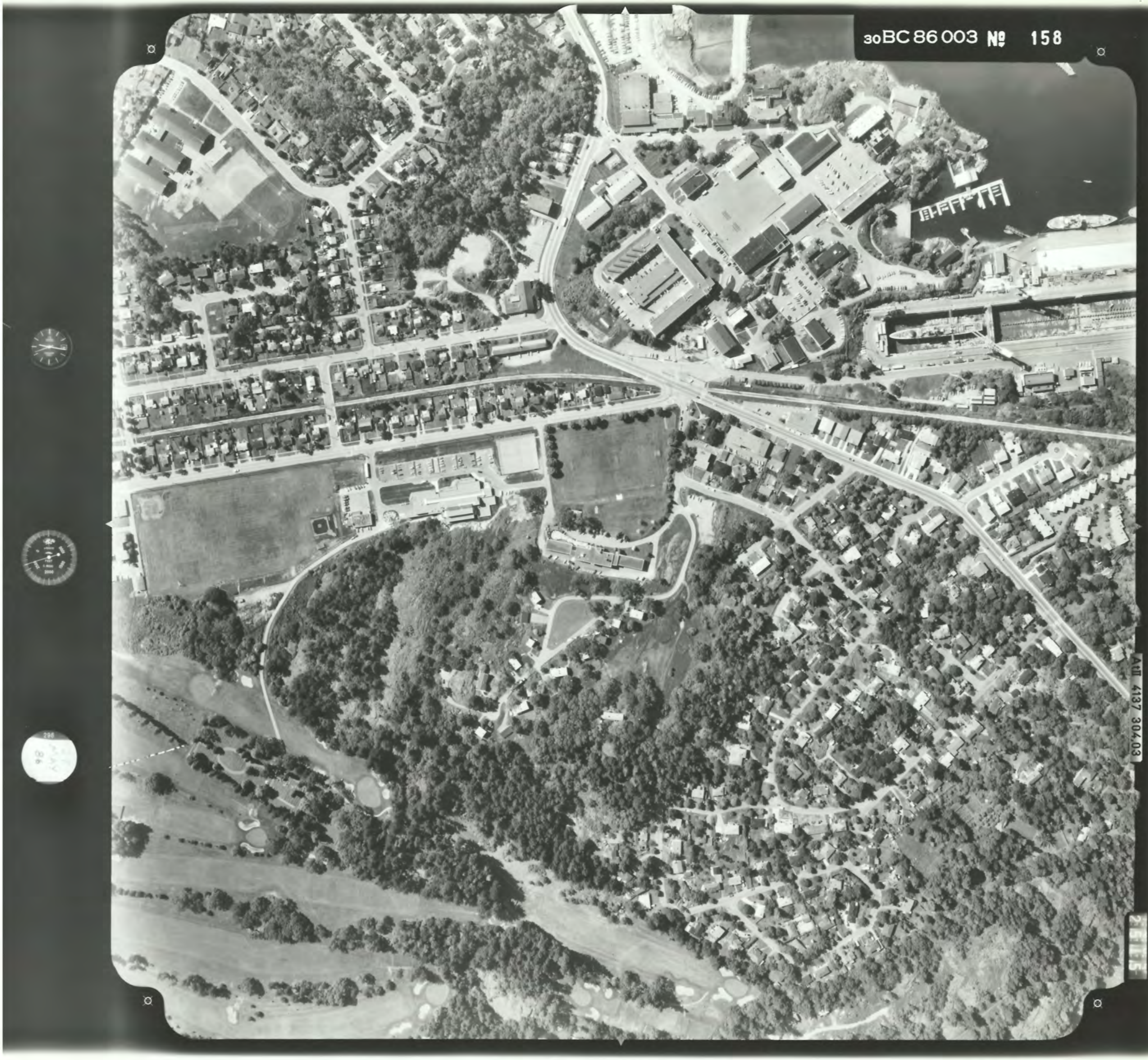
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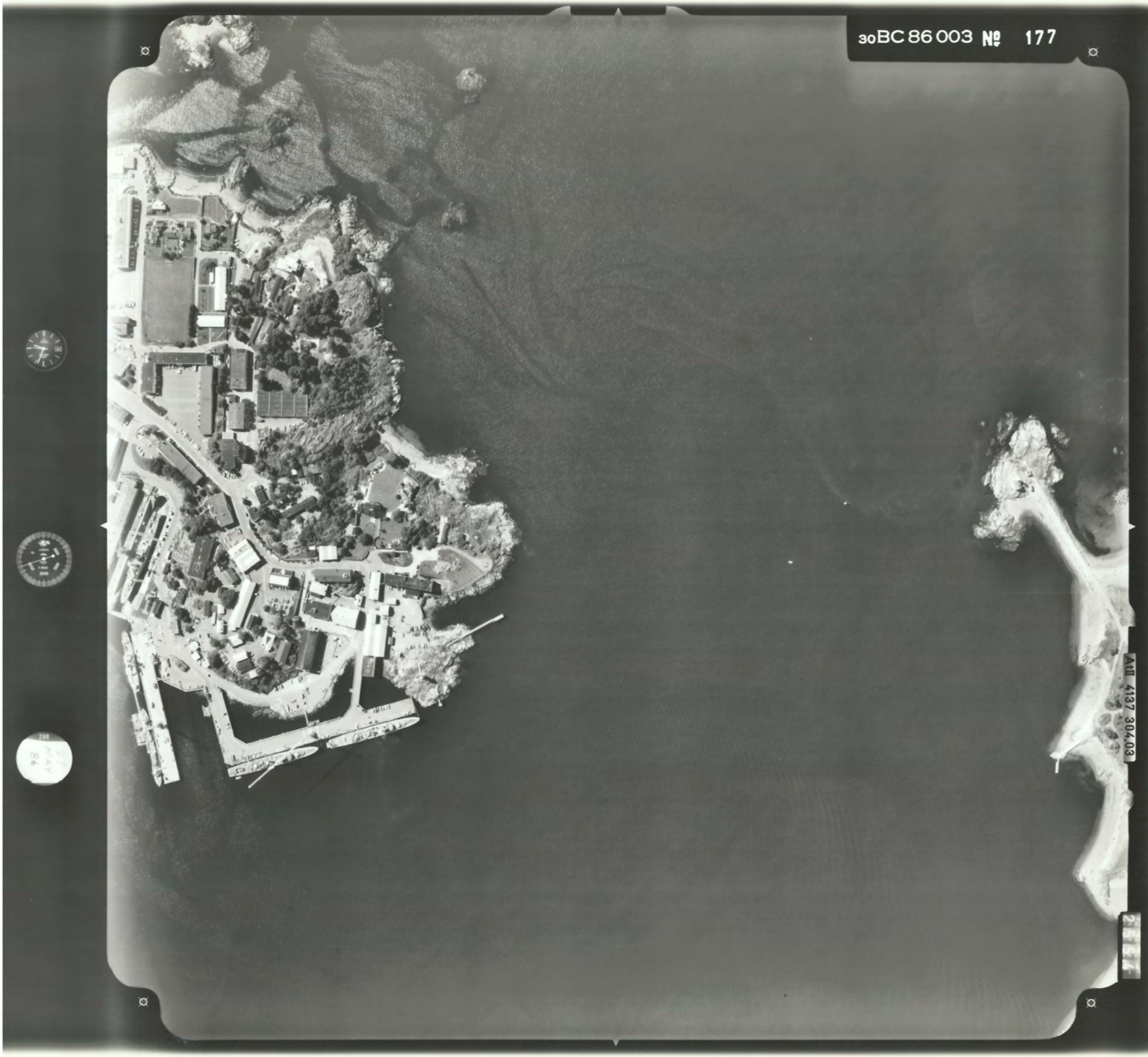
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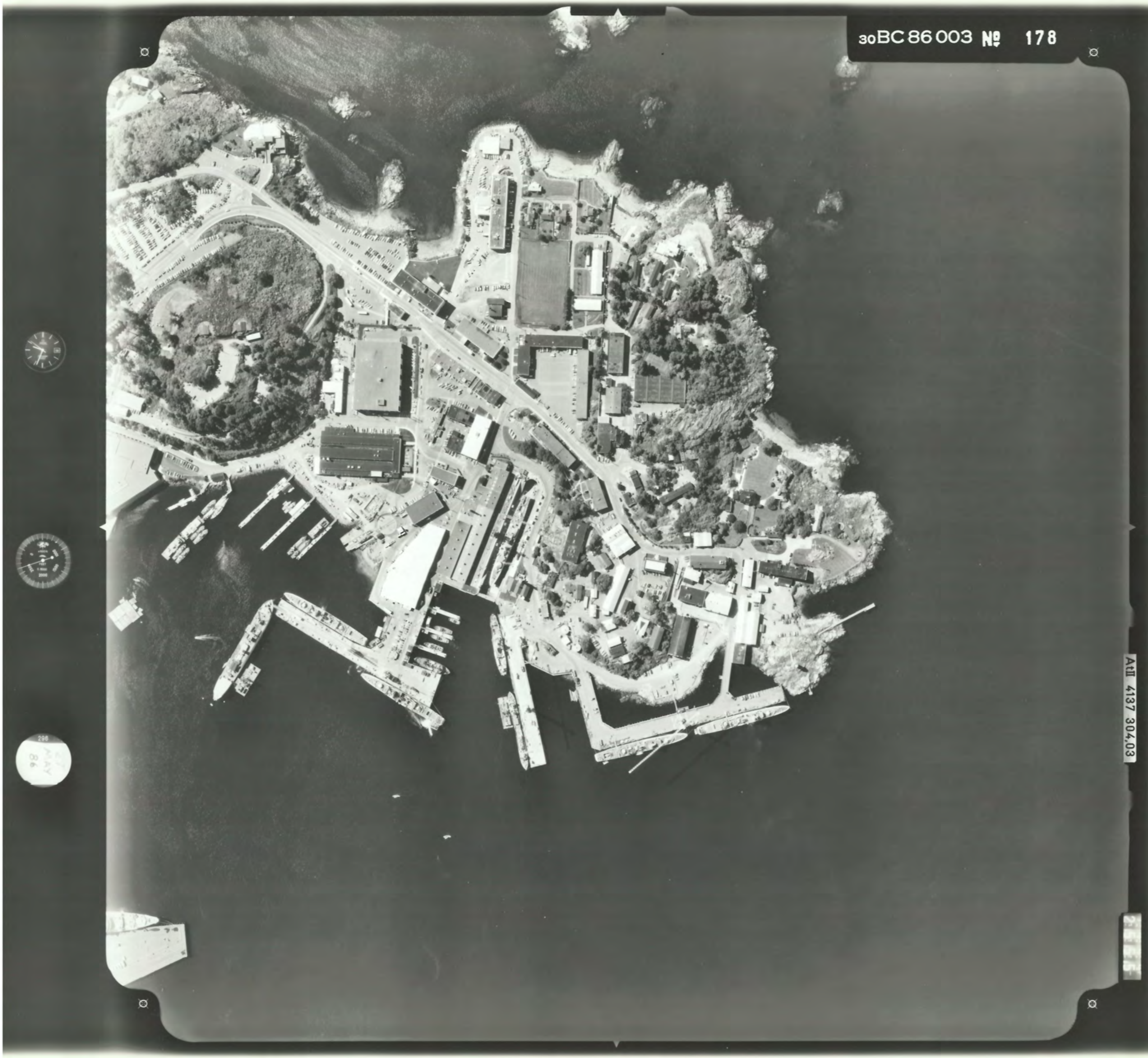
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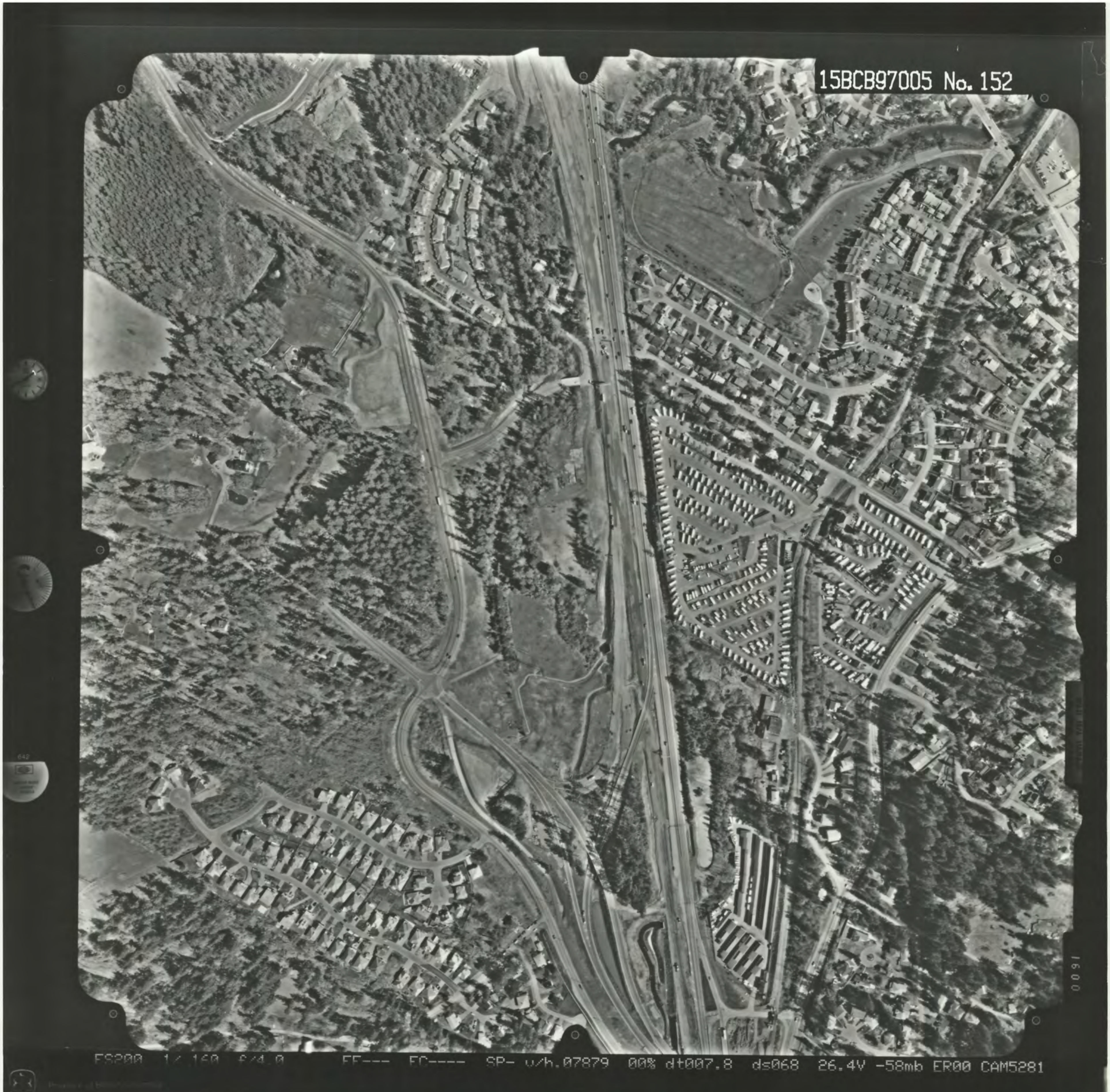
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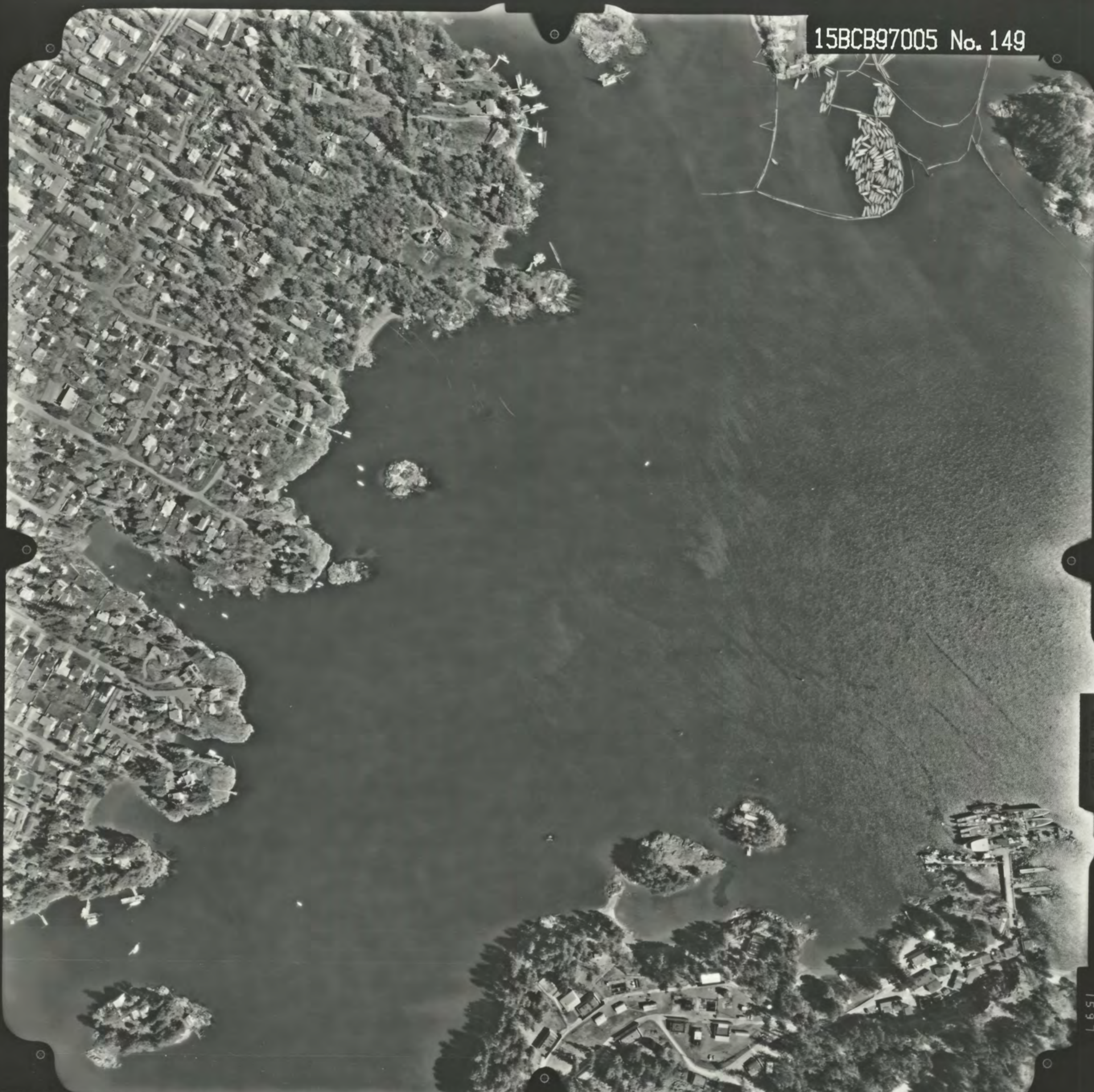

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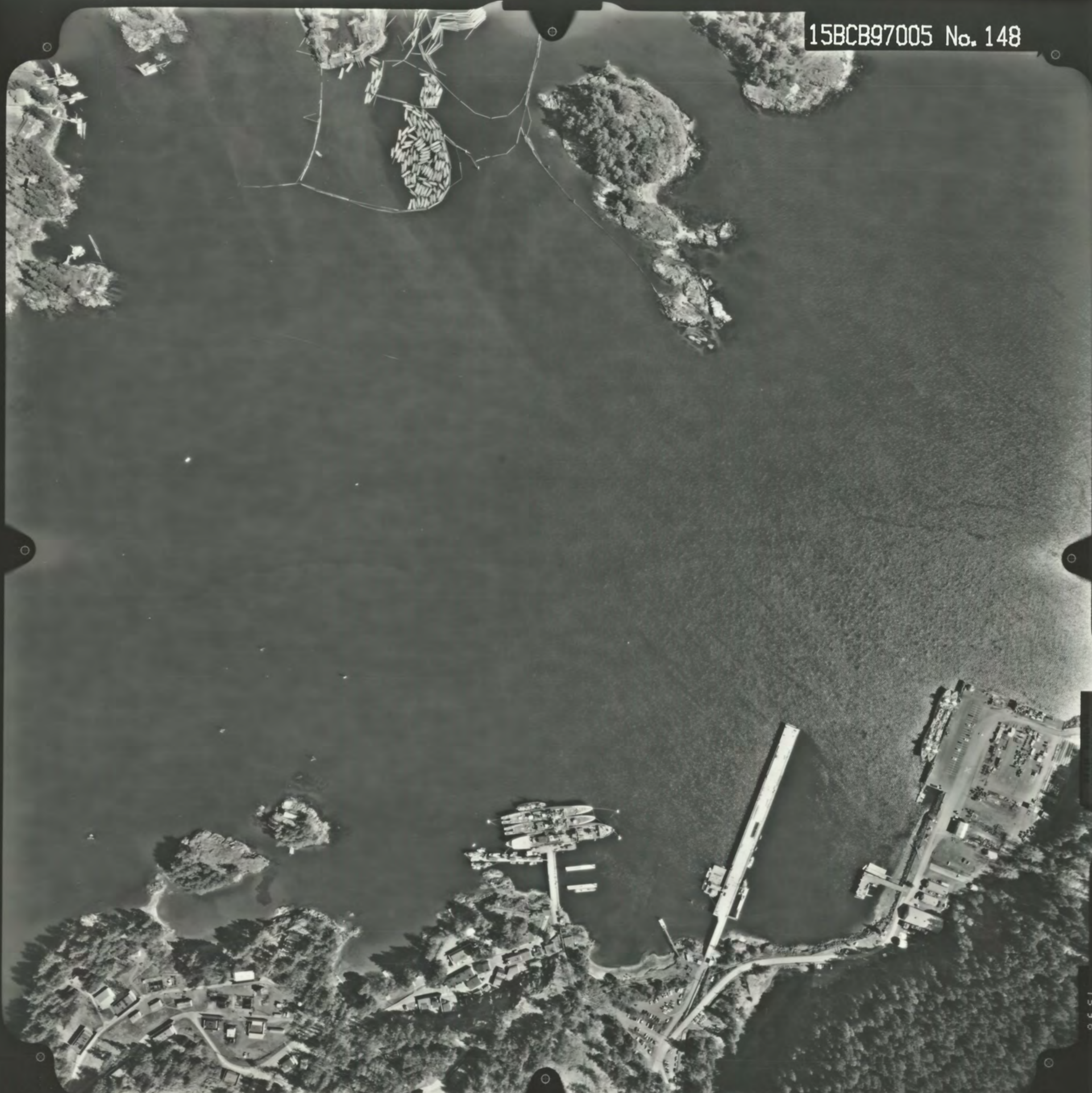

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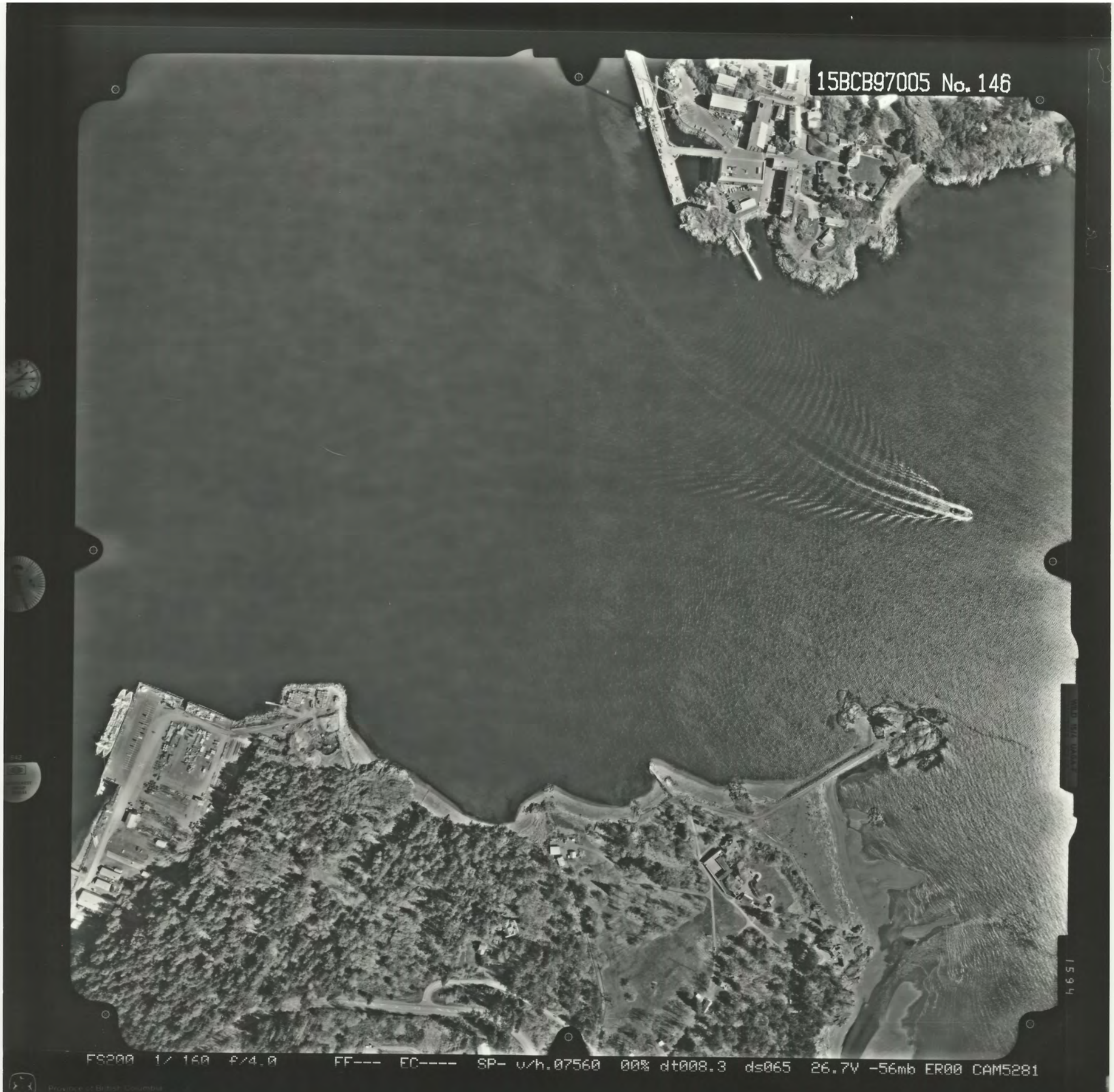
Province of British Columbia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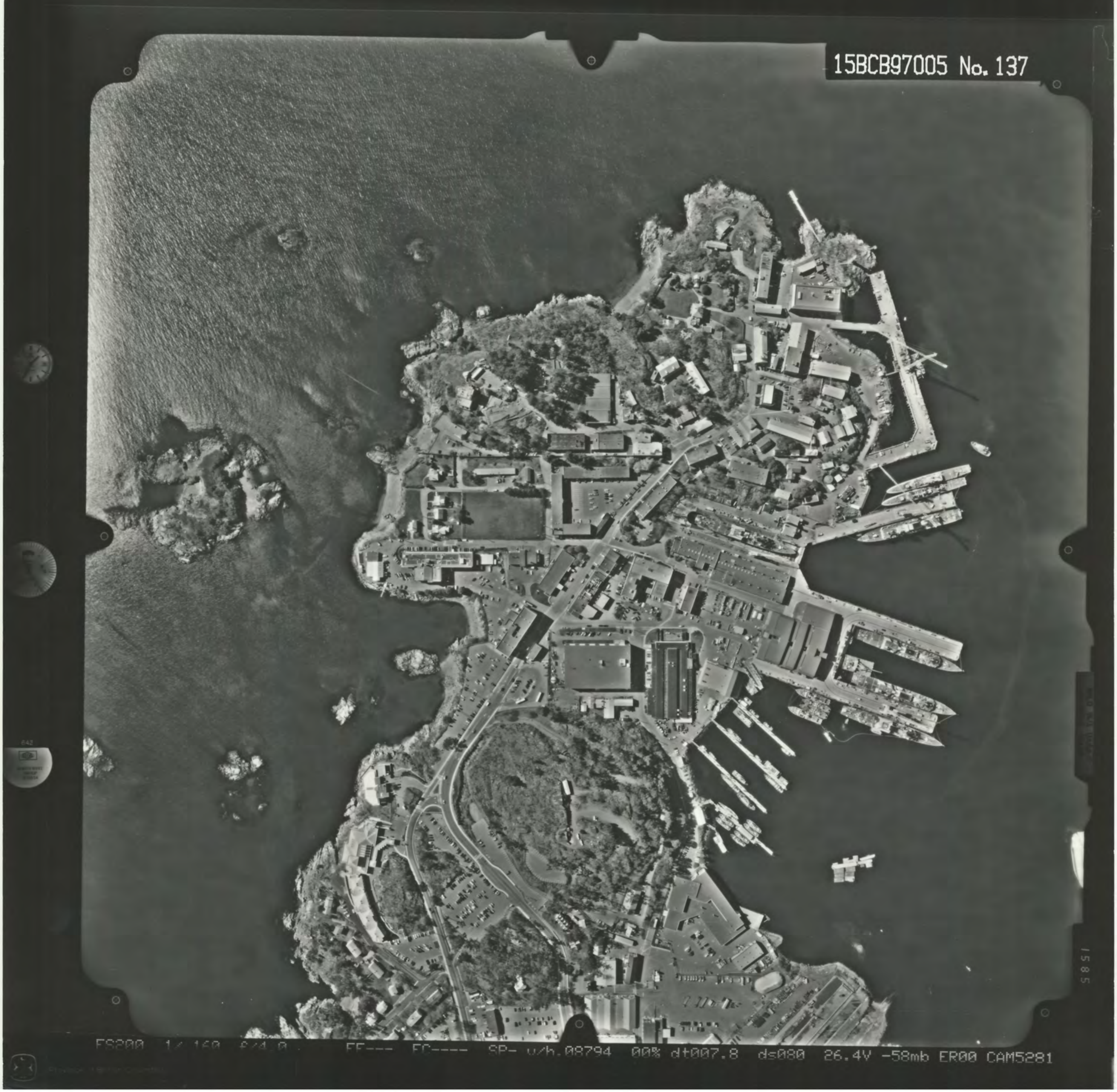
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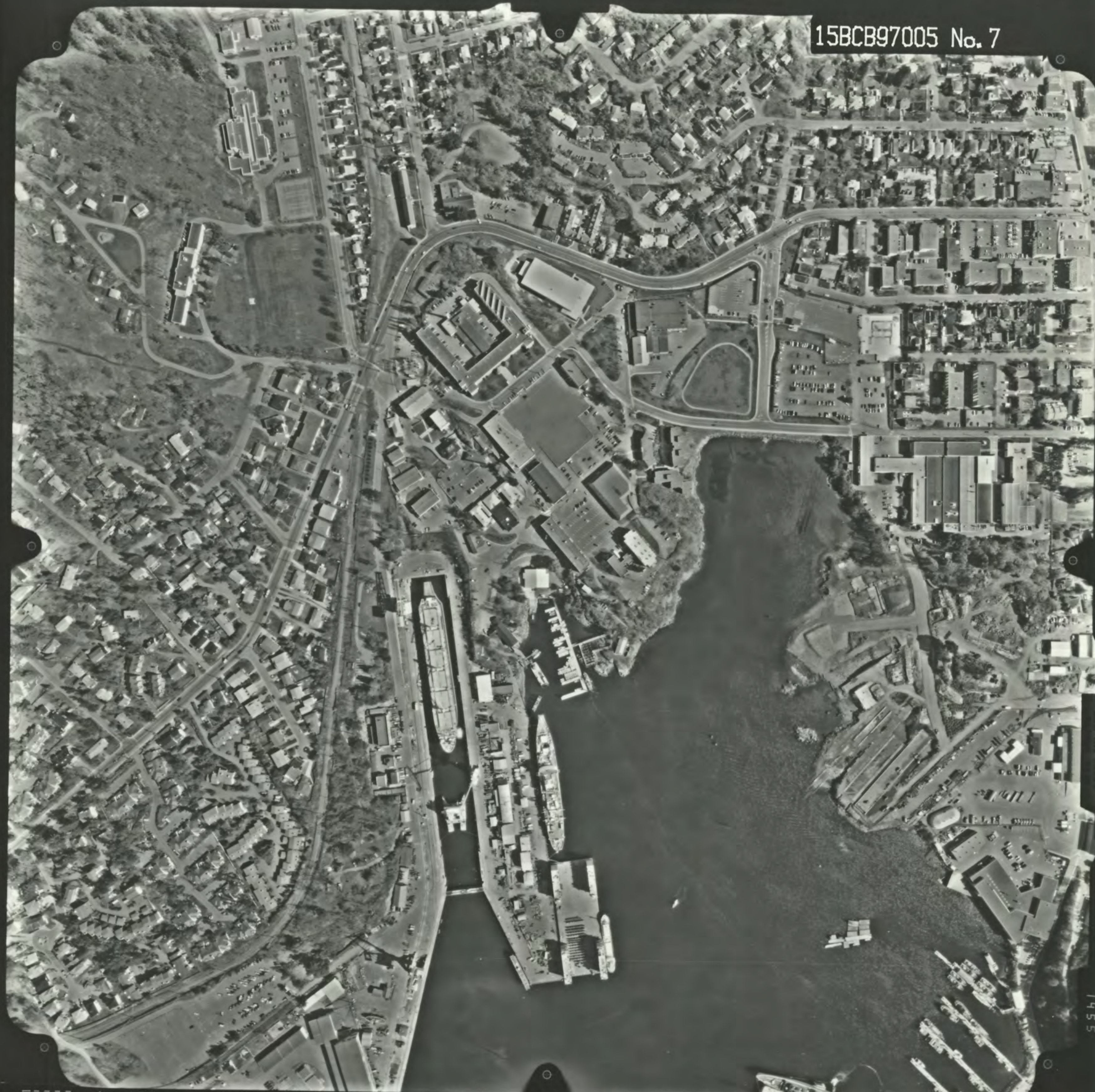

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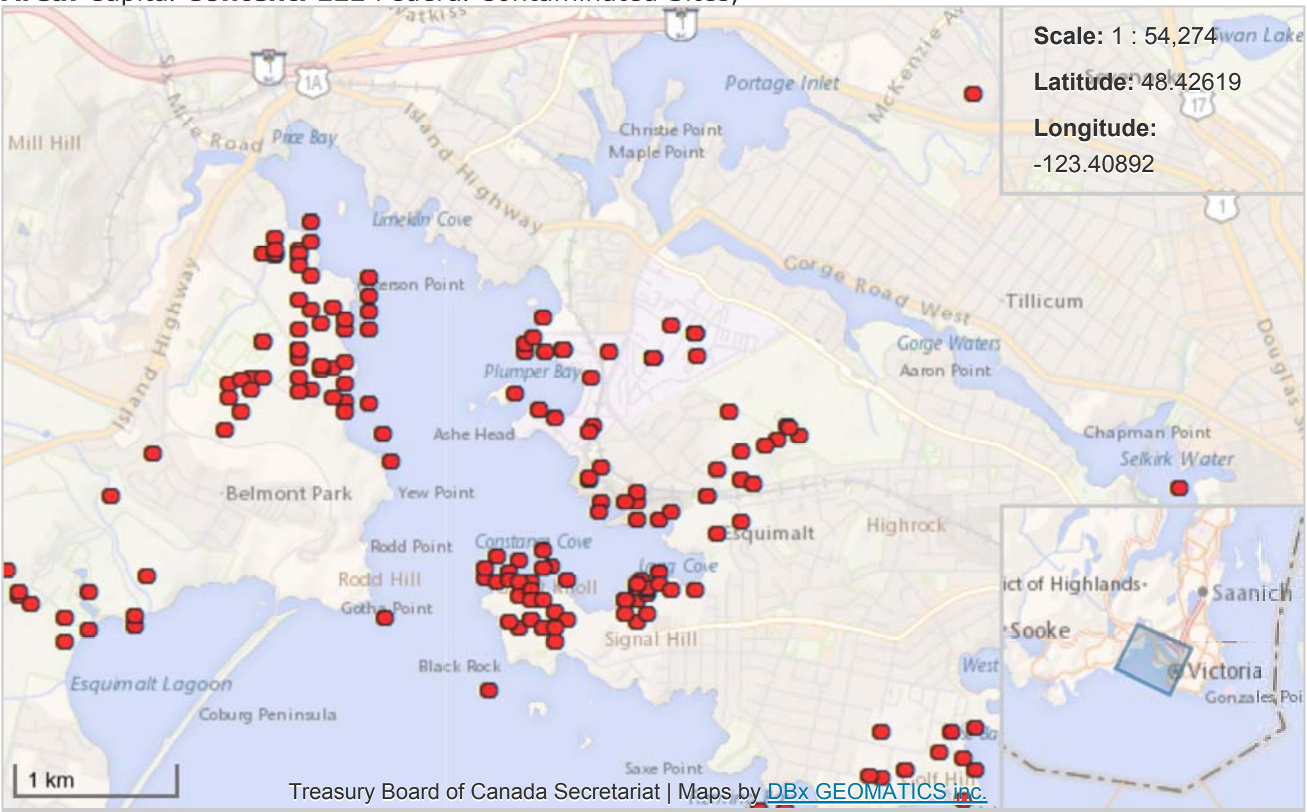
APPENDIX B

Regulatory Information

Treasury Board of Canada Secretariat

DFRP/FCSI - Map Navigator

Area: Capital **Content:** 222 Federal Contaminated Sites,



Layers

- Federal Properties
- Federal Buildings
- Federal Contaminated Sites
- Economic Region
- Census Divisions
- Census Subdivisions
- Metropolitan Areas
- Federal Electoral Districts
- Treaty Areas

[1] This layer is visible only when the map scale is smaller than 1:3,000,000.

[2] Google base maps are only available when the map scale is smaller than 1:60,000.

IMPORTANT NOTE: The tables below are currently not synchronized with the map content. Please click on the following hyperlink if you want to update the tables content: **UPDATE TABLES**

Federal Properties

Federal Properties
Page(s):

Select the number of rows per page 5

Federal Buildings

Federal Contaminated Sites

Appendix B: Regulatory Information

Authorization Number	Authorization Type	Issue Date	Waste Type	State	Facility Type - Description	Facility Address
4772	Permit	08/08/1977	Effluent	Cancelled	Elementary School - sewage	3291 Happy Valley Road, Victoria
6081	Asphalt Plant Regulation	26/09/1997	Air	Active	Asphalt Plant	740 Industrial Way, Victoria BC V9B 6E2
8241	Permit	11/05/1989	Effluent	Cancelled	Chlorination/Dechlorination	680 Montreal Street, CRD BC V8V 1Z8
15601	Permit	18/09/2000	Air	Active	n/a	765 Industrial Way, Victoria
18363	Operational Certificate	19/02/2008	Effluent	Active	Reclaimed water production plant Reclaimed water production facility at Victoria inner harbour Reclaimed water used for toilet flushing, landscape irrigation and impoundment. Overflow from impoundment into Victoria Harbour	101-1117 Wharf Street, Victoria BC V8W 2S6
100051	Hazardous Waste Regulation	20/09/2007		Active	Biocell at Highwest Landfill	1943 Millstream Road, Victoria BC V9B 6E2
100174	Organic Matter Recycling Regulation	06/03/2008		Active	Compost	1416 B Alan Road, Victoria BC V9E 2C5
100183	Organic Matter Recycling Regulation	07/03/2008		Cancelled	Compost	UVic Finerty Road Victoria
100184	Organic Matter Recycling Regulation	07/03/2008		Active	Compost	4370 Interurban Rd Victoria BC V9E 2C3
100302	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	28/07/2008		Active	Automotive recycler Automotive recycler	232 Trans Canada Highway, Malahat BC V0R 2L0
100327	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	01/08/2008		Active	Steel Recycling Facility Waste metal collection and recycling depot, including wet/dry vehicles. A diesel powered metal shredder is used to shred and sort, metals (ferrous, non-ferrous and non-metals). This site also accepts demolition wastes, bottles for recycling	2770 Pleasant St, Victoria BC
100382	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	13/08/2008		Active	automobile dismantling Automobile dismantling	1297 Glenshire Drive, Victoria BC V9C 3W7
100384	Code of Practice for Concrete and Concrete Products	26/08/2008		Active	Concrete Production	439 Bay Street, Victoria BC V8T 1P5
103167	Vehicle Dismantling and Recycling Industry Environmental Planning Regulation	05/02/2009		Withdrawn	Sales and service of new and used motorcycles, their parts and accessories. Sales and service of new and used motorcycles, their parts and accessories.	D-611 David Street, Victoria BC V8T 2C9
103821	Permit	31/03/2010	Air	Active	Electric motor rebuilding Electric motor rebuilding shop	859 Viewfield Road, Victoria BC V9A 4V2

Appendix B: Regulatory Information

Authorization Number	Authorization Type	Issue Date	Waste Type	State	Facility Type - Description	Facility Address
103965	Petroleum Storage and Distribution Facilities Storm Water Regulation	09/09/2009		Withdrawn	Transfer area is drained into an oil/water sparator that discharges into the storm sewer situated adjacent to the property	2515 Rock Bay Ave, Victoria BC V8T 4R5
104612	Petroleum Storage and Distribution Facilities Storm Water Regulation	03/03/2010		Active	Petroleum products storage and distribution facility	2515 Rock Bay Avenue, Victoria BC V8T 4R5
105554	Hazardous Waste Regulation	20/04/2011	Hazardous Waste	Cancelled	Ellice Recycle and Ralmax Development's barge ramp facility	2800 Bridge Street, Victoria BC x
106038	Hazardous Waste Regulation	27/02/2012	Hazardous Waste	Active	Soil Treatment Biocell - Landfill	1943 Millstream Rd, Victoria BC
106597	Petroleum Storage and Distribution Facilities Storm Water Regulation	08/02/2013		Active	Langford Cardlock	2596 Sooke Road, Colwood BC V9B 1X7
106843	Permit	09/01/2014	Refuse	Active	Soil storage three fill areas (Fill area 1, 2 and 3) for permanent storage of contaminated soil	203 Harbour Road, Victoria BC V9A 3S2

APPENDIX C
Harbour Occupants

APPENDIX A-1: Harbour Occupants as of 1873

Area	Usage	Dates
Northern Shore - Cole Island	- munitions magazine	- 1860-1938
East Side - land between southern shore Thetis Cove & northern Plumper Bay - north shore Thetis Cove	- "Indian Village" - unidentified building	- 1873 - by 1860-1873
Constance Cove - Lang Cove - Skinner Cove	- named "Village Bay" - intact, with inland stream	- ca 1873 - 1848-1920s
Duntze Head/Naval Yard Peninsula Area - Thetis Island - Esquimalt Village - Western part/naval yard - Western part/naval yard inland - East of Grant Knoll - SE of landing East of Grant Knoll - directly inland east of Duntze Head, near first Naval Yard Boundary Line (West of Signal Hill) - inland east of Grant Knoll & south of "Landing"	- Naval Coal Wharf Naval Coal Store/Note: island still intact, separate - Fraser's River ("Cariboo") Gold Rush traffic landing here/Esquimalt Village & Wharf St. developed/small wharf - Admiralty/Naval land has enlarged wharf - "The Factory": Smith shop, Smelter/Engine House - cable, paint, chain, timber, lumber, ordnance, cordage/stores; fitting house - Boathouse - Landing - "Factory" - Paint, Oil, Ordnance, Victualling Stores, Naval stores, Condemned Stores, Engine	- (1860-1880) - 1858 - 68 - 1865 - by 1873 - by 1858 - by 1863-67 - by 1863-67
West Side - Southern entrance, west side	- Fisgard Lighthouse	- 1860-present

APPENDIX A-2: Harbour Occupants as of 1896

Area	Usage	Dates
Northern Shore		
- Northern harbour, inland	- Esquimalt & Nanaimo Railway	- 1886-present?
- Cole Island	- magazine, incl. boathouse, jetty, mine & shell store, shell filling house, ordnance store, 4 powder magazines, quick firing ammunition store, store for empty cases	- 1860-1938
East Side		
- North of Skinner Cove	- Hudson's Bay Co. Post	- ca 1896
- Land between southern shore Thetis Cove & northern Plumper Bay	- "Indian Village"	-
- Along eastern side of harbour	- E & N Railway (splits & runs down peninsula area in Plumper Bay)	- construction starts 1884; operative 1886-present
- Plumper Bay peninsula area, southwest of Thetis Cove	- "Cannery" (platform extends out into water; appears on 1896 hydrographic chart)	- by 1896-(on 1947 chart; not present on 1967 chart)
Constance Cove		
- Lang Cove area	- Isbestor's Pier (identified as Foster's Pier in 1896)	- ca 1895
- between Pilgrim & Lang	- Infectious ward	- ca 1895
- Pilgrim Cove area	- Jetty/landing stage/wharf	-
- West of Skinner Cove	- Hudson's Bay Co. wharf	- by 1895
- Lang Cove area	- Brown family operated Slipway cradle & jetty/BC Marine slipway (known in 1895 as "Marine Slipway"/1896 "slipway"/1897-1914 BC Marine Railway Co. Cradle)	- 1893-1914
- North of Skinner Cove	- E&N Railway/Esquimalt & Craigflower Rd./Hudson's Bay Co./4 large bldgs	- ca 1896
- Pilgrim Cove	- Royal Naval Hospital	- ca 1896
- Northeast Signal Hill	- Fosters Pier	- ca 1896
- North of Signal Hill	- wharf with bldgs	- ca 1895
- Shoreline N.E. of Signal Hill	- Isbestor's Pier (identified as Foster's Pier in 1896)	- ca 1895
- North of Signal Hill	- Submarine Mine Establishment, with tramway	- ca 1895
- Shoreline N.W. of Signal Hill	- boathouse; cement & timber store	
- West of Signal Hill	- War Department boundary	

APPENDIX A-2 (CONT.)		
Duntze Head/Naval Yard Peninsula Area		
- adjacent to Grant Knoll	- additional boathouse built with small shipwright shop next to it	- 1879
- Western portion	- Drydock built	- 1886-87
- Naval Yard	- Boat store/additional slipway to boat house	- ca 1883
	- Graving dock used by Royal Navy, Canadian gov't, private commercial ships (highest usage period)	- 1887-1927
- Esquimalt Village	- Larger dock/landing/Wharf St. runs north to south	- 1858-1940s
- Thetis Island	- Drydock excavations fill to unite island to land	- 1880
	- Coal sheds 12' high with increased storage capacity - now 2673 tons	- 1895
- West of Thetis Island	- Current bldgs constructed by 1903, capacity of 10,000 tons	- ca 1899-1903
- Western area	- Pumphouse - housed all pumping equipment for drydock	- 1886
- Grant Knoll	- Wharf further enlarged to "A" Jetty/coal wharf/drydock fenced gov't prop.	- 1885
- The "Factory"	- (another) boathouse, small shipwright shop, torpedo boat slipway	- 1879
	- New building for the "Factory". Housed: machine shops; blacksmith boiler shops; moulding shop (w/blast furnaces); coppersmith; galvanizing tank (busy during WWI); pattern makers shop	- 1891-present?
- Shoreline northwest of Signal Hill and northeast of Duntze Head	- Esquimalt wharf and landing stage (at the northern end of Wharf St.)	- ca 1895
- Grant Knoll, Duntze Head & slightly east	- Royal Naval Yard: major ship repairs; factory size tripled. Yard included iron store, oil store, lumber store, electrical store, cordage store, boat house, boat slip, torpedo boat house, torpedo boat slip, torpedo sub depot, chain cable store, sail loft & paint store, timber store.	- developed late 1870s - early 1890s
- Duntze Head & south	- War Office Encroachments #3, #4, Royal Naval Yard paddock, War Office Encroachment #1, War Office Encroachment #2	- ca 1895
West Side		
- Rodd Pt.	- Belmont/SW Belmont has 2 bldgs	1896

APPENDIX A-3: Harbour Occupants in 1925

Area	Usage	Dates
Northern Shore		
- Parsons Bridge	- Blacksmith shop/brass foundry (slaughterhouse/piggery)/tannery ?	- 1900-1930s
- Cole Island	- Magazines used by Royal Navy/Royal Canadian Navy/Army	- WWI
- Inland northern harbour	- Esquimalt and Namaimo railway	- 1886-present?
- Northern harbour	- oyster beds	- up to1920-1930s
East Side		
- Thetis Cove, opposite Richards Island	- Large, fuel wharf	- 1920s
- Plumper Bay & North	- E & N Railway	- by 1886-?
- inland Plumper Bay	- Oil tank "(conspicuous)"	- 1921 (on chart)-1947
- Thetis Cove	- Machine shop (off of E & N Railway)	- 1918
- Indian Reserve	- Star Shipyard	- 1905-77 (?)
- Plumper Bay area	- Empire Cannery/V.H. Todd & Sons, Ltd. Empire owned by Todds	- by 1896-1947
- Southwestern shore of Thetis Cove	- Oil wharf	- 1925-present
	- Small vessel wharf	- Early 1900s-present
Constance Cove		
- Pilgrim Cove	- Boat House/RCN Barracks inland	- 1920s
- Skinner Cove	- Proposed Esquimalt Graving Dock	- (opens 1926)
- Lang Cove	- Slipway becomes Yarrows (graving dock & shipyard)	- 1914-1946
- Inland Pilgrim Cove	- Royal Navy Hospital (incl. dead house, infectious ward, disinfecting house)	- ca 1913-1914
	- Joint Services Magazine	
- Signal Hill and northern shoreline	- Submarine Mining Establishment, including offices, shops, stores and stone jetty for handling mines jutting into Constance Cove	- 1899-1906
	- Imperial forces returned to England, minefield operation discontinued; abandoned buildings become part of Canadian Ordnance complex.	- 1906
	- 9.2" gun battery	- 1912-1939

APPENDIX A-3(CONT.)		
<u>Duntze Head/Naval Yard Peninsula Area</u>		
- Western portion	- Drydock used by Royal Navy/Royal Canadian Navy/ Can. Gov't./Commerical ships	- 1887-1927
- Western portion	- Drydock closed	- 1927-1945 closure
- Esquimalt Village	- Pioneer St. northern end - hotel/public landing	- 1858-1939
	- float plane lounge	- 1920s-30s
	- Esquimalt wharf smaller	- by 1910
- Thetis Island	- Naval Coal store capacity of 10,000 tons, with coal chute and crane	- 1903-1942
- Grant Knoll	- filled w/unknown substance when marine railway built	- 1910-1911
- Esquimalt Village	- incorporated; gets sewer system	- 1912
- Western portion	- Naval Land - now Royal Canadian Navy	- 1910-11
- Works Dept. Yard	- painters, smithers, galvanizing shops	- by 1903
- West Cove (north from Bldg 115)	- Marine railway (Bldg 116)	- 1913-46 - 1910-1984
- Adjacent to Grant Knoll (Bldg 109)	- Sail loft & oil store	- 1903
	- receiving & sale store	- 1920
	- sail loft & pitch deposit	- 1923
- Adjacent to Grant Knoll (Bldg 113)	- Shipwright shop & spar shed	- built 1901-1917 1922-1950s
- Adjacent to Grant Knoll (Bldg 115)	- "Shipwright & riggers marine ship repair unit" ("concrete floor with open slope to the sea")	- 1913-1946
- Northeastern shoreline of Duntze' Head (Southwestern shoreline of Constance Cove)	- The "Factory" <u>cf</u> 1896 chart (machine shops, blacksmith boiler ships, moulding shops, etc.)	- 1891-present
	- Heavy usage of galvanizing tank	- WWII
<u>West Side</u>		
- up from Limekiln Cove	- Lime kilns	- 1925

APPENDIX A-4: Harbour Users as of 1967

Area	Usage	Dates
Northern shore		
- Northern harbour	- very dense log boom storage	- 1930s-1960s
- Inland northern harbour	- Esquimalt and Nanaimo Railway	- 1886-present
East Side		
- Plumper Bay & north	- E & N Railway	- 1886-?
- Along Hallowell Rd., adj. to Esquimalt Band Reserve	- West Isle Logging, Ltd./Futura Forest Products sawmill (PCBs & chlorophenol contaminants found later)	- 1967-1983
- Southwestern shore of Thetis Cove	- Wharf (old oil wharf; now serving sawmill?)	- by 1925-present
- Munroe Head	- Yarrows Ltd # 2 Plant	- by 1947 (on charts) to 1958
- South of Richard Island, north of Plumper Bay	- numerous piles	- 1967 chart
- Plumper Bay	- "Booming Ground & numerous piles"; also "Ruins"	- 1967 chart
- Paddy Pass	- dead heads	- 1967 chart
- Esquimalt Band Reserve, southern portion	- piles	- 1967 chart
- Munroe Head	- floats in northern portion - floating breakwater off of tip, running NW/SE - several large buildings & "travelling crane" - small square platform offshore	- 1967 chart
- View Royal	- residential development, and small business development; septic tanks on rocky ground	- 1970s-present
Constance Cove		
- (Skinner Cove)	- Esquimalt Graving Dock high usage period	- 1965-1973
- Lang Cove	- "Wallace" owned (or titled) shipyard & drydock	- 1946-72 (since 1893)
- South of Esquimalt Graving Dock	- Government Jetty E, Dept. of Public Works	- ?-present
- Pilgrim Cove	- piles/2 small (? piers) on north shore/8 piers along south	- 1967
- Lang Cove	- "Yarrows" (?) substantially built up	- ca 1967
- Signal Hill and northern shoreline	- buildings absorbed by HMC Dockyard Esquimalt & occupied by civilian work force	- since WWII

APPENDIX A-4(CONT.)		
<u>Duntze Head/Naval Yard Peninsula Area</u>:		
-Western portion	- Drydock used by Royal Canadian Navy; peak usage 1954-1964.	- 1945-present
-Thetis Island	- Gun shed and carpenter shop	- 1951-1970
-Thetis Island	- Jetty A; enlarged Jetty B; ways southwest of jettys; complex pier structure east & south of Jetty C; 3 piers off of Jetty C	- <u>ca</u> 1967
- Lang Cove	- small jetty southwest of Jetty A	- <u>ca</u> 1967
- Area adjacent to Grant Knoll (Bldg 109) - Grant Knoll area (Bldg 113) - b/n Grant Knoll & Jetty A	- electric store - shipwright & spar shed - carpenter shop - Civilian paint shop - Bldg 114 - Torpedo storage - Bldg 115B - Shipwright's cradle shop-Bldg 117 - Haulout - Bldg 116 - Civilian Paint Shop - Bldg 119 - Boat store - Bldg 120	- 1951 - 1920-1950s - 1950s - 1950s- (?) (1953/55 Dockyard, Naden utilities map)
- Inland between Jetty A & B	- P.N.L. Jetty - Bldg 133 - The "Factory" still operative - Above called "Naval Stores"	- 1891-present - 1951 - 1955
- Northeastern shoreline of Duntze Head (southwestern shoreline of Constance Cove)	- Third section of factory (moulding shop; coppersmith; galvanizing tank; pattern makers shop) demolished & replaced by parking lot	
- Various parts of dockyard and Duntze Head area	- sandblasting	- 1949-present
<u>West Side</u>		
- Southern tip Smart Is., to northern McCarthy Is., to fuel oil jetty	- power line/"dol s." & piles McCarthy Is. area	- 1967 chart
- Between Dunn's Nook & Patterson Point	- "G Jetty"/float north of G Jetty/very large Naval Supply Depot with tank	- 1967
- Southern entrance	- Fisgard Island & Rodd Pt. connected (Fill?)	- 1967
- North of Yew Pt.	- "D Jetty"/ (w/4 bldgs/wharf-like structures); ship traffic & minor repairs - sandblasting inland from "D" Jetty	- ?-present - ?-present
- Dunn's Nook	- Fuel oil jetty "F"/piles within Nook	- ?-present

APPENDIX A-5: Harbour Users as of 1987

Area	Usage	Dates
Northern Entrance		
- Inland northern harbour	- Esquimalt & Nanaimo Railway	- 1886-present (?)
- Cole Island	- Prov. Gov't of Parks Canada"takeover & stabilization" (ex-magazines)	- 1974
- View Royal	- (possibly) faulty septic tank discharge from residential & small business areas	- 1970s-present
- Mill Stream	- PETRO CAN OIL holdings upstream	- ( )
- Northern harbour	- sparse log boom storage	- 1970s-present
East Side		
- Inland Plumper Bay & North	- E & N Railway	- 1886-present
- Along Hallowell Rd. adjacent to Esquimalt Bank Reserve	- Futura Forest Products mill (& West Isle Logging Ltd), with wharf (old oil wharf)	- (1970-late 1980s)
- End of Hallowell Rd/south shore Thetis Cove	- Fibermax Timber Corp. - Victoria Plywood	- 1986-present - ?-late 1980s
Constance Cove		
- Lang Cove	- Private graving dock/Ship yard = Versatile Pacific	- 1972-1989
- Between Yarrows & Signal Hill	- Bldg 508 Shipwright & plastic shops	- 1985
- South of & adj. to DPW Graving Dock	- Government Jetty E	- (?-present)
- Signal Hill and northern shoreline	- Ship Repair Unit (Pacific) plastic shop & sandblasting site; Base Transportation Vehicle park on extensive landfill into Constance Cove; Base Supply use of Ordnance store buildings; Naval Officers' Training Centre small training vessels berthed & maintained; some Queen's Harbour Master's department facilities	- ca 1981

APPENDIX A-5(CONT.)		
<u>Duntze Head/Naval Yard Peninsula Area</u>		
- Northern shore of CFB Esquimalt, b/n Jetty A & B	- Oily Waste Water Treatment Plant initiated; no previous treatment	- (1980s)
- Thetis Island	- sheet metal shop (?)	- 1970
- Northern shore of CFB Esquimalt, b/n Jetty A & B	- ship repair functions	- current ?
	- The "Factory" now known as "Pipe Shop-MSRU-RCMP offices"	- 1970
	- The "Factory" now known as "Pipe Shop & offices"	- 1981
- Between Jetty A & B, Northern shore of CFB Esquimalt	- (next to above) Bldg 55: general lagging. Steam pipes, turbo blowers, refrigeration pipes	- by 1985
- Inland & slightly west of B Jetty	- Bldg 176: Painters/sandblasting	- as of 1985
- Immed. east of drydock	- Bldg 190: Machine shop mechanical - Bldg 190B: Diesel shop - Bldg 191: Outside fitting shop	- as of 1985
- Inland from C Jetty	- Bldg 130: Sheet metal shop/sealers and cleaners - sandblasting	- as of 1985
- Inland from C Jetty	- Bldg 143: Shipwright & plastic shops	- as of 1985
- Near main gate (near "neck" of peninsula)	- Bldg 213: Metal finishing/chemical cleaning, etc. - Bldg 215: Weapon systems mechanical (outside fitting & installation)	- as of 1985
- Drydock area & Duntze Head area	- sandblasting	- 1949-present
- Northern shoreline of CFB Esquimalt	- Jetty A: Ship traffic, ship discharge, repair & minor fueling	- (?-present)
	- Jetty B: Ship traffic, ship discharge, repair & minor fueling	- (?-present)
	- Jetty C: "Refit Jetty" for major repairs, refits, and minor fueling	- (?-present)
<u>West Side</u>		
- Yew Point	- crab deaths due to "Black Spot Disease" (eventually throughout harbour)	- <u>ca</u> 1984
- North of Dunn's Nook	- "F" Jetty: Naval Fuel jetty, ship traffic, discharge	- ?-present
- North of Dunn's Nook	- "G Jetty" small vessal traffic	- ?-present
- North of Yew Point	- sandblasting inland from "D" Jetty	- ?-present
- North of Yew Point	- "D" Jetty patrol boat traffic, minor repairs	- ?-present

APPENDIX A-6: Current Major Harbour Users

Area	Usage	Dates
Northern Entrance		
- View Royal	- (Possibly) faulty septic tanks/residential & small business development	- 1970s-present
- Northern Harbour	- sparse log boom storage	- 1970s-present
- Inland Northern harbour	- Esquimalt & Nanaimo Railway	- 1886-present?
East Side		
- Plumper Bay & north	- E & N Railway	- 1886-present
- end of Hallowell Rd	- Fibermax Timber Corp;	- 1986-present
	- Victoria Plywood Co-op	- ?-present
- Along Hallowell Rd	- Pacific Forest	- (1990)
- View Royal	- residential & small business development; faulty septic systems	- 1990-present
Constance Cove		
- Lang Cove	- Dredging	- (Lt(N) Smith)
- Signal Hill and northern shoreline	- Further expansion of HMC Dockyard Esquimalt facilities	- 1980s-present
- Lang Cove	- Drydock/shipyd know as "Yarrows" again	- 1989-present
- Esquimalt (DPW) Graving Dock	- Ship refit & repair activities; Government "E" Jetty	- 1926-present
Duntze Head/Naval Yard Peninsula Area		
- North shore CFB Esquimalt, between Jetty A & B	- Bldg 243, unidentified outfall pipe	- current
- Western tip	- FMG construction site: discovery of lead contaminated soils	- summer-winter 1992
- Dockyard & Western portion of Duntze Head	- Continued industrial activity	- 1870s-present
- Northern shoreline CFB Esquimalt	- "A" Jetty: ship traffic, discharge & repair; minor fueling	- to present
	- "B" Jetty: ship traffic, discharge & repair; minor fueling	- to present
	- "C" Jetty: "Refit Jetty" for major repairs, refits and minor refueling	- to present
West Side		
- Patterson Pt.	- DND Fire Training Area	- to present
- North of Yew Pt.	- "D" Jetty: patrol boat traffic, ship discharge & repair	- post WWII to present
- North of Yew Pt.	- Sandblasting inland from "D" Jetty	- to present
- North of Dunn's Nook	- "F" Jetty ship traffic, discharge & repair; Naval Fuel Jetty	- to present
- North of Dunn's Nook	- "G" Jetty ship traffic, discharge & repair	- to present

APPENDIX D

Areas of Potential Environmental Concern

Areas of Potential Environmental Concern

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
APEC A – Fill				
A1	Southern part of Dockyard	Metals dump/fill material	Soil, Groundwater	Metals
A2	Fill between Grants Knoll and Dockyard	Fill used to join island to mainland prior to 1946	Soil, Groundwater	Metals, PAH
A3	Dockyard A-Jetty and B-Jetty Fill	Shoreline filling to raise ground level	Soil, Groundwater	Metals, PAHs
A4	Dockyard shoreline fill materials	Filling activities	Soil, Groundwater	Metals, hydrocarbons
A5	Infilled cove on north side of Signal Hill	Fill activities – backfilled with waste materials	Soil, Groundwater	Metals, PAH, hydrocarbons
A6	Soil capsules, Yarrows	Contaminated soil dredgeate containment cell	Soil, Groundwater	PAHs, metals
A7	Black Sands Beach, Yarrows	Deposition of black sandblast grit	Soil, Groundwater, Sediment	Metals
A8	Yarrows area	Fill activity	Soil, Groundwater	Metals, hydrocarbons
A9	Lang Cove	Deposition of contaminated sediments and fill material to reclaim land	Soil, Groundwater, Sediment	Metals, hydrocarbons
A10	Pilgrim Cove	Historical filling	Soil, Groundwater	Metals, hydrocarbons
A11	Skinner Cove	Historical filling	Soil, Groundwater	Metals, hydrocarbons
A12	Munroe Head	Historical filling	Soil, Groundwater, Sediment	Metals, PAHs, hydrocarbons. PCBs
A13	Dallas Bank	Foreshore fill material	Sediments Soil	N/A
A14	Ashe Head	Infilled cove	Soil, Groundwater	Metals, PAHs
A15	South side of Plumper Bay	Fill materials	Soil	Metals
A16	Fill material on south east side of Plumper Bay	Fill materials	Soil	Metals, PAHs, hydrocarbons
A17	Central part of Plumper Bay	Fill material on shoreline	Soil	Metals, hydrocarbons
A18	Southeast of West Isle site, Plumper Bay	Fill material on shoreline	Soil	Metals, PAHs, hydrocarbons
A19	West Isle shoreline, Plumper Bay	Fill material on shoreline	Soil	Metals, PAHs, hydrocarbons, chlorophenols
A20	West Isle Site, Plumper Bay	Fill material	Soil, Groundwater	Metals, hydrocarbons, chlorophenols

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
A21	Fibremax fill material north shore of Plumper Bay	Fill material	Soil	Metals, hydrocarbons
A22	Fibremax fill material on Fibremax peninsular, Plumper Bay	Fill material	Soil	Metals, hydrocarbons, PAHs
A23	Fibremax fill material north side of property, Plumper Bay/Thetis Cove	Fill materials	Soil	Metal
A24	Fibremax site, Plumper Bay	Fill material	Soil, Groundwater	Metals, hydrocarbons, phenols
A25	Victoria Plywood, Thetis Cove	Filled embayment area	Soil, Groundwater	Metals and hydrocarbons
A26	Thetis Cove shoreline	Fill material	Soil, Groundwater	Metals and hydrocarbons
A27	Thetis Cove shoreline	Fill material	Soil, Groundwater	Metals, hydrocarbons
A28	Dunns Nook/F-Jetty, Colwood	Shoreline fill materials	Soil, Groundwater, Sediment	Metals, hydrocarbons
A29	Colwood D-Jetty	Fill materials to the west of D-Jetty, including sandblast material	Soil, Groundwater, Sediment	Metals
A30	Colwood D-Jetty	Fill material adjacent to west side of D-Jetty	Soil, Groundwater, Sediment	Metals
A31	Yew Point, Colwood	Fill materials	Soil, Groundwater, Sediment	Metals
A32	Fisgard Island	Unknown fill quality used in constructing the causeway to the lighthouse	Soil, Sediments	Metals, hydrocarbons
A33	Thetis Cove shoreline	Fill material	Sediment	Metals, PAHs, hydrocarbons
A34	Thetis Cove shoreline	Fill material	Sediment	Metals, PAHs hydrocarbons
APEC B - ASTs, USTs, Other Hydrocarbons				
B1	Infilled cove on north side of Signal Hill	Tanks		Hydrocarbons, metals
B2	OWWTP at Dockyard	Potential for accidental release to harbour	Soil, groundwater, sediments	Hydrocarbons, PAHs
B3	B-Jetty at Dockyard	6 fuel tanks	Soil, groundwater, sediments	Hydrocarbons
B4	Pilgrim Cove	Fuel tanks/fuel pump	Soil, Groundwater	Hydrocarbons
B5	CFSA, Munroe Head	Presence of ASTs	Soil, Groundwater	Hydrocarbons

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
B6	Victoria Plywood, Thetis Cove	Oil wharf	Soil, Groundwater, Sediment	Hydrocarbons
B7	Indian Reserve	Former fuel tank located at north end of reserve-	Soil, Groundwater	Hydrocarbons (Bunker C)
B8	Victoria Plywood, Thetis Cove	Former tanks; 11 ASTs and 2 USTs	Soil, Groundwater, Sediment	Hydrocarbons, metals
B9	Victoria Plywood, Thetis Cove	Pipeline	Soil, Groundwater	Hydrocarbons
B10	Gasoline Dock, north of F-Jetty, Colwood	AST on shoreline	Soil, Groundwater Sediments, Aquatic receptors	Hydrocarbons
B11	F-Jetty at Colwood	Fuel supply lines to F-Jetty	Soil, Groundwater, Sediment	Hydrocarbons
B12	Esquimalt Graving Dock	AST	Soil, Groundwater, Sediment	Hydrocarbons
APEC C - Operational Activities				
C1	Dockyard	Historical and current activities associated with ship building, repair and maintenance	Soil, Groundwater	Metals, PCBs, hydrocarbons
C2	DND dry dock at Dockyard	Sandblasting activities	Sediments	Metals, hydrocarbons
C3	Yarrows ship building activities	Historical activities associated with ship building and repair (blacksmith, machine and sheet metal shop) and the Signal Hill lease lots	Soil, Groundwater	Metals, PCBs, hydrocarbons
C4	Esquimalt Graving Dock	Operational practices such as sandblasting activities	Soil, Groundwater, Sediment	Metals, PCBs, hydrocarbons, TBT
C5	Jenkins Marine, Munroe Head	Boat building and operational activities	Soil, Groundwater	Metals, hydrocarbons, PCBs, TBT
C6	Plumper Bay	Cement/Concrete plant on north side of Plumper Bay – operational activities	Soil, Groundwater, Sediment	Unknown
C7	West Isle Site, Plumper Bay	Historical operational activities associated with mill	Soil, Groundwater	Unknown
C8	Fibremax, Plumper Bay	Historical activities associated with mill	Soil, Groundwater Sediment	Unknown
C9	Victoria Plywood, Thetis Cove	Former mill activities	Soil, Groundwater, Sediment	Hydrocarbons, metals, PCBs, phenols, PAHs
C10	Seaplane operation, Limekiln cove, View Royal	Refuelling of small planes and operational activities	Sediment	Hydrocarbons
C11	Fire Fighting Training Area, Colwood	Historical and current FFTA operational activities	Soil, Groundwater, Sediment	Hydrocarbons, PFOS/PFOA

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
C12	Colwood bunkers	Operational activities - bunkers historically used to store munitions, more recently hazardous chemicals	Soil, Groundwater	Metals, PCBs, hydrocarbons
C13	Smart Island	Soil contamination from activities on the island	Soil	Metals
C14	McCarthy Island	Soil contamination from activities on the island	Soil	Metals
C15	Cole Island	Potential waste materials from historical operational activities	Soil	Metals, hydrocarbons
C16	Dunns Nook, Colwood	Sandblast grit from operational activities in the area	Sediments	Metals
C17	D-Jetty, Colwood	Maintenance and operational activities	Sediments	PAHs, PCB's, metals, hydrocarbons
C18	Yew Point, Colwood	Dredgeate material from operational activities	Soil, Groundwater, Sediment	Metals
C19	DND Colwood	Historical and current operational activities associated with supply depot, sandblasting, refuelling and dredgeate storage	Soil, Groundwater, Sediment	Metals, hydrocarbons
C20	Fisgard Island	Maintenance and operational activities	Soil, Groundwater, Sediment	Metals, hydrocarbons
C21	Dockyard and Signal Hill	Historical sandblasting activities	Soil, Groundwater, Sediment	Metals
C22	Munroe Head	Historical operational activities associated with welding and pipe shop and an overhead crane.	Soil, Groundwater	Metals, hydrocarbons PCBs
C23	Munroe Head	Former slipway area	Soils	Metals
C24	Pilgrim Cove	Shipwright	Soil, Groundwater, Sediment	Metals, hydrocarbons TBT
C25	Esquimalt Graving Dock	AEC 11 – Waterlot sediments	Sediment	Metals, PAHs, PCBs, TBT Hydrocarbons
C26	Victoria Plywood, Thetis Cove	Pollution Control Permit for discharge into harbour	Sediment	Phenols, hydrocarbons Metals
C27	Northern part of Esquimalt Harbour	Log booming causing accumulation of wood waste on sea floor	Sediments, Aquatic life	Organic material
C28	Dockyard	Operational activities associated with moored ships at docks at Dockyard	Sediment, Aquatic life	Metals, PAHs, TBT,

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
C29	Colwood	Operational activities associated with moored ships at docks at CFB Esquimalt, Colwood	Sediment, Aquatic life	Metals, PAHs, TBT
C30	CFSA, Munroe Head	Operational activities associated with small docks, including scraping and repainting small boats	Sediment, Aquatic life	Metals, PAHs, TBT
C31	Upland area to the north and west of F-Jetty, Colwood	Historical presence of a limestone handling facility, historical presence of a sawmill and booming grounds.	Soil, Groundwater, Sediment	Not known
C32	Shoreline of View Royal	Historical commercial activities in the area	Sediment, Aquatic life	Not known
C33	Esquimalt Harbour mouth	Antisubmarine cables, potentially lead lined	Sediment, Aquatic life	Metals
C34	Esquimalt Harbour	Cable ties from log booming activities in the harbour	Sediment, Aquatic life	Metals
C35	Millstream Creek (entering Esquimalt Harbour)	Upstream historical and current activities	Sediment, Aquatic life	Not known
C36	G-Jetty, Colwood	Ship maintenance	Sediment, Aquatic life	Metals, PAHs, TBT
C37	F-Jetty, Colwood	Harbour basin used as a mortar range	Sediment, Aquatic life	Metals
C38	D-Jetty, Colwood	Materials store	Soil, Groundwater, Sediment	Not known
C39	Small wharf in Pilgrim Cover	Activities associated with small wharfs	Sediment Aquatic life	Not known
APEC D - Treated Timbers				
D1	A-Jetty and floating docks, Dockyard and Signal Hill	Leaching of preservatives from treated timber piles	Sediments	PAHs
D2	Pilgrim Cove	Leaching of preservatives from treated timber piles	Sediments	PAHs
D3	Esquimalt Graving Dock	Leaching of preservatives from treated timber piles	Sediments	PAHs
D4	CFSA, Munroe Head	Leaching of preservatives from treated timber piles	Sediment	PAHs
D5	Shoreline of View Royal	Leaching of preservatives from small docks and jetties constructed using treated timber piles.	Aquatic receptors, Sediments	PAHs, metals, hydrocarbons
D6	G-Jetty, Colwood	Leaching of preservatives from treated timber piles	Sediments, Aquatic receptors	PAHs

APEC ID	LOCATION	ISSUE(S)/ ACTIVITY(IES)	MEDIA TYPE	PCOC
D7	D-Jetty, Colwood	Leaching of preservatives from treated timber piles	Sediments, Aquatic receptors	PAHs
D8	Plumper Bay	Leaching of preservatives from treated timber piles	Sediments, Aquatic receptors	PAHs
APEC E - PCBs				
E1	East of C-Jetty, adjacent to Yarrows area	Pole mounted transformers	Soil, groundwater, sediments	PCBs
E2	Victoria Plywood, Thetis Cove	PCB contamination from improperly stored capacitors	Soil, Groundwater	PCBs
E3	G-Jetty, Colwood	Pole mounted transformers	Soil, Groundwater, Sediment	PCBs
E4	Colwood Bunkers	PCB storage	Soil, Groundwater, Sediment	PCBs
APEC F - Spills				
F1	West Isle Site, Plumper Bay	Chlorophenols from spill	Soil, Groundwater	Chlorophenols
F2	Victoria Plywood, Thetis Cove	Leak of hydraulic oil and chain oil	Soil, Groundwater	Hydrocarbons
F3	Shoreline of View Royal	Local storage of domestic quantities of chemicals and paints with spill potential.	Aquatic receptors, Sediments	PAHs, metals, hydrocarbons
F4	Dunns Nook, Colwood	Spillage	Soil, Groundwater, Sediment	Hydrocarbons
F5	Harbour wide	Spillages into the harbour	Sediments, Aquatic life	Unknown
APEC G - Stormwater Outfalls				
G1	Harbour wide stormwater outfalls	Discharge of contaminated sediments from upland sources	Sediment, Aquatic life	Metals, PAHs
G2	Esquimalt Graving Dock stormwater outfalls	Stormwater outfalls	Sediment	Metals TBT

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Esquimalt Harbour Overview & Areas

Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Un-surveyed seafloor
- Federal Harbour Limit

APECs

- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or PAHs

Notes

1. APEC ID defined by class (group) and numeric value within that class.
2. Locations should be considered approximate.
3. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- APECs: Golder, 2006
- Organic Cover, Un-surveyed Seafloor: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 1

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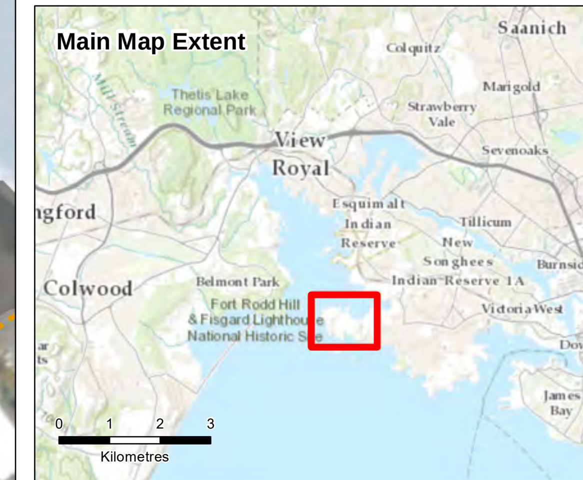
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Dockyard & Signal Hill



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- Un-surveyed seafloor
- Federal Harbour Limit

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 2

HEMMERA
Public Works and Government Services Canada

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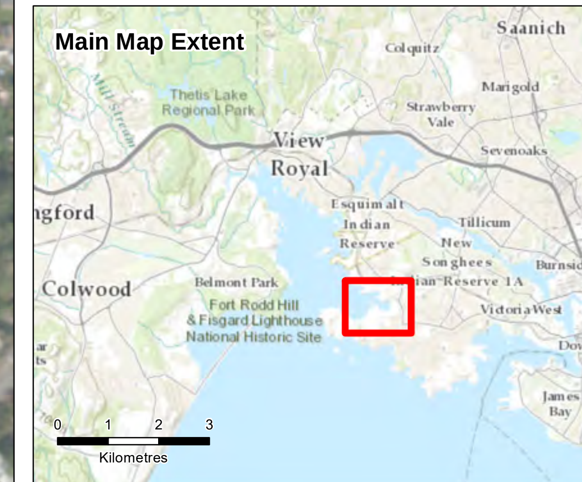
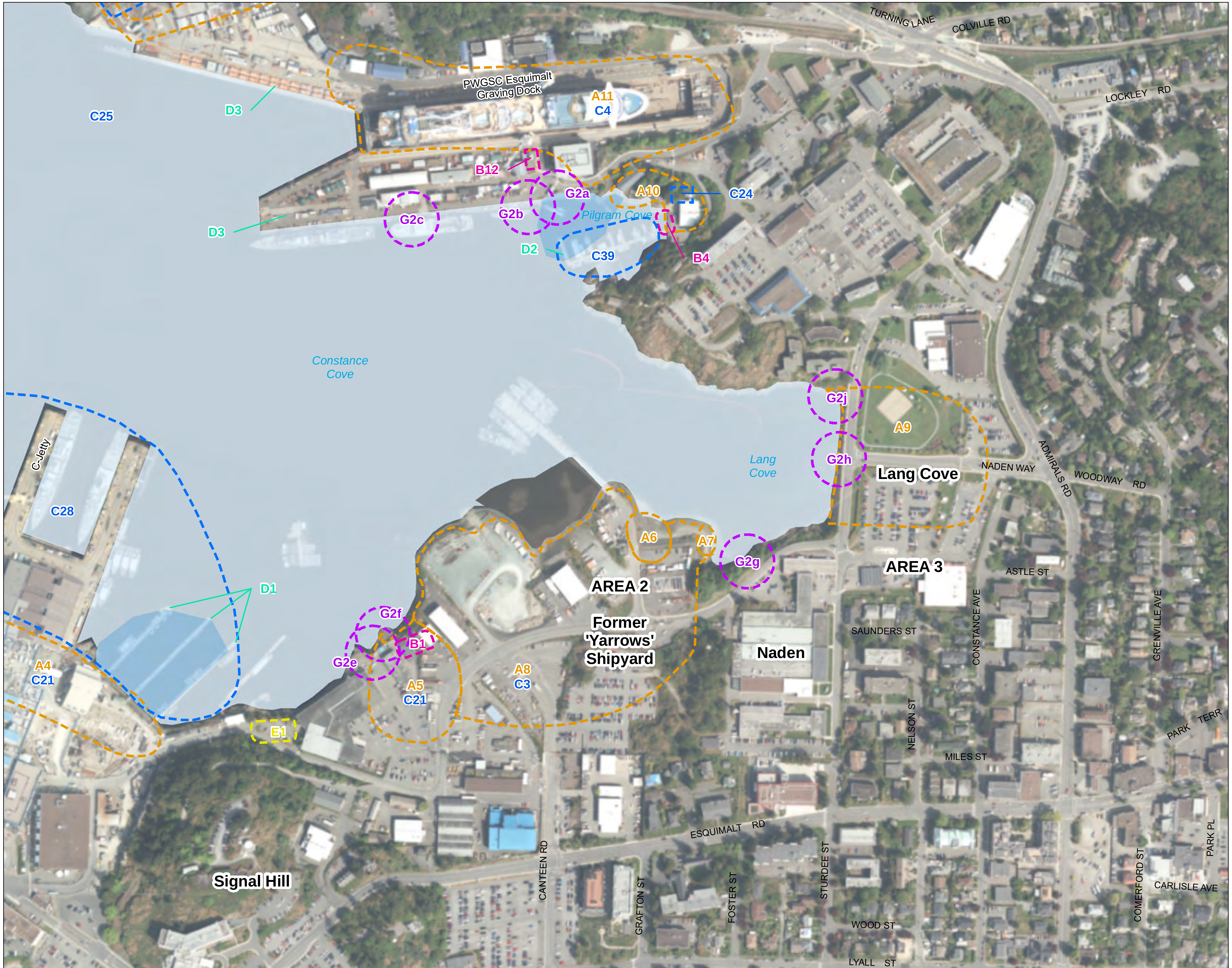
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Yarrows, Naden, & Lang





Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- Un-surveyed seafloor

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

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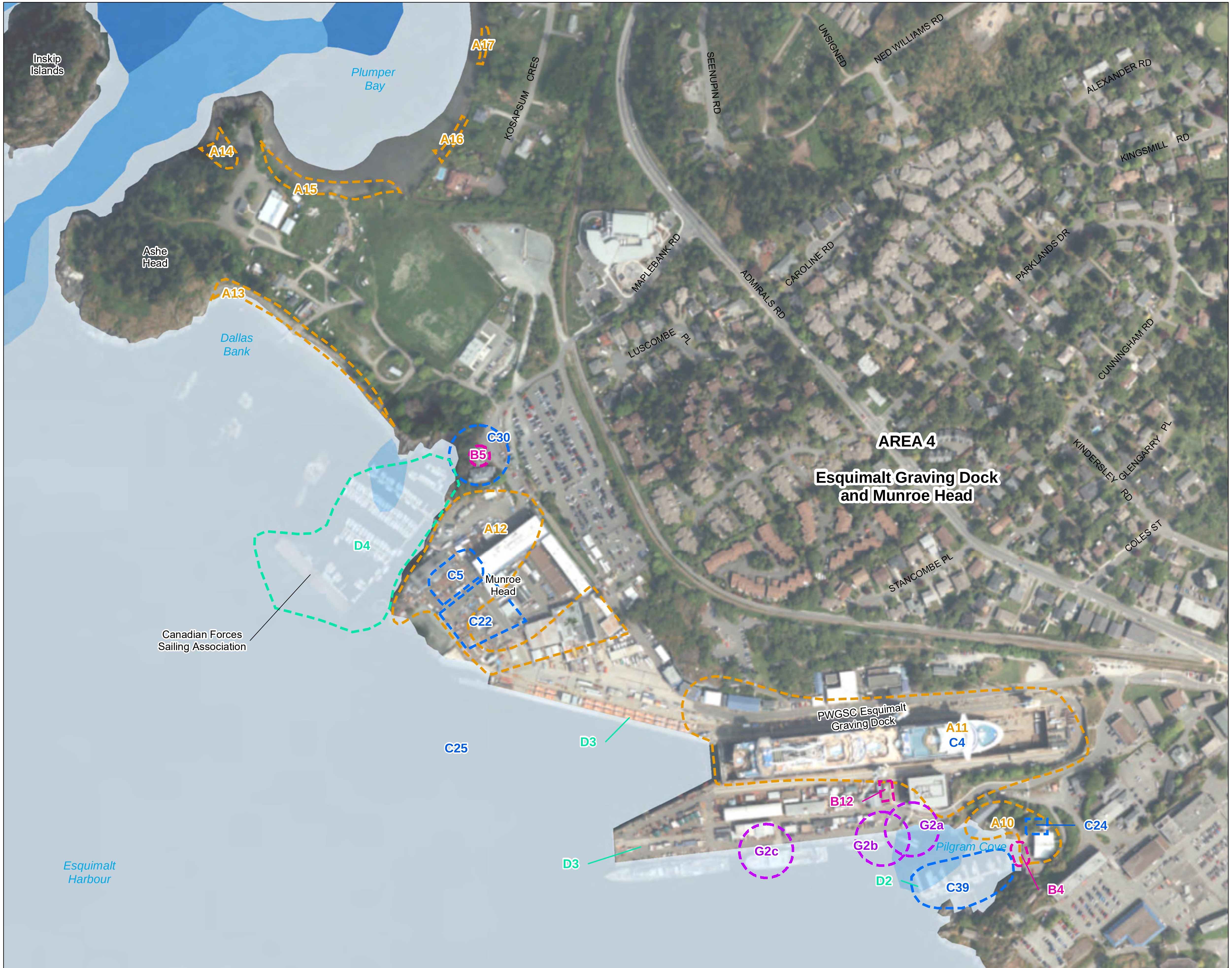
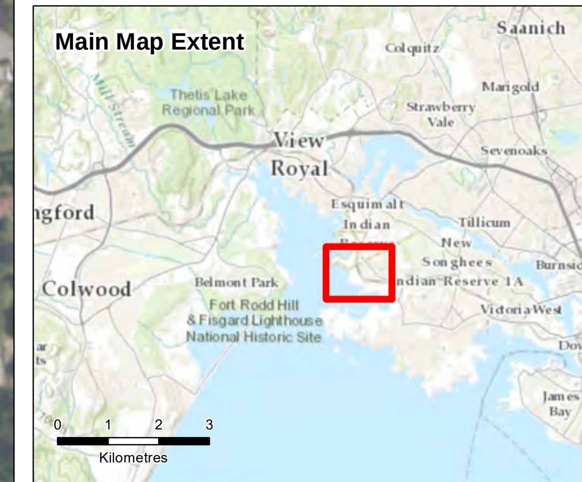
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Graving Dock & Munroe Head





Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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Public Works and Government Services Canada

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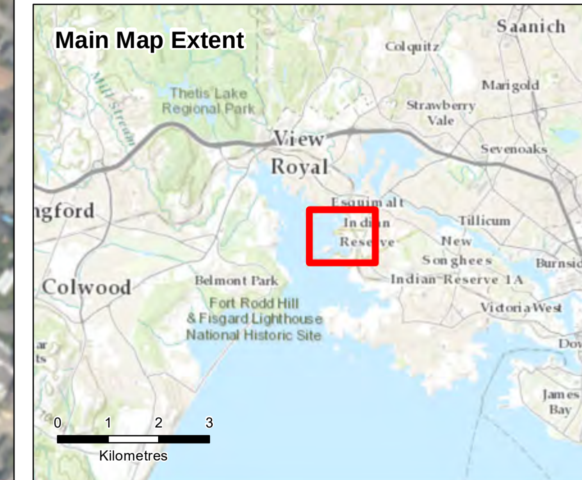
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Esquimalt and Songhees Reserve

Main Map Extent



Legend

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- > 80% organic cover

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or

Notes

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2. Locations should be considered approximate.
3. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:4,000

0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 5

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Public Works and Government Services Canada

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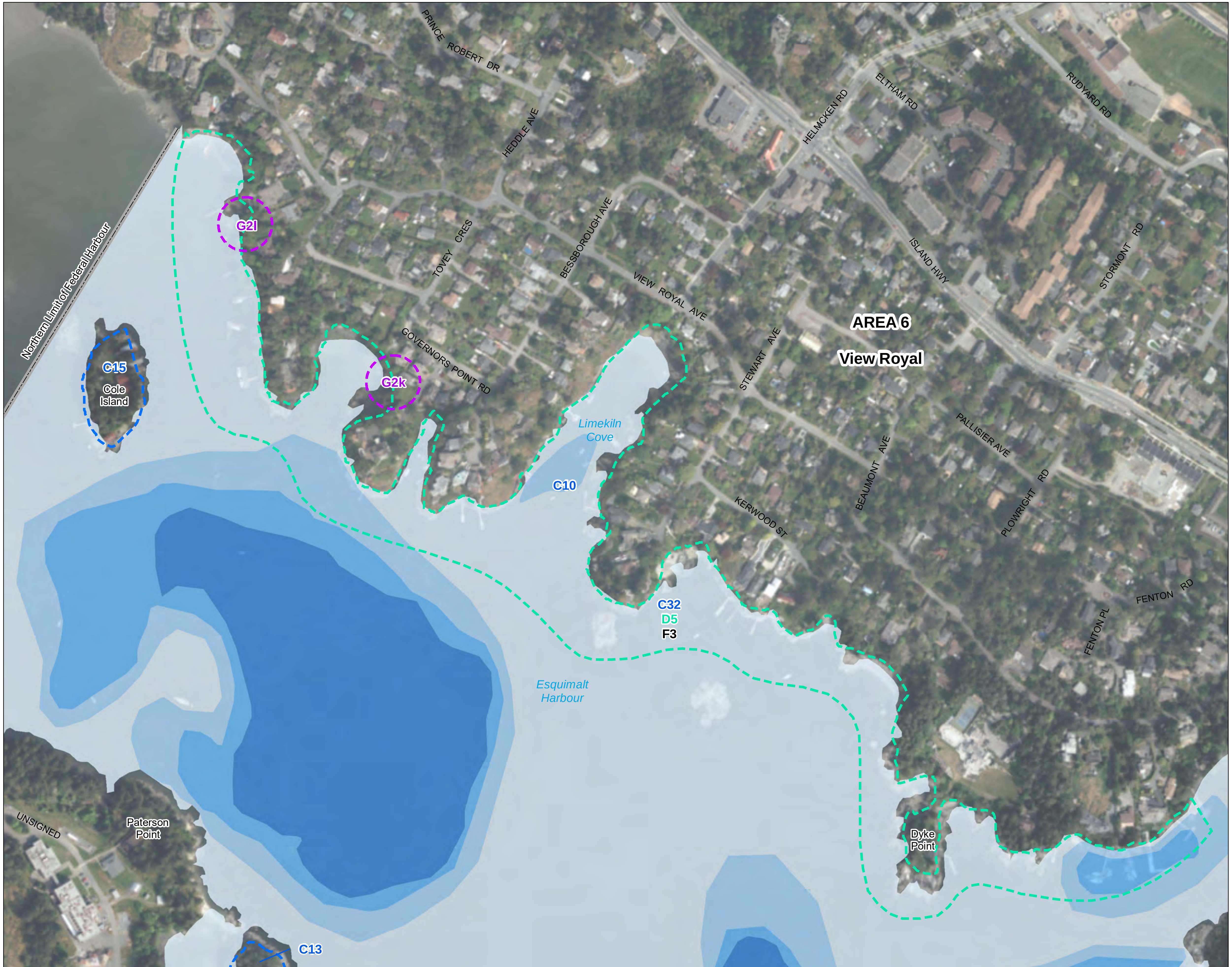
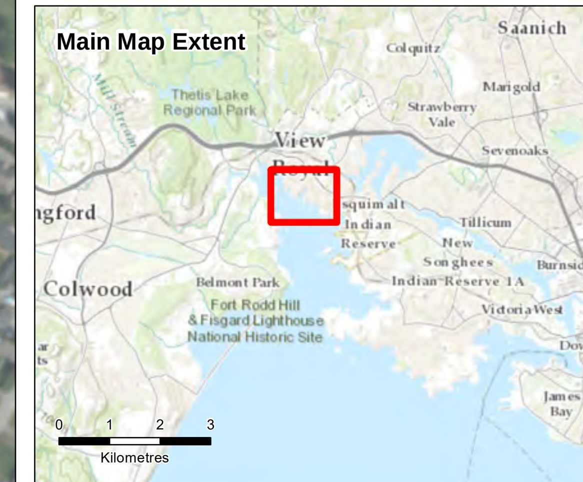
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - View Royal



Main Map Extent



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Federal Harbour Limit

APECs

- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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2. Locations should be considered approximate.
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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:4,000

0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 6

HEMMERA

Public Works and Government Services Canada

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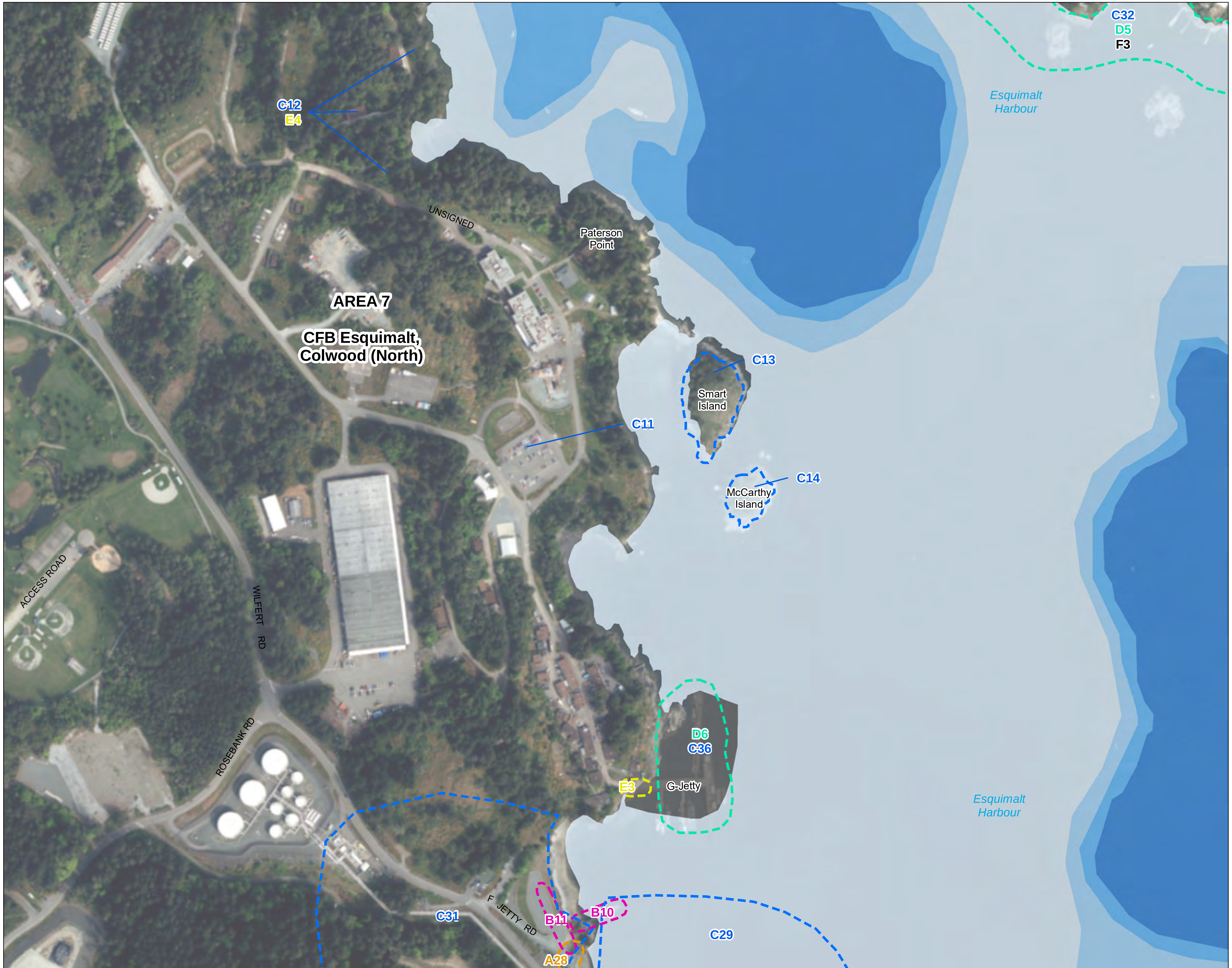
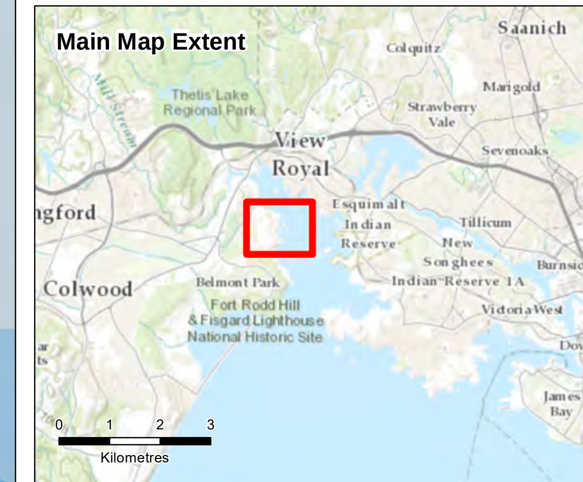
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - CFB Esquimalt, Colwood (North)





Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Un-surveyed seafloor

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs

Notes

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

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1:4,000

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 7

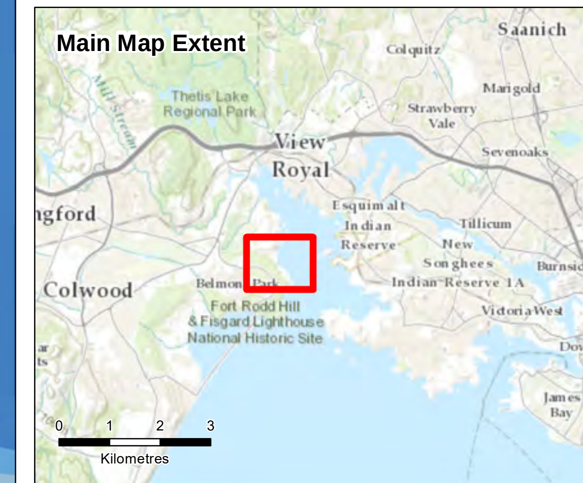
HEMMERA

Public Works and Government Services Canada

Path: O:\376240\04\mxd\Fig2-9_376_240_04_APECs_Detailed_161024.mxd

Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - CFB Esquimalt, Colwood (Central)



Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- 30 - 80% organic cover
- > 80% organic cover
- Un-surveyed seafloor

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group B - ASTs, USTs, Other Hydrocarbons
  PCOCs - Hydrocarbons and/or PAHs
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group D - Treated Timbers
  PCOCs - PAHs
- Group E - PCBs
  PCOCs - PCBs
- Group F - Spills
  PCOCs - Chlorophenols and/or hydrocarbons and/or

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- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:4,000

0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 8

HEMMERA

Public Works and Government Services Canada

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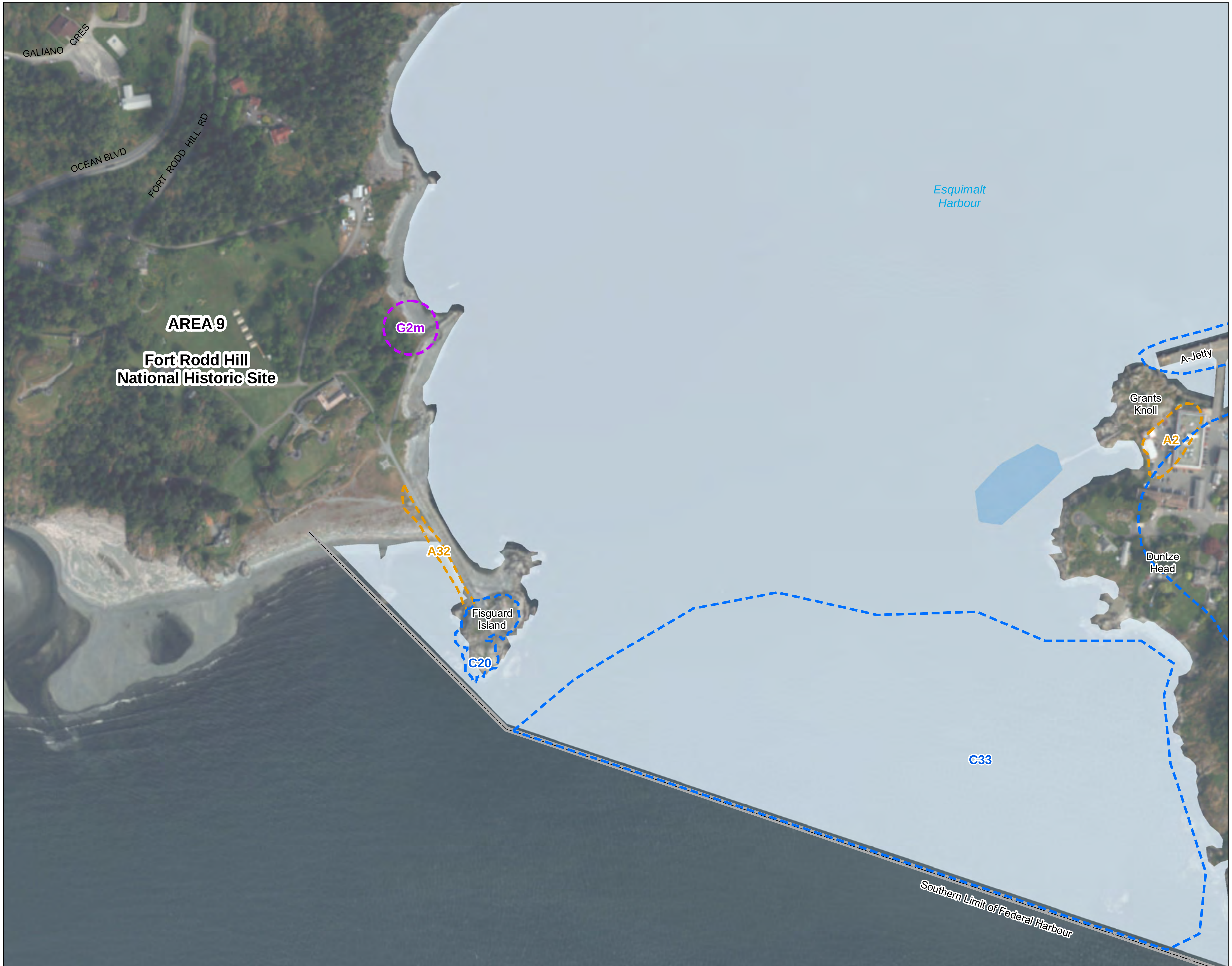
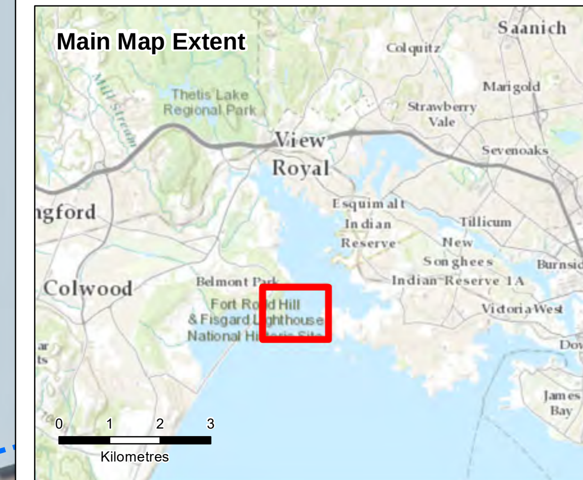
Esquimalt Harbour Woodwaste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Areas of Potential Environmental Concern (APECs) - Fort Redd Hill National Historic Site





Legend

- Trace (<5%) organic cover
- 5 - 30% organic cover
- Federal Harbour Limit

APECs

- Group A - Fill
  PCOCs - Metals and/or PAHs and/or hydrocarbons
- Group C - Operational Activities
  Metals and/or PAHs and/or hydrocarbons and/or phenols and/or PCBs and/or PFOS/PFOA
- Group G - Stormwater Outfalls
  PCOCs - Metals and/or PAHs

Notes

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N

1:4,000

0 50 100 150 200
Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.04	Production Date: Nov 23, 2016	Figure 9

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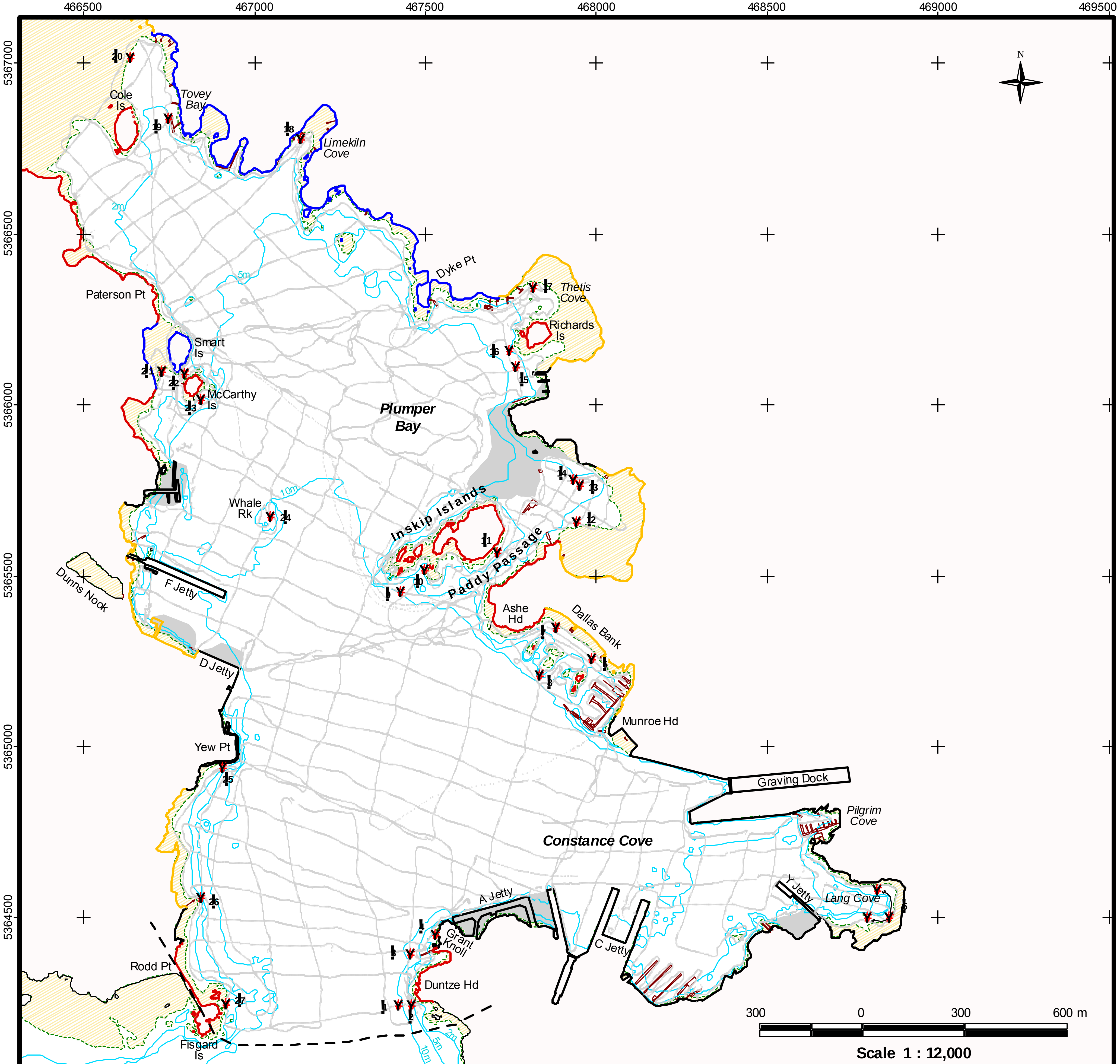
APPENDIX E

Background Biophysical Conditions of Esquimalt Harbour

7.0 MAP FOLIO



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 3. Video Survey Tracklines & Dive Observation Sites

Dive Sites

Site number (see Report text, Table 3)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

Physical Shore Type *

Rock

Rock and Sediment

Sediment

Estuary, Marsh or Lagoon

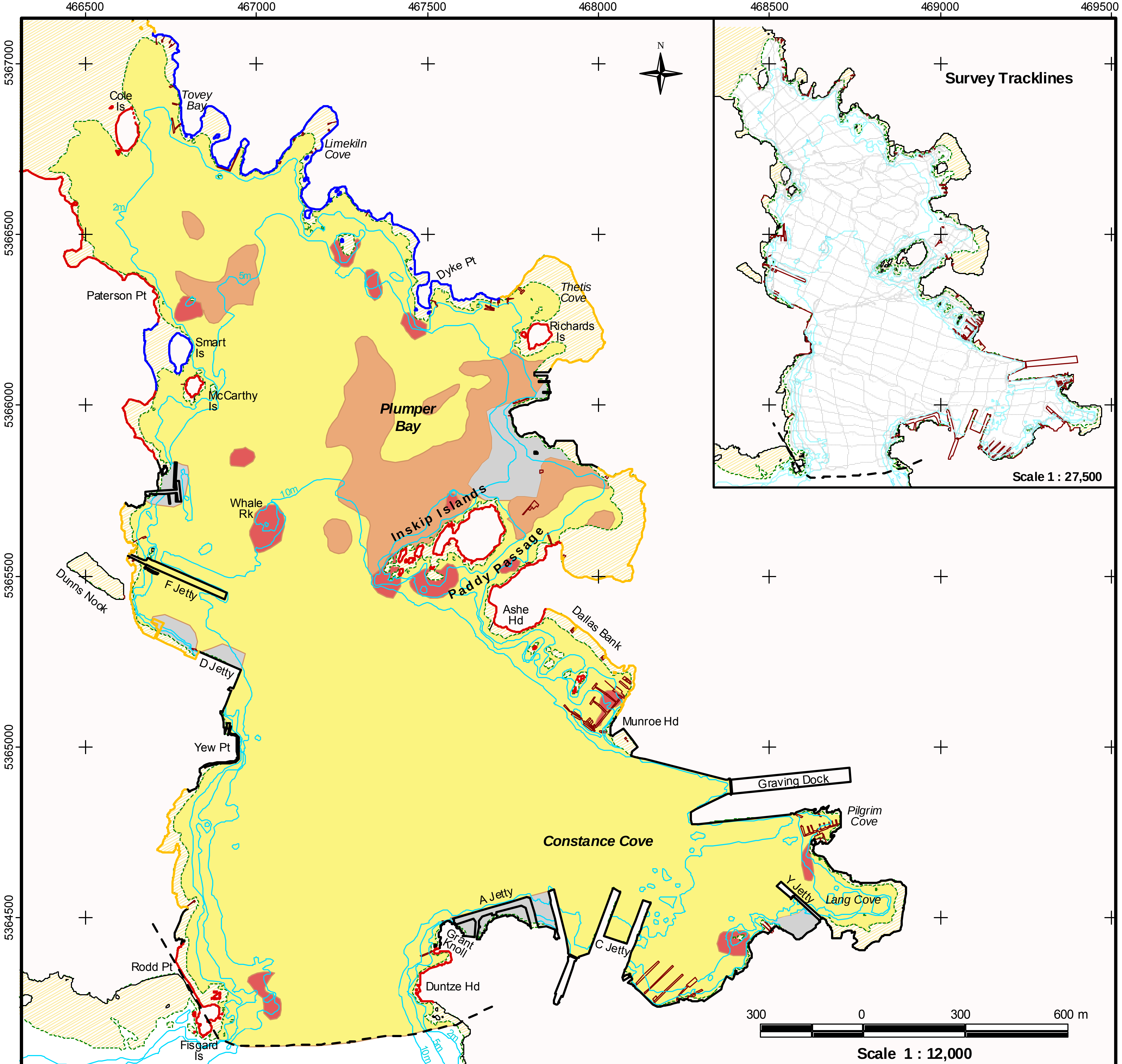
Man-Made

* Source: Westland, 2000

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 4. Substrate Type

- Sediment
- Rock or rock with sediment veneer
- Wood & bark debris (substrate obscured)

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

Physical Shore Type *

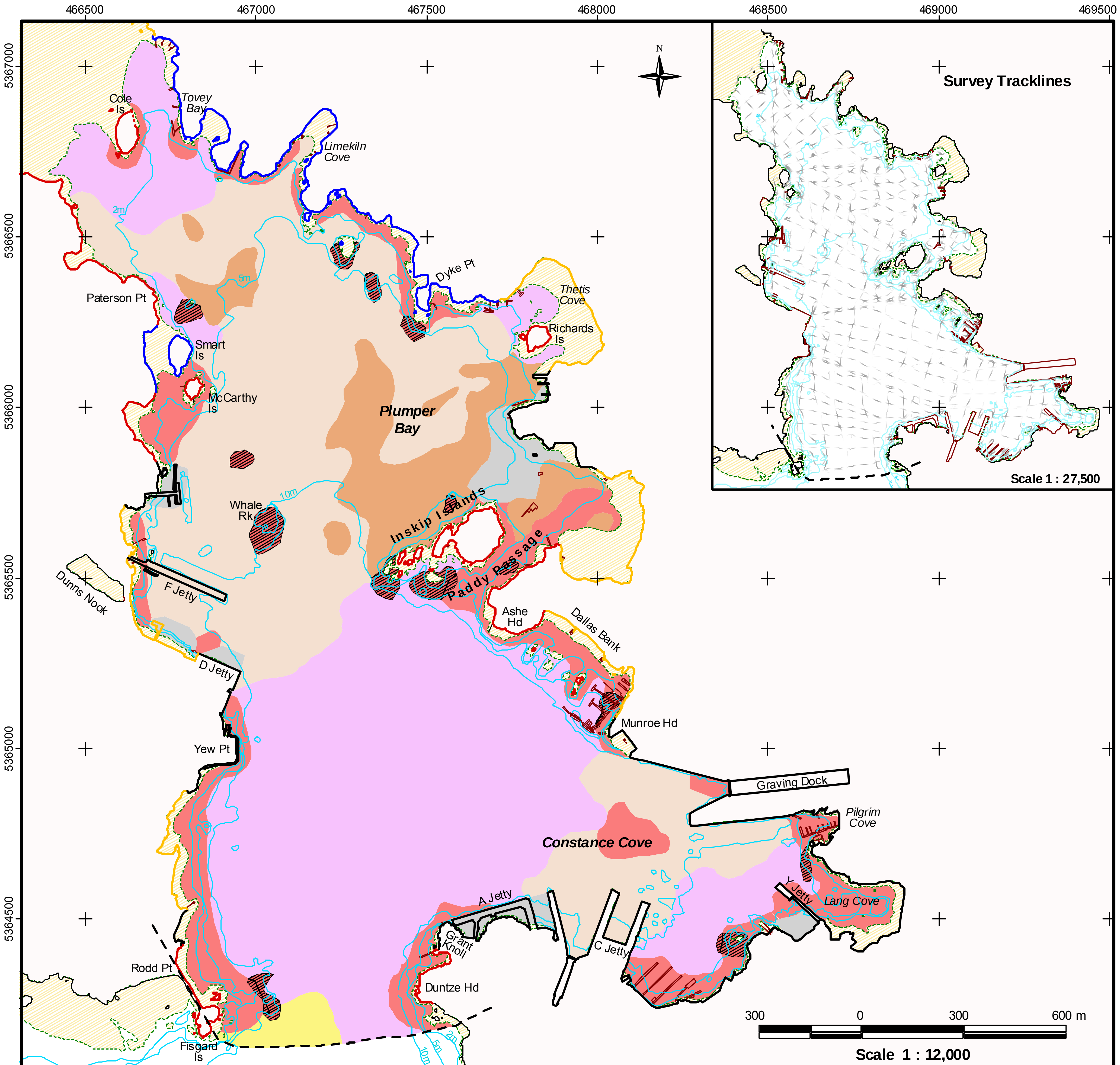
- Rock
- Rock and Sediment
- Sediment
- Estuary, Marsh or Lagoon
- Man-Made

* Source: Westland, 2000

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 5. Sediment Size Class

- Gravel
- Gravelly Mud/Sand
- Mud/Sand
- Sand
- Rock or rock with sediment veneer
- Wood & bark debris (substrate obscured)

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

Physical Shore Type *

- Rock
- Rock and Sediment
- Sediment
- Estuary, Marsh or Lagoon
- Man-Made

* Source: Westland, 2000

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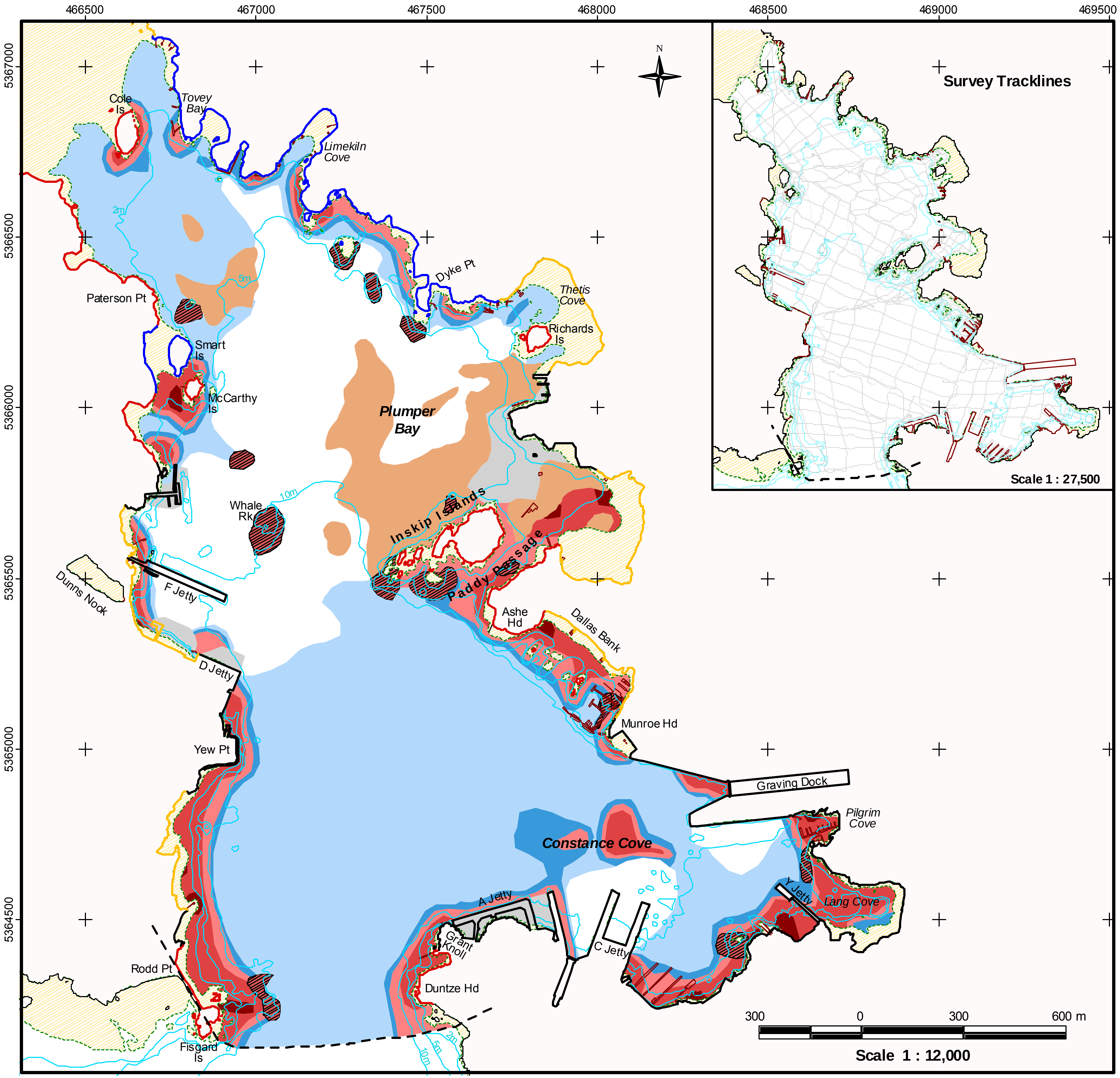
Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 6. Gravel Cover

- Trace - 5%
- 5 - 30%
- 30 - 50%
- 50 - 80%
- > 80%
- Rock or rock with sediment veneer
- Wood & bark debris (substrate obscured)

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

Physical Shore Type *

- Rock
- Rock and Sediment
- Sediment
- Estuary, Marsh or Lagoon
- Man-Made

* Source: Westland, 2000

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SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

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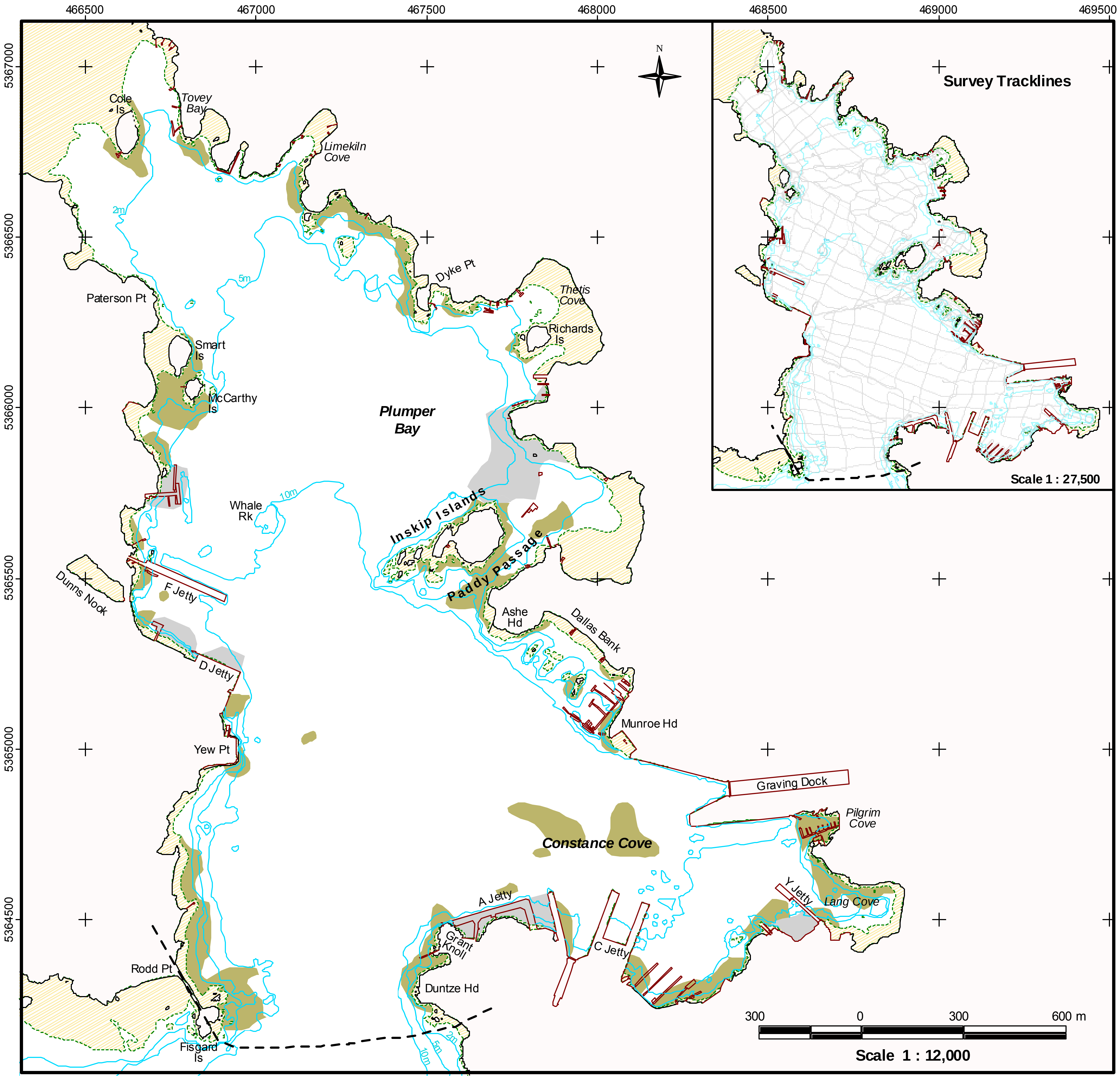
February 5, 2004

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 7. Boulder and Cobble Cover

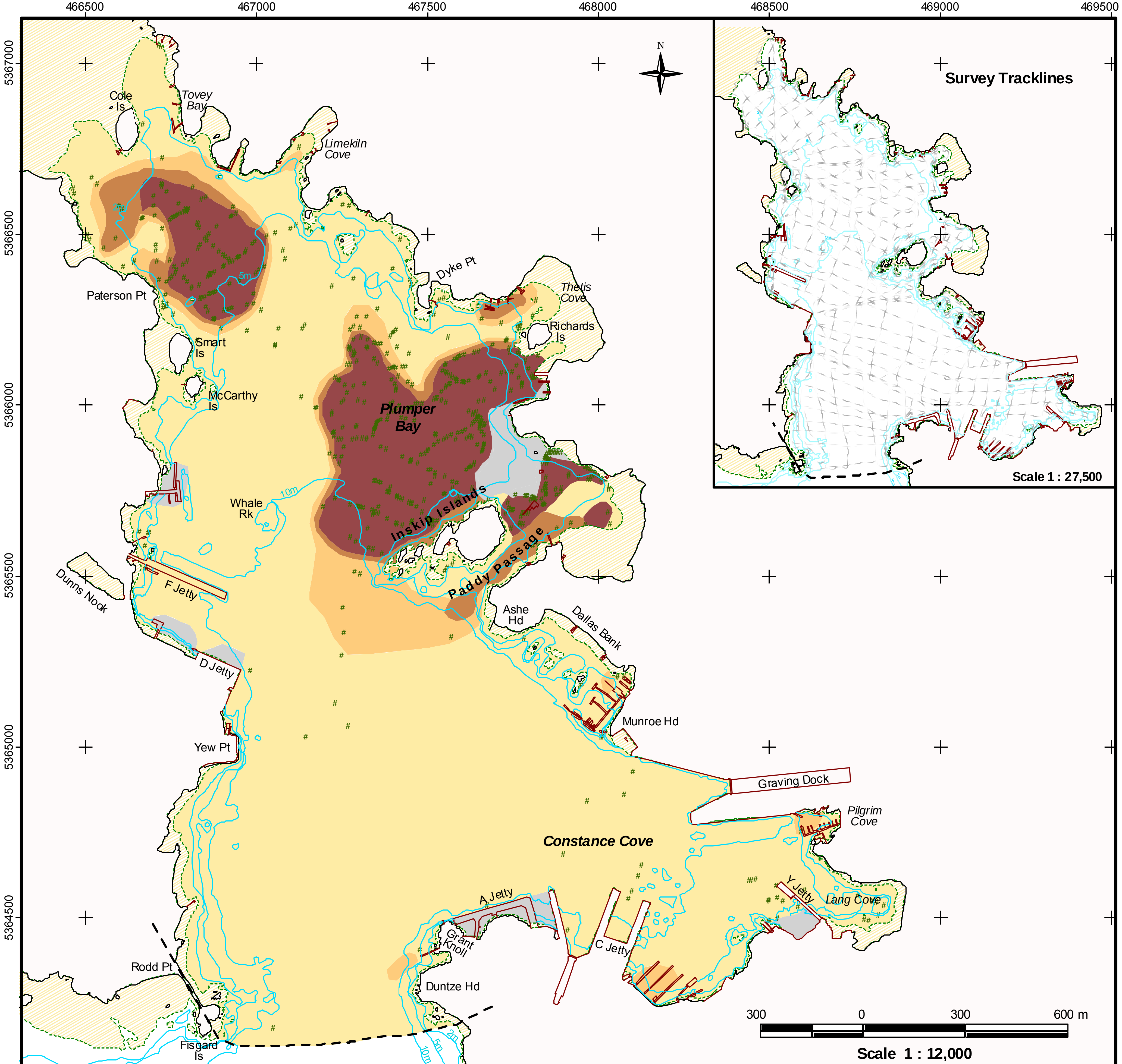


Trace to 5%

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
0m Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 8. Organic Cover

Trace - 5%
5 - 30%
30 - 80%
> 80%

Logs

Shoreline
Pier/Wharf/Jetty/Dock
Om Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

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June 27-28, 2000

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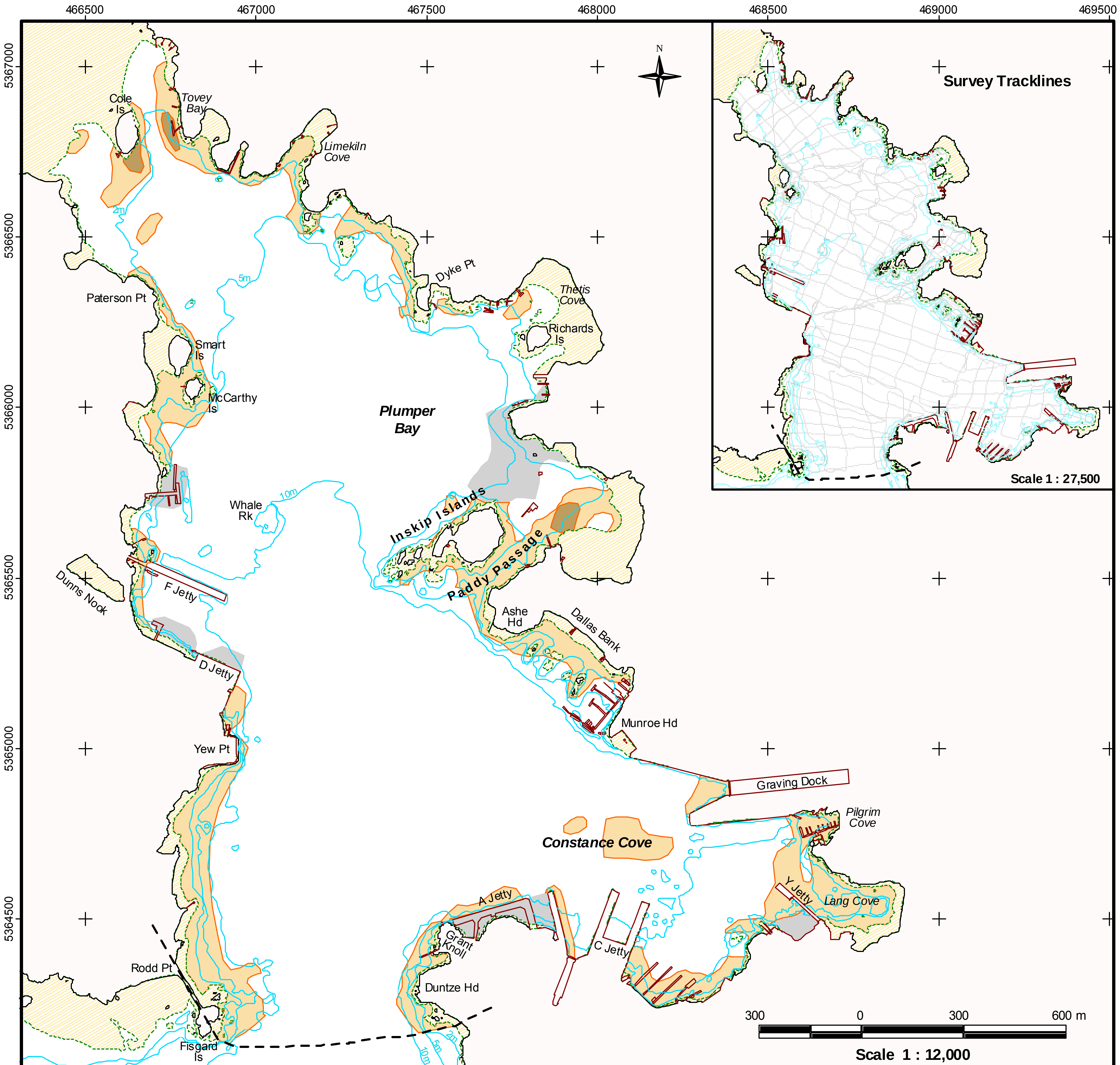

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 9. Shell Cover

5 - 30%

30 - 50%

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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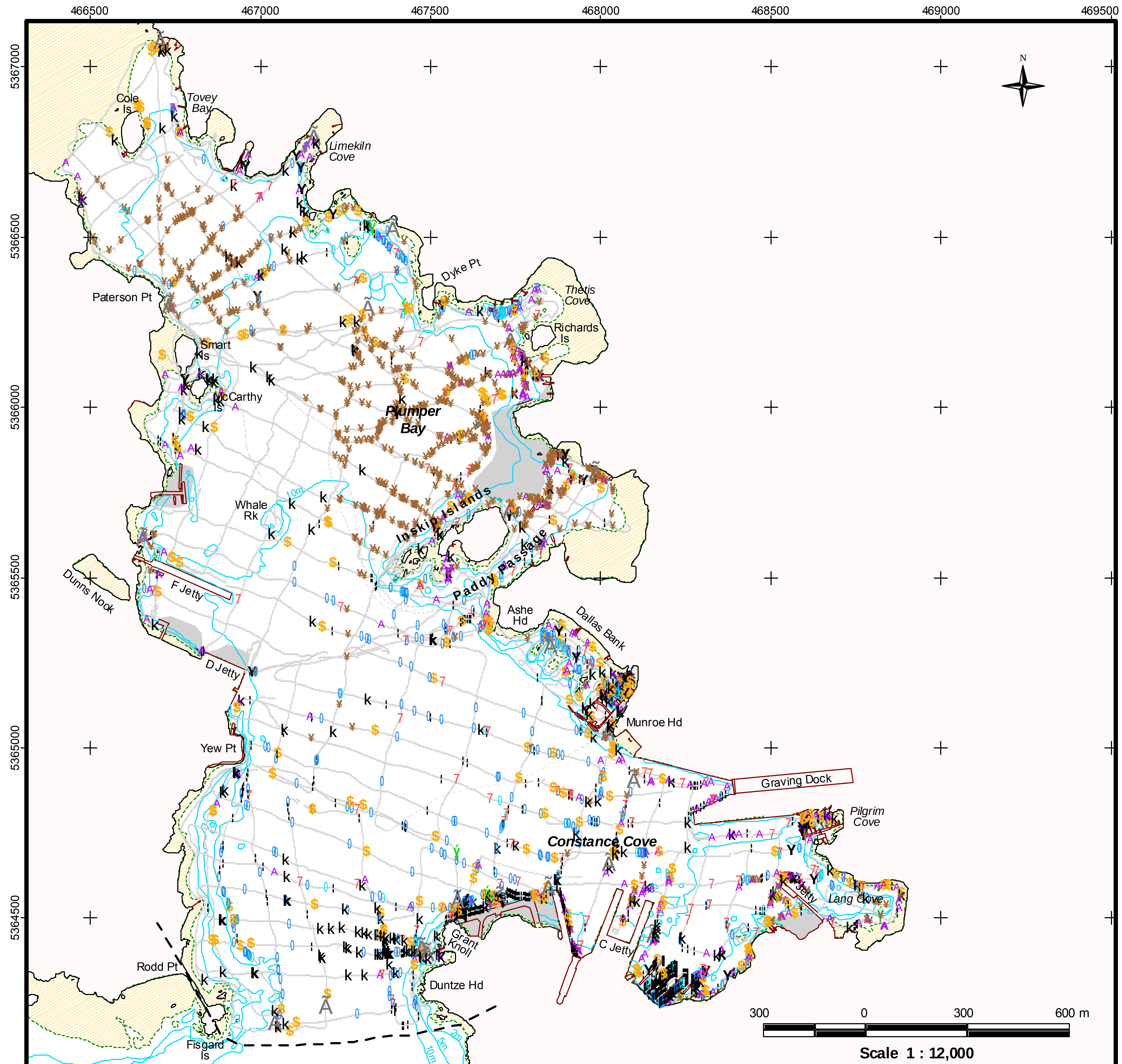

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 10. Man-made Objects

- Bottle
- Aggregation of Bottles
- Cable/Wire/Rope
- Cans
- Garbage
- Logs
- Metal Objects
- Other
- Pipe
- Tire
- Wood Debris

- Shoreline
- Pier/Wharf/Jetty/Dock
- 0m Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

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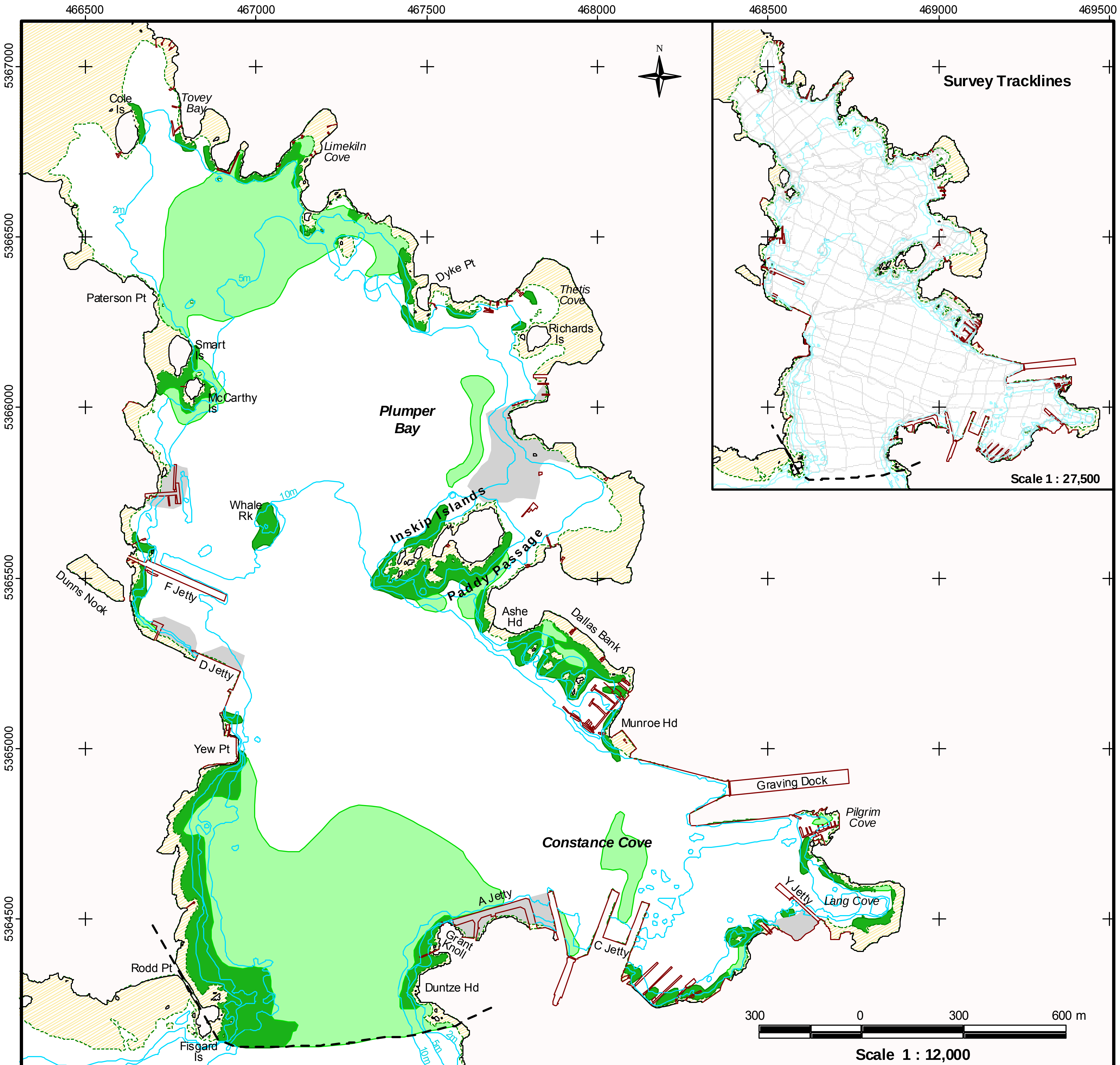
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 11. Vegetation Cover

Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

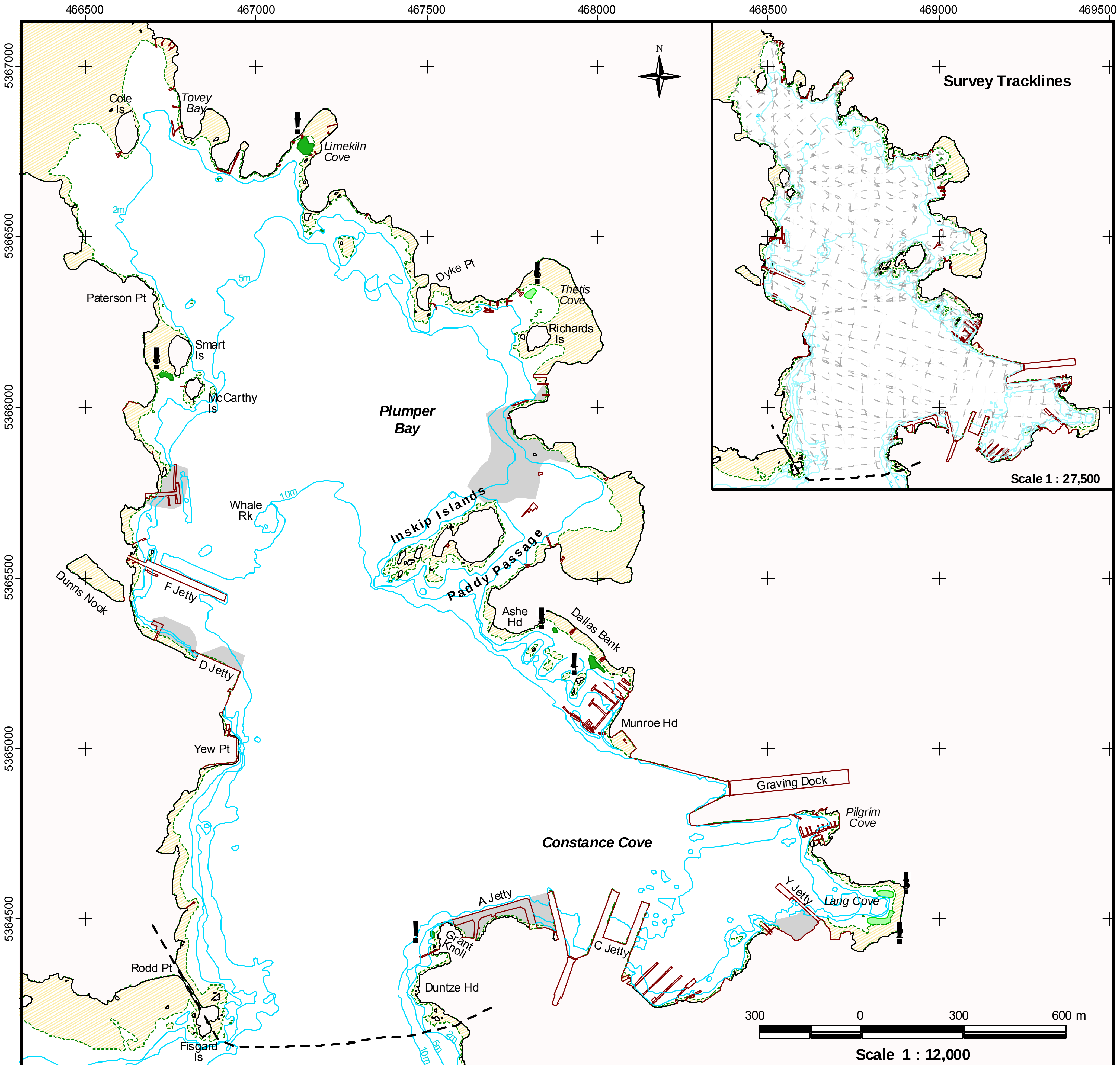
No Survey

Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 12. Eelgrass Beds *(Zostera marina)*

Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

Eelgrass Bed number (see Report text, Table 10)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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Dive: May 25-29, 2000
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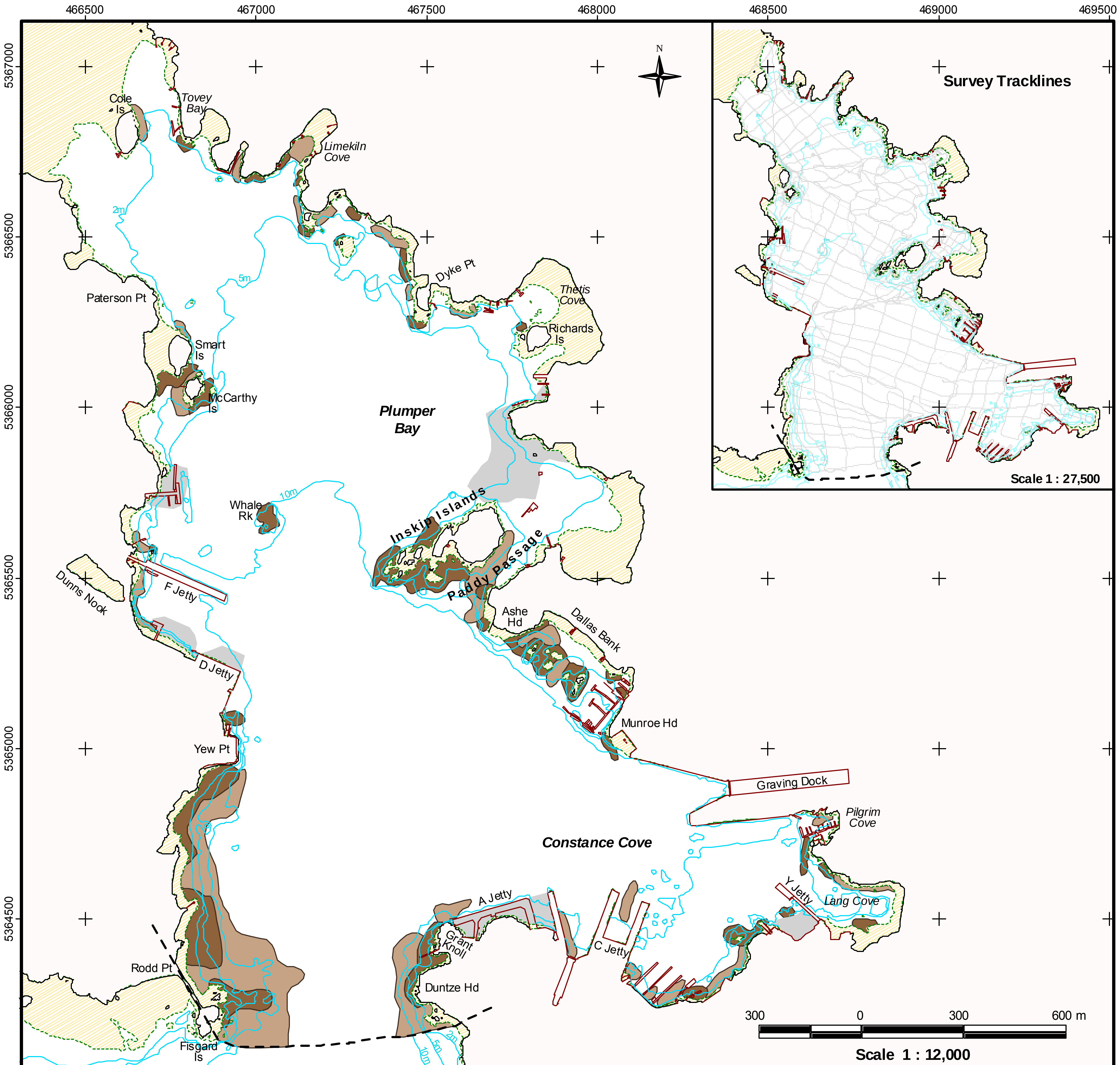

A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 13. Kelps

Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

No Survey

Survey Trackline

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Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
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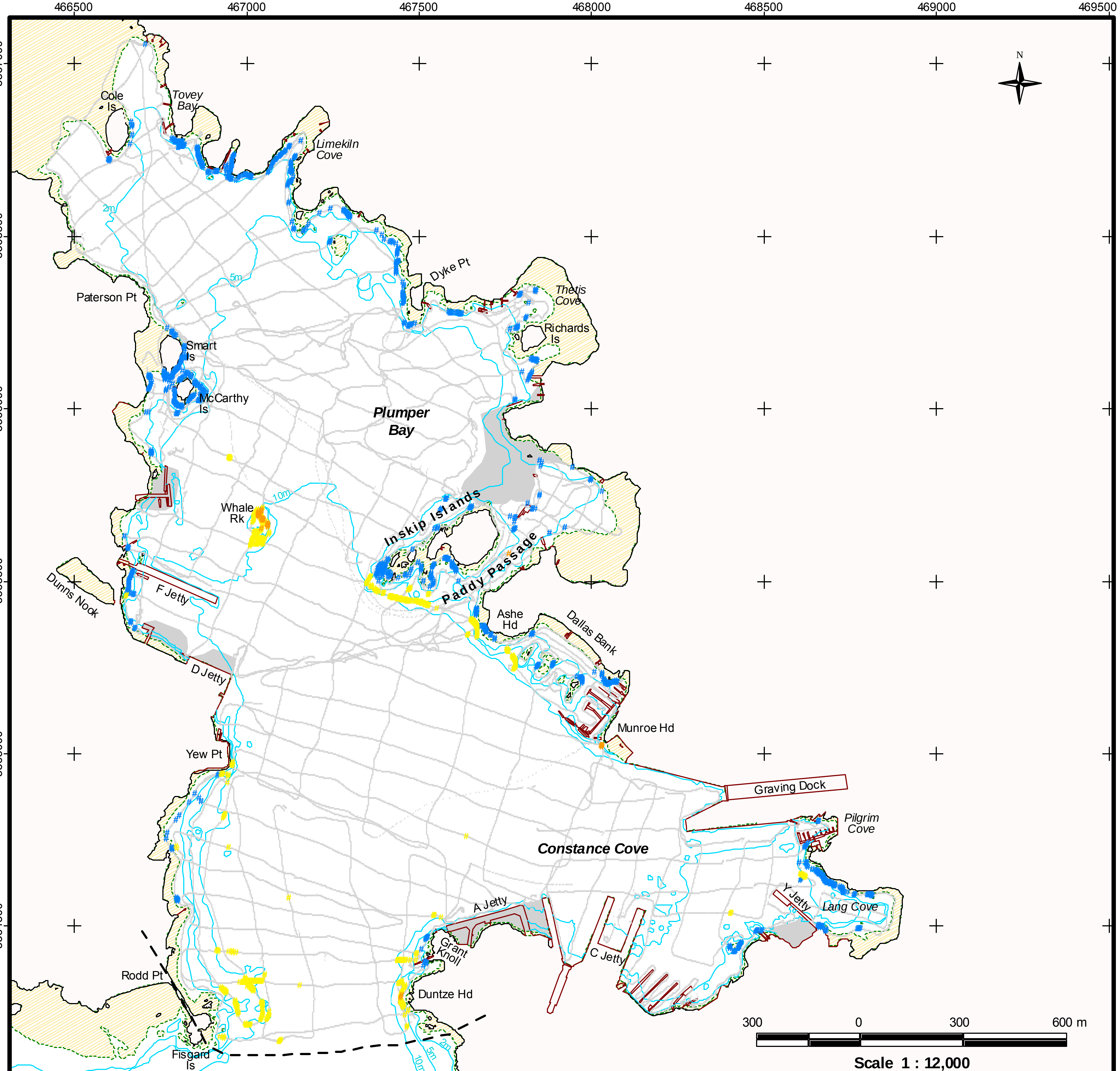
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 14.
Agarum, Nereocystis and Sargassum

Symbol	Species
#	*Nereocystis leutkeana*
#	*Agarum*
#	*Sargassum muticum*

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
Om Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

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Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
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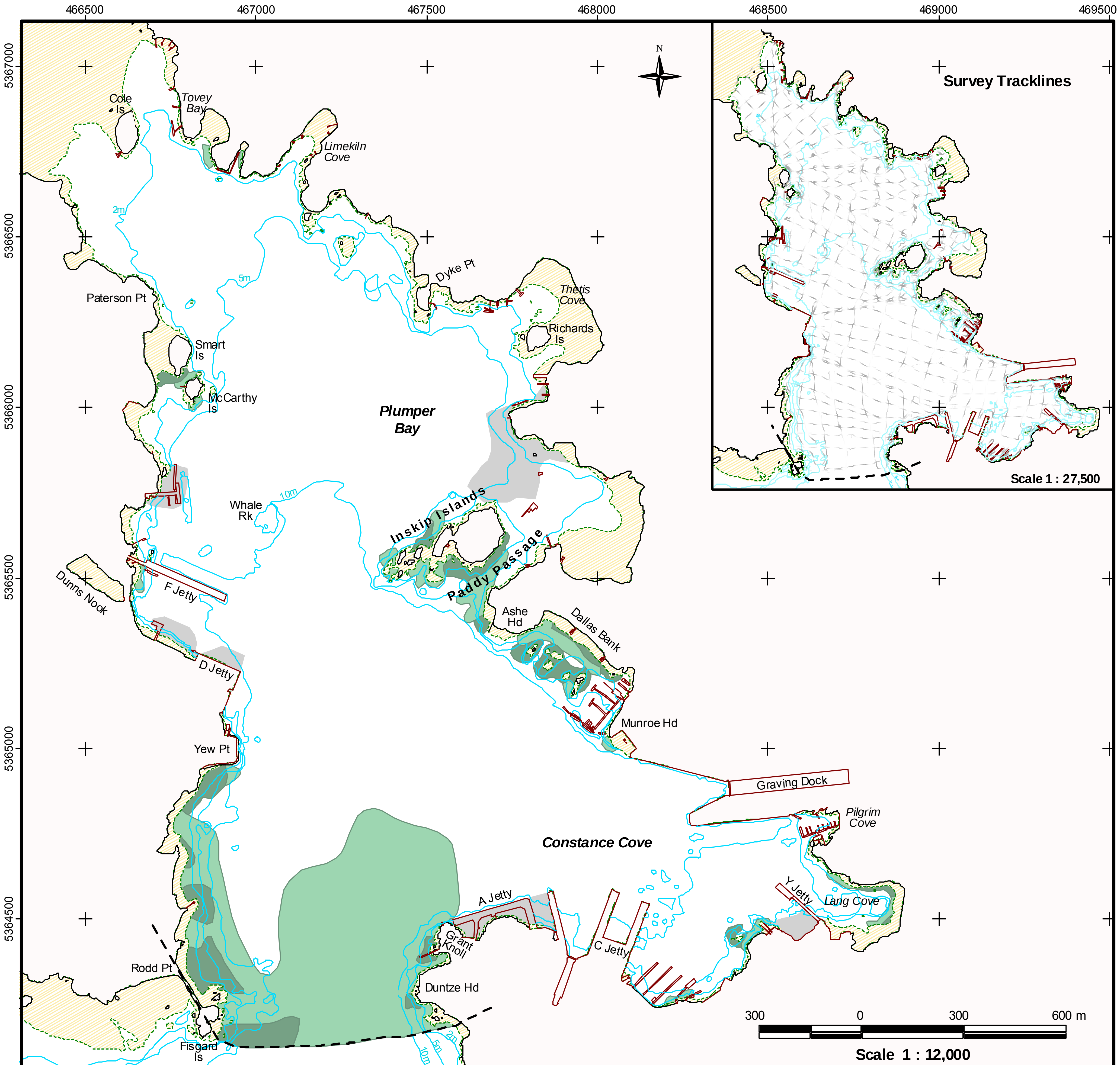
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 15. Foliose Green Algae

Sparse - Low Cover (Trace - 25%)

Moderate - Dense Cover (25 - 100%)

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
0m Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

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SIMS: March 21-31, 2000
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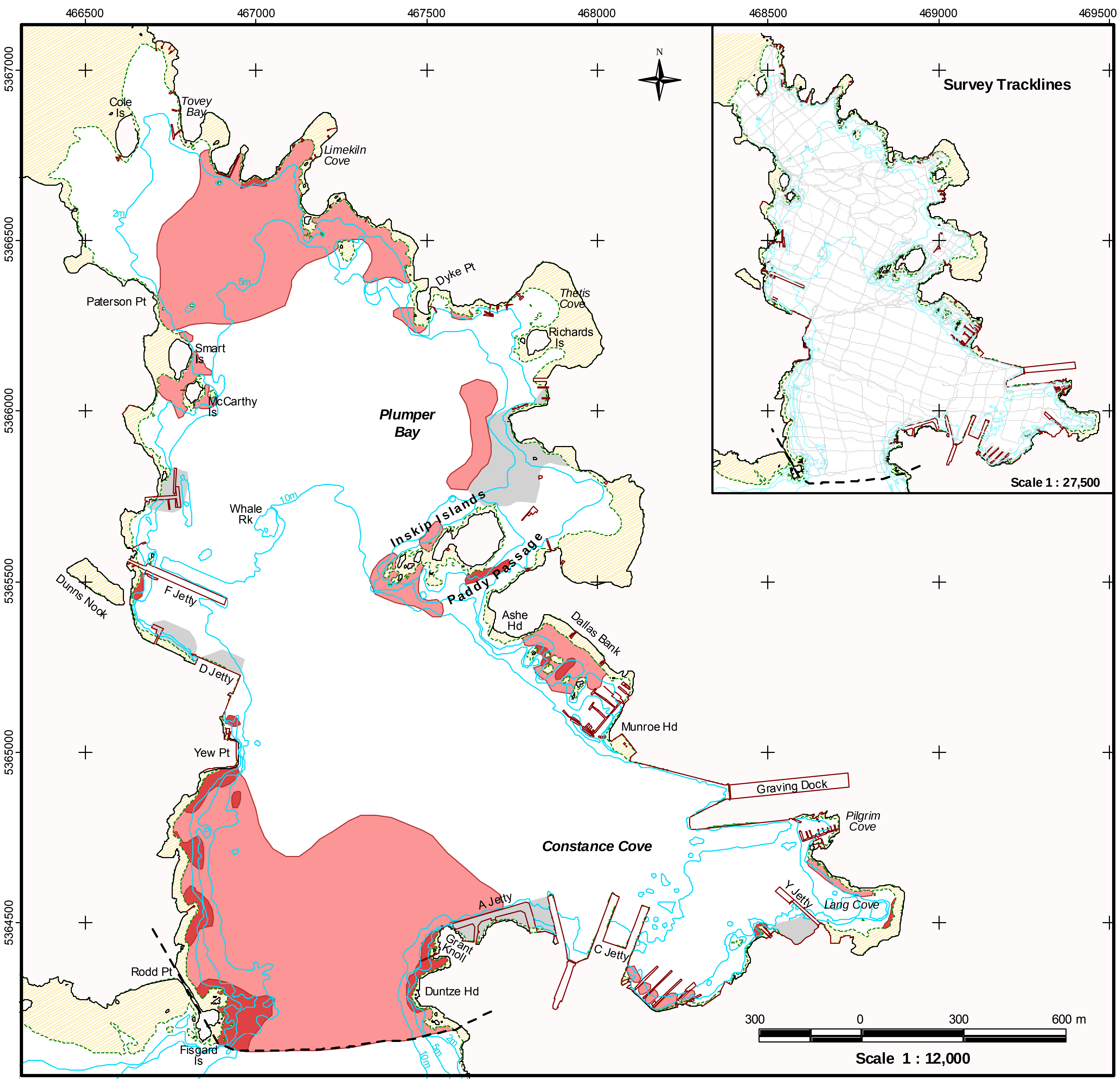
Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 16. Filamentous Red Algae

- Sparse - Low Cover (Trace - 25%)
- Moderate - Dense Cover (25 - 100%)

- Shoreline
- Pier/Wharf/Jetty/Dock
- Om Contour (Chart Datum)
- 2, 5, 10m Contours
- Survey Boundary
- Intertidal Zone
- Upland
- No Survey
- Survey Trackline

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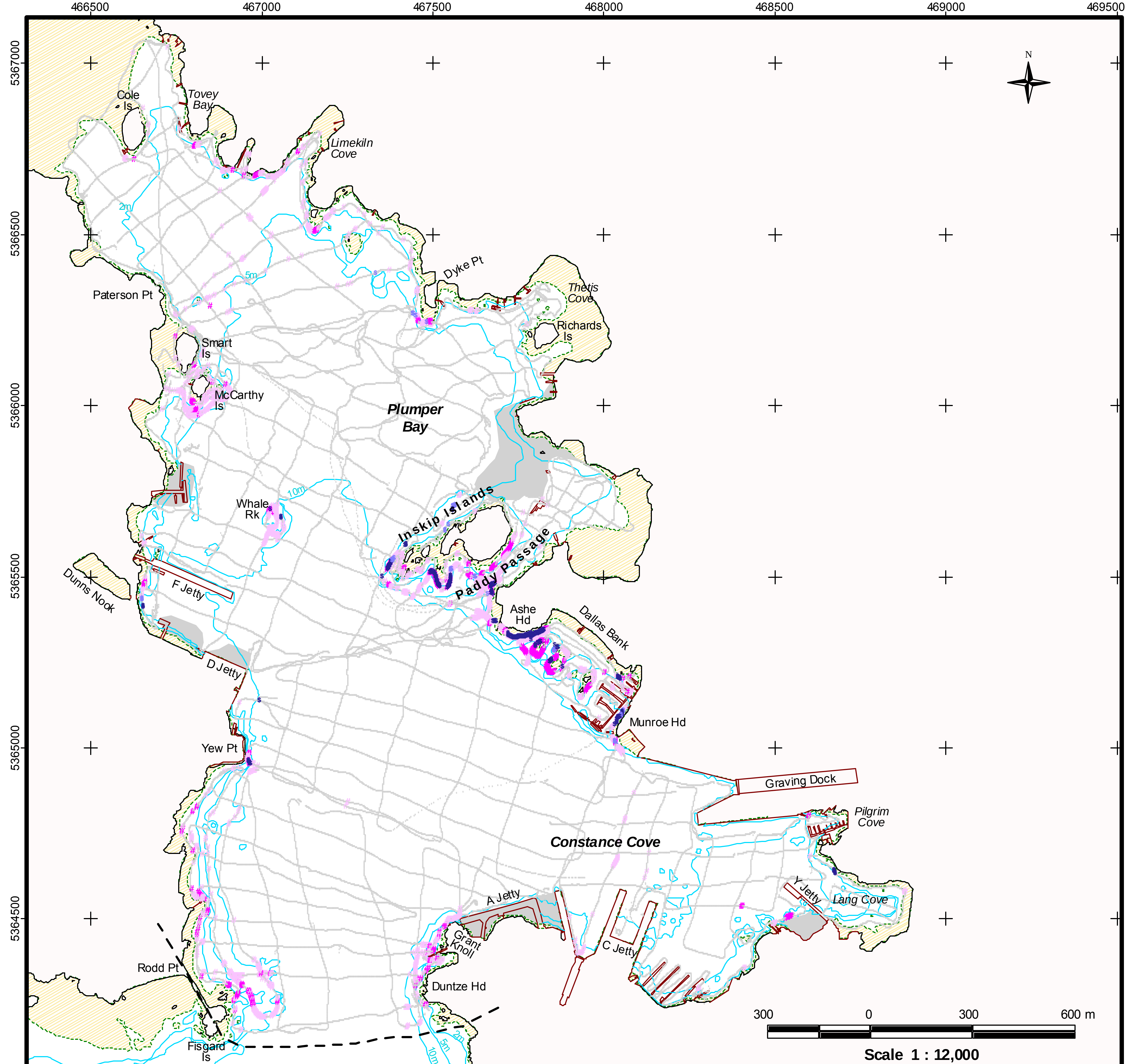
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 17. Foliose & Coralline Red Algae

Foliose Red Algae

- # Sparse - Low Cover (Trace - 25%)
- # Moderate - Dense Cover (25 - 100%)

Coralline Red Algae

- $ Sparse - Low Cover (Trace - 25%)
- $ Moderate - Dense Cover (25 - 100%)

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
0m Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

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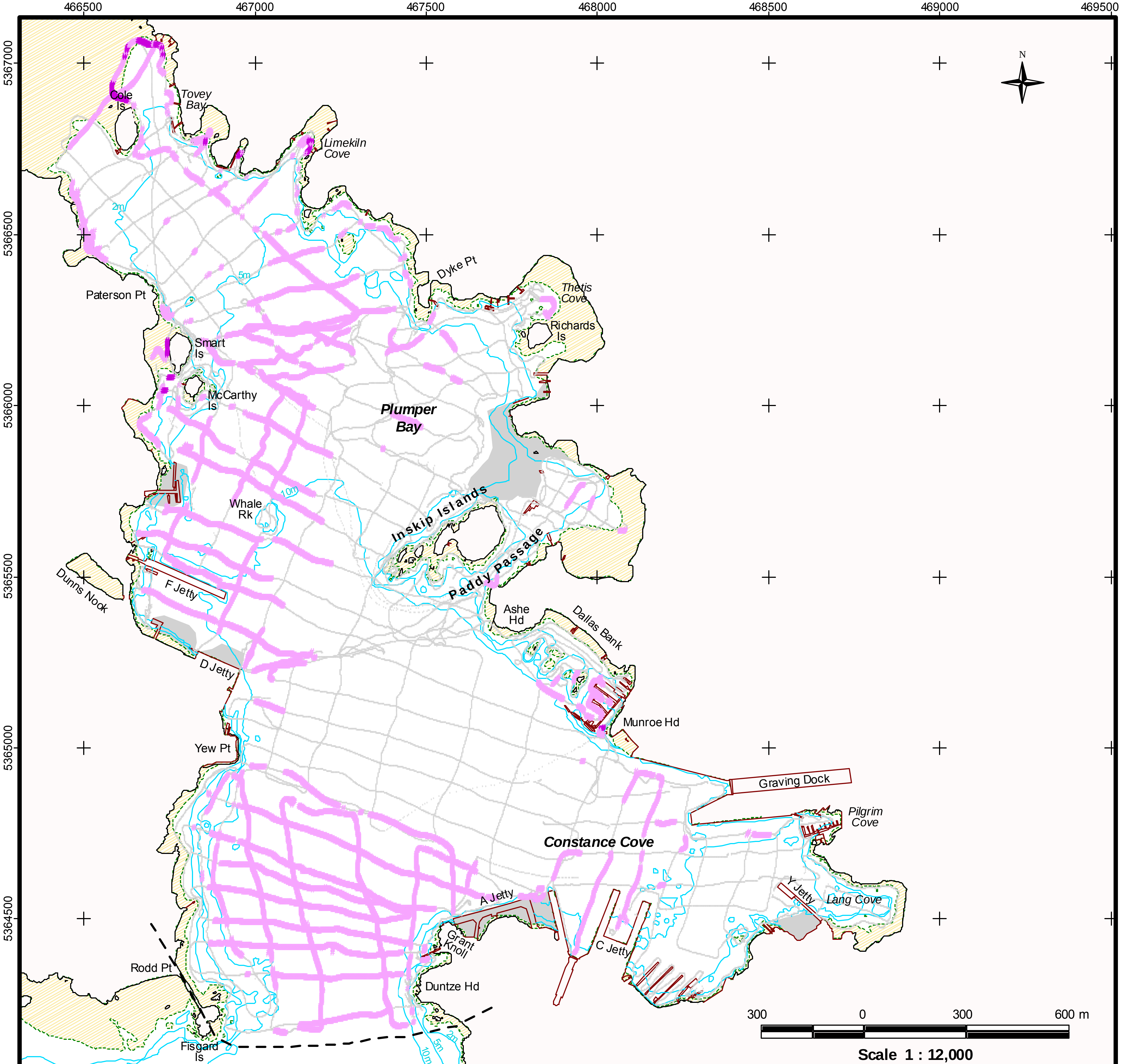
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 18. Infaunal Burrows

Distribution

Few/Patchy

Continuous

Shoreline

Pier/Wharf/Jetty/Dock

Om Contour (Chart Datum)

2, 5, 10m Contours

Survey Boundary

Intertidal Zone

Upland

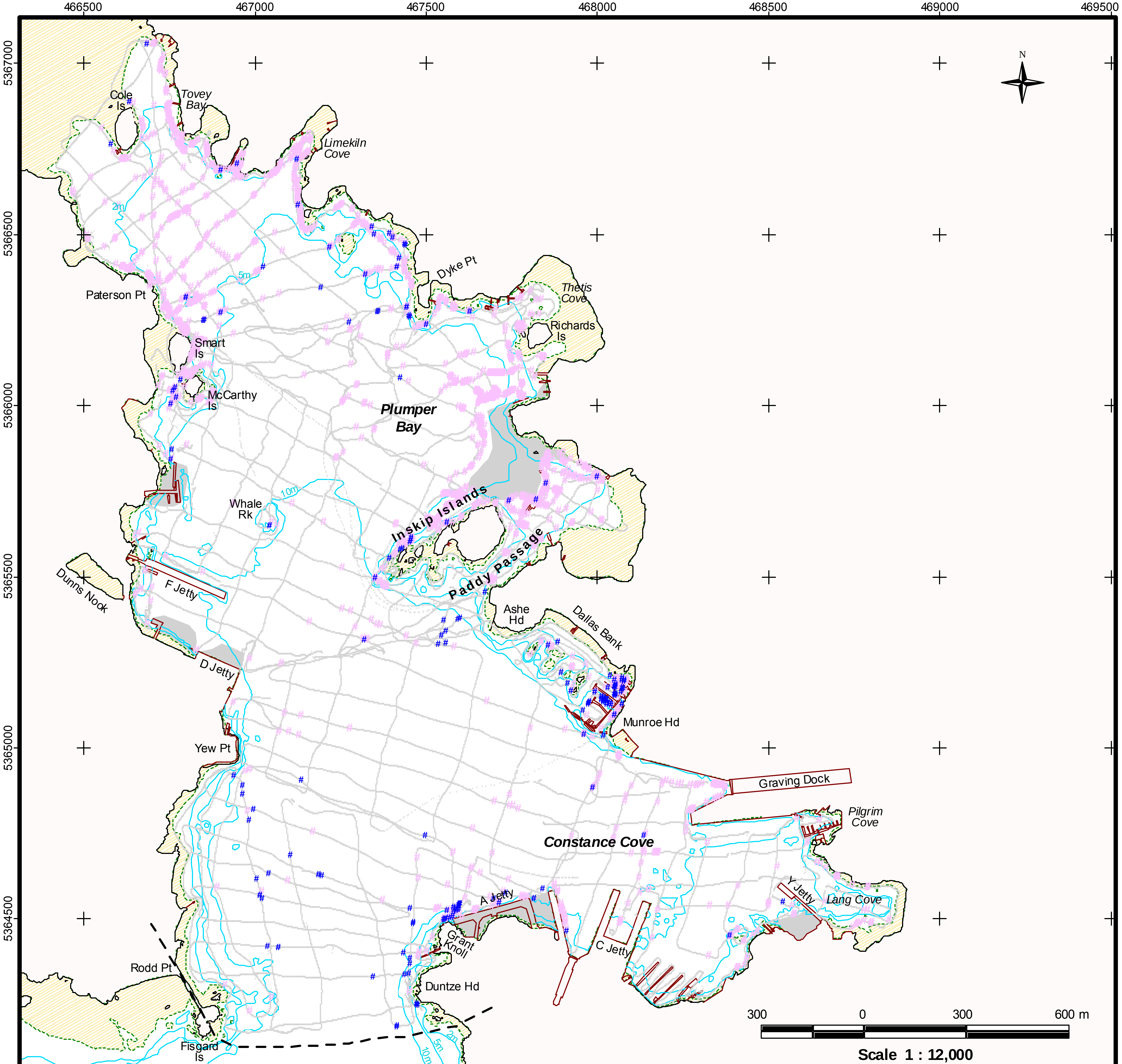
No Survey

Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 19. Anemones

Metridium

Urticina sp. (Tealia)

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
0m Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
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June 27-28, 2000

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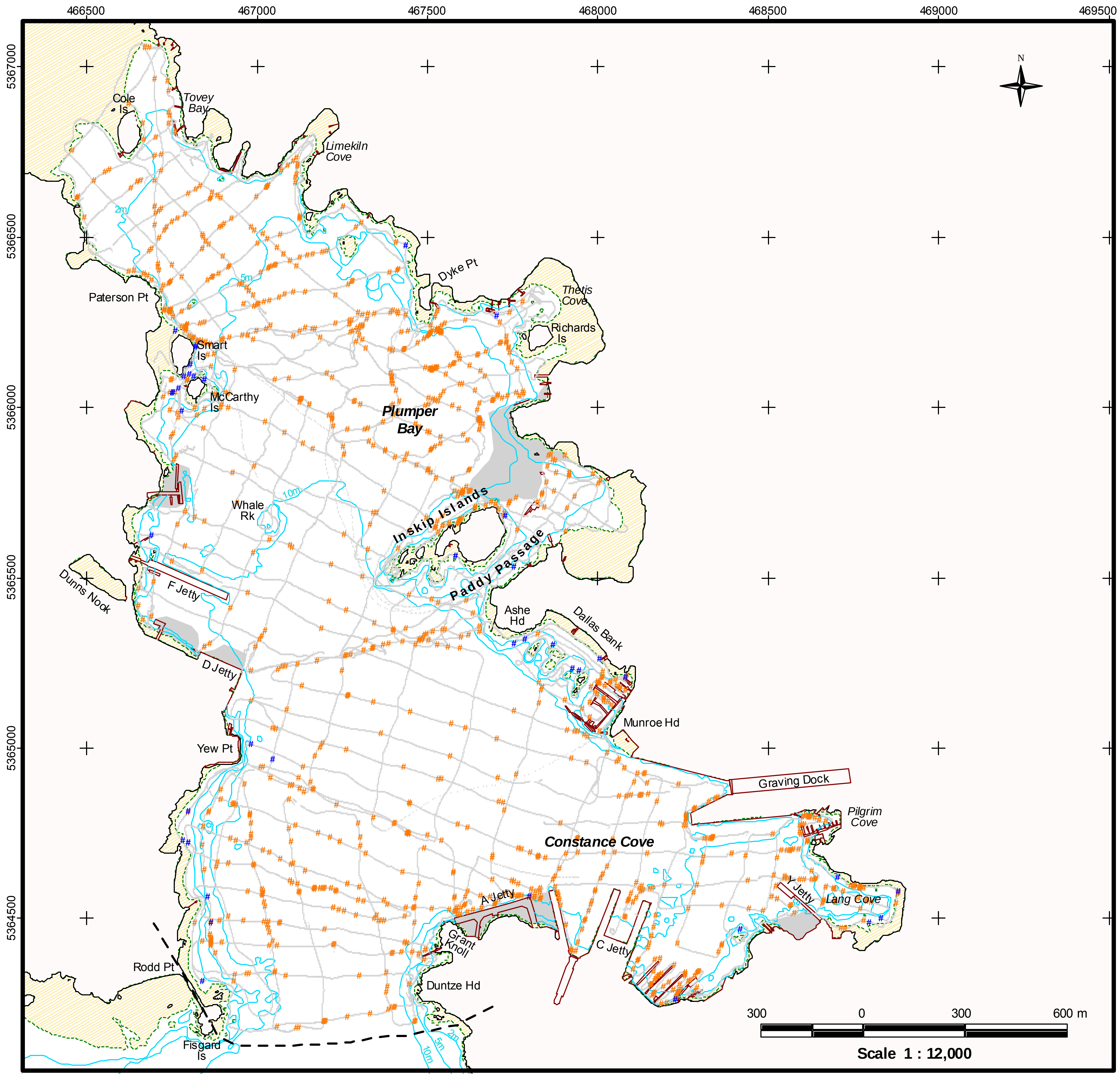
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 20. Crabs

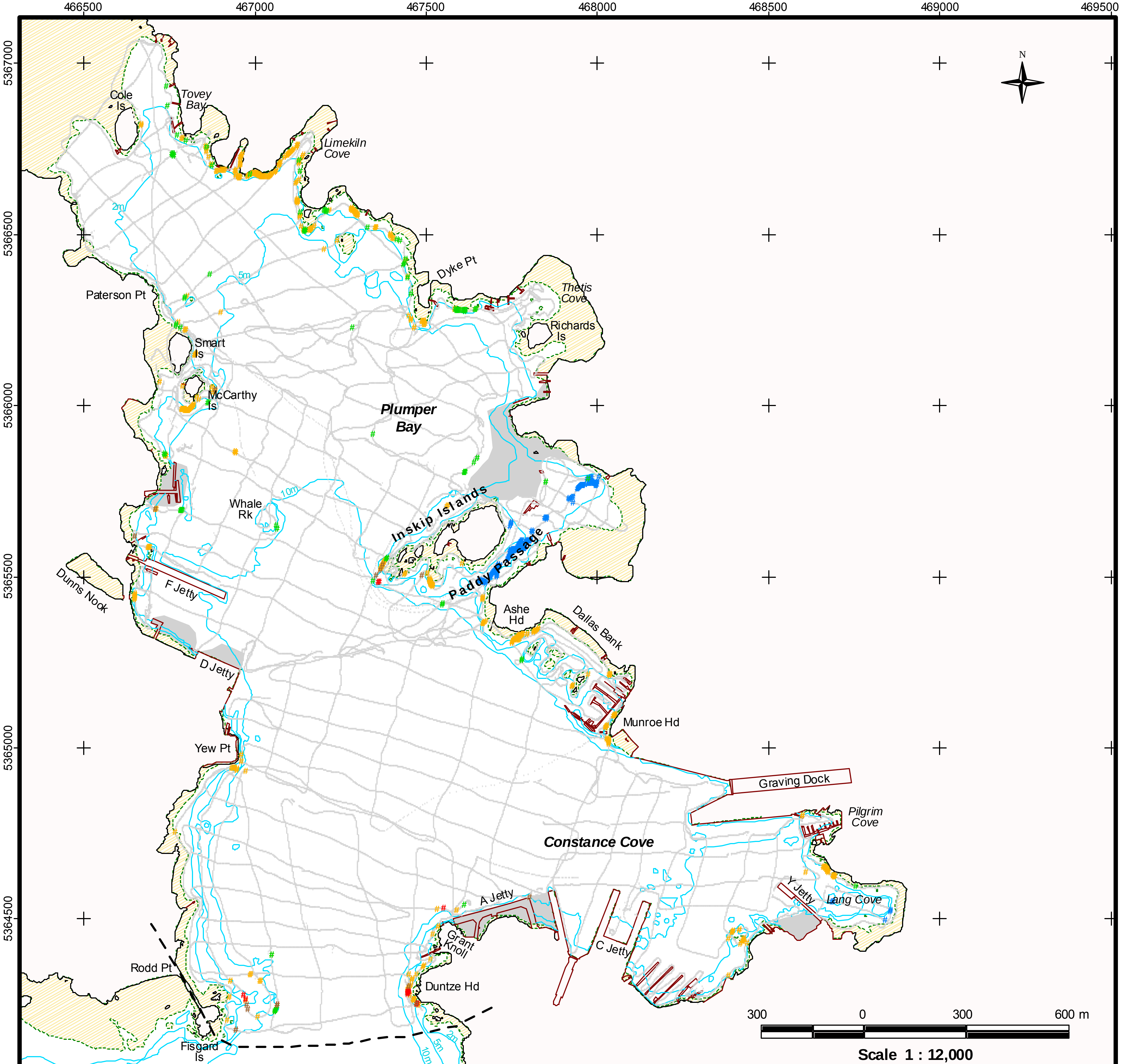
\# *Cancer sp. (C. magister, C. gracilis)*

\# **Red Rock Crabs** *(Cancer productus)*

Shoreline
Pier/Wharf/Jetty/Dock
0m Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 21. Other Invertebrates

- # **Red Sea Urchins** *(Strongylocentrotus franciscanus)*
- # **California Sea Cucumbers** *(Parastichopus californicus)*
- # **Burrowing Sea Cumbers** *(Cucumaria miniata)*
- # **Piddock Clams** *(Zirfaea pilsbryi)*
- # **Bryozoans**

Shoreline	Intertidal Zone
Pier/Wharf/Jetty/Dock	Upland
Om Contour (Chart Datum)	No Survey
2, 5, 10m Contours	Survey Trackline
Survey Boundary	

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
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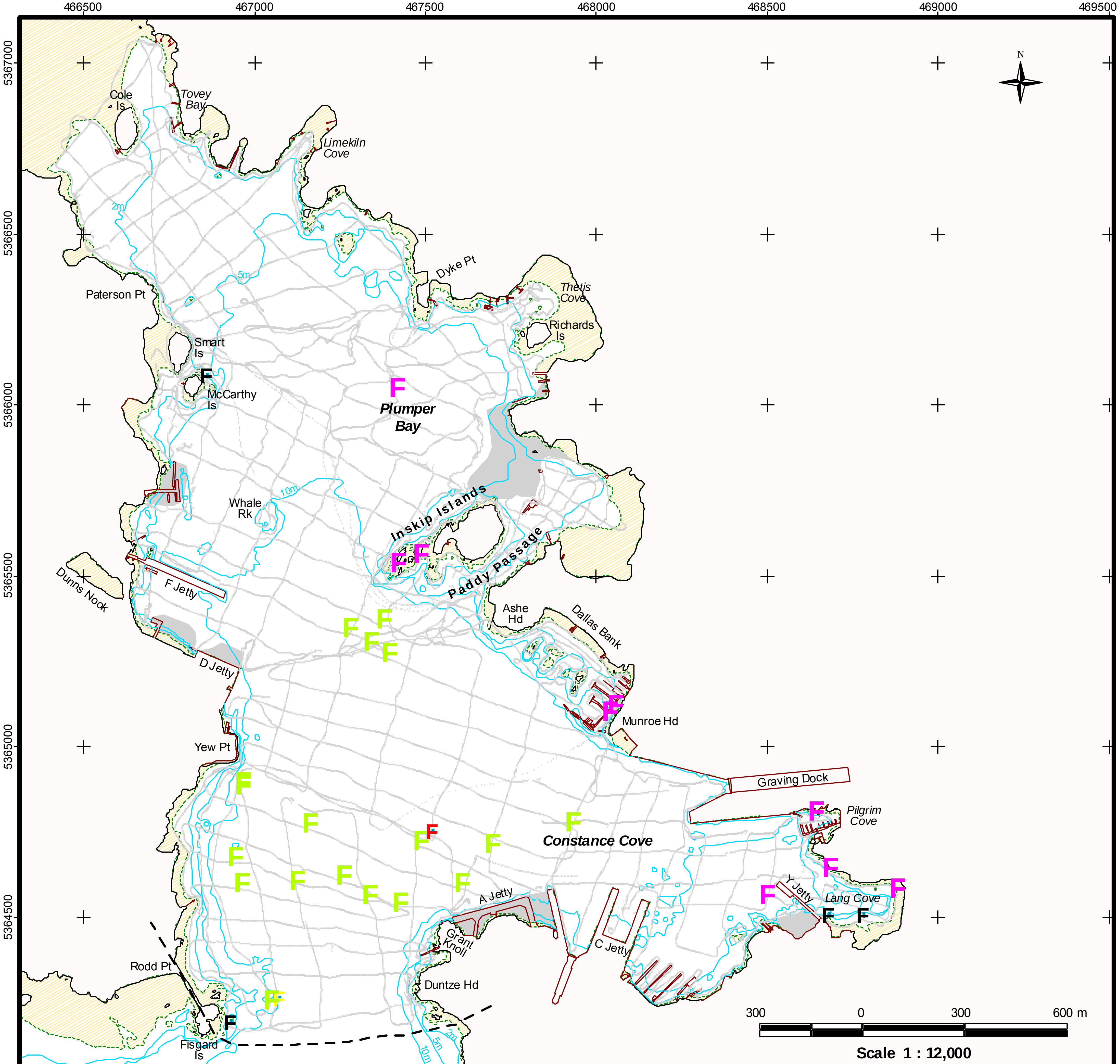


A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 22. Fish Observations

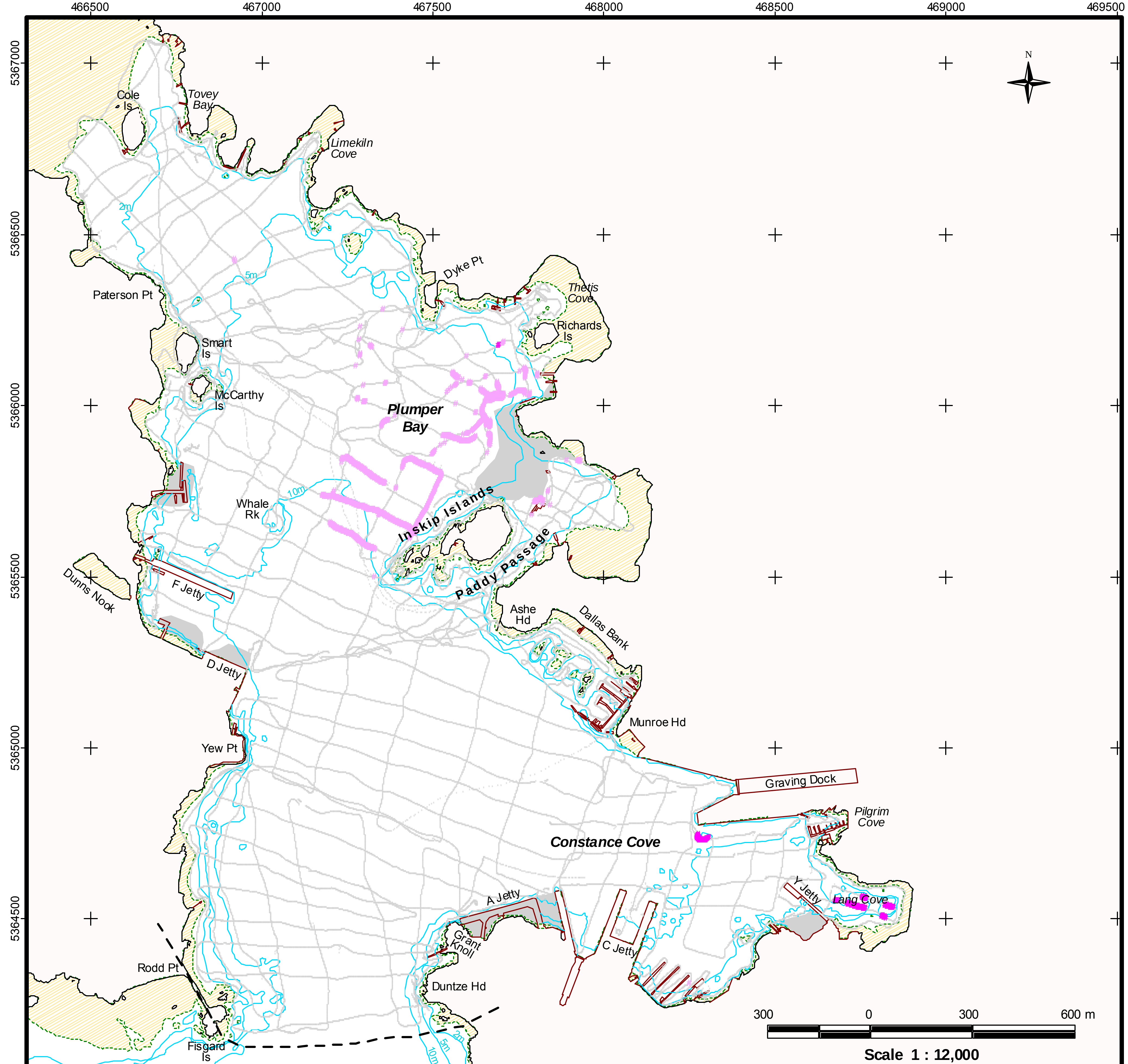
F Greenling
F Perch
F Sculpin
F Sole
F Unidentified Fish

Shoreline
Pier/Wharf/Jetty/Dock
0m Contour (Chart Datum)
2, 5, 10m Contours
Survey Boundary
Intertidal Zone
Upland
No Survey
Survey Trackline

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
Dive: May 25-29, 2000
June 27-28, 2000

Map Edition:
February 5, 2004



A Subtidal Survey of the Physical and Biological Features of Esquimalt Harbour

Figure 23. Bacterial Mats

Distribution

Few/Patchy

Uniform

Shoreline		Intertidal Zone	
Pier/Wharf/Jetty/Dock		Upland	
Om Contour (Chart Datum)		No Survey	
2, 5, 10m Contours		Survey Trackline	
Survey Boundary			

ARCHIPELAGO MARINE RESEARCH LTD

Survey Dates:
SIMS: March 21-31, 2000
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June 27-28, 2000

Map Edition:
February 5, 2004

APPENDIX F

Side Scan Sonar Results

NOTES

1. ON 30 AUGUST 2016, TERRA REMOTE SENSING INC (TRSI) CONDUCTED A SIDE SCAN SONAR SURVEY OF THE ESQUIMALT HARBOUR. DATA WERE COLLECTED FROM FROM ASH HEAD NORTH TO COLE I. THE AREA NORTH OF COLE ISLAND DRIES AT LOW TIDE AND WAS TOO SHALLOW TO COLLECT REASONABLE SIDE SCAN DATA, PARTICULARLY WHEN THE SEABED IS VISIBLE AT LOW TIDE.
2. POSITION AND HEADING DATA WERE COLLECTED USING A HEMISPHERE VS-111 GPS. DIFFERENTIAL CORRECTORS WERE RECEIVED FROM RICHMOND COAST GUARD BEACON. GPS DATA WERE RECORDED AT ONE SECOND INTERVALS TO TRSI's PROPRIETARY NAVIGATION AND DATA LOGGING SOFTWARE *RTC*.
3. SIDE SCAN SONAR DATA WERE COLLECTED USING AN EDGETECH 4200 DUAL FREQUENCY SYSTEM TOWED NEAR THE WATER SURFACE. THE DATA WERE COLLECTED AT 50 METRE HORIZONTAL SCAN RANGE (100 METRE SWATH) AT BOTH 300 AND 900 KHZ. DATA WERE LOGGED TO JSF AND XTF FORMAT USING DISCOVER SOFTWARE AND PROCESSED USING SONAR WIZ. WHERE SHOWN, SIDE SCAN IMAGERY (900 KHZ) DEPICTS HIGHER SEABED REFLECTIVITY AS LIGHTER (WHITE), AND LOWER SEABED REFLECTIVITY (IE. ACOUSTIC SHADOWS) AS DARKER (BLACK).
4. BATHYMETRIC DATA WERE COLLECTED ALONG THE SIDE SCAN LINES USING A KNUDSEN 320M SINGLE BEAM ECHOSOUNDER WITH A 200 KHZ - 6 DEGREE BEAM-WIDTH TRANSDUCER.
5. WATER LEVELS DURING THE BATHYMETRIC DATA COLLECTION WERE COLLECTED USING RTK GPS.
6. THE SHORELINE AND LAND FEATURES SHOWN ON THE DRAWINGS ARE FROM CHS ECN DATA.

LEGEND

S□□B□D D□PTHS □WH□R□ SHOW□□

5 — CONTOURED DEPTHS ARE FOR REFERENCE ONLY AND ARE FROM CHS ECN DATA, ALL REFERENCED TO CHART DATUM

S□□B□D □□□T□R□S □WH□R□ SHOW□□ □□ROM SID□ SC□□ SO□□R D□T□ (30 AUGUST 2016)

ROCK OUTCROP, INCLUDING ADJACENT SUBCROP

WOOD WASTE ZONE (PRIMARILY LOGS)

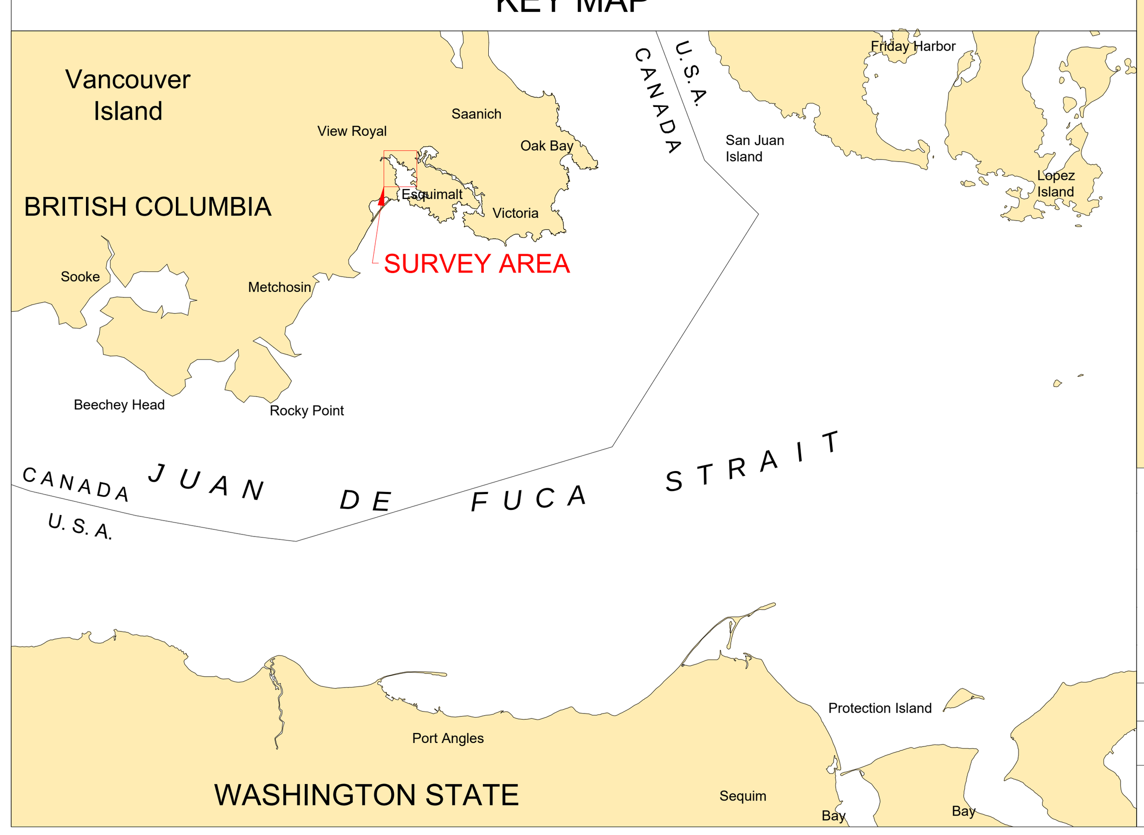
ANCHOR BLOCK (CONCRETE)

UNIDENTIFIED SONAR TARGET (VARIOUS SIZES AND SHAPES)

S□R□□Y TR□C□S □WH□R□ SHOW□□

15:30 15:30 15:30 TRSI SIDE SCAN SURVEY TRACKLINE (30 AUGUST 2016)

KEY MAP



NO	REMARKS	DATE	TRADE	INDEP CHKD	DFTG	DFTG CHKD	INSPD	REV	ACPT
0	Submitted in Final	27 Oct 2016	EXISTING CONDITIONS	KK	KK	MR	client	TA	TA
A	Submitted in draft	16 Sept 2016	EXISTING CONDITIONS	trsi	KK	MR	client	client	client

REVISIONS

SURV	KK,TCB	30Aug2016
PROCD	KK	31Aug2016
DFTG	KK	1Sept2016
CHKD	MR	16Sept2016
INSPD	______	______
REV	______	______
ACPT	______	______

GENERAL NOTES

Equipment
Survey vessel: *Doppler*
Surface Positioning: Hemesphere VS111 GPS
Navigation/Acquisition Software: RTC(TRSI)
Bathymetry: Knudsen 320M, 200kHz - 8° beam
Morphology and Stratigraphy: EdgeTech 4200

Drawing Parameters
Projection: UTM Zone 10N Datum: NAD83
Central Meridian (CM): 123°W
Scale Factor at CM: 0.9996
False Easting: 500000 False Northing: 0
Vertical Datum: LLWLT (Chart Datum)

CLIENT

HEMMERA

TERRA REMOTE SENSING INC.
1962 Mills Road
Sidney, BC Canada
V8L 5Y3
Ph: (250) 656-0931
Fax: (250) 656-4604
Web: www.terraremote.com

PROJECT
Esquimalt Harbour Side Scan Sonar Survey
Wood Waste Delineation

TITLE
Side Scan Sonar Mosaic

DWG NO CAD _ R 0 SHT NO. 2 of 3

TRSI PROJECT No.: 000-2795

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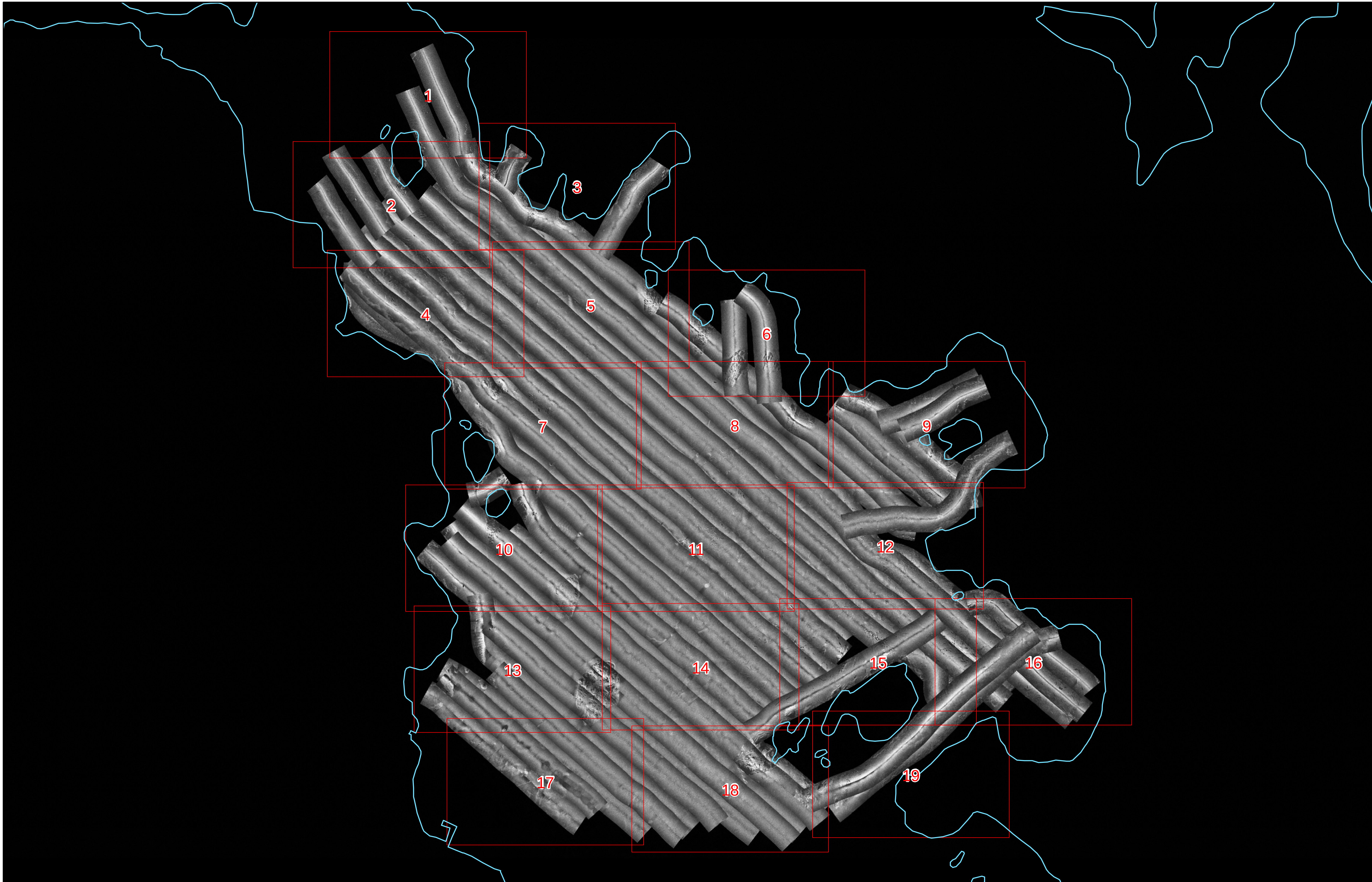
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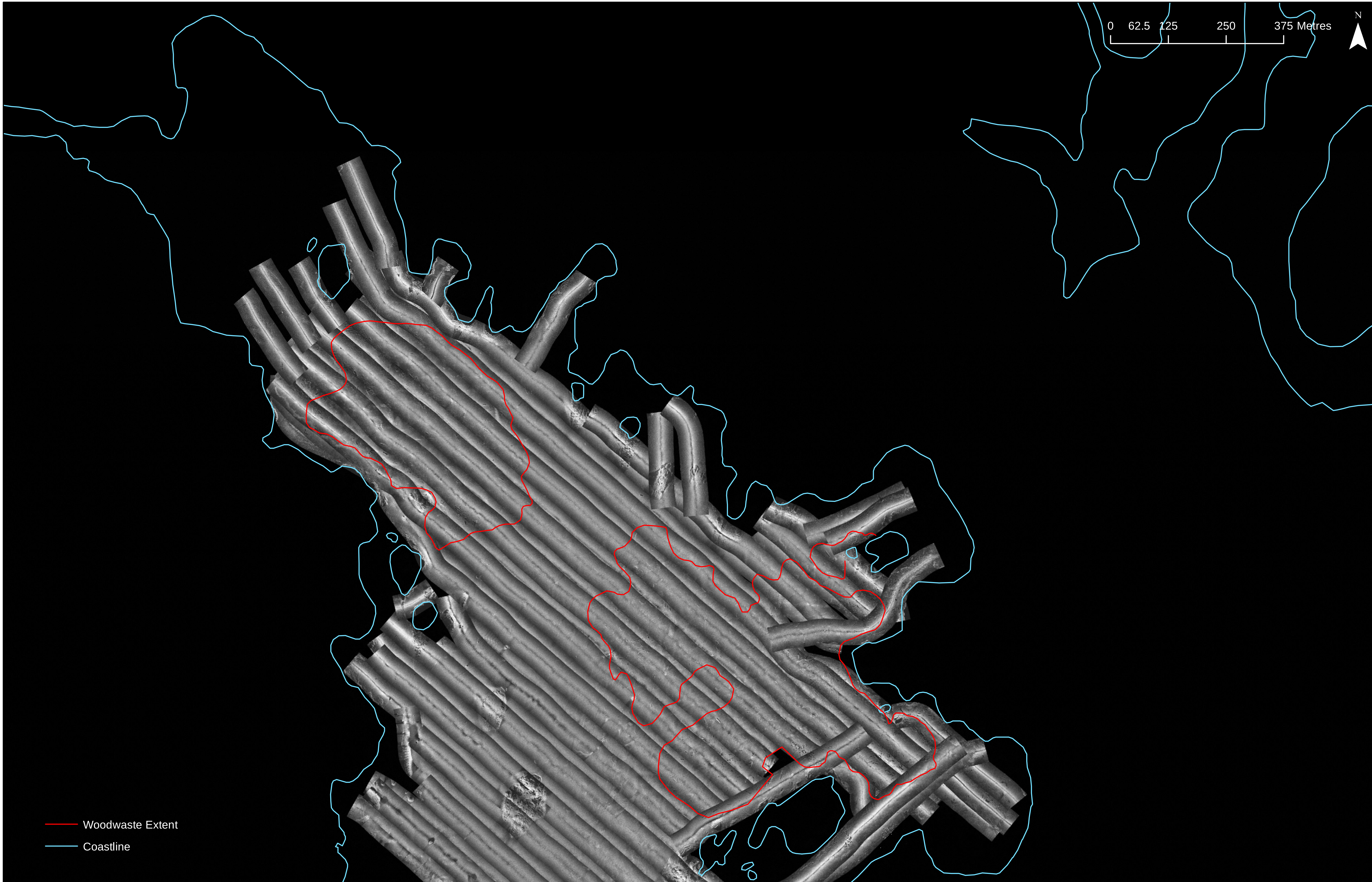
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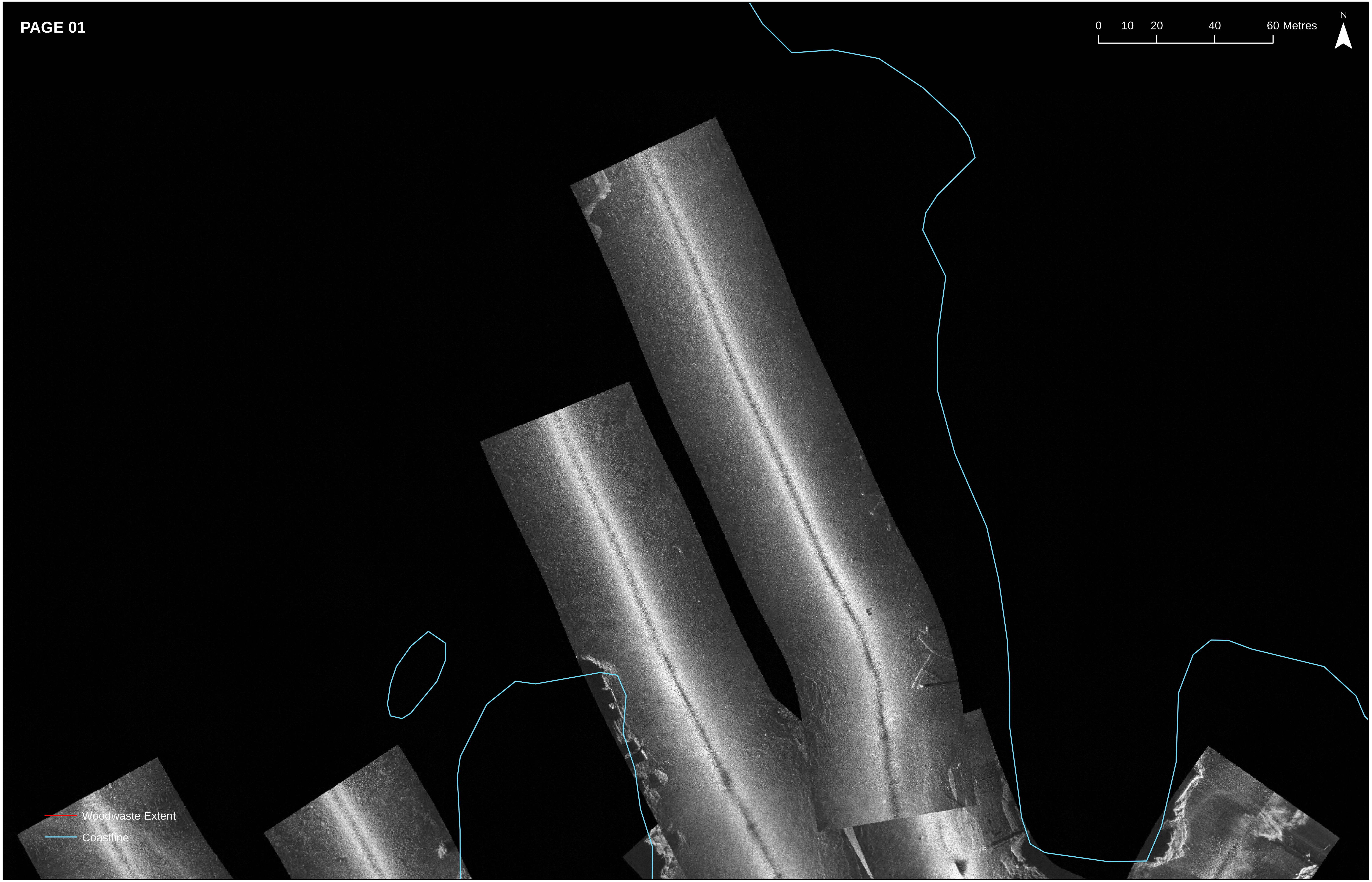
62.5
125
250
375 Metres
N
Woodwaste Extent
Coastline

PAGE 01



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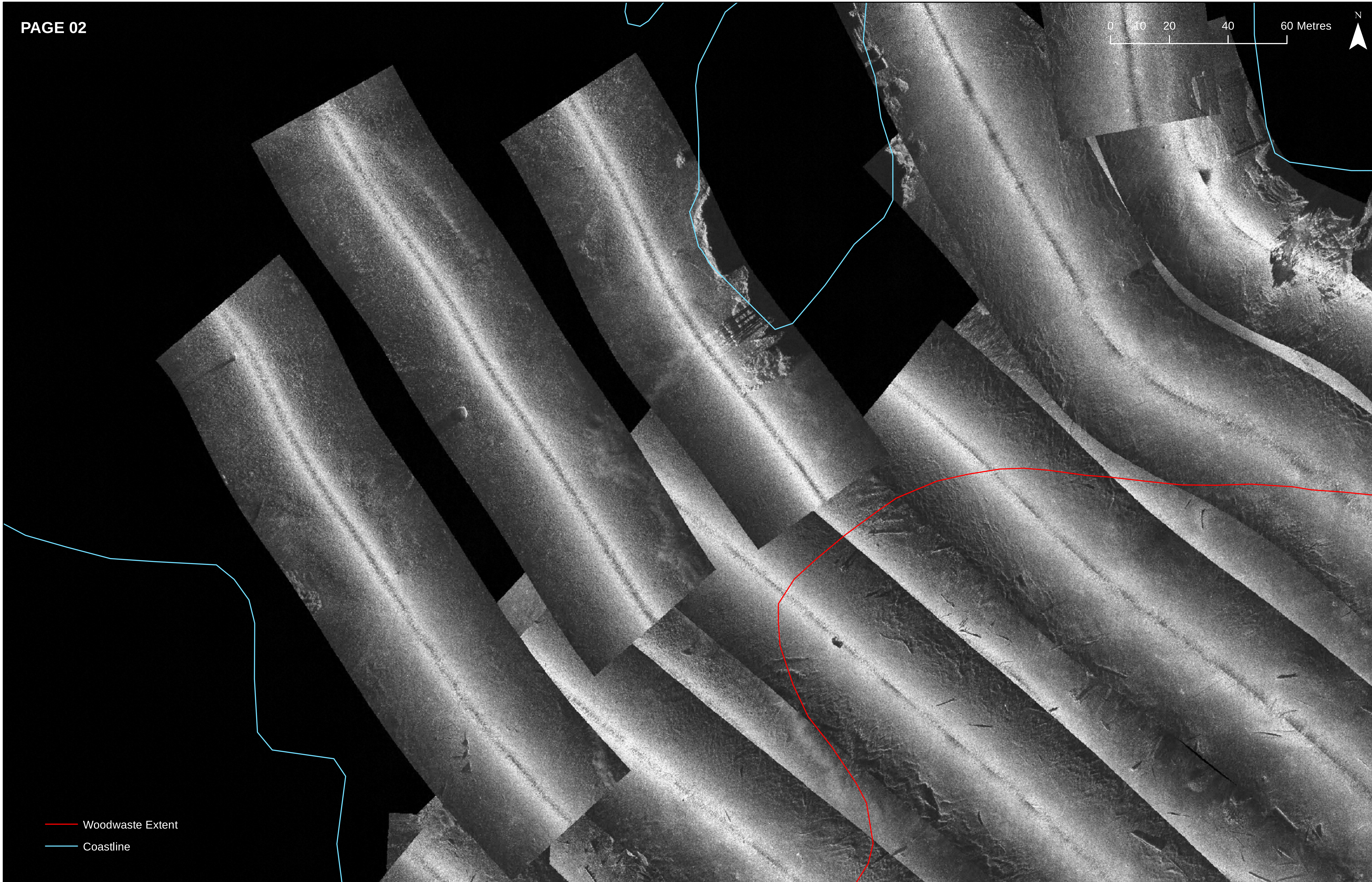

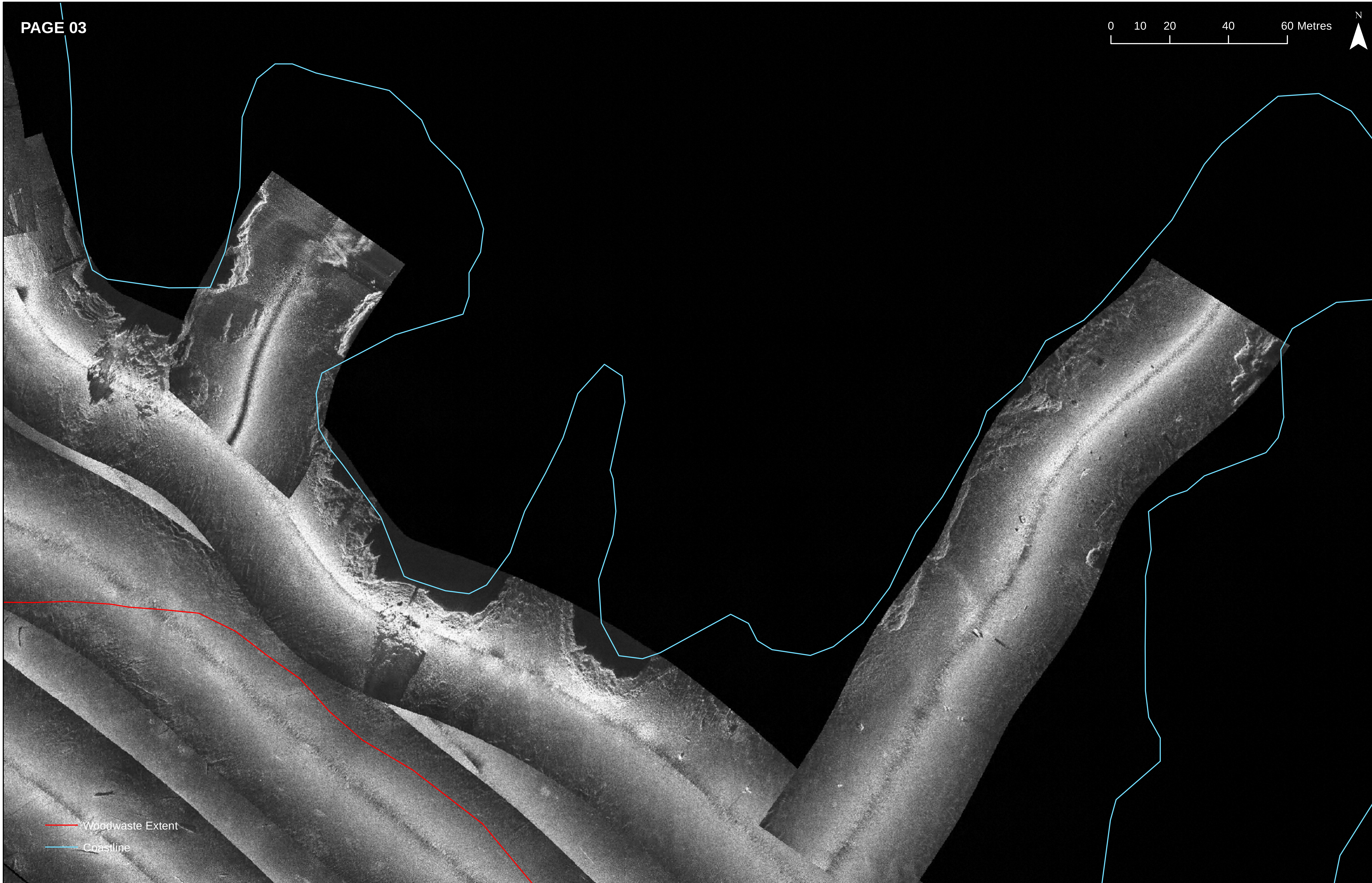
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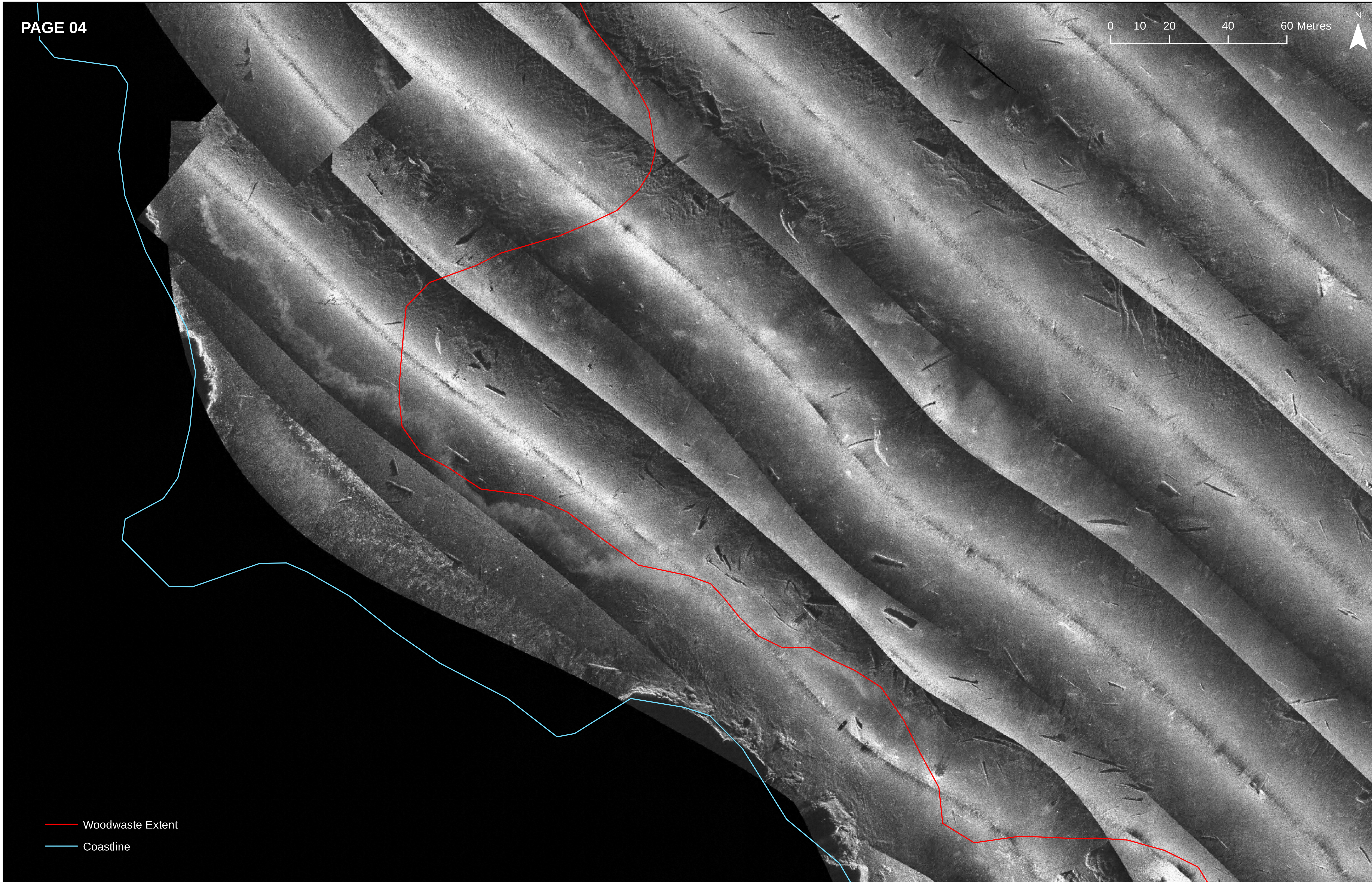
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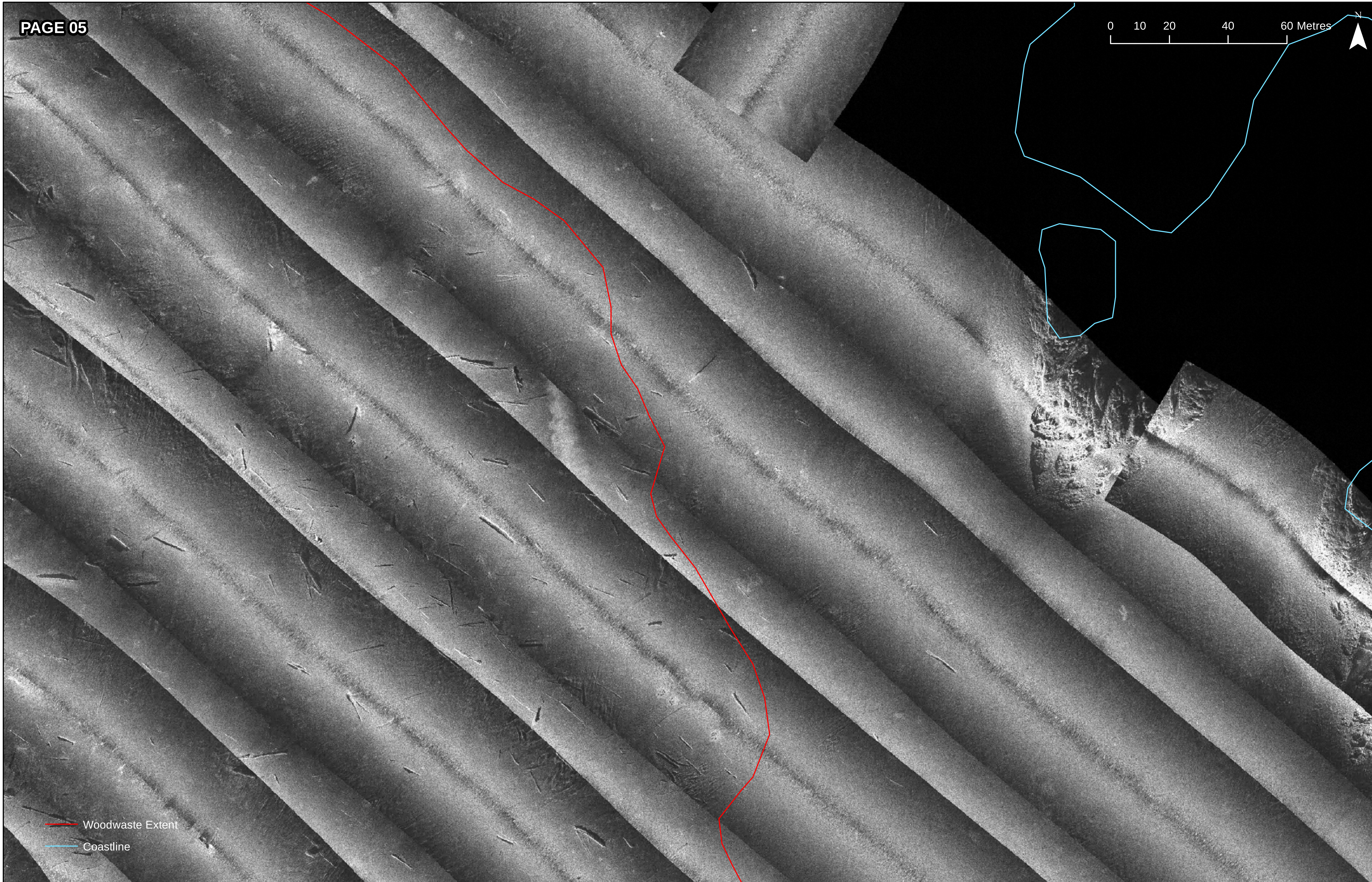
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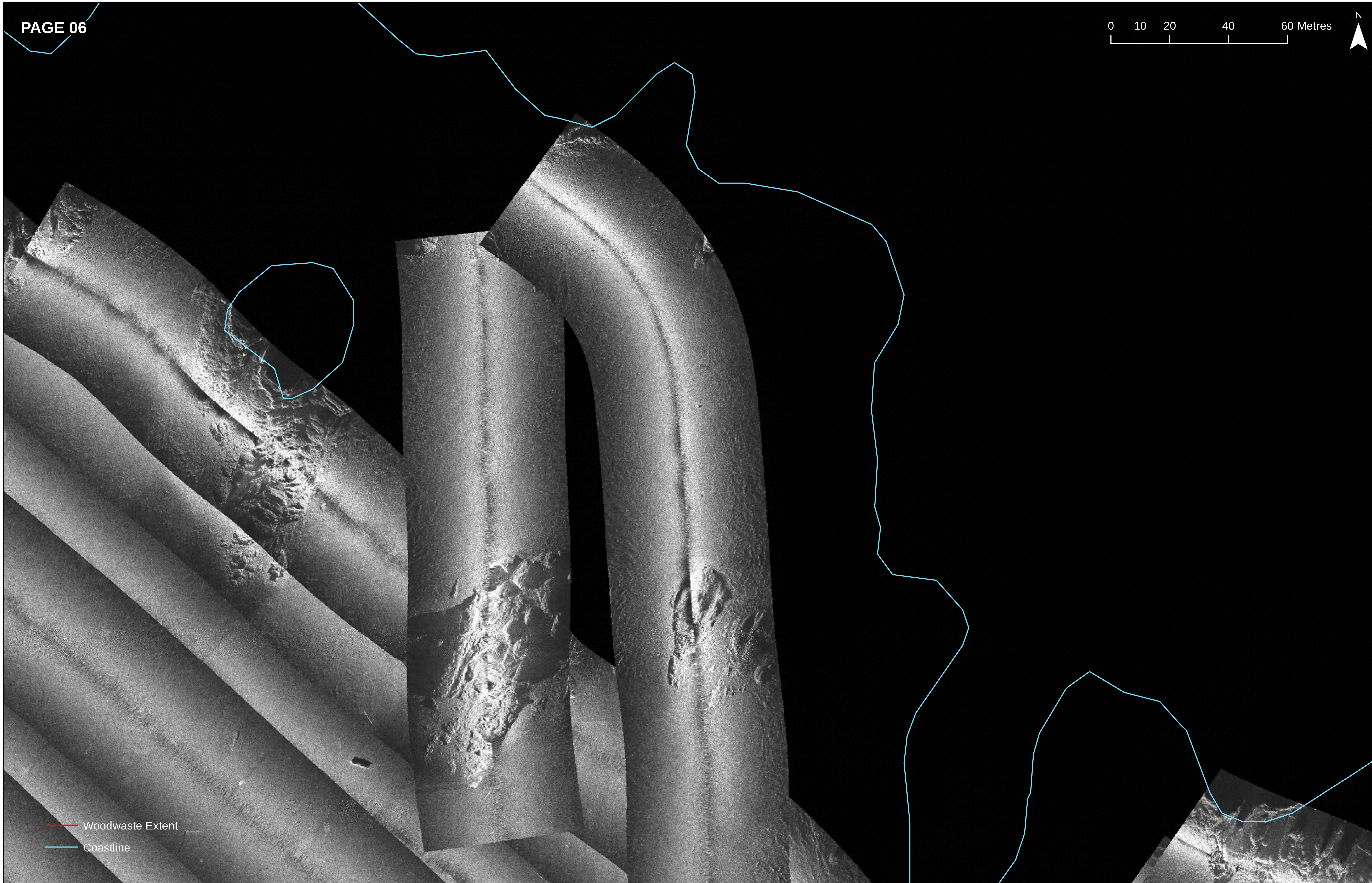

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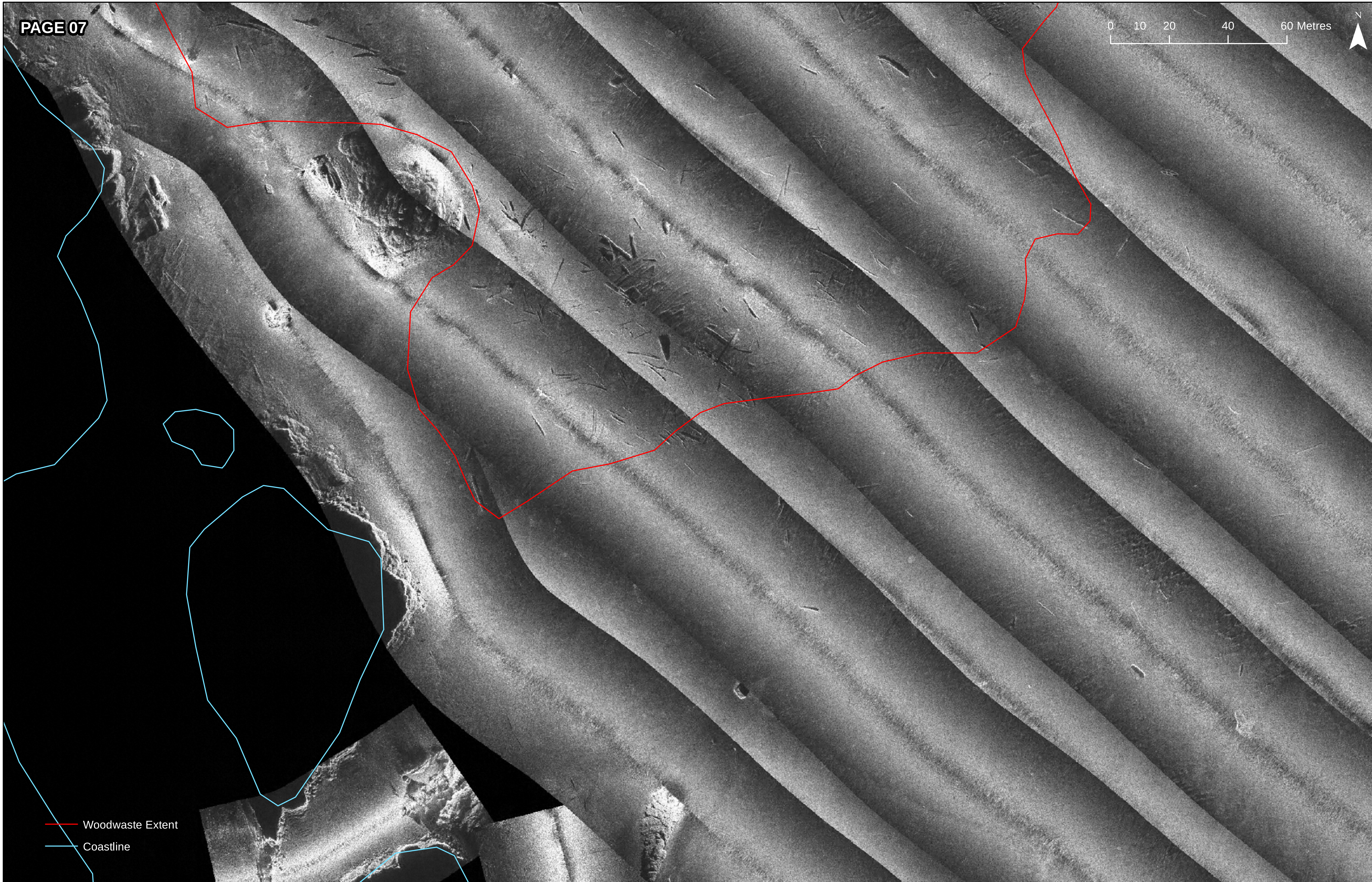
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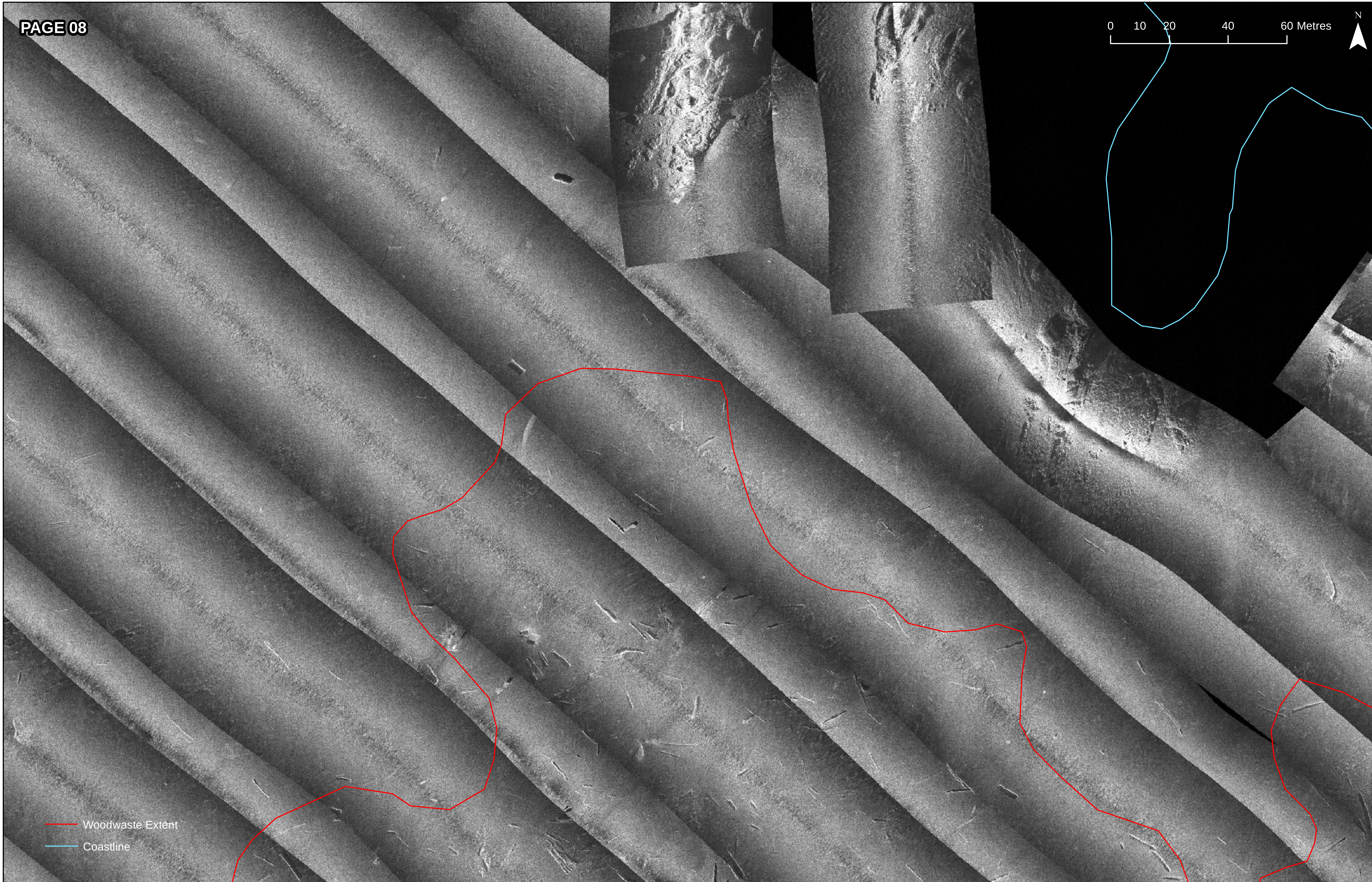
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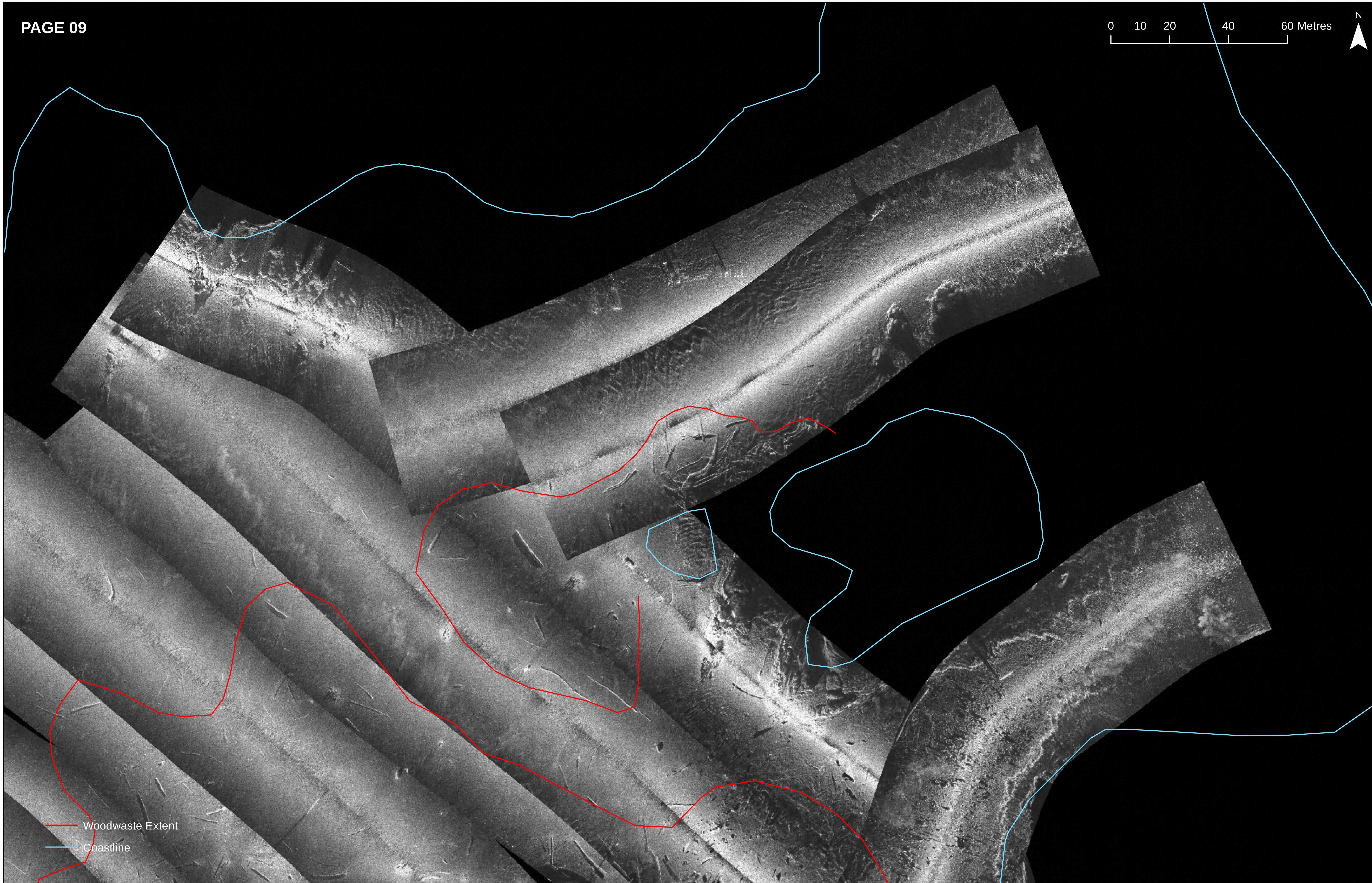
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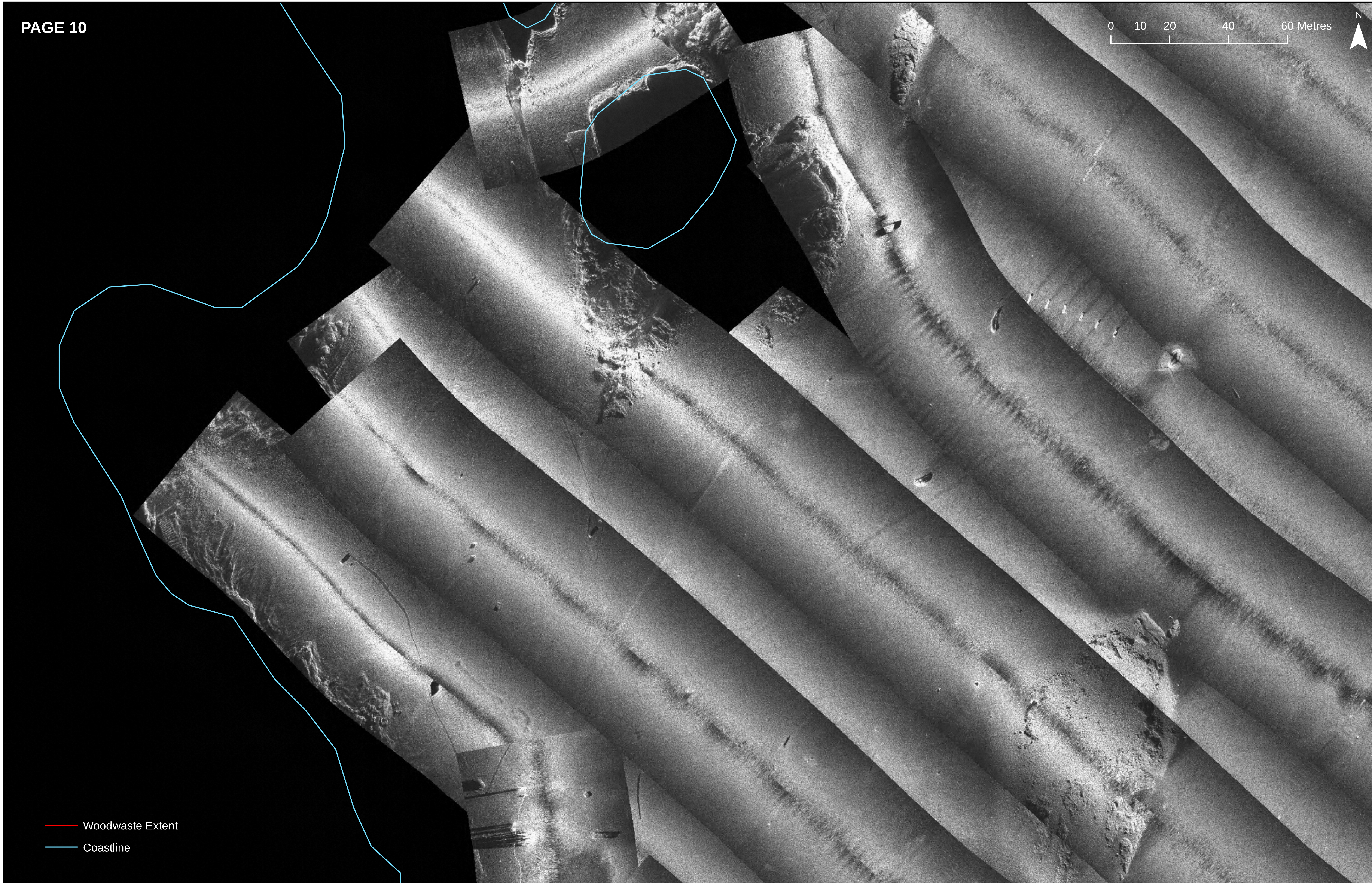
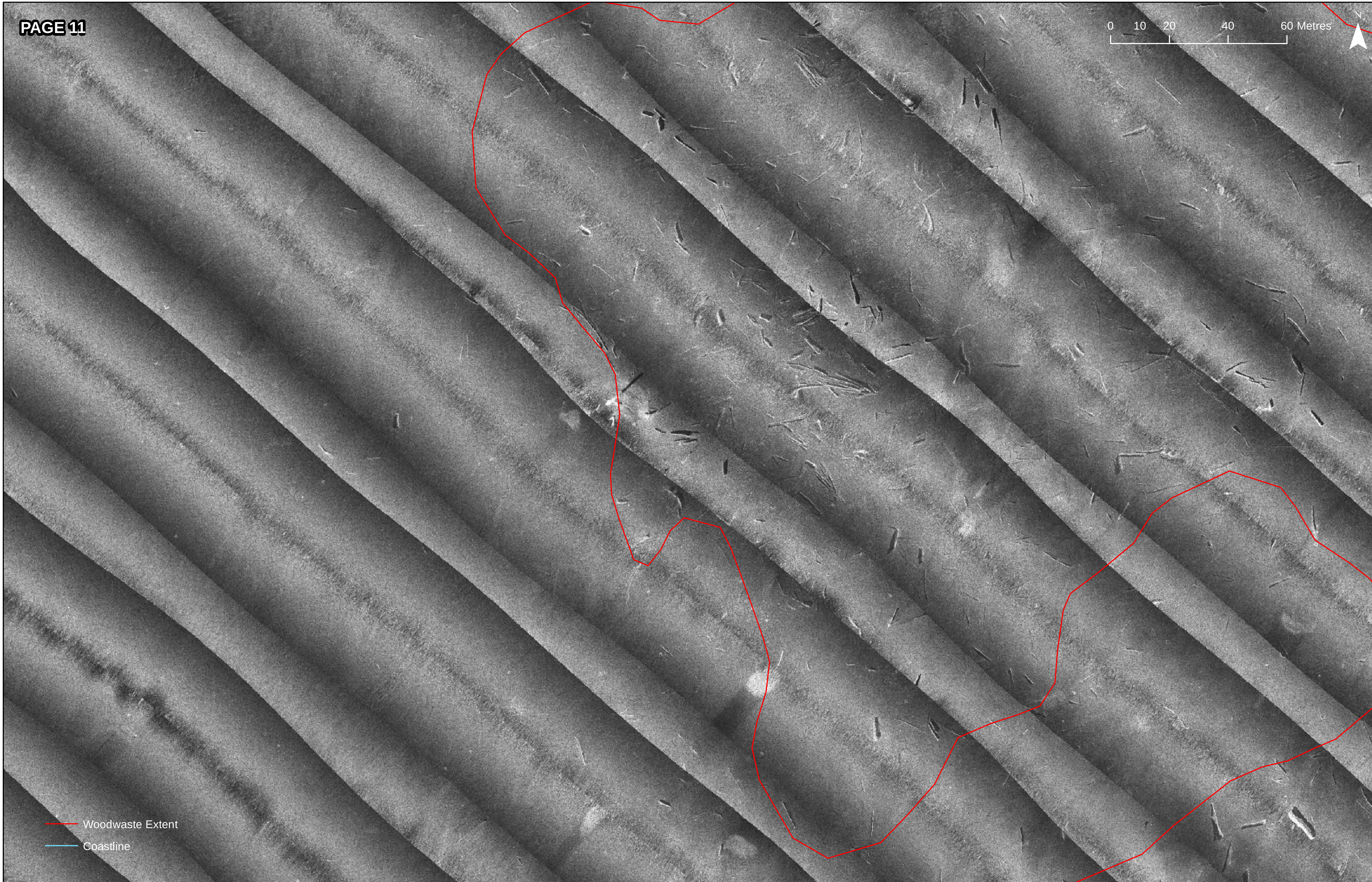
Woodwaste Extent
Coastline

PAGE 10

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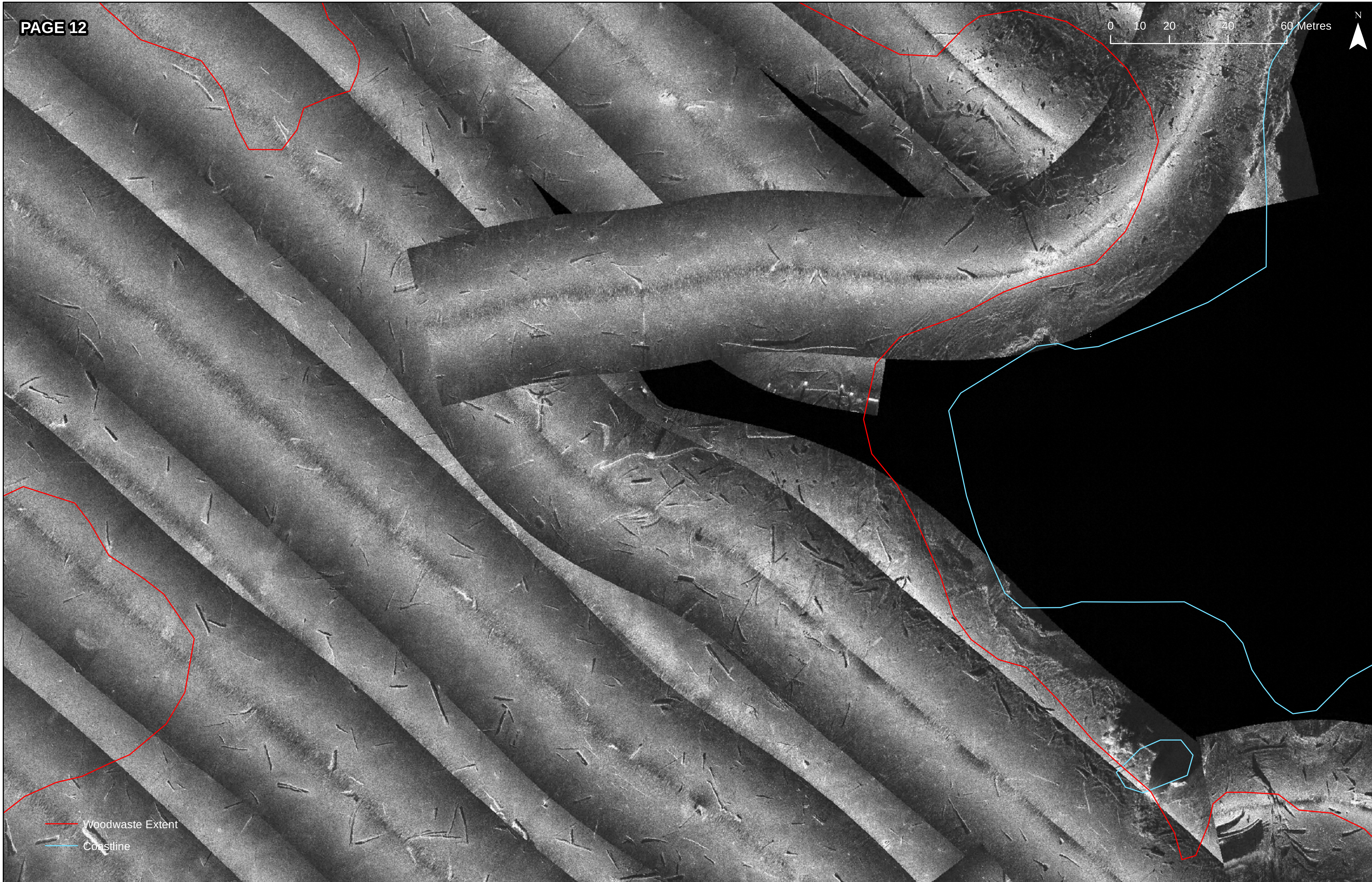

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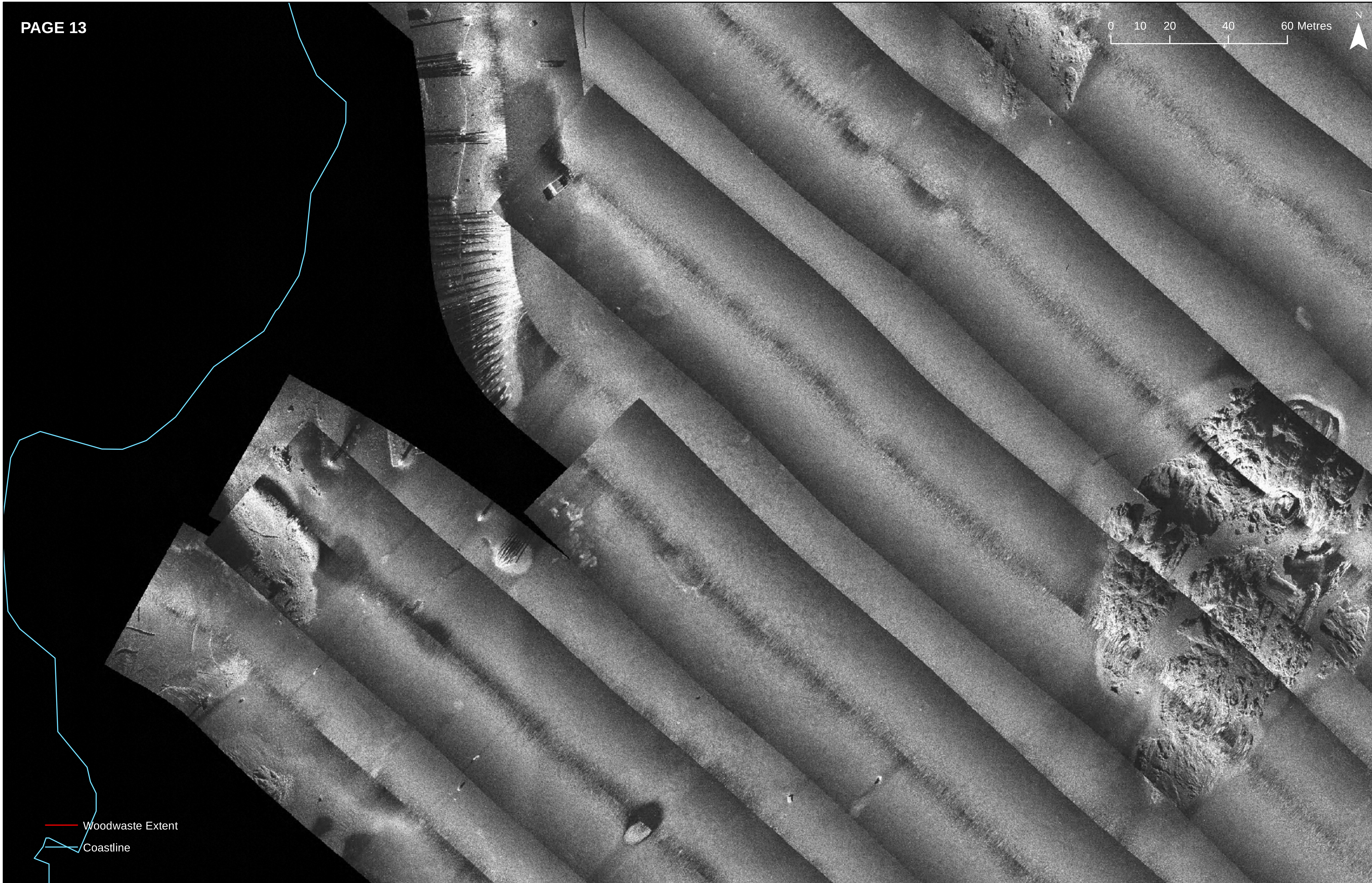
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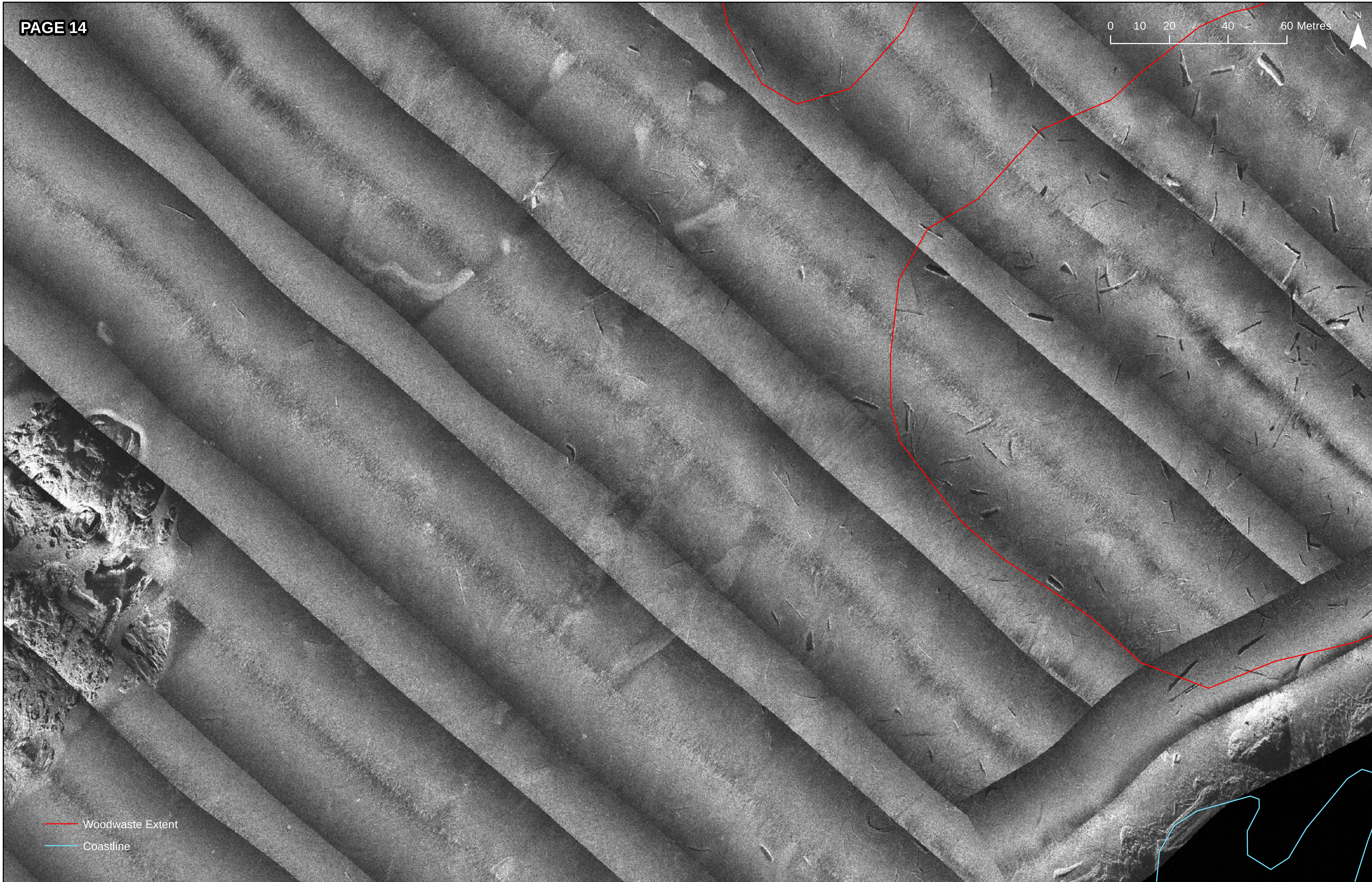
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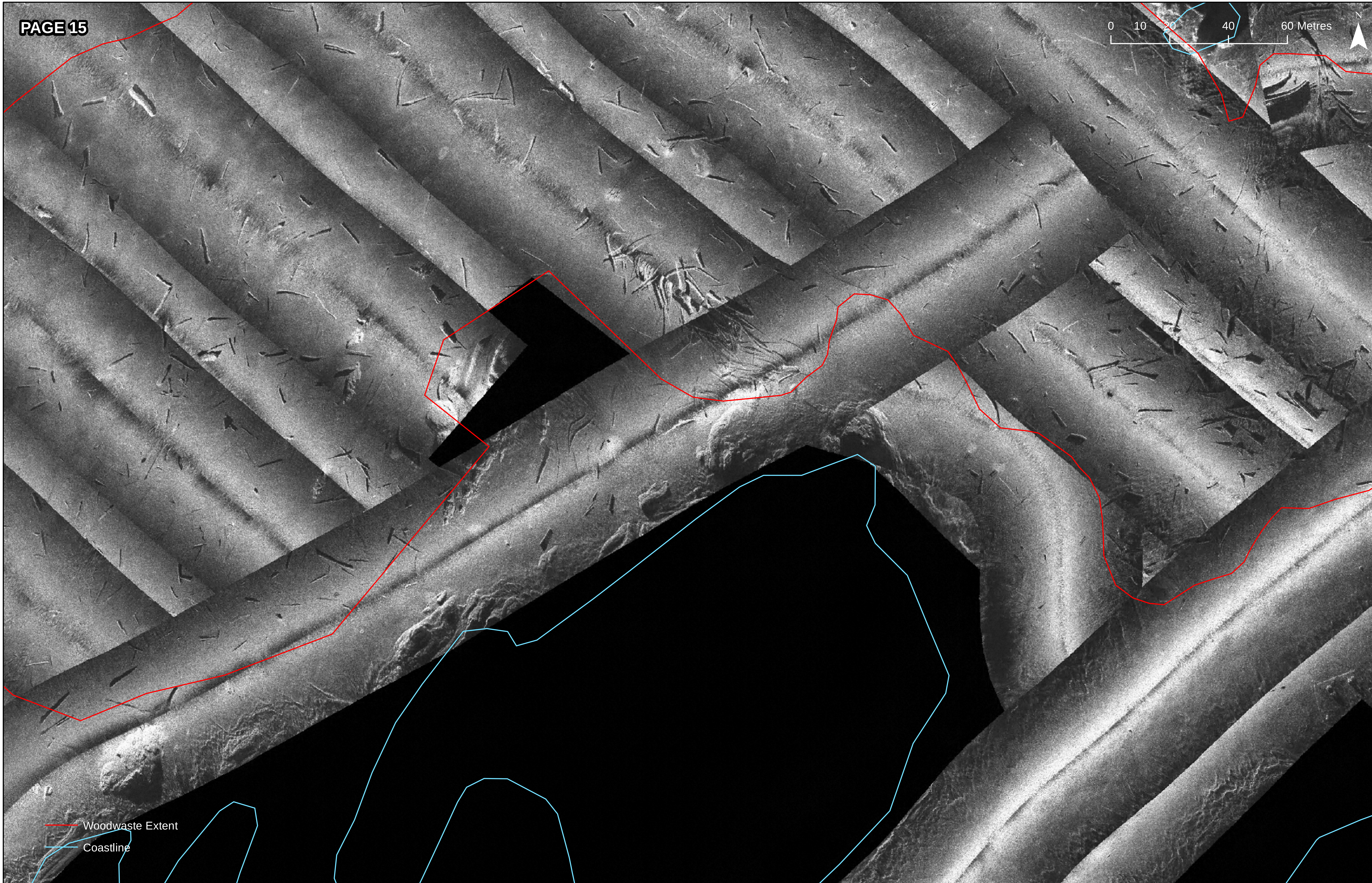

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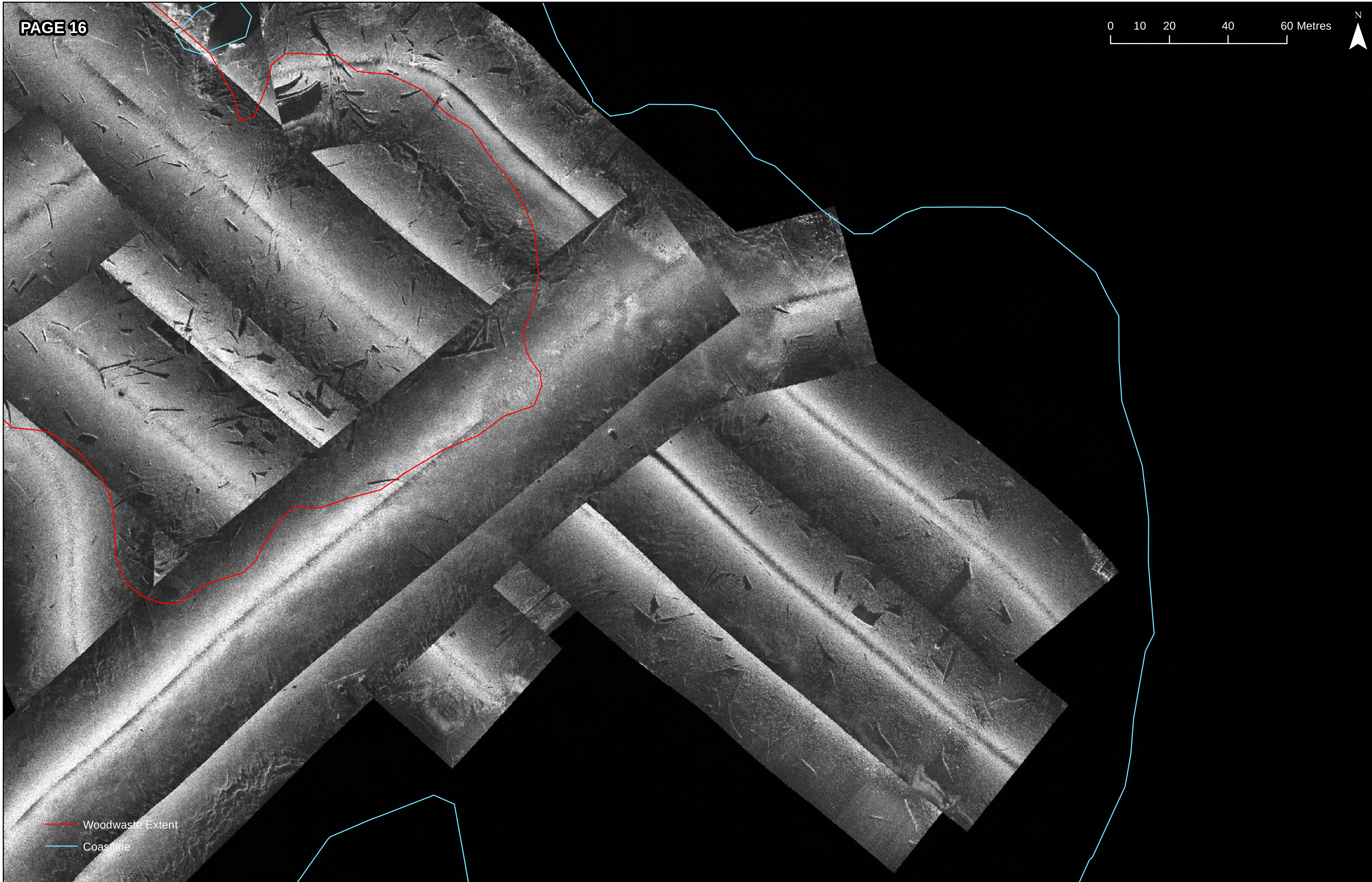
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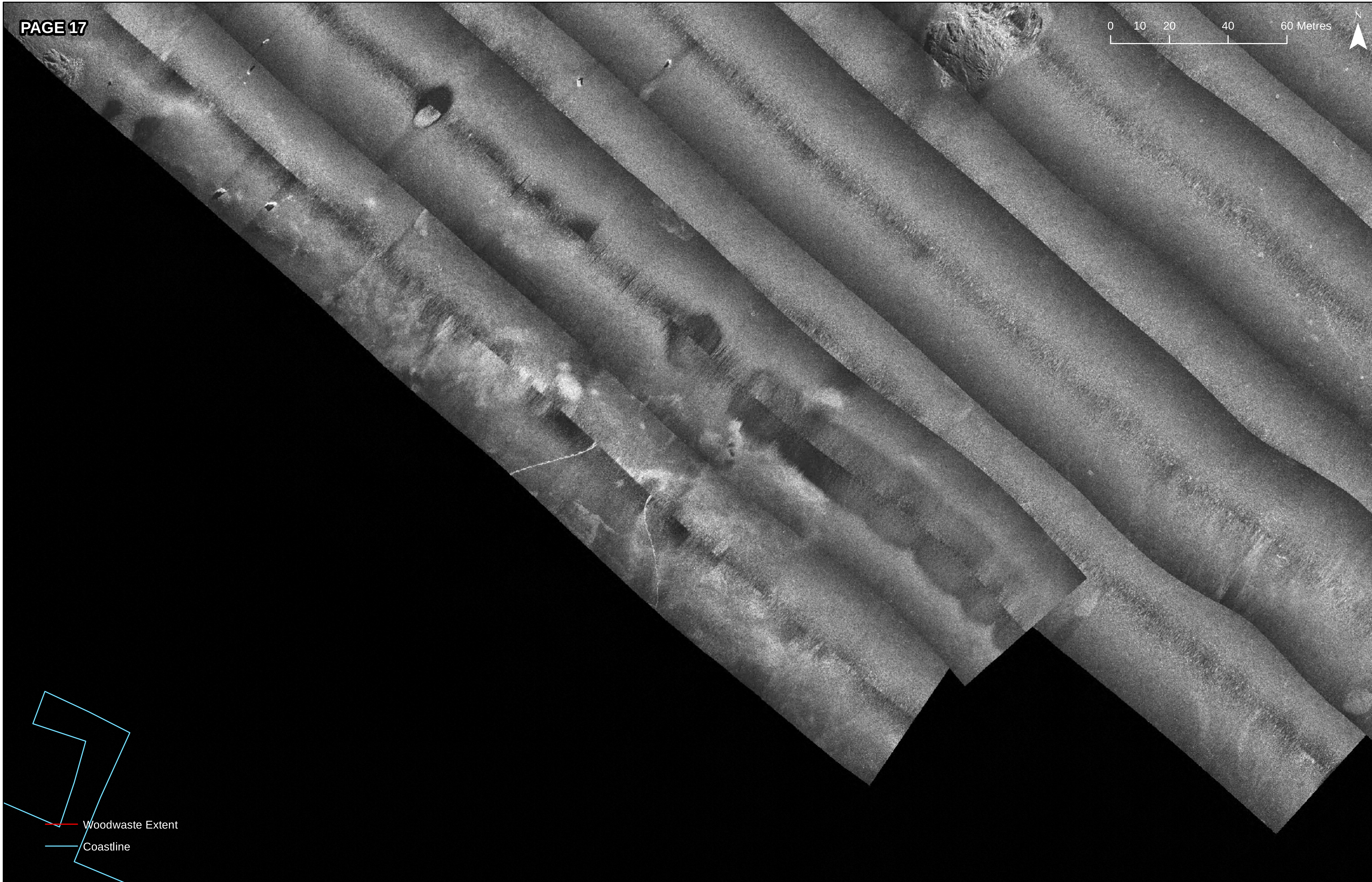
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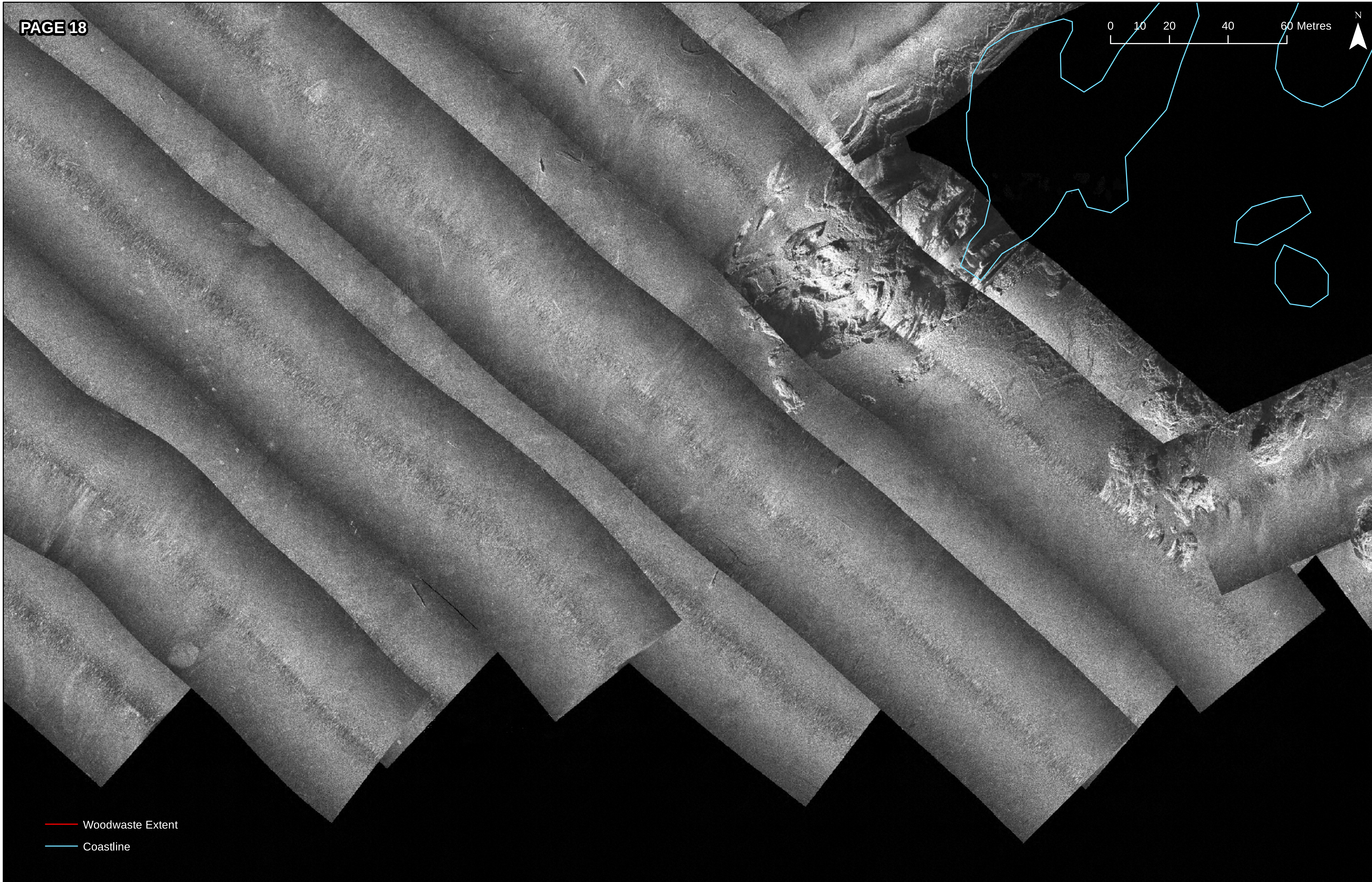
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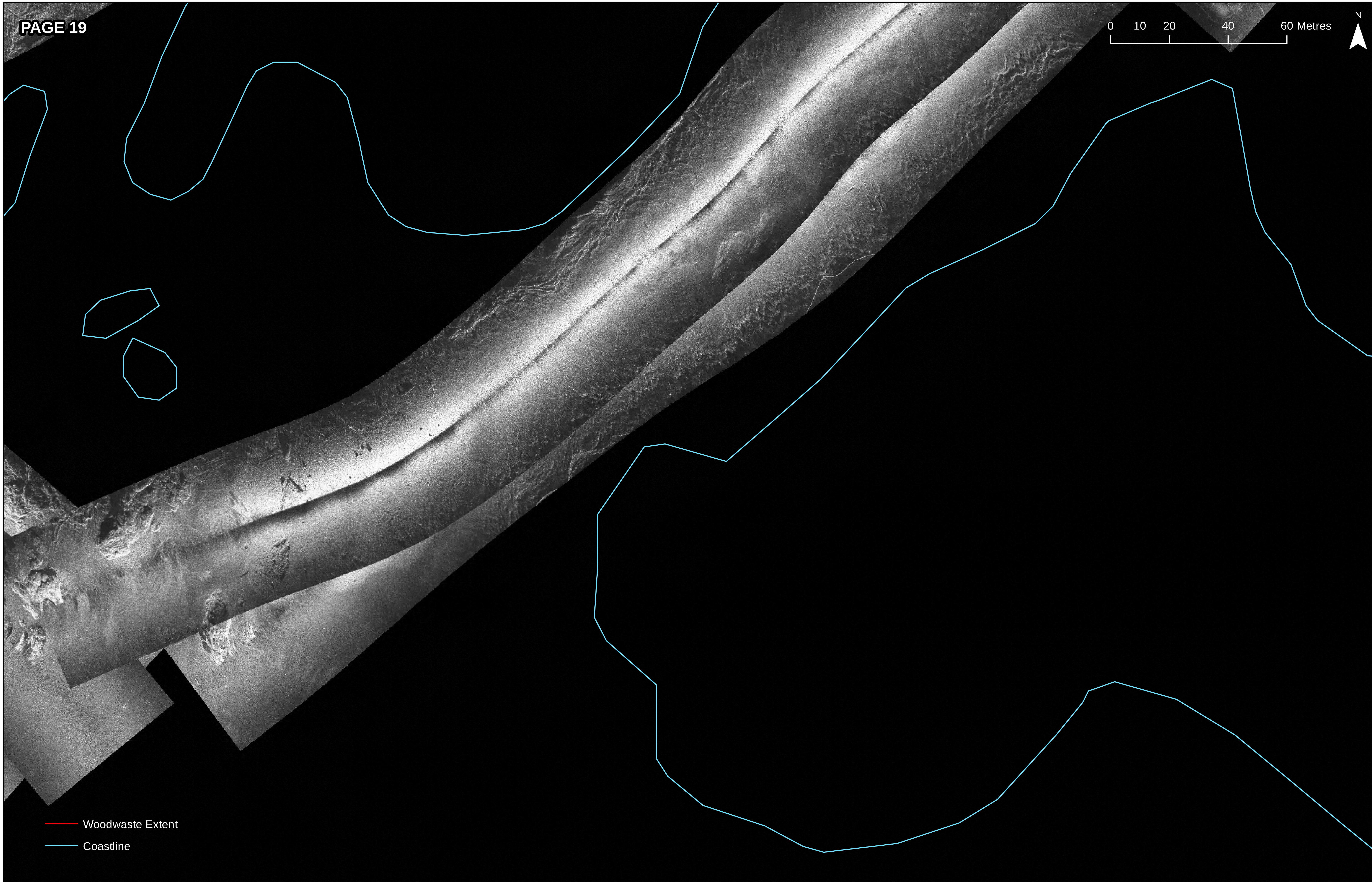
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Woodwaste Extent
Coastline

APPENDIX G

Sediment Core Photo Examples

Photo G1: Esquimalt Harbour Borehole T14-01 Sand/silt transitions to sand/silt with shell debris/hash at -0.2m

Photo G2: Esquimalt Harbour Borehole T24-01 Consists entirely of sand/silt and no wood waste

Photo G3: Pedder Bay Borehole T21-01 Consists entirely of coarse sand and no wood waste

Photo G4: Esquimalt Harbour Borehole T31-03 Organic transitions to organic with trace wood fibre/debris (-0.15m) which transitions to silt with trace shell debris/hash at -0.2m

Photo G5: Esquimalt Harbour Borehole T54-03 Organic with wood fibre/debris transitions to silt with trace wood fibre/debris at -0.2m

Photo G6: Esquimalt Harbour Borehole T27-03 Organic with trace wood fibre/debris transitions to organic with wood fibre/debris at -0.3m, which transitions to silt with trace shell debris/hash at -0.3m

Photo G7: Esquimalt Harbour Borehole T27-05 Organic with trace wood fibre/debris transitions to dense wood fibre/debris at -0.1m

Photo G8: Esquimalt Harbour Borehole T56-01 Organic with wood fibre/debris for the length of the borehole core

Photo G9: Esquimalt Harbour Borehole T11-05 Organic with trace wood fibre/debris transitions to organic with wood fibre/debris at -0.15m, and then to sand/silt at -0.3m

Photo G10: Esquimalt Harbour Borehole T48-01 Organic with wood fibre/debris transitions to silt with shell debris/hash at -0.3m

Photo G11: Esquimalt Harbour Sonic Drill BH15 Organic with wood fibre/debris transitioning to silt/clay with shell debris at -0.254m

Photo G12: Esquimalt Harbour Sonic Drill BH14 Organic with wood fibre/debris transitioning to sand/silt with shell debris at -0.366m

Photo G13: Esquimalt Harbour Sonic Drill BH29 Showing the transition from organic with wood fibre/debris to silt/sand with trace shell debris at -1.74m

Photo G14: Esquimalt Harbour Sonic Drill BH7 Wood fibre/debris transitions to silt/sand with trace shell debris at -1.778m

Photo G15: Esquimalt Harbour Sonic Drill BH20 Wood fibre/debris transitions to sand/silt with trace shell debris at -0.84m

Photo G16: Esquimalt Harbour Sonic Drill BH19 Wood fibre/debris transitions to silt/sand with shell debris at -0.42m

APPENDIX H

Wood Waste Depth Cross Sections

Esquimalt Harbour Wood Waste Asessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Overview of Cross Section Locations in Esquimalt Harbour

Legend

- Sampling Location (Bottom depth of wood waste was reached during sampling)
- Sampling Location (Bottom depth of wood waste was not reached during sampling)
- 0.6 Sampled Wood Waste Depth (m)
- Completed by Hand Core
- Completed by Sonic Drill Core
- Cross-Section
- First Nations Waterlot Boundary (Esquimalt and Songhees Waterlots)
- Limit of Federal Harbour
- Area of Interest (AOI)
- Esquimalt Graving Dock Dredge Boundary
- Study Area

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- First Nations Waterlot Boundary, Limit of Federal Harbour, Area of Interest, Esquimalt Graving Dock Dredge Boundary, Study Area: Digitized courtesy of PWGSC and SLR - DQERA to Support Environmental Risk Management, Esquimalt Harbour, BC, BICS Sample Locations (2013 and 2015) Included in the DQERA. Drawing No. 19, Rv. 0.2, July 21, 2016, Project No. 205.03774.00001.
- Aerial Image: Capital Regional District, 2015
- Inset Basemap: ESRI World Topographic Map

N

1:8,000

0 100 200 300 400

Metres

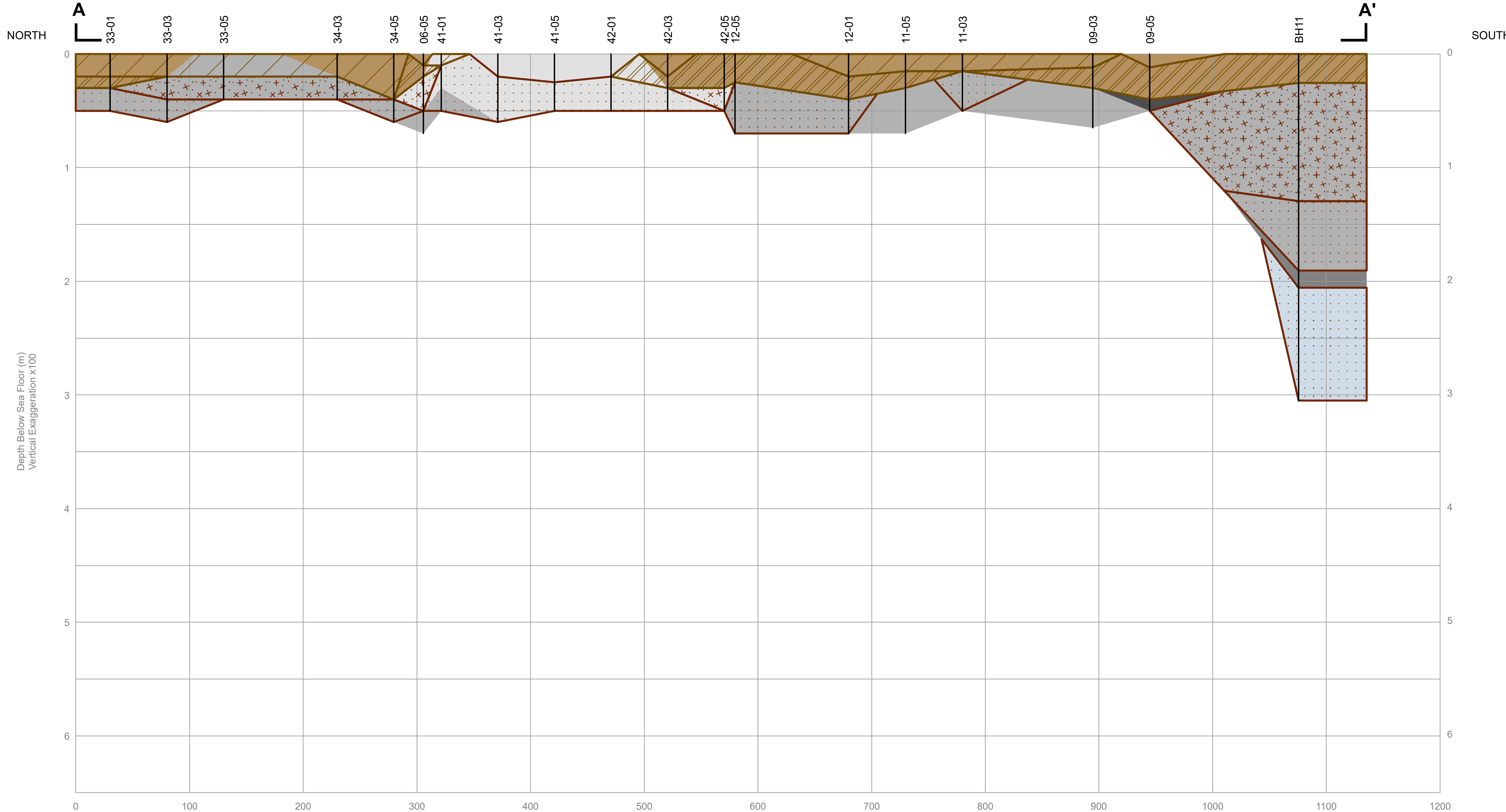
NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

376-240.08	Production Date: Jan 11, 2019	Figure H-1

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Organic
- Sand / Silt / Gravel
- Sand Lens
- Sand / Silt
- Silt
- Silt / Clay / Sand
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:3,500

Vertical Exaggeration x100

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

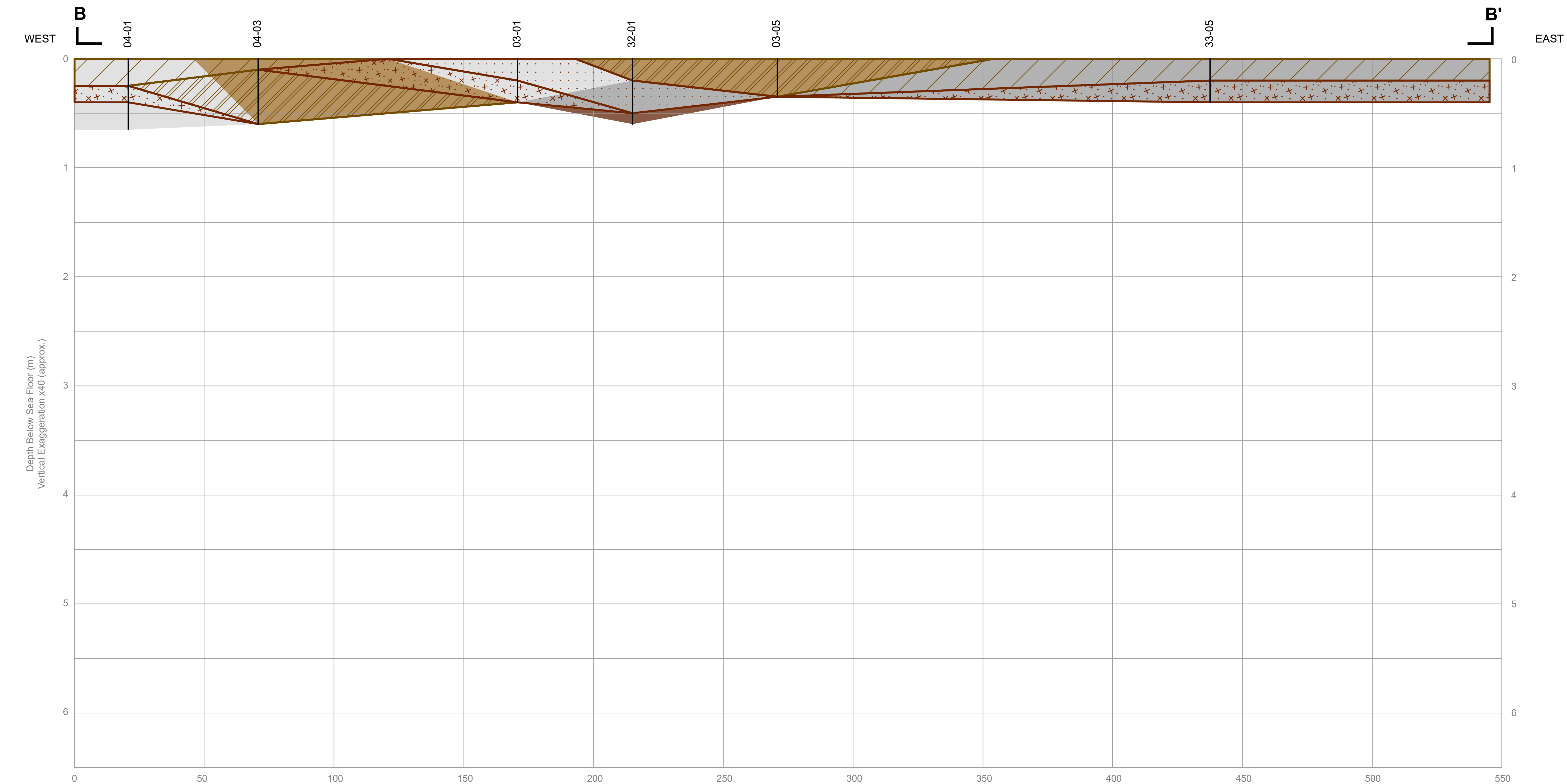
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - A-A'

376-240.08	Production Date: Jan 11, 2019	Figure H-2

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Sand / Silt
- Silt
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:1,500

Vertical Exaggeration x40 (approx.)

0 25 50 75 100

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

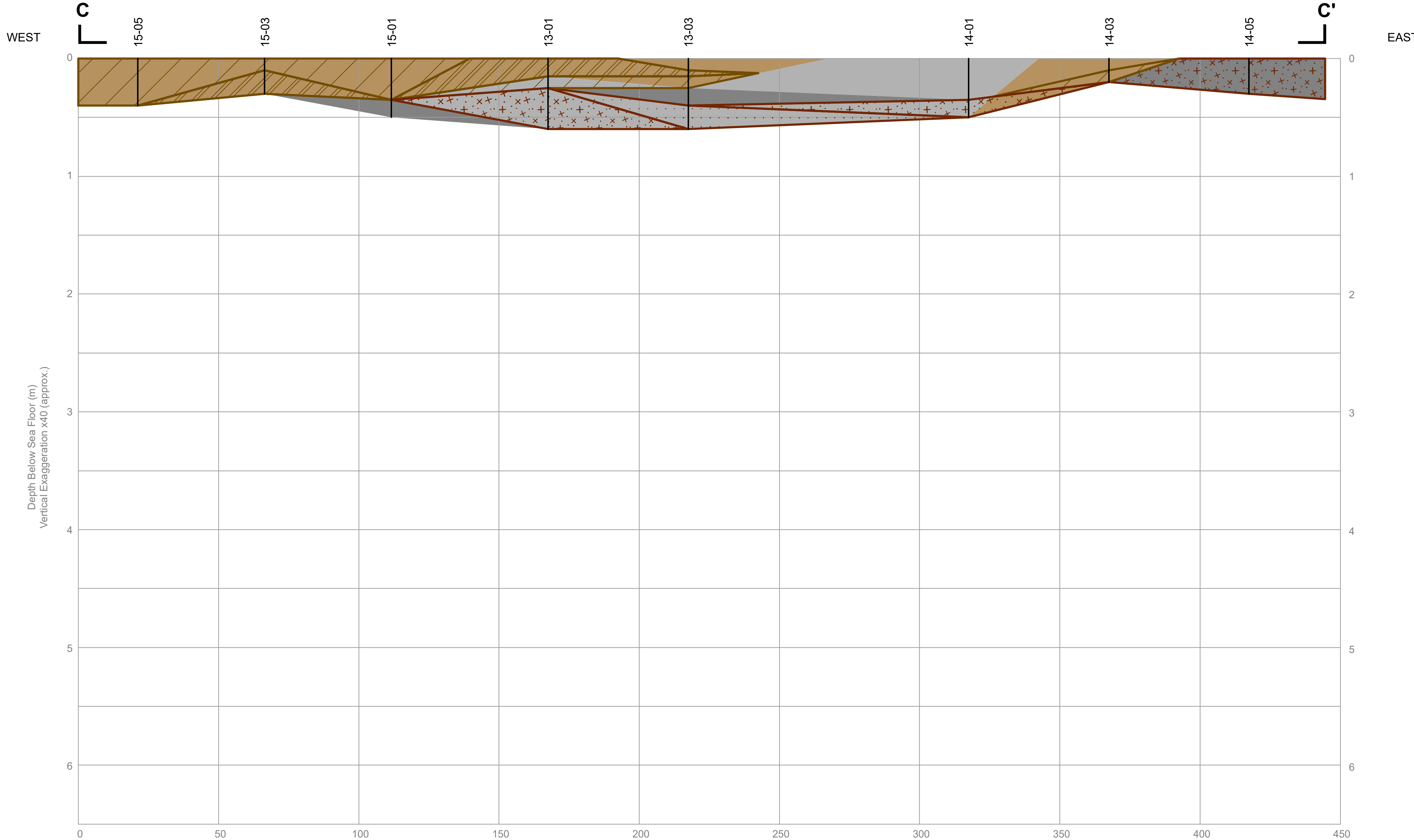
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - B-B'

376-240.08	Production Date: Jan 11, 2019	Figure H-3

Hemmera
An Ausenco Company

Public Works and Government Services Canada



Legend

- Organic
- Sand
- Sand / Silt
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:1,500

Vertical Exaggeration x40 (approx.)

0 25 50 75 100

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

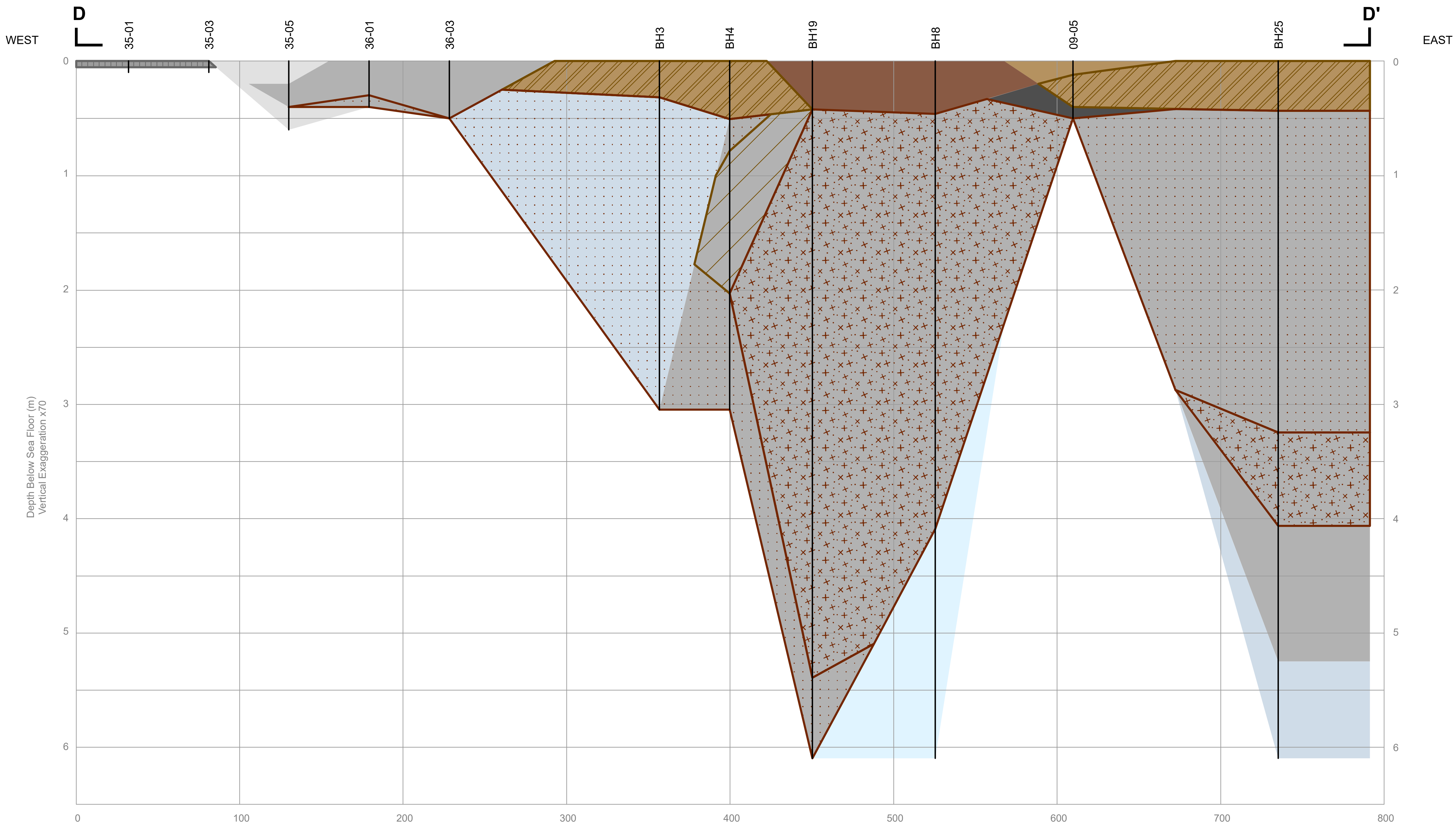
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - C-C'

376-240.08	Production Date: Jan 11, 2019	Figure H-4

Hemmera An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Rock
- Sand / Silt / Gravel
- Sand / Silt
- Silt
- Silt / Clay
- Silt / Clay / Sand
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:2,500

Vertical Exaggeration x70

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

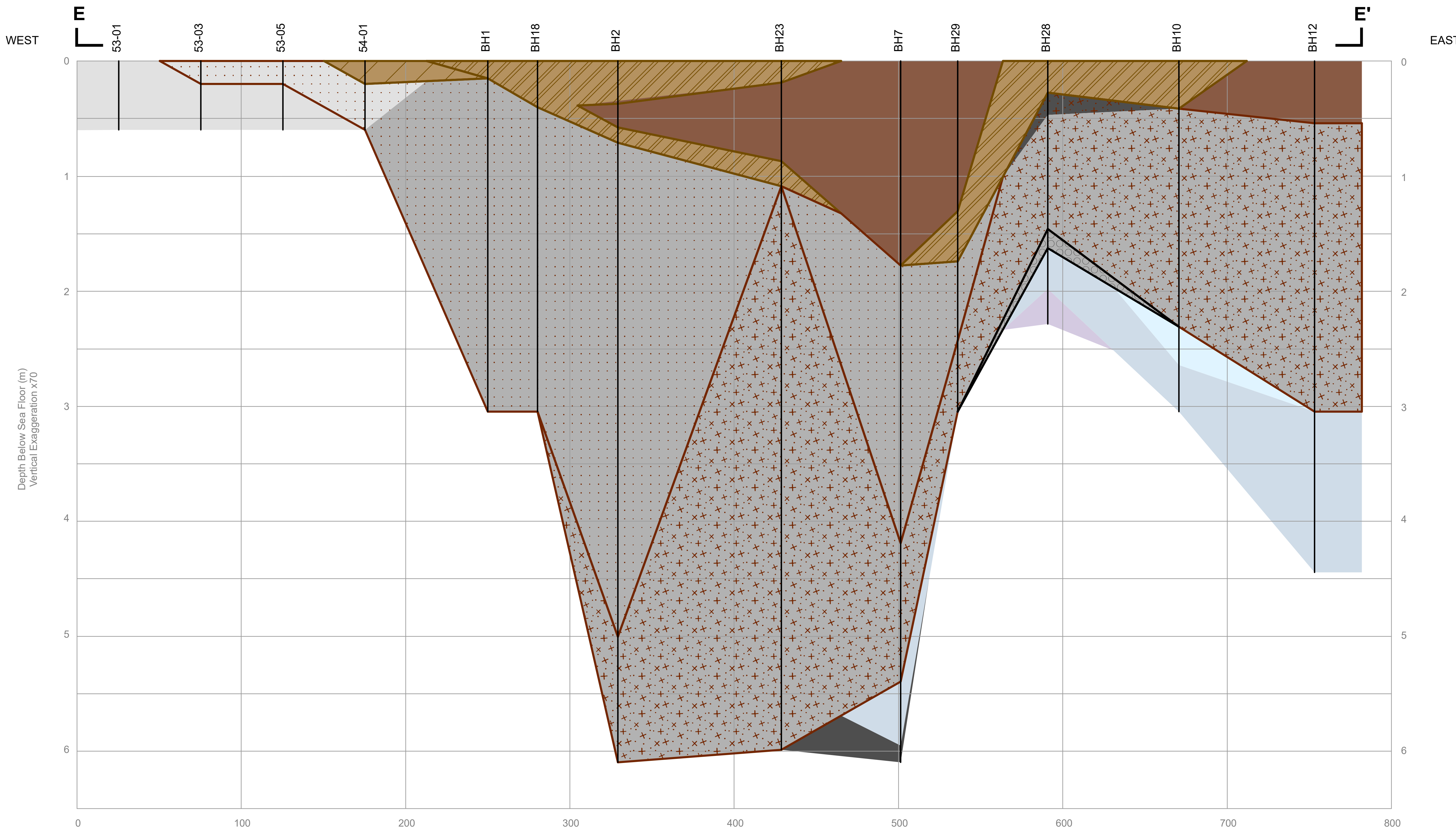
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - D-D'

376-240.08	Production Date: Jan 11, 2019	Figure H-5

Hemmera An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Sand / Silt / Gravel
- Sand / Silt
- Silt
- Silt / Clay
- Silt / Clay / Sand
- Bedrock
- Trace Cobble
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:2,500

Vertical Exaggeration x70

0 50 100 150 200

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

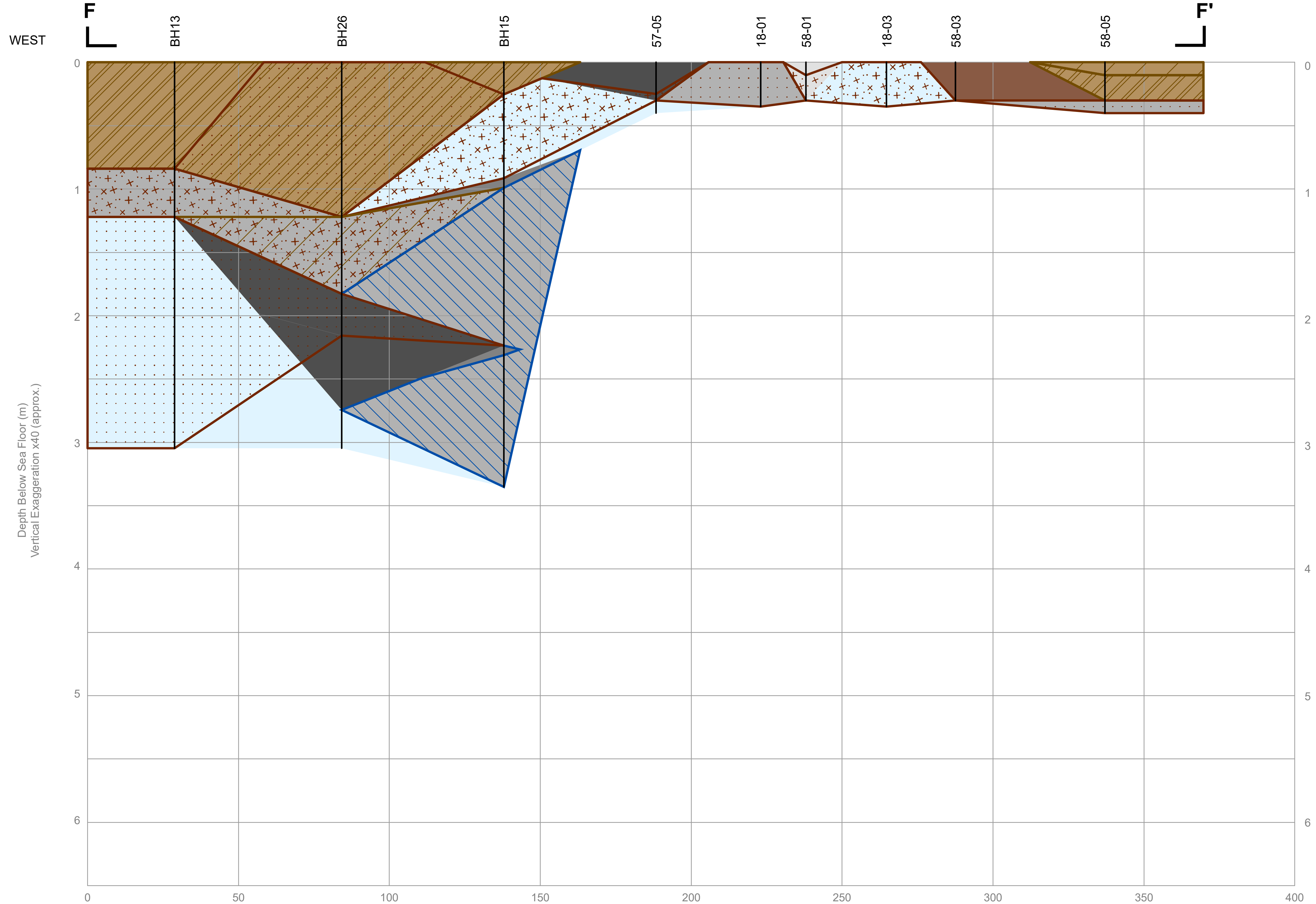
Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - E-E'

376-240.08	Production Date: Jan 11, 2019	Figure H-6

Hemmera An Ausenco Company

Public Works and Government Services Canada



Legend

- Wood Fibre and Wood Debris
- Organic
- Sand / Silt / Gravel
- Sand Lens
- Sand / Silt
- Silt
- Silt / Clay
- Trace Clay
- Shell Debris and/or Hash
- Trace Shell Debris and/or Hash
- Wood Fibre and Wood Debris
- Trace Wood Fibre and Wood Debris

Notes

1. Locations should be considered approximate.
2. This figure is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

1:1,500

Vertical Exaggeration x40 (approx.)

0 25 50 75 100

Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

Esquimalt Harbour Wood Waste Assessment
DND, CFB Esquimalt, Esquimalt Harbour, BC

Cross Section of Wood Waste Deposits and Sediment Types in Surface Sediment Layers - F-F'

376-240.08	Production Date: Jan 11, 2019	Figure H-7

Hemmera An Ausenco Company

Public Works and Government Services Canada

Path: O:\376\240\08\mxd\Fig H_7_376_240_08_EsquimaltHarbour_CrossSection_FF_180304.mxd

APPENDIX I

Biophysical and Sediment Chemistry Data

Section	Parameter															
Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	I3	I3	I3	I3	I3	I4	I4	I4	I4	I4	W1	W1	W1	W1	W1
	OLD Sample ID	I3-01	I3-04	I3-02	I3-05	I3-03	I4-01	I4-04	I4-02	I4-05	I4-03	W1-01	W1-04	W1-02	W1-05	W1-03
	NEW Transect ID	01	01	01	01	01	02	02	02	02	02	03	03	03	03	03
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	01-01	01-02	01-03	01-04	01-05	02-01	02-02	02-03	02-04	02-05	03-01	03-02	03-03	03-04	03-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-2.74	-3.66	-4.88	-5.49	-5.79	-7.01	-7.32	-7.62	-7.93	-8.54	-5.49	-6.40	-6.40	-6.40	-6.40
	Depth gauge (ft):	-9	-12	-16	-18	-19	-23	-24	-25	-26	-28	-18	-21	-21	-21	-21
	Tide (m):	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-1.2	-2.2	-3.4	-4.0	-4.3	-5.5	-5.8	-6.1	-6.4	-7.0	-3.4	-4.3	-4.3	-4.3	-4.3
Sediment analyses	Sample Date			Oct-28		Sep-19			Oct-28		Sep-19			Sep-19		Oct-28
	Grab Sample Time			11:33					11:59							10:58
	WP			65					70							63
	Sulphide (as H2S)			21					3.8							24
	Ammonia (N)			10.8					10.4							49.1
	pH			7.92					8.21							7.34
	Total Sulphide			20					3.54							22.1
	TOC (0-10cm)					5400			26000		30000			75000		
	TOC (20-40cm)										12000					
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date			oct 27					oct 27							oct 27
	Sample Time			15:22					15:19							14:52
	WP			046					045							040
	Temp			10.17					10.18							10.2
	Conductivity/salinity			31.84					31.88							31.9
	DO %			82.4					87.8							82.6
	DO mg/L			7.56					8.06							7.57
	pH			7.92					7.9							7.9
Substrate	Silt	90	100	100	100	50	50	25	100	100	100	100	100	100	100	65
	Sand					50	40	25								
	Gravel						10	50								
	Cobble	10														
	Boulder															
	Bedrock															
	Shell			1.5	2	7	20	10	2.5						1	
	Wood waste															35
	Bare															
	WW Depth	0		0		0	0		0		0.2	0		0.55		0.5
	WW State	closed		closed		closed	closed		closed		closed	closed		open		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	I3	I3	I3	I3	I3	I4	I4	I4	I4	I4	W1	W1	W1	W1	W1
		OLD Sample ID	I3-01	I3-04	I3-02	I3-05	I3-03	I4-01	I4-04	I4-02	I4-05	I4-03	W1-01	W1-04	W1-02	W1-05	W1-03
		NEW Transect ID	01	01	01	01	01	02	02	02	02	02	03	03	03	03	03
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	01-01	01-02	01-03	01-04	01-05	02-01	02-02	02-03	02-04	02-05	03-01	03-02	03-03	03-04	03-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-2.74	-3.66	-4.88	-5.49	-5.79	-7.01	-7.32	-7.62	-7.93	-8.54	-5.49	-6.40	-6.40	-6.40	-6.40
		Depth gauge (ft):	-9	-12	-16	-18	-19	-23	-24	-25	-26	-28	-18	-21	-21	-21	-21
		Tide (m):	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-1.2	-2.2	-3.4	-4.0	-4.3	-5.5	-5.8	-6.1	-6.4	-7.0	-3.4	-4.3	-4.3	-4.3	-4.3
		Probe												1.00		1.00	
Biological	Kelp detritus	Kelp detritus						10	1								
	Beggatoa spp.	bacterial mat									95			60	55	55	
	Diatoms	Diatoms	90	95	95	95	75			95			45	40	45	45	60
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp	2.5														
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes					0.5	0.5	2									
	Mounds					0.5	1										
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab	0.5	1	1	1			0.5				0.5		0.5		
	Metacarcinus magister	Dungeness crab						0.5			0.5						
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp						0.5	1.5								
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	W2	W2	W2	W2	W2	I2	I2	I2	I2	I2	I1	I1	I1	I1	I1
	OLD Sample ID	W2-01	W2-04	W2-02	W2-05	W2-03	I2-01	I2-04	I2-02	I2-05	I2-03	I1-01	I1-04	I1-02	I1-05	I1-03
	NEW Transect ID	04	04	04	04	04	05	05	05	05	05	06	06	06	06	06
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	04-01	04-02	04-03	04-04	04-05	05-01	05-02	05-03	05-04	05-05	06-01	06-02	06-03	06-04	06-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.01	-7.01	-7.01	-6.71	-6.40	-7.93	-7.93	-7.93	-7.62	-7.62	-7.01	-7.93	-7.93	-7.93	-7.93
	Depth gauge (ft):	-23	-23	-23	-22	-21	-26	-26	-26	-25	-25	-23	-26	-26	-26	-26
	Tide (m):	2.1	2.1	2.1	2.1	2.1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	Depth m CD:	-4.9	-4.9	-4.9	-4.6	-4.3	-6.1	-6.1	-6.1	-5.8	-5.8	-5.2	-6.1	-6.1	-6.1	-6.1
Sediment analyses	Sample Date					Oct-28			Sep-20		Oct-28	Oct-28		Sep-20		
	Grab Sample Time					10:44					10:00	9:47				
	WP					62					59	58				
	Sulphide (as H2S)					18					120	20				
	Ammonia (N)					57.4					35	20.2				
	pH					7.46					7.65	8.03				
	Total Sulphide					17					111	19.2				
	TOC (0-10cm)					88000			38000					25000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments					WP 060, 061 were too full of wood waste to						piece of large bark and some shell/ shell hash				
YSI Sampling	Sample Date					oct 27					oct 27	oct 27				
	Sample Time					14:48					15:02	14:17				
	WP					039					042	033				
	Temp					10.2					10.19	10.17				
	Conductivity/salinity					31.92					31.85	31.82				
	DO %					82.4					75	87.2				
	DO mg/L					7.56					6.88	8.01				
	pH					7.89					7.88	7.94				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell										1					
	Wood waste				100	100			5							
	Bare															
	WW Depth	0.25		0.45		0.55	0.35		0.25		0.3	0		0.1		0.2
	WW State	closed		closed		open	closed		closed		closed	closed		closed		closed

		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information		Transect Survey Date	Sep-19	Sep-19	Sep-19	Sep-19	Sep-19	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	W2	W2	W2	W2	W2	I2	I2	I2	I2	I2	I1	I1	I1	I1	I1
		OLD Sample ID	W2-01	W2-04	W2-02	W2-05	W2-03	I2-01	I2-04	I2-02	I2-05	I2-03	I1-01	I1-04	I1-02	I1-05	I1-03
		NEW Transect ID	04	04	04	04	04	05	05	05	05	05	06	06	06	06	06
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	04-01	04-02	04-03	04-04	04-05	05-01	05-02	05-03	05-04	05-05	06-01	06-02	06-03	06-04	06-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.01	-7.01	-7.01	-6.71	-6.40	-7.93	-7.93	-7.93	-7.62	-7.62	-7.01	-7.93	-7.93	-7.93	-7.93
		Depth gauge (ft):	-23	-23	-23	-22	-21	-26	-26	-26	-25	-25	-23	-26	-26	-26	-26
		Tide (m):	2.1	2.1	2.1	2.1	2.1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
		Depth m CD:	-4.9	-4.9	-4.9	-4.6	-4.3	-6.1	-6.1	-6.1	-5.8	-5.8	-5.2	-6.1	-6.1	-6.1	-6.1
		Probe		1.00					0.30					0.30		0.70	
Biological	Kelp detritus	Kelp detritus						15									
	Beggatoa spp.	bacterial mat	20	87	37	3		93	95	95	95	95	95	70	95	93	95
	Diatoms	Diatoms	33	10	15												
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																1
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab				0.5	0.5										
	Metridium farcimen	giant plumose anemone				0.5											
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout													2		
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish					50										
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	F1	F1	F1	F1	F1	F2	F2	F2	F2	F2	W5	W5	W5	W5	W5
	OLD Sample ID	F1-01	F1-04	F1-02	F1-05	F1-03	F2-01	F2-04	F2-02	F2-05	F2-03	W5-01	W5-04	W5-02	W5-05	W5-03
	NEW Transect ID	07	07	07	07	07	08	08	08	08	08	09	09	09	09	09
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	07-01	07-02	07-03	07-04	07-05	08-01	08-02	08-03	08-04	08-05	09-01	09-02	09-03	09-04	09-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-2.74	-2.74	-2.74	-3.05	-3.35	-3.96	-4.27	-4.57	-4.57	-4.88	-10.06	-10.06	-10.06	-9.76	-9.76
	Depth gauge (ft):	-9	-9	-9	-10	-11	-13	-14	-15	-15	-16	-33	-33	-33	-32	-32
	Tide (m):	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-1.0	-1.0	-1.0	-1.3	-1.7	-2.3	-2.6	-2.9	-2.9	-3.2	-8.0	-8.0	-8.0	-7.7	-7.7
Sediment analyses	Sample Date	Oct-28		Sep-20			Oct-28		Sep-20					Sep-20		Oct-28
	Grab Sample Time	9:12					9:23									13:55
	WP	55					56									78
	Sulphide (as H2S)	0.029					31									200
	Ammonia (N)	10.9					29.8									50.4
	pH	8.09					7.45									7.79
	Total Sulphide	0.0273					29.5									186
	TOC (0-10cm)			9300					24000					86000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments	shell hash					small amounts of bark									
YSI Sampling	Sample Date	oct 27					oct 27							oct 27		
	Sample Time	14:32					14:35							13:33		
	WP	036					037							024		
	Temp	10.18					10.2							10.16		
	Conductivity/salinity	31.8					31.86							31.87		
	DO %	89.4					85.7							77.3		
	DO mg/L	8.21					7.86							7.09		
	pH	7.93					7.93							7.87		
Substrate	Silt	55	45	40	100	90	90	100	40	100	80	100	95	100	100	100
	Sand	37	55	60		10	10									
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell	8	5	5			2		0.5							
	Wood waste		0.1	20			43	8	60		20		5			
	Bare															
	WW Depth	0		0		0.1	0		0		0.3	0.3		0.3		0.4
	WW State	closed		closed		closed	closed		closed		closed	open		closed		closed

		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information		Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	F1	F1	F1	F1	F1	F2	F2	F2	F2	F2	W5	W5	W5	W5	W5
		OLD Sample ID	F1-01	F1-04	F1-02	F1-05	F1-03	F2-01	F2-04	F2-02	F2-05	F2-03	W5-01	W5-04	W5-02	W5-05	W5-03
		NEW Transect ID	07	07	07	07	07	08	08	08	08	08	09	09	09	09	09
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	07-01	07-02	07-03	07-04	07-05	08-01	08-02	08-03	08-04	08-05	09-01	09-02	09-03	09-04	09-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-2.74	-2.74	-2.74	-3.05	-3.35	-3.96	-4.27	-4.57	-4.57	-4.88	-10.06	-10.06	-10.06	-9.76	-9.76
		Depth gauge (ft):	-9	-9	-9	-10	-11	-13	-14	-15	-15	-16	-33	-33	-33	-32	-32
		Tide (m):	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-1.0	-1.0	-1.0	-1.3	-1.7	-2.3	-2.6	-2.9	-2.9	-3.2	-8.0	-8.0	-8.0	-7.7	-7.7
		Probe														0.20	
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat											80	80	88	92	100
	Diatoms	Diatoms			50	50	43	75	80	70	73						
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp	30														
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed	1														
	Ulva lactuca	sea lettuce															
	Holes			3													
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab						0.5			0.5	0.5					
	Metacarcinus magister	Dungeness crab		0.5		1											
	Metridium farcimen	giant plumose anemone		0.5			0.5	4		2		4					
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown						0.5									

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
	Field Survey #	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	W6	W6	W6	W6	W6	T2	T2	T2	T2	T2
	OLD Sample ID	W6-01	W6-04	W6-02	W6-05	W6-03	T2-01		T2-02		T2-03
	NEW Transect ID	10	10	10	10	10	11	11	11	11	11
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	10-01	10-02	10-03	10-04	10-05	11-01	11-02	11-03	11-04	11-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-9.76	-9.76	-9.15	-8.54	-7.32	-8.84	-8.84	-8.84	-8.84	-8.84
	Depth gauge (ft):	-32	-32	-30	-28	-24	-29	-29	-29	-29	-29
	Tide (m):	2.1	2.1	2.1	2.1	2.1	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-7.7	-7.7	-7.0	-6.4	-5.2	-6.4	-6.4	-6.4	-6.4	-6.4
Sediment analyses	Sample Date			Sep-20		Oct-28	Oct-28		Sep-20		
	Grab Sample Time					14:09	13:34				
	WP					79	76				
	Sulphide (as H2S)					30	77				
	Ammonia (N)					67.5	33.4				
	pH					7.37	7.41				
	Total Sulphide					27.8	72.8				
	TOC (0-10cm)			110000					70000		
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments					wood waste, bark in larger pieces					
YSI Sampling	Sample Date					oct 27	oct 27				
	Sample Time					13:28	13:36				
	WP					023	025				
	Temp					10.15	10.14				
	Conductivity/salinity					31.8	31.84				
	DO %					84.3	82.3				
	DO mg/L					7.74	7.56				
	pH					7.9	7.89				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100
	Sand										
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste	18	1			1					
	Bare										
	WW Depth	0.6		0.6		0.6	0.6		0.5		0.3
	WW State	open		open		open	open		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20
		Field Survey #	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	W6	W6	W6	W6	W6	T2	T2	T2	T2	T2
		OLD Sample ID	W6-01	W6-04	W6-02	W6-05	W6-03	T2-01		T2-02		T2-03
		NEW Transect ID	10	10	10	10	10	11	11	11	11	11
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	10-01	10-02	10-03	10-04	10-05	11-01	11-02	11-03	11-04	11-05
		Point ID	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-9.76	-9.76	-9.15	-8.54	-7.32	-8.84	-8.84	-8.84	-8.84	-8.84
		Depth gauge (ft):	-32	-32	-30	-28	-24	-29	-29	-29	-29	-29
		Tide (m):	2.1	2.1	2.1	2.1	2.1	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-7.7	-7.7	-7.0	-6.4	-5.2	-6.4	-6.4	-6.4	-6.4	-6.4
		Probe						0.60	0.60	0.60	0.60	0.60
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat	100	93	95	85	13	100	100	100	100	100
	Diatoms	Diatoms										
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade										
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp										
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce										
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab					1			1		
	Metacarcinus magister	Dungeness crab										
	Metridium farcimen	giant plumose anemone	2									2
	Metridium senile	short plumose anemone										
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp										
	Pandalus platyceros	spot prawn										
	Pandalus unknown	Pandalus unknown										
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish	15									
	Sculpin unknown	sculpin unknown	0.5									

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	T2	T2	T2	T2	T2	F3	F3	F3	F3	F3	F4	F4	F4	F4	F4
	OLD Sample ID	T-04		T2-05		T2-06	F3-01	F3-04	F3-02	F3-05	F3-03	F4-01	F4-04	F4-02	F4-05	F4-03
	NEW Transect ID	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	12-01	12-02	12-03	12-04	12-05	13-01	13-02	13-03	13-04	13-05	14-01	14-02	14-03	14-04	14-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-8.84	-8.84	-8.84	-8.84	-8.84	-7.93	-7.32	-7.01	-6.71	-6.71	-5.79	-5.18	-4.27	-3.35	-3.05
	Depth gauge (ft):	-29	-29	-29	-29	-29	-26	-24	-23	-22	-22	-19	-17	-14	-11	-10
	Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-6.4	-6.4	-6.4	-6.4	-6.4	-5.5	-4.9	-4.6	-4.3	-4.3	-3.4	-2.8	-1.9	-1.0	-0.6
Sediment analyses	Sample Date	Oct-28		Sep-20			Oct-28				Sep-21			Sep-21		Oct-28
	Grab Sample Time	13:14					12:53									12:21
	WP	75					73									71
	Sulphide (as H2S)	47					230									6.4
	Ammonia (N)	36.4					39.7									8.22
	pH	7.37					7.52									8.06
	Total Sulphide	44					219									6
	TOC (0-10cm)			72000			58000				68000			5800		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	oct 27					oct 27									oct 27
	Sample Time	13:40					13:59									13:53
	WP	026					030									029
	Temp	10.15					10.18									10.27
	Conductivity/salinity	31.87					29.3									31.75
	DO %	78.1					81.2									82.9
	DO mg/L	7.17					7.57									7.6
	pH	7.89					7.9									7.9
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	30	5	5	3
	Sand												70	90	95	90
	Gravel													5		
	Cobble															
	Boulder															
	Bedrock															
	Shell											5		7	3	7
	Wood waste						0.1	0.1	0.1	0.1	0.1		10		33	
	Bare															
	WW Depth	0.4		0.65		0.25	0.35		0.6		0.4	0		0.2		0
	WW State	closed		open		closed	closed		closed		open	closed		closed		closed

Transect Sampling Information		**Year**	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-20	Sep-20	Sep-20	Sep-20	Sep-20	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	T2	T2	T2	T2	T2	F3	F3	F3	F3	F3	F4	F4	F4	F4	F4
		OLD Sample ID	T-04		T2-05		T2-06	F3-01	F3-04	F3-02	F3-05	F3-03	F4-01	F4-04	F4-02	F4-05	F4-03
		NEW Transect ID	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	12-01	12-02	12-03	12-04	12-05	13-01	13-02	13-03	13-04	13-05	14-01	14-02	14-03	14-04	14-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-8.84	-8.84	-8.84	-8.84	-8.84	-7.93	-7.32	-7.01	-6.71	-6.71	-5.79	-5.18	-4.27	-3.35	-3.05
		Depth gauge (ft):	-29	-29	-29	-29	-29	-26	-24	-23	-22	-22	-19	-17	-14	-11	-10
		Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-6.4	-6.4	-6.4	-6.4	-6.4	-5.5	-4.9	-4.6	-4.3	-4.3	-3.4	-2.8	-1.9	-1.0	-0.6
		Probe	0.60	0.60	0.60	0.60	0.60		0.20		0.40			0.17			
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	100	100	100	100	100	70	95	100	99	97	75				
	Diatoms	Diatoms												58	80	80	60
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched													1		
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp											2				
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes															2	
	Mounds															1	
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab												1	1		1
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone			5			1					2			0.5	
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab											1				
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	W4	W4	W4	W4	W4	W3	W3	W3	W3	W3	T4	T4	T4	T4	T4
	OLD Sample ID	W4-01	W4-04	W4-02	W4-05	W4-03	W3-01	W3-04	W3-02	W3-05	W3-03	T4-01		T4-02		T4-03
	NEW Transect ID	15	15	15	15	15	16	16	16	16	16	17	17	17	17	17
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	15-01	15-02	15-03	15-04	15-05	16-01	16-02	16-03	16-04	16-05	17-01	17-02	17-03	17-04	17-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.32	-7.32	-7.01	-6.71	-5.79	-8.84	-8.84	-8.54	-8.23	-7.93	-5.18	-5.18	-5.18	-5.18	-5.18
	Depth gauge (ft):	-24	-24	-23	-22	-19	-29	-29	-28	-27	-26	-17	-17	-17	-17	-17
	Tide (m):	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9
	Depth m CD:	-5.3	-5.3	-5.0	-4.7	-3.8	-6.8	-6.8	-6.5	-6.2	-5.9	-3.3	-3.3	-3.3	-3.3	-3.3
Sediment analyses	Sample Date	Sep-21		Oct-28			Oct-28		Sep-21					Oct-28		Sep-21
	Grab Sample Time			13:03			12:37							15:24		
	WP			74			72							86		
	Sulphide (as H2S)			24			12							4.1		
	Ammonia (N)			53.9			64.4							25.3		
	pH			7.23			7.25							7.77		
	Total Sulphide			22.5			11.6							3.83		
	TOC (0-10cm)	98000							72000					60000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture			75			68									49
	Available (KCl) Ammonia (N) (AVS)			19.6			19.2									6.99
	Soluble (2:1) pH (AVS)			7.63			7.76									7.95
	Sulphide (AVS)			2700			352									492
	Grab Sampling Comments						pieces of bark in sampler							wood waste at waypoints 084 and 085 made it		
YSI Sampling	Sample Date			oct 27			oct 27									Oct 27
	Sample Time			13:44			13:48									13:19
	WP			027			028									021
	Temp			10.19			10.2									10:16
	Conductivity/salinity			31.84			31.81									31.79
	DO %			83.4			85									82.8
	DO mg/L			7.65			7.79									7.6
	pH			7.89			7.91									7.9
Substrate	Silt	100	100	100	100	100	100	100	100	50	100	75	75	75	75	75
	Sand											25	25	25	25	25
	Gravel															
	Cobble														10	
	Boulder															
	Bedrock															
	Shell													80		80
	Wood waste	0.1	0.1	0.1	0.1	0.1		0.1	0.1	50			100		100	
	Bare															
	WW Depth	0.35		0.3		0.4	0.2		0.2		0.35	0.35		0.3		0.4
	WW State	closed		closed		closed	closed		closed		closed	open		open		open

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	W4	W4	W4	W4	W4	W3	W3	W3	W3	W3	T4	T4	T4	T4	T4
		OLD Sample ID	W4-01	W4-04	W4-02	W4-05	W4-03	W3-01	W3-04	W3-02	W3-05	W3-03	T4-01		T4-02		T4-03
		NEW Transect ID	15	15	15	15	15	16	16	16	16	16	17	17	17	17	17
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	15-01	15-02	15-03	15-04	15-05	16-01	16-02	16-03	16-04	16-05	17-01	17-02	17-03	17-04	17-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.32	-7.32	-7.01	-6.71	-5.79	-8.84	-8.84	-8.54	-8.23	-7.93	-5.18	-5.18	-5.18	-5.18	-5.18
		Depth gauge (ft):	-24	-24	-23	-22	-19	-29	-29	-28	-27	-26	-17	-17	-17	-17	-17
		Tide (m):	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9
		Depth m CD:	-5.3	-5.3	-5.0	-4.7	-3.8	-6.8	-6.8	-6.5	-6.2	-5.9	-3.3	-3.3	-3.3	-3.3	-3.3
		Probe		0.20		0.30			0.50				0.50	0.50	0.40	0.20	0.20
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	83	88	99	99	90	83	80	80	48	83					
	Diatoms	Diatoms															
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp											80			80	40
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab										0.5					
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone									1	0.5					
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp														10	
	Pandalus platyceros	spot prawn														10	
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
	Field Survey #	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	T4	T4	T4	T4	T4	F6	F6	F6	F6	F6
	OLD Sample ID	T4-04		T4-05		T4-06	F6-01	F6-04	F6-02	F6-05	F6-03
	NEW Transect ID	18	18	18	18	18	19	19	19	19	19
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	18-01	18-02	18-03	18-04	18-05	19-01	19-02	19-03	19-04	19-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-5.18	-5.18	-5.18	-5.18	-5.18	-12.20	-12.20	-11.89	-11.28	-9.76
	Depth gauge (ft):	-17	-17	-17	-17	-17	-40	-40	-39	-37	-32
	Tide (m):	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0
	Depth m CD:	-3.3	-3.3	-3.3	-3.3	-3.3	-10.2	-10.2	-9.9	-9.3	-7.8
Sediment analyses	Sample Date	Sep-21		Oct-28			Oct-27		Sep-21		
	Grab Sample Time			15:07			14:26				
	WP			83			52				
	Sulphide (as H2S)			0.035			0.05				
	Ammonia (N)			9.17			39.6				
	pH			8.06			7.73				
	Total Sulphide			0.0329			0.0467				
	TOC (0-10cm)	39000							50000		
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture			32			53				
	Available (KCl) Ammonia (N) (AVS)			2.96			9.74				
	Soluble (2:1) pH (AVS)			8.42			7.61				
	Sulphide (AVS)			58.2			225				
	Grab Sampling Comments			lots of whole shells made sampling			bark wood waste, 2inch chunks				
YSI Sampling	Sample Date			oct 27			oct 27				
	Sample Time			13:23			13:03				
	WP			022			019				
	Temp			10.23			10.14				
	Conductivity/salinity			31.8			31.82				
	DO %			82.5			78.1				
	DO mg/L			7.57			7.18				
	pH			7.88			7.88				
Substrate	Silt	75	75	75	75	40	70	60	65	70	40
	Sand	25	25	25	25	60	30	40	35	30	50
	Gravel										10
	Cobble										
	Boulder										
	Bedrock										
	Shell	40	40		50		1	2			
	Wood waste	40					10	10	15	43	
	Bare										
	WW Depth	0		0		0	0.1		0.2		0.15
	WW State	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21
		Field Survey #	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	T4	T4	T4	T4	T4	F6	F6	F6	F6	F6
		OLD Sample ID	T4-04		T4-05		T4-06	F6-01	F6-04	F6-02	F6-05	F6-03
		NEW Transect ID	18	18	18	18	18	19	19	19	19	19
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	18-01	18-02	18-03	18-04	18-05	19-01	19-02	19-03	19-04	19-05
		Point ID	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-5.18	-5.18	-5.18	-5.18	-5.18	-12.20	-12.20	-11.89	-11.28	-9.76
		Depth gauge (ft):	-17	-17	-17	-17	-17	-40	-40	-39	-37	-32
		Tide (m):	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0
		Depth m CD:	-3.3	-3.3	-3.3	-3.3	-3.3	-10.2	-10.2	-9.9	-9.3	-7.8
		Probe	0.20	0.50	0.60	0.40	0.30					
Biological	*Kelp detritus*	Kelp detritus										
	Beggatoa spp.	bacterial mat										
	Diatoms	Diatoms			80	50		55	50	35		
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade							1		1	
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp		30			20				15	100
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce					20					
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab		1			2		1	1		
	Metacarcinus magister	Dungeness crab									0.5	
	Metridium farcimen	giant plumose anemone										
	Metridium senile	short plumose anemone										
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp							3			
	Pandalus platyceros	spot prawn										2
	Pandalus unknown	Pandalus unknown							5			
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate						4				
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown								1		
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish										2
	Sculpin unknown	sculpin unknown						1	1			

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	F5	F5	F5	F5	F5	O1	O1	O1	O1	O1	O2	O2	O2	O2	O2
	OLD Sample ID	F5-01	F5-04	F5-02	F5-05	F5-03	O1-01	O1-04	O1-02	O1-05	O1-03	O2-01	O2-04	O2-02	O2-05	O2-03
	NEW Transect ID	20	20	20	20	20	21	21	21	21	21	22	22	22	22	22
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	20-01	20-02	20-03	20-04	20-05	21-01	21-02	21-03	21-04	21-05	22-01	22-02	22-03	22-04	22-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-12.50	-12.50	-12.50	-12.50	-12.50	-4.88	-5.79	-6.40	-7.01	-7.32	-7.62	-8.23	-7.93	-8.54	-8.84
	Depth gauge (ft):	-41	-41	-41	-41	-41	-16	-19	-21	-23	-24	-25	-27	-26	-28	-29
	Tide (m):	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-10.5	-10.5	-10.5	-10.5	-10.5	-2.8	-3.7	-4.3	-4.9	-5.2	-5.5	-6.1	-5.8	-6.4	-6.7
Sediment analyses	Sample Date	Sep-21		Oct-27					Sep-22		Oct-21	Oct-21				Sep-22
	Grab Sample Time			16:08												
	WP			51												
	Sulphide (as H2S)			0.099							5.7	0.017				
	Ammonia (N)			30							7.26	9.64				
	pH			7.75							8.1	7.92				
	Total Sulphide			0.0928							5.4	0.0163				
	TOC (0-10cm)	35000							1600							8700
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture			57							28	34				
	Available (KCl) Ammonia (N) (AVS)			13.8							7.26	9.64				
	Soluble (2:1) pH (AVS)			7.73							8.1	7.92				
	Sulphide (AVS)			323							44	85.5				
	Grab Sampling Comments			bark wood waste, 2inch chunks												
YSI Sampling	Sample Date			oct 27							oct 27	oct 27				oc t27
	Sample Time			12:58							10:00	10:05				10:05
	WP			018							005	006				007
	Temp			10.16							10.21	10.29				10.3
	Conductivity/salinity			31.92							31.86	31.89				31.97
	DO %			68.1							80.3	76.7				73.4
	DO mg/L			6.25							7.35	7.05				6.77
	pH			7.81							7.78	7.81				7.78
Substrate	Silt	55	70	70	70	70	10	10	10	20	20	40	50	50	60	60
	Sand	45	30	30	30	30	90	90	90	80	80	60	50	50	40	40
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell		1										0.5	1		
	Wood waste	30	7.5	40	20	13										
	Bare															
	WW Depth	0.25		0.2		0.2	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information		Transect Survey Date	Sep-21	Sep-21	Sep-21	Sep-21	Sep-21	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	F5	F5	F5	F5	F5	O1	O1	O1	O1	O1	O2	O2	O2	O2	O2
		OLD Sample ID	F5-01	F5-04	F5-02	F5-05	F5-03	O1-01	O1-04	O1-02	O1-05	O1-03	O2-01	O2-04	O2-02	O2-05	O2-03
		NEW Transect ID	20	20	20	20	20	21	21	21	21	21	22	22	22	22	22
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	20-01	20-02	20-03	20-04	20-05	21-01	21-02	21-03	21-04	21-05	22-01	22-02	22-03	22-04	22-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-12.50	-12.50	-12.50	-12.50	-12.50	-4.88	-5.79	-6.40	-7.01	-7.32	-7.62	-8.23	-7.93	-8.54	-8.84
		Depth gauge (ft):	-41	-41	-41	-41	-41	-16	-19	-21	-23	-24	-25	-27	-26	-28	-29
		Tide (m):	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-10.5	-10.5	-10.5	-10.5	-10.5	-2.8	-3.7	-4.3	-4.9	-5.2	-5.5	-6.1	-5.8	-6.4	-6.7
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	5	23	43	55	60	63	53	70	73	78	80	78	88	80	80
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp						13	18	13	85	25	5		3		
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed							8			20	10	15	15	15	15
	Ulva lactuca	sea lettuce						63									
	Holes								0.5				7	7	7.5	4.5	5.5
	Mounds														0.5	1	1
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab		1	0.5											0.5	
	Metacarcinus magister	Dungeness crab							0.5					0.5	1	0.5	0.5
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab	1														
	Pandalus danae	coon striped shrimp	0.5				3										
	Pandalus platyceros	spot prawn			0.5												
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species						2.5	0.5		1	1					
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate	0.5		0.5												
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															0.5
	Sebastes spp. YOY	young of the year rockfish											1				
	Sculpin unknown	sculpin unknown												1			

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	O3	O3	O3	O3	O3	O4	O4	O4	O4	O4	O5	O5	O5	O5	O5
	OLD Sample ID	O3-01	O3-04	O3-02	O3-05	O3-03	O4-01	O4-04	O4-02	O4-05	O4-03	O5-01	O5-04	O5-02	O5-05	O5-03
	NEW Transect ID	23	23	23	23	23	24	24	24	24	24	25	25	25	25	25
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	23-01	23-02	23-03	23-04	23-05	24-01	24-02	24-03	24-04	24-05	25-01	25-02	25-03	25-04	25-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.32	-8.23	-8.54	-8.54	-8.84	-8.84	-9.15	-9.15	-9.15	-9.45	-8.84	-8.84	-9.15	-8.84	-9.45
	Depth gauge (ft):	-24	-27	-28	-28	-29	-29	-30	-30	-30	-31	-29	-29	-30	-29	-31
	Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-5.2	-6.1	-6.4	-6.4	-6.7	-6.7	-7.0	-7.0	-7.0	-7.4	-6.7	-6.7	-7.0	-6.7	-7.4
Sediment analyses	Sample Date	Sep-22		Oct-21			Oct-21		Sep-22					Sep-22		Oct-21
	Grab Sample Time															
	WP															
	Sulphide (as H2S)			0.063			0.025									14
	Ammonia (N)			6.96			19.8									16.9
	pH			7.91			8.16									8.24
	Total Sulphide			0.0593			0.0235									13.1
	TOC (0-10cm)	7300							7200					6000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture			37			37									35
	Available (KCl) Ammonia (N) (AVS)			6.96			19.8									16.9
	Soluble (2:1) pH (AVS)			7.91			8.16									8.24
	Sulphide (AVS)			92.5			173									224
	Grab Sampling Comments															
YSI Sampling	Sample Date			oct 27			oct 27		oct 27			oct 27		oct 27		oct 27
	Sample Time			9:50			9:55		9:55			10:10		10:10		10:10
	WP			001			003		004			008		009		010
	Temp			10.14			10.15		10.14			10.16		10.25		10.12
	Conductivity/salinity			31.59			31.92		31.91			31.81		31.91		31.87
	DO %			68.7			74.1		84.3			81.2		78.8		76.8
	DO mg/L			6.24			6.62		7.55			7.43		7.22		7.03
	pH			7.44			7.61		7.7			7.85		7.86		7.87
Substrate	Silt	35	60	50	60	60	60	50	50	50	40	40	40	40	30	40
	Sand	65	40	50	40	40	40	50	50	50	60	60	60	60	70	60
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell						0.5							0.5	0.5	
	Wood waste															
	Bare															
	WW Depth	0.15		0		0	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	O3	O3	O3	O3	O3	O4	O4	O4	O4	O4	O5	O5	O5	O5	O5
		OLD Sample ID	O3-01	O3-04	O3-02	O3-05	O3-03	O4-01	O4-04	O4-02	O4-05	O4-03	O5-01	O5-04	O5-02	O5-05	O5-03
		NEW Transect ID	23	23	23	23	23	24	24	24	24	24	25	25	25	25	25
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	23-01	23-02	23-03	23-04	23-05	24-01	24-02	24-03	24-04	24-05	25-01	25-02	25-03	25-04	25-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-7.32	-8.23	-8.54	-8.54	-8.84	-8.84	-9.15	-9.15	-9.15	-9.45	-8.84	-8.84	-9.15	-8.84	-9.45
		Depth gauge (ft):	-24	-27	-28	-28	-29	-29	-30	-30	-30	-31	-29	-29	-30	-29	-31
		Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-5.2	-6.1	-6.4	-6.4	-6.7	-6.7	-7.0	-7.0	-7.0	-7.4	-6.7	-6.7	-7.0	-6.7	-7.4
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	55	80	83	80	83	63	55	78	85	53	70	63	65	70	
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair										18					
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp						83	75						85	83	90
	Sacharina groenlandica	split kelp	50	38	55	58	58			90	78	70	30	53			
	Sarcodietheca gaudichaudii	succulent seaweed											63	18	2.5	0.5	
	Ulva lactuca	sea lettuce										2.5					
	Holes		3									0.5					
	Mounds		1													0.5	
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab														0.5	
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab	2	0.5										0.5			
	Metridium farcimen	giant plumose anemone					0.5										
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp				1		3									
	Pandalus platyceros	spot prawn	0.5										0.5				
	Pandalus unknown	Pandalus unknown	5	2.5	2	5	10.5	3	5	4	8.5	5	3	1.5	1	1	2.5
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab	0.5	0.5		0.5					0.5	1.5					
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback				1											
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish		1	0.5		0.5	1	0.5	0.5							
	Sculpin unknown	sculpin unknown	1														

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
	Field Survey #	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	O6	O6	O6	O6	O6	T3	T3	T3	T3	T3
	OLD Sample ID	O6-01	O6-04	O6-02	O6-05	O6-03	T3-01		T3-02		T3-03
	NEW Transect ID	26	26	26	26	26	27	27	27	27	27
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	26-01	26-02	26-03	26-04	26-05	27-01	27-02	27-03	27-04	27-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-9.15	-9.45	-9.76	-9.45	-9.45	-11.59	-10.98	-10.98	-10.98	-10.67
	Depth gauge (ft):	-30	-31	-32	-31	-31	-38	-36	-36	-36	-35
	Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Depth m CD:	-7.0	-7.4	-7.7	-7.4	-7.4	-9.5	-8.9	-8.9	-8.9	-8.6
Sediment analyses	Sample Date	Oct-21				Sep-22	Ept-23		Oct-28		
	Grab Sample Time								14:40		
	WP								81		
	Sulphide (as H2S)	0.014							11		
	Ammonia (N)	22.4							31.3		
	pH	8.21							7.3		
	Total Sulphide	0.0127							10.3		
	TOC (0-10cm)					5400	68000				
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture	36									
	Available (KCl) Ammonia (N) (AVS)	22.4									
	Soluble (2:1) pH (AVS)	8.21									
	Sulphide (AVS)	69.4									
	Grab Sampling Comments								wood waste, bark		
YSI Sampling	Sample Date								oc t27		
	Sample Time								15:38		
	WP								049		
	Temp								10.17		
	Conductivity/salinity								31.93		
	DO %								76.3		
	DO mg/L								7		
	pH								7.87		
Substrate	Silt	40	40	40	40	40	100	100	100	100	100
	Sand	60	60	60	60	60					
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste									40	30
	Bare										
	WW Depth	0		0		0	0.6		0.3		0.6
	WW State	closed		closed		closed	open		open		open

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-22	Sep-22	Sep-22	Sep-22	Sep-22	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
		Field Survey #	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	O6	O6	O6	O6	O6	T3	T3	T3	T3	T3
		OLD Sample ID	O6-01	O6-04	O6-02	O6-05	O6-03	T3-01		T3-02		T3-03
		NEW Transect ID	26	26	26	26	26	27	27	27	27	27
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	26-01	26-02	26-03	26-04	26-05	27-01	27-02	27-03	27-04	27-05
		Point ID	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-9.15	-9.45	-9.76	-9.45	-9.45	-11.59	-10.98	-10.98	-10.98	-10.67
		Depth gauge (ft):	-30	-31	-32	-31	-31	-38	-36	-36	-36	-35
		Tide (m):	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
		Depth m CD:	-7.0	-7.4	-7.7	-7.4	-7.4	-9.5	-8.9	-8.9	-8.9	-8.6
		Probe						0.40	0.60	0.50	0.40	0.40
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat						100	100	50	100	100
	Diatoms	Diatoms	55	50	80	75	70			50		
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade										
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp	87	45	82	50	53					
	Sacharina groenlandica	split kelp		45		45						
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce										
	Holes					1	0.5					
	Mounds					0.5						
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab									3	
	Metacarcinus magister	Dungeness crab										
	Metridium farcimen	giant plumose anemone							4	8	4	12
	Metridium senile	short plumose anemone										
	Pagurus sp.	hermit crab										
	Pandalus danae	coon striped shrimp		0.5			1.5					
	Pandalus platyceros	spot prawn	0.5		5							
	Pandalus unknown	Pandalus unknown	3.5	4		3.5	8					
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab		1.5								
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback		1								
	Platichthys stellatus	starry flounder									1	
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish				2						
	Sculpin unknown	sculpin unknown										

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
	Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	OLD Transect ID	T3	T3	T3	T3	T3	I5	I5	I5	I5	I5	I6	I6	I6	I6	I6
	OLD Sample ID	T3-04		T3-05		T3-06	I5-01	I5-04	I5-02	I5-05	I5-03	I6-01	I6-04	I6-02	I6-05	I6-03
	NEW Transect ID	28	28	28	28	28	29	29	29	29	29	30	30	30	30	30
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	28-01	28-02	28-03	28-04	28-05	29-01	29-02	29-03	29-04	29-05	30-01	30-02	30-03	30-04	30-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-10.37	-10.67	-10.37	-10.37	-10.67	-13.11	-12.80	-12.80	-13.11	-12.80	-12.80	-12.50	-12.50	-12.50	-11.59
	Depth gauge (ft):	-34	-35	-34	-34	-35	-43	-42	-42	-43	-42	-42	-41	-41	-41	-38
	Tide (m):	2.2	2.2	2.2	2.2	2.2	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	Depth m CD:	-8.2	-8.5	-8.2	-8.2	-8.5	-11.3	-11.0	-11.0	-11.3	-11.0	-11.0	-10.7	-10.7	-10.7	-9.8
Sediment analyses	Sample Date	Oct-28		Sep-23					oc t27					Oct-27		Sep-23
	Grab Sample Time	14:26							17:12					16:48		
	WP	80							54					53		
	Sulphide (as H2S)	18							0.012					0.027		
	Ammonia (N)	34.9							29.5					28		
	pH	7.21							7.85					7.8		
	Total Sulphide	16.7							0.0112					0.025		
	TOC (0-10cm)			63000												18000
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture								49					52		
	Available (KCl) Ammonia (N) (AVS)								10.3					9.98		
	Soluble (2:1) pH (AVS)								7.92					7.82		
	Sulphide (AVS)								63.4					129		
	Grab Sampling Comments								small amount of wood waste					small amount of wood waste		
YSI Sampling	Sample Date	oct 27							oct 27					oct 27		
	Sample Time	15:43							13:11					14:45		
	WP	050							020					053		
	Temp	10.16							10.15					10.14		
	Conductivity/salinity	31.91							31.71					31.88		
	DO %	78.2							58.2					81		
	DO mg/L	7.17							5.34					7.43		
	pH	7.86							7.87					7.9		
Substrate	Silt	100	100	100	100	100	60	70	70	60	60	70	70	70	70	60
	Sand						40	30	30	40	40	30	30	30	30	30
	Gravel															10
	Cobble															
	Boulder															
	Bedrock															
	Shell						1	1		2	2.5		0.5	0.5		
	Wood waste	20	30							2	2	2.5	0.1	1		
	Bare															
	WW Depth	0.5		0.45			0		0		0	0		0		0
	WW State	open		closed			closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23	Sep-23
		Field Survey #	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OLD Transect ID	T3	T3	T3	T3	T3	I5	I5	I5	I5	I5	I6	I6	I6	I6	I6
		OLD Sample ID	T3-04		T3-05		T3-06	I5-01	I5-04	I5-02	I5-05	I5-03	I6-01	I6-04	I6-02	I6-05	I6-03
		NEW Transect ID	28	28	28	28	28	29	29	29	29	29	30	30	30	30	30
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	28-01	28-02	28-03	28-04	28-05	29-01	29-02	29-03	29-04	29-05	30-01	30-02	30-03	30-04	30-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-10.37	-10.67	-10.37	-10.37	-10.67	-13.11	-12.80	-12.80	-13.11	-12.80	-12.80	-12.50	-12.50	-12.50	-11.59
		Depth gauge (ft):	-34	-35	-34	-34	-35	-43	-42	-42	-43	-42	-42	-41	-41	-41	-38
		Tide (m):	2.2	2.2	2.2	2.2	2.2	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
		Depth m CD:	-8.2	-8.5	-8.2	-8.2	-8.5	-11.3	-11.0	-11.0	-11.3	-11.0	-11.0	-10.7	-10.7	-10.7	-9.8
		Probe	0.40	0.40	0.40	0.40	0.40										
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	100	100	100	100	100										
	Diatoms	Diatoms						28	35	23	33	10	23	13	18	10	
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp														8	75
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes							3.5	1.5	1.5	1	1.5			0.5	1.5	
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab						0.5	0.5				0.5				
	Metridium farcimen	giant plumose anemone	6						0.5								
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															1.5
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown											1.5			5	
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															1
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate											1				
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole								0.5							
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	10a	10a	10a	10a	10a	10b	10b	10b	10b	10b	11a	11a	11a	11a	11a
	OLD Sample ID	10a-01	10a-04	10a-02	10a-05	10a-03	10b-01	10b-04	10b-02	10b-05	10b-03	11a-01	11a-04	11a-02	11a-05	11a-03
	NEW Transect ID	31	31	31	31	31	32	32	32	32	32	33	33	33	33	33
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	31-01	31-02	31-03	31-04	31-05	32-01	32-02	32-03	32-04	32-05	33-01	33-02	33-03	33-04	33-05
	Point ID	1	2	3	4	5	1	2	3	4	5	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	5.79	-6.10	-6.10	-6.40	-6.40	-6.40	-6.71	-6.71	-7.01	-7.62	-6.40	-6.40	-6.40	-7.01	-6.40
	Depth gauge (ft):	19	-20	-20	-21	-21	-21	-22	-22	-23	-25	-21	-21	-21	-23	-21
	Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.5	2.5	2.5	2.5	2.5
	Depth m CD:	8.0	-3.9	-3.9	-4.2	-4.2	-4.2	-4.5	-4.5	-4.8	-5.4	-3.9	-3.9	-3.9	-4.5	-3.9
Sediment analyses	Sample Date	Oct-19		Oct-19					Oct-19		Oct-19	Oct-19		Oct-19		
	Grab Sample Time															
	WP															
	Sulphide (as H2S)	60									160	130				
	Ammonia (N)	7.03									13	17.7				
	pH	8.1									7.84	7.68				
	Total Sulphide	56									146	123				
	TOC (0-10cm)			34000					31000					21000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	oct 27									oct 27	oct 27				
	Sample Time	14:43									14:57	14:26				
	WP	038									041	035				
	Temp	10.18									10.2	10.15				
	Conductivity/salinity	31.88									31.91	31.89				
	DO %	85.5									78.6	83.1				
	DO mg/L	7.84									7.2	7.63				
	pH	7.91									7.89	7.92				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste															
	Bare															
	WW Depth	0		0.2		0	0.5		0.4		0.4	0.3		0.4		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	10a	10a	10a	10a	10a	10b	10b	10b	10b	10b	11a	11a	11a	11a	11a
		OLD Sample ID	10a-01	10a-04	10a-02	10a-05	10a-03	10b-01	10b-04	10b-02	10b-05	10b-03	11a-01	11a-04	11a-02	11a-05	11a-03
		NEW Transect ID	31	31	31	31	31	32	32	32	32	32	33	33	33	33	33
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	31-01	31-02	31-03	31-04	31-05	32-01	32-02	32-03	32-04	32-05	33-01	33-02	33-03	33-04	33-05
		Point ID	1	2	3	4	5	1	2	3	4	5	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	5.79	-6.10	-6.10	-6.40	-6.40	-6.40	-6.71	-6.71	-7.01	-7.62	-6.40	-6.40	-6.40	-7.01	-6.40
		Depth gauge (ft):	19	-20	-20	-21	-21	-21	-22	-22	-23	-25	-21	-21	-21	-23	-21
		Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.5	2.5	2.5	2.5	2.5
		Depth m CD:	8.0	-3.9	-3.9	-4.2	-4.2	-4.2	-4.5	-4.5	-4.8	-5.4	-3.9	-3.9	-3.9	-4.5	-3.9
		Probe	70.00	70.00	70.00	50.00	30.00	40.00	40.00	30.00	20.00	20.00	20.00	20.00	30.00	20.00	40.00
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat				5		30	20	10	50	80				5	5
	Diatoms	Diatoms	80	80	80	50	80	70	60	80	50	10	90	90	90	80	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp					1										
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone			1	1											
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19
	Field Survey #	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	11b	11b	11b	11b	11b	14a	14a	14a	14a	14a
	OLD Sample ID	11b-01	11b-04	11b-02	11b-05	11b-03	14a-01	14a-04	14a-02	14a-05	14a-03
	NEW Transect ID	34	34	34	34	34	35	35	35	35	35
Transect Sampling Information	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	34-01	34-02	34-03	34-04	34-05	35-01	35-02	35-03	35-04	35-05
	Point ID	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-7.32	-7.32	-7.32	-7.93	-7.32	-7.80	-6.20	-6.90	-11.90	-12.60
	Depth gauge (ft):	-24	-24	-24	-26	-24	-7.8				
	Tide (m):	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-4.8	-4.8	-4.8	-5.4	-4.8	-5.4	-3.8	-4.5	-9.5	-10.2
	Sample Date	Oct-19		Oct-19							Oct-19
	Grab Sample Time										
	WP										
	Sulphide (as H2S)	26									
	Ammonia (N)	9.64									41.2
	pH	7.83									8.25
	Total Sulphide	24.3									
	TOC (0-10cm)			33000							32000
Sediment analyses	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments										
	Sample Date	oct 27					oct 27				
	Sample Time	14:22					15:31				
	WP	034					047				
YSI Sampling	Temp	10.17					10.16				
	Conductivity/salinity	31.85					31.87				
	DO %	84					90.6				
	DO mg/L	7.71					8.31				
	pH	7.94					7.91				
	Silt	100	100	100	100	100					100
	Sand										
	Gravel										
	Cobble							40			
	Boulder							50			
Substrate	Bedrock						100		100	100	
	Shell							10			
	Wood waste										
	Bare										
	WW Depth	0.4		0		0.4	0		0		0
	WW State	open		closed		closed	closed		closed		closed

Transect Sampling Information		**Year**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**	**2016**
		Transect Survey Date	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**	**Oct-19**
		Field Survey #	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
		OLD Transect ID	**11b**	**11b**	**11b**	**11b**	**11b**	**14a**	**14a**	**14a**	**14a**	**14a**
		OLD Sample ID	**11b-01**	**11b-04**	**11b-02**	**11b-05**	**11b-03**	**14a-01**	**14a-04**	**14a-02**	**14a-05**	**14a-03**
		NEW Transect ID	**34**	**34**	**34**	**34**	**34**	**35**	**35**	**35**	**35**	**35**
		Point	**01**	**02**	**03**	**04**	**05**	**01**	**02**	**03**	**04**	**05**
		NEW Sample ID	**34-01**	**34-02**	**34-03**	**34-04**	**34-05**	**35-01**	**35-02**	**35-03**	**35-04**	**35-05**
		Point ID	**1**	**4**	**2**	**5**	**3**	**1**	**4**	**2**	**5**	**3**
		Distance	**0**	**25**	**50**	**75**	**100**	**0**	**25**	**50**	**75**	**100**
		Depth gauge (m):	**-7.32**	**-7.32**	**-7.32**	**-7.93**	**-7.32**	**-7.80**	**-6.20**	**-6.90**	**-11.90**	**-12.60**
		Depth gauge (ft):	**-24**	**-24**	**-24**	**-26**	**-24**	**-7.8**				
		Tide (m):	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**
		Depth m CD:	**-4.8**	**-4.8**	**-4.8**	**-5.4**	**-4.8**	**-5.4**	**-3.8**	**-4.5**	**-9.5**	**-10.2**
		Probe	**40.00**	**30.00**	**20.00**	**20.00**	**20.00**					
Biological	Kelp detritus	**Kelp detritus**										
	Beggatoa spp.	**bacterial mat**	20	50	50	30	30					
	Diatoms	**Diatoms**	80	50	50	50	30			80		10
	Agarum fimbriatum	**fringed sieve kelp**						60				
	Coralline crust spp.	**pink encrusting coralline seaweed**								10		
	Desmerasria viridis	**Stringy acid hair**										
	Gracilaria											
	Red blade	**red blade**							5			
	Red branched	**Red branched**										
	Red filamentous	**red filamentous**							10			
	Sacharina latissima	**sugar kelp**				30	30	5				
	Sacharina groenlandica	**split kelp**										
	Sarcodietheca gaudichaudii	**succulent seaweed**										
	Ulva lactuca	**sea lettuce**										
	Holes											
	Mounds											
	Balanus glandula	**acorn barnacle**						10			40	
	Cancer productus	**red rock crab**	1						1		1	
	Dirona							1				
	Metacarcinus gracilis	**graceful rock crab**									1	
	Metacarcinus magister	**Dungeness crab**										
	Metridium farcimen	**giant plumose anemone**										
	Metridium senile	**short plumose anemone**							2		2	
	Pagurus sp.	**hermit crab**										
	Pandalus danae	**coon striped shrimp**										
	Pandalus platyceros	**spot prawn**							5		22	
	Pandalus unknown	**Pandalus unknown**										
	Parastichopus californicus	**red sea cucumber**								2		
	Pisaster ochraceaus	**Ochre sea star**						1				
	Pugetia productus	**kelp crab**										
	shrimp species	**shrimp species**										
	Stronglyocentrotus franciscanus	**red urchin**								2	2	
	Styela montereyensis	**stalked tunicate**										
	Tresus sp.	**gaper clams**										
	Urticina unknown	**Anemone unknown**										
		Tunicate										
	Aulorhynchus flavidus	**Tube snout**										
	Citharichthys stigmaeus	**speckled sand dab**										
	Clupea pallasii	**Pacific herring**			30							
	Lumpenus sagitta	**Smanke prickleback**										
	Platichthys stellatus	**starry flounder**										
	Pleuronichthys coenosus	**C-O sole**										
	Sebastes spp. YOY	**young of the year rockfish**						8			50	
	Sculpin unknown	**sculpin unknown**						1	1	1		

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	14b	14b	14b	14b	14b	16a	16a	16a	16a	16a	16b	16b	16b	16b	16b
	OLD Sample ID	14b-01	14b-04	14b-02	14b-05	14b-03	16a-01	16a-04	16a-02	16a-05	16a-03	16b-01	16b-04	16b-02	16b-05	16b-03
	NEW Transect ID	36	36	36	36	36	37	37	37	37	37	38	38	38	38	38
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	36-01	36-02	36-03	36-04	36-05	37-01	37-02	37-03	37-04	37-05	38-01	38-02	38-03	38-04	38-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-11.90	-11.80	-11.40	-11.60	-11.50	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-12.80	-12.50	-12.50
	Depth gauge (ft):						-43	-43	-43	-43	-43	-43	-43	-42	-41	-41
	Tide (m):	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Depth m CD:	-9.5	-9.4	-9.0	-9.2	-9.1	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.3	-10.0	-10.0
Sediment analyses	Sample Date	Oct-19		Oct-19			Oct-20		Oct-20			Oct-20		Oct-20		
	Grab Sample Time															
	WP															
	Sulphide (as H2S)	7.3					0.04					62				
	Ammonia (N)	8.16					5.88					11.7				
	pH	7.83					7.81					7.88				
	Total Sulphide	6.84					0.038					58				
	TOC (0-10cm)			35000					23000					25000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	oct 27					oct 27					oct 27				
	Sample Time	15:34					12:53					12:49				
	WP	048					017					016				
	Temp	10.19					10.15					10.16				
	Conductivity/salinity	31.85					31.91					31.91				
	DO %	78.5					77.4					66.9				
	DO mg/L	7.2					7.1					6.14				
	pH	7.86					7.87					7.84				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	10														
	Bare															
	WW Depth	0		0		0	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-19	Oct-19	Oct-19	Oct-19	Oct-19	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	14b	14b	14b	14b	14b	16a	16a	16a	16a	16a	16b	16b	16b	16b	16b
		OLD Sample ID	14b-01	14b-04	14b-02	14b-05	14b-03	16a-01	16a-04	16a-02	16a-05	16a-03	16b-01	16b-04	16b-02	16b-05	16b-03
		NEW Transect ID	36	36	36	36	36	37	37	37	37	37	38	38	38	38	38
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	36-01	36-02	36-03	36-04	36-05	37-01	37-02	37-03	37-04	37-05	38-01	38-02	38-03	38-04	38-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-11.90	-11.80	-11.40	-11.60	-11.50	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-13.11	-12.80	-12.50	-12.50
		Depth gauge (ft):						-43	-43	-43	-43	-43	-43	-43	-42	-41	-41
		Tide (m):	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
		Depth m CD:	-9.5	-9.4	-9.0	-9.2	-9.1	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.3	-10.0	-10.0
		Probe	30.00	60.00	60.00	10.00	20.00	20.00	0.00	20.00	20.00	20.00	0.00	50.00	20.00	0.00	50.00
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat			10	5	5										
	Diatoms	Diatoms	5	5					80	40	90	90	50	80	30	90	80
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab									1						
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	12a	12a	12a	12a	12a	12b	12b	12b	12b	12b	13a	13a	13a	13a	13a
	OLD Sample ID	12a-01	12a-04	12a-02	12a-05	12a-03	12b-01	12b-04	12b-02	12b-05	12b-03	13a-01	13a-04	13a-02	13a-05	13a-03
	NEW Transect ID	39	39	39	39	39	40	40	40	40	40	41	41	41	41	41
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	39-01	39-02	39-03	39-04	39-05	40-01	40-02	40-03	40-04	40-05	41-01	41-02	41-03	41-04	41-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-8.84	-9.15	-8.84	-8.84	-8.84	-8.84	-8.84	-8.84	-8.54	-8.54	-8.54	-8.54	-8.54	-7.93	-8.54
	Depth gauge (ft):	-29	-30	-29	-29	-29	-29	-29	-29	-28	-28	-28	-28	-28	-26	-28
	Tide (m):	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
	Depth m CD:	-6.5	-6.8	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.2	-6.2	-6.2	-6.2	-6.2	-5.6	-6.2
Sediment analyses	Sample Date			Oct-20		Oct-20			Oct-20		Oct-20	Oct-20		Oct-20		
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					79					66	31				
	Ammonia (N)					11.7					12.3	19.3				
	pH					7.78					7.77	7.67				
	Total Sulphide					74.7					62	28.9				
	TOC (0-10cm)			25000					27000					28000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date					oct 27					oct 27	oct 27				
	Sample Time					15:14					15:10	14:14				
	WP					044					043	032				
	Temp					10.19					10.19	10.15				
	Conductivity/salinity					31.48					29.97	31.85				
	DO %					79.3					82.8	83				
	DO mg/L					7.29					7.69	7.62				
	pH					7.88					7.89	7.91				
Substrate	Silt	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste															
	Bare															
	WW Depth	0		0		0	0		0		0	0.1		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		**Year**	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	12a	12a	12a	12a	12a	12b	12b	12b	12b	12b	13a	13a	13a	13a	13a
		OLD Sample ID	12a-01	12a-04	12a-02	12a-05	12a-03	12b-01	12b-04	12b-02	12b-05	12b-03	13a-01	13a-04	13a-02	13a-05	13a-03
		NEW Transect ID	39	39	39	39	39	40	40	40	40	40	41	41	41	41	41
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	39-01	39-02	39-03	39-04	39-05	40-01	40-02	40-03	40-04	40-05	41-01	41-02	41-03	41-04	41-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-8.84	-9.15	-8.84	-8.84	-8.84	-8.84	-8.84	-8.84	-8.54	-8.54	-8.54	-8.54	-8.54	-7.93	-8.54
		Depth gauge (ft):	-29	-30	-29	-29	-29	-29	-29	-29	-28	-28	-28	-28	-28	-26	-28
		Tide (m):	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
		Depth m CD:	-6.5	-6.8	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-6.2	-6.2	-6.2	-6.2	-6.2	-5.6	-6.2
		Probe	30.00	20.00	40.00	30.00	40.00	50.00	30.00	30.00	40.00	40.00					
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat	60	70	60	60	60	60	70	70	50	50	50	50	50	50	50
	Diatoms	Diatoms	40	30	40	40	40	40	30	30	50	50	50	50	50	50	50
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab			1											1	
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
Transect Sampling Information	Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
	Field Survey #	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	13b	13b	13b	13b	13b	17a	17a	17a	17a	17a
	OLD Sample ID	13b-01	13b-04	13b-02	13b-05	13b-03	17a-01	17a-04	17a-02	17a-05	17a-03
	NEW Transect ID	42	42	42	42	42	43	43	43	43	43
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	42-01	42-02	42-03	42-04	42-05	43-01	43-02	43-03	43-04	43-05
	Point ID	1	4	2	5	3					
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-8.54	-85.28	-9.45	-98.40	-9.45	-12.80	-13.72	-13.11	-13.41	-12.80
	Depth gauge (ft):	-28	-26	-31	-30	-31	-42	-45	-43	-44	-42
	Tide (m):	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-6.2	-83.0	-7.2	-96.1	-7.2	-10.4	-11.3	-10.7	-11.0	-10.4
Sediment analyses	Sample Date	Oct-20		Oct-20			Oct-21				Oct-21
	Grab Sample Time										
	WP										
	Sulphide (as H2S)	23					11				
	Ammonia (N)	18.7					20.1				
	pH	7.7					7.75				
	Total Sulphide	21.4					10.2				
	TOC (0-10cm)			33000							22000
	TOC (20-40cm)										
	TOC (30-40cm)										
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments										
YSI Sampling	Sample Date	oct 27					Oct 27				
	Sample Time	14:09					12:44				
	WP	031					015				
	Temp	10.16					10.15				
	Conductivity/salinity	31.9					30.88				
	DO %	58.7					68.9				
	DO mg/L	5.39					6.37				
	pH	7.86					7.85				
Substrate	Silt	100	100	100	100	100	100	90	100	90	90
	Sand										
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste							10		10	10
	Bare										
	WW Depth	0		0.3		0.3	0.2		0		0
	WW State	closed		closed		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-20	Oct-20	Oct-20	Oct-20	Oct-20	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
		Field Survey #	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	13b	13b	13b	13b	13b	17a	17a	17a	17a	17a
		OLD Sample ID	13b-01	13b-04	13b-02	13b-05	13b-03	17a-01	17a-04	17a-02	17a-05	17a-03
		NEW Transect ID	42	42	42	42	42	43	43	43	43	43
		Point	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	42-01	42-02	42-03	42-04	42-05	43-01	43-02	43-03	43-04	43-05
		Point ID	1	4	2	5	3					
		Distance	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-8.54	-85.28	-9.45	-98.40	-9.45	-12.80	-13.72	-13.11	-13.41	-12.80
		Depth gauge (ft):	-28	-26	-31	-30	-31	-42	-45	-43	-44	-42
		Tide (m):	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-6.2	-83.0	-7.2	-96.1	-7.2	-10.4	-11.3	-10.7	-11.0	-10.4
		Probe						0.00	0.00	0.00	0.00	0.00
Biological	Kelp detritus	Kelp detritus										
	Beggatoa spp.	bacterial mat	50	50	50	50	50					
	Diatoms	Diatoms	50	50	50	50	50	80	80	90	80	80
	Agarum fimbriatum	fringed sieve kelp										
	Coralline crust spp.	pink encrusting coralline seaweed										
	Desmerasria viridis	Stringy acid hair										
	Gracilaria											
	Red blade	red blade										
	Red branched	Red branched										
	Red filamentous	red filamentous										
	Sacharina latissima	sugar kelp		30				10	10			
	Sacharina groenlandica	split kelp										
	Sarcodietheca gaudichaudii	succulent seaweed										
	Ulva lactuca	sea lettuce						10		10		
	Holes											
	Mounds											
	Balanus glandula	acorn barnacle										
	Cancer productus	red rock crab										
	Dirona											
	Metacarcinus gracilis	graceful rock crab										
	Metacarcinus magister	Dungeness crab								1		
	Metridium farcimen	giant plumose anemone										
	Metridium senile	short plumose anemone				2						
	Pagurus sp.	hermit crab						1		1		
	Pandalus danae	coon striped shrimp				3				1	15	
	Pandalus platyceros	spot prawn										
	Pandalus unknown	Pandalus unknown										
	Parastichopus californicus	red sea cucumber										
	Pisaster ochraceaus	Ochre sea star										
	Pugetia productus	kelp crab										
	shrimp species	shrimp species										
	Stronglyocentrotus franciscanus	red urchin										
	Styela montereyensis	stalked tunicate										
	Tresus sp.	gaper clams										
	Urticina unknown	Anemone unknown										
		Tunicate										
	Aulorhynchus flavidus	Tube snout										
	Citharichthys stigmaeus	speckled sand dab										
	Clupea pallasii	Pacific herring										
	Lumpenus sagitta	Smanke prickleback										
	Platichthys stellatus	starry flounder										
	Pleuronichthys coenosus	C-O sole										
	Sebastes spp. YOY	young of the year rockfish										
	Sculpin unknown	sculpin unknown										

Transect Sampling Information	Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
	Transect Survey Date	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
	Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	OLD Transect ID	17b	17b	17b	17b	17b	18a	18a	18a	18a	18a	18b	18b	18b	18b	18b
	OLD Sample ID	17b-01	17b-04	17b-02	17b-05	17b-03	18a-01	18a-04	18a-02	18a-05	18a-03	18b-01	18b-04	18b-02	18b-05	18b-03
	NEW Transect ID	44	44	44	44	44	45	45	45	45	45	46	46	46	46	46
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	44-01	44-02	44-03	44-04	44-05	45-01	45-02	45-03	45-04	45-05	46-01	46-02	46-03	46-04	46-05
	Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-13.41	-13.11	-13.41	-13.11	-13.41	-5.49	-7.62	-11.59	-11.89	-12.80	-13.72	-14.02	-14.02	-13.72	-13.72
	Depth gauge (ft):	-44	-43	-44	-43	-44	-18	-25	-38	-39	-42	-45	-46	-46	-45	-45
	Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	Depth m CD:	-11.0	-10.7	-11.0	-10.7	-11.0	-3.1	-5.2	-9.2	-9.5	-10.4	-11.3	-11.6	-11.6	-11.3	-11.3
Sediment analyses	Sample Date	Oct-21				Oct-21			Oct-21		Oct-21			Oct-21		Oct-21
	Grab Sample Time															
	WP															
	Sulphide (as H2S)	0.22									1.1					0.021
	Ammonia (N)	8.63									5.95					10
	pH	7.83									7.97					7.88
	Total Sulphide	0.211									1.05					0.02
	TOC (0-10cm)					15000			13000					18000		
	TOC (20-40cm)															
	TOC (30-40cm)															
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date	Oct 27		Oct 27					Oct 27					Oct 27		
	Sample Time	12:39		12:34					12:24					12:27		
	WP	014		013					011					012		
	Temp	10.13		10.16					10.13					10.13		
	Conductivity/salinity	31.86		31.92					31.88					31.9		
	DO %	77.9		73.3					73					74.9		
	DO mg/L	7.16		6.72					6.67					6.87		
	pH	7.88		7.85					7.84					7.87		
Substrate	Silt	90	90	100	100	100			80	100	100		100	100	100	100
	Sand						20									
	Gravel						50	20	20							
	Cobble						30	30								
	Boulder															
	Bedrock							50								
	Shell															
	Wood waste	10	10													
	Bare															
	WW Depth	0		0		0	0		0.3		0	0		0		0
	WW State	closed		closed		closed	closed		open		closed	closed		closed		closed

Transect Sampling Information		Year	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
		Transect Survey Date	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21	Oct-21
		Field Survey #	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		OLD Transect ID	17b	17b	17b	17b	17b	18a	18a	18a	18a	18a	18b	18b	18b	18b	18b
		OLD Sample ID	17b-01	17b-04	17b-02	17b-05	17b-03	18a-01	18a-04	18a-02	18a-05	18a-03	18b-01	18b-04	18b-02	18b-05	18b-03
		NEW Transect ID	44	44	44	44	44	45	45	45	45	45	46	46	46	46	46
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	44-01	44-02	44-03	44-04	44-05	45-01	45-02	45-03	45-04	45-05	46-01	46-02	46-03	46-04	46-05
		Point ID	1	4	2	5	3	1	4	2	5	3	1	4	2	5	3
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-13.41	-13.11	-13.41	-13.11	-13.41	-5.49	-7.62	-11.59	-11.89	-12.80	-13.72	-14.02	-14.02	-13.72	-13.72
		Depth gauge (ft):	-44	-43	-44	-43	-44	-18	-25	-38	-39	-42	-45	-46	-46	-45	-45
		Tide (m):	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
		Depth m CD:	-11.0	-10.7	-11.0	-10.7	-11.0	-3.1	-5.2	-9.2	-9.5	-10.4	-11.3	-11.6	-11.6	-11.3	-11.3
		Probe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	50.00	60.00	50.00	0.00	0.00	0.00	0.00
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	80	80	80	80	70					30	40	40	40	40	40
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria							30	10								
	Red blade	red blade									5						
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp							10		20		20		10		
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed								20							
	Ulva lactuca	sea lettuce							10	10							
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab						1	1								
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab										2					
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn		4	5			12	25	12				5			
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams									3						
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout								1							
	Citharichthys stigmaeus	speckled sand dab												1			
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish								4							
	Sculpin unknown	sculpin unknown															

	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
Transect Sampling Information	Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24
	Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	47	47	47	47	47	48	48	48	48	48	49	49	49	49	49
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	47-01	47-02	47-03	47-04	47-05	48-01	48-02	48-03	48-04	48-05	49-01	49-02	49-03	49-04	49-05
	Point ID															
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-4.88	-5.18	-5.49	-5.49	-5.18	-5.18	-5.18	-5.49	-5.49	-5.49	-12.20	-11.59	-10.98	-10.98	-10.98
	Depth gauge (ft):	-16	-17	-18	-18	-17	-17	-17	-18	-18	-18	-40	-38	-36	-36	-36
	Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.8	2.8	2.8	2.8	2.8
	Depth m CD:	-2.7	-3.0	-3.3	-3.3	-3.0	-3.0	-3.0	-3.3	-3.3	-3.3	-9.4	-8.8	-8.2	-8.2	-8.2
Sediment analyses	Sample Date	Jan-24		Jan-24		Jan-24	Jan-24		Jan-24		Jan-24	Jan-24		Jan-24		Jan-24
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					0.13					0.008					0.007
	Ammonia (N)					16.1					12.4					11.2
	pH					7.42					7.58					7.59
	Total Sulphide					0.122					0.0078					0.0067
	TOC (0-10cm)	44000		19000			58000		61000			26000		14000		
	TOC (20-40cm)															
	TOC (30-40cm)	17000		11000		9200	26000		12000		12000	13000		10000		11000
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date															
	Sample Time															
	WP															
	Temp															
	Conductivity/salinity															
	DO %															
	DO mg/L															
	pH															
Substrate	Silt	50	80	100	100	100	100	70	80	70	90	100	100	100	100	100
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	50	20					30	20	30	10					
	Bare															
	WW Depth	0		0.1		0	0.3		0.3		0.2	0		0		0
	WW State	closed		closed		closed	closed		closed		closed	closed		closed		closed

Transect Sampling Information		**Year**	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
		Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24
		Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	47	47	47	47	47	48	48	48	48	48	49	49	49	49	49
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	47-01	47-02	47-03	47-04	47-05	48-01	48-02	48-03	48-04	48-05	49-01	49-02	49-03	49-04	49-05
		Point ID															
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-4.88	-5.18	-5.49	-5.49	-5.18	-5.18	-5.18	-5.49	-5.49	-5.49	-12.20	-11.59	-10.98	-10.98	-10.98
		Depth gauge (ft):	-16	-17	-18	-18	-17	-17	-17	-18	-18	-18	-40	-38	-36	-36	-36
		Tide (m):	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.8	2.8	2.8	2.8	2.8
		Depth m CD:	-2.7	-3.0	-3.3	-3.3	-3.0	-3.0	-3.0	-3.3	-3.3	-3.3	-9.4	-8.8	-8.2	-8.2	-8.2
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat															
	Diatoms	Diatoms	90	90	90	95	95	20	20	20	10	10	90	90	90	90	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp		10													
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes												7				
	Mounds																
	Balanus glandula	acorn barnacle											5				
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab															
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone								3							
	Pagurus sp.	hermit crab															
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown												2	3	4	
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Section	Parameter										
Transect Sampling Information	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
	Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
	Field Survey #	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	50	50	50	50	50	51	51	51	51	51
	Point	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	50-01	50-02	50-03	50-04	50-05	51-01	51-02	51-03	51-04	51-05
	Point ID										
	Distance	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-11.28	-11.28	-10.98	-11.28	-11.28	-10.37	-10.98	-10.98	-10.98	-10.98
	Depth gauge (ft):	-37	-37	-36	-37	-37	-34	-36	-36	-36	-36
	Tide (m):	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
	Depth m CD:	-8.5	-8.5	-8.2	-8.5	-8.5	-7.6	-8.2	-8.2	-8.2	-8.2
Sediment analyses	Sample Date	Jan-24		Jan-24		Jan-24	Jan-25		Jan-25		Jan-25
	Grab Sample Time										
	WP										
	Sulphide (as H2S)					0.011					0.048
	Ammonia (N)					14					15.5
	pH					7.56					7.75
	Total Sulphide					0.01					0.0449
	TOC (0-10cm)	24000		24000			24000		28000		
	TOC (20-40cm)										
	TOC (30-40cm)	14000		14000		17000	18000		16000		16000
	Moisture										
	Available (KCl) Ammonia (N) (AVS)										
	Soluble (2:1) pH (AVS)										
	Sulphide (AVS)										
	Grab Sampling Comments										
YSI Sampling	Sample Date										
	Sample Time										
	WP										
	Temp										
	Conductivity/salinity										
	DO %										
	DO mg/L										
	pH										
Substrate	Silt	100	100	100	100	100	100	100	100	100	100
	Sand										
	Gravel										
	Cobble										
	Boulder										
	Bedrock										
	Shell										
	Wood waste										
	Bare										
	WW Depth	0		0		0	0		0		0
	WW State	closed		closed		closed	closed		closed		closed

Transect Sampling Information		**Year**	**2017**	**2017**	**2017**	**2017**	**2017**	**2017**	**2017**	**2017**	**2017**	**2017**
		Transect Survey Date	**Jan-24**	**Jan-24**	**Jan-24**	**Jan-24**	**Jan-24**	**Jan-25**	**Jan-25**	**Jan-25**	**Jan-25**	**Jan-25**
		Field Survey #	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
		OLD Transect ID	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
		OLD Sample ID	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
		NEW Transect ID	**50**	**50**	**50**	**50**	**50**	**51**	**51**	**51**	**51**	**51**
		Point	**01**	**02**	**03**	**04**	**05**	**01**	**02**	**03**	**04**	**05**
		NEW Sample ID	**50-01**	**50-02**	**50-03**	**50-04**	**50-05**	**51-01**	**51-02**	**51-03**	**51-04**	**51-05**
		Point ID										
		Distance	**0**	**25**	**50**	**75**	**100**	**0**	**25**	**50**	**75**	**100**
		Depth gauge (m):	**-11.28**	**-11.28**	**-10.98**	**-11.28**	**-11.28**	**-10.37**	**-10.98**	**-10.98**	**-10.98**	**-10.98**
		Depth gauge (ft):	**-37**	**-37**	**-36**	**-37**	**-37**	**-34**	**-36**	**-36**	**-36**	**-36**
		Tide (m):	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**
		Depth m CD:	**-8.5**	**-8.5**	**-8.2**	**-8.5**	**-8.5**	**-7.6**	**-8.2**	**-8.2**	**-8.2**	**-8.2**
		Probe										
Biological	Kelp detritus	**Kelp detritus**										
	Beggatoa spp.	**bacterial mat**										
	Diatoms	**Diatoms**	90	90	90	80	90	90	90	80	80	80
	Agarum fimbriatum	**fringed sieve kelp**										
	Coralline crust spp.	**pink encrusting coralline seaweed**										
	Desmerasria viridis	**Stringy acid hair**										
	Gracilaria											
	Red blade	**red blade**										
	Red branched	**Red branched**										
	Red filamentous	**red filamentous**										
	Sacharina latissima	**sugar kelp**										
	Sacharina groenlandica	**split kelp**										
	Sarcodietheca gaudichaudii	**succulent seaweed**										
	Ulva lactuca	**sea lettuce**										
	Holes										2	2
	Mounds											
	Balanus glandula	**acorn barnacle**										
	Cancer productus	**red rock crab**										
	Dirona											
	Metacarcinus gracilis	**graceful rock crab**										
	Metacarcinus magister	**Dungeness crab**										
	Metridium farcimen	**giant plumose anemone**										
	Metridium senile	**short plumose anemone**										
	Pagurus sp.	**hermit crab**										
	Pandalus danae	**coon striped shrimp**										
	Pandalus platyceros	**spot prawn**										
	Pandalus unknown	**Pandalus unknown**			12	2					1	
	Parastichopus californicus	**red sea cucumber**										
	Pisaster ochraceaus	**Ochre sea star**										
	Pugetia productus	**kelp crab**										
	shrimp species	**shrimp species**										
	Stronglyocentrotus franciscanus	**red urchin**										
	Styela montereyensis	**stalked tunicate**										
	Tresus sp.	**gaper clams**										
	Urticina unknown	**Anemone unknown**										
		Tunicate										
	Aulorhynchus flavidus	**Tube snout**										
	Citharichthys stigmaeus	**speckled sand dab**										
	Clupea pallasii	**Pacific herring**										
	Lumpenus sagitta	**Smanke prickleback**										
	Platichthys stellatus	**starry flounder**										
	Pleuronichthys coenosus	**C-O sole**										
	Sebastes spp. YOY	**young of the year rockfish**										
	Sculpin unknown	**sculpin unknown**										

Transect Sampling Information	Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
	Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23
	Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	52	52	52	52	52	53	53	53	53	53	54	54	54	54	54
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	52-01	52-02	52-03	52-04	52-05	53-01	53-02	53-03	53-04	53-05	54-01	54-02	54-03	54-04	54-05
	Point ID															
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-10.67	-10.67	-10.67	-10.67	-10.37	-12.20	-12.20	-12.20	-12.20	-12.20	-12.20	-12.80	-12.20	-12.20	-11.89
	Depth gauge (ft):	-35	-35	-35	-35	-34	-40	-40	-40	-40	-40	-40	-42	-40	-40	-39
	Tide (m):	2.8	2.8	2.8	2.8	2.8	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	Depth m CD:	-7.9	-7.9	-7.9	-7.9	-7.6	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.6	-10.0	-10.0	-9.7
Sediment analyses	Sample Date	Jan-25		Jan-25		Jan-25	Jan-23		Jan-23		Jan-23	Jan-23		Jan-23		Jan-23
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					0.008					0.011					0.008
	Ammonia (N)					14.8					11.6					12.5
	pH					7.48					7.57					7.12
	Total Sulphide					0.0075					0.01					0.0077
	TOC (0-10cm)	55000		64000			25000		30000			38000		53000		
	TOC (20-40cm)															
	TOC (30-40cm)	19000		16000		19000	14000		18000		17000	16000		24000		140000
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	Sample Date															
	Sample Time															
	WP															
	Temp															
	Conductivity/salinity															
	DO %															
	DO mg/L															
	pH															
Substrate	Silt	70	90	60	20	90	100	70	100	1000	100	90	70	90	80	70
	Sand															
	Gravel															
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	30	10	40	80	10		30				10	30	10	20	30
	Bare															
	WW Depth	0.2		0.2		0.3	0		0		0	0.2		0.5		0.5
	WW State	closed		closed		closed	closed		closed		closed	closed		open		open

Transect Sampling Information		Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
		Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23	Jan-23
		Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	52	52	52	52	52	53	53	53	53	53	54	54	54	54	54
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	52-01	52-02	52-03	52-04	52-05	53-01	53-02	53-03	53-04	53-05	54-01	54-02	54-03	54-04	54-05
		Point ID															
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-10.67	-10.67	-10.67	-10.67	-10.37	-12.20	-12.20	-12.20	-12.20	-12.20	-12.20	-12.80	-12.20	-12.20	-11.89
		Depth gauge (ft):	-35	-35	-35	-35	-34	-40	-40	-40	-40	-40	-40	-42	-40	-40	-39
		Tide (m):	2.8	2.8	2.8	2.8	2.8	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
		Depth m CD:	-7.9	-7.9	-7.9	-7.9	-7.6	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.6	-10.0	-10.0	-9.7
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat			5	5											
	Diatoms	Diatoms	50	70	80	50	80	90	90	90	90	90	90	90	80	90	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade															
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes																
	Mounds																
	Balanus glandula	acorn barnacle															
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab														1	
	Metacarcinus magister	Dungeness crab		1													
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone															
	Pagurus sp.	hermit crab															1
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	**Year**	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
	Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
	Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	NEW Transect ID	55	55	55	55	55	56	56	56	56	56	57	57	57	57	57
	Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
	NEW Sample ID	55-01	55-02	55-03	55-04	55-05	56-01	56-02	56-03	56-04	56-05	57-01	57-02	57-03	57-04	57-05
	Point ID															
	Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
	Depth gauge (m):	-10.06	-9.76	8.84	-8.84	-9.15	-9.45	-10.06	-9.76	-9.45	-9.15	-4.88	-4.57	-3.96	-4.88	-5.18
	Depth gauge (ft):	-33	-32	29	-29	-30	-31	-33	-32	-31	-30	-16	-15	-13	-16	-17
	Tide (m):	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.8
	Depth m CD:	-7.4	-7.1	11.5	-6.1	-6.4	-6.8	-7.4	-7.1	-6.8	-6.4	-2.1	-1.8	-1.2	-2.1	-2.4
Sediment analyses	**Sample Date**	Jan-24		Jan-24		Jan-24	Jan-24		Jan-24		Jan-24	Jan-25		Jan-25		Jan-25
	Grab Sample Time															
	WP															
	Sulphide (as H2S)					1.5					0.042					0.006
	Ammonia (N)					25.8					23.9					12.1
	pH					7.3					7.15					7.83
	Total Sulphide					1.38					0.0399					0.0095
	TOC (0-10cm)	140000		120000			140000		120000			190000		150000		
	TOC (20-40cm)															
	TOC (30-40cm)	160000					170000		75000		140000					1500
	Moisture															
	Available (KCl) Ammonia (N) (AVS)															
	Soluble (2:1) pH (AVS)															
	Sulphide (AVS)															
	Grab Sampling Comments															
YSI Sampling	**Sample Date**															
	Sample Time															
	WP															
	Temp															
	Conductivity/salinity															
	DO %															
	DO mg/L															
	pH															
Substrate	**Silt**		40	10	30	10	100	100	100	60	20					20
	Sand															40
	Gravel															40
	Cobble															
	Boulder															
	Bedrock															
	Shell															
	Wood waste	100	60	90	70	90				40	80	100	100	90	90	
	Bare															
	WW Depth	0.5		0.1		0.1	0.4		0.4		0.4	0.3		0.3		0
	WW State	open		open		open	open		open		open	open		open		closed

Transect Sampling Information		Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
		Transect Survey Date	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-24	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25
		Field Survey #	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		NEW Transect ID	55	55	55	55	55	56	56	56	56	56	57	57	57	57	57
		Point	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
		NEW Sample ID	55-01	55-02	55-03	55-04	55-05	56-01	56-02	56-03	56-04	56-05	57-01	57-02	57-03	57-04	57-05
		Point ID															
		Distance	0	25	50	75	100	0	25	50	75	100	0	25	50	75	100
		Depth gauge (m):	-10.06	-9.76	8.84	-8.84	-9.15	-9.45	-10.06	-9.76	-9.45	-9.15	-4.88	-4.57	-3.96	-4.88	-5.18
		Depth gauge (ft):	-33	-32	29	-29	-30	-31	-33	-32	-31	-30	-16	-15	-13	-16	-17
		Tide (m):	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.8
		Depth m CD:	-7.4	-7.1	11.5	-6.1	-6.4	-6.8	-7.4	-7.1	-6.8	-6.4	-2.1	-1.8	-1.2	-2.1	-2.4
		Probe															
Biological	Kelp detritus	Kelp detritus															
	Beggatoa spp.	bacterial mat		10			5		30	50				30			
	Diatoms	Diatoms	90	90	80	90	80	90	60	50	70	60	60	50	50	70	90
	Agarum fimbriatum	fringed sieve kelp															
	Coralline crust spp.	pink encrusting coralline seaweed															
	Desmerasria viridis	Stringy acid hair															
	Gracilaria																
	Red blade	red blade				5											
	Red branched	Red branched															
	Red filamentous	red filamentous															
	Sacharina latissima	sugar kelp															
	Sacharina groenlandica	split kelp															
	Sarcodietheca gaudichaudii	succulent seaweed															
	Ulva lactuca	sea lettuce															
	Holes							2									
	Mounds																
	Balanus glandula	acorn barnacle												10			
	Cancer productus	red rock crab															
	Dirona																
	Metacarcinus gracilis	graceful rock crab			1												
	Metacarcinus magister	Dungeness crab															
	Metridium farcimen	giant plumose anemone															
	Metridium senile	short plumose anemone											3		8		
	Pagurus sp.	hermit crab											1				
	Pandalus danae	coon striped shrimp															
	Pandalus platyceros	spot prawn															
	Pandalus unknown	Pandalus unknown															
	Parastichopus californicus	red sea cucumber															
	Pisaster ochraceaus	Ochre sea star															
	Pugetia productus	kelp crab															
	shrimp species	shrimp species															
	Stronglyocentrotus franciscanus	red urchin															
	Styela montereyensis	stalked tunicate															
	Tresus sp.	gaper clams															
	Urticina unknown	Anemone unknown															
		Tunicate															
	Aulorhynchus flavidus	Tube snout															
	Citharichthys stigmaeus	speckled sand dab															
	Clupea pallasii	Pacific herring															
	Lumpenus sagitta	Smanke prickleback															
	Platichthys stellatus	starry flounder															
	Pleuronichthys coenosus	C-O sole															
	Sebastes spp. YOY	young of the year rockfish															
	Sculpin unknown	sculpin unknown															

Transect Sampling Information	Year	2017	2017	2017	2017	2017	error check
	Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	1
	Field Survey #	4	4	4	4	4	1
	OLD Transect ID	n/a	n/a	n/a	n/a	n/a	1
	OLD Sample ID	n/a	n/a	n/a	n/a	n/a	1
	NEW Transect ID	58	58	58	58	58	1
	Point	01	02	03	04	05	1
	NEW Sample ID	58-01	58-02	58-03	58-04	58-05	1
	Point ID						
	Distance	0	25	50	75	100	1
	Depth gauge (m):	-3.66	-2.44	-1.83	-2.13	-2.44	1.00
	Depth gauge (ft):	-12	-8	-6	-7	-8	1
	Tide (m):	2.8	2.8	2.8	2.8	2.8	1.0
	Depth m CD:	-0.9	0.4	1.0	0.7	0.4	1
Sediment analyses	Sample Date	Jan-25		Jan-25		Jan-25	1.00
	Grab Sample Time						1.00
	WP						1.00
	Sulphide (as H2S)					0.01	1.00
	Ammonia (N)					3.6	1.00
	pH					7.37	1.00
	Total Sulphide					0.0095	1.00
	TOC (0-10cm)	49000		37000			1.00
	TOC (20-40cm)						
	TOC (30-40cm)			22000		17000	
	Moisture						1.00
	Available (KCl) Ammonia (N) (AVS)						1.00
	Soluble (2:1) pH (AVS)						1.00
	Sulphide (AVS)						1.00
	Grab Sampling Comments						1.00
YSI Sampling	Sample Date						1.00
	Sample Time						1.00
	WP						1.00
	Temp						1.00
	Conductivity/salinity						1.00
	DO %						1.00
	DO mg/L						1.00
	pH						1.00
Substrate	Silt	100			40	100	1.00
	Sand		50	50			1.00
	Gravel		50	50			1.00
	Cobble						1.00
	Boulder						1.00
	Bedrock						1.00
	Shell						1.00
	Wood waste				60		1.00
	Bare						1.00
	WW Depth	0		0.4		0.35	
	WW State	closed		closed		closed	

Transect Sampling Information		Year	2017	2017	2017	2017	2017	error check
		Transect Survey Date	Jan-25	Jan-25	Jan-25	Jan-25	Jan-25	1
		Field Survey #	4	4	4	4	4	1
		OLD Transect ID	n/a	n/a	n/a	n/a	n/a	1
		OLD Sample ID	n/a	n/a	n/a	n/a	n/a	1
		NEW Transect ID	58	58	58	58	58	1
		Point	01	02	03	04	05	1
		NEW Sample ID	58-01	58-02	58-03	58-04	58-05	1
		Point ID						
		Distance	0	25	50	75	100	1
		Depth gauge (m):	-3.66	-2.44	-1.83	-2.13	-2.44	1.00
		Depth gauge (ft):	-12	-8	-6	-7	-8	1
		Tide (m):	2.8	2.8	2.8	2.8	2.8	1.0
		Depth m CD:	-0.9	0.4	1.0	0.7	0.4	1
		Probe						1.00
Biological	Kelp detritus	Kelp detritus						1.00
	Beggatoa spp.	bacterial mat						7128
	Diatoms	Diatoms	90	70	30	90	90	12277
	Agarum fimbriatum	fringed sieve kelp						60
	Coralline crust spp.	pink encrusting coralline seaweed						10
	Desmerasria viridis	Stringy acid hair						18
	Gracilaria							40
	Red blade	red blade						17
	Red branched	Red branched						1
	Red filamentous	red filamentous						10
	Sacharina latissima	sugar kelp						1549
	Sacharina groenlandica	split kelp						682
	Sarcodietheca gaudichaudii	succulent seaweed						203
	Ulva lactuca	sea lettuce						125.5
	Holes							66
	Mounds							6.5
	Balanus glandula	acorn barnacle						65
	Cancer productus	red rock crab		1				7.5
	Dirona							1
	Metacarcinus gracilis	graceful rock crab						23
	Metacarcinus magister	Dungeness crab						13
	Metridium farcimen	giant plumose anemone						60.5
	Metridium senile	short plumose anemone						22
	Pagurus sp.	hermit crab						7
	Pandalus danae	coon striped shrimp						43
	Pandalus platyceros	spot prawn						109
	Pandalus unknown	Pandalus unknown						114
	Parastichopus californicus	red sea cucumber						2
	Pisaster ochraceaus	Ochre sea star						1
	Pugetia productus	kelp crab						7
	shrimp species	shrimp species						5
	Stronglyocentrotus franciscanus	red urchin						4
	Styela montereyensis	stalked tunicate						5
	Tresus sp.	gaper clams					1	4
	Urticina unknown	Anemone unknown						1
		Tunicate						1
	Aulorhynchus flavidus	Tube snout						3
	Citharichthys stigmaeus	speckled sand dab						1
	Clupea pallasii	Pacific herring						30
	Lumpenus sagitta	Smanke prickleback						2
	Platichthys stellatus	starry flounder						1
	Pleuronichthys coenosus	C-O sole						1
	Sebastes spp. YOY	young of the year rockfish						136
	Sculpin unknown	sculpin unknown						8

biologica

Abundance data in matrix format, including total taxa (species richness) count per sample, and total abundance per sample for Hemmera Esquimalt Harbour 2017.

Biologica Sample #				Grand Total	17-033-001	17-033-002	17-033-003	17-033-004	17-033-005	17-033-006	17-033-011	17-033-012	17-033-013	17-033-014	17-033-015	17-033-016	17-033-017	17-033-018
Client Sample #					04-05	04-05	07-03	07-03	12-03	12-03	15-01	15-01	41-03	41-03	43-05	43-05	45-03	45-03
Replicate					Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02
Date Sampled					07/03/2017								08/03/2017	08/03/2017				
Debris Volume					High	High	High	High	Standard	High	Standard	Standard	Standard	Standard	Standard	Standard	High	High
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	ANOL	Naididae	Paranais litoralis	2												1		
ANNE	ANOL	Naididae	Tectidrilus sp.	389	16	106	96	122										46
ANNE	POER	Dorvilleidae	Schistomeringos annulata	11	4	2	4							1				
ANNE	POER	Dorvilleidae	Schistomeringos longicornis	11				3		2								
ANNE	POER	Dorvilleidae	Schistomeringos sp.	24		18											6	
ANNE	POER	Glyceridae	Glycera americana	1											1			
ANNE	POER	Goniadidae	Glycinde picta	84	5	3	2	3	2	2	3	1		2	4	8	8	4
ANNE	POER	Goniadidae	Glycinde sp.	49		4		5		2				2	4	6		
ANNE	POER	Hesionidae	Micropodarke dubia	4		2	2											
ANNE	POER	Hesionidae	Oxydromus pugettensis	6	4												2	
ANNE	POER	Hesionidae	Podarkeopsis glabrus	63	2	16	10	8						2	1	1		
ANNE	POER	Hesionidae	Podarkeopsis perkinsi	1									1					
ANNE	POER	Hesionidae	Podarkeopsis sp.	2						2								
ANNE	POER	Lumbrineridae	Lumbrineridae indet.	2			2											
ANNE	POER	Lumbrineridae	Lumbrineris californiensis	8														8
ANNE	POER	Lumbrineridae	Scoletoma tetraura complex	1,016		2									181	237		4
ANNE	POER	Nephtyidae	Bipalponephtys cornuta	11									1		1			
ANNE	POER	Nephtyidae	Nephtys punctata	1												1		
ANNE	POER	Nereididae	Alitta virens	1				1										
ANNE	POER	Nereididae	Nereis procera	13			8	4										
ANNE	POER	Nereididae	Platynereis bicanaliculata	127	2		24	38									58	3
ANNE	POER	Onuphidae	Onuphidae indet.	1				1										
ANNE	POER	Onuphidae	Onuphis sp.	2														2
ANNE	POER	Pholoidae	Pholoe minuta	1														
ANNE	POER	Phyllodocidae	Eteone californica	1				1										
ANNE	POER	Phyllodocidae	Eteone longa complex	1														
ANNE	POER	Phyllodocidae	Eteone sp.	1				1										
ANNE	POER	Phyllodocidae	Eteone tuberculata	6				1		2								
ANNE	POER	Phyllodocidae	Eumida longicornuta	2	2													
ANNE	POER	Phyllodocidae	Phyllodoce hartmanae	1											1			
ANNE	POER	Polynoidae	Gattyana cirrhosa	1														
ANNE	POER	Polynoidae	Harmothoe imbricata	1				1										
ANNE	POER	Polynoidae	Hesperonoe adventor	1		1												
ANNE	POER	Polynoidae	Tenonia priops	2														
ANNE	POER	Sphaerodoridae	Sphaerodoropsis sphaerulifer	2														
ANNE	POER	Syllidae	Brania sp.	1				1										
ANNE	POER	Syllidae	Exogone dwisula	32	2	22	2	2								2		
ANNE	POER	Syllidae	Syllis cornuta	1											1			
ANNE	POSE	Ampharetidae	Ampharete labrops	390	8	18	148	186			4	4	1	3	1		4	8
ANNE	POSE	Ampharetidae	Ampharete lineata	1														
ANNE	POSE	Ampharetidae	Ampharetidae indet.	1												1		
ANNE	POSE	Capitellidae	Capitella capitata complex	132		2	2		16	14	1	3	11	9			14	14
ANNE	POSE	Capitellidae	Heteromastus filobranchus	31											9	8		
ANNE	POSE	Capitellidae	Mediomastus ambiseta	2														2
ANNE	POSE	Capitellidae	Mediomastus californiensis	36		4	4	8									4	16
ANNE	POSE	Chaetopteridae	Spiochaetopterus costarum complex	6														2
ANNE	POSE	Cirratulidae	Aphelochaeta glandaria complex	2,088				1		2	1				431	440		20
ANNE	POSE	Cirratulidae	Aphelochaeta monilaris	330		2									45	66		
ANNE	POSE	Cirratulidae	Aphelochaeta sp.	59								1						
ANNE	POSE	Cirratulidae	Chaetozone setosa complex	205								1			42	42		47
ANNE	POSE	Cirratulidae	Cirratulidae indet.	2										2				
ANNE	POSE	Cirratulidae	Kirkegaardia sp.	4		4												
ANNE	POSE	Cossuridae	Cossura pygodactylata	19											1	8		
ANNE	POSE	Magelonidae	Magelona longicornis	2														
ANNE	POSE	Maldanidae	Euclymene sp. nr. zonalis	59											6	16		2
ANNE	POSE	Maldanidae	Praxillella pacifica	2														

Biologica Sample #				Grand Total	17-033-001	17-033-002	17-033-003	17-033-004	17-033-005	17-033-006	17-033-011	17-033-012	17-033-013	17-033-014	17-033-015	17-033-016	17-033-017	17-033-018
Client Sample #					04-05	04-05	07-03	07-03	12-03	12-03	15-01	15-01	41-03	41-03	43-05	43-05	45-03	45-03
Replicate					Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02
Date Sampled					07/03/2017								08/03/2017	08/03/2017				
Debris Volume					High	High	High	High	Standard	High	Standard	Standard	Standard	Standard	Standard	Standard	High	High
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	POSE	Opheliidae	Armandia brevis	2,646	102	28	18	16	168	348	65	32	206	136	1	1	52	32
ANNE	POSE	Opheliidae	Ophelina acuminata	3											1	1		
ANNE	POSE	Orbiniidae	Leitoscoloplos pugettensis	1											1			
ANNE	POSE	Orbiniidae	Scoloplos acmeceps	6													2	4
ANNE	POSE	Oweniidae	Galathowenia oculata	1														
ANNE	POSE	Oweniidae	Owenia fusiformis	86			34	52										
ANNE	POSE	Sabellidae	Euchone incolor	22											2	3		
ANNE	POSE	Spionidae	Dipolydora cardalia	2											1			
ANNE	POSE	Spionidae	Dipolydora sp.	6											2			2
ANNE	POSE	Spionidae	Paraprionospio alata	12						2					2			
ANNE	POSE	Spionidae	Polydora sp. complex	10				5							3	2		
ANNE	POSE	Spionidae	Prionospio (Minuspio) lighti	1,140	74	346	66	187		28	34	19	8	32	19	17	30	18
ANNE	POSE	Spionidae	Prionospio (Prionospio) sp.	1											1			
ANNE	POSE	Spionidae	Pseudopolydora paucibranchiata	5			2	2							1			
ANNE	POSE	Spionidae	Spiophanes berkeleyorum	2												1		
ANNE	POSE	Sternaspidae	Sternaspis affinis	2											2			
ANNE	POSE	Terebellidae	Lanassa venusta venusta	4									1					
ANNE	POSE	Terebellidae	Polycirrus sp. complex	1				1										
ANNE	POSE	Trichobranchidae	Terebellides sp.	1												1		
ARTH	CRAM	Aoridae	Aoroides intermedia	230													200	30
ARTH	CRAM	Aoridae	Aoroides sp.	46		40									1	1		
ARTH	CRAM	Aoridae	Aoroides spinosa	18	14													4
ARTH	CRAM	Caprellidae	Caprella kennerlyi	2														2
ARTH	CRAM	Caprellidae	Caprella mendax	6													6	
ARTH	CRAM	Caprellidae	Caprellidae indet.	2														2
ARTH	CRAM	Isaeidae	Gammaropsis spinosa	1														
ARTH	CRAM	Isaeidae	Isaeidae indet.	1														
ARTH	CRAM	Isaeidae	Photis brevipes	14		2											2	
ARTH	CRAM	Isaeidae	Photis sp.	8	4	4												
ARTH	CRAM	Isaeidae	Protomedeia prudens	2														
ARTH	CRAM	Melitidae	Desdimelita desdichada	13				1							1	3		
ARTH	CRAM	Oedicerotidae	Deflexilodes sp.	6												3		
ARTH	CRAM	Oedicerotidae	Oedicerotidae indet.	1								1						
ARTH	CRAM	Oedicerotidae	Westwoodilla tone	9											1	2	2	4
ARTH	CRAM	Phoxocephalidae	Eobrolgus chumashi	10													4	6
ARTH	CRAM	Phoxocephalidae	Heterophoxus affinis	2														
ARTH	CRAM	Phoxocephalidae	Heterophoxus sp.	1												1		
ARTH	CRAM		Amphipoda indet.	8	8													
ARTH	CRCI		Balanomorpha indet.	17	6		6	1				1						
ARTH	CRCU	Leuconidae	Eudorella pacifica	1														
ARTH	CRCU	Leuconidae	Eudorella sp.	2														
ARTH	CRCU	Leuconidae	Leucon sp.	4														
ARTH	CRDE	Callianassidae	Neotrypaea gigas	5								2					1	
ARTH	CRDE	Cancridae	Cancridae indet.	1													1	
ARTH	CRDE	Crangonidae	Crangon alaskensis	3			1								1		1	
ARTH	CRDE	Hippolytidae	Lebbeus sp.	1														1
ARTH	CRDE	Pinnotheridae	Pinnixa schmitti	20							1							
ARTH	CRDE	Pinnotheridae	Pinnixa sp.	8		2									1	2		
ARTH	CRIS	Limnoriidae	Limnoria lignorum	4														
ARTH	CRLE	Nebaliidae	Nebalia pugettensis complex	206													202	2
ARTH	CRTA	Leptocheliidae	Leptochelia dubia complex	7	4											2		
MISC	BRYO	Vesiculariidae	Bowerbankia gracilis	2														
MISC	CNHY	Corynidae	Corynidae indet.	2														2
MISC	CNHY	Corynidae	Sarsia tubulosa	1				1										
MISC	CNHY	Corynidae	Slabberia sp.	1				1										
MISC	CNHY	Pandeidae	Amphinema dinema	1				1										
MISC	NTEA	Amphiporidae	Amphiporus imparispinosus	1				1										
MISC	NTEA	Emplectonematidae	Paranemertes californica	6			2	4										
MISC	NTEA	Lineidae	Cerebratulus californiensis	52		4	16	18										
MISC	NTEA	Lineidae	Micrura sp.	1										1				
MISC	NTEA	Tubulanidae	Tubulanus polymorphus	15			6	9										

Biologica Sample #				Grand Total	17-033-001	17-033-002	17-033-003	17-033-004	17-033-005	17-033-006	17-033-011	17-033-012	17-033-013	17-033-014	17-033-015	17-033-016	17-033-017	17-033-018
Client Sample #					04-05	04-05	07-03	07-03	12-03	12-03	15-01	15-01	41-03	41-03	43-05	43-05	45-03	45-03
Replicate					Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02
Date Sampled					07/03/2017								08/03/2017	08/03/2017				
Debris Volume					High	High	High	High	Standard	High	Standard	Standard	Standard	Standard	Standard	Standard	High	High
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
MISC	NTEA	Tubulanidae	Tubulanus sp.	2														2
MISC	NTEA		Anopla indet.	1														
MISC	URAS		Stolidobranchiata indet.	1				1										
MOLL	MOBI	Cardiidae	Clinocardiinae indet.	19			4	8			1					1		
MOLL	MOBI	Cardiidae	Clinocardium nuttallii	18				18										
MOLL	MOBI	Lasaeidae	Kurtiella tumida	43			6	3							11	3	4	
MOLL	MOBI	Lucinidae	Lucinoma annulatum	2														2
MOLL	MOBI	Lucinidae	Parvilucina tenuisculpta	3											1	1		
MOLL	MOBI	Nuculidae	Acila castrensis	54											16	18		
MOLL	MOBI	Nuculidae	Ennucula tenuis	5												1		
MOLL	MOBI	Tellinidae	Macoma carlottensis	26											3	2		
MOLL	MOBI	Tellinidae	Macoma nasuta	103	2	1					14	3	1	4	4	4	4	3
MOLL	MOBI	Tellinidae	Macoma sp.	105	4	6	6	13	1	4	3			1		1		6
MOLL	MOBI	Tellinidae	Tellina modesta	1														
MOLL	MOBI	Tellinidae	Tellina sp.	26			8	5									2	4
MOLL	MOBI	Thyasiridae	Axinopsida serricata	76											6	15	4	
MOLL	MOBI	Veneridae	Leukoma staminea	5														
MOLL	MOBI	Veneridae	Nutricola sp.	54											6	15		
MOLL	MOBI	Veneridae	Veneridae indet.	7							1					2		
MOLL	MOBI		Bivalvia indet.	56	2	18	8	16						1				
MOLL	MOGA	Columbellidae	Astyris gausapata	3													2	
MOLL	MOGA	Littorinidae	Lacuna vincta	4													2	2
MOLL	MOGA	Onchidorididae	Loy thompsoni	1												1		
MOLL	MOGA	Pyramidellidae	Odostomia sp.	27												4		
MOLL	MOGA	Pyramidellidae	Turbonilla sp.	9														
MOLL	MOGA	Rissoidae	Alvania compacta	131			16	50								6	44	2
MOLL	MOGA	Rissoidae	Alvania sp.	22				16									4	2
MOLL	MOGA		Cephalaspidea indet.	4														
MOLL	MOGA		Gastropoda indet.	50	2	2	10	27								1	4	
			Total Abundance	**10,802**	**267**	**659**	**513**	**844**	**187**	**408**	**128**	**68**	**230**	**196**	**817**	**952**	**668**	**310**
			Total Unique Taxa (species richness)	**117**	**17**	**21**	**26**	**37**	**4**	**10**	**10**	**11**	**8**	**10**	**36**	**39**	**26**	**31**

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Abundance data in matrix format, including total taxa (species richness) count per s

Biologica Sample #				17-033-019	17-033-020	17-033-021	17-033-022	17-033-023	17-033-024	17-033-025	17-033-026	17-033-027	17-033-028	17-033-029	17-033-030	17-033-031	17-033-032
Client Sample #				46-03	46-03	50-01	50-01	53-01	53-01	54-03	54-03	59-01	59-02	61-01	61-01	60-01	60-02
Replicate				Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02			Rep 01	Rep 02		
Date Sampled												07/03/2017	07/03/2017	10/03/2017	10/03/2017	09/03/2017	09/03/2017
Debris Volume				Standard	Standard	Standard	Standard	Standard	Standard	High	High	High	High	Standard	High	Standard	Standard
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	ANOL	Naididae	Paranais litoralis														1
ANNE	ANOL	Naididae	Tectidrilus sp.													3	
ANNE	POER	Dorvilleidae	Schistomeringos annulata														
ANNE	POER	Dorvilleidae	Schistomeringos longicornis									2				1	3
ANNE	POER	Dorvilleidae	Schistomeringos sp.														
ANNE	POER	Glyceridae	Glycera americana														
ANNE	POER	Goniadidae	Glycinde picta	1	3	1			2	4	6		4	4	6	6	
ANNE	POER	Goniadidae	Glycinde sp.		6	3			1		2	2	2	4	6		
ANNE	POER	Hesionidae	Micropodarke dubia														
ANNE	POER	Hesionidae	Oxydromus pugettensis														
ANNE	POER	Hesionidae	Podarkeopsis glabrus		4			1		2	2	2		7		2	3
ANNE	POER	Hesionidae	Podarkeopsis perkinsi														
ANNE	POER	Hesionidae	Podarkeopsis sp.														
ANNE	POER	Lumbrineridae	Lumbrineridae indet.														
ANNE	POER	Lumbrineridae	Lumbrineris californiensis														
ANNE	POER	Lumbrineridae	Scoletoma tetraura complex	236	268	1	1	4	1	28	44			1	8		
ANNE	POER	Nephtyidae	Bipalponephtys cornuta						1	2	4				2		
ANNE	POER	Nephtyidae	Nephtys punctata														
ANNE	POER	Nereididae	Alitta virens														
ANNE	POER	Nereididae	Nereis procera		1												
ANNE	POER	Nereididae	Platynereis bicanaliculata													2	
ANNE	POER	Onuphidae	Onuphidae indet.														
ANNE	POER	Onuphidae	Onuphis sp.														
ANNE	POER	Pholoidae	Pholoe minuta		1												
ANNE	POER	Phyllodocidae	Eteone californica														
ANNE	POER	Phyllodocidae	Eteone longa complex	1													
ANNE	POER	Phyllodocidae	Eteone sp.														
ANNE	POER	Phyllodocidae	Eteone tuberculata		2												1
ANNE	POER	Phyllodocidae	Eumida longicornuta														
ANNE	POER	Phyllodocidae	Phyllodoce hartmanae														
ANNE	POER	Polynoidae	Gattyana cirrhosa											1			
ANNE	POER	Polynoidae	Harmothoe imbricata														
ANNE	POER	Polynoidae	Hesperonoe adventor														
ANNE	POER	Polynoidae	Tenonia priops							2							
ANNE	POER	Sphaerodoridae	Sphaerodoropsis sphaerulifer		2												
ANNE	POER	Syllidae	Brania sp.														
ANNE	POER	Syllidae	Exogone dwisula												2		
ANNE	POER	Syllidae	Syllis cornuta														
ANNE	POSE	Ampharetidae	Ampharete labrops			1					4						
ANNE	POSE	Ampharetidae	Ampharete lineata	1													
ANNE	POSE	Ampharetidae	Ampharetidae indet.														
ANNE	POSE	Capitellidae	Capitella capitata complex					1			2	30	6	4	2		1
ANNE	POSE	Capitellidae	Heteromastus filobranchus	6	6						2						
ANNE	POSE	Capitellidae	Mediomastus ambiseta														
ANNE	POSE	Capitellidae	Mediomastus californiensis														
ANNE	POSE	Chaetopteridae	Spiochaetopterus costarum complex	1						2					1		
ANNE	POSE	Cirratulidae	Aphelochaeta glandaria complex	546	633			1		6		2		3	2		
ANNE	POSE	Cirratulidae	Aphelochaeta monilaris	87	130												
ANNE	POSE	Cirratulidae	Aphelochaeta sp.								58						
ANNE	POSE	Cirratulidae	Chaetozone setosa complex	13	59									1			
ANNE	POSE	Cirratulidae	Cirratulidae indet.														
ANNE	POSE	Cirratulidae	Kirkegaardia sp.														
ANNE	POSE	Cossuridae	Cossura pygodactylata	3	7												
ANNE	POSE	Magelonidae	Magelona longicornis		2												
ANNE	POSE	Maldanidae	Euclymene sp. nr. zonalis	12	23												
ANNE	POSE	Maldanidae	Praxillella pacifica		2												

Biologica Sample #				17-033-019	17-033-020	17-033-021	17-033-022	17-033-023	17-033-024	17-033-025	17-033-026	17-033-027	17-033-028	17-033-029	17-033-030	17-033-031	17-033-032
Client Sample #				46-03	46-03	50-01	50-01	53-01	53-01	54-03	54-03	59-01	59-02	61-01	61-01	60-01	60-02
Replicate				Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02			Rep 01	Rep 02		
Date Sampled												07/03/2017	07/03/2017	10/03/2017	10/03/2017	09/03/2017	09/03/2017
Debris Volume				Standard	Standard	Standard	Standard	Standard	Standard	High	High	High	High	Standard	High	Standard	Standard
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
ANNE	POSE	Opheliidae	Armandia brevis			5	11	50	19	152	52	458	343	154	102	66	29
ANNE	POSE	Opheliidae	Ophelina acuminata		1												
ANNE	POSE	Orbiniidae	Leitoscoloplos pugettensis														
ANNE	POSE	Orbiniidae	Scoloplos acmeceps														
ANNE	POSE	Oweniidae	Galathowenia oculata		1												
ANNE	POSE	Oweniidae	Owenia fusiformis														
ANNE	POSE	Sabellidae	Euchone incolor	6	11												
ANNE	POSE	Spionidae	Dipolydora cardalia		1												
ANNE	POSE	Spionidae	Dipolydora sp.												2		
ANNE	POSE	Spionidae	Paraprionospio alata	3	1						4						
ANNE	POSE	Spionidae	Polydora sp. complex														
ANNE	POSE	Spionidae	Prionospio (Minuspio) lighti	1	21	4		1	30	10	64	6	20	54	28	13	10
ANNE	POSE	Spionidae	Prionospio (Prionospio) sp.														
ANNE	POSE	Spionidae	Pseudopolydora paucibranchiata														
ANNE	POSE	Spionidae	Spiophanes berkeleyorum		1												
ANNE	POSE	Sternaspidae	Sternaspis affinis														
ANNE	POSE	Terebellidae	Lanassa venusta venusta		1						2						
ANNE	POSE	Terebellidae	Polycirrus sp. complex														
ANNE	POSE	Trichobranchidae	Terebellides sp.														
ARTH	CRAM	Aoridae	Aoroides intermedia														
ARTH	CRAM	Aoridae	Aoroides sp.											1	2	1	
ARTH	CRAM	Aoridae	Aoroides spinosa														
ARTH	CRAM	Caprellidae	Caprella kennerlyi														
ARTH	CRAM	Caprellidae	Caprella mendax														
ARTH	CRAM	Caprellidae	Caprellidae indet.														
ARTH	CRAM	Isaeidae	Gammaropsis spinosa	1													
ARTH	CRAM	Isaeidae	Isaeidae indet.		1												
ARTH	CRAM	Isaeidae	Photis brevipes													5	5
ARTH	CRAM	Isaeidae	Photis sp.														
ARTH	CRAM	Isaeidae	Protomedeia prudens	2													
ARTH	CRAM	Melitidae	Desdimelita desdichada	1	1										6		
ARTH	CRAM	Oedicerotidae	Deflexilodes sp.	1	1									1			
ARTH	CRAM	Oedicerotidae	Oedicerotidae indet.														
ARTH	CRAM	Oedicerotidae	Westwoodilla tone														
ARTH	CRAM	Phoxocephalidae	Eobrolgus chumashi														
ARTH	CRAM	Phoxocephalidae	Heterophoxus affinis	1	1												
ARTH	CRAM	Phoxocephalidae	Heterophoxus sp.														
ARTH	CRAM		Amphipoda indet.														
ARTH	CRCI		Balanomorpha indet.					3									
ARTH	CRCU	Leuconidae	Eudorella pacifica		1												
ARTH	CRCU	Leuconidae	Eudorella sp.								2						
ARTH	CRCU	Leuconidae	Leucon sp.								4						
ARTH	CRDE	Callianassidae	Neotrypaea gigas			2											
ARTH	CRDE	Cancridae	Cancridae indet.														
ARTH	CRDE	Crangonidae	Crangon alaskensis			1											
ARTH	CRDE	Hippolytidae	Lebbeus sp.														
ARTH	CRDE	Pinnotheridae	Pinnixa schmitti	1	15			2	1								
ARTH	CRDE	Pinnotheridae	Pinnixa sp.									2					1
ARTH	CRIS	Limnoriidae	Limnoria lignorum												4		
ARTH	CRLE	Nebaliidae	Nebalia pugettensis complex									2					
ARTH	CRTA	Leptocheliidae	Leptochelia dubia complex														1
MISC	BRYO	Vesiculariidae	Bowerbankia gracilis												2		
MISC	CNHY	Corynidae	Corynidae indet.														
MISC	CNHY	Corynidae	Sarsia tubulosa														
MISC	CNHY	Corynidae	Slabberia sp.														
MISC	CNHY	Pandeidae	Amphinema dinema														
MISC	NTEA	Amphiporidae	Amphiporus imparispinosus														
MISC	NTEA	Emplectonematidae	Paranemertes californica														
MISC	NTEA	Lineidae	Cerebratulus californiensis													5	9
MISC	NTEA	Lineidae	Micrura sp.														
MISC	NTEA	Tubulanidae	Tubulanus polymorphus														

Biologica Sample #				17-033-019	17-033-020	17-033-021	17-033-022	17-033-023	17-033-024	17-033-025	17-033-026	17-033-027	17-033-028	17-033-029	17-033-030	17-033-031	17-033-032
Client Sample #				46-03	46-03	50-01	50-01	53-01	53-01	54-03	54-03	59-01	59-02	61-01	61-01	60-01	60-02
Replicate				Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02	Rep 01	Rep 02			Rep 01	Rep 02		
Date Sampled												07/03/2017	07/03/2017	10/03/2017	10/03/2017	09/03/2017	09/03/2017
Debris Volume				Standard	Standard	Standard	Standard	Standard	Standard	High	High	High	High	Standard	High	Standard	Standard
taxcode	grpcode	Family	TaxonName	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Abundance
MISC	NTEA	Tubulanidae	Tubulanus sp.														
MISC	NTEA		Anopla indet.						1								
MISC	URAS		Stolidobranchiata indet.														
MOLL	MOBI	Cardiidae	Clinocardiinae indet.	1						2	2						
MOLL	MOBI	Cardiidae	Clinocardium nuttallii														
MOLL	MOBI	Lasaeidae	Kurtiella tumida	1	5		1			2	2					3	2
MOLL	MOBI	Lucinidae	Lucinoma annulatum														
MOLL	MOBI	Lucinidae	Parvilucina tenuisculpta		1												
MOLL	MOBI	Nuculidae	Acila castrensis	11	7			2									
MOLL	MOBI	Nuculidae	Ennucula tenuis	1	2			1									
MOLL	MOBI	Tellinidae	Macoma carlottensis	2	12				3					1	2	1	
MOLL	MOBI	Tellinidae	Macoma nasuta	5	9	1		5	7	6	3	1		8	6	2	10
MOLL	MOBI	Tellinidae	Macoma sp.							8	18	3		4		14	13
MOLL	MOBI	Tellinidae	Tellina modesta		1												
MOLL	MOBI	Tellinidae	Tellina sp.	1							6						
MOLL	MOBI	Thyasiridae	Axinopsida serricata	18	33												
MOLL	MOBI	Veneridae	Leukoma staminea	5													
MOLL	MOBI	Veneridae	Nutricola sp.	10	23												
MOLL	MOBI	Veneridae	Veneridae indet.		1				1		2						
MOLL	MOBI		Bivalvia indet.							4	4					1	2
MOLL	MOGA	Columbellidae	Astyris gausapata		1												
MOLL	MOGA	Littorinidae	Lacuna vincta														
MOLL	MOGA	Onchidorididae	Loy thompsoni														
MOLL	MOGA	Pyramidellidae	Odostomia sp.	8	6			1	4	4							
MOLL	MOGA	Pyramidellidae	Turbonilla sp.	2	7												
MOLL	MOGA	Rissoidae	Alvania compacta	2	6									1			4
MOLL	MOGA	Rissoidae	Alvania sp.														
MOLL	MOGA		Cephalaspidea indet.									4					
MOLL	MOGA		Gastropoda indet.								2	2					
			Total Abundance	**991**	**1,321**	**19**	**13**	**72**	**71**	**234**	**291**	**516**	**375**	**249**	**183**	**125**	**95**
			Total Unique Taxa (species richness)	**33**	**42**	**8**	**3**	**12**	**11**	**13**	**19**	**11**	**4**	**14**	**16**	**13**	**14**

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Benthic report of quality control and quality assurance for Hemmera Esquimalt Harbour 2017.

Biologica Sample ID	Client Sample ID	Replicate	Debris Volume	Subsample	Sorting Efficiency QC: Spotcheck	Subsampling Accuracy
17-033-001	04-05	Rep 01	High	1/2	95.83%	
17-033-002	04-05	Rep 02	High	1/2		
17-033-003	07-03	Rep 01	High	1/2		
17-033-004	07-03	Rep 02	High	Whole		95.30%
17-033-005	12-03	Rep 01	Standard	Whole		
17-033-006	12-03	Rep 02	High	1/2	100.00%	
17-033-007	14-03	Rep 01-A	Not analyzing	na		
17-033-008	14-03	Rep 01-B	Not analyzing	na		
17-033-009	14-03	Rep 02-A	Not analyzing	na		
17-033-010	14-03	Rep 02-B	Not analyzing	na		
17-033-011	15-01	Rep 01	Standard	Whole		
17-033-012	15-01	Rep 02	Standard	Whole		
17-033-013	41-03	Rep 01	Standard	Whole	100.00%	
17-033-014	41-03	Rep 02	Standard	Whole		
17-033-015	43-05	Rep 01	Standard	Whole		
17-033-016	43-05	Rep 02	Standard	Whole		
17-033-017	45-03	Rep 01	High	1/2	96.91%	97.80%
17-033-018	45-03	Rep 02	High	1/2		
17-033-019	46-03	Rep 01	Standard	Whole		
17-033-020	46-03	Rep 02	Standard	Whole	99.39%	
17-033-021	50-01	Rep 01	Standard	Whole		
17-033-022	50-01	Rep 02	Standard	Whole		
17-033-023	53-01	Rep 01	Standard	Whole		
17-033-024	53-01	Rep 02	Standard	Whole		
17-033-025	54-03	Rep 01	High	1/2	100.00%	
17-033-026	54-03	Rep 02	High	1/2		
17-033-027	59-01		High	1/2		
17-033-028	59-02		High	1/2		
17-033-029	61-01	Rep 01	Standard	Whole		
17-033-030	61-01	Rep 02	High	1/2		
17-033-031	60-01		Standard	Whole		
17-033-032	60-02		Standard	Whole		
				Average:	98.69%	96.55%

Quality Control

Sorting efficiency: [(total count – organisms recovered in spot check and/or re-sort) / total count] x 100%

Spot Check: 25% of sample debris resorted for 19% of samples

Sediment Chemistry Test		Units	EQL	BCCSR Sed. Marine Sensitive	BCCSR Sed. Marine Typical	CCME Sediment Aquatic Life (Marine, ISGQ)	CCME Sediment Aquatic Life (Marine, PEL)	DAS reference Criterion	BH3		BH5		BH8	
									Surficial	>30cm	Surficial	>30cm	Surficial	>30cm
Grain Size	Silt (<0.0625mm and >0.0039mm)	%	0.01	-	-	-	-	-	96.59	95.99	94.87	97.96	67.66	71.02
	Clay (<0.0039mm)	%	0.01	-	-	-	-	-	-	-	-	-	21.82	21.84
	Sand (<2.00mm & >0.063mm)	%	0.01	-	-	-	-	-	3.2	3.56	3.99	1.84	9.94	6.42
	Gravel (>2.00mm)	%	0.01	-	-	-	-	-	0.2	0.45	1.13	0.2	0.58	0.72
Inorganics	Moisture	%	0.3	-	-	-	-	-	44	39	42	40	39	39
	Percent Saturation	%		-	-	-	-	-	89.8	79.1	87.1	85.5	82.3	75.5
	Ammonia	mg/kg	2	-	-	-	-	-	-	-	-	-	-	-
	Chloride	mg/kg	48	-	-	-	-	-	11,900	9060	11,900	9980	10,300	9010
	pH (Initial)	pH_Units		-	-	-	-	-	8.52	8.9	8.56	8.94	8.76	8.77
	Phosphorus	mg/kg	10	-	-	-	-	-	-	-	955	790	919	886
Metals	Soluble Chloride	mg/L	100	-	-	-	-	-	13,300	11,500	13,600	11,700	12,600	11,900
	Sodium ion (1+)	mg/kg	2.4	-	-	-	-	-	6680	5170	6710	5820	5950	5210
	Aluminium	mg/kg	100	-	-	-	-	-	-	-	16,600	16,700	14,100	15,400
	Antimony	mg/kg	0.1	-	-	-	-	-	-	-	0.21	0.2	0.15	0.16
	Arsenic	mg/kg	0.5	26	50	7.24	41.6	7.24	-	-	7.69	8.18	6.53	7.17
	Barium	mg/kg	0.1	-	-	-	-	-	-	-	46	36.1	35.4	34.6
	Beryllium	mg/kg	0.2	-	-	-	-	-	-	-	0.32	0.31	0.26	0.29
	Bismuth	mg/kg	0.1	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1
	Cadmium	mg/kg	0.05	2.6	5	0.7	4.2	0.6	-	-	3.31	2.2	3.05	2.73
	Calcium	mg/kg	100	-	-	-	-	-	-	-	12,000	6960	13,800	8450
	Chromium (III+VI)	mg/kg	1	99	190	52.3	160	52.3	-	-	34.7	34.8	29	31.2
	Cobalt	mg/kg	0.3	-	-	-	-	-	-	-	6.13	6.72	5.32	5.96
	Copper	mg/kg	0.5	67	130	18.7	108	18.7	-	-	22.2	22.4	16.7	20
	Iron	mg/kg	100	-	-	-	-	-	-	-	24,400	25,800	21,100	23,000
	Lead	mg/kg	0.1	69	130	30.2	112	30.2	-	-	13.3	4.47	3.68	3.84
	Lithium	mg/kg	5	-	-	-	-	-	-	-	19	22.5	16.1	16.4
	Magnesium	mg/kg	100	-	-	-	-	-	-	-	8200	8160	6880	7510
	Manganese	mg/kg	0.2	-	-	-	-	-	-	-	205	222	182	203
	Mercury	mg/kg	0.05	0.43	0.84	0.13	0.7	0.75	-	-	0.236	<0.05	<0.05	<0.05
	Molybdenum	mg/kg	0.1	-	-	-	-	-	-	-	3.98	4.09	3.42	3.08
	Nickel	mg/kg	0.8	-	-	-	-	-	-	-	21.7	23.3	18.5	20.3
	Potassium	mg/kg	100	-	-	-	-	-	-	-	2520	2590	2160	2280
	Selenium	mg/kg	0.5	-	-	-	-	-	-	-	0.8	0.79	0.75	0.75
	Silver	mg/kg	0.05	-	-	-	-	-	-	-	0.115	0.101	0.09	0.1
	Sodium	mg/kg	100	-	-	-	-	-	-	-	10,200	9790	8630	8910
	Strontium	mg/kg	0.1	-	-	-	-	-	-	-	86.7	48.9	90.9	57.4
	Thallium	mg/kg	0.05	-	-	-	-	-	-	-	0.361	0.308	0.364	0.379
	Tin	mg/kg	0.1	-	-	-	-	-	-	-	1.74	0.47	0.38	0.4
	Titanium	mg/kg	1	-	-	-	-	-	-	-	1160	1160	1080	1140
	Uranium	mg/kg	0.05	-	-	-	-	-	-	-	2.05	1.86	1.74	1.58
	Vanadium	mg/kg	2	-	-	-	-	-	-	-	51.5	53.5	45.9	49.9
	Zinc	mg/kg	1	170	330	124	271	124	-	-	72	64.9	54.9	56.8
	Zirconium	mg/kg	0.5	-	-	-	-	-	-	-	9.39	9.32	8.02	8.76
PAH	2-methylnaphthalene	mg/kg	0.001	0.12	0.24	0.0202	0.201	-	0.038	0.008	0.012	0.0097	0.0077	0.0063
	Acenaphthene	mg/kg	0.0005	0.055	0.11	0.00671	0.0889	-	0.066	<0.0005	0.0014	0.00083	<0.0005	<0.0005
	Acenaphthylene	mg/kg	0.0005	0.079	0.15	0.00587	0.128	-	0.067	<0.0005	0.0012	<0.0005	<0.0005	<0.0005
	Anthracene	mg/kg	0.001	0.15	0.29	0.0469	0.245	-	0.43	0.0013	0.0056	0.001	<0.001	<0.001
	Benzo(a)anthracene	mg/kg	0.001	0.43	0.83	0.0748	0.693	-	1.2	0.002	0.012	0.0015	0.0015	<0.001
	Benzo(a) pyrene	mg/kg	0.001	0.47	0.92	0.0888	0.763	-	0.76	0.0015	0.0087	<0.001	0.0012	<0.001
	Benzo(b)fluoranthene	mg/kg	0.001	-	-	-	-	-	0.81	0.0025	0.015	0.002	0.0026	0.0016
	Benzo(b+j)fluoranthene	mg/kg	0.001	-	-	-	-	-	1.2	0.0025	0.023	0.002	0.0026	0.0016
	Benzo(g,h,i)perylene	mg/kg	0.05	-	-	-	-	-	-	-	-	-	-	-
	Benzo(k)fluoranthene	mg/kg	0.001	-	-	-	-	-	0.4	<0.001	0.0073	<0.001	<0.001	<0.001
	Chrysene	mg/kg	0.001	0.52	1	0.108	0.846	-	1.2	0.0028	0.014	0.0033	0.0021	0.0021
	Dibenz(a,h)anthracene	mg/kg	0.0005	0.084	0.16	0.00622	0.135	-	0.11	<0.0005	0.0019	<0.0005	<0.0005	<0.0005
	Fluoranthene	mg/kg	0.001	0.93	1.8	0.113	1.494	-	2	0.0036	0.022	0.0032	0.0035	0.0018
	Fluorene	mg/kg	0.001	0.089	0.17	0.0212	0.144	-	0.16	0.0026	0.0042	0.0027	0.0021	0.0015
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.002	-	-	-	-	-	0.32	<0.002	0.0054	<0.002	<0.002	<0.002
	Naphthalene	mg/kg	0.001	0.24	0.47	0.0346	0.391	-	0.05	0.0015	0.0038	0.002	0.0015	<0.001
	High Molecular Weight PAHs	mg/kg	0.001	-	-	-	-	-	6.9	0.013	0.082	0.012	0.012	0.0063
	Total PAHs	mg/kg	0.001	10	20			2.5	9	0.036	0.13	0.037	0.031	0.019
	Phenanthrene	mg/kg	0.001	0.34	0.65	0.0867	0.544	-	1.3	0.0096	0.018	0.0092	0.0069	0.005
	Low Molecular Weight PAHs	mg/kg	0.001	-	-	-	-	-	2.1	0.023	0.046	0.025	0.018	0.013
	Pyrene	mg/kg	0.001	0.87	1.7	0.153	1.398	-	1.7	0.0036	0.024	0.004	0.0041	0.0024
	B(a)P Total Potency Equivalent	mg/kg	0.01	-	-	-	-	-	1.2	<0.01	0.016	<0.01	<0.01	<0.01
PCB	PCBs (Sum of total)	mg/kg	0.01	0.12	0.23	0.0215	0.189	0.1	<0.1	<0.01	<0.25	<0.1	<0.1	<0.1

Sediment Chemistry Test		Units	EQL	BCCSR Sed. Marine Sensitive	BH10			BH15		BH16		BH18	BH20		BH27		BH28		BH29	
					Surficial	>30cm	>30 dup	Surficial	>30cm	Surficial	>30cm	Surficial	Surficial	>30cm	Surficial	>30cm	Surficial	>30cm	Surficial	>30cm
Grain Size	Silt (<0.0625mm and >0.0039mm)	%	0.01	-	-	56.62	59.85	-	67.98	56.11	50.71	94.91	-	37.64	22.31	75.34	-	-	37.3	80.99
	Clay (<0.0039mm)	%	0.01	-	-	18.05	20.88	-	-	-	-	-	-	23.43	-	-	-	-	-	-
	Sand (<2.00mm & >0.063mm)	%	0.01	-	-	23.88	17.1	-	28.72	38.29	34.18	4.64	-	34.14	58.86	22.91	-	-	36.67	16.16
	Gravel (>2.00mm)	%	0.01	-	-	1.45	2.17	-	3.3	5.6	15.11	0.45	-	4.8	18.84	1.75	-	-	26.03	5.5
Inorganics	Moisture	%	0.3	-	69	34	40	65	20	60	19	43	81	45	42	20	59	22	74	64
	Percent Saturation	%		-	176	67.9	85.4	-	75.9	130	48.1	84.7	269	95.2	52.8	70.6	124	50	336	145
	Ammonia	mg/kg	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chloride	mg/kg	48	-	35,600	8030	10,700	-	5390	22,400	3680	12,700	56,400	12,600	6270	4000	23,300	4530	37,900	24,400
	pH (Initial)	pH_Units		-	7.95	8.24	8.71	8.59	7.97	8.24	9.07	8.64	8.07	8.8	8.98	8.12	8.45	9.15	7.65	8.36
	Phosphorus	mg/kg	10	-	955	833	876	750	818	734	575	792	528	1080	904	777	737	372	503	953
Metals	Soluble Chloride	mg/L	100	-	20,200	11,800	12,500	-	7110	17,300	7640	14,900	21,000	13,300	11,900	5660	18,800	9050	11,300	16,800
	Sodium ion (1+)	mg/kg	2.4	-	19,900	4640	6340	-	3510	12,800	2360	7200	30,100	6840	3640	2620	13,300	2600	21,300	13,300
	Aluminium	mg/kg	100	-	17,000	11,600	14,300	8510	31,400	10,800	13,600	16,900	6180	16,700	9130	22,300	13,100	8220	6210	18,700
	Antimony	mg/kg	0.1	-	1.12	0.16	0.16	0.41	0.34	0.36	0.21	0.28	0.21	0.4	0.24	0.28	0.49	0.15	0.3	0.65
	Arsenic	mg/kg	0.5	***26***	14.7	6.33	7.87	7.6	9.4	5.27	3.74	7.08	4.16	9.06	5.69	5.93	7.97	5.06	3.15	13.3
	Barium	mg/kg	0.1	-	58.9	25.6	32.1	23.9	92.3	28.2	37.5	41.1	17.6	47.7	26.3	76.1	41.8	14	22.2	55.8
	Beryllium	mg/kg	0.2	-	0.31	0.21	0.26	<0.2	0.47	<0.2	0.22	0.31	<0.2	0.34	<0.2	0.36	0.23	<0.2	<0.2	0.35
	Bismuth	mg/kg	0.1	-	0.16	<0.1	<0.1	<0.1	0.13	<0.1	<0.1	<0.1	<0.1	0.14	<0.1	0.11	0.11	<0.1	<0.1	0.2
	Cadmium	mg/kg	0.05	***2.6***	*3.32*	*2.91*	*3.13*	1.81	0.093	2.48	0.285	2.04	1.4	2.43	1.39	0.132	2.18	0.619	1.45	*2.65*
	Calcium	mg/kg	100	-	8980	10,300	7520	16,000	7700	7090	9840	7060	8350	30,600	49,800	9070	36,000	17,300	8270	11,900
	Chromium (III+VI)	mg/kg	1	***99***	44.7	23.5	30.2	18.3	60.8	23.3	27.5	33.5	18.4	33.5	18.3	43.5	26.8	15.4	17	40.6
	Cobalt	mg/kg	0.3	-	7.32	4.66	5.64	4.66	21.5	5.38	8.54	6.12	2.51	6.43	5.36	15.1	5.28	5.52	2.8	7.33
	Copper	mg/kg	0.5	***67***	*76.2*	15.2	18.9	32.1	*70.1*	39.3	22.5	24.7	29.7	35	16.5	46.7	37.2	10.8	31.6	59.5
	Iron	mg/kg	100	-	32,800	17,400	21,300	15,000	48,500	16,600	22,600	24,700	11,200	25,100	16,000	36,500	19,500	13,400	17,300	29,300
	Lead	mg/kg	0.1	***69***	40.5	3.27	3.84	12.1	6.52	21.8	3.36	24.6	16.5	56.3	6.12	5.23	37.3	1.76	17.3	60.8
	Lithium	mg/kg	5	-	20	13.5	15.8	7.1	24.9	10.1	13.8	20.7	6.5	18.4	8.7	18.9	13.9	7.8	7	21.7
	Magnesium	mg/kg	100	-	11,100	5630	7090	6030	14,700	6740	7040	8180	8860	8310	4650	10,900	7450	4190	7170	10,400
	Manganese	mg/kg	0.2	-	227	165	191	165	721	178	347	200	106	210	185	514	171	142	164	242
	Mercury	mg/kg	0.05	***0.43***	*0.44*	<0.05	<0.05	0.12	0.054	0.198	<0.05	0.35	0.19	*0.902*	0.067	<0.05	*0.605*	<0.05	0.206	*1.13*
	Molybdenum	mg/kg	0.1	-	26.9	2.57	4.21	11.1	0.84	10.8	1.32	3.75	18	5.7	4.22	0.55	10.2	3.12	22.7	11.7
	Nickel	mg/kg	0.8	-	26.6	15.8	19.9	13.2	52	16.4	24.4	21.5	10.4	23.2	14.2	40.7	18.2	11.2	10.9	26.9
	Potassium	mg/kg	100	-	3280	1690	2180	1350	3420	1880	2200	2520	2500	2620	1150	2590	2180	798	1840	3110
	Selenium	mg/kg	0.5	-	2.04	0.63	0.82	0.79	<0.5	0.85	<0.5	0.68	1.19	1.08	<0.5	<0.5	1.14	<0.5	1.05	1.36
	Silver	mg/kg	0.05	-	0.308	0.079	0.098	0.085	0.108	0.141	<0.05	0.121	0.12	0.18	0.067	0.068	0.228	<0.05	0.128	0.419
	Sodium	mg/kg	100	-	28,500	6510	8620	13,500	6400	15,700	4060	10,100	42,400	13,300	5440	4970	17,000	2850	26,200	20,900
	Strontium	mg/kg	0.1	-	87.1	66.4	50.2	109	51.1	56.4	53.9	53.7	90.8	184	333	58.6	231	106	87.5	99.4
	Thallium	mg/kg	0.05	-	0.528	0.484	0.398	0.34	0.074	0.443	0.14	0.243	0.195	0.434	0.335	0.073	0.421	0.268	0.197	0.349
	Tin	mg/kg	0.1	-	9.02	0.41	0.39	2.31	0.51	4.19	0.29	1.94	3.46	11.8	1.31	0.41	7.8	0.19	2.46	12.2
	Titanium	mg/kg	1	-	937	923	1060	589	1410	777	965	1010	363	1090	732	1080	890	803	373	1170
	Uranium	mg/kg	0.05	-	8.04	1.27	1.89	3.53	0.407	2.69	0.701	1.89	5.21	2.55	1.96	0.364	3.34	1.05	5.67	3.96
	Vanadium	mg/kg	2	-	71.6	38.3	47.1	36.1	111	45.5	52.2	49.6	38	55.8	36.2	83.4	50	35.2	40.8	66.6
	Zinc	mg/kg	1	***170***	141	44.6	54.8	61.6	86.7	95	40.9	71.8	64.9	88.9	96	66.8	85.2	22.6	158	124
	Zirconium	mg/kg	0.5	-	9.36	6.21	7.86	4.53	7.24	5.45	6.7	8.2	4.67	4.8	4.91	7.02	7.05	4.48	4.36	10.4
PAH	2-methylnaphthalene	mg/kg	0.001	***0.12***	0.027	0.0056	0.0064	<0.054	<0.02	<0.048	<0.02	0.019	0.017	0.02	<0.02	<0.02	0.019	0.001	0.0089	0.043
	Acenaphthene	mg/kg	0.0005	***0.055***	0.0091	<0.0005	<0.0005	<0.014	<0.005	0.028	<0.005	0.0018	0.016	0.0077	<0.005	<0.005	0.0089	<0.0005	0.012	0.018
	Acenaphthylene	mg/kg	0.0005	***0.079***	0.015	<0.0005	<0.0005	0.015	<0.005	0.017	<0.005	0.0016	0.008	0.015	<0.005	<0.005	0.014	<0.0005	0.0081	0.023
	Anthracene	mg/kg	0.001	***0.15***	0.063	0.0015	<0.001	0.034	<0.004	0.055	<0.004	0.0058	0.056	0.039	0.013	<0.004	0.049	<0.001	0.035	0.093
	Benzo(a)anthracene	mg/kg	0.001	***0.43***	0.096	0.002	0.0013	0.081	<0.02	0.094	<0.02	0.013	0.063	0.076	0.025	<0.02	0.078	<0.001	0.038	0.13
	Benzo(a) pyrene	mg/kg	0.001	***0.47***	0.13	0.0023	<0.001	0.093	<0.02	0.067	<0.02	0.018	0.048	0.087	0.023	<0.02	0.079	<0.001	0.04	0.14
	Benzo(b)fluoranthene	mg/kg	0.001	-	0.14	0.0024	0.0029	0.12	<0.02	0.094	<0.02	0.021	0.049	0.07	0.032	<0.02	0.11	<0.001	0.037	0.19
	Benzo(b+j)fluoranthene	mg/kg	0.001	-	0.2	0.0035	0.0029	0.19	<0.02	0.14	<0.02	0.031	0.074	0.11	0.032	<0.02	0.17	<0.001	0.056	0.28
	Benzo(g,h,i)perylene	mg/kg	0.05	-	-	-	-	<0.14	<0.05	<0.12	<0.05	-	-	-	<0.05	<0.05	-	-	-	-
	Benzo(k)fluoranthene	mg/kg	0.001	-	0.065	0.0011	<0.001	0.063	<0.02	0.048	<0.02	0.01	0.024	0.035	<0.02	<0.02	0.057	<0.001	0.017	0.085
	Chrysene	mg/kg	0.001	***0.52***	0.15	0.0039	0.0037	0.13	<0.02	0.12	<0.02	0.017	0.098	0.097	0.045	<0.02	0.13	<0.001	0.071	0.2
	Dibenz(a,h)anthracene	mg/kg	0.0005	***0.084***	0.02	<0.0005	0.00067	<0.054	<0.02	<0.048	<0.02	0.0028	0.0096	0.016	<0.02	<0.02	0.013	<0.0005	0.005	0.019
	Fluoranthene	mg/kg	0.001	***0.93***	0.26	0.005	0.0019	0.21	<0.02	0.44	<0.02	0.028	0.27	0.2	0.088	<0.02	0.27	<0.001	0.18	0.37
	Fluorene	mg/kg	0.001	***0.089***	0.016	0.0014	0.0017	<0.054	<0.02	<0.048	<0.02	0.0062	0.024	0.014	<0.02	<0.02	0.014	<0.001	0.019	0.027
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.002	-	0.073	<0.002	<0.002	0.057	<0.02	<0.048	<0.02	0.0086	0.035	0.062	<0.02	<0.02	0.044	<0.002	0.024	0.083
	Naphthalene	mg/kg	0.001	***0.24***	0.023	0.0012	<0.001	<0.027	<0.01	0.038	<0.01	0.0067	0.026	0.026	0.01	<0.01	0.032	<0.001	0.017	0.059
	High Molecular Weight PAHs	mg/kg	0.001	-	1	0.021	0.01	0.8	<0.02	1.1	<0.02	0.11	0.7	0.69	0.27	<0.02	0.89	<0.001	0.47	1.4
	Total PAHs	mg/kg	0.001	***10***	1.3	0.036	0.024	0.92	<0.02	1.3	<0.02	0.18	0.96	0.91	0.32	<0.02	1.1	0.001	0.63	1.8
	Phenanthrene	mg/kg	0.001	***0.34***	0.093	0.0047	0.0055	0.072	<0.01	0.095	<0.01	0.023	0.11	0.095	0.025	<0.01	0.1	<0.001	0.068	0.16
	Low Molecular Weight PAHs	mg/kg	0.001	-	0.25	0.014	0.014	0.12	<0.02	0.23	<0.02	0.065	0.26	0.22	0.048	<0.02	0.24	0.001	0.17	0.43
	Pyrene	mg/kg	0.001	***0.87***	0.39	0.0079	0.0029	0.29	<0.02	0.34	<0.02	0.035	0.21	0.22	0.089	<0.02	0.32	<0.001	0.14	0.49
	B(a)P Total Potency Equivalent	mg/kg	0.01	-	0.2	<0.01	<0.01	-	-	-	-	0.027	0.079	0.13	-	-	0.13	<0.01	0.059	0.22
PCB	PCBs (Sum of total)	mg/kg	0.01	***0.12***	*<0.75*	<0.1	<0.02	*<0.6*	<0.01	*<0.13*	<0.01	*<0.5*	*<0.5*	*<0.5*	<0.1	<0.01	*<0.13*	<0.01	*<2*	*<0.75*

APPENDIX J

Detailed Pilot Study Project Cost Estimate

Fiscal Year	Task Description	Project Manager	Biologist 1 (Marine Biology)	Biologist 2 (Sediment Chemistry)	Technician 1 (Biologist/ Diver)	Technician 2 (Biologist/ Diver)	Technician 3 (Diver)	Technician 4 (Sediment Chemistry)	GIS Specialist	Total Hours	Subtotal Labour Fees	Disbursements		Subconsultant Fees	Notes/assumptions
												Travel/Living	Direct Expenses		
	Finalized Site Selection and Regulatory Requirements									**155**	**$17,636.00**	**$1,245.00**	**$200.00**	**$2,500.00**	
	Planning and Logistics	2	2	2	2			2		10	$1,204.00				Kickoff meeting
	Finalized selection of Pilot Study site and reference site		2		5					7	$810.00				Analysis and Decision on Final site selection and reference
1	Navigation Protection Act - Notice of Works		2		5				2	9	$990.00				Notice of Works, engagement with TC
	Disposal at Sea - Beneficial Use Exemption for Use of Clean Fill	2	2	6	10			60	2	82	$9,276.00	$1,245.00	$200.00		Project Description, Sample Plan, Sediment Characterization Report, Engagement with ECCC
	Fisheries Act - Serious Harm Assessment	2	8		35				2	47	$5,356.00				Serious harm assessment, Request for Review, engagement with DFO
	Clean fill Sediment Chemistry Analysis													$2,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, 7 samples
	Pilot Study Setup and Characterization of Baseline Conditions									**302**	**$33,636.00**	**$4,000.00**	**$3,400.00**	**$151,000.00**	
	Fieldwork Planning and Logistics	2	2		20	10	10		5	49	$5,436.00				Sample plan, HASP, Fieldwork coordination
	Fieldwork	2			50	50	50			152	$17,056.00	$4,000.00	$3,400.00		Labour: pilot project setup, 4 days of sampling, mob and demob. Disbursements: 4 nights accomodation, 4.5 days per diem, vehicle rental, ferry fares, pilot study setup supplies (buoys, rope, cement cinder blocks, dive safety gea
	Data entry and Analysis				10	10	10	10	10	50	$5,380.00				Entry of field data, compilation of laboratory results, figure creation
	Reporting	2	5	5	12	12		10	5	51	$5,764.00				Letter style report on baseline conditions
	Sediment Chemistry Analysis													$16,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, ammonia, sulphides, dioxins/furans, 33 samples
	Nautilus Bioassay Analysis													$112,000.00	Analysis: 1 acute and 1 chronic per sample, 33 samples = 66 tests
	Biologica Benthic Invertebrate Analysis													$18,000.00	Biologica technician labour, supplies, lab analysis of 11 samples
	Dive Boat Operator													$4,500.00	4 days, plus SCUBA tank rentals and air fills
2	**Application of Pilot Study Treatments**									**275**	**$30,787.00**	**$5,900.00**	**$3,000.00**	**$2,480,800.00**	
	Fieldwork Planning and Logistics	2	6		20	10	10		5	53	$5,936.00				Implementation Plan, HASP, Fieldwork coordination
	Fieldwork				60	60	60			180	$20,160.00	$5,900.00	$3,000.00		Labour: 5 days of dive support for pilot implementation, mob and demob. Disbursements: 5 nights accomodation, 5.5 days per diem, vehicle rental, ferry fares, equipment (dive safety gear, etc)
	Reporting	2	5		10	10	10		5	42	$4,691.00				Treatment Application Memo, EM Summary Report
	Dredgeate Sediment Chemistry Analysis													$8,000.00	Analysis: TCLP Metals, LEPH/HEPH/PAH, PCB, TOC, BTEX, Grain Size, % Moisture, Na/Cl, 9 composites
	Dredge Contractor													$899,100.00	Dredge to scow, transport of dredgeate to barge ramp
	Transport of Dredged Materials													$80,000.00	Transport of dreadgeate by dump truck to upland facility
	Upland Facility Disposal of Dredgeate													$1,488,000.00	Cost of disposal at upland facility (assumed weight of 2000kg/m3, and disposal cost of $1.86/kg based on disposal of drill cuttings from November 2017)
	Dive Boat Operator													$5,700.00	5 days, plus SCUBA tank rentals and air fills
	Effectiveness Monitoring - Year 1									**248**	**$27,698.00**	**$3,000.00**	**$1,800.00**	**$131,800.00**	
	Fieldwork Planning and Logistics	2	2		10	5	5		5	29	$3,196.00				Sample plan, HASP, Fieldwork coordination
	Fieldwork	2			40	40	40			122	$13,696.00	$3,000.00	$1,800.00		Labour: 3 days of sampling, mob and demob. Disbursements: 3 nights accomodation, 3.5 days per diem, ferry fare, vehicle rental, equipment (dive safety)
	Data entry and Analysis				5	10	10	10	5	40	$4,370.00				Entry of field data, compilation of laboratory results, figure creation
3	Reporting	2	5	5	10	10	10	10	5	57	$6,436.00				Letter style report on Year 1 conditions compared with baseline
	Sediment Chemistry Analysis													$16,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, ammonia, sulphides, dioxins/furans, 33 samples
	Nautilus Bioassay Analysis													$112,000.00	Analysis: 1 acute and 1 chronic per sample, 33 samples = 66 tests
	Dive Boat Operator													$3,300.00	3 days, plus SCUBA tank rentals and air fills
	Effectiveness Monitoring - Year 2									**271**	**$30,358.00**	**$4,000.00**	**$1,800.00**	**$151,000.00**	
	Fieldwork Planning and Logistics	2			10	5	5			22	$2,496.00				Sample plan, HASP, Fieldwork coordination
	Fieldwork	2			50	50	50			152	$17,056.00	$4,000.00	$1,800.00		labour: 4 days of sampling, mob and demob, and pilot project takedown. Disbursements: 4 nights accomodation, 4.5 days per diem, vehicle rental, ferry fares, equipment (dive safety gear, etc)
	Data entry and Analysis				5	10	10	10	5	40	$4,370.00				Entry of field data, compilation of laboratory results, figure creation
	Reporting	2	5	5	10	10	10	10	5	57	$6,436.00				Letter style report on Year 1 and 2 conditions compared with baseline
	Sediment Chemistry Analysis													$16,500.00	Analysis: Metals, PAH, PCB, TOC, Grain Size, % Moisture, ammonia, sulphides, dioxins/furans, 33 samples
4	Nautilus Bioassay Analysis													$112,000.00	Analysis: 1 acute and 1 chronic per sample, 33 samples = 66 tests
	Biologica Benthic Invertebrate Analysis													$18,000.00	Biologica technician labour, supplies, lab analysis of 11 samples
	Dive Boat Operator													$4,500.00	4 days, plus SCUBA tank rentals and air fills
	Determination of Pilot Study Effectiveness Report									**327**	**$36,460.00**	**$0.00**	**$0.00**	**$10,000.00**	
	Data and Analysis		2	10	60	60		30	20	182	$20,100.00				Detailed statistical and community analsyes, interpolative mapping, figure creation
	Final Report	5	10	10	60	10	10	30	10	145	$16,360.00				Final reporting, determination of effectiveness and remedial recommendations
	Biologica Benthic Invertebrate Consulting Services													$10,000.00	Data processing and interpretation consultation
	Subtotal Hours	33	58	43	499	372	300	182	91	1578					
	Rate	$128.00	$125.00	$125.00	$112.00	$112.00	$112.00	$112.00	$90.00						
	Sub-total Fees	$4,224.00	$7,250.00	$5,375.00	$55,888.00	$41,664.00	$33,600.00	$20,384.00	$8,190.00		$176,575.00	$18,145.00	$10,200.00	$2,927,100.00	

Total Labour Fees	**$ 176,575**
Total Disbursements	**$ 28,345**
Total Subconsultant Fees	**$ 2,927,100**
Total Estimated Pilot Scope	**$ 3,132,020**

Category	Cost
Year 1	**$ 21,581**
Year 2	**$ 2,712,523**
Year 3	**$ 164,298**
Year 4	**$ 233,618**
Total Estimated Pilot Scope	**$ 3,132,020**

APPENDIX F
DFO *Fisheries Act* Assessment of Serious Harm

Appendix F: Assessment of Serious Harm to Fish

Assessment of serious harm to fish resulting from Project effects on marine fish and fish habitats include an assessment of activities that result in fish mortality and those that result in either destruction or permanent alteration of fish habitat.

Not all interactions resulting in fish mortality or changes to fish habitat are expected to be serious harm to fish that are part of, or support, a CRA fishery. Serious harm is defined as the death of fish or the permanent alteration to, or destruction of, fish habitat of a spatial scale, duration, or intensity that limits, diminishes, or precludes the ability of fish to use that habitat for one or more of their life processes (DFO 2013*a*). The assessment for potential of serious harm to fish resulting from the interaction between the Project activities and fish and fish habitat, after the implementation of avoidance and mitigation measures, (summarized in **Section 2.4**, **Table 4**), was conducted using the criteria defined below.

<u>Residual Effects Criteria</u>

Five criteria were used to characterize the possibility of serious harm to fish and fish habitat:

1. habitat availability
2. habitat value
3. habitat dependency
4. localized effect
5. anticipated residual harm to fish.

Habitat Availability

Habitat availability provides a relative qualitative assessment of the availability and condition of nearby habitat. Effects to a fish population from the permanent alteration or destruction of habitat may increase with low availability and condition of nearby habitat. Three qualitative definitions of habitat availability were used.

1. Low (L) – the affected fish habitat is the only habitat of its type and quality in the immediate area of the Project.
2. Moderate (M) – the same kind and quality of fish habitat being affected is moderately abundant in the immediate area of the Project.
3. High (H) - the same kind and quality of fish habitat being affected is highly abundant in the immediate area of the Project.

Habitat Value

The value of habitat is determined by the ecological function provided and the ability to support life processes of local CRA fisheries species.

1. Low (L) – CRA species that occur locally are not expected to use the habitat to support life processes.
2. Moderate (M) – CRA species may use the habitat to carry out one or more life processes but can use other habitat types to support the same life processes.
3. High (H) – CRA species are reliant on the affected habitat for one or more life processes, which can not be accommodated using other habitat types.

Habitat Dependency

Fish population dependence on habitat can be characterized by the functional support of the habitat and relative abundance of similarly functional habitat nearby. Four qualitative definitions of habitat dependency were used:

1. Negligible (N) – species may occur in the affected habitat but are not dependent on the habitat to carry out one or more life processes.
2. Low (L) – species use affected habitat to carry out one or more life processes, but habitat that provides similar ecological function(s) is available in the local area.
3. Medium (M) – species use affected habitat to carry out life processes, but habitat that provides similar ecological function(s) is limitedly available in the local area.
4. High (H) – species rely entirely on affected habitat to carry out life processes, and there is no habitat that provides this ecological function.

Localized Effect

A localized effect characterizes weather or not the Project impacts are expected to have an effect on fish or fish habitat that could reduce the ongoing productivity of fish populations that use the Project area. Localized effect is characterized as yes or no.

1. Yes (Y) – a localized effect is expected after application of avoidance and mitigation measures.
2. No (N) – a localized effect is not expected after application of avoidance and mitigation measures.

Residual Serious Harm to Fish

Residual serious harm to fish is anticipated after efforts to avoid and mitigate Project effects have been implemented and through an analysis of the residual effects criteria defined above. Residual serious harm conclusions are presented below:

1. Yes (Y) – residual serious harm to fish from a Project component is expected.
2. No (N) – residual serious harm to fish from a Project component is not expected.

<u>Fish mortality</u>

Mortalities of mobile fish from implementation of the Project are expected to be avoided by scheduling the construction of the Pilot Project during the DFO least risk winter window for Area 19 Victoria (December 1 – February 15) and by implementing the mitigation measures outlined in **Section 2.4**, **Table 4** (DFO 2013*b*). Fish are anticipated to avoid the Project area during the placement of the ENR (clean sand) and In Situ Treatment (clean sand/siderite) and the construction methodology is not predicted to result in mortality and/or injury to fish (e.g., through elevated underwater noise).

Mortalities of sessile and infaunal invertebrates located within the Pilot Project footprint may occur through burial during material placement. It is possible that certain species and individuals may be less susceptible to injury or mortality from burial due to their life histories, spatial distribution within the substrate, and post-construction depth of cover. However, to remain conservative, mortality of all individuals within the footprint is assumed. Infaunal invertebrate mortality cannot be mitigated, however the impacted invertebrates represent a small fraction of the local population and will not impact the local population; subsequently, bivalve mortalities are not expected to result in serious residual harm. Generally, infaunal invertebrate density within the Project footprint is low.

Water Quality

The mitigation measures outlined in **Section 2.4**, **Table 4** are expected to avoid any mortality and/or injury to fish from elevated turbidity levels and/or direct contact from equipment. Temporary changes in water quality resulting from construction of the Project are not anticipated to result in serious harm to fish due to mortality and/or injury.

Permanent Alteration of Fish Habitat

A total of 10,200 m^2 of subtidal habitat will be permanently altered by the placement of a 15 – 45 cm layer of either ENR (clean sand) or In Situ (clean sand/siderite) treatments, which represents approximately 0.3% of the available subtidal fish habitat within the Harbour (304 hectares). However, based on the properties of siderite, it has been concluded that the In Situ Amendment Treatment of clean sand (95%) blended with siderite material (5%) does not constitute a risk to fish or fish habitat from a change in sediment concentrations or the introduction of deleterious materials. The application of clean sand enhances subtidal fish habitat in the northern Harbour by replacing the biologically active zone with clean sediment in order to provide an oxygenated layer to promote benthic infauna community recruitment and establishment of a productive benthic community (Breems and Goodman 2009, Washington State 2013). The In Situ Amendment is expected to act similar to clean sand and provide a suitable clean substrate for benthic colonization while simultaneously restoring degraded conditions (by removing toxic H_2S).

The existing habitat value of the proposed Project location is low, extensive assessment work has demonstrated that it is degraded and does not support any sensitive life history processes of any CRA species. Habitat dependency on the Project location is negligible. The area that will be affected is characterized by degraded soft substrates consisting mainly of silt, with the presence of surficial wood waste in some areas, and wood waste deposits up to 2.0 m in others. The sediment contains abundant *Beggiatoa* spp. bacterial mats, an indicator of degraded habitats, and elevated toxic porewater sulfides.

Post-construction, the substrate available to benthic fish and the infaunal community (e.g., the top 30 cm of substrate) will consist of clean, oxygenated material composed of ENR (100% sand) or In Situ Amendment (composed of 95% sand and 5% siderite). The habitat will become immediately available for colonization by epifaunal and infaunal invertebrates and fish. Over time, the siderite is expected to bind with H_2S, reducing the overall toxicity of decomposition by-products in the underlying substrate. The resulting habitat quality of the project footprint will be higher following construction as clean, oxygenated substrate is colonized by the infaunal community and succession takes place.

The proposed Project is not expected to have a localized effect on fish populations. The communities found within the proposed footprint are stable and found throughout subtidal soft sediments in Esquimalt Harbour. The permanent alteration of 10,200 m^2 of substrate is not anticipated to result in serious harm to fish or fish habitat.

Summary

Under the *Fisheries Act*, proponents are responsible for avoiding and mitigating serious harm to fish that are part of or support CRA fisheries:

> *35. (1) No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery.*
>
> *Serious harm to fish* is defined as "the death of fish or any permanent alteration to, or destruction of, fish habitat". Only when proponents are unable to completely avoid or mitigate serious harm to fish will projects require authorization under section 35 (2) of the *Fisheries Act* in order for the project to proceed.

The Fisheries Protection Policy Statement (DFO 2013) interprets *serious harm to fish* as:

- **The death of a fish**;
- A **permanent alteration** to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursey, rearing, or food supply areas, or a mitigation corridor, or any other area in order to carry out one or more of their life processes.
- The **destruction of fish habitat** of a spatial scale, duration, or intensity that fish can no longer reply upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one of more of their life processes.

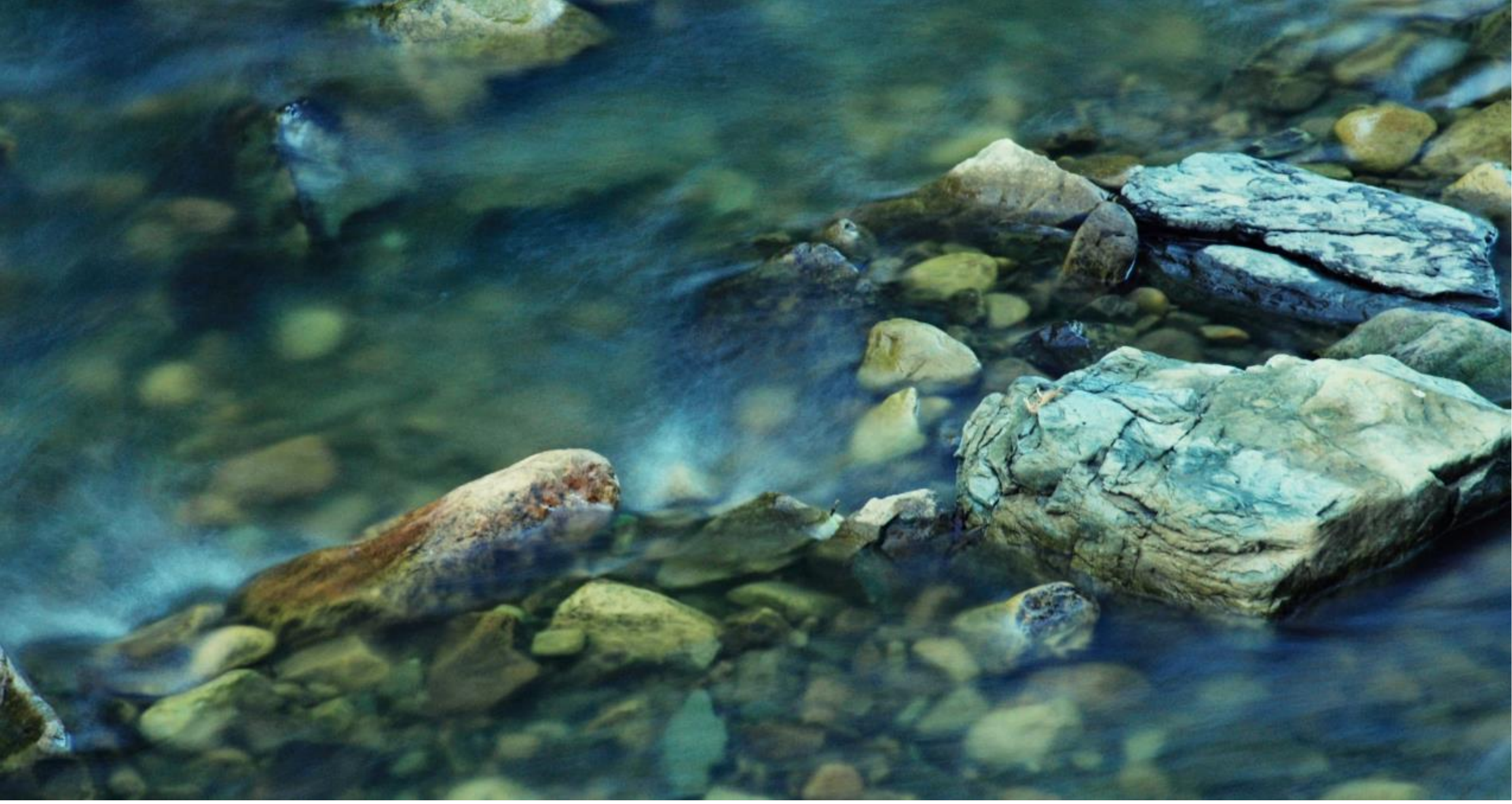
After incorporation of measures to avoid and mitigate serious harm to fish that are part of a CRA fishery, or fish that support such a fishery, no serious harm is anticipated to result from construction of the Project (**Table F1**). The project activities will remediate and enhance low quality degraded subtidal fish habitat to become higher quality substrate for colonization and establishment of benthic communities.

The total area of fish habitat that will be affected by the Project, but is not expected to result in Residual Serious Harm to Fish, includes the alteration of 10,200 m^2 of soft, subtidal substrate for the purposes of enhancement/remediation of degraded habitat. Additionally, the mortality of a small number of benthic bivalves as a result of material placement is not expected to result in Residual Serious Harm to Fish.

Table F1 Summary of Project Components, Habitat Types, Effects on Fish and Fish Habitat, Residual Harm Criteria, and Required Offsetting for the Connector Road Project

Habitat Type	Project Component	Effect Type	Area of Habitat Affected (m^2)	Habitat Availability	Habitat Value	Habitat Dependency	Localized Effect	Residual Serious Harm to Fish
N/A	Burial or crushing during sand/siderite placement	Invertebrate Mortality	**N/A**	N/A	N/A	N/A	N	N
Subtidal Habitat	Placement of sand/siderite	Permanent alteration	**10,200**	H	L	N	N	N
N/A	Disturbance to Fish Behaviour	Temporary Avoidance	**N/A**	N/A	N/A	N/A	N	N

Appendix B-2
Environmental Management Plan



July 2019
DND Wood Waste Remediation Pilot Project

Environmental Management Plan

Prepared for Public Works and Government Services Canada

July 2019
DND Wood Waste Remediation Pilot Project

Environmental Management Plan

Prepared for
Public Works and Government Services Canada

Prepared by
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Project Number: 170553-21.05
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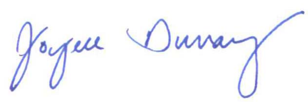
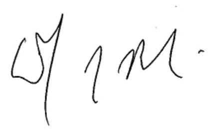
SIGNATURES

We trust that this Environmental Management Plan provides sufficient information for your present needs. If you have any questions, please do not hesitate to contact the undersigned.





Joy Dunay
Author

Dan Berlin
Senior Reviewer

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ABBREVIATIONS

BC	British Columbia
BMP	best management practice
CD	Chart Datum
cm	centimetre
DFAR	Daily Field Activity Report
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DR	Departmental Representative
EED	Environmental Effects Determination
EIR	Environmental Incident Report
EM	Environmental Monitor
EMA	Environmental Management Act
EMP	Environmental Management Plan
ENR	enhanced natural recovery
EPP	Environmental Protection Plan
FSEMS	Formation Safety Environment Management System
HASP	Health and Safety Plan
m	metre
mg/L	milligrams per litre
Project	DND Wood Waste Remediation Pilot Project
PWGSC	Public Works and Government Services Canada
QHM	Queen's Harbour Master
QP	Qualified Professional
RFI	Request for Information
SARA	Species at Risk Act
SDS	Safety Data Sheet
TOC	total organic carbon
WQMP	Water Quality Monitoring Plan
WWMA	Wood Waste Management Area

1 Introduction

1.1 Overview

This Environmental Management Plan (EMP) has been prepared for the Department of National Defence (DND) Wood Waste Remediation Pilot Project (Project) and is based on potential environmental effects and mitigation measures identified in the Canadian Environmental Assessment Act, 2012 (CEAA 2015) Section 67 Environmental Effects Determination (EED) for the Project as well as other relevant environmental legislation and bylaws.

The contents of this EMP are organized as follows:

- **Section 1.0, Introduction:** Provides overview of the Project and the purpose and organization of the EMP.
- **Section 2.0, Environmental Setting:** Provides summary of the physical, biological and social/cultural setting of the Project Work Site.
- **Section 3.0, Roles and Responsibilities:** Describes roles, responsibilities, and reporting relationships of DND, Public Works and Government Services Canada (PWGSC), the Environmental Monitor (EM), and the Contractor(s) for implementing environmental management and mitigation measures.
- **Section 4.0, Regulatory Setting:** Outlines environmental legislation, authorizations, permits, approvals, and best management practices (BMPs) applicable to the work.
- **Section 5.0, Environmental Requirements:** Summarizes measures that will be undertaken for protection of environmental resources, components to be included in the contractor's Environmental Protection Plan (EPP), and environmental site inspection and monitoring activities that will be undertaken to assess and document that environmental management goals set for the Project are being met.
- **Section 6.0, Environmental Incidents:** Defines environmental incidents and outlines reporting and notification protocol to DND, PWGSC and relevant regulatory agencies.
- **Section 7.0, Environmental Monitoring Implementation Plan:** Describes how the monitoring of environmental performance objectives, potential environmental risks, and mitigation measures identified in the EMP will be implemented.
- **Section 8.0, Construction Quality Assurance Plan:** Documents construction management requirements and outline communication pathways for PWGSC and its project consultants responsible for implementation, administration, and monitoring of the Project.
- **Appendix A, Water Quality Monitoring Plan (WQMP):** The WQMP outlines the scope of water quality monitoring that will be undertaken during project activities and identifies appropriate monitoring parameters, performance objectives, and a decision framework to guide appropriate response to where changes in water quality are observed.

- **Appendix B, Example Reporting Templates:** Examples of reporting templates are provided as guidance for expected contents.
- **Appendix C, Project Contact List:** Provides the key contact information for staff that will serve in these roles for the Project.
- **Appendix D, Submittals Tracking Table:** Provides the tracking of contractor submittals and the review by PWGSC and the Consultant.

This EMP is intended to be read in conjunction with applicable environmental approvals, authorizations, and permits for the Project as well as contract requirements. This report was prepared for Canada in accordance with the terms and conditions outlined in Contaminated Sites Marine Sediment Contract No. EZ897-172925/001/VAN. The scope of work for this report (Task 7: Pre-Construction Documents) was outlined in Anchor QEA's "Workplan for Esquimalt Harbour Wood Waste Remediation Project, Canadian Forces Base Esquimalt, Victoria, BC," dated 20 May 2019. Task Authorization for the above work plan was provided by PWGSC on 21 May 2019 under TA 700445589.

1.2 Project Background

DND, which administers Esquimalt Harbour, is implementing a remediation and risk management program in Esquimalt Harbour as part of a long-term strategy to address sediments that have been contaminated by historical industrial activities. Various remediation projects have been or are currently being undertaken in Esquimalt Harbour as part of the remediation and risk management program. The DND Wood Waste Remediation Pilot Project is the latest project being planned under this program and is being undertaken under the Federal Contaminated Sites Action Plan (Anchor QEA 2018).

DND has retained PWGSC as its contracting authority for the Project. PWGSC will designate a representative (the PWGSC Representative) to advise, coordinate and monitor the work on behalf of DND. A contractor will be retained to undertake the work.

The Project is one of several phased remediation projects intended to address contaminated sediment sites within Esquimalt Harbour (Figure 1). As part of this phased remediation effort, sediments in the northern portion of Esquimalt Harbour were evaluated for presence of wood waste and potential impacts on the aquatic environment. An estimated 640,000 m^2 of sediments contain wood waste at the sediment surface or near the sediment surface within northern Esquimalt Harbour. Literature and previous studies within Esquimalt Harbour have shown wood waste deposits to negatively affect marine benthic communities through physical alteration of sediments and increased toxicity from by-products of anaerobic decomposition, especially porewater sulphides.

Anchor QEA has assessed potential remedial technologies to address the presence of wood waste within several Wood Waste Management Areas (WWMAs; Figure 1) in northern Esquimalt Harbour, including monitored natural recovery, enhanced natural recovery (ENR), in situ treatment, capping, and dredging (Anchor QEA 2019a). These remedial options need to be further assessed in order to plan and design a long-term solution. Two potential remedial technologies for addressing wood waste include ENR and In Situ Treatment, each of which has the potential to improve benthic conditions that contribute to low benthic diversity within the WWMAs and also potentially to address the presence of elevated porewater sulphides, which are likely contributing to benthic toxicity. A description of each of these technologies is provided below:

- ENR refers to placing a layer of clean material (usually sand) on top of sediments to speed up (or enhance) the natural recovery process. ENR immediately replaces the biologically active zone with clean sediment. This clean layer is not intended to provide complete containment of the underlying contaminated sediments and may mix with the underlying sediment over time. ENR does not reduce the mass of wood waste or bind wood waste by-products (i.e., sulphides), leaving the possibility that some degradation by-products could build up to high enough levels to diffuse through the ENR layer and potentially adversely affect the surface sediment over the long term.
- In situ treatment involves the placement of reactive material mixed with sand in a thin layer over sediment (similar to ENR). In situ treatment has not been used to treat wood waste-impacted sediments at other sites; however, a range of treatment amendments are available that can effectively bind sulphides (e.g., H_2S) so they are not biologically available. The potential use of in situ treatment for remediation of wood waste-impacted sediment was evaluated by Anchor QEA using technical literature review, geochemical transport modeling, and laboratory bench-scale tests on site sediment (Anchor QEA 2019a). The results of these studies show that in situ treatment using a blend of clean sand and siderite (iron carbonate [$FeCO_3$]) is expected to be effective at long term sulphide sequestration.

1.3 Project Description

The Project has been designed to: 1) evaluate the site-specific effectiveness of ENR (clean sand cover) and in situ treatment (clean sand cover amended with siderite) for remediating wood waste-impacted sediments, and 2) test the constructability of blending and placing the amended sand material in two different wood waste areas with unique physical and geotechnical characteristics. The Project is scheduled for construction in the fall of 2019 and will include monitoring to assess effectiveness at addressing adverse surface sediment conditions associated with the presence of wood waste.

The Project consists of design, construction, and monitoring of no action, constructed ENR, and constructed in situ treatment areas within Esquimalt Harbour for assessment and comparison. No removal of wood waste-impacted sediment will be conducted as part of the Project. The results of the Project will be used to inform selection of the preferred remedial actions for sediments impacted by wood waste in Esquimalt Harbour and the implementation of in situ treatment should it be selected.

Based on site characterization, the Work Site has been divided into five WWMAs that have different historical sources, physical conditions, geochemical conditions, and/or site use (Anchor QEA 2019b). Two specific work areas were selected from within the WWMAs for the Project: one area in WWMA-1 (Esquimalt Harbour North) and a second in WWMA-4 (Inskip Island West). The location of the work areas relative to the WWMAs and wood waste thickness and wood waste cover are shown in Figures 2 and 3, respectively.

- Work Area 1 is located in WWMA-1 in an area characterized by soft surface sediments comprising finer wood waste. The Project objectives in this work area are to evaluate *performance* of ENR and in situ treatment for remediation of wood waste-impacted sediments and to examine the *implementability* of different placement methods on the softer surface sediments in this area. Placed materials in Work Area 1 may be more likely to mix with the softer surface sediments, which could make more difficult the placement of a well-defined layer of ENR or in situ treatment cover material. Six 30-metre (m) by 30-m test areas have been identified in Work Area 1, five of which will receive material placement and one that will serve as a control plot. Each test area will be separated by 50 m. Each of the six 30-m by 30-m test areas will be within a footprint that is 190 by 110 m for Work Area 1.
- Work Area 2 is located in WWMA-4 in an area characterized by firmer surface sediments and high density of coarse wood waste. Successful methods for placing material on firm surface sediments are well documented; therefore, the Project will not evaluate different placement methods in Work Area 2. The Project will focus only on the *performance* of ENR and in situ treatment for remediation of sediments impacted by coarse wood waste in Work Area 2. Three 30-m by 30-m test areas have been identified in Work Area 2, two of which will receive material placement and one that will serve as a control plot. Each test area will be separated by 50 m. In addition, the contractor will place sand within 10 m by 10 m practice areas within Work Area 2 to refine the various placement methods and demonstrate that the means and methods used are adequate to meet specification requirements. Each of the three 30-m by 30-m test areas and the 10-m by 10-m practice areas will be within a footprint that is 110 by 200 m for Work Area 2.

Two materials will be used for the pilot cap study. Material 1 (clean sand) will consist of imported clean sand. Material 2 (amended sand) will consist of imported sand amended with granular siderite, with the siderite comprising 5% by dry weight. Most test areas will have a targeted sand cover placement thickness of 30 centimetres (cm), with a 15-cm tolerance, which could result in a final thickness that ranges from 15 to 45 cm. If the material is effectively placed within Work Area 1, an additional test area will be placed that will target 60 cm thick to assess the potential for capping within soft sediment areas. The bearing capacity of the wood waste will also be assessed through placement of two small rock mounds (1.5 m high by 8 m in diameter) within Work Area 2, which may be incorporated into future cleanup or habitat restoration design elements.

Imported sand will be transported to the Work Areas by barge. Amended sand will be mixed off site or on the barge prior to placement.

The Project will be monitored following placement over the next year. Monitoring is anticipated to involve physical monitoring, diver surveys, and sediment profile imaging, as well as chemical monitoring for porewater sulphides and biological monitoring for benthic community re-colonization.

1.4 Objectives

The overall objective of the EMP is to provide a framework for the management of potential environmental effects during the Project through the implementation of protection measures. Specifically, the EMP identifies:

- Roles, responsibilities, and communication structure of DND, PWGSC, and the Contractor(s) during construction
- Federal and provincial environmental legislation and municipal bylaws that apply to the Project
- Measurable environmental protection requirements, including environmental mitigation measures and monitoring that are to be undertaken during implementation
- Environmental incident reporting protocols in the event an environmental incident occurs during implementation of the Project

The EMP addresses project effects identified in the engineering design and allows for a process of continuous improvement and adaptive management if additional effects are identified during construction. However, it should be noted that minimal environmental effects are anticipated since the Project includes the addition of clean sand/amended clean sand to two small Work Areas with no dredging or removal of wood waste or any contaminated material.

2 Environmental Setting

This section provides a summary of the environmental resources in and adjacent to the Project Work Areas. A more detailed description is provided in the EED report (Hemmera 2019).

2.1 Physical Environment

The Project Work Areas are located in the northern portion of Esquimalt Harbour. The harbour is relatively shallow, ranging from 5 to 12 m Chart Datum (CD) in depth within the limits of the Federal Harbour, and a maximum depth of 16 m CD at the harbour entrance (CRD 2019). Water depths are between -4.5 and -6 m CD within Work area 1 and between -8.5 and -5 m CD within Work Area 2.

The dominant subtidal substrate type within Esquimalt Harbour has been classified as 87% granular materials (gravel, sand, and fines) with a few subtidal bedrock outcrops (CRD 2019). Sediment in the northern portion of the harbour and around Plumper Bay is mainly silt, with large areas of wood waste at or near the sediment surface, while the southern and nearshore areas have higher proportions of sand.

Based on observations from the supplemental data collection efforts conducted in 2018 and 2019, seafloor substrate within Work Area 1 contains soft, flocculant surface sediments and seafloor substrate within Work Area 2 contains firm surface sediment and high density of coarse wood waste (Anchor QEA 2019c). Most of the site exceeded a total organic carbon (TOC) concentration of 3% (more than 60% of laboratory analyses from the site exceeded 3% TOC). Samples from the site ranged from 0.04% to 35% with a median of 4.3% in 202 samples.

Elevated porewater sulphides are a by-product of wood waste decomposition and were found throughout the site. Porewater sulphide concentrations were measured in 65 samples (including replicates) with values ranging from 0.27 milligrams per litre (mg/L) to 206 mg/L. More than 80% of samples exceeded 2 mg/L, which has been shown to cause toxicity in highly sensitive species. The median was 25 mg/L, which is above levels that have been shown to cause adverse impacts to the benthic community, as reported in scientific literature. The Podger (unpublished) literature survey aggregates sulphide toxicity values from scientific literature for numerous marine species, which are impacted by sulphide concentrations of about 1 to 2 mg/L for highly sensitive species. In general, elevated porewater sulphide was generally co-located with sediment containing wood waste; however, porewater sulphide was not always co-located with sediment containing wood waste, indicating that spatial heterogeneities, seasonal variability, and other location-specific factors affect porewater sulphide concentrations, in addition to wood waste.

Other chemical parameters (i.e., metals, organics) were measured in a subset of surface grab samples and leave surface (post-dredge) samples within the WWMAs. A few surface samples had detections of dioxin and furans, polychlorinated biphenyl Aroclors, and/or polycyclic aromatic hydrocarbons (pyrene) detections that exceed the probable effects level; however, none of these were located within the Project Work Areas 1 or 2.

2.2 Biological Environment

The biological conditions of the site have been assessed through visual benthic surveys, benthic community enumeration, and ex situ bioassay tests. Visual diver surveys indicated the sulphur-respiring *Beggiatoa* spp. (bacterial mats) was present within much of the site, with percent coverage ranging up to 100% in several locations during summer months. Similar to porewater sulphide, *Beggiatoa* spp. tended to be co-located with wood waste but were not always only found in wood waste areas. Consistent with the visual surveys, the presence of *Beggiatoa* spp. was co-located with higher TOC (e.g., >3%). Consistent with the visual surveys, the presence of *Beggiatoa* was co-located with higher TOC (e.g., >3%). The presence of diatoms was co-located with areas of lower TOC (e.g., <3%), which was indicative of fewer benthic impacts.

A benthic community impact analysis was performed to assess the impact of wood waste on the existing benthic community (Hemmera 2018). The infauna community composition and species richness analysis showed that the study area generally shows signs of impairment, and that species richness is negatively correlated with TOC. Study area infauna community was dominated by opportunistic species or had very low abundance in most stations (Hemmera 2018).

Within the Project Work Areas, the only marine invertebrate organism observed during dive surveys conducted by Hemmera in January 2017 and December 2019 was one graceful rock crab (*Metacarcinus gracilis*). No invertebrate species at risk are expected to occur in the Project Work Areas (Hemmera 2018; Anchor QEA 2019c).

Marine vegetation was sparse within the Project Work Areas. Where present, vegetation consisted of unidentified red bladed algae (5%), unidentified species of diatoms (up to 90%), and tube snout (*Aulorhynchus flavidus*, 2%).

Several species of salmonids and Pacific herring may migrate through the Project Work Areas. Pacific herring are not expected to spawn in the Project Work Areas but may spawn in adjacent areas. Other marine fish species, such as flatfish, have the potential to occur in the Project Work Areas.

Within the Project Work Areas, smaller marine mammals can potentially pass through, including harbour seal, California sea lion, Steller sea lion, Dall's porpoise, and harbour porpoise. Larger marine mammals, such as killer whales, are not likely to be present in the Project Work Areas but may occur near the entrance of the harbour. Seven of these marine mammal species are known or have potential to occur in Esquimalt Harbour, four of which are species at risk (Section 8.3).

Marine birds may occur near the Project Work Areas, but the project is not expected to affect any nesting, as the project duration is short and conducted all from water-based equipment.

2.3 Social and Cultural Environment

Esquimalt Harbour is administered by DND and is governed by the Canada Marine Act, the Natural and Man-Made Harbour Regulations (pursuant to the Canada Marine Act), and the Esquimalt Harbour Practices and Procedures (pursuant to the Canada Marine Act). The Queen's Harbour Master (QHM) is the Transport Canada designated Harbour Authority for Esquimalt Harbour. All vessels entering or departing Esquimalt Harbour must contact the QHM Operations on marine VHF channel 10 or by telephone at (250) 363-2160.

Vessels entering and exiting Esquimalt Harbour include naval ships accessing DND Jetties, commercial traffic accessing the Esquimalt Graving dock, pleasure craft of all sizes, and recreational and commercial crab harvesting vessels (Golder 2018).

As per the Esquimalt Harbour Practices and Procedures, all crab harvesting is only allowed outside of the controlled access zones and water lease areas. However, since 2016, Fisheries and Oceans Canada (DFO) has closed Esquimalt Harbour to all harvesting, including commercial, recreational, and Aboriginal crab harvesting (DFO 2018).

The work will not impede recreational or cultural use of the harbour. Ships at anchor must register with QHM Operations and cannot remain at anchor for longer than 2 weeks.

Project Work Areas are located within the asserted traditional territories of the Songhees Nation and the Esquimalt Nation. No heritage resources, including archaeological sites or area of archaeological potential, have been identified in the Project Work Areas.

3 Roles and Responsibilities

This section describes the roles and responsibilities of DND, PWGSC, and the Contractor for implementing, inspecting, and reporting on the effectiveness of the environmental mitigation measures. The team organization and communication structure are illustrated in Figure 4. Appendix C (Table 1) provides the key contact information for staff that will serve in these roles for the Project.

3.1 Department of National Defence

DND is the proponent of the Project and is the overall authority. DND is responsible for the overall compliance with federal and provincial legislation. All communications with DND are to go through PWGSC. All communications with outside regulatory agencies are to go through DND, except as required by relevant laws and regulations. For example, in the event of a spill the responsible person or company will report the spill in accordance with the British Columbia (BC) Provincial Spill Reporting Regulation as described in Section 5.2.10.

DND staff includes the following:

- **DND Project Director:** Manages Project development activities, including the preparation of documents necessary to obtain departmental approval and funding allocation; ensures that the Project objectives are aligned with the established operational requirements and are maintained throughout Project completion.
- **DND Project Leader:** Represents the DND on all communications internally with the Project team and externally with stakeholders regarding the Project; also responsible for all detailed day-to-day activities and functions of the Project for DND.
- **Queen's Harbour Master:** Manages and oversees the movement of vessels in the harbour. The Contractor and Departmental Representative (DR) will liaise with the QHM of the Project schedule and of any changes in activities that might affect operations, such as schedule changes or unanticipated construction activities that may impact operations (e.g., vessel interference).

3.2 Public Works and Government Services Canada

PWGSC is DND's representative for the Project (PWGSC Representative) and is responsible for day-to-day compliance with environmental mitigation measures, permits, approvals, and authorizations. PWGSC may retain an EM to confirm that environmental management measures and controls are implemented in accordance with regulatory approvals, authorizations and permits, environmental components of the contract requirements, including this EMP, and the EPP prepared by the Contractor. The Contractor(s) and the EM will communicate with PWGSC about environmental aspects of the Project. All communications to DND will go through PWGSC.

Environmental monitoring will be conducted by or under the supervision of a Qualified Professional (QP). For the purposes of this EMP, a QP is defined as a person who is registered and/or licensed in the relevant jurisdiction with his or her appropriate professional association and/or licensing authority, acts under that professional association's and/or licensing authority's code of ethics, and is subject to disciplinary action by that professional association and/or licensing authority, and through suitable education, experience, accreditation, and knowledge can be reasonably relied on to provide advice within his or her area of expertise.

PWGSC staff includes the following:

- **PWGSC Program Manager:** Responsible for coordinating the delivery of the entire Project and managing the entire Project team.
- **Departmental Representative:** Serves as PWGSC's single point of contact for coordination with the contractor and technically and administratively manages the contract (e.g., coordinate/facilitate Project planning and scheduling; manage consultant team and contractor in day-to-day implementation of the Contract; reviews and accepts all Project submittals; review, coordinate, and manage advisory response to Requests for Information (RFIs); issues stop-work order when necessary; monitors and controls, through surveillance of Project activities, ensuring that relevant portions of the Project are implemented; interface directly with the Contractor to maintain an awareness in planning and scheduling of QA/QC processes).
- **PWGSC Health and Safety Coordinator:** Reviews the contractor's submitted Health and Safety Plan (HASP) and periodically visit the site to assess the Contractor's compliance, as well as DND safety protocols.

3.3 Consultant

The Consultant is Anchor QEA, the Designer of Record for the Project. The Consultant serves in an advisory role for technical support, construction management, and environmental monitoring. The Consultant will review submittals from the Contractor to determine if the submitted items and revisions are consistent with the design objectives, and will provide feedback, as appropriate. The consultant will also provide technical review, input, and recommended response language to the DR on RFIs and other Contractor inquiries.

In addition, the Consultant will be responsible for 1) field inspection and monitoring of the contractor's construction activities, for QA purposes only, and 2) environmental monitoring during construction (to confirm that environmental management measures and controls are implemented in accordance with regulatory approvals and environmental components of the Contract requirements, and as described in this EMP).

3.4 External Stakeholders

The External Stakeholders include the First Nations, Provincial Agencies, DFO, Environment Canada, and the community. These are generally considered external communications for the purposes of the Project, and the DND Project Leader will respond to any requests from the External Stakeholders regarding on-site activities associated with the Project and coordinate with PWGSC, the Consultant, and Contractor as necessary. The DND Project Leader will also inform the External Stakeholders of any changes in the scope of the Contract that will affect them. The Communications Plan, as part of the Project Management Plan, outlines further details on liaising procedures with External Stakeholders (Anchor QEA 2018).

All communications with External Stakeholders and/or the public will be addressed by DND for on-site activities and by the Contractor for all off-site activities. The Consultant and PWGSC will review the Communications Plan to understand intended lines of communication, but all inquiries for both on and off-site communications will go through DND. As needed, the Consultant will also be available to assist PWGSC with support for public meetings/discussions associated with on-site construction activities.

3.5 Contractor(s)

The Contractor(s) will be responsible for the actions of its agents, employees, and subcontractors, and thus will undertake all reasonable actions to have environmental protection measures in place and working effectively throughout the Project Work Site. The contractor(s) will:

- Adhere to requirements set out in regulatory authorizations, approvals and permits, and contract requirements, including this EMP.
- Undertake effective communication with work crews and subcontractors, such that environmental responsibilities and requirements are understood prior to the commencement of work and are implemented during the work. This will include disseminating information from orientation and other meetings to personnel not in attendance at those meetings.
- Retain an Environmental Specialist with appropriate skills to prepare the EPP(s) and evaluate performance against the requirements outlined in regulatory approvals, authorizations, and permits, as well as environmental protection goals provided in this EMP and the contract requirements. The environmental specialist will also conduct environmental monitoring to verify and document that the objectives of environmental legislation, terms and conditions of regulatory permits and approvals, and environmental contract requirements, including this EMP, are being met. Environmental monitoring tasks will include participating in meetings, conducting work site inspections, and reporting. The Contractor's Environmental Specialist will also be a QP (as defined in Section 3.2).
- Use equipment and implement work procedures and controls to prevent and/or reduce work-related disturbance to environmental, social, heritage, archaeological, and cultural resources.

- Take preventative and corrective measures in response to non-conformance with regulatory permits, approvals and the contract requirements, including this EMP.
- Immediately respond to environmental incidents (defined in Section 6.0).

3.6 Reporting

3.6.1 Field-Based Inspection and Construction Monitoring Reporting

The field-based inspection and construction monitoring to be conducted by Anchor QEA field inspector will include the following:

- Monitor compliance with Contract requirements, ensuring that each item of work complies with the Specifications and Drawings.
- Identify activities that do not comply with the Contract requirements and reason(s) why the work was not completed in accordance with the requirements of the Contract.
- Coordination with the DR and Contractor will be required to decide the appropriate course of action to verify that completed work meets the intent of the Contract and project objectives.
- Regularly document construction progress or lack thereof.

3.6.1.1 Daily Field Activity Reporting

To keep track of details, the Anchor QEA field inspector will maintain a Daily Field Activity Report (DFAR), using their own company standard formats. An example form for Anchor QEA's DFAR is provided in Appendix B. The DFAR will record all items of importance regarding the work performed, including the following:

- **Conditions.** Conditions (e.g., weather, predicted tides, etc.), and any adverse conditions may have affected the Contractor's operations.
- **Activities.** Details of each activity (e.g., schedule, location); specific activity observation requirements are detailed in Section 8.3.
- **QA/QC Activities.** All QA/QC activities performed by the Contractor and/or PWGSC's subcontractors on days when these activities are performed.
- **Difficulties.** All difficulties encountered by field staff or the Contractor, rationale for the difficulty and any resolution that may have been reached by the DR and Contractor.
- **Deficiencies and Violations:** Construction safety incidents, labor, etc.
- **Progress Information.** Any delays, actions taken, and actions contemplated through coordination with the DR and Contractor.
- **Construction Downtime.** Daily and cumulative amount of time tracked as Contractor's downtime.
- **Equipment.** Arrival at the site and shipment from the site of each major item of equipment (by manufacturer, model, serial number, and capacity), equipment in use and any idle equipment.

- **Tests.** All tests and results thereof.
- **Photo Log.** Key photographs to illustrate the work conducted.

Reporting of the environmental monitoring (as described in Section 3.6.2.2) will be appended to the DFAR. The DFAR will be submitted as one compiled daily report to the DR on the next working day following completion of the construction activities/monitoring.

3.6.2 Environmental Reporting

3.6.2.1 Spill and Environmental Incident Reporting

Refer to Section 5.2.10 for spill reporting procedures, and Section 6.0 for environmental incident reporting.

3.6.2.2 Daily Environmental Monitoring Reporting

Environmental inspection and monitoring reports will be prepared by the contractor, appended to the DFAR, and submitted daily to the DR. Example report templates are provided in Appendix B. Reports may be submitted, as required, to regulatory agencies, First Nations, and public stakeholders by DND. Daily environmental monitoring reports will include, at a minimum, the following information:

- A description of construction activities undertaken during the reporting period
- A description of site inspections and monitoring activities undertaken
- Results of testing (e.g., water quality data)
- A description of environmental issues and corresponding mitigation measures implemented, and communication steps taken
- Tracking of emerging and outstanding environmental issues
- Photos documenting construction activities, environmental issues, and corresponding mitigation measures
- Reporting on environmental incidents (e.g., spills) and corrective action taken

3.6.3 Completion Reporting

Anchor QEA will prepare a completion report following completion of the Project. The report will summarize the Project activities conducted for environmental and construction monitoring, as well as field inspection. The completion report will include representative site photographs, a summary of monitoring data collected, a summary of construction activities including verification of depth of material, environmental management and issues during construction, how these issues were managed, and mitigation measures. GSI deliverables will be provided in Formation Safety and Environment standard requirements.

4 Regulatory Setting

Table 1 provides a summary of federal and provincial environmental legislation and municipal bylaws, as well as authorizations, permits and approvals issued for the Project (current to June 2019). This legislation provides the framework for the procedures described in Section 5.0 of this EMP. This section is not necessarily exhaustive or all-inclusive; it is the Contractor's responsibility to understand the regulatory context governing their activities and to act accordingly. Should clarification of any environmental issue be required, the Contractor should consult the original regulation or legislative document.

If additional authorizations, permits or approvals are required, the Contractor(s) will be provided with copies received by DND from regulatory agencies and will be responsible for complying with the terms and conditions specified within these documents as well as the provisions of the statutes under which the approvals have been issued. DND and the Contractor(s) will be required to keep copies of all Project approvals, authorizations, and permits available for inspection as needed at the Project Work Areas.

4.1 Applicable Best Management Practices and Guidelines

Table 2 provides a list of applicable BMPs and guidelines that apply to the Project.

5 Environmental Requirements

This section is an overview of environmental requirements of the Project and is intended to be read in conjunction with environmental legislation, authorizations, permits, and approvals issued for the Project, BMPs and guidance documents (Section 4.0), and the contract requirements for the Project, which includes this EMP. The environmental requirements are based on potential Project effects identified in the EED Report and other relevant environmental legislation and bylaws.

5.1 Environmental Protection Plan

Prior to the commencement of the Project, the Contractor will prepare an EPP that demonstrates how they will satisfy the requirements set out in this EMP. The Contractor will retain a QP to prepare the EPP. The EPP will include the following information:

- Organization chart and names of persons responsible for EPP implementation and compliance
- Training requirements
- Site and activity-specific measures that will be implemented, equipment that will be used, and maintenance that will be undertaken
- Contingency procedures in the event that environmental protection goals are not being met
- Drawings, for example, showing work and storage areas

The EPP will include, at a minimum, procedures for the following:

- Dust and emissions control
- Water quality protection
- Spill prevention and response
- Silt curtain control
- Sediment and erosion control
- Non-hazardous waste storage and disposal
- Monitoring for presence of herring and marine mammals a as well as triggers for modifying work
- Archaeological chance find management

The EPP will be part of submissions by the contractor and will be reviewed by DND/PWGSC and must be accepted prior to construction to make sure it meets the intent of the EMP. The contractor will address any deficiencies in the EPP.

5.2 Protection Measures

5.2.1 Air Quality

References

- The Township of Esquimalt Maintenance of Property and Nuisance Regulation Bylaw, 2014, No. 2826.
- EED Report: DND Wood Waste Remediation Pilot Project
- Contract technical specifications

Mitigation Measures and Monitoring

Air Quality Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
Dust and Emissions Control Plan will include specific measures that will be undertaken to meet prohibitions outlined within relevant municipal bylaws and exposure limits outlined within the Occupational Health and Safety Regulation.	Contractor	Before work commences
Mitigation Measures		
Implement dust control measures (such as the use of water as a dust suppressant) as outlined in the design specifications.	Contractor	On-going during work
Vessels and equipment will be well maintained and in good working order.	Contractor	On-going during work
Efforts will be made to minimize exhaust emissions. The contractor will be encouraged to use clean alternative fuels for vessels and equipment. Idling of vessels and equipment will be minimized.	Contractor	On-going during work
Monitoring		
Project activities will be observed for conformance with the Contractor's Dust and Emissions Control Plan.	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	On-going during work

5.2.2 Water Quality

References

- Fisheries Act
- Canada Shipping Act and associated regulations
- Environmental Management Act (EMA)
- Capital Regional District Bylaw No. 2922 (Consolidated)
- WQMP (Appendix A)
- EED Report: DND Wood Waste Remediation Pilot Project
- Contract technical specifications

- Formation Safety and Environment Management System Directives for spill response, storage tanks, and effluent management

Mitigation Measures and Monitoring

Water Quality Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
Water Quality Protection Plan as part of the EPP which will include specific measures that will be undertaken and equipment to be used to meet the water quality objectives outlined in the WQMP for material placement.	Contractor	Before work commences
Spill Prevention and Response Plan as part of the EPP which will include specific measures that will be undertaken to prevent and respond to spills.	Contractor	Before work commences
Silt Curtain Control Plan as part of the EPP to describe how the silt curtain will be installed, maintained and inspected, if required to protect water quality. If required, silt curtain should be inspected daily from the surface of the water.	Contractor	Before work commences
Sediment and Erosion Control Plan as part of the EPP which will include specific measures that will be undertaken and equipment to be used to prevent transport and erosion of barge sand during periods of rain and/or wind.	Contractor	Before work commences
Mitigation Measures		
Material Placement		
Sand cover material must be clean, fine-grained sand material, free of organic material as similar in nature to the native sediment within the Work Site as practical and must conform to specific gradations as indicated in the specifications.	Contractor. Results will be review and approved by the PWGSC Representative prior to use	Before material placement
As outlined in the specifications, the contractor must describe in its construction work plan what means, methods and procedures will be used to prevent water quality requirement exceedances, and what contingency actions will be taken to restore compliance.	Contractor	Before material placement
A silt curtain may be required to be used during material placement activities if water quality performance requirements outlined in the WQMP cannot be met without a silt curtain.	Contractor	On-going during work
As outlined in the specifications, the contractor must employ placement means and methods that will avoid resuspending sea bed sediment during placement activities and prevent excessive mixing of the placed material with the sea bed sediment.	Contractor	On-going during work
As outlined in the specifications, the contractor must not place material by rapid dumping of a barge load; rather, it must be placed in a controlled manner.	Contractor	On-going during work
Monitoring		
Water quality monitoring requirements will be undertaken as outlined in the WQMP.	Contractor’s Environmental Specialist	On-going during work
Implementation of monitoring procedures outlined in the WQMP to verify that the performance objectives are being met and employ	Contractor	On-going

Water Quality Protection Measures	Responsibility	Timing
management decisions in the event that the performance objectives are not met.		

5.2.3 *Marine Vegetation, Invertebrates, and Fish and Fish Habitat*

References

- Fisheries Act
- DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat
- EED Report: DND Wood Waste Remediation Pilot Project

Mitigation Measures and Monitoring

Marine Vegetation, Invertebrates, and Fish and Fish Habitat Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
The EPP will include Contractor monitoring requirements for fish and triggers for modifying work.	Contractor	Before work commences
Mitigation Measures		
All Work Activities		
Before entering Esquimalt Harbour, remove plants, algae, and animals attached to or inside vessels to help avoid the spread of marine invasive species.	Contractor	Before work commences and ongoing during work
Monitoring		
General		
Work is scheduled to occur within the least risk window for fish (DFO in-water work window). However; if delays occur and the work window falls between 15 February and June 1, a qualified EM will visually observe from the surface of the water for spawning herring (i.e., schools of herring depositing eggs or releasing milt) and herring eggs within and adjacent to the Project Work Site. Monitoring for spawning herring and herring eggs will be undertaken every day that in-situ water quality monitoring is conducted. If herring spawning is observed within in-water work areas, the PWGSC Representative will be informed and work with potential to affect herring egg masses or emergent larvae will be stopped for 10 to 14 working days. If herring eggs are found on equipment, the PWGSC Representative will be informed, and work will be stopped and will not resume until after eggs have hatched.	PWGSC's EM	During in-water works between February 15 and June 1
For work within a silt curtain, if large schools of fish are observed in the enclosed silt curtain, in-water work should be temporarily suspended, and the silt curtain opened to allow fish to escape.	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	During in-water works

Material will be placed in such a way as to not increase the risk of mortality and or injury to fish within the Work Site. The material will be placed carefully by clamshell barge either near the water surface, below the surface within approximately 1 m of the substrate), or by some method approved by the Contractor, PWGSC, and the EM.	Contractor	On-going during work

5.2.4 Marine Mammals

References

- Marine Mammal Regulations
- Species at Risk Act
- DFO's "Watching Marine Wildlife" (DFO 2019)
- EED Report: DND Wood Waste Remediation Pilot Project
- Formation Safety and Environment Management System Directives

Mitigation Measures and Monitoring

Marine Mammal Protection Measures	**Responsibility**	**Timing**
Environmental Protection Plan Components		
The EPP will include Contractor monitoring requirements for marine mammals and triggers for modifying work.	Contractor	Before work commences
Mitigation Measures		
Vessels will follow standard boat operation when in proximity to marine mammals in accordance with the Marine Mammal Regulations and DFO's guidance for watching marine wildlife: • Under no circumstances, other than in the case of an emergency, will vessels approach within 200 m of any killer whale or within 100 m of all other whales, dolphins and porpoises. For all other marine mammal encounters, vessels will avoid approaching within 100 m of a marine mammal in the water or a seal/sea lion haul out. • As safe navigation allows, reduce speed to less than 7 knots when within 400 m of the nearest whale. Avoid abrupt course changes. • If seals or sea lions are encountered, reduce boat speed, minimize wake, wash and noise, and then slowly pass without stopping. Avoid sudden changes in speed and direction. • Pay attention and move away, slowly and cautiously, at the first sign of disturbance or agitation. • Do not disturb, move, feed or touch any marine wildlife, including seal pups. • Emergency collisions with marine mammals, or a sighting of an entangled or injured marine mammal, are to be immediately reported to Coast Guard (VHF Channel 16) or Whale Emergency Network (1-800-465-4336). Additionally, DND	Contractor	On-going during work

Formation Safety and Environment needs to be contacted for all marine mammal issues.		
If a marine mammal is observed in the enclosed silt curtain area, in-water work should be suspended, and the silt curtain opened to allow it to escape.	Contractor	On-going during work
Monitoring		
Marine mammal monitoring will be implemented during all in-water activities as a component of the environmental monitoring, with presence/absence communicated to the contractor.	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	During all in-water activities
Visual observations of work within a silt curtain will be made to verify that marine mammals do not become entrapped. If a marine mammal is observed in the enclosed area, the PWGSC Representative will be informed, and in-water work will be suspended, and the enclosed area opened to allow the mammal to leave.	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	On-going during work

5.2.5 Birds

References

- Migratory Birds Convention Act
- Wildlife Act
- EED Report: DND Wood Waste Remediation Pilot Project
- DND Formation Safety Environment Management System (FSEMS) Natural Resource Management Directive E5

Mitigation Measures and Monitoring

Bird Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
The EPP will include Contractor monitoring requirements for birds and triggers for modifying work.	Contractor	Before work commences
Mitigation Measures		
If a bird is observed nesting nearby on Inskip Island, an appropriately qualified biologist should be contacted to evaluate whether the work activities may disturb nesting activities.	Contractor	On-going during work
Monitoring		
Monitoring for signs of nesting, injured or dead birds will be undertaken by a qualified EM.	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	On-going during work

5.2.6 Navigation

References

- Esquimalt Harbour – Practices and Procedures (Royal Canadian Navy 2019)

- Canada Shipping Act and its associated regulations
- Contract technical specifications
- EED Report: DND Wood Waste Remediation Pilot Project

Mitigation Measures and Monitoring

Navigation Protection Measures	Responsibility	Timing
Navigation Control Plan		
The Contractor must submit a Navigation Control Plan describing means and methods by which vessel movements and harbour control procedures and practices will be completed and monitored.	Contractor	Before work commences
Mitigation Measures		
The work will be conducted in accordance with the Esquimalt Harbour Practices and Procedures.	Contractor	On-going during work
Material transported by barge into, within, and out of Esquimalt Harbour requires the Contractor to coordinate directly with QHM pursuant to the Canada Marine Act. The PWGSC Representative requires 72-hour notification of all material transported by barge into or out of Esquimalt Harbour. Material barge transport movements within Esquimalt Harbour require a 24-hour notification to the QHM.	Contractor	As necessary
Work will be phased to minimize disruptions to other vessel traffic which includes mitigations in the specifications (i.e., stand-by time).	Contractor	On-going during work
QHM will be consulted for overnight moorage of vessels and provided points of contact for any emergencies involving the vessels.	Contractor	On-going during work
Additional emergency docking and navigation management procedures outlined in the Navigation Control Plan will be followed.	Contractor	On-going during work
Monitoring		
PWGSC and QHM will be monitoring the contractor’s execution of work including navigation in Esquimalt Harbour.	PWGSC’s EM and QHM	On-going during work

5.2.7 In-Air Noise, Light and Odour

References

- The Township of Esquimalt, Maintenance of Property and Nuisance Regulation Bylaw, 2014, No. 2826.
- The Town of View Royal: Noise Bylaw No. 523, 2003.
- The City of Colwood: Colwood Noise Bylaw, Bylaw No. 1594, 2016.
- The City of Colwood: Nuisance (Controlled Substance) Bylaw No. 851, 2006
- EED Report: DND Wood Waste Remediation Pilot Project
- Contract technical specifications

Mitigation Measures and Monitoring

In-Air Noise, Light and Odour Protection Measures	Responsibility	Timing
Mitigation Measures		
The Contractor must comply with local ordinances regarding noise control while conducting activities at the Work Site.	Contractor	On-going during work
The contractor is to meet the intent of Township of Esquimalt, Colwood, and View Royal Noise By-laws at the Work Site boundary or modify work activities. Noise restrictions apply within the hours of 7:00 p.m. to 7:00 a.m. between Monday and Saturday and at all times on Sundays and statutory holidays. The City of Colwood also limits creating noise or sound by the operation of drills, compressors or other equipment used to prepare land for blasting before 8:00 a.m. or after 5:00 p.m., Monday to Saturday, and at all times on Sundays and Statutory Holidays. The contractor must undertake noisier work activities during daytime hours and modify activities based on noise monitoring and resident feedback.	Contractor	On-going during work
Construction equipment must be operated with exhaust systems in good repair to minimize noise.	Contractor	On-going during work
Make sure that noise control devices (i.e., mufflers and silencers) on construction equipment are properly maintained.	Contractor	On-going during work
The contractor must implement use of lighting shrouds for work to be completed during night-time hours to minimize lighting disruptions to local residents.	Contractor	On-going during work
Monitoring		
Air noise monitoring may be conducted on an as needed basis if complaints are received, to verify that specified bylaw noise levels are met. Complaints received about noise will be reviewed to evaluate the need to implement additional noise monitoring or modifications to activities.	DND/PWGSC	On-going during work

5.2.8 Spill Prevention and Emergency Response

References

- Fisheries Act
- Migratory Birds Convention Act
- Canada Shipping Act
- EMA and Spill Reporting Regulation
- Esquimalt Harbour Practices and Procedures
- EED Report: DND Wood Waste Remediation Pilot Project
- FSEMS Spill Response Directive SE5
- FSEMS Emergency Reporting Directive SE1
- Contract technical specifications

Mitigation Measures and Monitoring

<table>
<tr><th>Spill Prevention and Emergency Response Protection Measures</th><th>Responsibility</th><th>Timing</th></tr>
<tr><td colspan="3">Environmental Protection Plan Components</td></tr>
<tr><td>The Spill Prevention and Emergency Response Plan which will include specific measures that will be undertaken, and equipment used, to prevent spills and to respond to emergencies. At a minimum, the plan will include:
Procedures for spill prevention including refueling of marine equipment within the Work Site and within Esquimalt Harbour.
Procedures, response actions, and reports to be used in the event of an unforeseen spill of regulated substance, including containment, recovery, and clean-up procedures
Spill incident report forms
On-site spill/release clean-up materials, equipment, and locations
Names and telephone numbers of persons and organizations that may be contacted in the event of a potential environmental incident, including PWGSC/ DND and representatives, the Contractor's Environmental Specialist(s), Contractor(s) representative and local emergency response organizations.
The Plan will be available for inspection by the PWGSC Representative and regulatory agency personnel and will be posted at conspicuous locations in the work site and in relevant machinery.</td><td>Contractor</td><td>Before work commences</td></tr>
<tr><td colspan="3">Mitigation Measures</td></tr>
<tr><td>To reduce the risk of fluid spills reaching the aquatic environment and to protect worker safety, the Contractor will follow, at a minimum, the following mitigation measures:
Vessels and machinery will arrive on-site in a clean/good condition and maintained free of fluid leaks.
All work will be conducted in a manner that does not result in the deposit of a toxic or deleterious substance into waters frequented by fish.
All field personnel will be made aware of the location of emergency spill response equipment and the procedures necessary to contain spills of any fluid.
Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.
Secondary containment trays will also be used for any products that have potential to leak or spill, such as gasoline, diesel fuel, oil, paints, and solvents
Appropriate spill control equipment will be kept on site at all times during the work.
Operating personnel are to be familiar with the contents and use of spill response equipment and the location and operation of emergency 'shut-offs'.</td><td>Contractor</td><td>On-going during work</td></tr>
</table>

• Materials contaminated by a Project-related release of deleterious substances will be recovered and placed into containment for subsequent off-site disposal at an appropriate facility.		
Monitoring		
The work area will be inspected for effectiveness of control measures put into place by the Contractor(s).	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	On-going during work
Reporting		
For spills to the marine environment, the Contractor will immediately notify the PWGSC Representative upon detection of the spill. As per the Esquimalt Harbour Practices and Procedures, the Fisheries Act, the Canada Shipping Act and the EMA, the Contractor will also notify Emergency Management BC (1-800-663-3456) and the Queen's Harbour Master (250-363-2160). For spills to land, refer to the Spill Reporting Regulation to determine if the spill is reportable to Emergency Management BC. If the spill to land is of a reportable size, the Contractor will report the spill to the PWGSC Representative and Emergency Management BC (1-800-663-3456). A written report will be provided to the PWGSC Representative and applicable government agencies within 24 hours of any spill to the marine environment, or a reportable spill to land. Additional reports will be to the PWGSC Representative and applicable government agencies as per the Spill Reporting Regulation (Amended October 2018) of the EMA.	Contractor	On-going during work

5.2.9 Non-Hazardous Waste Management

References

- Formation Safety and Environment Management System Directives
- Contract technical specifications
- Canada Marine Act
- Canada Shipping Act
- Transportation of Dangerous Goods Act
- BC Transportation of Dangerous Goods Act
- Navigation Protection Act
- Fisheries Act
- EMA
- Contaminated Sites Regulation (pursuant to EMA)
- EED Report: DND Wood Waste Remediation Pilot Project
- Contract technical specifications

Mitigation Measures and Monitoring

Non-Hazardous Waste Management Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
Specific measures to be undertaken and equipment to be used to manage nonhazardous waste will be described. The measures will address, at a minimum: • A list of approved locations that will accept recyclable and non-recyclable solid nonhazardous construction wastes to be generated during the Work • The types and quantities of materials to be recycled, as well as those requiring disposal, names of construction waste material haulers, and approved disposal facilities that meet the requirements of the EMA.	Contractor	Prior to work commencing
Mitigation Measures		
Refuse and debris related to the Work will be collected and disposed of at approved disposal facilities in compliance with laws and requirements of all authorities having jurisdiction.	Contractor	On-going during work
The Contractor will not dump, burn, bury, or allow others under its control to dump, burn, or bury construction wastes and refuse associated with the Work. Should refuse or construction wastes related to the Work be dumped, the Contractor will immediately act to clean up and remove the waste material to an approved location.	Contractor	On-going during work
The Contractor's work area will have a recycling and waste management program in place. Among other things, clearly labelled garbage bins with lids and recycling containers must be made available for food waste and recyclable office waste. The Contractor will arrange for the placement of garbage receptacles and recycling containers at key locations within the Work Site such as in the vicinity of the laydown area. Garbage bins kept outside will have lids sufficient to keep wildlife from accessing the waste inside.	Contractor	On-going during work
The Contractor will establish regular clean up and disposal programs to prevent the unnecessary accumulation of excessive construction waste and refuse.	Contractor	On-going during work
Monitoring		
The work area will be inspected for effectiveness of control measures put into place by the Contractor(s).	Contractor's Environmental Specialist. PWGSC's EM may do spot checks	As necessary

5.2.10 Hazardous Materials Handling and Storage

References

- BC Fire Code
- National Fire Code of Canada
- Transportation of Dangerous Goods Act
- BC Transportation of Dangerous Goods Act

- Workplace Hazardous Materials Information System
- EMA
- Hazardous Waste Regulation (pursuant to EMA)
- BC Field Guide to Fuel Handling Transportation & Storage
- Formation Safety and Environment Management System Directive
- EED Report: DND Wood Waste Remediation Pilot Project
- Contract technical specifications

Mitigation Measures and Monitoring

Hazardous Materials Handling and Storage Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
Specific measures that will be undertaken and equipment that will be used to manage hazardous materials will be described, including: • The proposed location and types of facilities where hazardous materials will be stored and handled, and where construction equipment will be refueled. • Details of containment facilities for fuels, oils, antifreeze, and other liquid forms of hazardous materials such that spills can be contained and collected before contaminants enter soils or reach any watercourse or storm water system. This information may be included in the Health and Safety Plan prepared by the Contractor for the Project.	Contractor	Prior to work commencing
Mitigation Measures		
Hazardous materials will be disposed of in accordance with law and the requirements of all authorities having jurisdiction.	Contractor	On-going during work
Should the on-site storage of hazardous materials such as gasoline or oils be required, secondary containment capable of holding at least 110% of all hazardous materials stored within will be in place.	Contractor	On-going during work
Above ground storage tank areas will be bermed, lined, and have in place appropriate drainage systems for removing accumulated rainwater.	Contractor	On-going during work
Current Safety Data Sheets (SDS)[1] and an inventory will be maintained for all controlled substances used, stored, and handled on-site associated with Project activities.	Contractor	On-going during work
An area will be designated, as required, for the transfer or temporary storage of hazardous materials and wastes. The area will be clearly labelled and controlled in accordance with Workplace Hazardous Materials Information System and other statutes.	Contractor	On-going during work
Where construction activities involve the handling, storage, and removal of hazardous waste, the Contractor(s) will maintain the following records: • Inventories of types and quantities of hazardous waste generated, stored, or removed	Contractor	On-going during work

• Manifests identifying hazardous waste haulers and disposal destinations • Disposal certification documents		
Personnel will be trained in the handling and transportation of dangerous goods and controlled substances.	Contractor	On-going during work
Monitoring		
The work area will be inspected for effectiveness of control measures implemented by the Contractor(s).	Contractor's Environmental Specialist. DCC's EM may do spot checks	As necessary

Notes:
1. Formerly called "material safety data sheets" or MSDS.

5.2.11 Archaeology

References

- Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under the *Canadian Environmental Assessment Act, 2012* (March 2015) (Canadian Environmental Assessment Agency 2015)
- Heritage Conservation Act
- B.C. Archaeological Impact Assessment Guidelines. (Archaeology Branch, Ministry of Forests, Lands, Natural Resource Operations and Rural Development 1989)
- EED Report: DND Wood Waste Remediation Pilot Project

Mitigation Measures and Monitoring

Archaeology Protection Measures	Responsibility	Timing
Environmental Protection Plan Components		
The EPP will include Archaeological Chance Find Management procedures	Contractor	Before work commences
Mitigation Measures		
Archaeological Chance Find Management Guidelines are to be followed if sediment will be handled (i.e., removal if a test area is overfilled, etc.). Totes for storage and protection of items will be provided along with a cedar box and blanket for HR if identified.	Contractor	As necessary
Monitoring		
Monitoring of excavated sediments, if applicable, will include provisions for the collection of observed historically, archaeologically, or paleontologically significant artifacts, features, and faunal materials, as well as human remains.	PWGSC's Archaeologist will conduct periodic monitoring and respond to chance find call-outs.	On-going during work

5.3 Environmental Site Inspections

Environmental site inspection tasks are outlined in Table 3. These inspections will be separate from inspections carried out by the Contractor as part of their implementation and quality control for the EPP. Environmental site inspections should be undertaken at the beginning of the work and throughout the program thereafter dependent on the activities and equipment on-site. The frequency of inspections may be increased based on direction from PWGSC or based on co-ordination with PWGSC/DND regarding the results of the inspections.

The Contractor is responsible for mechanical inspections by qualified personnel, for maintaining health and safety equipment and procedures for their work, and for maintaining equipment logs (maintenance and inspection) which can be produced upon request to verify that mechanical inspections are being conducted.

6 Environmental Incidents

An environmental incident is an event that has caused, or has the potential to cause:

- Damage to aquatic or terrestrial habitat
- Adverse/harmful effects to fish, wildlife or other environmental resources
- Adverse publicity associated with impacts on the environment
- Violation of statutes or regulatory authorizations
- Environmental damage

Examples of environmental incidents include, but are not limited to:

- Spill to the marine environment or a spill of reportable size under the EMA Spill Reporting Regulation
- Deposit of a deleterious substance
- Serious harm to fish without prior authorization
- Injury to marine mammals or birds

All environmental incidents are to be reported to DND immediately via the PWGSC Representative. Refer to Section 5.2.10 for additional spill reporting requirements to be undertaken by the Contractor. An Environmental Incident Report (EIR) is to be prepared and submitted by the Contractor(s) to provide a timely and accurate internal written notification of environmental incidents to DND. The deadline for submission of the initial spill report to EIR is within 24 hours following an incident. The EIR will include the following information:

- Who reported, and responded, to the incident
- A description of the incident (e.g., date, time, cause, personnel present, type of material spilled, environment affected)
- Actions taken to mitigate the incident
- Preventative measures implemented following the incident
- Photo documentation
- Spill Report Number issued by Emergency Management BC if applicable

The written EIR is not intended to take the place of verbal notification of an incident requiring immediate action or further notification of regulatory agencies (e.g., a spill that affects neighbouring properties or requires assistance in the supply or deployment of containment equipment).

As well as internal reporting to PWGSC and DND and external reporting to authorities listed in Section 5.2.10, it may be necessary in some situations to report an environmental incident to local municipal environmental representatives (Township of Esquimalt, City of Colwood) and owners of neighbouring properties (e.g., DND, QHM). DND will provide these notifications.

In the event that the incident is considered an emergency, and the PWGSC Representative is not available, or where a delay in notification could result in environmental damage or risk to human health, PWGSC's EM will provide these notifications. Notification of corrective measures and closure of the incident may also be reported, as per direction from DND.

7 Environmental Monitoring Implementation Plan

The purpose of an Environmental Monitoring Implementation Plan is to describe how the monitoring of environmental performance objectives, potential environmental risks, and mitigation measures identified in the EMP will be implemented. Due to the limited scope and short duration of the Project, a separate Environmental Monitoring Implementation Plan was not prepared for this effort, and the implementation plan steps are provided in this EMP.

The Project consists of the following components:

- Mobilization and demobilization
- Placement of material
- In-water transportation (of placement material)

To assure compliance of environmental requirements (Section 5), the environmental monitoring for this program will include the elements described in the subsequent sections.

7.1 Water Quality Monitoring

Water quality will be monitored daily following the WQMP provided in Appendix A.

7.2 Pacific Herring Monitoring

The Pacific Herring spawning season is typically mid-March to mid-April (DFO 2019). The construction window should not overlap with the spawning season; however, as a protective measure, visual observations for herring spawn will occur during construction.

The following monitoring will be undertaken for Pacific herring:

- The EM will visually observe from the surface of the water for spawning herring (i.e., schools of herring depositing eggs or releasing milt) and herring eggs within the in-water project areas. Monitoring for spawning herring and herring eggs will be undertaken every day that in situ water quality monitoring is being conducted. Milt should be visible as white opaque water from the surface of the water, and attached eggs may be more visible on vegetation or equipment at low tide. Spawning herring may also attract birds and marine mammals, which may be observed from the surface of the water.
- If herring spawning is observed within in-water project areas, the EM will inform PWGSC and work with the potential to affect herring egg masses or emergent larvae will be stopped until safe to resume work.

If herring eggs are found on equipment, the EM will inform PWGSC, and work will be stopped and will not resume until after eggs have hatched.

7.3 Marine Mammal Monitoring

Several marine mammal species are known to occur in and around Esquimalt Harbour, four of which are Species at Risk (Table 4). Construction activities will not generate significant underwater noise. If marine mammals are encountered during material placement, the protection measure outlined in Section 5.2.5 will be implemented.

7.4 Bird Monitoring

Monitoring for signs of injured or dead birds will be undertaken by a qualified EM.

7.5 In-Air Noise, Light, and Odour Monitoring

In the event that complaints regarding in-air noise, light, or odour from the project are received from neighbouring municipalities (i.e., Colwood, View Royal, and Esquimalt), monitoring will be undertaken to determine if applicable bylaws are being followed. If bylaws are not being followed, the EM will discuss potential mitigation measures with PWGSC and the contractor.

7.6 Non-Hazardous and Hazardous Waste Management

Spot checks on equipment and non-hazardous/hazardous material storage will be conducted by a qualified EM to ensure waste management control measures are put into place by the Contractor(s).

8 Construction Quality Assurance Plan

The purpose of this section is to document construction management requirements and outline communication pathways for PWGSC and its project consultants responsible for implementation, administration, and monitoring of the Project. Due to limited scope and short duration of the Project, a separate Construction Quality Assurance Plan was not prepared for this effort.

8.1 Project Construction Activities

The key construction activities and sequencing for the Project provided in this section are intended to be conceptual (in the general order of occurrence, as provided in Specification Section 01 11 55 [General Instructions]) and may be modified by the Contractor, for acceptance by PWGSC, as needed to complete the work. Specific construction activities to be performed as part of the Project include the following:

- Mobilization, approval of pre-construction submittals and materials, and pre-construction surveys
- Material placement
    - Practice placement in Work Area 2 and approval of work by the DR
    - Material placement in Work Area 2
        - Test areas must be completed in the following order: test areas 7 and 8
    - Material placement in Work Area 1
        - Test areas must be completed in the following order: test areas 1, 2, 3, 4, and 5 (optional work, if needed and as directed by the DR)
    - All work must be completed in one test area before moving on to the next test area
    - The contractor may move on to the next test area while waiting for approval of work in the previous test area
    - A maximum of two test areas may be completed within each work day
- Post-construction surveys should be conducted to verify spatial extent and thickness of placed fill materials within the practice area and each test area once they are completed
- Demobilization, which is anticipated to occur daily, can occur once placement in all test areas has been approved by the DR

The Specification sections and drawings constitute the standard against which the contractor's performance is measured. Criteria for acceptance are either explicitly stated or provided as a measurable standard. Discrepancies between Specification sections of the contract must be addressed through RFI procedures, and clarifications given to the contractor. The work to be performed by the contractor will not only include all the requirements specified throughout each of the Specification sections and drawings, but also information provided in the Unit Price Table (included in the tender documents), site information (including reference drawings, documents, surveys, and other data reports), applicable contract documents, as well as this EMP.

8.2 Construction Management Activities

8.2.1 Contract Award Meeting

As specified in the Specifications, within 10 working days following Contract Award, the DR will request a Contract Award Meeting to discuss and resolve administrative procedures and responsibilities. The DR will select appropriate parties to attend the Contract Award Meeting.

8.2.2 Contractor Pre-Construction Meeting

DND and PWGSC PM, the DR, the Consultant Contractor, the Contractor's site superintendent, and major subcontractors, and supervisors will attend the Contractor pre-construction meeting following the Contract Award Meeting. Per Section 01 11 55 (General Instructions), the Contractor will schedule and organize the Contractor pre-construction meeting following the award of the Contract.

Meeting notes will be compiled by the Contractor and distributed in draft format to all attendees for review and comment. The meeting notes will be updated accordingly and then issued as a final record of the meeting.

8.2.3 DND/PWGSC/Consultant Pre-Construction Meeting

Prior to the start of construction activities (between the Contract Award meeting and the Contractor pre-construction meeting), DND, PWGSC, and the Consultant will meet to review protocol for communication and to run through scenarios for typical daily execution of the Project work. This pre-construction meeting will be used to finalize identification of the Consultant point of contact and to further refine procedures for communication between DND, PWGSC, the Consultant, and the Contractor.

8.2.4 Review of Submittals

Submittals are required from the Contractor to supplement the Drawings and Specifications by showing the detail necessary to construct, verify, and confirm items to be incorporated into the work. Submittals will require review by the DR or the Consultant (if applicable). Document control procedures (review, distribution and storage, elimination of obsolete documents, and control of document changes) will be the responsibility of the DR and are outlined in the PWGSC Records and Document Management Plan, as part of the Project Management Plan (Anchor QEA 2018).

Submittals and the review of submittals will be tracked by PWGSC and the Consultant with the Submittal Tracking Table (Appendix D). This table contains all Contractor submittals and will be used to track the progress of each submittal from its initial receipt by PWGSC to its final acceptance.

Contractor submittals are provided directly to the DR (generally as an RFI) before being passed onto the Consultant for review. The Consultant will, in turn, provide feedback (e.g., comments, questions, or revisions) on the submittal to the DR, which will be conveyed back to the Contractor. The Submittal Review Table can track multiple revisions of a submittal, if necessary.

The DR may call upon the Consultant to review other submittals and other aspects of construction as they arise.

8.2.5 Construction Meetings

Technical and environmental requirements of the Project are to be reviewed by the Contractor(s) and their crews in the Contractor pre-construction meeting (see Section 8.2.2) and daily tailgate meetings. Due to the short construction window, weekly meetings are not anticipated.

The Contractor will hold daily tailgate meetings in accordance with Specification Section 01 31 19 (Project Meetings). Besides the Contractor, additional attendees may include the inspectors, field staff, and other interested parties. The purpose of this meeting is to have a field review of staff safety and potential safety concerns, as well as planned daily work activities and related environmental concerns.

8.3 Inspection Requirements

General inspection requirements for the Project construction activities are described in the following sections.

8.3.1 Material Placement

Per Specification Section 35 37 10 (Material Placement), inspection requirements of the field inspectors for material placement will include the following:

- Daily inspection of work, including means, methods, and sequencing of material placement and compliance with Drawings and Specifications.
- Review of Contractor Daily Construction Reports to ensure that reporting of activities completed is consistent with observation of the activities and in compliance with the requirements of the Drawings and Specifications.
- Daily observation of work activities to ensure the following:
- The Contractor is implementing BMPs while conducting material placement, as described in its Construction Work Plan.
- The Contractor is using materials that meet the gradation requirements provided in the Specifications.
- The Contractor is employing means and methods that allow for placement of materials within the defined material placement thicknesses and including the vertical placement tolerances.

- The Contractor is using the approved siderite and blending the siderite and sand to the required concentration.
- The Contractor is in compliance with environmental protection requirements as stated in Specification Section 01 35 43 (Environmental Procedures), and in accordance with the permits.
- The Contractor places materials in a manner that minimizes the resuspension of sediment.

8.3.1.1 Import Material Inspection and Testing

The Contractor is required to provide materials testing for Material Types 1 and 3 (clean sand and rock, respectively) brought to the Work Site and intended for use on the Project. Material Types 1 and 3 must be analyzed for metals, polycyclic aromatic hydrocarbons, light extractable petroleum hydrocarbons, and heavy extractable petroleum hydrocarbons, but additional analyses may be necessary based on the current and historical land uses at the source site. In addition, Material Type 1 must have chemical concentrations lower than the Canadian Council of Ministers of the Environment Sediment Quality Guidelines “Probable Effects Levels” and Contaminated Sites Regulation Generic Numerical Sediment Criteria for typical sites. For light extractable petroleum hydrocarbons and heavy extractable petroleum hydrocarbons, concentrations must be lower than the Contaminated Sites Regulation numerical soil standards for residential land use.

The Contractor will provide test results of Contractor laboratory testing to the Consultant and PWGSC for review and acceptance no less than 2 weeks prior to the start of placement activities at the Work Site.

The Consultant and DR may complete inspections of the borrow facilities (that will provide the backfill material to the Work Site) in advance of materials being brought to the Work Site for placement. The Consultant and DR must accept the borrow facility(ies) prior to the Contractor importing the materials to the Work Site.

Upon arrival of imported material to the Work Site, Anchor QEA field inspectors will conduct visual observations of the stockpiles of material on the material barges to evaluate general compliance with the Specification requirements and to compare to observations from the borrow site inspections described above. These observations will be recorded in the DFAR and include the following:

- General appearance of material (color, gradation, odor, etc.)
- Evidence of staining or sheen
- Presence of debris

If results of visual inspection indicate that imported material is not in compliance with the Specifications, the field inspectors will notify the DR for follow-up notification to the Contractor.

Anchor QEA may collect samples of the stockpiles of fill materials (as appropriate) for laboratory analysis for QA chemical testing.

If the field inspectors' review of material placement post-construction surveys indicates discrepancies between surveys and Specifications, the inspectors will notify the DR in writing of the recommendations for corrective action.

8.3.2 Surveying and Positioning Control

Per Specification Section 02 21 13 (Surveying and Positioning Control), the Contractor will contract with a surveyor (to be determined) to conduct various bathymetric surveys during completion of the Project. Objectives and general scope for completion of surveys for the Project include the following:

- The Contractor will identify and describe means and methods for establishing and maintaining positioning control throughout completion of the construction activities required in the Contract documents. Construction inspectors will verify that the Contractor can demonstrate acceptable positioning control prior to the start of construction activities at the Work Site.
- The Contractor will complete a pre-construction bathymetric survey of the Work Site to verify seabed elevations for completion of material placement activities.
- The Contractor will conduct daily progress surveying to provide QC of the material placement work, and to calculate or verify volumes, areas, limits, and positions.
- The Contractor will conduct post-construction surveys once they have completed material placement work in each test area to verify that targeted placement thicknesses have been achieved.

The Consultant will review results of all Contractor surveys on an ongoing basis to verify that survey results demonstrate consistency with the progress of work reported in the Contractor Daily Construction Reports, and to confirm completion of the work in accordance with the requirements of the Contract documents. The Consultant will notify the DR immediately if review of Contractor surveys indicates that work being completed is not in compliance with the requirements of the Drawings and Specifications, and provide recommendations for corrective action for the DR to consider.

8.3.2.1 Quality Assurance for Surveying

The DR will review the Contractor's QC surveys to ensure they are complete and accurate.

8.4 Safety

All field inspectors will be responsible for observing and reporting on safety issues. The Contractor is responsible for Work Site safety; however, if field inspectors observe unsafe actions, they will immediately notify the Contractor and inform the DR.

The Consultant will operate under its own HASPs and the Contractor's HASP for the Project. Consultant HASP will be provided to the Contractor for inclusion with the Contractor HASP. All health and safety incidents or near misses will be reported to the DR and DND.

9 References

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Tables

Table 1
Relevant Environmental Legislation

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Pilot Project	Approval/Permit OR Requirements Met
Federal			
Canadian Environmental Assessment Act, 2012	Section 67 specifies that Federal Authorities must not make a decision about a proposed "project" on federal lands unless the proposed "project" is determined to be unlikely to cause significant adverse environmental effects, or the Governor in Council decides that those effects are justified. Section 5 provides protections against adverse project effects to 'any structure, site or thing that is of historical, archaeological, paleontological or architectural significance'.	The proposed Project meets the definition of a "project" under the Act, and an Environmental Effects report has been prepared.	No formal approval required. The Environmental Effects Determination indicates that the Project is unlikely to cause significant adverse environmental effects with mitigation measures that have been recommended.
Fisheries Act	Section 35 prohibits causing serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery unless authorized under the Act.	Project involved work in water which has the potential to cause serious harm to fish.	Serious harm to fish is not anticipated for the scope of work as outlined in Anchor 2018. A Request for Review will be submitted by Department of National Defence to Fisheries and Oceans Canada.
	Section 36 prohibits the deposit of a deleterious substance in water frequented by fish.	Project activities require work in and around water that could cause a release of deleterious substances. Placement of siderite (iron carbonate) is not a deleterious substance, as described in the Environmental Effects Determination.	Water quality performance objectives have been developed in the Water Quality Monitoring Plan to help meet the intent of this section. Contractor also to prepare and implement a Spill Prevention and Response Plan, Water Quality Protection Plan and a Sediment and Erosion Control Plan.
	Section 38 specifies a duty to notify and take corrective measures when serious harm to fish or deposit of a deleterious substances occurs, or when there is a serious and imminent danger of such an occurrence	Project involves work in and around water that contains fish and fish habitat.	Reporting requirements are to be considered in the development of the Contractor's communications and spill response plans.
Deposit out of the Normal Course of Events Notification Regulations under the Fisheries Act	The regulations identify the "prescribed person" for notifications under Section 38 of the Fisheries Act	The BC Provincial Emergency Program, now called Emergency Management BC, is the 24-hour emergency telephone service for spill reporting and spill notification to relevant provincial and federal agencies.	Spill reporting requirements are to be considered in the development of the Contractor's spill response plan.
Marine Mammal Regulations under the Fisheries Act	Section 7 prohibits the disturbance of marine mammals except when fishing for marine mammals under the authority of these Regulations. Subsections 7(3) to 7(4) of the Marine Mammal Regulations (amended in June 2018) identify the following approach distances for marine mammals: - 100 metres for whale, dolphin and porpoise - 200 metres for killer whale populations in BC and the Pacific Ocean	Marine mammals may occur in and adjacent to the Wood Waste Remediation Project Work Site.	Mitigation measures will be implemented to avoid disturbing marine mammals.

Table 1
Relevant Environmental Legislation

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Pilot Project	Approval/Permit OR Requirements Met
Aquatic Invasive Species Regulations Under the Fisheries Act	Prohibitions on import, transport, possession and/or release for species listed in Part 2 of the Schedule in the Regulations.	Vessels used for the Wood Waste Remediation Project project have the potential to unintentionally transport invasive species.	Mitigation measures will be implemented to avoid the introduction of invasive species.
Species at Risk Act (S.C. 2002, c. 29)	The Species at Risk Act contains prohibitions that make it an offence to: - kill, harm, harass, capture, or take an individual of a species listed in Schedule 1 of the Species at Risk Act as endangered, threatened or extirpated; - possess, collect, buy, sell or trade an individual of a species listed in Schedule 1 of the Species at Risk Act as endangered, threatened or extirpated; - damage or destroy the residence (e.g., nest or den) of one or more individuals of a species listed in Schedule 1 of the Species at Risk Act as endangered, threatened or extirpated	Several marine mammal species at risk have some potential to occur in the in-water project areas including harbour porpoise, killer whales, and Steller sea lions. Common Nighthawk, a Species at Risk Act Schedule 1 threatened species, may nest on the gravel at Yew Point.	Mitigation measures will be followed to avoid contravening the Act.
Migratory Birds Convention Act	Section 5.1/ 5.2 prohibits the deposit of a substance that is harmful to migratory birds.	Migratory birds may occur in the Wood Waste Remediation Project Work Site, and deposition of a substance such as fuel may harm migratory birds.	Mitigation measures will be implemented to avoid depositing harmful substances.
Migratory Birds Regulations (pursuant to the Migratory Birds Convention Act)	Section 6 – Prohibits the disturbance, destruction or removal of a nest or related shelter, or egg of a migratory bird, or possession of a live migratory bird, or a carcass, nest or egg of a migratory bird.	No land-based staging areas will be used in Esquimalt Harbour for this project.	General prohibition – no authorization issued.
Navigation Protection Act	Regulates and protects navigable waters in Canada including Esquimalt Harbour. No work will be built or placed in, on, over, under, through or across any navigable water unless approved or exempted under this Act.	Project works meet the assessment criteria for the Minor Works Order and are classified as "designated works" under the Act.	A Notice to the Minister is not required under the Act for works classified as "designated works" as long as all legal requirements are met.
Canada Marine Act	The Act establishes the means of management of ports and harbour facilities such as through the establishment of ports and harbour authorities. The Queen's Harbour Master is the designated Authority for Esquimalt Harbour. Esquimalt Harbour Practices and Procedures are made pursuant to the Act. Procedures include marine spill response and reporting.	The Project will be undertaken in Esquimalt Harbour.	Esquimalt Harbour Practices and Procedures shall be followed by all harbour users associated with the Project.
Canada Shipping Act	The Act promotes safety in marine transportation and recreational boating; protects the marine environment from damage due to navigation and shipping activities; prohibits the discharge of pollutants and contains reporting requirements; and prescribes regulations for vessels on or in any Canadian waterway through the "Collision Regulations".	Project involves work in a waterway.	All vessels used by the Contractor will comply with the relevant orders and regulations of the Canada Shipping Act including pollution prevention and reporting.
Transportation of Dangerous Goods Act	Regulates the transport of dangerous goods in Canada, whether by rail, road, air, or water, and establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with prescribed safety marks. The Act also establishes requirements regarding emergency response assistance plans.	Dangerous goods may be transported during this Project.	Hazardous materials associated with the Project will be transported in accordance with this Act.

Table 1
Relevant Environmental Legislation

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Pilot Project	Approval/Permit OR Requirements Met
Provincial			
Environmental Management Act	Prohibition against the introduction of waste into the environment in such a manner or quantity as to cause pollution, unless the introduction of that waste is conducted in accordance with a permit, approval, order, or regulation. The Act also prohibits causing pollution which is defined in the Act as "…the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment."	This general prohibition is addressed by the water quality protection measures developed for the Project as outlined in the Water Quality Monitoring Plan.	No wastes will be introduced into the environment.
Hazardous Waste Regulation (pursuant to Environmental Management Act)	Hazardous wastes are wastes that could harm human health or the environment if not properly handled and disposed of. The Hazardous Waste Regulation includes the identification, handling, transport, disposal and treatment of hazardous wastes.	No hazardous wastes will be generated during this Project.	General provisions – no authorization issued.
Contaminated Sites Regulation (pursuant to Environmental Management Act)	The Contaminated Sites Regulation provides a process for identifying and tracking the movement and deposition of soils from contaminated sites. Previously (prior to November 2017), the Contaminated Sites Regulation Schedule 7 was applicable to the assessment of soils/sediments being relocated or disposed on provincial land. The Stage 10 amendments allow use of the soil standards as applicable to the receiving site, in determining when a Contaminated Soil Relocation Agreement might be required to relocate soil to a receiving site. The Contaminated Sites Regulation is also relevant to the characterization, transportation and disposal of the dredged materials to provincial lands.	No dredging or removal of contaminated sediment will occur during this project.	General provisions – no authorization issued.
Spill Reporting Regulation (pursuant to Environmental Management Act)	The regulation defines a "spill" as: (a) an unauthorized release of a listed substance that enters, or is likely to enter a body of water, or (b) the release or discharge of listed substance into the environment in an amount exceeding the listed quantity. The regulation identifies to whom spills are to be reported and the reporting requirements.	Listed substances might be used during the Project. Emergency Program, now called Emergency Management BC is the 24-hour emergency telephone service for notification and follow up reporting.	The requirements of the Regulation are to be considered in the development of a spill response plan.
Wildlife Act	<u>Section 34</u> – A person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys: (c) a bird or its egg (d) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl (e) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg	No nesting is anticipated during this project as the work is all water-based without any staging areas in Esquimalt Harbour.	General prohibition – no authorization issued. Mitigation measures will be followed to avoid contravening the Act.
Heritage Conservation Act	Archaeological sites that predate AD 1846 are automatically protected. Heritage wrecks, consisting of the remains of vessels or aircraft after two or more years have passed since they sank, crashed, or were abandoned, are also protected under the Act.	Provincial legislation and guidelines are applied in the absence of federal statutory directives with respect to how heritage resources should be "considered" (i.e., managed). Discovery of unanticipated archaeological sites, and/ or a heritage wreck is possible during WWRP.	Monitoring of excavated sediments, if applicable, will include provisions for the collection of observed archaeologically or historically significant artifacts, features, and faunal materials, as well as human remains.

Table 1
Relevant Environmental Legislation

Act, Regulation, or Bylaw	Description	Applicability to Wood Waste Remediation Pilot Project	Approval/Permit OR Requirements Met
Transportation of Dangerous Goods Act	Regulates the transport of all dangerous goods in British Columbia on provincial highways and ferry routes. The Act establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with prescribed safety marks.	Dangerous goods may need to be transported for this Project.	General provisions – no authorization issued. Any hazardous materials associated with the Project will require be transported with a manifest.
Municipal			
Town of View Royal Bylaw No. 523 (2003)	Outlines noise disturbance in the Town.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
City of Colwood Noise Bylaw, No. 1594 (2016)	Outlines noise disturbance during certain hours and days of the week.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
City of Colwood Traffic and Highway Regulation Bylaw, No. 1134 (2010)	Designates truck routes for heavy trucks (over 8,600 kilograms).	If over-land transportation is undertaken, specific truck routes may need to be used.	A Traffic Management Plan will be prepared by the contractor if over-land transport is undertaken.
Township of Esquimalt Maintenance of Property and Nuisance Regulation Bylaw No. 2826 (2014)	Regulates the maintenance of property, unsightly property, and nuisance, including noise.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
Township of Esquimalt Bylaw No. 2898 (2017)	The Bylaw identifies roads that are not acceptable for trucks over 10,000 kilograms within Esquimalt.	If over-land transportation is undertaken, specific truck routes may need to be used.	A Traffic Management Plan will be prepared by the contractor if over-land transport is undertaken.
Capital Regional District Bylaw No. 2922 (Consolidated) (2016)	Regulate the discharge of waste into sewers connected to a sewage discharge facility operated by the Capital Regional District	Potential for Contractor to want to discharge waste into sewers.	In the event that the Contractor wishes to discharge waste such as barge stormwater, into the Capital Regional District sewer system, the Contractor will apply for permits/authorizations for such a discharge.

Table 2
Applicable Best Management Practices and Guidelines

Best Management Practice / Guidelines	Applicability to the Project
Fisheries and Oceans Canada's Measures to Avoid Causing Harm to Fish and Fish Habitat: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html	Provides advice that will help to avoid causing serious harm to fish and fish habitat.
British Columbia Guidelines for Industry Emergency Response Plans: https://www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/planning-prevention-response/industry-emergency-response-plans	Provides information for preparing a plan to respond to emergencies.
Department of National Defence Formation Safety Environmental Management System Directives and Shipyard best management practices	Directives for emergency reporting, solid waste management, hazardous materials management, spill response, storage tanks, and effluent management.
Fisheries and Oceans Canada's watching marine wildlife: https://www.dfo-mpo.gc.ca/species-especes/mammals-mammiferes/watching-observation/infographic/100-200-400-eng.html	Identifies minimum distances and measures to avoid disturbance to marine mammals.

Table 3
Environmental Site Inspection Tasks

Environmental Component	Description
Air Quality	Visually observe activities for conformance with the Dust and Emissions Control Plan.
Water Quality - Spill Prevention and Response	Confirm that the Contractor spill prevention and emergency response plan is posted on-site, readily available to personnel, and discussed at daily pre-job briefings.
	Confirm with the Contractor that operating personnel are familiar with the locations, contents and use of spill response equipment.
	Confirm with the Contractor that operating personnel are familiar with the location and operation of emergency ‘shut-offs’, and the notification procedures to be followed in the event of an emergency or environmental incident.
	Verify that spill response equipment is available on site and confirm with the Contractor that trained personnel are available to deploy the spill response equipment.
	Verify that Safety Data Sheets are available on site.
	Confirm with the Contractor that operating personnel are familiar with the locations and use of the Safety Data Sheets.
	Visually inspect equipment for hydraulic fluid, fuel and other leaks.
	Equipment logs (maintenance and inspection) may occasionally be checked to verify that maintenance/inspection of equipment is being conducted in accordance with Department of National Defence directives.
	Confirm with the Contractor that the spill prevention and emergency response measures have the capability to effectively manage spills resulting from their activities and operations.
	Visual observation of fueling events and confirm that they conform to Spill Prevention and Response Plan.
Water Quality - Stormwater Pollution Prevention	Visually inspect stormwater protection measures on the barge so they are functioning to prevent pollution from entering surface waters.
Water Quality - Silt Curtain (if required)	Visibly inspect silt curtain daily from above water for damage, shift in location, anchorage to shore (if applicable), and conformance with the Silt Curtain Control Plan (if silt curtain is required).
Water Quality - Sediment and Erosion Control	Visually inspect erosion control measures on the barge to confirm they conform to the Soil Erosion Control Plan and that they are functioning as intended.
Noise, Light and Odour	Inspect work areas and work activities for conformance with the Noise, Light and Odour Plan. Conduct in-air noise monitoring in the event complaints are received.
Non-Hazardous Waste Storage and Disposal	Inspect work areas and work activities for conformance with the Non-hazardous Waste Storage and Disposal Plan.
Hazardous Materials Storage and Disposal	Inspect hazardous materials storage for compliance with Hazardous Materials Storage and Disposal Plan.
Archaeological Chance Find	Inspect materials for archaeological chance finds and include provisions for the collection of observed archaeologically or historically significant artifacts, features, and faunal materials, as well as human remains

Table 4
Marine Mammal Species at Risk and Known to Occur in Esquimalt Harbour

Common Name (Scientific Name)	BC Conservation Data Centre Status	COSEWIC Status	SARA Status
Harbour Porpoise – Pacific Ocean population (*Phocoena vomerina*)	Blue	SC	1/SC
Killer Whale - Northeast Pacific southern resident population (*Orcinus orca pop. 5*)	Red	E	1/E
Killer Whale – West Coast transient population (*Orcinus orca pop. 3*)	Red	T	1/T
Steller Sea Lion (*Eumetopias jubatus*)	Blue	SC	1/SC

Notes:

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

E: Endangered

SARA: Species at Risk Act

SC: Special Concern

T: Threatened

Figures

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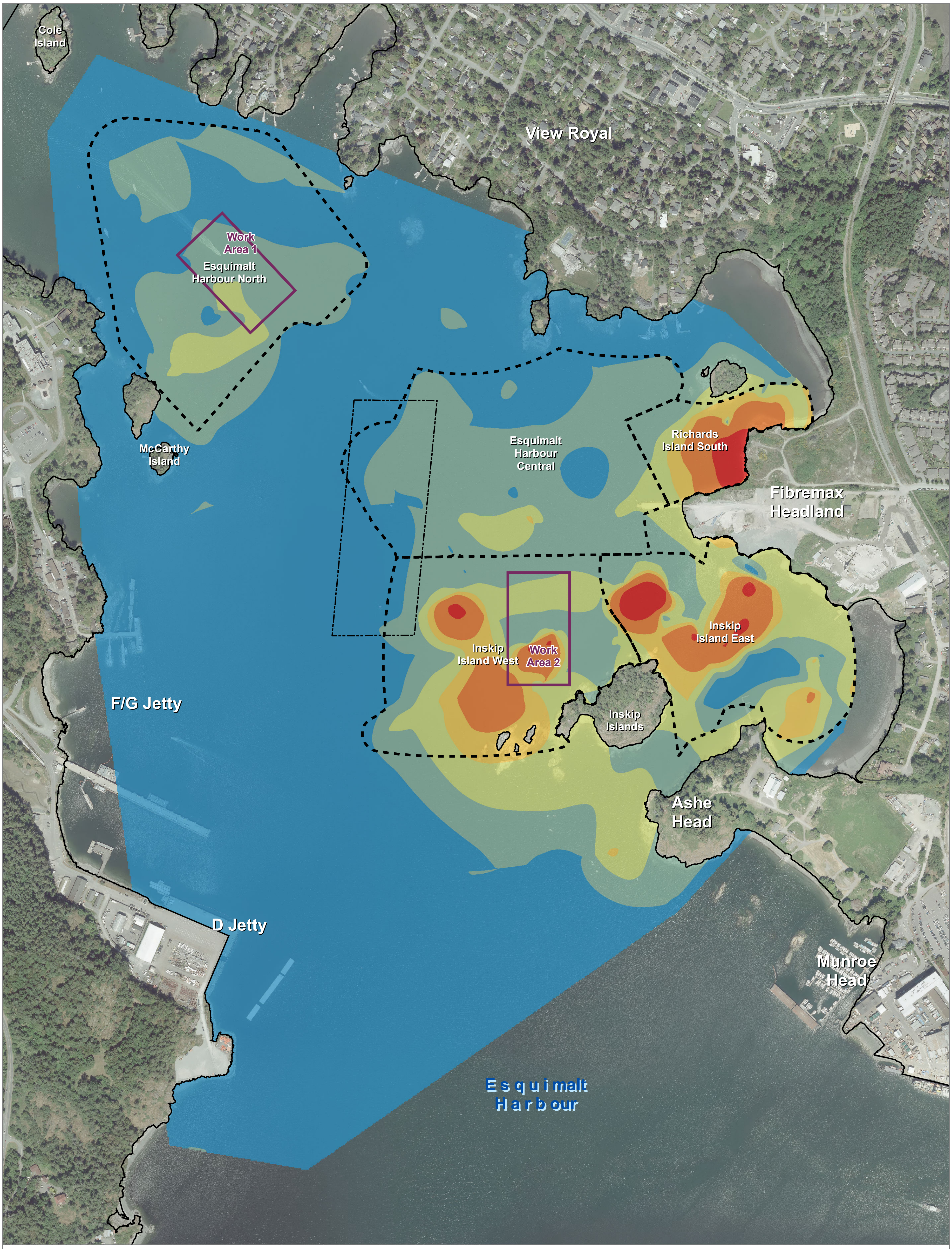
ANCHOR QEA

Figure 1
Esquimalt Harbour Sites and Vicinity Map
Wood Waste Remediation Project - Environmental Management Plan



LEGEND:

- WWMAs
- Pilot Project Work Areas
- Jones Marine Lease Boundary

Wood Waste Thickness (metres)

- 0 - 0.2
- 0.21 - 0.4
- 0.41 - 0.6
- 0.61 - 0.8
- 0.81 - 1.5
- 1.51 - 3.55

NOTES:

1. The wood waste thickness surface was created using a Natural Neighbor interpolation method.
2. Jones Marine Waterlot Lease boundary corner points coordinates provided by DND.

DND = Department of Defence
WWMA = Wood Waste Management Area

0 200
Metres

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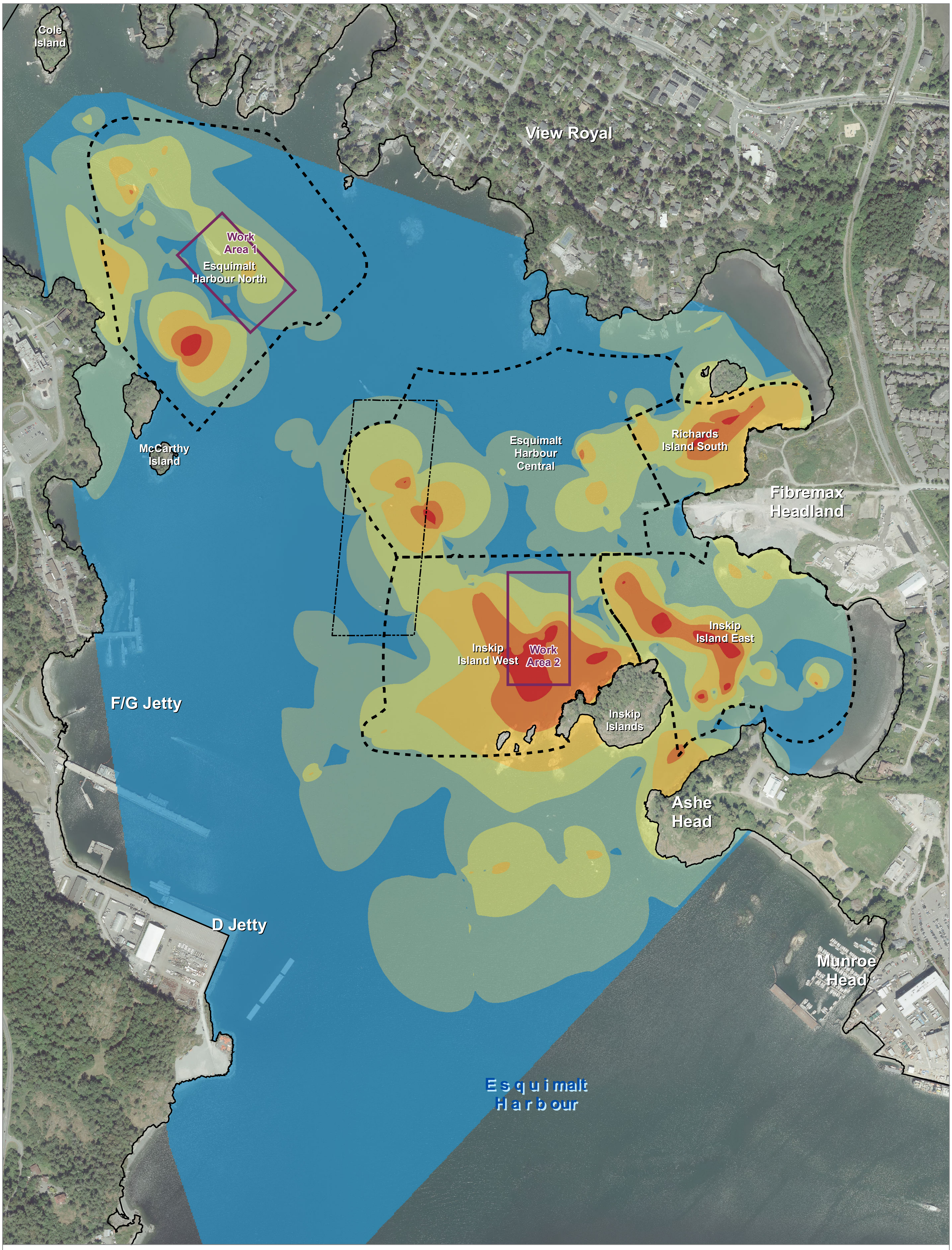
ANCHOR QEA

Figure 2
Pilot Project Work Areas with Wood Waste Thickness
Wood Waste Remediation Project - Environmental Management Plan



LEGEND:

WWMAs

Pilot Project Work Areas

Jones Marine Lease Boundary

Wood Waste (% Cover)

0 - 1

1.1 - 10

10.1 - 25

25.1 - 50

50.1 - 75

75.1 - 100

NOTES:
1. The wood waste percent cover was created using a Natural Neighbor interpolation method.
2. Jones Marine Waterlot Lease boundary corner points coordinates provided by DND.
DND = Department of Defence
WWMA = Wood Waste Management Area

0 200
Metres

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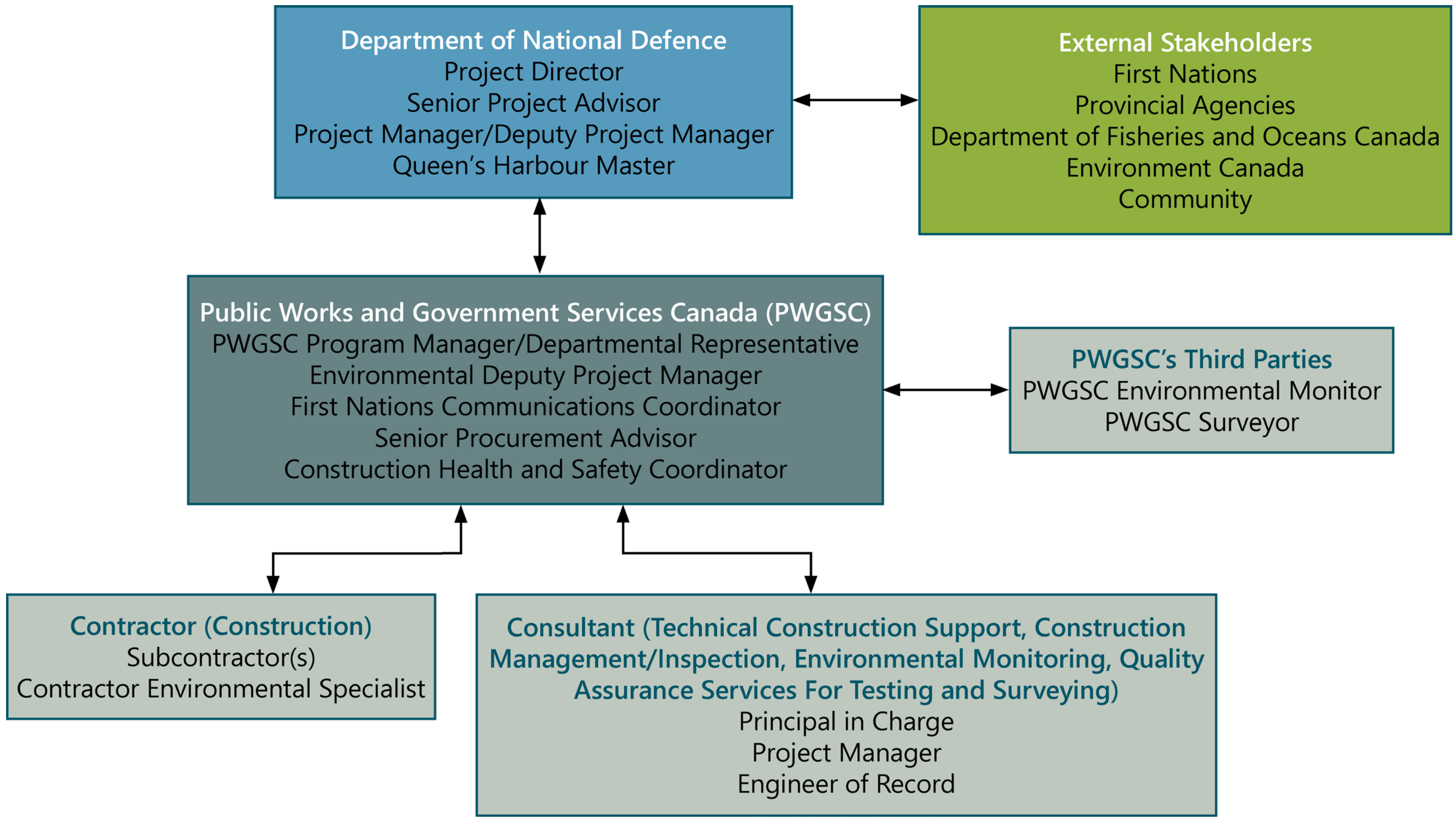
Figure 3
Pilot Project Work Areas with Wood Waste Cover
Wood Waste Remediation Project - Environmental Management Plan



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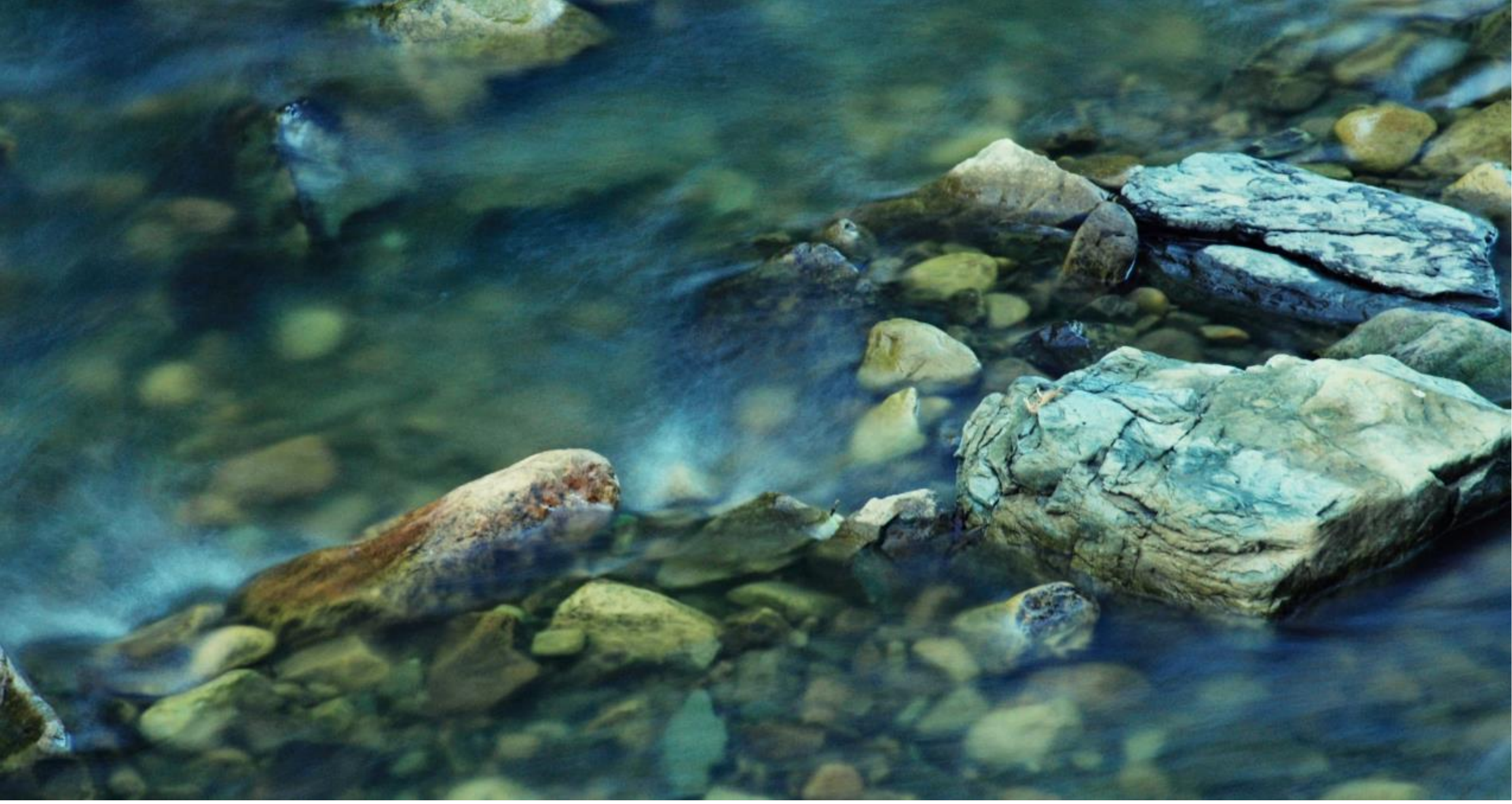
ANCHOR QEA

Figure 4
Environmental Team Organizational and Communication Structure

Appendix A
Water Quality Monitoring Plan



July 2019
DND Wood Waste Remediation Pilot Project

Water Quality Monitoring Plan

Prepared for Public Works and Government Services Canada

July 2019
DND Wood Waste Remediation Pilot Project

Water Quality Monitoring Plan

Prepared for
Public Works and Government Services Canada

Prepared by
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Project Number: 170553-21.05
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TABLE OF CONTENTS

TABLES

FIGURES

ABBREVIATIONS

CD	chart datum
DND	Department of National Defence
EMP	Environmental Management Plan
m	metres
mg/L	milligrams per litre
NTU	nephelometric turbidity unit
Project	DND Wood Waste Remediation Pilot Project
PWGSC	Public Works and Government Services Canada
QA/QC	quality assurance/quality control
QP	Qualified Professional
RPD	relative percent difference
TA	Task Authorization
TSS	total suspended solids
WQG	water quality guideline
WQMP	Water Quality Monitoring Plan

1 Introduction

1.1 Background

The Department of National Defence (DND), which administers Esquimalt Harbour, is implementing a remediation and risk management program in Esquimalt Harbour as part of a long-term strategy to address sediments that have been contaminated by historical industrial activities. Various remediation projects have been or are currently being undertaken in Esquimalt Harbour as part of the remediation and risk management program. The DND Wood Waste Remediation Pilot Project (Project) is the latest project being planned under this program and is being undertaken under the Federal Contaminated Sites Action Plan (Anchor QEA 2018a). DND has retained Public Works and Government Services Canada (PWGSC) as its contracting authority for the Project. PWGSC will designate a representative (the PWGSC Representative) to advise, coordinate, and monitor the work on behalf of DND. A contractor will be retained to undertake the work.

Anchor QEA, LLC, was retained by PWGSC on behalf of DND to develop a Water Quality Monitoring Plan (WQMP) that will be implemented during the Project to monitor water quality during material placement. The WQMP, which is part of the Environmental Management Plan (EMP), outlines the scope of monitoring that will be undertaken during Project activities and identify appropriate parameters and assessment criteria.

This report was prepared for Canada in accordance with the terms and conditions outlined in the PWGSC Contaminated Sites Marine Sediment Contract No. EZ897-172925/001/VAN. The scope of work for this report (Task 7: Pre-Construction Documents) was outlined in Anchor QEA's "Workplan for Esquimalt Harbour Wood Waste Remediation Project, CFB Esquimalt, Victoria, BC," dated 20 May 2019. Task Authorization (TA) for the above work plan was provided by PWGSC on 21 May 2019 under TA 700445589.

1.2 Objectives

The objectives of the WQMP are to address the following:

- Outline the scope of water quality monitoring that will be undertaken during Project activities including location and frequency of monitoring
- Identify appropriate parameters and assessment criteria
- Present decision criteria and high-level management actions
- Present data compilation and quality assurance/quality control (QA/QC) measures

1.3 Report Structure

The WQMP includes the following components:

- A description of baseline water quality conditions in Esquimalt Harbour, including an evaluation of implications for the Project (Section 2.0)
- Parameters to be monitored (Section 3.1) and limits that will trigger management actions (Section 3.2)
- Methodology for in situ water quality monitoring for real-time assessment and collection of water for laboratory analysis (Section 3.3)
- Validation of total suspended solids (TSS) levels and plume direction (Section 3.4)
- Monitoring data QA/QC procedures that will be undertaken to verify the reliability of collected data (Section 3.5)
- Monitoring data management procedures (Section 3.5.3)
- Reporting (Section 4.0)

This WQMP is intended to be read in conjunction with the EMP, environmental approvals, authorizations, and contract requirements for the Project.

A summary of federal and provincial pollution prevention legislation is provided in the EMP for the Project. The intent of this WQMP is to provide direction to DND, Consultants, and the Contractor that is consistent with the provisions for environmental protection contained in that legislation. Should further clarification of any environmental issue be required, the appropriate regulation or legislative document should be consulted, or advice sought from DND.

2 Project Area and Location

The Project Work Areas are located in the northern portion of Esquimalt Harbour (Figure 1). The harbour is relatively shallow, ranging from 5 to 12 metres (m) Chart Datum (CD) in depth within the limits of the Federal Harbour, and a maximum depth of 16 m CD at the harbour entrance (CRD 2019).

Surface water in Esquimalt Harbour exchanges with waters of the Strait of Juan de Fuca through the harbour entrance, Royal Roads passage, which is approximately 750 m across. The relatively wide entrance of the harbour allows the tidal regime of the harbour to match surrounding areas outside the harbour.

Based on Canadian Tide and Current Tables, Esquimalt Harbour's mean tide is 1.8 m (relative to CD) with a reported large tide of 3.1 m. The mean tide Higher High Water is 2.5 m, and the large tide Higher High Water is 3.4 m. The mean Lower Low Water is 0.7 m, and the large tide Lower Low Water is 0.1 m (DFO 2010).

An investigation of currents and tidal effects in the harbour was conducted in 2010 (Golder 2011). A vessel-mounted acoustic doppler current profiler was towed along five survey lines to determine current speeds and direction over an entire tidal cycle. Exchange of water through the mouth of the harbour during peak flood and ebb tidal periods resulted in depth-averaged current speeds in excess of 1 m per second near the mouth of the harbour. For most of the harbour, including the Project Work Areas, the measured currents were shown to be typically weak and variable in direction (Golder 2011).

2.1 Water Quality in Esquimalt Harbour

2.1.1 Surface Water Quality

Existing surface water quality is relevant to Project water quality monitoring because:

- It provides a characterization of pre-project water quality conditions
- It provides a basis of "background" conditions against which monitoring data can be compared, such that interpretation (by a Qualified Professional [QP])[1] of water quality monitoring results is better supported.

A brief overview of contaminants data is provided here, with additional detail on background turbidity data provided because this parameter will be a substantial component of the water quality

[1] A QP is defined as a person who is registered and/or licensed in the relevant jurisdiction with his or her appropriate professional association and/or licensing authority, acts under that professional association's and/or licensing authority's code of ethics, and is subject to disciplinary action by that professional association and/or licensing authority, and through suitable education, experience, accreditation, and knowledge can be reasonably relied on to provide advice within his or her area of expertise. This definition was adapted from the Municipal Wastewater Regulation (pursuant to the BC Environmental Management Act).

monitoring program during material placement. In the event that further interpretation is needed, the QP should refer to the original reports referenced below. Overall, the available data indicate the importance of collecting project-specific data because intermittent events unrelated to in-water construction activities can affect what is relatively good water quality in Esquimalt Harbour (Anchor QEA 2016).

Water quality data for Esquimalt Harbour are available from surface water samples collected during multiple separate investigations between 2005 and 2017. Metals were generally found to be below or at federal (CCME 1999) and provincial (MOEACC 2018) water quality guidelines (WQGs), with slightly higher concentrations occurring near the mouth of the Esquimalt Graving Dock than in Esquimalt Harbour to the west (Golder 2006a, b; SLR 2008, 2014). Polycyclic aromatic hydrocarbons (PAHs) were also below WQGs except in some samples collected near Outfall D adjacent to Munroe Head on the east side of Esquimalt Harbour in 2005. This dataset is limited, and these conditions should not be assumed to represent background concentration at the time the Project is implemented.

Turbidity monitoring was undertaken in Esquimalt Harbour between 18 October and 15 December 2010 prior to remedial dredging at the Esquimalt Graving Dock (Golder 2011). Turbidity values ranged between 0 and 165 nephelometric turbidity units (NTU) south of D Jetty and up to 817 NTU at stations on the east side of Esquimalt Harbour. The 99th percentile of all NTU values observed in the field was 6.4 NTU (n = 59,000). The short-duration peaks in turbidity observed during the program may have been due to sediment re-suspension caused by operational activities including boat/tug activity, propeller wash, or by natural re-suspension of sediments caused by wind-waves and tidal currents. Turbidity monitoring was also undertaken between 4 January and 28 April 2017 during remedial dredging and backfilling at D Jetty and F/G Jetty (Golder 2017). Ambient turbidity measured during the program was generally low (<2 NTU), while turbidity at 100 m from the dredging or backfilling activities ranged between 0 and 107.5 NTU.

Manual monitoring of turbidity, water temperature, pH, and dissolved oxygen was undertaken at each of the automated turbidity monitoring stations at the Esquimalt Graving Dock (Golder 2011), and at far-field reference locations adjacent to Plumper Bay during the remedial dredging program at D Jetty and F/G Jetty (Golder 2017). Water column profile data was also collected from the Project area in December 2018 (Anchor QEA 2019). During each monitoring program, these parameters were relatively consistent among sampling stations and across water depths, indicating that the harbour was relatively well mixed (Table 1). Turbidity measurements in the Project area were mostly 0 NTU, but were measured above 0 NTU, up to 0.9 NTU in intervals at the surface or near the sediment in several samples (Anchor QEA 2019). These data may not be representative of conditions during colder or warmer weather when stratification may occur. Potential stratification of the water column will need to be taken into consideration during monitoring for potential turbidity plume generation and distribution.

2.1.2 Turbidity Implications for the WQMP

On average, turbidity in Esquimalt Harbour is low, with mean values typically being less than 5 NTU[2] at most stations and median turbidity being <1 NTU. However, the data available from the turbidity loggers demonstrates that Esquimalt Harbour turbidity can, at times be "patchy." Additionally, large turbidity events (e.g., two orders of magnitude increases) can occur as short-duration (i.e., hours long) transient events, for example from activities such as ship passage and propeller wash. Thus, a turbidity value that represents an increase over background and thus the operational characterization of background (i.e., during Project activities) will be an important information item because it will aid in deciding if turbidity measurements are of concern or if turbidity measurements are simply normal, transient events associated with operations in the harbour.

Two WQMP considerations are raised by these observations:

- A greater number of reference stations and/or samples than recommended here could be necessary. That determination should be made under operational conditions and with the benefit of visual observations made and turbidity data collected during operations. Because the turbidity monitoring costs are not unit costs (equipment rental plus staff time), this should not appreciably impact the monitoring implementation costs.
- An appropriate response to a single high turbidity value that is outside the range of data depicted in Table 1 is to resample and to identify the reasons for that increase prior to implementing more stringent operational controls. Because of the characteristics of background turbidity data (short duration, relatively high magnitude transient events), there is a risk of incorrect presumptive decisions that could affect the Project cost and schedule.

[2] For reference, a turbidity reading of 5 NTU is the upper limit for drinking water turbidity. Prior to Metro Vancouver implementing filtration, this was the approximate cloudiness of Vancouver tap water on a "bad day."

3 Water Quality Monitoring

This section describes the following components of the water quality monitoring program that will facilitate verification that environmental controls for the Project are adequate, and provide environmental management data that will be used to identify when additional controls on, or cessation of, Project activities are necessary:

- Monitoring parameters
- Decision criteria and management actions
- Manual ("real-time") in situ water quality monitoring
- Collection of water samples for laboratory analysis of total and dissolved iron

Water quality in and adjacent to the Project Work Site may be affected by Project activities through the following:

- Induced suspension of solids and turbidity during placement of material
- Fuel and hydraulic spills from equipment

The WQMP provides a monitoring program for induced turbidity and TSS caused by placement of cover material through the water column, as this is the primary component of the Project that has potential to affect water quality.

3.1 Monitoring Parameters

The WQMP includes measurement of various parameters that will provide information to manage potential effects from the Project. Background information on these parameters is provided below. Table 2 provides the water quality criteria that will be used for the Project.

3.1.1 Total Suspended Solids

TSS encompasses both inorganic solids such as clay, silt, and sand, and organic solids such as algae and detritus and is a gravimetric measurement of the dry weight of suspended particulate material (solids) per unit volume of water. The measurement of TSS requires the collection of a sample and submission of that sample to the laboratory. Analysis is done by filtering the sample onto a glass fibre filter and drying the sample at a specified temperature. Data for this analysis are typically available on a 24-hour turnaround.

A TSS concentration of 75 milligrams per litre (mg/L) for induced suspension of solids will also be used to manage day-to-day material placement.

3.1.2 Turbidity

Turbidity is a measure of the optical properties (e.g., scattering of light) of particulates suspended in water. Turbidity is often used for the day-to-day management of material placement activities as the results are available in real-time. Turbidity is measured using an instrument that measures the passage of light through the sample as well as the scattered light that is reflected from the sediment particles and reports values in units such as NTU. Turbidity can be measured on-site, in real and near-real time.

Anchor QEA (2018b) developed a TSS-turbidity relationship from data collected during the Plumper Bay Ash Head Remediation Project in Esquimalt Harbour. Based on this relationship, a TSS of 75 mg/L is related to a turbidity of 90 NTU, and a TSS of 40 mg/L is related to a turbidity of 30 NTU (Figure 2).

3.1.3 Dissolved Oxygen

Dissolved oxygen provides a measure of the amount of oxygen available for aquatic organisms. The oxygen content in the atmosphere is 21%, which equates to approximately 210,000 parts per million. However, the amount of oxygen dissolved in water is temperature and salinity-dependent but on the order of 10 parts per million or less. The ability of aquatic organisms to obtain oxygen from water is therefore susceptible to reductions in dissolved oxygen. In Esquimalt Harbour, dissolved oxygen concentrations of 7.03 to 9.29 mg/L were measured during fall 2010 and winter 2017. Concentrations were variable between locations and were lower deeper in the water column than at the surface (Table 1).

Dissolved oxygen will be measured in situ during manual water quality monitoring and results will be available in near real-time. The information will be used by the QP to evaluate potential for environmental impacts, for example to interpret whether effects are project-related or the result of natural processes.

3.1.4 pH

The pH measures how acid or alkaline a substance is with a pH of 7 being neutral (neither acid nor alkaline). Normal seawater pH values are slightly alkaline (in fall 2010 and winter 2017, pH values of 7.86 to 8.17 were measured in Esquimalt Harbour [Table 1]) and seawater chemistry has the ability to resist minor changes but can be overcome when such changes are substantial. pH can be influenced by natural processes such as photosynthesis during algal blooms, which can result in elevated pH (i.e., >9 pH units), whereas material placement is not likely to change pH values to an extent that is, on its own, harmful. pH changes can affect the toxicity of other substances and it is therefore a necessary parameter to monitor so that interpretation of certain results by a QP is possible.

pH will be measured in situ during manual water quality monitoring.

3.1.5 Iron

There is no marine water quality guideline for iron. However, since siderite contains iron carbonate, water samples will be collected as indicated in Section 3.2 for submission to an analytical laboratory for analysis of total and dissolved iron. The purpose of collecting iron data will be to document concentrations of iron during pilot placement.

3.2 Decision Criteria and Management Actions

3.2.1 Overview

There are presently no specific regulations pertaining to discharge from in-water material placement projects. The specific parameters and points of compliance are generally determined by agreement at the project level through the process of environmental review and consultation with the responsible regulatory agencies such to meet the general provisions of the environmental statutes.

Regulatory compliance is typically evaluated at the point at which an operator no longer exercises control over a discharge. For the Project, this will be 25 m (point of compliance) from the edge of the work zone.

To verify that these controls are sufficient to protect the surrounding environmental values, additional assessment will be carried out approximately 100 m away (assessment point) where water quality should meet ambient WQGs or a pre-specified change from background condition.

Table 2 provides the water quality criteria for both the operational compliance point (25 m from the work zone) and the assessment point as represented by the outer boundary of the work zone. The management consideration for these criteria are related to the control of particulates and to minimize the potential for physical effects to aquatic biota.

3.2.2 Decision Framework for Material Placement

The decision framework for implementing management actions during material placement is comprised of a series of steps to allow for adaptive management that will be responsive to environmental protection goals without unnecessary disruption to the operational needs of the Project as illustrated in Figure 3. The decision framework is based on real-time measurements of turbidity. Other factors may also be considered in a decision by PWGSC to implement management actions, for example, interaction with other projects occurring at the same time or the extent of visually obvious turbidity.

The steps in the decision framework are as follows:

1. Regular monitoring (Section 3.3) is undertaken to evaluate potential for induced turbidity (i.e., the change in turbidity greater than background) at the edge of the work zone (i.e., the assessment point) during material placement activities.
2. If turbidity at the assessment point is observed to be less than the ambient WQG (i.e., <5 NTU above background), regular monitoring of turbidity continues, with no application of management actions. In the event that turbidity is greater than the ambient WQG, the level of exceedance determines whether:
    a. In situ turbidity measurements will be conducted after 4 hours when induced turbidity is between 5 and 90 NTU above background and after 2 hours when induced turbidity is >90 NTU. In situ turbidity measurements will be made at three locations along the assessment point (100 m from the work zone) at three depths (1 m below surface, mid-water column, and 2 m above the seabed) (Figure 4).
    b. Implementation of management actions is warranted when induced turbidity at the assessment point is >90 NTU above background for material placement. The management action will be implemented, followed by in situ turbidity measurements at the assessment point as described in Step 2a to evaluate the effectiveness of the management action.
3. Step 2 is repeated. If the ambient WQG is met at the assessment point, regular monitoring is continued, and the process returns to Step 1. If the ambient WQG is exceeded at the assessment point, the level of exceedance determines whether and when additional in situ turbidity measurements should be conducted or management actions are implemented.
4. If, after Steps 2 and 3, induced turbidity continues to exceed the ambient WQG at the assessment point:
    a. Management actions will be implemented if induced turbidity is >5 and <90 NTU, and in situ measurements will include collection of turbidity measurements at three depths and five locations along the compliance point (25 m from the edge of the work zone) as well as at the assessment point (100 m from the edge of the work zone). The purpose of the additional monitoring locations is to collect information about the behavior of the turbidity plume that can be used by a QP to evaluate the potential for environmental effects (which is determined in part by a combination of duration and magnitude). The QP will need to take into account background conditions, visual observations, and level of accuracy of field instrumentation when assessing which course of action should be taken.
    b. Material placement will be temporarily stopped if induced turbidity is >90 NTU. After corrective actions are implemented, material placement may re-commence as will regular turbidity monitoring.
5. If, after Step 4a, induced turbidity continues to exceed the ambient WQG at the assessment point (i.e., is >5 and <90 NTU) or is >90 NTU at the compliance point, material placement will be

stopped, and corrective actions will be implemented. Material placement and regular turbidity monitoring may then resume.

6. Collection of water samples for laboratory analysis of TSS and iron. Collection will be at the discretion of the QP.

3.3 In Situ and Laboratory Water Quality Monitoring

3.3.1 Types of Monitoring

Both in situ measurements and collection of water samples for laboratory analysis will be undertaken during water quality monitoring. The management of day-to-day Project activities will rely on in situ monitoring of turbidity.

3.3.1.1 In Situ Monitoring

The focus of the in situ water quality monitoring program will be manual "real-time" turbidity measurements, although in situ measurements of pH and dissolved oxygen will also be made occasionally to evaluate the effect of Project activities on these parameters. The assumed number of monitoring locations is described and summarized in Table 3; however, a greater or lesser number of measurements may be made depending on the conditions at the time (e.g., presence of confounding sources of turbidity or additional monitoring triggered per the decision framework for implementing management actions [Figure 3]).

3.3.1.2 Water Sampling for Laboratory Analysis

Water samples will also be collected for laboratory analysis from the monitoring locations. Samples for laboratory analysis of TSS and total and dissolved iron will be collected as noted in Table 3. TSS and iron data are being collected to document these parameters during material placement. Due to the short duration of the project and minimal risk of contamination (no dredging and placement of clean material), laboratory analyses will be analyzed on a standard turn-around-time.

3.3.2 Monitoring Locations

In situ measurements and sample collection for laboratory analysis will be conducted both up-current and down-current of the works and will be adjusted throughout the event depending on the location of Project activity and the direction of prevailing current at the time of sampling (as noted in Section 2.0, currents in Esquimalt Harbour are variable). The locations will be documented using hand-held GPS and laser rangefinder units. The selection of specific monitoring locations will be refined on the basis of site-specific conditions and work locations. A conceptual layout of the monitoring locations are provided in Figure 5 and described below.

3.3.2.1 Compliance Point Samples

Samples will be collected at a distance of 25 m from the edge of the work zone (material placement bucket). Turbidity measurements will be collected from multiple depths:

- At the surface of the water column: 1 m below the surface.
- At the bottom of the water column: 2 m above the sea bed (the grab sampler should be fitted with a weighted lead to help prevent the sampler itself from hitting the seabed and causing re-suspension of solids that may become entrained in the sample).
- Mid-water column: this can be approximately half-way between the surface and bottom of the water column when it is not stratified, or just below the density barrier (i.e., thermocline or halocline) when/if stratification is occurring.

3.3.2.2 Assessment Point Samples

Samples will be collected at a distance of 100 m down-current from the point at which the operator no longer exercises control over the discharge material (e.g., from the edge of the work zone). It is proposed that turbidity measurements will be made at three locations along this radius with discrete measurements at three depths, as noted above. In the event that confirmatory sampling is triggered, two additional locations may also be sampled at this distance, for a total of five.

3.3.2.3 Reference Samples

Samples will be collected outside of the Project Work Site influence, and other material placement project influences, to obtain reference (or background) turbidity measurements. During periods of time when the potential for non-project related activities (e.g., vessels berthing at nearby jetties) to influence background turbidity, a higher number of reference stations will be sampled, including near-field (two stations) and far-field (three stations) locations. When the potential for non-project related activities is low, fewer reference samples may be collected. Turbidity will be measured at three depths, in the same manner as the compliance point samples. When the potential for confounding activities is relatively low, the QP may take turbidity measurements at fewer reference locations.

3.3.3 Monitoring Frequency

Because of the short duration of the project, in-situ monitoring will be conducted every day for the entire project. Water samples for laboratory analysis will be collected during material placement at the frequency summarized in Table 3. Iron testing will only be conducted during placement of amended sand (siderite).

3.4 TSS/Turbidity Relationship

TSS data will be collected to assess the best management practices used for the Project, but because of the short duration of the project, and since there is no dredging activity, insufficient data will be collected to validate the TSS/turbidity relationship. Information collected on the TSS/turbidity relationship will be provided in the Completion Report.

3.5 Quality Assurance/Quality Control (QA/QC)

3.5.1 Field

3.5.1.1 General

The following general guidelines will apply to field sampling activities:

- Sampling equipment will be decontaminated between sampling stations where applicable (i.e., when sampling for analysis of contaminants).
- Samples will be:
  - Collected in containers and preserved as necessary with supplies provided by the analytical laboratory.
  - Collected in such way as to minimize the introduction of foreign material to the sample and the loss of material of interest from the sample prior to analysis.
  - Stored in coolers with ice packs[3] during collection and shipping.
- Sufficient volume will be collected, where possible, such that required analytical detection limits can be met and quality control samples can be analyzed.
- Field meters will be calibrated according to manufacturers' instructions and calibrations will be verified with applicable commercially-formulated calibration standard solutions. Calibration records will be kept and submitted with data reports.
- Chain-of-custody documentation will be maintained to document holding times and storage conditions and sample continuity.
- Field duplicate samples will be collected where applicable, and the relative percent difference (RPD) calculated to provide a measure of method precision:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

In accordance with the BC Field Sampling Manual (BC MOE 2013), an RPD value of ±20% for values ≥5 times the method detection limit will be used to identify notable differences between original and duplicate samples. RPDs are not calculated for values <5 times the method detection limit due to increased variability near analytical detection limits.

[3] Ice packs or ice in sealed bags. Loose ice is not recommended due to the potential for sampling containers to shift and break when the ice melts (BC MOE 2013).

3.5.1.2 Water Sampling for Laboratory Analysis

Duplicate water samples will be collected for laboratory analysis at a rate of 10% (i.e., for every 10 samples collected, one sample will be collected as a duplicate) and analyzed for the same set of parameters as the original sample.

Equipment blanks will be collected once per week and analyzed for total and dissolved iron.

3.5.2 Laboratory

Samples for chemical analyses will be submitted to Canadian Association of Laboratory Accreditation-accredited laboratories. Laboratory QA/QC will include analysis of laboratory duplicates, method blanks, matrix spikes, and certified reference materials as appropriate (i.e., depending on the parameter).

Prior to entry into the data management system (Section 3.5.3), laboratory data will be reviewed to verify that they are reliable. For example, this review may include checking the following:

- Sample control numbers of the chain of custody sheets and laboratory reports match.
- Confirmation that hold times have been met.
- Results are provided for samples submitted and analyses requested.
- Method blanks are below method detection limits and data reporting limits.
- Results of QC samples (e.g., duplicate samples, matrix spikes, certified reference materials) are within an acceptable range.

3.5.3 Data Management

Protocols for managing data quality will include the following:

- For field collection of water quality measurements, templates standardizing data collection requirements will be developed and used by the Environmental Monitor to promote consistency of data collection. Information to document includes:
  - Field personnel
  - Weather conditions and other site observations relevant to interpretation of monitoring data
  - Station ID
  - Unique ID for laboratory samples with linkage to site identifiers as appropriate
  - Depth of sample
  - Sample type (e.g., “normal,” field duplicate, equipment blank)
  - Unit of measurement
  - Equipment used
  - Where there are missing values (e.g., data were not collected), explanatory notes will be recorded

- Data (laboratory chemistry and field measurements) will be entered into a data management system agreed to between PWGSC and the Environmental Monitor following confirmation that laboratory and field data quality objectives were met (Section 3.5.2). Data that do not meeting the data quality objectives for the Project will be flagged.
- A number of different platforms are available for data management. The specific platform for data management will be selected by the Environmental Monitor in conjunction with PWGSC.
- Data entry (either manual or transfer of electronic data) will be cross-checked by a second person at a rate of approximately 10% of entries. The rate of verification will be increased proportionately to errors found, if any.

Archives of original hard and electronic copies, as appropriate, of data files will be maintained for future reference, including original laboratory reports, electronic data files (e.g., telemetry files from automated data loggers), field notes and QA/QC documentation.

4 Reporting

4.1 General

Results of regular real-time monitoring will be documented in daily reports provided to PWGSC who will forward reports to other applicable parties on the frequency outlined in the EMP (daily reporting and monitoring completion reporting following completion of the Project). Laboratory data will be reported in the Completion Report.

4.1.1 Exceedances

The Environmental Monitor undertaking the monitoring outlined in this WQMP will document exceedances and provide photographs of any plumes in daily reports and report exceedances and other compliance events to PWGSC (who will provide reports to other parties as applicable) as soon as possible commensurate with the severity of the event.

5 References

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Tables

Table 1
Vertical Profile Data from Esquimalt Harbour

Parameter	Depth	Ambient Water Quality Measurements (Mean Values)					
		EGD[1]		Munroe Head[1]		Plumper Bay[2]	
		Easting 5365323	Northing 0467871	Easting 5364985	Northing 0468117	Easting[3] 5365421	Northing 0467933
Turbidity (NTU)	Shallow (0–4 m)	0.76		0.53		0.65	
	Mid-water (4–8 m)	0.57		0.63		0.53	
	Deep (8 m+)	0.59		—		0.51	
	All depths	0.64		0.55		0.56	
Temp. (°C)	Shallow (0–4 m)	7.78		8.51		8.12	
	Mid-water (4–8 m)	7.70		8.00		8.03	
	Deep (8 m+)	7.51		—		7.94	
	All depths	7.69		8.42		8.03	
Dissolved Oxygen (mg/L)	Shallow (0–4 m)	7.53		7.27		9.22	
	Mid-water (4–8 m)	7.31		7.25		9.34	
	Deep (8 m+)	7.37		—		9.32	
	All depths	7.40		7.27		9.29	
pH	Shallow (0–4 m)	7.93		8.07		7.97	
	Mid-water (4–8 m)	8.03		8.15		7.95	
	Deep (8 m+)	8.07		—		7.94	
	All depths	8.00		8.08		7.95	

Notes:

1. Data collected in October/November 2010 (Golder 2011)

2. Data collected between January and April 2017 (Golder 2017)

3. Location is approximate center of reference locations used to calculate mean values

EGD: Esquimalt Graving Dock

m: metre

mg/L: milligrams per litre

NTU: nephelometric turbidity units

Table 2

Water Quality Criteria

Parameter	Compliance Point[1]		Assessment Point[2]
Total Suspended Solids	Material placement	<75 mg/L (over background)	<10 mg/L over background at any given time (<24 h duration) when background is <100 mg/L; <10% of background when background is >100 mg/L
Turbidity[3]	Turbidity values as compliance limits for the discharge are not commonly specified for effluents. For the purposes of day-to-day management of dredging activities, turbidity value based on the TSS/turbidity relationship derived (Section 3.1; Figure 2) and are applied as over background values.		<5 NTU over background[4,5] when background is <50 NTU; <10% of background when background is >50 NTU
Dissolved Oxygen	>5 mg/L[6]		>8 mg/L
pH	6.5 to 9.0 [3]		7.0 to 8.7 [7]
Metals –iron	See Table 3		See Table 3

Notes:

1. Point of Discharge (POD) taken to be the established set-back or safe working distance from active operations (e.g., 25 m from the edge of the material placement bucket).

2. Receiving environment taken to be the edge of the work zone or assessment point (i.e., 100 m from the edge of the material placement bucket).

3. The range of pH specified for protection of marine waters is 7.0 – 8.7 to protect mollusk embryo development, based on BC MOE ambient water quality guidelines for pH (BC MOE 1991). However, for the purposes of managing pH during construction projects, DFO has typically specified the same range as for freshwater (6.5 to 9.0), recognizing that these pH differences are small, short-term in nature, are not harmful, and with marine water buffering, the pH water quality guidelines will be met very quickly. Transient pH excursions to less than 7 or greater than 8.7 units are common natural occurrences in coastal environment.

4. Background is defined as the NTU value measured in the receiving environment up current from the activity.

5. The baseline monitoring program indicated that background turbidity in Esquimalt Harbour is relatively low (mean = 3.8 NTU). However, intermittent increases to 400 NTU have been observed in related to vessel operations at the EGD and storm events. Therefore, turbidity will be evaluated for WWRP as induced turbidity above background measured at the time of sampling.

6. Based on British Columbia MOE ambient water quality guidelines for instantaneous minimum dissolved oxygen (BC MOE 2016).

7. Based on MOE ambient water quality guidelines for pH (MOE 1991).

h: hour

mg/L: milligrams per litre

NTU: nephelometric turbidity units

POD: point of discharge

TSS: total suspended solids

Table 3
Monitoring Program Summary

Type of Sample	Number of Locations[1]	Number of Depth Intervals	Estimated Number of Samples for Analysis of TSS and Iron[2,3]	Frequency of Laboratory Samples[4]	
				Week 1	Week 2
Compliance Point (Placement Location)				Once daily (standard TAT)	Once, every three days (standard TAT)
25 m[5] from edge of bucket	1	3	3		
Assessment Point					
100 m from placement location	3	3	9		
References					
Near-field	2	3	6		
Far-field	3	3	9		

Notes:

1. The actual number of locations from which samples are collected for laboratory analysis will be determined by the Qualified Professional and number of reference samples collected will be dependent on the need to evaluate the potential for non-project related activities (e.g., vessels berthing) to influence background turbidity.

2. Total and dissolved iron.

3. Iron samples will only be collected during monitoring when amended sand cover (siderite) is placed. Sand only test plots will only require TSS testing.

4. Field duplicates will be collected at a rate of approximately 10% for quality control purposes and equipment blanks will be collected once per week (Section 3.5).

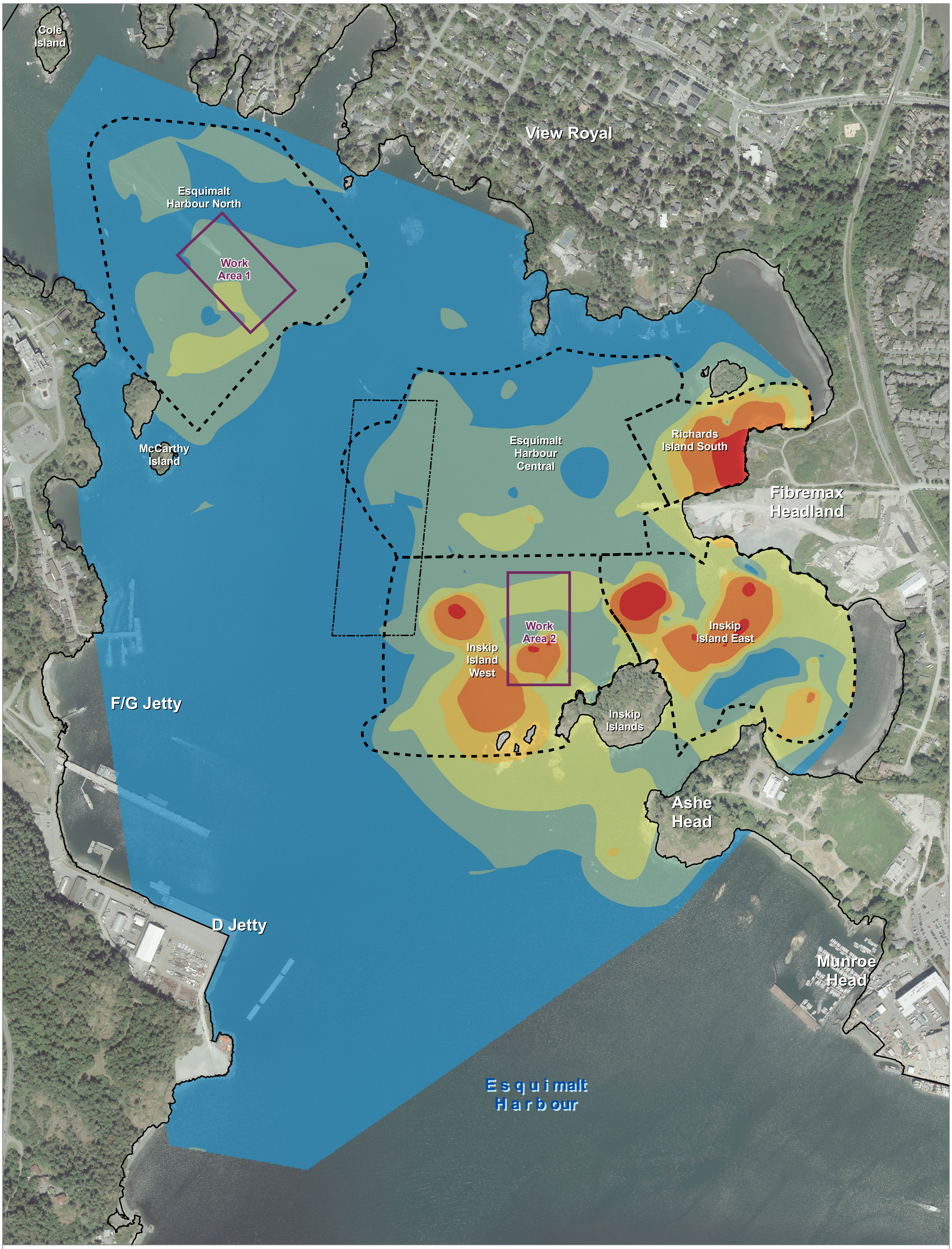
5. This is a safety buffer.

m: metre

TAT: turnaround time.

TSS: total suspended solids

Figures



LEGEND:

WWMAs

Pilot Project Work Areas

Jones Marine Lease Boundary

Wood Waste Thickness (metres)

0 - 0.2

0.21 - 0.4

0.41 - 0.6

0.61 - 0.8

0.81 - 1.5

1.51 - 3.55

NOTES:

1. The wood waste thickness surface was created using a Natural Neighbor interpolation method.
2. Jones Marine Waterlot Lease boundary corner points coordinates provided by DND.

DND = Department of Defence
WWMA = Wood Waste Management Area

0 200
Metres

Publish Date: 2019/07/17, 10:44 AM | User: jsfox
Filepath: \\orcas\GIS\Jobs\090553-03_Esquimalt_Harbour\Maps\WoodWaste\WQMP\Fig1_WoodWaste_Thickness_WQMP.mxd

ANCHOR QEA

Figure 1
Pilot Project Work Areas
Wood Waste Remediation Project – Water Quality Monitoring Plan

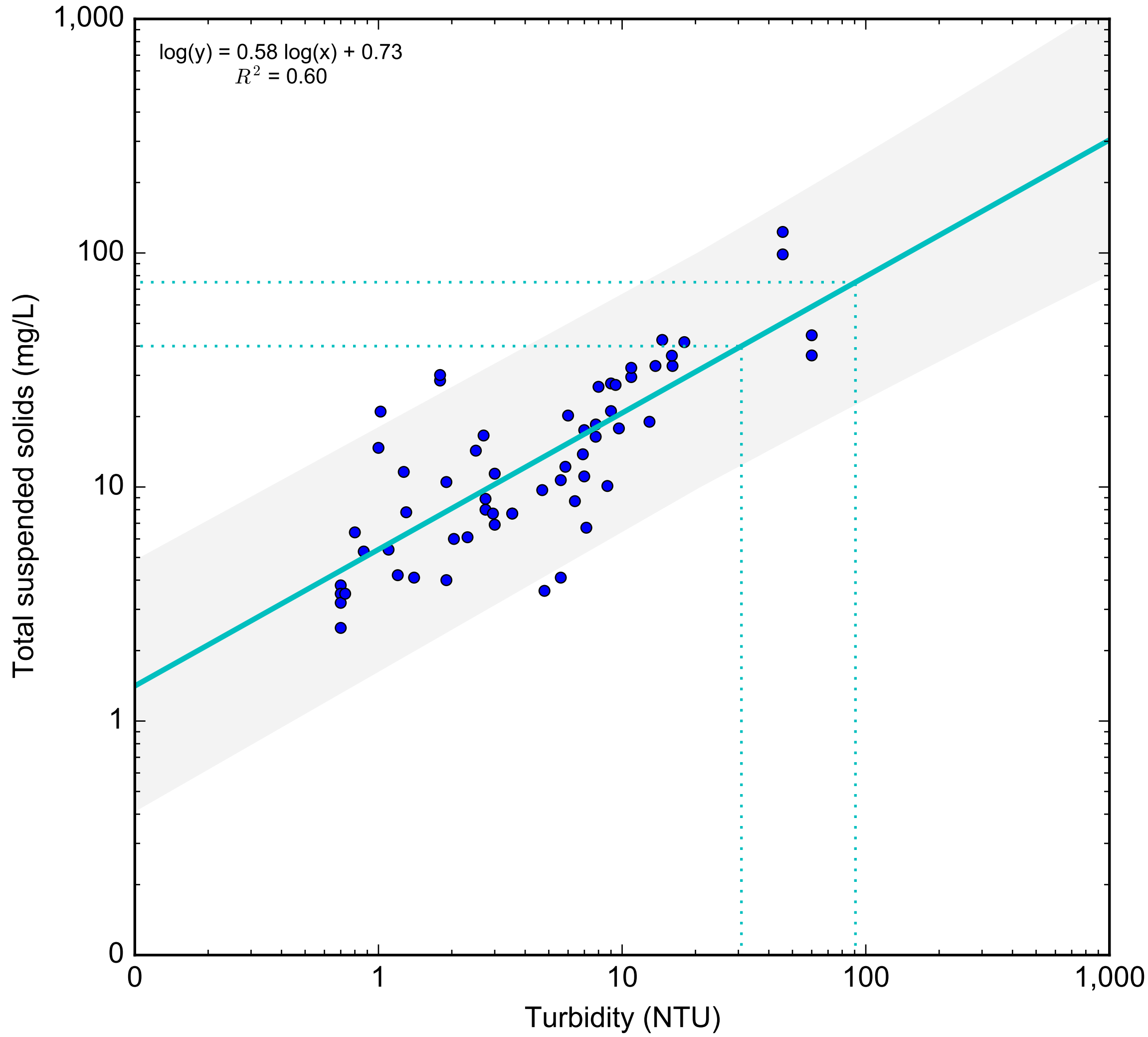
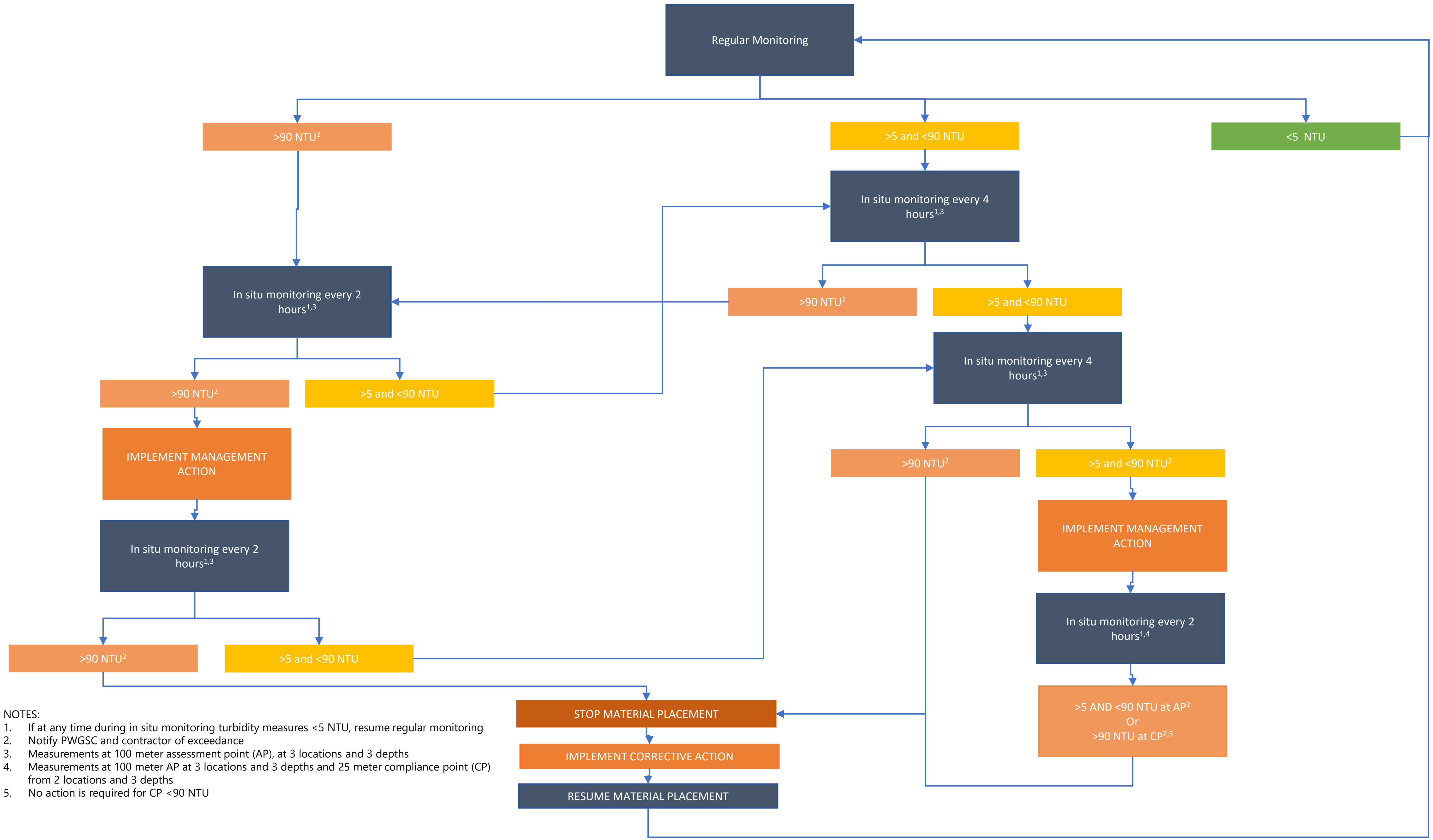


Figure 2

Total Suspended Solids - Turbidity Relationship for Compliance Points

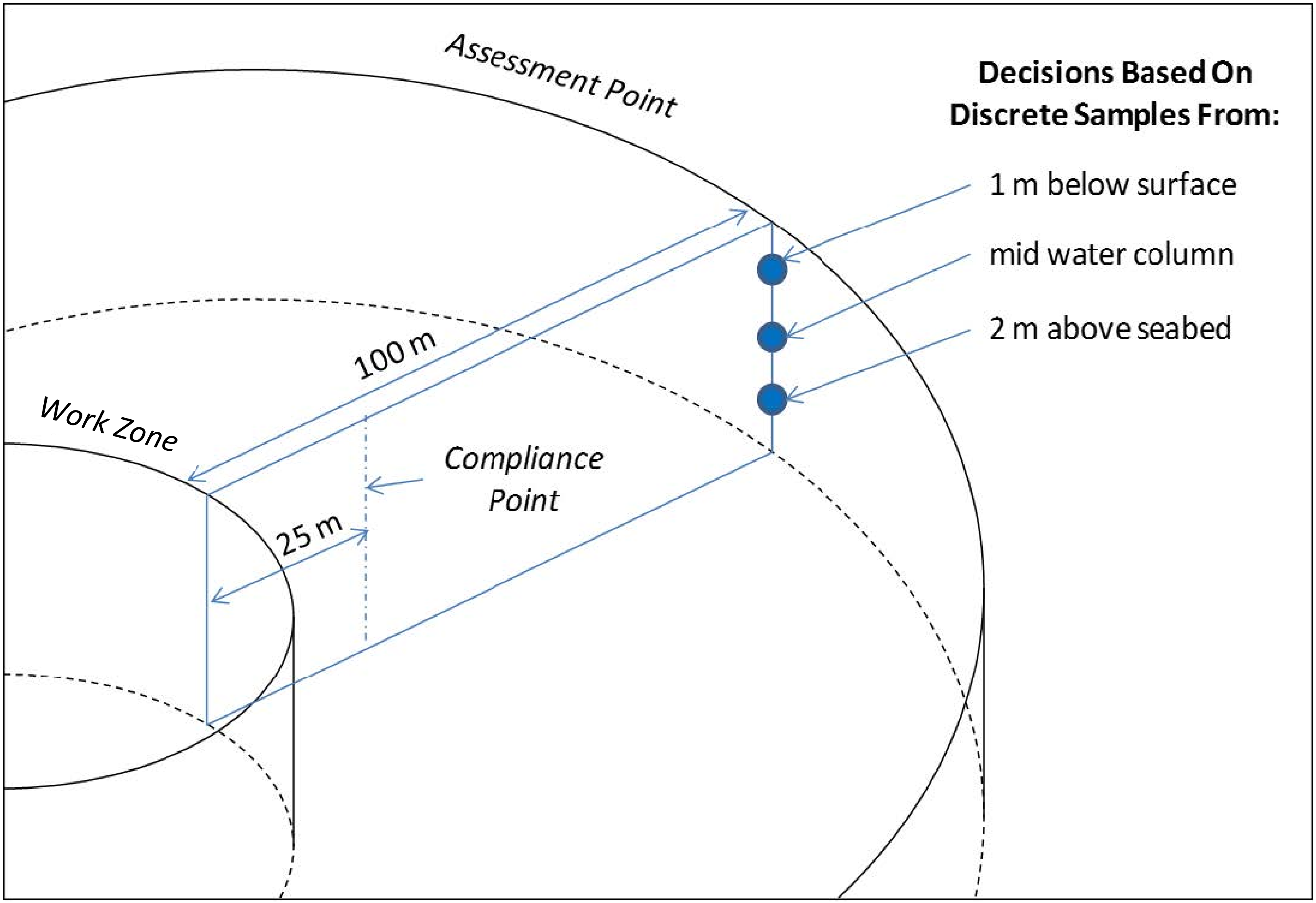
Green line represents best-fit regression line.
Gray shading represents prediction interval (95% confidence).
Turbidity of 30.9 NTU associated with TSS of 40 mg/L.
Turbidity of 90.7 NTU associated with TSS of 75 mg/L.



NOTES:
1. If at any time during in situ monitoring turbidity measures <5 NTU, resume regular monitoring
2. Notify PWGSC and contractor of exceedance
3. Measurements at 100 meter assessment point (AP), at 3 locations and 3 depths
4. Measurements at 100 meter AP at 3 locations and 3 depths and 25 meter compliance point (CP) from 2 locations and 3 depths
5. No action is required for CP <90 NTU

ANCHOR QEA

Figure 3
Decision Framework for Implementing Management Actions During Material Placement Based on Real-Time Monitoring of Turbidity

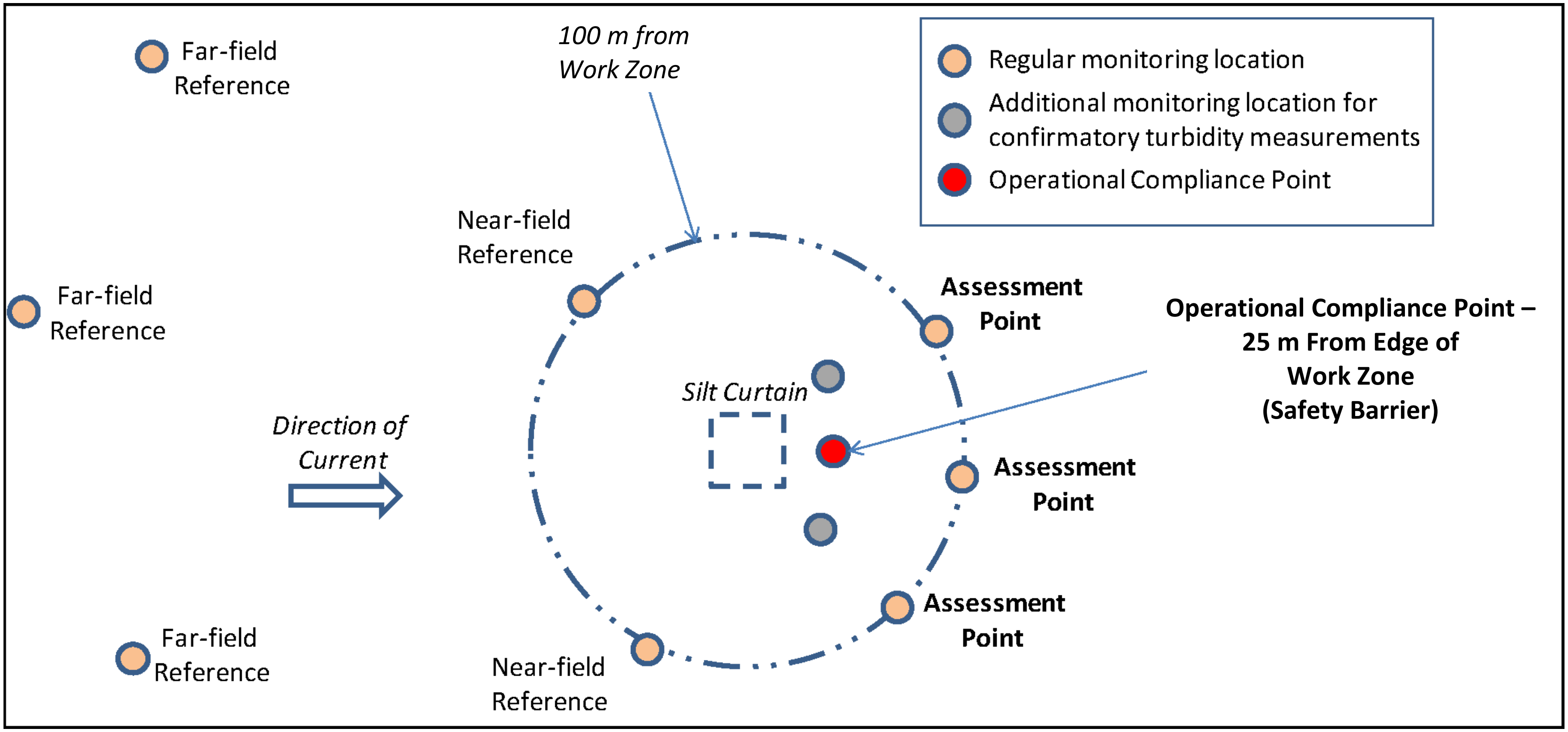


Source: Golder 2019

Filepath: \\Fuji\Anchor\Projects\PWGSC\Esquimalt Harbour\Wood Waste\Deliverables\EMP-WQMP\EMP\Appendix A - WQMP\Figures\Figure 4 Conceptual Layout of Turbidity Measurements in the Water Column.docx

ANCHOR QEA

Figure 4
Conceptual Layout of Turbidity Measurements in the Water Column
Water Quality Monitoring Plan
DND Wood Waste Remediation Pilot Project



Source: Golder 2019

Filepath: \\Fuji\Anchor\Projects\PWGSC\Esquimalt Harbour\Wood Waste\Deliverables\EMP-WQMP\EMP\Appendix A - WQMP\Figures\Figure 5 Conceptual Layout of Monitoring Locations for Material Placement Activities.docx

Appendix B
Example Reporting Templates

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

[Enter date]

To: Recipient(s)

From: Author(s)

cc: Other(s)

Re: Environmental Monitoring Daily Summary

1.0 Introduction

2.0 Construction Activities

3.0 Environmental Monitoring Activities

3.1 Environmental Site Inspections and Observations

3.2 Water Quality Monitoring

Table 1
Summary of In Situ Water Quality Measurements

Parameter	Performance	Surface Range	Mid-Depth Range	Bottom Range	Comments

3.3 Marine Mammal Monitoring

3.4 Fish Monitoring

3.5 Bird Monitoring

4.0 Emerging Issues

Table 2
Emerging Issues

Date Noted	Environmental	Recommendation/Action	Comments	Completed

5.0 Closure

6.0 References

DAILY FIELD ACTIVITY REPORT (DFAR)

PROJECT NO.:
PROJECT NAME: Wood Waste Remediation Project – Pilot Study
REPORT DATE
REPORT NUMBER
CONTRACTOR NAME:
DFAR PREPARED BY:

Report Submitted to:		Contractor Name and Contact:		Weather Temp. And Precip.			
Client:	PWGSC	General		AM:			
		Subs		PM:			
cc:	AQ			Times of Site Visits:			
				From		To	

HEALTH AND SAFETY

Attend daily safety mtg. ☐ Yes ☐ No	Health & Safety concern or issue?	

http://www.waterlevels.gc.ca/eng/station?sid=7109

DAILY TIDE PREDICTIONS IN FEET	DATE	TIME	HEIGHT (m)	HEIGHT (FT)
Station ID: 7109				
Esquimalt Harbour				
Time Zone: PST				
Datum: Chart				
Sea State				

CONSTRUCTION OBSERVATIONS

Location	Description of field activity, observations, hours of work, changes, and recommendations to Owner	Further Action Recommended to Owner

DREDGE VOLUME / WORK CONDUCTED

TASK Specification Reference	Location / Dredge Unit / Description	Quantity / Progress

Field Representative Signature

Checked By:

Date

DAILY FIELD ACTIVITY REPORT (DFAR)

ENVIRONMENTAL MONITORING		
Type of Monitoring	**Acceptable**	**Comment**
Air Quality	☐ Yes ☐ No	
Site Management	☐ Yes ☐ No	
Noise	☐ Yes ☐ No	

PERSONNEL ON SITE (EST.)			
Name (or Labor Category)	**Organization**	**Number Personnel**	**Notes**

EQUIPMENT ON SITE		
Type of Equipment	**Organization**	**Notes / Status / Usage**

DAILY FIELD ACTIVITY REPORT (DFAR)

PHOTOGRAPHS	
Comment:	**Comment:**
Comment:	**Comment:**

Appendix C
Project Contact List

Table 1
Project Contact List

Name	Role or Title	Email	Address	Office Phone	Mobile Phone
Department of Defence (DND)					
Duane Freeman	Project Director	duane.freeman@forces.gc.ca	PO Box 17000 Station Forces Victoria, BC V9A 7N2	Direct: 250-363-5063	250-480-9554
Mike Bodman	Senior Project Advisor	michael.bodman@forces.gc.ca	Building D-9, CFB Esquimalt PO Box 17000 Station Forces Victoria BC V9A 7N2	Direct: 250-363-4824	250-812-1540
Mike Waters	Project Leader	michael.waters@forces.gc.ca	PO Box 17000 Station Forces Victoria BC V9A 7N2	Direct: 250-363-7457	250-213-1653
Kara Foreman	Deputy Project Leader	Kara.foreman@forces.gc.ca	PO Box 17000 Station Forces Victoria BC V9A 7N2	Direct: 250-363-2177	778-984-9900
Public Works and Government Services Canada (PWGSC)					
Kristen Ritchot	Departmental Representative, Design and Environmental Project Manager, Environmental Monitoring	kristen.ritchot@pwgsc-tpsgc.gc.ca	401, 1230 Government Street Victoria, BC V8W 3X4	Direct: 250-363-7861	250-208-4008
Andrew Smith	First Nations Communications Coordinator, Senior Procurement Advisor	Andrew.g.smith@pwgsc-tpsgc.gc.ca	401, 1230 Government Street Victoria, BC V8W 3X4	Direct: 250-363-8441	250-812-7975
Chris Patterson	Construction Health and Safety Coordinator	chris.patterson@pwgsc.gc.ca	401, 1230 Government Street Victoria, BC V8W 3X4	Direct: 604-812-9768	604-812-9768
Anchor QEA, LLC (Lead Consultant: Project Engineering, Construction Management, Environmental Monitoring)					
Tom Wang	Principal in Charge	twang@anchorqea.com	1201 3rd Avenue, Suite 2600 Seattle, WA 98101	Main: 206-287-9130 Direct: 206-903-3314	206-465-0900

Name	Role or Title	Email	Address	Office Phone	Mobile Phone
Dan Berlin	Project Manager	dberlin@anchorqea.com	1201 3rd Avenue, Suite 2600 Seattle, WA 98101	Main: 206-287-9130 Direct: 206-903-3322	206-409-7268
Kathy Ketteridge	Engineer of Record (Contract Drawings and Specifications)	kketteridge@anchorqea.com	1605 Cornwall Avenue, Bellingham, WA 98225	Main: 360-733-4311 Direct: 360-715-2709	360-319-8069
MCCOI Marine Ltd. (Quality Assurance Bathymetric Surveying)					
Matt Fawcus	Surveyor	matt@mccoi-marine.com	PO Box 2091, Sechelt, BC Canada, V0N 3A0	--	604-740-6616

Appendix D
Submittals Tracking Table

SUBMITTALS TRACKING TABLE

Project: **Wood Waste Remediation Project - Pilot Project**

Contractor:

Project Number: **R.098682.001**

Date Updated:

Updated with Contractor Schedule dated:

STATUS KEY: AC = Accepted RJ = Rejected/Re-Submit RR = Revise & Re-Submit MC = Make Corrections Noted SI = Submit Specific Item

Submittal Info				Status					Notes
Spec Section	Submittal Type	Submittal	Manufacturer / Supplier / Comment	Date required from Contractor	Date Received from Contractor	RFI # (if applicable)	Design Team Lead	STATUS	Notes
01 11 55	Pre-Construction	Notice of Project							
01 11 55	Pre-Construction	Construction Work Plan							
01 11 55	Pre-Construction	Initial "month by month" Cash Flow Estimate							
01 11 55	Pre-Construction	Environmental Protection Plan (EPP)							
01 11 55	Pre-Construction	Health and Safety Plan							
01 11 55	Pre-Construction	Construction Quality Control Plan							
01 11 55	Pre-Construction	Security Clearance Documentation							
01 35 00.50	Pre-Construction	Navigation Control Plan							
01 35 00.50	Pre-Construction	Floating Equipment Certificate of Qualification, including Floating Plant Form							
01 35 00.50	Pre-Construction	Safety Management System (SMS) for All Registered Vessels							
01 31 19	Progress	Minutes of Progress Meeting(s)							
01 11 55	Progress	Coordination Drawings							
35 20 23	Progress	Daily Construction Report							
35 20 23	Progress	Progress Claims							
01 11 55	Progress	“Month-by-month” Cash Flow Estimates							
01 11 55	Progress	Breakdown of the Contract Unit Rates and Lump Sum Prices							
01 11 55	Progress	Record Documents							
02 21 13	Progress	Post-Construction Bathymetric Survey(s) and Quantity Calculations							
01 35 29.14	Progress	Health and Safety Program Requirements, including, but not limited to: Incident and Accident Reports, and complete set of MSDS and other WHMIS requirements							
01 35 00.50	Progress	Vessel Information, including vessel name; registration number; type of vessel; and last port of call							
01 35 00.50	Progress	For any new equipment brought on site, new Floating Equipment Certificate of Qualification, including Floating Plant Form							
01 45 00	Progress	Inspection and Laboratory Test Reports							
02 21 13	Progress	Progress Survey(s) and Quantity Calculations							
35 20 23	Progress	Empty and Full Barge Displacement Measurements							
35 37 10	Progress	Marine Surveyor Report (for documentation of the seaworthiness of each transport barge)							
35 37 10	Progress	Material Types 1 and 2 Samples and Cover Type 3 Samples							
35 37 10	Progress	Material Types 1 and 3 Laboratory Test Results							
01 11 55	Post-Construction	Record Documents							
01 78 30	Post-Construction	Certificate of Completion							
01 78 30	Post-Construction	Notification of Contractor Inspection Completion							

Appendix B-3
Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Fisheries and Oceans Canada
Pêches et Océans Canada

Pacific Region
Ecosystems Management Branch
3190 Hammond Bay Road
Nanaimo, BC
V9T 6N7

Région du Pacifique
Gestion des ecosystems
3190 rue Hammond Bay
Nanaimo, CB
V9T 6N7

September 30, 2019

Our file *Notre référence*

19-HPAC-00546

Michael Waters
Department of National Defence
CFB Esquimalt
Building 199D, Room 302
Victoria, B.C. V9A 7N2

Subject: Wood Waste Remediation, Esquimalt Harbour, Esquimalt – Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Dear Mr. Michael Waters:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your proposal on July 24, 2019. We understand that you propose to conduct a wood waste remediation pilot project in Esquimalt Harbour, British Columbia consisting of the following:

- Placing a thin layer (0.3 – 0.6m) of clean sand on top of mud/sand sediment covered with wood waste material. Material will be placed in 3 test areas resulting in a 2,700m^2 total footprint;
- Placing a thin layer (0.3m) of mixed siderite (5%) with clean sand (95%) on top of mud/sand sediment covered with wood waste material. Material will be placed in 4 test areas resulting in a 3,600m^2 total footprint;
- Conducting practice placements in 10m x 10m plots using three methods resulting up to a 4,400m^2 total footprint. Practice placements will occur prior to the placement of materials in test areas listed above;
- Placing boulders in the practice area to create two circular rock mounds (up to 2m height x 6m diameter); and
- Conducting subsequent monitoring to investigate the effectiveness of placing the material on subtidal benthic habitats impacted by wood waste.

We understand the following aquatic species listed under the *Species at Risk Act* may use the area in the vicinity of where your proposal is to be located:

- NE Pacific Southern Resident Killer Whale listed as Endangered;
- Northern Abalone listed as Endangered;
- NE Pacific Transient Killer Whale listed as Threatened;

.../2

- Stellar Sea Lion listed as Special Concern; and
- Harbour Porpoise listed as Special Concern.

Our review considered the following information, herein called the 'Project Plan':
- *Request for Review Form* submitted by Mike Waters, Department of National Defence (DND), received July 24, 2019;
- *Due Diligence Environmental Effects Determination Report, Physical Activity: DND Wood Waste Remediation Project* and Appendices prepared by Hemmera Envirochem, dated July 23, 2019;
- Information received via telephone correspondence between Mike Waters (DND) and Larissa Chin (the Program); and
- *Water Quality Monitoring Plan* prepared by Anchor QEA, dated July 2019.

Your proposal has been reviewed to determine whether it is likely to result in:
- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the Aquatic Invasive Species Regulations.

The aforementioned impacts are prohibited unless authorized under their respective legislation and regulations.

Provided that you incorporate your proposed avoidance and mitigation measures that are described in your Project Plan, the Program is of the view that your proposal will not require an authorization under the *Fisheries Act*, the *Aquatic Invasive Species Regulations* or the *Species at Risk Act*.

Should your plans change or if you have omitted some information in your proposal, further review by the Program may be required. Consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains your responsibility to remain in compliance with the *Fisheries Act*, avoid prohibited effects on listed aquatic species at risk, any part of their critical habitat or the residences of their individuals, and prevent the introduction of non-indigenous species.

It is also your *Duty to Notify* DFO if you have caused, or are about to cause, the death of fish by means other than fishing and/or the harmful alteration, disruption or destruction of fish habitat. Such notifications should be directed to (http://www.dfo-mpo.gc.ca/pnw-ppe/CONTACT-eng.html) or to the DFO-Pacific Observe, Record and Report phone line (1-800-465-4336).

.../3

Please notify this office at least 10 days before starting your project. A copy of this letter should be kept on site while the work is in progress. It remains your responsibility to meet all other federal, territorial, provincial and municipal requirements that apply to your proposal.

If you have any questions with the content of this letter, please contact Larissa Chin at our Nanaimo office at 250-758-4978, or by email at Larissa.Chin@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Boone Barber, RPBio
Senior Biologist
Fish and Fish Habitat Protection Program

Appendix C
DND Reference Documents and Guidelines

Appendix C-1
DND CAD/BIM Standard

National Defence / Défense nationale

DND CAD/BIM Standard

CETO (Construction Engineering Technical Order) C-98-002-CAD/FP-003 replacing obsolete CETO D-98-000-MIS/SF-003 Drawing Standards and Symbols.

August 2012

Version 2.3

OPI: DCAE 6

Canada

August 2012

National Defence Headquarters
Major-General George R. Pearkes Building
101 Colonel By Drive
Ottawa, ON, K1A OK2

For inquiries, please contact ADM(IE) DCAE 6
(613) 995-3269

Preface

This CAD/BIM Standard manual has been developed by ADM (IE) as an initiative to consolidate and update the existing *Guidelines and Conventions for the Production of Engineering and Architectural Drawings*.

A French version of this document is also available. If there is a discrepancy between the French document and the English document, the latter shall be considered correct.

Table of Contents

1 Introduction

Traditionally this Standard has focused on CAD and the requirements surrounding the graphics and drawing conventions in support of AEC project delivery. While the basic requirements involving CAD remain, it is important to introduce Building Information Modeling (BIM) support within the framework of the DND CAD Standard to suit AEC industry advances. This standard has been renamed the *DND CAD/BIM Standard Version 2.3*.

The practical use of any drawing or package of drawings within the **Department of National Defence** (**DND**) does not terminate with the construction of the facility, but continues over the life cycle of the facility. Therefore, all drawings produced for or by DND upon promulgation of this CETO shall conform to the standards herein.

All drawings produced as part of the final contract document package shall be completely computer-generated; manual revisions to existing drawings are not permitted.

This Standard supports AutoCAD, the de facto standard in the Canadian design industry. DND also provides support for MicroStation users on an ad hoc basis. Certain restrictions are made with the *DND CAD/BIM Standard*, with line types for example, to ensure smooth translations between these CAD systems.

1.1 PURPOSE

A set of exhaustive rules for preparing engineering drawings is not attainable. The intent of this document is to supply sufficient direction so that drawings can be presented in a consistent manner.

This document provides drawing standards to which final DND drawings shall adhere, regardless of the CAD system used.

Reasons to comply:

- Improve the clarity, consistency, and compatibility of the drawings that are submitted to DND regardless of CAD system
- Maximize interoperability of the digital drawing file between CAD systems
- Reduce the amount of rework or reconfigurations that are required when drawings are accepted
- Ensure ease and accuracy of siting data migration to GIS
- Improve the ability to create printable copies of electronic files that are received
- Reduce the need for re-submissions by consultants hired to assist DND

1.2 SCOPE

This document is designed to inform stakeholders of the graphic presentation requirements of the final design/contract drawing. It is not intended to cover any technical or CAD software-specific instructions on how to achieve the standards set out herein.

See the DND CAD/BIM Standard Companion Document Listing section in this document for a list of supporting documents that cover other areas of the standard.

1.2.1 Keeper of the CAD/BIM Standard

The Keeper of the *CAD/BIM Standard* is the CAD/BIM Chief, DCAE 6, who is responsible for maintaining the documents.

Contact Information

Mailing Address:
National Defence Headquarters
Major-General George R. Pearkes Building
101 Colonel By Drive
Ottawa, ON, K1A 0K2

Office Location:
180 Kent Street
Minto Building
Ottawa, ON (14-117)

Attention: John Hale, Chief CAD/BIM
DCAE 6
(613) 995-3269
john.hale@forces.gc.ca

Please refer all questions and comments to the above contact when required.

1.2.2 Revisions to this Document

It is recognized that the standard will evolve over time due to software changes and improved strategies. Any suggestions and corrections that may improve future releases should be submitted to the Keeper of the CAD/BIM Standard.

1.3 TERMINOLOGY

In an effort to distinguish requirements from suggested guidelines, this standard uses the terminology defined below:

Table 1-1

SHALL	Expresses a requirement or order (i.e., the consultant must follow this condition to be compliant)
SHOULD	Expresses a recommendation (i.e., it is not mandatory, but strongly advised)
MAY	Expresses an option or that which is permissible (e.g., consultants may deliver projects in CAD or BIM)
CAN	Expresses possibility or capability (i.e., the option is practicable)

1.4 DEFINITIONS

Table 1-2

OUTSIDE	Project work that consists only of exterior items including external utilities, roads, survey information, etc.
INSIDE	Project work that consists only of interior building items including floor plans, internal utilities, furniture layouts, building elevations, and building structure.
SITING	Project work that consists of GIS information, such as site plans.
CIVIL	Project work that consists of civil engineering, such as road design, bridges, etc.
DESIGN MODELS	A model file contains elements or entities that represent the actual objects that are being drawn or designed (e.g., walls, doors, columns, sidewalks, pavement, curbs, etc.). This is referred to as Model Space in AutoCAD, and Design Model in MicroStation.
SHEET LAYOUTS	A model file used to assemble design model data, border graphics and annotation to compose the final plotted drawing. This is referred to as Paper Space in AutoCAD, and Sheet Model in MicroStation.
LAYERS	Classification system for graphics in the design/drawing file. Allows grouping of drawing components, which enables the user to turn items on and off, change colour, line width, and other properties as a group. The term Layer is used in AutoCAD whereas the term Level is used in MicroStation.

1.5 ACRONYMS

Table 1-3

ADM(IE)	Assistant Deputy Minister Infrastructure and Environment
AIA	American Institute of Architects
DND	Department of National Defence
AE	Architect Engineer
AEC	Architectural, Engineering, and Construction
CAD	Computer Aided Design
CETO	Construction Engineering Technical Orders
GIS	Geographic Information System
ISO	International Organization for Standardization
SI	International System of Units
N/A	not applicable

1.6 LEGEND

The following symbols are used throughout this document.

Table 1-4

Symbols	Definition
✍	Important note
🕮	Reference to information found in another document or manual

1.7 DND CAD/BIM STANDARD COMPANION DOCUMENT LISTING

Table 1-5

Document Name	Description
DND CAD/BIM Standard C-98-002-CAD/FP-003	**Document that prescribes general requirements and drawing convention standards**
Annex A: Layers C-98-002-CAD/FP-004	Listing of DND Standard Layers and abbreviations
Annex B: Symbols C-98-002-CAD/FP-005	Listing of DND Standard Symbols for reference
Annex C: DND Location Codes C-98-002-CAD/FP-009	Listing of DND Location Codes, which form part of the DND Drawing Number naming convention.
Annex D: Change Request Form	Form completed to track change requests
Tool Kit Documents	
Annex E: Tool Kit Guide for AutoCAD C-98-002-CAD/FP-006	Document covering all aspects of working with the DND Standard using AutoCAD software
Annex F: Tool Kit Guide for Civil 3D	Document covering all aspects of working with the DND Standard using Civil 3D software
Annex G: Tool Kit Guide for Revit	Document covering all aspects of working with the DND Standard using Revit software
Annex H: Interim BIM Project Guide	Document introducing submission requirements for BIM projects
Annex I: Menu Manager Content	Listing of Menu Manager menus and content for reference.

📖 See the "What's New" document to review changes to standard documentation and delivered DND software since the last release.

✍ **Some or all *DND CAD/BIM Standard* documents can be accessed in PDF format from one of the following web addresses:**

DND Personnel Only:
http://admie.ottawa-hull.mil.ca/dgme/DCAE/CAD_Standards/cad_std_and_guidelines_e.asp

Public Website:
http://www.acsnb.com/dnd

2 General Requirements

2.1 BILINGUAL REQUIREMENTS

Ensure that where bilingual documents are required, drawings are prepared to allow application of notes, titles, etc., in both official languages without compromising drawing clarity.

2.2 METRIC REQUIREMENTS

All drawings detailing construction engineering, architectural, and related works for DND facilities shall be prepared using the International System of Units (SI). Units for linear dimensioning are restricted to the metre (m) and the millimetre (mm). Whole numbers will indicate millimetres [e.g., the coordinate (600,1250) is referenced in millimetres], and decimal expressions to three places of decimals will indicate metres [e.g., the coordinate (1.200, 25.000) is referenced in metres].

For AutoCAD format drawings, “Insertion Scale” & “Length” parameters of the drawing units shall be set accordingly.

In certain applications, the "NPS" designation is used to describe the size of piping and appurtenances. This is acceptable provided current manufacturing standards for the items concerned have not been converted from imperial to metric units.

2.3 REVISION TEXT

Where applicable, red-line, bubble or revision clouds shall be used to denote all changed items on the drawings. Where applicable, these revisions shall be called out by a reference to the title block (utilizing a number enclosed in a triangle to reference date, description, etc.).

2.4 AS-BUILT REQUIREMENTS

Upon completion of the project, final project drawings (all disciplines) shall be updated to “As-Built” status by the consultant/contractor responsible for the work. Final “As-Built” drawings shall be both hard copy and native digital files.

2.5 GIS REQUIREMENTS

2.5.1 Closed Shapes

All shapes drawn shall be “closed shapes” and all symbols shall conform to the *CAD/BIM Standard* by having a **graphic point at the point of origin**. This is particularly important for siting as it ensures that data migration to GIS can be performed correctly.

2.5.2 Coordinate System

The project manager will provide additional instructions for siting project requirements related to coordinate system, geodetic datum and global origin, as this information is unique to each base (client).

3 Drawing Number Convention

3.1 DRAWING NUMBER

Contract and other non-standard drawings shall be numbered with the combination of the **Job Number** and the **Drawing Sheet Number**. See Table 3-1.

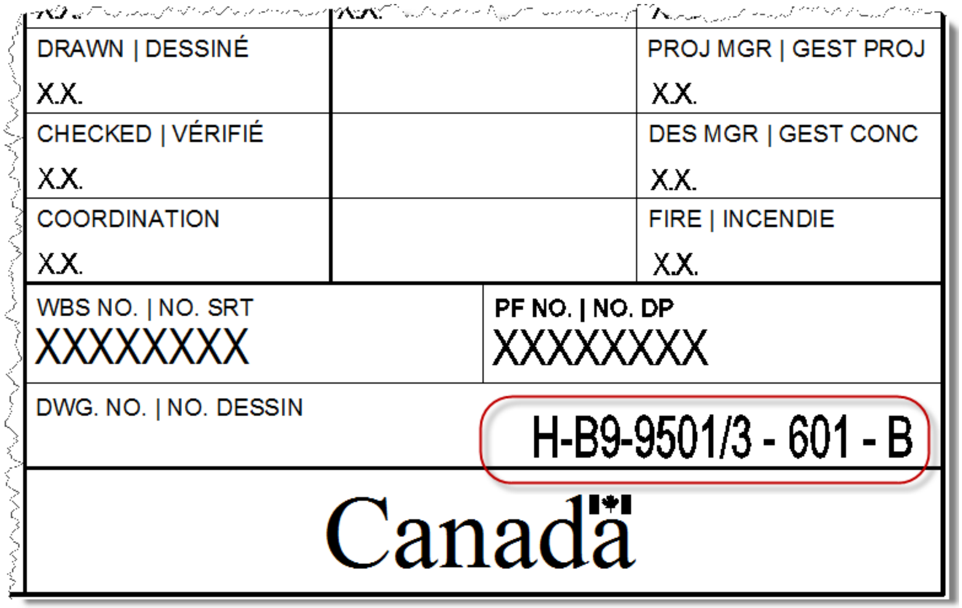
See Appendix E for numbering sketches, site records, and standard drawings.

Using as an example **H-B9-9501/3-601B**, the drawing number has the following parts:

Table 3-1: Part of Drawing Number

Job Number	Drawing Sheet Number
H-B9-9501/3	601B

Figure 3-1: Sample of Drawing Number in the Title block



3.1.1 Drawing Number Responsibilities

H-B9-9501/3-601B

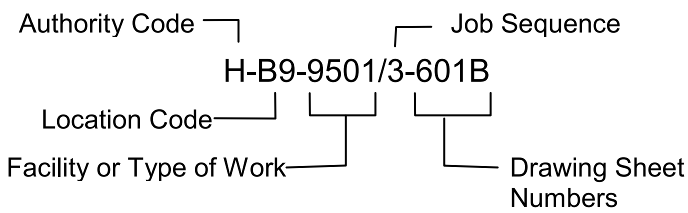
Job numbers are issued by DND Headquarters, Command, or Base via the project manager assigned to the project. The number assigned should be checked with the base (the client) to ensure that it is correct.

H-B9-9501/3-**601B**

Drawing Sheet Numbers are the responsibility of the consultant or designer developing the project.

3.1.2 Drawing Number Breakdown

Using as an example **H-B9-9501/3-601B**, the job number and the drawing sheet number have the following parts:



3.1.3 Job Number

Job Number H-B9-9501/3 is broken down as follows:

Authority Code

H-B9-9501/3-601B

The authority code is a letter signifying the design agency responsible for the production of the drawing.

Table 3-2: Authority Codes

Code	Description
H	Headquarters
C	Command
L	Local (base)

Location Code

H-**B9**-9501/3-601B

The location code is a combined letter and number system that represents the site, establishment or base at which the building or service is located.

📖 See **Annex C**: **DND Location Codes**.

Facility or Type of Work

H-B9-**9501**/3-601B

The first two digits indicate the type of work or facility, and the second two digits represent a specified standard design for a work or facility.

📖 See Appendix E for a list of codes for type of work or facility.

Job Sequence Number

H-B9-9501/**3**-601B

This number indicates subsequent projects involving the same work or building.

3.1.4 Drawing Sheet Number

Drawing sheet number **601B** is broken down as follows:

Table 3-3: Drawing Sheet Number Breakdown

Trade Number	Sequential Number	Bilingual Indicator
6	01	B

Trade Number

H-B9-9501/3-**6**01B

DND utilizes the following trade (discipline) codes to identify drawings by trade and provide a standard sequence within the final submission.

Table 3-4: Trade Codes

Trade Code	Description
0	Cover sheet and very small projects where two or more disciplines appear on the same drawing shall use 0 as the trade identifier of the drawing number.
1	Siting
2	Structural
3	Architectural
4	Mechanical
5	Electrical
6	Civil
7	Communication
8	Fire Safety/Security
9	Interior Design

Sequential Number

H-B9-9501/3-6**01**B

The following digits are the sequential numbers identifying the sheet for the accompanying trade number.

Each trade sequential number is to have 2 digits and begin with 01. For example, the first drawing in a Siting series is 101 and the first drawing in a Civil series is 601. See Table 3-5.

Table 3-5: Sequential Number Values

Code Value	Description
01	First Drawing in the series
02	Second Drawing in the series
03	Third Drawing in the series
- - - Continued to 99 as necessary - - -	

- **For large projects, where a trade sequence is expected to exceed 99 drawings, the sequential number shall have 3 digits beginning with 001. For example, the first drawing in an Architectural series is 3001.**

Bilingual Indicator

H-B9-9501/3-601**B**

Drawings shall be produced in both official languages. When both languages appear on the same sheet, the letter **'B'** shall follow the drawing number, indicating a bilingual drawing.

Where there is too much detail for this method to be practicable, separate English and French drawings shall be prepared. Although both sheets will show the same drawing number, the English only sheet will have no Bilingual Indicator and the French only sheet will be identified by the letter **'F'** placed immediately after the drawing sheet number.

Table 3-6: Bilingual Indicator Values

Code Value	Description
B	Drawing is bilingual
F	Drawing is French

3.2 ELECTRONIC FILE NAME

The electronic drawing file name is the same as the Drawing Number in the title block except it includes the file extension.

- **No slashes are allowed in file names; they need to be replaced with hyphens**.

For example, for Drawing Number **H-B9-9501/3-601B**, the drawing filename is **H-B9-9501-3-601B.dgn or H-B9-9501-3-601B.dwg**

4 Electronic File Standard

The information in this section covers the computer-based standards of the final DND drawing. See the accompanying guides for system-specific requirements, instructions, and information on how to comply with the DND standard.

4.1 DRAWING COMPOSITION

The following describes the drawing set-up and composition of the final drawings.

4.1.1 DND Border Set-up

- All final DND drawings shall use one of DND's Standard borders (**see Tables 5.1 and 5.2**).
- Borders can be placed as an **external reference or as a block**.
- Border blocks shall not be exploded.
- Borders can be placed in or referenced to the sheet layout. Borders shall not be scaled in a sheet layout. The scaling of the design should occur through scaled reference or viewport attachments.
- All layout viewport scales shall be locked when submitted.
- Borders should be initially set up using a DND template.

4.1.2 Actual Size Requirement

All drawing information shall be drawn true scale (1:1). That is, if a roadway segment is 100 metres long, the line drawn to represent it shall also be 100 metres long.

4.1.3 Reference Files

External reference files shall only be used during design development. All external reference files shall be bound within the final delivered electronic drawing file.

4.1.4 One Design Per File

Each drawing in a drawing set shall reside in separate electronic files. It is not acceptable for a single drawing file to contain 601, 602, 603, etc.

Multiple sheet layouts should be used to plot the same information with different sized borders, etc., but NOT to create separate drawings of the drawing set (e.g., drawings that would normally have separate drawing numbers such as: H-B9-9501/3-601B).

4.1.5 Layout Vs. Design Model Information

The following rules shall be used when determining where information should reside:

- Only items that are not graphically linked to objects in the design model shall appear in sheet layout (e.g., borders, title blocks, general notes, titles, legends, notes to computer operators that are not to be printed).
- All notes directly linked to the design should be placed in the design model (e.g., leaders, dimensions, and labels).

- All design information shall be placed in the design model (e.g., buildings, doors, column grids, dimensions, names, etc.).

4.1.6 New, Demolition, and Existing Features

In situations where you need to show existing design items in combination with items that are new, to be demolished, or relocated, it is preferred to have the existing design items subdued to appear as background information. This is achieved by making existing items appear grey and lightened; all other content is displayed normally or emphasized through bolding.

The following are acceptable options on how new, demolition, relocated and existing design items should be organized in the file.

Option 1: Prior to drawing a new design, move all demolition items to the demolition layers provided. Create a new layer for all existing items (e.g., A_EXST) and move all existing features to this layer. Use the provided layers for the NEW design items.

Option 2: For situations where separate design layers are needed to show new and existing construction, the standard layer naming convention shall be used for NEW and EXISTING. A status suffix of "**_NEW**" shall be placed at the end of the layer name for NEW items (e.g., A_WALL_NEW). A suffix of "**_EXST**" shall be placed at the end of the layer name for EXISTING items (e.g., A_WALL_EXST).

Option 3: The drawing containing the demolition or existing information can be kept as is and referenced to a new drawing where you use the provided layers for the NEW design items. You have the option in this case to override the display of the item attributes of the reference to suit.

Option 4: Where you have separate drawing files to show different construction conditions or phases, such as having a separate "Demolition Plan" and "New Floor Plan", all layers with existing items to remain should be appended with the status "_EXST" with their color and weight modified according to the standard. All other content that is new, to be removed, or relocated should be placed on their appropriate layers as provided, allowing them to appear bolder than the existing items to remain in the background.

Existing items to be removed may be marked with an "X", and existing items for Removal and Relocation with an "R."

Where all information can be accommodated on one plan, items may be marked as follows:

"X" - Removal

"R" - Removal and Relocate

"E" - Existing to Remain

"N" - New

4.2 LAYER STANDARD

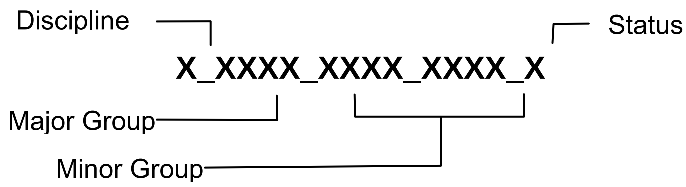
Exceptions to the standard will be accepted only in cases where items cannot be classified into one of the predefined layers. Layer names that are created shall follow the general DND layer name structure, and a description shall be provided.

🕮 Refer to **Annex A: Layers** for a list of available predefined layer names.

4.2.1 DND Layer Name Structure

All DND Layer names generally consist of four or more fields separated by underscores (_).

Dashes (“-”) or spaces (“ ”) shall not be used in any DND Layer names.



Discipline Designator X_xxxx_xxxx_xxxx_x

The discipline designator is the first field indicating the level feature discipline. The discipline designator fields are mandatory except for COMMON layers. See Table 4-1 for a complete list of DND discipline designators.

Table 4-1 : DND Discipline Designator

Discipline Designator			
INSIDE		**OUTSIDE**	
A	Architectural/Interior	SI	Siting
S	Structural	C	Control
M	Mechanical	E	Environmental
F	Fire Protection	B	Boring Log
P	Plumbing	G	Geotechnical
E	Electrical	H	Hazardous Materials
T	Telecommunications	HI	Historical Plan
		G	General Key Plan
		P	Planimetry - General
		P_AF	Planimetry – Airfield
		P_H	Planimetry – Hydrology
		P_M	Planimetry – Marine
		P_RAP	Planimetry - Paving
		P_V	Planimetry – Vegetation
		T	Topography
		U_A	Utilities – Abandoned
		U	Utilities – General
		U_C	Utilities – Communications
		U_D	Utilities – Drainage/Storm
		U_E	Utilities – Electrical
		U_G	Utilities – Gas
		U_H	Utilities – Heating
		U_M	Utilities – Marine
		U_S	Utilities – Sanitary
		U_W	Utilities – Water
		Z	Zone
		C	Civil
		L	Landscape

Major Group x_**XXXX**_xxxx_xxxx_x

The major group is an abbreviation that identifies a grouping of common types of drawing information relevant to each discipline.

Minor Group x_xxxx_**XXXX_XXXX**_x

This optional group is to subdivide the major group field to identify each level more precisely.

📖 See **Annex A** for DND layer abbreviations used for the major and minor groups.

Status x_xxxx_xxxx_xxxx_**X**

The status is an optional identifier to specify the current state of the layer.

Most DND predefined layers do not include the status identifier. Table 4-2 lists predefined standard statuses and their layer properties that can be appended to any layer.

Table 4-2 : DND Predefined Layer Statuses

Status	Color	Line type	Weight	Description
_HIDE	*	DND_DASHED_MED	*	To identify or display hidden features
_NEW	*	*	0.50mm	To identify new construction or features
_EXST	252	*	0.25mm	To identify existing conditions or features
_ABAN	252	*	0.25mm	To identify abandoned features
_DEMO	6	DND_DASHED_SHORT	0.35mm	To identify features to be demolished

"*" - denotes that the property does not change when the status is appended to the layer.

4.2.2 ByLayer

All features shall be drawn with their properties of colour, line width, and line style set to "ByLayer." This allows all properties of the objects to be inherited from the settings of the layer in which they are "placed." The CAD user can change the line width, colour, and line style by simply changing the properties of the entire layer.

4.2.3 Layer Types

The DND Layer name structure differs depending on the type. DND has identified 3 types:

- **INSIDE: Project work that consists only of interior building items**
  These Layer names are based on American Institute of Architects' (AIA) guidelines for layer structure and properties.

- **OUTSIDE: Project work that consists only of exterior items**
  These Layer names are based on layer requirements of GIS standards as previously developed by DND.

- **COMMON: Layers that are not uniquely INSIDE nor OUTSIDE or are common to both, such as some text features.**
  These layers will loosely follow the same structure as INSIDE, except the discipline designator is omitted; therefore, the layer starts with an underscore (_).

Table 4-3: DND Layer Samples

DND Layer Samples			
Type	**Layer Name**	**Discipline**	**Description**
INSIDE	A_WALL_FULL_EXTR_EXST	Architectural	Exterior full height walls - Existing
	A_ELEV_CASE	Interior	Wall mounted casework
OUTSIDE	C_Horizontal_Control	Control Plan	Horizontal controls
	T_Contour_Int_Dep_Obsc	Topography Plan	Contour intermediate depressed obstructed
	U_C_UG_Optical_Lines	Utilities - Communication	Underground lines optical fibre
COMMON	_PLT_WHITE *	N/A	Features on this layer / level print **white**
	_ANNO_NPLT *		Features on this layer / level do **NOT** print
	_ANNO_DIMS		Dimension features
	_ANNO_TXTE		English text
	_ANNO_TXTF		French text

* These are special layers available.

4.3 LINE WIDTH

Standards for varying widths of lines have been established to improve presentation and readability of drawings. While CAD systems have the capability of showing a wide array of line widths, only a small number of them are required for drawing legibility.

The line widths displayed in the table below shall be used for all drawings unless substantial improvement in readability can be gained through the use of additional widths.

Table 4-4 : DND Preferred Pen Widths

Line Widths	Pen Widths (mm)	Examples of use
Extra Fine	0.09	Grids
Fine	0.18	Hatching, centerlines
Thin	0.25	Light and background features
Medium	0.35	Miscellaneous Features
Wide	0.50	Section lines, Grade line, Rebar
Extra Wide	0.70	Border outline

See Appendix A: Pen Width & Colour Assignments for a complete list of acceptable DND line widths.

4.4 COLOUR

The following are important notes on the use of colours on DND drawings:

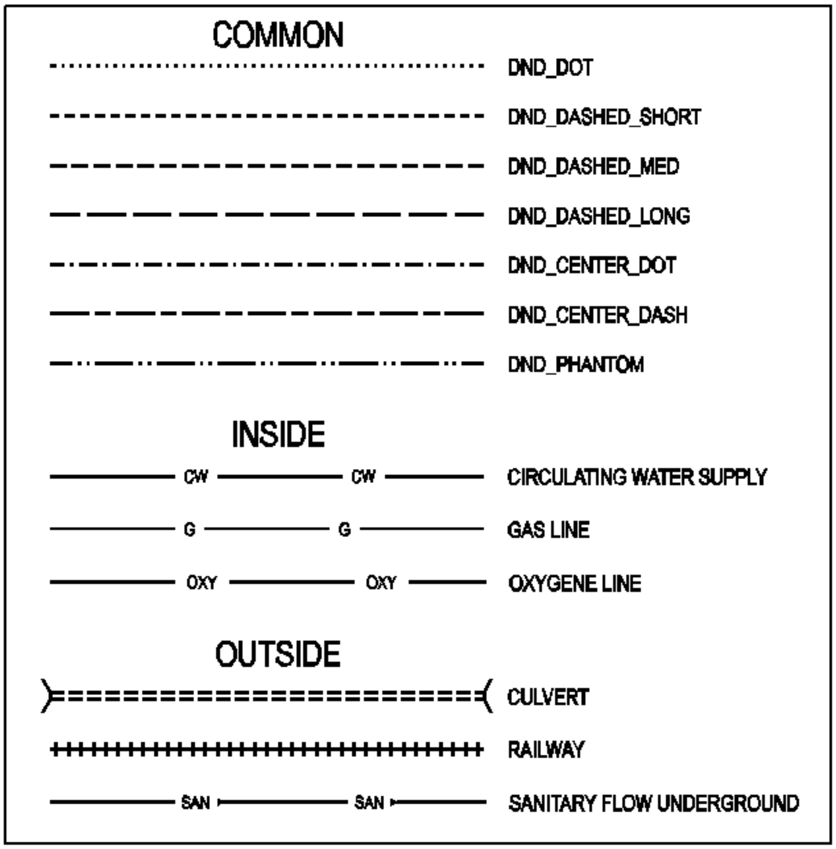
- The **AutoCAD colour table** shall be used as the colour scheme on all DND drawings to improve interoperability between CAD systems.
- Colour is not used to determine printing pen width. Pen width is determined by the line weight attribute.
- A relationship between line weight and colour has been standardized and shall be maintained where possible to improve screen clarity between features and layers.
- Certain colours have been designated to print either screened at a given percentage or at their given colours on monochrome prints with the use of DND plot styles or pen tables.
- Colour 255 in AutoCAD (0 in MicroStation) is not used except for objects placed on layer _PLT_WHITE
- All objects shall be placed using the colour attribute set to "BYLAYER" where possible.
- See Appendix A: Pen Width & Colour Assignments for tables on DND colour assignments.

4.5 LINE TYPES / STYLES

DND has standardized a set of custom line styles to improve interoperability between CAD systems. DND line styles are separated into 3 groups:

- COMMON – general line styles
- INSIDE – line styles generally used within the interior of building
- OUTSIDE – line styles generally used on the exterior of building

Figure 4-1: Sample DND Line Styles



The following rules shall be followed on DND Drawings:

- Only the available DND line styles shall be used.
- All objects shall be placed using the line style attribute set to “BYLAYER” where possible.
- Line style scale shall be adjusted using the available global system variable such as, “LTScale” in AutoCAD (do not set custom line style scale at the object level).
- See Appendix B: DND Custom Line Styles for the complete list of DND line styles.

4.6 TEXT STYLES

DND has adopted a number of text styles to ensure that drawing text display and print in a consistent manner. To improve interoperability between CAD systems, true type fonts shall be used throughout all drawings.

Text on DND submitted drawings shall be Arial Narrow, size 2.5 mm for general notes, dimensions, and annotation. Details, titles, sections, etc., shall be Arial, size 5 mm.

Other requirements to consider:

- Full-size drawings are often printed at half-size; therefore, text size shall be scaled appropriately to accommodate this requirement.

- All text presented on the drawing should have a vertical orientation and be **UPPERCASE.**

Table 4-5: DND Test Styles and Font Use

Style Name	Font	Size (mm)	Description	Example Items
General_Text	Arial Narrow	2.5	General text in drawing	General Notes, Dimensions, Annotation, Call-outs
Name_Text	Arial Narrow	3.5	Room Name Text	Room Names or text that require more emphasis
Title_Text	Arial	5	Some Border and Title Cover sheet text	Cover Sheets, Borders, Titles, Headings, Drawing number, Project Location, Discipline names.
ID_Text	Arial Narrow	2.0	To identify an object like a pole, MH, valve, etc.	Pole # or name, MH # or name, valve # or name
Border_Text	Arial Narrow	N/A	Border Text Only	Not for General Use Not to be modified
Canada_Logo	Times New Roman	N/A	Canada Logo Only	Not for General Use Not to be modified
Exceptions: Use of other fonts, heights, and styles shall be minimized. Exceptions only allowed when unusual clarity issues require use of other fonts.				

4.7 DIMENSION STYLES

DND has adopted a number of dimension styles to ensure that drawing dimensions display and print in a consistent manner. To improve interoperability, these dimension styles are available in both CAD systems.

Table 4-6: DND Dimension Styles

Style names	Where to Use	Term. Types	Units	Angle Format
DND_Architectural	INSIDE - architectural discipline only	slash	Millimetres (whole number)	Decimal degrees
DND_MM	INSIDE – buildings and building features	arrow	Millimetres (whole number)	Decimal degrees
DND_Metre	OUTSIDE – Engineering or Siting	arrow	Metres (Three decimal places)	Degrees, minutes and seconds

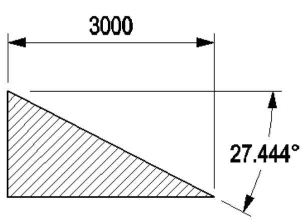
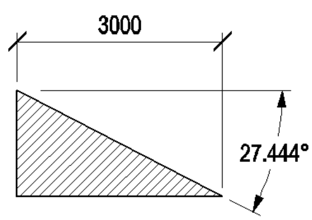
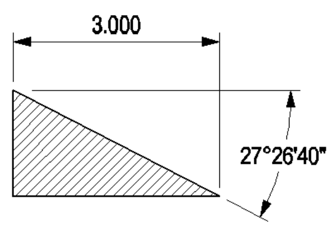
The following rules shall be followed:

- The true dimensions value shall be shown and not be overridden or altered.
- Where part of the drawing is not to scale (NTS) or there is a break in the information, the dimension shown shall be followed by the abbreviation NTS or by using a break symbol in the dimension line.
- Units shall not be designated
- The following note shall be placed on the drawing:

INSIDE millimetre drawings: *All dimensions shown are in millimetres unless otherwise noted*

OUTSIDE metre drawings: *All dimensions shown are in metres unless otherwise noted*

Table 4-7: DND Dimension Style Samples

DND_MM	DND_Architectural	DND_Metre
		

5 Drawing Conventions

5.1 INTRODUCTION

This section addresses the presentation of graphic requirements for lines, text, leaders, dimensions, etc.

5.2 DRAWING BORDER

All DND standard borders that are unique to DND are based on ISO B series sizes and ANSI sizes.

The **B1 1000x707** border shall be used for all project drawings. See Table 5-1.

Table 5-1: DND Standard Border Sizes

<table>
<tr><th>DND Name Designation (Layout Name)</th><th>Size (mm) (h x w)</th><th>Paper Size Standard</th><th>Notation</th></tr>
<tr><td>B1 1000 x 707</td><td rowspan="2">1000 x 707</td><td rowspan="2">ISO B1</td><td>DND B1 border (Engineering Title block)</td></tr>
<tr><td>Cover 1000x707</td><td>DND Cover Sheet for B1 size</td></tr>
</table>

Table 5-2 includes the DND Borders that can be used in special cases approved by the project manager.

Table 5-2: DND Standard Border Sizes

<table>
<tr><th>DND Name Designation (Layout Name)</th><th>Size (mm) (h x w)</th><th>Paper Size Standard</th><th>Notation</th></tr>
<tr><td>A0 1189 x 841</td><td>1189 x 841</td><td>ISO A0</td><td>DND A0 border (Engineering Title block)</td></tr>
<tr><td>A1 841 x 594</td><td>841 x 594</td><td>ISO A1</td><td>DND A1 Border (Engineering Title block)</td></tr>
<tr><td>B3 500 x 353</td><td>500 x 353</td><td>ISO B3</td><td>Half-size of B1 Border (Engineering Title block)</td></tr>
<tr><td>Tabloid</td><td rowspan="3">431.8 x 279.4</td><td rowspan="4">ANSI “B”</td><td>17x11 border (Engineering Title block)</td></tr>
<tr><td>11 x 17_L</td><td>Landscape (horizontal title block)</td></tr>
<tr><td>11 x 17_DATA</td><td>Landscape</td></tr>
<tr><td>11 x 17</td><td>279.4 x 431.8</td><td>Portrait</td></tr>
<tr><td>Legal</td><td>215.9 x 355.6</td><td rowspan="2">8.5” x 14” (Legal)</td><td>Portrait</td></tr>
<tr><td>Legal_L</td><td>355.6 x 215.9</td><td>Landscape</td></tr>
</table>

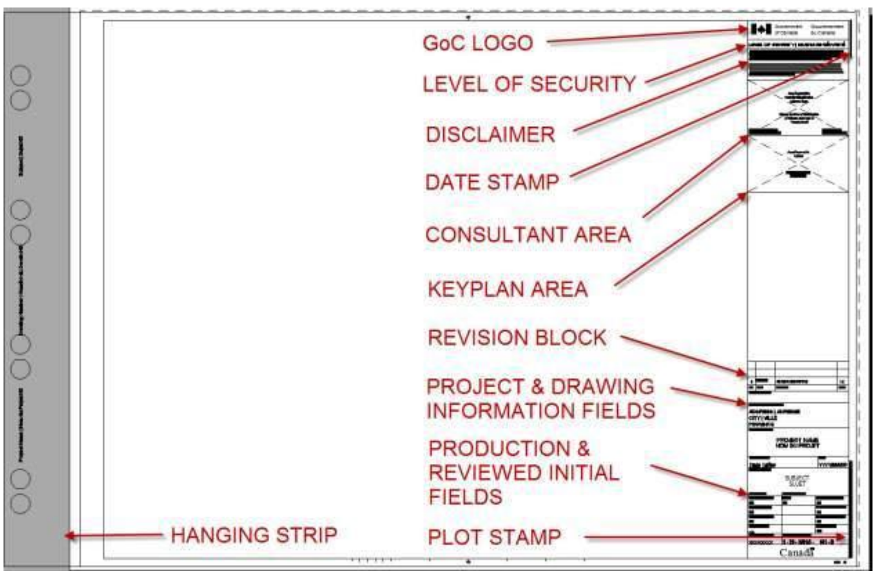
Letter	279.4 x 215.9	ANSI “A”	Portrait
Letter_L	215.9 x 279.4		Landscape

5.2.1 English & French Borders

All borders are bilingual; however, there is an English and French version for each border size. That is, French is the primary language in the French borders. The language version is indicated with a suffix of **_E** for **English** and **_F** for **French** for all layout names. All English and French borders are also stored in separate template files indicated by the suffix _E & _F. For example, **dnd_layouts_ctb_E.dwg** contains only English borders.

5.2.2 Standard B1 Title block

Figure 5-1: B1 Border



The DND B1 Title block contains the following components:

Table 5-3: Title Block Components

Component Items	Description
GoC Logo	Government of Canada wordmark
Level of Security	Status of current drawing security level
Disclaimer	Copyright information for use of drawings
Consultant Area	Area reserved for consultant identification and logo
Key plan Area	Area reserved for key plan when needed
Date Stamp	Date of last revision made to border drawing
Revision Block	Drawing revision #, date, revision description and initials to

	list history of revisions, addenda, as-built information, etc.
Project & Drawing Information Fields	Project, subject, location, and other drawing information
Production & Reviewed Identification Fields	Various initials fields. Reviewed fields required may vary from base to base.
Plot Stamp	Generated drawing info at printing time. Info includes file name, layout name, user name, date and time.
Hanging Strip	98mm wide trim line for hanging strip.

Level of Security

There are five level of security options to indicate the current drawing's security level:

- TO BE REVIEWED
- UNCLASS
- CONFIDENTIAL
- SECRET
- TOP SECRET

Production & Reviewed Identification Fields

The following describe the initial fields used in the production and reviewed grouping.

Production Initial Fields

Initial fields in the production grouping are predetermined and shall not be changed.

Figure 5-2: Cover Sheet

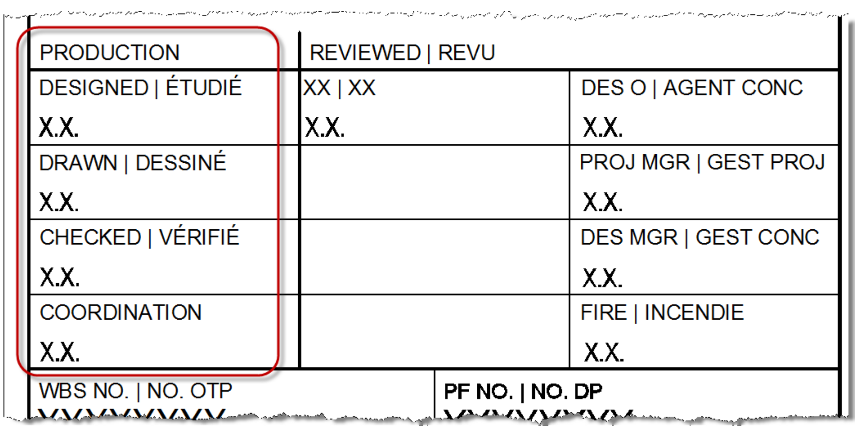


Table 5-4: Production Fields

Predetermined Fields	Required Content
DESIGNED	Initials of the engineer or architect responsible for the design
DRAWN	Initials of the CAD user responsible for drawing preparation
CHECKED	Initials of the individual responsible for checking drawing accuracy
COORDINATION	Initials of the individual, designated by the (prime) consultant as responsible for overall coordination and delivery of the final design package

Reviewed Field Initials

Some initial fields in the Reviewed grouping have been predetermined. Empty fields have been provided for base specific initials if required.

Figure 5-3: Cover Sheet

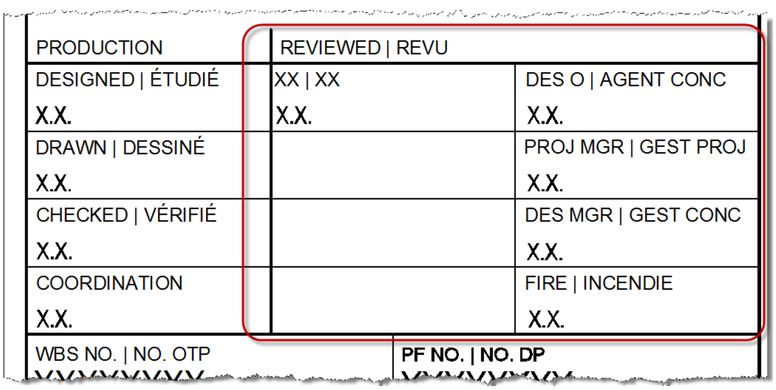


Table 5-5: Reviewed Fields

Predetermined Fields	Description
DES O	Design Officer
PROJ MGR	Project Manager
DES MGR	Design Manager
FIRE	Fire Chief

The following table lists other initials that may be used. The empty fields provided shall be used for these or any other additional fields required by the base.

Table 5-6: Field Initials

Fields	Description
ENG O	Engineering Officer

PROJ O	Project Officer
CUSTOMER	Customer or Client
MP/W	Military Police/Wing
SECT OC	Officer Commanding Engineer Services Company
COMMS	Communication
WFC	Wing Fire Chief
REQT/ENG O	Requirements Officer / Engineering Officer
WCEO	Wing Construction Engineering Officer

5.2.3 Cover Sheet

The DND cover sheet is required unless the project manager specifically states otherwise.

Figure 5-4: Cover Sheet

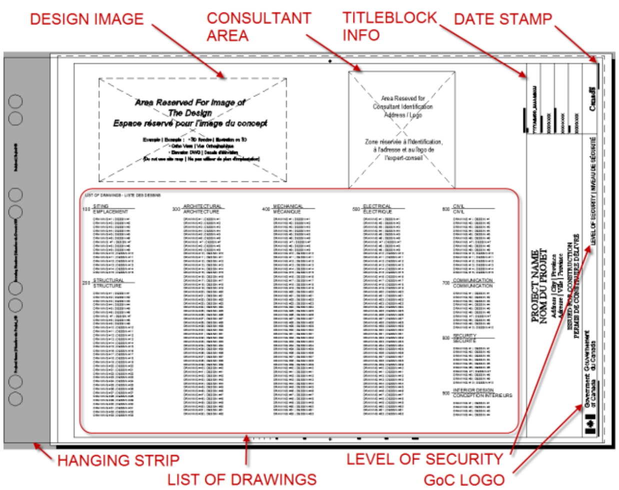


Table 5-7: Cover Sheet Fields

Cover Items	Description
Design Image	Space for the image of the design
Consultant Area	Area reserved for consultant identification and logo
Title block Info	Project, job number, location information, etc.
Date Stamp	Date of last revision made to border drawing
Hanging Strip	98mm wide trim line for hanging strip
List of Drawings	List of drawings by discipline
Level of Security Markings	Status of current drawing security level *(default value = to be reviewed)*
GoC Logo	Government of Canada wordmark
Plot Stamp Info	Generated drawing info at printing time. Info includes file name, layout name, user name, date and time.

The following items shall be completed on each cover sheet of each drawing set:

- Project Number (WBS - Work Breakdown Structure, issued for Level 1)
- Job Number
- Location
- Project Name
- List of Drawings (by discipline)

5.3 DRAWING SCALES

The proper scales should be selected to avoid overcrowded or ambiguous conditions on the drawings.

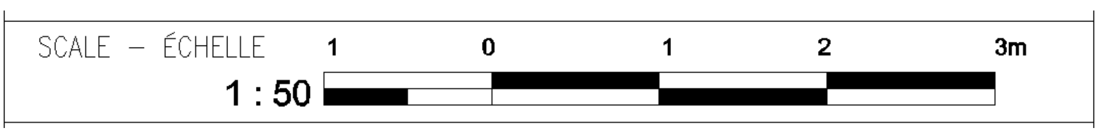
📖 See Appendix C: DND Preferred Drawing Scales & Respective Text Size

The selection of scales for supporting drawings of auxiliary and related equipment shall reflect the same considerations.

5.3.1 Graphic Scale

Graphic bar scales shall be used on all drawings to indicate the units of measurement and the ratio. See Figure 5-5.

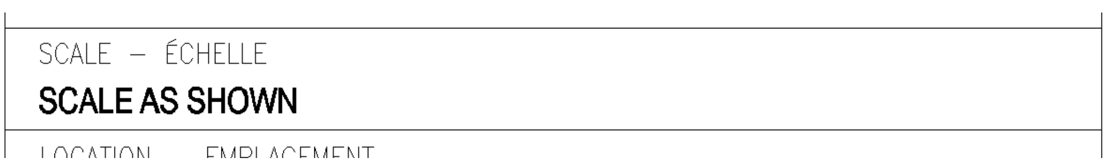
Figure 5-5: Graphic Bar Scale in Title block



5.3.2 Multiple Scale Requirements

When two or more scales are used on the same drawing sheet, each scale shall be clearly indicated below each particular title, and the notation “AS NOTED” or “SCALE AS SHOWN” indicated in the Project /Subject Identification Block. See Figure 5-6.

Figure 5-6: Scale Notation in Title Block



5.4 SECTION AND DETAIL IDENTIFIERS

DND has standard symbols to use for cross-referencing information in drawings. These standard symbols shall be used where possible to identify sections and details, and as labelling titles.

📖 See Appendix D: DND Section and Detail Identifiers for samples of DND Identifiers and appropriate uses.

5.5 ABBREVIATIONS

Abbreviations should be kept to a minimum, and when used, a legend should be provided.

5.6 LEGEND

A legend is required for all symbols that are used in the drawing set.

Appendix A: Pen Width & Colour Assignments

Table A-1 contains the complete list of DND Standard pen widths and the colours assigned to each width.

Note the following:

- All DND colours are based on the AutoCAD colour table.
- AutoCAD line weight and pen width are represented by the same value. MicroStation weight equivalents are expressed in whole numbers.
- Line widths with an asterisk (*) are preferred DND pen widths.
- Colours in Table A-1 are generally designated to print black through the use of DND plot styles or pen tables.

These tables should also be referenced when examining **Annex A: Layers** where a line weight is assigned to each layer utilized in DND drawings.

Table A-1 - DND Pen Widths and Colour Assignments

Line Widths	Pen Width mm (AutoCAD Line weight)	MicroStation WT	Colour-to-Width Assignments								
			Blue	Green	Red	Magenta	Cyan	Yellow	Orange	Grey	White
Extra Fine*	**0.09**	**WT = 0**								9, 251	7 (Width Varies)
Fine *	**0.18**	**WT = 1**	5, 150	100	10	210	130	50	30	8	
Thin *	**0.25**	**WT = 2**	151,160,161	3, 61, 81, 91	1	201	121,131	51	11, 21		
	0.30	WT = 3	111, 120								
Medium *	**0.35**	**WT = 4**	162,172	82, 92, 122	12, 232	6	132	2	22, 31		
	0.40	WT = 5	170, 181								
Wide *	**0.50**	**WT = 6**	163,173	83, 113, 123	230	203, 213	4	53	23, 40		
	0.60	WT = 7				231, 241					
Extra * Wide	**0.70**	**WT = 8**		84		204			24		
	1.00	WT = 9	180	80	244	220					
	1.06	WT = 10		90							
	1.20	WT = 11		93							
	1.4	WT = 12		96	33			52			
	1.58	WT = 13	152	103	240	222					
	2.0	WT = 14	182	110	242	200					

The following tables list colours designated to print either screened at a given percentage or at their given colours on monochrome prints with the use of DND plot styles or pen tables.

Table A-2 - DND Screened Colours Available on Monochrome Prints

Screened Colours Available on Monochrome Prints (Colour Number by Colour Group)						
% Screen	**Blue**	**Green**	**Red**	**Magenta**	**Cyan**	**Yellow**
25%	143	73	13	214	133	54
50%	144	74	14	215	134	55
75%	145	75	15	216	135	56

Table A-3 - DND Black Screen Colours on Monochrome Prints

Black Screened Colours		
Colour Group	**Colour Number**	**% Screened**
Shades of Black	245	10 %
	246	20 %
	247	30 %
	248	40 %
	249	60 %
	250	80 %

Table A-4 - DND Colours Available on Monochrome Prints

Colours Available on Monochrome Prints (by colour group)						
(Following colours print with Primary Colours)						
Blue (5)	**Green(3)**	**Red (1)**	**Magenta (6)**	**Cyan (4)**	**Yellow (2)**	**Grey**
170	70	20	211	140	41	-
(Following colours print with colour number)						
Blue	**Green**	**Red**	**Magenta**	**Cyan**	**Yellow**	**Grey**
171, 190	71, 72	32, 243	212, 221	141, 142	42, 43, 60	252, 253, 254

Appendix B: DND Custom Line Styles

Table B-1

Linetype Name	Example	Replacement for: AutoCAD Linetypes	Description
DND CUSTOM LINETYPES - COMMON			
CONTINUOUS		N/A	SOLID
DND_DOT		DOT2	DOT
DND_DASHED_SHORT		HIDDEN2	MEDIUM DASHED
DND_DASHED_MED		DASHED2	LONG DASHED
DND_DASHED_LONG		DASHEDX2	DOT DASH
DND_CENTER_DOT		DASHDOT2	SHORT DASHED
DND_CENTER_DASH		CENTER2	DASH DOT DOT
DND_PHANTOM		DIVIDE2	LONG DASH SHORT DASH

Linetype Name	Example	Description
DND CUSTOM LINETYPES - INSIDE		
ACET	ACET	ACETYLENE LINE
BRINE_RETURN	BR	BRINE RETURN
BRINE_SUPPLY	B B	BRINE SUPPLY
CA	CA	COMPRESSED AIR LINE
CHILL_WTR_FLOW	CH	CHILLED WATER FLOW
CHILL_WTR_RETURN	CHR	CHILLED WATER RETURN
CIRC_WTR_FLOW	CW	CIRCULATING WATER FLOW
CIRC_WTR_RETURN	CWR	CIRCULATING WATER RETURN
CGS	CGS	COLD GLYCOL SUPPLY LINE
CGR	CGR	COLD GLYCOL RETURN LINE
COMP_AIR	A A	COMPRESSED AIR
COND_WTR_FLOW	C C	CONDENSER WATER FLOW
COND_WTR_RETURN	CR	CONDENSER WATER RETURN
DCW		DOMESTIC COLD WATER
DHW		DOMESTIC HOT WATER
DHWR		DOMESTIC COLD WATER
DEIONW	DEIONW	DEIONIZED WATER LINE
DEMIN	DEMIN	DEMIN WATER LINE
DIST	DIST	DISTILLED WATER LINE
DRAIN	D D	DRAIN
FEED_PUMP	○○	FEEDWATER PUMP
FIRE_LINE	F F	FIRE LINE
FUEL_OIL_FLOW	FOF	FUEL OIL FLOW
FUEL_OIL_RETURN	FOR	FUEL OIL RETURN
FUEL_OIL_VENT	FOV	FUEL OIL TANK VENT
HGS	HGS	HOT GLYCOL SUPPLY LINE
HGR	HGR	HOT GLYCOL RETURN LINE
GAS_LINE	G G	GAS LINE
HP_RETURN	//	HIGH PRESSURE RETURN
HP_STEAM	//	HIGH PRESSURE STEAM
HR	HR	HOT WATER RETURN LINE
HS	HS	HOT WATER SUPPLY LINE
HUMID_LINE	H	HUMIDIFICATION LINE
MP_RETURN	/	MEDIUM PRESSURE RETURN
MP_STEAM	/	MEDIUM PRESSURE STEAM
OW	OW	OILY WASTE LINE
OXY	OXY	OXYGEN LINE
REFR_DISCHARGE	RD	REFRIGERANT DISCHARGE
REFR_SUCTION	RS	REFRIGERANT SUCTION
SPRINKLER_BRANCH	○	BRANCH AND HEAD SPRINKLER LINE
SPRINKLER_DRAIN	S	DRAIN SPRINKLER LINE
SPRINKLER_MAIN	S S	MAIN SPRINKLER LINE
VAC_CLEAN	V V	VACUUM CLEANING
VAC_PUMP	○	VACUUM PUMP

Linetype Name	Example	Description
DND CUSTOM LINETYPES - OUTSIDE		
ACID_L	◁ ACID	SEWER LINE FOR ACID
ACID_R	ACID ▷	SEWER LINE FOR ACID
AM_OH	AM	SEWER LINE FOR ACID
AM_UG	AM	SEWER LINE FOR ACID
AVIATOR_FUEL	AF	AVIATOR FUEL
BANK		EMBANKMENT
BERM		BERM
CAC_OH	CAC	CRASH ALARM OVERHEAD LINE
CAC_UG	CAC	CRASH ALARM UNDERGROUND LINE
CEILO_OH		CEILOMETER OVERHEAD LINE
CEILO_UG	CEIL	CEILOMETER UNDERGROUND LINE
COMM_OH	COM	COMMUNICATION OVERHEAD LINE
COMM_UG	COM	COMMUNICATION UNDERGROUND LINE
COMM_UG_ENCASED	COM	COMMUNICATION UNDERGROUND LINE ENCASED
CONID		CONTOUR INTERMEDIATE DEPRESSED
CONIDO		CONTOUR INTERMEDIATE DEPRESSED OBSC
CONXD		CONTOUR INDEX DEPRESSED
CONXDO		CONTOUR INDEX DEPRESSED OBSC
CTV_OH	TV	CABLE TV OVERHEAD
CTV_UG	TV	CABLE TV UNDERGROUND
DITCH	▷ ▷	WATER DIRECTIONAL FLOW IN BOTTOM OF DITCH
EXP_JOINT_BELLOW		EXPANSION JOINT BELLOWS TYPE
EXP_JOINT_SLIDING		EXPANSION JOINT SLIDING TYPE
FENCE_1	x x	STATE NUMBER AND SIZE OF DUCT
FENCE_2	x x	STATE NUMBER AND SIZE OF DUCT
FENCE_3	○ ○	STATE NUMBER AND SIZE OF DUCT
FENCE_4	○ ○	STATE NUMBER AND SIZE OF DUCT
FIRE_OH	F	FIRE ALARM OVERHEAD LINE
FIRE_UG	F	FIRE ALARM UNDERGROUND LINE
GAS_OH	G	GAS OVERHEAD LINE
GAS_UG	G	GAS UNDERGROUND LINE
GAS_UTIL	GU	GAS UTILITY LINE
GUIDE	○ ○ ○ ○	GUIDE RAIL
HEAT_FUEL	HF	HEATING FUEL
HPS	HPS	HIGH PRESSURE STEAM
HPS_UG	HPS	HIGH PRESSURE STEAM UNDERGROUND
HTW	HTW	HIGH TEMP WATER
HTW_UG	HTW	HIGH TEMP WATER UNDERGROUND
ICC	ICC	INSULATING CONCRETE CONDUIT
ICC_UG	ICC	INSULATING CONCRETE CONDUIT UGND

Linetype Name	Example	Description
DND CUSTOM LINETYPES - OUTSIDE (...cont.)		
IHC	IHC	INSULATING HYDROCARBON
IHC_UG	IHC	INSULATING HYDROCARBON UNDERGROUND
INT_OH	INT	INTERCOM OVERHEAD
INT_UG	INT	INTERCOM UNDERGROUND
IR_WAT	IW	IRRIGATION WATER UNDERGROUND LINES
LPS	LPS	LOW PRESSURE STEAM
LPS_UG	LPS	LOW PRESSURE STEAM UNDERGROUND
LTW	LTW	LOW TEMP WATER
LTW_UG	LTW	LOW TEMP WATER UNDERGROUND
MET_OH	MET	METEOROLOGICAL OVERHEAD LINE
MET_UG	MET	METEOROLOGICAL UNDERGROUND LINE
MTW	MTW	MEDIUM TEMP WATER
MTW_UG	MTW	MEDIUM TEMP WATER UNDERGROUND
OPT_OH	O	OPTICAL FIBRE OVERHEAD
OPT_UG	O	OPTICAL FIBRE UNDERGROUND
PMC	PMC	PREFABRICATED METALLIC CONDUIT
PMC_UG	PMC	PREFABRICATED METALLIC CONDUIT UGND
PRI_OH_2400V_1	P3	PRIMARY OVERHEAD 2400V 1 PHASE
PRI_OH_2400V_3	P2	PRIMARY OVERHEAD 2400V 3 PHASE
PRI_OH_25000V	P1	PRIMARY OVERHEAD 25000V
PRI_UG_2400V_1	P3	PRIMARY UNDERGROUND 2400V 1PHASE
PRI_UG_2400V_3	P2	PRIMARY UNDERGROUND 2400V 3 PHASE
PRI_UG_25000V	P1	PRIMARY UNDERGROUND 25000V
PRIM_OH	P	PRIMARY OVERHEAD LINE
PRIM_UG	P	PRIMARY UNDERGROUND LINE
RAILWAY		RAILWAY
RAIL_ABDN		RAILWAY ABANDONED
RETURN_OH	R	RETURN, CONDENSATE OR WATER
RETURN_UG	R	RETURN, CONDENSATE OR WATER UGND
SAN	SAN	SANITARY UNDERGROUND LINE
SAN_R	SAN ▷	SANITARY FLOW UNDERGROUND LINE
SAN_L	NAS ▷	SANITARY FLOW UNDERGROUND LINE
SCC_OH	SC	SIREN CONTROL OVERHEAD LINE
SCC_UG	SC	SIREN CONTROL UNDERGROUND LINE
SEC_OH_120/208V	S1	SECONDARY OVERHEAD 120/208V
SEC_OH_120/240V	S2	SECONDARY OVERHEAD 120/240V
SEC_OH_220V	S4	SECONDARY OVERHEAD 220V
SEC_OH_550V	S3	SECONDARY OVERHEAD 550V
SEC_OH_600/347V	S5	SECONDARY OVERHEAD 600/347V
SEC_UG_120/208V	S1	SECONDARY UNDERGROUND 120/208V

Linetype Name	Example	Description
DND CUSTOM LINETYPES - OUTSIDE (...cont.)		
SEC_UG_120/240V	——— — — — S2 ———	SECONDARY UNDERGROUND 120/240V
SEC_UG_220V	——— — — — S4 ———	SECONDARY UNDERGROUND 220V
SEC_UG_550V	——— — — — S3 ———	SECONDARY UNDERGROUND 550V
SEC_UG_600/347V	——— — — — S5 ———	SECONDARY UNDERGROUND 600/347V
SECOND_OH	——— S ———	SECONDARY OVERHEAD LINE
SECOND_UG	——— — — — S ———	SECONDARY UNDERGROUND LINE
STORM_R	——— ST ▷———	STORM DRAIN LINE
STORM_L	——— ꓕS ▷———	STORM DRAIN LINE
STREET_OH	——— SL ———	STREET LIGHT OVERHEAD LINE
STREET_UG	——— — — — SL ———	STREET LIGHT UNDERGROUND LINE
TELE_OH	——— T ———	TELEPHONE OVERHEAD LINE
TELE_UG	——— — — — — T ———	TELEPHONE UNDERGROUND LINE
USLFAR	———————	SANITARY LINE FLOW ARROW
USWS	——— SWS ———	SALT WATER SUPPLY
WATER	——— W ———	WATER LINE UNDERGROUND

Appendix C: DND Preferred Drawing Scales & Respective Text Size

Table C-1

OUTSIDE				
Drawing Type	**Metric Scale Factor**	**2.5 mm plotted text size (mm)**	**3.5 mm plotted text size (mm)**	**5 mm plotted text size (mm)**
Site Plans	1:1	2.5	3.5	5
	1:200	500	700	1000
	1:250	625	875	1250
	1:500	1250	1750	2500
	1:750	1875	2625	3750
	1:1000	2500	3500	5000
	1:2000	5000	7000	10000
	1:2500	6250	8750	12500
	1:3000	7500	10500	15000
	1:4000	10000	14000	20000
	1:5000	12500	17500	25000
	1:10000	25000	35000	50000
	1:15000	37500	52500	75000
	1:20000	50000	70000	100000
	1:50000	125000	175000	250000
	1:100000	250000	350000	500000
	1:200000	500000	700000	1000000
	1:250000	625000	875000	1250000
	1:500000	1250000	1750000	2500000
Elevations	1:100	250	350	500
Sections	1:200	500	700	1000
	1:50	125	175	250
Details	1:100	250	350	500
	1:200	500	700	1000
	1:5	12.5	17.5	25
	1:10	25	35	50
	1:25	62.5	87.5	125

INSIDE				
Drawing Type	**Metric Scale Factor**	**2.5 mm plotted text size (mm)**	**3.5 mm plotted text size (mm)**	**5 mm plotted text size (mm)**
Floor Plans	1:1	2.5	3.5	5
	1:50	125	175	250
	1:75	187.5	262.5	375
	1:100	250	350	500
	1:200	500	700	1000
	1:250	625	875	1250
Roof Plan	1:200	500	700	1000
Exterior Elevations	1:100	250	350	500
	1:200	500	700	1000
Interior Elevations	1:50	125	175	250
	1:100	250	350	500
Cross Sections	1:50	125	175	250
	1:100	250	350	500
	1:200	500	700	1000
Wall Sections	1:20	50	70	100
	1:25	62.5	87.5	125
Stair Details	1:10	25	35	50
Details	1:5	12.5	17.5	25
	1:10	25	35	50
	1:25	62.5	87.5	125

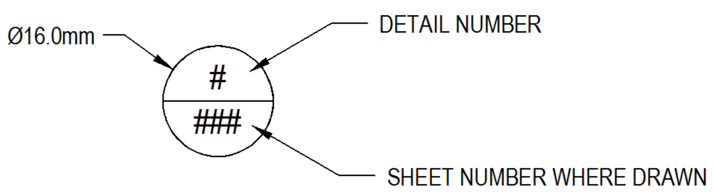
Appendix D: DND Section & Detail Identifiers

DND standard symbols shall be used for all cross-referencing identifiers. Refer to Annex B: Symbols for a list of available symbols.

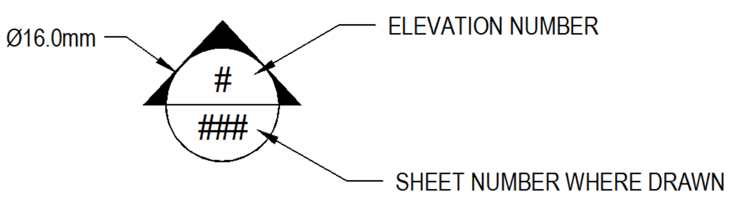
✍ **Details and Elevations are identified by a number; Sections are identified by a letter.**

Figure D-1 Identifiers: Section, Details, and Elevations

Detail Identifier



Elevation Identifier



Section Identifier

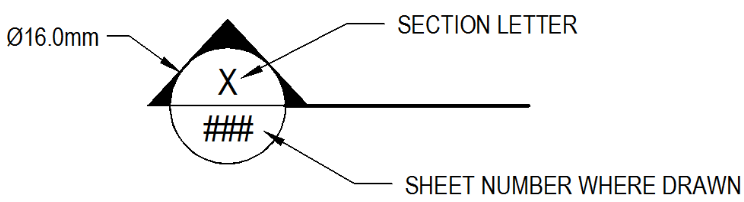
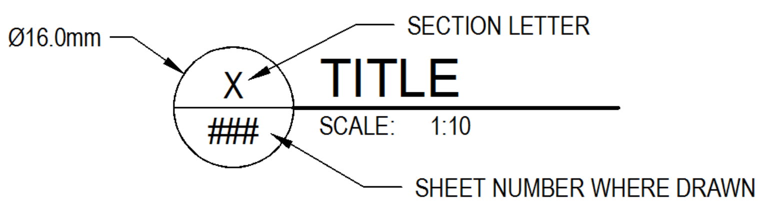


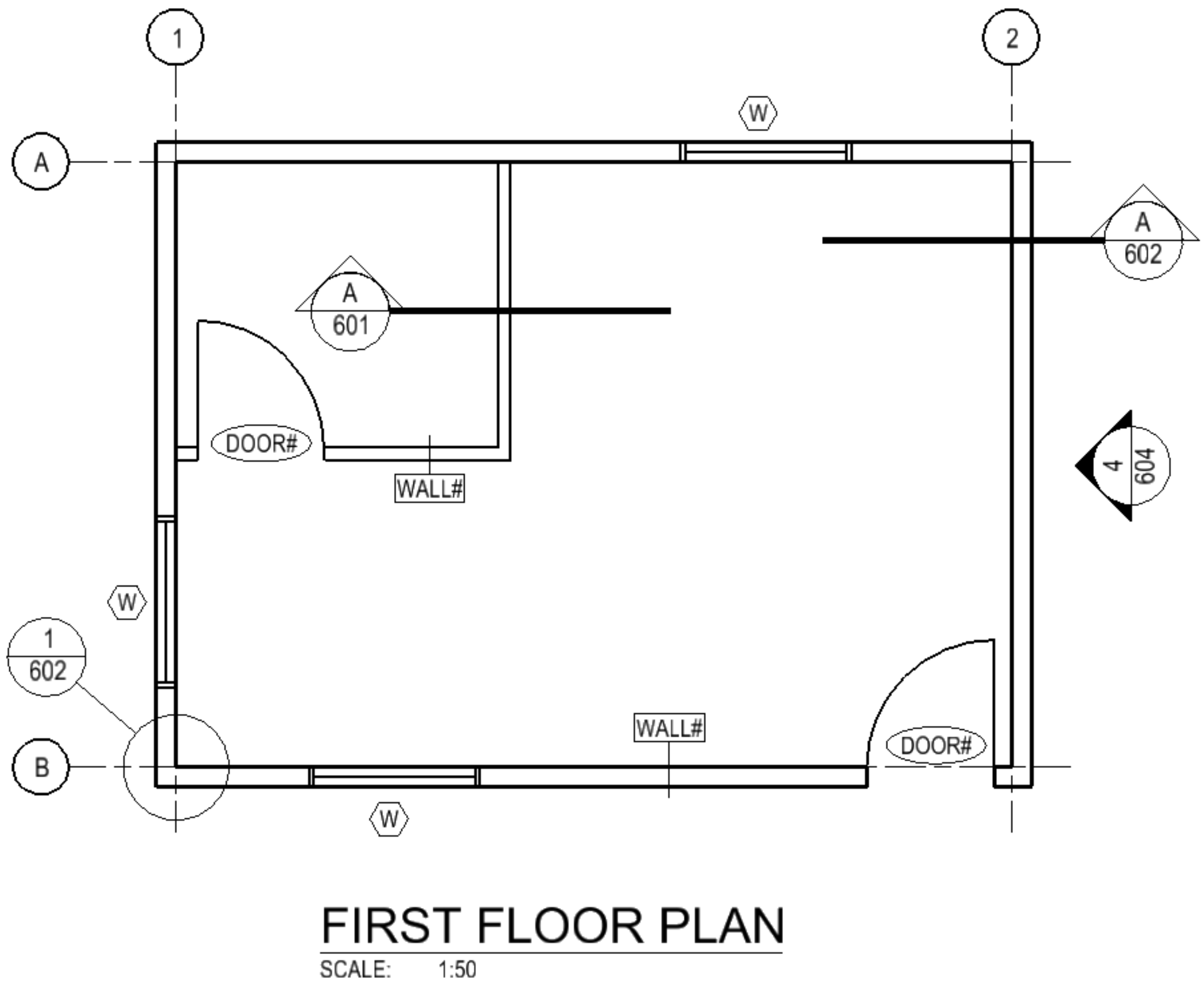
Figure D-2 Title Identifier: Section, Details, and Elevations



Sample Use of DND Identifiers

- **It is acceptable practice to have 2 identifiers with the same detail numbers or section letters, provided that the sheet numbers are different. For example, this sample Floor Plan shows 2 Section "A" identifiers for 2 different section details, which is acceptable since one section is drawn on sheet 601 and the other on sheet 602.**

Figure D-3



Appendix E: Types of Work and Buildings

Codes indicated with "shading" are used by National Defence Headquarters.

Table E-1

0100		Administration Buildings
0200		Airfields including Parking Aprons, Runways, Lighting, VASIS
	0201	Parking Aprons, Runways
	0202	Apron concrete (hangar)
	0203	Airfield lighting
	0204	Arrest barrier
	0205	Taxi lighting
	0206	Runway lighting
	0207	Radar dome lighting
	0208	Helicopter landing pad
	0209	Exterior flight lighting
	0210	Substation (airfield)
	0211	
	0212	
	0213	VASIS
	0220	Noise exposure
	0221	Airport zoning
	0222	Electromagnetic interference
0300		Armouries and Drill Halls
0400		
0500		Air Transport Terminal Facilities
0600		Band Buildings
0700		Bridges
0800		
0900		Cemeteries
1000		Chapels
1100		Control Towers
1200		Cranes and Lifting Appliances
1300		Multiple-use Building
1400		Detention Barracks, Guard Houses
1500		Standard Detail Drawings
1600		Drydocks
1700		Security Systems (Intrusion Alarms, Access Control, CCTV, etc)
1750		Shielded Enclosure
1760		Surveillance and Security
1800		
1900		Exposition Buildings and Structures (including Museums)
2000		Miscellaneous Exterior Installations
2100		
2200		
2300		Fire Halls
2400		
2500		Garages
2600		Gate Houses
2700		
2800		
2900		
3000		Hangars – Aircraft

3030		Hangars – Tank
3050		Hangars – Gun (including gun sheds)
3100		
3200		Hospitals and Dental Clinic
3300		Residence
3400		
3500		Junior Ranks Clubs and Canteens
3600		
3700		
3800		Kitchen Installations
3900		
4000		Laboratory Buildings
4100		
4200		Magazines
4300		Masts and Towers Except for Telecommunications
4400		
4500		Messes – Cadets
4600		Messes – Officers
4700		Messes – WOs and Sgts
4800		Messes – Men's
4900		Messes – Combined
5000		
5100		Meteorological Structures
5200		
5300		
5400		
5500		Operations Buildings
5600		
5700		
5800		Plants
	5800	Central Heating Plants (including non-standard CHPs)
	5810	Water Treatment Plants
	5820	Sewage Treatment Plants
	5830	Power Generating Plants
	5840	Detached heating plants (serving one building only)
	5870	
	5880	
	5890	
5900		POL Storage Installations (including propane)
6000		Post Office Buildings
6100		Prefabricated Buildings
6200		Property Survey – Legal
6300		
6400		Photographic Buildings
6500		Quarters – Type 1, Trainees
6600		Quarters – Type 4, Single Officers
6700		Quarters – Type 3, Single NCOs
6800		Quarters – Type 2, Ordinary Ranks
6900		Quarters – Combined Single
7000		Quarters – Married Quarters
7050		Formally PMQ's
7001		Garages for PMQ
7100		Deployed Camp (e.g., Bosnia)
	7101	Grounds including fencing, grading, Camp Layout
	7104	Water Distribution Systems
	7105	Exterior Sewage Systems
	7106	Exterior Electrical Systems

	7107	Exterior Lighting
	7112	Exterior Fire Protection Systems
	7115	Communications
7200		Deployable Structures Weather Events
7210		Generic Camp Design
7220		Generic Bunker Design
7300		Recruiting and Sub Recruiting Centres
7400		Ablution for Cadet and or Militia Camps
7450		Ablution Buildings and Structures
7500		Ranges and Training Areas
7550		Training Area (Drop Zone)
7600		
7700		Service Facilities (barber shops, beauty parlours, libraries, NPF shops, etc, not integral to other building types)
7800		
7900		Space Detection Installations
8000		Schools – Dependents
8100		Sea Plane Stations – Shipways
8200		Supply and Store Buildings
8300		Survival Buildings and Structures (excluding those under the 8730 series)
8400		Site Record Drawings
8500		Siting Multiple Buildings/Works
8600		Seedling Nurseries
8700		
8710		Radar Buildings and Towers (including SAGE and BUIC)
8730		Radio Buildings and Structures (including TX, RX, ADCOM, GATR, REGHQs, EASE, TELCO Buildings, and Antenna Farms)
8750	8750	Air Navigation Buildings
	8751	Ground Control Approach (GCA)
	8757	Precision Approach Radar (PAR)
	8760	Instrument Flight Rules Control Centre (IFRCC)
	8761	Area Surveillance Radar (ASR)
8800		Training Buildings and Structures
8900		Training/Recreation Facilities
9000		Decommissioning
9100		Environmental Project
9200		Land/ Property Procurement
9250		Reserve (Indian)
9300		Outside Services (including Pumping Stations)
	9301	Grounds including Fencing, Culverts, Retaining Walls, Grading and Seeding but excluding Airfields, Sports Ranges and Training Areas Fields
	9302	Pavements except Airfield Pavements
	9303	Exterior Heating Distribution Systems
	9304	Water Distribution Systems, including Pumping Stations
	9305	Exterior Sewage Systems, Storm and Sanitary
	9306	Exterior Electrical Distribution Systems including Sub Stations
	9307	Exterior Lighting Systems except Airfield Lighting
	9308	Exterior Gas Supply and Distribution Systems
	9309	Exterior Compressed Air Systems
	9310	Exterior Liquid Fuel Distribution Systems
	9311	POL Distribution Systems – Pipelines
	9312	Exterior Fire Protection Systems
	9313	Exterior Lighting Protection Systems
	9314	Exterior Communications Loop System (Telephone, Intercom, Data)
	9315	Communication Ducts – underground construction
	9330	Excavating Ext.
	9340	Underwater Exc. & Dredging

	9360	Y2K (opabacus)
9400		Water Storage Structures
9500		Wharves, Piers, and Jetties
9600		Workshops
9700		Geotechnical Soils Records
9800		Hydrographic
9900		Multiple Buildings/Works Projects

1. Unassigned numbers for types of works and buildings shall not be used without prior approval of —and/or promulgation of —an amendment by NDHQ.

   Please report any new codes to the Keeper of the Standard.

2. With the exception of the 5800 series (plants), the 7000 series (Married Quarters), the 9300 series (Outside Services) and the 9900 series (Multiple Building/Works Projects), the first two digits represent the type of works or building and the last two digits represent particular works or building. For example, the first garage at a base is identified as "2501," the second "2502" etc. When five garages already exist at a base, a new garage would be identified as "2506."

3. The drawings for work integral to a building shall bear the basic third series number of the building. Thus, a drawing to install a sprinkler system in the second garage at a base will have the basic third series number "2502."

4. Subsequent projects involving the same works or building shall have the basic third series number extended in numerical and chronological sequence by the addition of /1, /2, /3, etc. Thus to continue the above example, if the installation of a sprinkler system in the second garage at a base was the first subsequent project after completion of the garage, the third series number would be 2502/1.

5. The 5800 series (Plants) has been subdivided to provide identification for the type of plant involved, i.e., water treatment (5810), sewage treatment (5820), power generating (5830), etc. The first three digits represent the type of plant while the fourth digit identifies a particular plant. For example the first sewage treatment plant at a base is identified as "5821" and the second, as "5822."

6. It is not feasible to identify each married quarters with a number from the 7000 series (Quarters – Married Quarters). Therefore, for a project involving married quarters, the third series number "7000" shall be used and extended by the addition of /1, /2, /3, etc. Thus, a project showing the third series number "7000/2" signifies the second project involving any married quarters at that location.

7. The 9300 series (Outside Services) has also been subdivided to provide identification for particular groups of outside services. For example, all projects involving pavements (excluding airfield pavements defined specifically under the 0200 series) will use the basic third series number "9302." Before selecting a 9300-series number, it is important to ensure that the outside service or installation in question is not more adequately defined under another series. For subsequent projects the 9300 series number is extended in the same manner as for the 7000 series. Thus, a project showing the third series number "9302/5" signifies the fifth project involving pavements at that location.

8. The 9900 series (Multiple Buildings/Works Projects) shall be used for the third series number when a project involves similar maintenance, repairs or additions to more than one building or facility. Thus a project showing the third series number "9900/6" signifies the sixth multiple building/works project at that location. It should be noted that the sixth multiple building/works project is correctly identified as above and not as "9906."

9. In each case it shall be the responsibility of the design authority to obtain the facility identification portion of the third series in the drawing number from the Base Construction Engineering Officer (BCEO)

concerned. It shall be the responsibility of the BCEO to respond immediately by message or telephone to such requests. The third series number assigned by the BCEO shall be used to identify the works or building in perpetuity except when a permanent change in the function of a works or building occurs.

STANDARD DESIGN DRAWINGS AND SPECIFICATIONS

Using “S-2501-312” as an example, drawings within a standard design package depicting a particular works or building shall be numbered as follows:

a. **First Series.** The first series, “S”, indicates a standard design. As the design agency for development, preparation and promulgation of all standard design drawing and specification packages is NDHQ, there is no requirement to further identify the responsible design agency in the manner followed for contract/project drawings.

b. **Second Series.** The second series consists of four digits in which the first two digits indicate the type of works or building, and the second two digits represent a specified standard design for a works or building.

c. **Third Series.** The third series consists mostly of three digits in which the first digit represents the discipline shown on the drawing and the remaining digits indicate the drawing sheet number.

d. The standard number to be shown on the specifications and standard design drawing package cover sheet shall consist of the first and second series of the drawing numbers. Referring to the above example, a standard design drawing number, “S-2501-312” results from a standard number for the package of “S-2501”.

SKETCH DRAWINGS

Using as an example “SK-C40-2501-2,” sketch drawings shall be numbered in series as follows:

a. **First Series.** The first series, “SK,” indicates a sketch or preliminary drawing.

b. **Second Series.** The second series, a combined letter and number system, represents the site, establishment or base as detailed under Contract and Non-Standard Drawings. If the sketch has been prepared for development of a standard design, the second series shall consist solely of the letter “S.”

c. **Third Series.** The third series numbers for sketch drawings are assigned as described for Contract and Non-Standard Drawings.

d. **Fourth Series.** The fourth series indicates the drawing sheet number of the sketch.

SITE RECORD DRAWINGS

Using “H-C40-8410-101” as an example, site record drawings shall be numbered in series as follows:

a. **First Series.** The first series is a letter signifying the agency responsible for drawing preparation. The first series letter codes for site record drawings are the same as described earlier for contract and non-standard drawings.

b. **Second Series.** The first series is a combined letter and number system, which represents the site, establishment or base as previously detailed for contract and non-standard drawings.

c. **Third Series.** The third series consists of four digits. The first two digits identify the “8400” series, from the list of standard numbers for types of works and buildings, and are standard for all site record drawings. The third digit indicates the scale of the drawing as follows:

1 Overall site drawing

2 1:2000 (*1:2400)

5 1:500 (*1:600)

* Metric equivalent of previous imperial scales

The fourth digit may be a letter or a number. Letters indicate a “base drawing” and identify each component overlay and composite as follows:

A Base drawing showing buildings, roads, runways, manholes, poles, light standards and related plant.

B A clear film overlay showing contours, wooded areas, road classification and related planimetry.

C A composite reproduction of the two previous components reproduced in register.

The numbers identify a base or composite drawing to which pertinent details regarding specific services and facilities have been added:

1:2000 scale drawing

0 overall site drawing

1 utility drawing – water

2 utility drawing – sanitary sewer

3 utility drawing – storm sewer

4 utility drawing – heat distribution

5 utility drawing – gas, POL, compressed air

6 utility drawing – electrical, primary

7 utility drawing – fire alarm circuits

8 utility drawing – services beyond built-up area of site

1:500 scale drawings

0 overall site drawing

1 building and utilities drawing

2 building and electrical primary circuit drawing

3 building and electrical secondary circuit

4 building and electrical miscellaneous circuit drawing

d. **Fourth Series.** The fourth series consists of three digits. The first digit indicates the generation or satellite drawing as follows:

1 First generation (property and survey control)

2 Second generation (miniature site drawing)

3 Satellite drawing (scale 1:50 000)

4 Soils information

The last two digits indicate the drawing’s position in the series and are consecutive from “01.” A letter following the third digit, for example “101A, B, C, etc.” indicates that the sheet is back-up or related information to the sheet concerned, in this case, “101.” An example of related information would be borehole logs supplying information in addition to the borehole location drawing.

e. Although specifications may not always form part of the preparation of site record drawings, it is necessary to identify a job number for record purposes. The job number for site record drawings from which the drawing number quoted above was extracted would be H-C40-84.

STANDARD DETAIL DRAWING

Standard detail drawings are those prepared for miscellaneous items such as catch basins, manholes, fences, roads, transformer vaults, kiosks, fuel storage, etc. The standard details can be used for individual installations or incorporated within a set of contract drawings. Standard detail drawings shall be numbered in series as follows, using as an example, S-1506-401.

a. **First Series.** The first series, “S”, indicates a standard design.

b. **Second Series.** The second series consists of four digits. The first two digits identify the “1500” series from the list of standard numbers for types of works and buildings. The last two digits represent the numerical/chronological sequence of development and promulgation.

c. **Third Series.** The third series consists of three digits. The first digit represents the discipline shown on the drawing and the last two represent the consecutive drawing sheet number.

d. When a standard detail drawing is incorporated within a package of drawings for a specific project, it shall bear a drawing number identified with the project.

SCHEDULES

Schedules for delineating structural steel and reinforced concrete as well as room finish, door and hardware schedules shall be incorporated into the contract drawing package as warranted by the magnitude of the works and facilities being designed. All pertinent data, consistent with current professional engineering and architectural practice, shall be clearly indicated in a format approved for use by the responsible design agency or its delegated officers.

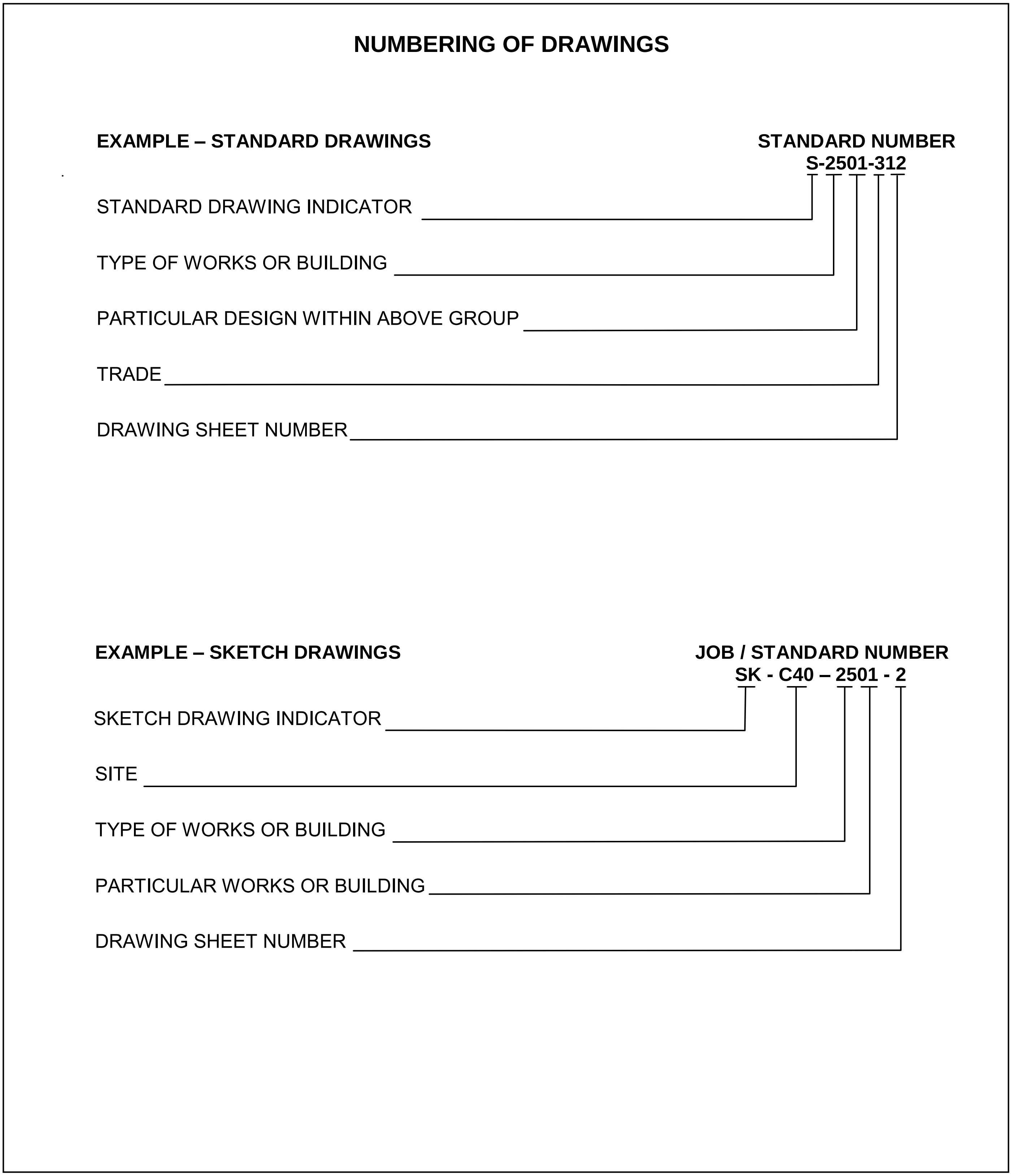


Figure E-1 (Sheet 1 of 2) Numbering of Drawings

NUMBERING OF DRAWINGS (Cont'd)

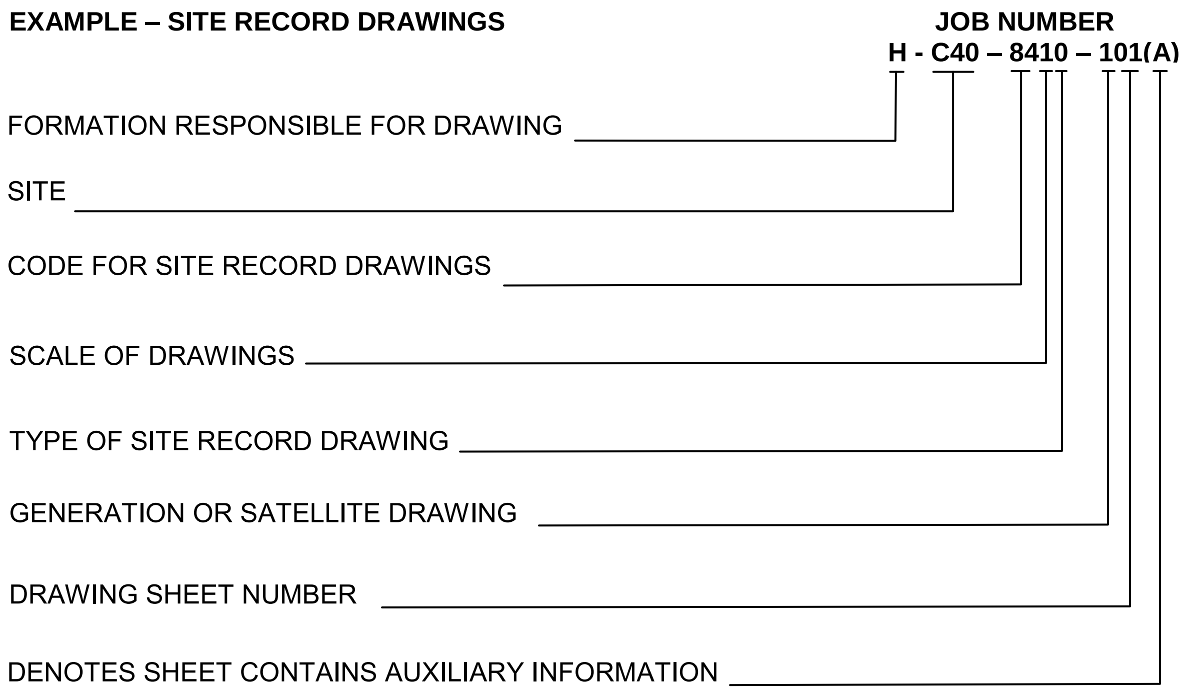


Figure E-1 (Sheet 2 of 2) Numbering of Drawings

Appendix C-2
Esquimalt Harbour Practices and Procedures

Esquimalt Harbour
Practices and Procedures

28 February 2019

1. Preamble

1-1 Esquimalt Harbour is a public harbour, within the meaning of Section 108 of the *British North America Act*, and subject to Federal jurisdiction. In these practices and procedures, it will be referred to simply as 'the harbour.' The harbour limits are all the navigable waters northward, from a line running from the southern extremity of Albert Head, intersecting at a 90º angle line running north and south astronomically, from the western tip of Saxe Point to the high-water mark of the northerly shore of Esquimalt Harbour.

1-2 For official nautical information on Esquimalt Harbour, refer to Chart 3419, published by Canadian Hydrographic Services.

1-3 The Minister of National Defence has designated the entire area of Esquimalt Harbour and its approaches, from the southern extremity of Albert Head and the western tip of Saxe Point, to be a Controlled Access Zone. Any vessel operating in close proximity of this zone may be approached and hailed by the Department of National Defence.

1-4 The harbour is open to the public within the limitations set out in an Order in Council regarding Controlled Access Zones. This provides for security zones surrounding Department of National Defence property, and warships berthed or moving in the harbour. Refer to Section 6 Controlled Access Zones for amplifying information.

1-5 These practices and procedures are made pursuant to the *Canada Marine Act* Section 56 and amplify the Natural and Man-made Harbour Navigation and Use Regulations.

1-6 These practices and procedures are intended to promote the safe and effective use, navigation, and environmental stewardship of the harbour. They are to be followed by all harbour users, including ships entering, manoeuvring, berthing, departing, anchoring, or working in the waters of Esquimalt Harbour, designated by regulation pursuant to the *Canada Marine Act* Section 104 Subsection (2).

1-7 For the purpose of these practices and procedures, where a subject is referred to in the singular, it will also represent the plural of the same subject.

1-8 These practices and procedures may be amended from time to time, as circumstances dictate. An emergency amendment(s) may be made to this document without notice and be effective immediately. Unless otherwise indicated, implementation of a practice or procedure will be effective 30 days after publication of the new or amended practice or procedure.

1-9 Unless authorized by a harbour official, no person shall, by act or omission, do anything or permit anything to be done in the harbour that has, or is likely to have, any of the following results:

a. adversely affect harbour operations;
b. interfere with navigation;
c. jeopardize the safety or health of persons or property;
d. obstruct or threaten any part of the harbour;
e. interfere with an authorized activity;
f. divert the flow of a river or stream, cause or affect currents, cause silting or the accumulation of material or otherwise reduce the depth of the waters;
g. cause a nuisance;
h. cause damage to ships; and

i. adversely affect sediment, soil, air or water quality.

1-10 Under the *Canada Marine Act* Section 59 Subsection (1)(a), it is an offence, subject to financial penalty, if a person or ship does not adhere to these practices and procedures.

2. Definitions

2-1 "BARGE" means a vessel designed with no means of self-propulsion.

2-2 "CANADIAN MARITIME DOCUMENT" means a licence, permit, certificate or other document that is issued by the Minister of Transport under Part 1 (General), 3 (Personnel), 4 (Safety), 9 (Pollution Prevention - Department of Transport) or 11 (Enforcement - Department of Transport) to verify that the person to whom or vessel to which it is issued has met requirements under that Part.

2-3 "CLEARANCE" means granting authorization to carry out a manoeuvre or task. This can be given verbally, in writing, or transmitted by electronic means.

2-4 "CONTROLLED ACCESS ZONE" means a zone designated by the Minister of National Defence, which includes all corresponding airspace above, and water and land below the zone. In general, Controlled Access Zones are areas intended to create buffer zones, to ensure the safety and security of Canadian Armed Forces and Department of National Defence naval vessels, materiel, and property, warships under the control of a visiting force, acting under the *Visiting Forces Act*, and personnel.

2-5 "DANGEROUS GOODS" has the meaning assigned in Section 2 of the *Transportation of Dangerous Goods Act, 1992*.

2-6 "HARBOUR OFFICIAL" means officials appointed pursuant to the *Canada Marine Act* Sections 106 and 108 and include the Queen's Harbour Master, Deputy Queen's Harbour Master, Harbour Traffic Control Officer, or other designated harbour officials.

2-7 "HOT WORK" means any work that uses flame, or that can produce a source of ignition, such as heating, cutting or welding.

2-8 "KNOTS" means nautical miles per hour.

2-9 "LIVE-ABOARD VESSEL" means any vessel used primarily as a residence, or any vessel represented as a place of business, a professional or other commercial enterprise, or a legal residence, except those vessels in contract with Canada.

2-10 "MASTER" means master, owner, agent, operator, or person in charge of a ship.

2-11 “PILOT” refers to Department of National Defence Pilot, BC Coast Pilot, or Public Services and Procurement Canada Docking Master.

2-12 “PLEASURE CRAFT” means a vessel that is used for pleasure and does not carry passengers, and includes a vessel of a prescribed class.

2-13 “PRINCIPAL TOWING SHIP” means the towing ship, the Master of which is responsible for the manoeuvring and conduct of all ships being towed.

2-14 “PSPC” within the context of these practices and procedures, means Public Services and Procurement Canada (PSPC) - Esquimalt Graving Dock (EGD) and designated PSPC Officers employed at this facility. In the case of vessels undergoing work of any kind at the PSPC EGD facilities, permission from a PSPC Officer will be deemed to have the same authority as that of a harbour official.

2-15 “SCALING” includes scraping, sanding, chipping, grinding, sandblasting, hydroblasting or any other means of dislodging paint, rust or other unwanted material from the hull, superstructure, machinery or equipment contained on-board, or otherwise attached to a ship.

2-16 “SEAPLANE” includes any aircraft designed to manoeuvre on the water.

2-17 “SHIP” means every description of vessel, boat or craft designed, used or capable of being used, solely or partly for marine navigation, whether self-propelled or not and without regard to the method of propulsion, and includes a seaplane and a raft or boom of logs or lumber.

2-18 “SMALL VESSEL” means all ships less than 20 metres in length.

2-19 “TOWED SHIP” means any ship that is not self-propelled, and in order to manoeuvre, it must be pushed or pulled by another ship.

2-20 “TRAFFIC CONTROL OFFICER” refers to the Officer of the Watch, on duty, in the Queen’s Harbour Master Harbour Control Office, or in the Regional Joint Operations Centre, Maritime Forces Pacific.

2-21 “VESSEL” see Ship definition.

3. Authority of Harbour Official

3-1 A harbour official may issue instructions directly to a ship. These instructions may be given verbally, electronically, or in writing. Notwithstanding the means by which they are conveyed, they carry the same weight.

3-2 A harbour official is the sole authority concerning all matters related to marine traffic control, within the limits of Esquimalt Harbour, including assigning berths or anchorages, or authorizing a ship to stay. In the absence of authorization from a harbour official, a ship taking up a position in the Esquimalt Harbour limits, because of the information obtained from other sources, may have to change its position upon receipt of instruction from a harbour official.

4. Entry, Movement, Departure Clearances

4-1 All ships, prior to entering, moving within, or departing Esquimalt Harbour shall contact the Queen's Harbour Master (QHM) Operations, on VHF Channel 10, or by telephone at 250-363-2160. Ships are to give as much advance notice as is practicable. The following information shall be conveyed in the clearance request:

a. ship name;
b. port of registry, if applicable;
c. time of arrival;
d. estimated time of departure;
e. length, breadth, and draft of the ship;
f. the presence of dangerous goods on-board; and
g. harbour destination.

4-2 No ship that has explosives (Class 1 as indicated in the *Transportation of Dangerous Goods Act*) on-board shall enter, move, or depart within the limits of Esquimalt Harbour unless authorized by a harbour official.

4-3 Ships requesting clearance from a harbour official, to enter Esquimalt Harbour and berth at a private facility or the PSPC EGD, shall first obtain permission from the owner or official of the facility in question.

5. Speed Limits

5-1 All ships manoeuvring within the limits of Esquimalt Harbour shall proceed at the posted speed limit, if any, and otherwise at a safe speed, not to exceed 7 knots.

5-2 In special circumstances, a harbour official may grant permission for ships to exceed the speed limit.

5-3 Ships shall reduce speed to minimum wake when passing berthed ships or vessels engaged in any marine operation, or as directed by a harbour official.

6. Controlled Access Zones

6-1 Vessels are at all times to remain 100 metres away from stationary vessels and 200 metres away from vessels underway. Unauthorized intrusions could lead to Federal prosecution. Further information concerning Controlled Access Zones is available in the Canadian Coast Guard Notices to Mariners, National Defence – Military Notices.

6-2 Any vessel may be hailed by the Queen's Harbour Master, and/or hailed and approached by any Military Police or Military Force Protection vessel. Due to force protection/security requirements, access to Esquimalt Harbour may be restricted and/or blocked.

7. Contractor Requirements – Marine Projects

7-1 The contractor warrants that all vessels used in Esquimalt Harbour are mechanically sound, completely seaworthy, equipped with readily accessible lifesaving equipment, will be adequately manned, and in full compliance with the *Canada Shipping Act*, 2001 (S.C. (Statutes of Canada) 2001, c. 26). Contractors must provide on demand and no later than 24 hours after demand, true copies of all Canadian Maritime Documents to a harbour official for vessels and crew related to requirements listed in the *Canada Shipping Act* and associated regulations.

7-2 Contractors must provide, upon demand by a harbour official, a recent condition survey (within the last 4 years) carried out by a qualified and certified marine surveyor, for barges and other marine equipment operated by the contractor in the harbour, clearly indicating that their condition meets all seaworthy and safety standards, and their suitability for the proposed use.

7-3 Contractors must provide documentation, upon demand by a harbour official, showing that their marine assets in Esquimalt Harbour are insured.

7-4 Commercial vessels under 15 Gross Tonnage must provide proof of current enrollment in the Transport Canada Small Vessel Compliance Program.

8. Commercial Ships

8-1 Commercial ships intending to anchor at Royal Roads shall, via their Shipping Agent, first obtain permission and an anchorage position, from a harbour official, by contacting the Queen's Harbour Master (QHM) Operations, on VHF Channel 10, or by telephone at 250-363-2160. The required procedure to request anchorage at a Royal Roads anchorage is under the heading "Forms" at www.esquimaltharbour.ca. The completion and return of the form is to be administered at least 1 hour prior to arrival at the anchoring position.

8-2 With the permission of a harbour official, first had and obtained, commercial ships may anchor in the anchorages described below:

Anchorage	Latitude	Longitude	Depth (metres)	Swing Radius (metres)
A	48°24.756 N	123°27.106 W	40	450
B	48°24.126 N	123°27.690 W	35	365
C	48°24.214 N	123°26.758 W	35	450
D	48°24.371 N	123°25.972 W	35	450
F	48°24.885 N	123°26.078 W	25	365

8-3 Anchoring in any other area of the Controlled Access Zone is prohibited unless approved in advance by a harbour official.

9. Pleasure Craft

9-1 All pleasure craft entering the harbour must be licenced or registered in accordance with the Small Vessel Regulations. All pleasure craft are required to register their arrival, intended duration of stay, and departure from the harbour, by contacting the Queen's Harbour Master (QHM) Operations, on VHF Channel 10, or a harbour official at 250-363-2160. Upon arrival, pleasure craft reporting requirement information must be provided to a harbour official. The required procedure to request pleasure craft anchorage is under the heading "Forms" at www.esquimaltharbour.ca. The completion and return of the form is to be administered within 1 hour of arrival in the harbour.

9-2 Pleasure craft, whether power driven or sail, and small vessels, which are operating under the guidance of the Small Vessel Regulations, shall not impede the passage and manoeuvring of larger commercial ships or naval ships, within the limits of Esquimalt Harbour, and shall, at all times, maintain a lookout while underway.

9-3 Pleasure craft may only anchor north of a line drawn between the south end of Richards Island and the north end of Smart Island. Every pleasure craft anchored in Esquimalt Harbour shall be moored with two anchors and in the manner directed by a harbour official. A harbour official must first approve anchoring in any other area of the harbour.

9-4 The following activities are prohibited in Esquimalt Harbour:

a. rafting of pleasure craft at anchor; and
b. live-aboard vessels, whether temporary or permanent, including the use of houseboats, rafts, scows, boats or other floating structures when such structures are used for sleeping or dwelling purposes.

10. Derelict, Abandoned, Illegally Anchored or Moored Vessels

10-1 Where the owner or person in charge of a vessel, in the harbour, is not available or refuses or neglects to obey any order to move the vessel, the Harbour Authority may, at the risk and expense of the owner of the vessel:

a. take possession of and move the vessel;
b. use any means and force reasonably necessary to move the vessel;
c. berth, anchor, moor the vessel at any place satisfactory to the Harbour Authority; or
d. remove and dispose of the vessel.

11. Sewage Discharge

11-1 No ship or person on-board a ship, shall discharge sewage into the tidal waters of Esquimalt Harbour. Sewage means human excrement and waste from toilets and other receptacles intended to receive or retain human body waste or other waste; however, does not include galley or washing facility waste. In addition, any vessel in Esquimalt Harbour that has a toilet must be fitted with a functioning Transport Canada approved marine sanitation device, holding tank, or temporary storage.

12. Marine Spill Response

12-1 Any person, facility, vessel or property, referred to as the Responsible Party, which causes a marine spill into Esquimalt Harbour, shall be responsible for the reporting, clean-up, and cost of the incident.

12-2 The Responsible Party is required to immediately notify Emergency Management British Columbia at 1-800-663-3456, the Harbour Authority at 250-363-2160, and initiate clean-up.

12-3 Once notified, the Harbour Authority will assess the situation, monitor the response, and provide assistance, as necessary.

12-4 In the event that the Responsible Party is either unwilling or unable to respond, the Harbour Authority may assume control of the response. Alternately, the Harbour Authority may request assistance from the applicable Federal Authority (e.g. Environment Canada, Canadian Coast Guard).

13. Tug or Pilot Services

13-1 When circumstances and conditions threaten environmental protection, safety of port infrastructure or navigational safety, a harbour official may require ships to obtain the services of a Pilot and tug(s).

14. Towing of Ships

14-1 The principal towing ship is at all times responsible for the safety and manoeuvring of its tow.

14-2 When entering, moving within, or departing Esquimalt Harbour, a ship shall use a towline length that permits immediate and positive control over the towed ship.

14-3 Ships are responsible for their tow and must ensure that sufficient assets are employed to account for all contingencies that may arise. Due to the risk of damage to other ships or port infrastructure, a trailing tug shall be secured when this is the safest course of action for the prevailing circumstances. An assist tug must accompany a tow in the following circumstances:

a. when proceeding east of a line drawn between Ashe Head and Grant Knoll; or
b. when arriving, departing, or working within 120 metres of Department of National Defence infrastructure, on the Colwood side of Esquimalt Harbour, incorporating D, F, and G Jetties.

14-4 Any deviation from these procedures must be approved, in advance, by the Harbour Authority.

15. Securing, Crewing, and Propulsion Requirements for Ships

15-1 All ships within the limits of Esquimalt Harbour shall have sufficient crew on-board to safely manoeuvre the ship alongside, or to depart a harbour facility, when instructed to do so by a harbour official. Crew, in sufficient numbers, shall be present at all times, to monitor the ship for safety and security purposes; to ensure that mooring lines and gangways are properly tended, and emergencies are responded to.

15-2 Propulsion power shall be available, at reasonable notice, to move the ship when instructed to do so by a harbour official. Before any repairs, maintenance, or other works are undertaken, that may hinder the ship's ability to move in a harbour facility or anchorage, clearance shall be obtained from a harbour official.

15-3 Anytime emergency repairs are commenced on a ship, at an Esquimalt Harbour facility, the Master of the ship will report to a harbour official the nature of the repairs, and outline the affect it has on the ship's ability to move. The Master shall provide an estimate of the time required to complete the repairs to a condition where the ship is capable of being safely moved.

15-4 Clearance will only be given to leave a ship unmanned, while within the limits of Esquimalt Harbour, if a harbour official is satisfied that the Master of the ship has made adequate securing arrangements; that mooring lines are tended, and that arrangements are in place to move the ship if instructed to do so. Since it is understood that the time required for preparing to move an unmanned ship may be longer than that required for a fully crewed ship, the length of the notification period will be agreed upon before this clearance is granted.

16. Turning of Propellers Alongside

16-1 A ship, when secured at a harbour facility in Esquimalt Harbour, shall not commence basin trials by turning shafts or engaging bow thrusters, without first obtaining permission from a harbour official, and taking the necessary precautions to not endanger the integrity of the harbour facility, its physical assets, other ships, or the environment.

16-2 Clearance may be conditional on extra precautions being followed, such as the use of additional mooring lines, tug assistance, and the equipment or machinery being run at minimum speed.

17. Scaling and Painting of Ships

17-1 A ship at anchor or at a berth, within the limits of Esquimalt Harbour, shall obtain clearance from a harbour official to perform scaling and painting of a ship's hull, machinery, or superstructure. Prior to clearance being granted, the person requesting the clearance shall make an assurance that adequate measures will be taken to protect the environment from the waste material created by the operation.

17-2 Scaling and painting shall not interfere with the operation of another user within the limits of Esquimalt Harbour. If a scaling operation involves hot work, then it shall not take place without a Hot Work Permit.

18. Equipment Protruding Beyond Ship's Side

18-1 Unless authorized, no rigging, cargo gear or other equipment on-board any ship berthed in Esquimalt Harbour shall overhang or project overboard, in a manner that may endanger life or property, or create a hazard to navigation. If any ship requires equipment to extend beyond the sides of the ship, they shall obtain clearance from a harbour official.

18-2 If any cargo gear or equipment is already swung out and another ship is manoeuvring in the vicinity, a harbour official may require the gear to be swung inboard until the danger is past.

19. Rafting of Ships

19-1 A ship may make fast to, or secure alongside another ship in Esquimalt Harbour, at a harbour facility, only with the clearance of a harbour official.

19-2 At Federal Government harbour facilities, every ship, when ordered by a harbour official, shall permit another ship to make fast to, or secure alongside it. Sufficient mooring lines, from the outboard ship, shall be passed ashore to ensure that excessive stresses are not placed on the inner ship's lines, and the outboard ship shall ensure that adequate fendering is provided.

19-3 To avoid overloading jetty bollards, ships shall assess the strain being placed on individual bollards before attaching multiple berthing lines.

20. Ship-to-Ship Transfers

20-1 No ship-to-ship transfer of goods shall take place until a harbour official has given clearance. Ship-to-ship transfers will be approved by a harbour official, only if the official has been apprised of the intention, and is of the opinion that all necessary steps shall be taken to preserve the integrity of the environment, and that there will be no adverse effects on other users of Esquimalt Harbour.

21. Activities that Require Pre-Authorized Approval

21-1 Pursuant to the Natural and Man-made Harbour Navigation and Use Regulations of the *Canada Marine Act*, **the approval of a harbour official is required prior to the commencement of all activities, including but not limited to the following:**

a. conducting a diving operation:

   (1) prior to commencement and upon completion of diving operations; and
   (2) all appropriate safety measures shall be taken, including but not limited to displaying flag Alpha, informing nearby vessels, and maintaining a constant listening watch on VHF Channel 10;

b. conducting a salvage operation:

   (1) notice to harbour users to avoid area of salvage operation;
   (2) measures taken to reduce or mitigate further risk or damage; and
   (3) emergency response resources notified;

c. transporting, loading, unloading, or transhipping explosives or other dangerous goods, industrial waste or pollutants:

(1) conducted at a specified facility or between adjacent ships, using appropriate cargo transfer equipment;
(2) measures taken to reduce or mitigate risk;
(3) displaying an all-around red light or flag Bravo; and
(4) emergency response resources notified;

d. carrying out a bunkering, fuelling or other oil transfer operation, a chemical transfer operation or a liquefied gas transfer operation:

(1) conducted at a specified fuelling facility, between adjacent ships, from a tanker truck ashore, or from a bunkering barge alongside, using appropriate cargo transfer equipment;
(2) measures taken to reduce or mitigate risk;
(3) displaying an all-around red light or flag Bravo; and
(4) emergency response resources notified;

e. conducting a dredging operation:

(1) results of the dredging operation will improve the use of the harbour;
(2) minimize impact on marine traffic and harbour use; and
(3) an environmental assessment must be completed and approved;

f. excavating or removing any material or substance:

(1) results of the excavation/removal operation will improve the use of the harbour;
(2) minimize impact on harbour use;
(3) an environmental assessment must be completed and approved; and
(4) coordination with upland property activities/landowners;

g. building, placing, rebuilding, repairing, altering, moving or removing any structure or work:

(1) results of these works will improve the use of the harbour;
(2) minimize impact on marine traffic and harbour use;
(3) an environmental assessment must be completed and approved; and
(4) coordination with upland property activities/landowners;

h. placing or operating a light or day marker:

   (1) suitable device to be used;
   (2) minimize impact on marine traffic and harbour use; and
   (3) light characteristics are to be in accordance with The Canadian Aids to Navigation System;

i. casting adrift a ship, log or other object:

   (1) minimize impact on marine traffic and harbour use; and
   (2) measures taken to mark obstruction and mitigate impacts;

j. conducting a race, regatta, trial, demonstration, organized event or similar activity:

   (1) minimize impact on marine traffic and harbour use;

k. causing a fire or explosion, conducting blasting or setting off fireworks, including setting off a flare or other signalling device;

l. placing a placard, bill, sign or device;

m. swimming:

   (1) permitted without permission in areas normally associated with recreational swimming;

n. launching a ship by slipway or crane;

o. conducting the take-off or landing of a seaplane;

p. laying up a ship;

q. placing, altering, removing or relocating an aid to navigation, buoy, mooring, float, picket, mark or sign;

r. mooring or anchoring a floating structure:

   (1) ensure berthing or moorage in a specified area that does not interfere with harbour use and traffic;
   (2) on-board measures taken to reduce or mitigate risk, including protecting the environment; and
   (3) minimize the possibility of nuisance and nuisance complaints;

s. fishing or crabbing:

(1) as depicted on Canadian Hydrographic Services Chart 3419, fishing is prohibited at the entrance to Esquimalt Harbour, and in an area east of McCarthy Island; and

(2) it shall only be conducted in areas that minimize the impact on marine traffic, harbour use, and it shall be conducted in accordance with the Department of Fisheries and Oceans Canada licencing requirements; and

t. conducting aquacultural research or operations.

Appendix C-3
Safety & Environment for Contractors

Défense nationale National Defence

CFB ESQUIMALT

Safety & Environment for Contractors

Produced: February 2015

Canada

EMERGENCY SERVICES - 911

Formation Level Contacts	
Base Construction Engineering Help Desk	250-363-2009
Base Logistics Hazardous Material Facility	250-363-2654
Harbour Control Office	250-363-2160
Queen's Harbour Master (duty cell)	250-889-0444
Formation Safety Officer Ionizing Radiation Safety Laser System Safety Radio Frequency Safety (RadHaz)	250-363-7500 250-363-7500 250-363-7500 250-363-7500
Formation Environment Officer	250-363-5063
Military Police Dispatch (non-emergency)	250-363-4032
External Contacts	
WorkSafe BC	1-888-WORKERS 1-888-967-5377
Provincial Emergency Program	1-800-663-3456

EMERGENCY SERVICES - 911

“Notwithstanding that contractual work is conducted on DND land, the work of private contractors and their employees is normally subject to the laws of the Province or Territory in which the work is being conducted. However, this does not relieve the Department of all responsibility and special provisions must be incorporated to safeguard our employees and protect DND’s and the CAF’s legal liability”.
DND General Safety Program Vol 1, Chap 2.

This infoflip® is designed to assist contractors and their employees in meeting their Safety and Environmental responsibilities as well as providing some guidance when working on DND property. It also contains information on when, how and who to contact for questions or guidance. It covers many facets of working with DND and can be used as a guide for commencement of work and a tool to contact the appropriate personnel for questions and advice.

General Safety Program

The Department of National Defence (DND) has a General Safety Program in place to ensure the safety and well-being of its employees and members. While a contractor is not considered an employee of DND, there are many aspects of the General Safety Program that will apply to non-employees, including contractors.

The General Safety program aims to:

- Minimize personal suffering and financial losses;
- Add to the efficiency of DND and the operational effectiveness of the Canadian Armed Forces (CAF); and
- Meet legislative requirements; and contributes to the morale and well-being of all DND employees and CAF members.

Formation/Ship Safety and Environment Management Systems

The Formation and Ship Class Safety and Environment Management Systems provide guidance to DND personnel on implementation of the Maritime Forces Pacific Safety and Environment policy that is specific to the Formation or Ship Class.

The Safety and Environment Management System (SEMS) manual is used to satisfy the requirements of DND, Command and Formation Safety and Environmental policies and directions. It also provides the guidance to ensure employees and workers are compliant with Formation, Base, Provincial and National policy and legislation for the protection and safety of all workers on DND property.

In most cases, contractors should request a full copy of any SEMS directive that relates to the type of work or hazards they may encounter. This infoflip® merely highlights the key points.

Injury Prevention

The goal of any safety program is the prevention of accidents and injuries. This infoflip® contains information on several of the programs covered by the Formation or Ship Safety and Environment Management Systems.

Many of these programs outline the use of specific **Personal Protective Equipment**. It is expected that contractors will comply with applicable legislation as well as DND standards where required.

Accessing DND Property

Most defence establishments have set procedures for accessing DND property. CFB Esquimalt is no exception. The security levels may change from time to time in response to potential threats, or as part of a training activity. Contractor ID cards may be required for access to most DND properties, and potentially building sites within it. Ensure you carry your Contractor ID with you at all times and be prepared to show it. **All personnel accessing DND property are subject to search.**

Parking

Vehicles require an access pass to enter most DND property. Be aware that there is little open parking on the base and you will be subject to ticketing/towing if you park improperly. Look for parking spots designated for contractors.

Secure Zones

Certain areas may be designated as Operations, Security, or High Security Zones and there are additional security requirements in these areas. For example, cell phones are not permitted in these areas and must be powered off, or secured elsewhere. You may also require a visitors pass or escort to access and move around these areas.

All contractor personnel should be aware of security requirements in the areas that they will be working in.

Designated or Controlled Materials

It is possible that your work as a contractor may require you to access documents or materials that are designated or controlled. This means there are additional requirements to protect the security of these documents or materials. For example, documents containing personal information on an individual may have a security designation of Protected A or Protected B. A user manual or set of schematics may be controlled if they are for systems that could affect national security if the details fell into the wrong hands. As well, ship equipment may be controlled and have special disposal requirements.

Be sure you are clear about the designation of documents or materials you have access to, and know whether it's a controlled item or document. Ask for direction on the standards for access, security and disclosure of these items

WorkSafeBC Workplace Inspections

If you or your organization is subject to a Worksafe BC inspection or investigation on CFB Esquimalt property, ensure you contact Formation Safety at 250-363-7500 so appropriate DND coordination is provided.

Although the goal is to eliminate accidents, there is still a chance one could happen, in spite of best efforts. When an accident happens, it's important to report it in a timely manner once the immediate requirement for first aid or emergency responders has been initiated.

First Aid

While contractors are responsible for providing their own first aid services for their workers, if immediate medical attention is required, there are first aid services available in many areas of CFB Esquimalt. It's advisable to enquire about the availability of first aid services in your work area so that you are familiar with its location and how to access it.

If emergency services are required, call **911**. **Note: many areas of the base have limited cell-phone coverage**. Ensure you indicate CFB Esquimalt when talking to the 911 operator. If calling from a DND landline, you will also dial **911**.

Automatic external defibrillator's (AEDs) are placed throughout CFB Esquimalt and in most cases, there is external signage on the buildings where they are located.

WorkSafeBC

All workers in BC are covered under the *Workers Compensation Act* and all accidents resulting in an injury must be reported to WorkSafeBC within three working days.

Refer to **WorkSafeBC.com** for detailed instructions on reporting an injury or death.

Hazardous Occurrence Reporting

In addition to the requirement to report an accident resulting in an injury to WorkSafe BC, accidents that result in a DND employee or military member being injured have additional reporting requirements under the General Safety Program. This also applies to accidents resulting in damage to DND property.

In the event of a severe injury, notify the Formation Safety Officer immediately at 250-363-7500.

While it isn't a contractor's responsibility to initiate the DND Hazardous Occurrence Reporting process, it's possible or likely that witness statements will be required, or the Hazardous Occurrence Investigator may contact you for more information. It is expected that contractors will cooperate to the best of their ability in all investigations.

Report all known or suspected injuries to the appropriate authorities.

Fall Arrest Systems

Canada Occupational Health and Safety Regulations state that fall protection equipment (FPE) must be worn by all workers working 2.4 meters or more above a permanent safe level. The harnesses shall be CSA approved and must be inspected prior to each use.

Ladder Safety

In some instances, portable ladders are the more practical way to carry out the work required. Used correctly, they can be a very handy tool; used incorrectly, they can be a source of injury. The following are some useful points for the correct use of a portable ladder.

1. The base of the ladder should be placed no less than one-quarter and no more than one-third of the length of the ladder from a point directly below the top of the ladder.
2. Where possible, the ladder should be secured in place.
3. A portable ladder that provides access from one level to another shall extend at least three rungs above the higher level.
4. No person shall work from any of the three top rungs of any single or extension portable ladder or from the two top rungs of any portable step ladder.
5. Metal or wire-bound portable ladders shall not be used where there is potential to come into contact with a live electrical circuit or equipment.

Mobile Elevated Work Structures

Caution is to be used when working from a mobile elevated work structure and in particular, when moving or repositioning the structure. There are many overhead obstructions and certain areas, such as dock yard, are very busy and often cluttered as supplies are moved on and off ships. FPE is required for all personnel.

Ship Safety

The same safety standards apply aboard any Royal Canadian Navy (RCN) vessel. If work must be done at height, the appropriate fall arrest system must be used. Ship's personnel can provide detailed guidance and direction specific to their ship.

Warning Signs

If any work at height poses a secondary danger to other personnel, warning signs shall be placed in a conspicuous place, and at a sufficient distance from the job.

All work done in a confined space is considered risky due to the many potential hazards that may be present. Under no circumstances should a contractor enter a confined space unless they have been authorized to do so and have been briefed on procedures.

Contractors are required to follow the requirements of the applicable regulatory body. (Canada Labour Code, Province).

The Entry Supervisor completes their assessment of the space and level of risk. This will include atmospheric testing to determine if a hazardous condition exists. The Entry Supervisor initiates a Confined Space Entry Permit and briefs the Entry Team prior to the commencement of any work.

The contractor's Emergency Response Team (ERT) is notified prior to and after the commencement of work. If the ERT is not available, the work may be postponed. If the ERT becomes unavailable while the confined space work is being done, the work must stop immediately and personnel must exit the confined space.

DND is not mandated to provide rescue teams for confined space entry, but will respond, if available. All confined space entries shall have a hazard assessment completed and a written safe to enter certificate completed by a qualified person.

Confined Space Entry Procedures

1. Ensure all energy sources have been isolated/locked out.
2. Ensure adequate ventilation is provided and the atmosphere tested.
3. Implement your company's confined space procedure.
4. Ensure entrant, rescue team and sentry are qualified.
5. Ensure hazard assessment completed.
6. Ensure entry plan completed.
7. Ensure rescue plan completed.
8. Ensure personnel are briefed on hazards and work to be conducted.
9. Ensure entry log is in place and used.
10. Ensure safe to enter certificate is completed and posted by qualified person.
11. Ensure rescue team and equipment are in place.

Report all known or suspected injuries to the appropriate authorities. **Accident Reporting (3)**

Radio Frequency (RF) radiation, also known as non-ionizing radiation, can pose a health hazard to personnel who are exposed to levels higher than Health Canada recommendations. These levels are individually known as the **Maximum Exposure Limit (MEL)**.

Through measurement, the distances (MEL distances) one must remain away from any given radiating emitter have been determined. These distances are held by the ship or unit owning these RF emitters.

Contractor personnel will be briefed on the applicable MEL distances and emitter control procedures prior to accessing a site with RF emitters in it. This briefing will be given by the Officer of the Day on ships.

Buildings with RF emitters will have a DND/CAF employee appointed to grant access to the roof and this person will provide the briefing on RF hazards resident there.

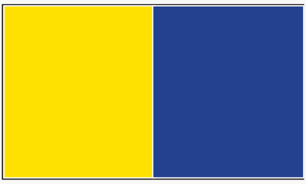
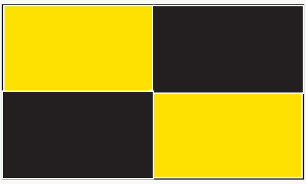
Sources of Radio Frequency (RF) Radiation

The more obvious source of RF radiation is from ship board equipment such as radar and communication antennas.

There are also RF emitters located on various buildings. These include D250, D199, D211, D100, D218, N92A, and N50. Proper roof access procedures, obtained from the contracting authority, must be described to personnel prior to commencing work on any roof.

Indicators for Radio Frequency (RF) Radiation Hazard

Ships will use a series of coloured flags to indicate the status of their RF transmitting capabilities.

FLAG ECHO Indicates that the vessel is rotating an antenna without radiating RF Energy.	
FLAG KILO Indicates that a person is working aloft and/or over the side.	
FLAG LIMA Indicates that the vessel is radiating RF Energy.	

Hazards of Electromagnetic Radiation

1. **Hazards of Electromagnetic Radiation to Fuel (HERF):** There is potential for **RF radiation** to cause spark ignition of volatile combustibles such as gasoline, fuels or solvents.

2. **Hazards of Electromagnetic Radiation to Ordnance (HERO):** **RF radiation** may cause ordnance or ammunition to inadvertently fire without notice or indication.

3. **Hazards of Electromagnetic Radiation to Personnel (HERP):** **RF radiation** can heat and burn body tissue and may occur through exposure to a nearby source, or through direct contact with an antenna wire, cable or metal railings that may be reradiating fields.

Suspected or Confirmed Exposure

Any personnel who suspect that they are being over exposed to radio frequency radiation should immediately move away from the source of radiation. **Any personnel who suspect or confirm they have been exposed to radio frequency radiation should seek immediate medical attention.** Medical personnel are to be advised that there may have been an RF over exposure.

Report all known or suspected injuries to the appropriate authorities. Accident Reporting (3)

Hot Work is defined as "any activity which has the potential of generating a source of ignition." This includes welding, burning, grinding, or the use of any spark-producing equipment.

Before any Hot Work can be carried out, a Hot Work Certificate must be issued. Contact the Base Fire Hall **250-363-1906** to receive a permit and a copy of **Fire Orders and Regulations for Contractors**.

Prior to the Hot Work Certificate being issued, a hazard assessment must occur, including the following:

- ❐ Remove all combustible or flammable materials
- ❐ Ensure fire cloth, smoke curtains and ventilation are in place
- ❐ Ensure all areas where a spark could land are protected
- ❐ If applicable, ensure the compartment(s) has been certified gas free
- ❐ Ensure electrical cables liable to be damaged have been covered with protective material

Once the Hot Work is to begin, the Fire Sentry(s) are to be briefed and will ensure the appropriate fire extinguisher(s) are on site.

Note: Gas free testing along with a new Hot Work Certificate must be conducted every 24 hours.

Completion of Hot Work

Once the Hot Work has been completed, the Fire Sentry(s) are required to stay on site for a minimum of 30 minutes. After inspecting the area, the Fire Sentry(s) will report to the customer or Fire Hall that the operation is complete.

Prohibited Hot Work

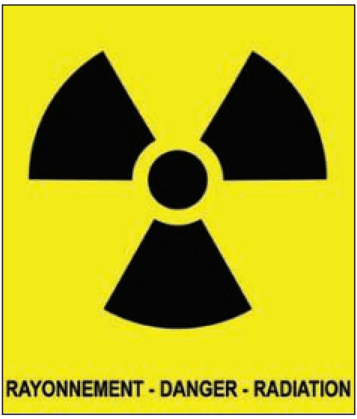
- ❐ In compartments containing unsealed flammable material
- ❐ On pipes containing any trace of fuel or lube oil
- ❐ Within two (2) meters of a magazine or fittings that enter the magazine
- ❐ On pipes containing any trace of sewage inside

In the event a fire is detected: Shout "FIRE, FIRE, FIRE" and exit the area in an orderly fashion. Notify the Base Fire Hall (911), no matter how small the fire.

Exposure to ionizing radiation can be harmful as it damages the internal structures of living cells. High doses can cause death over a short period of time, or other long term health issues from low doses over longer periods of time.

Sources of Ionizing Radiation

Potential sources of radiation can be specialized monitoring equipment, aircraft gauges, X-rays and even smoke detectors. The international symbol for ionizing radiation is the trefoil. In Canada, X-rays are identified by a different symbol.



Trefoil

X-Ray

Radiological Hazardous Occurrence (RHO) Procedures

- ❐ Hold your breath.
- ❐ **Attempt to breathe only once in fresh air!**
- ❐ Vacate the immediate area.
- ❐ Secure the area if possible.
- ❐ Call the Radiation Safety Officer.
- ❐ Remain nearby until released.

Report all known or suspected injuries to the appropriate authorities. **Accident Reporting (3)**

Suspected/Confirmed Contamination and/or Exposure

If there has been a suspected or confirmed over exposure, the person **MUST be sent to the hospital.** Ensure medical authorities are advised that the individual may have had a possible ionizing radiation over exposure and if applicable, that the source may be on the person's clothing.

As with any other injury or accident, the details must be reported to WorkSafe BC. It is the contractors responsibility to ensure this happens. **Accident Reporting (3)**.

Containment and Clean-up

If DND/CAF personnel are not yet aware of the contamination, ensure they are notified immediately. Units holding radioactive materials will have a Unit Radiation Safety Officer who must be notified of the contamination.

Areas must be evacuated and cordoned off until the clean-up has been completed. Only qualified personnel are permitted to do the clean-up; contractors should not attempt to clean a contaminated area.

Industrial Radiography

Contractors must be licensed by the Canadian Nuclear Safety Commission (CNSC) for Nuclear Gauges (e.g. Troxler Gauges) and Gamma Radiography and they must be able to present these licenses upon demand when on DND/CAF property.

For X-ray Radiography, the contractor must have one person on staff who is a CGSB Level II radiographer (licensed by NRCan).

For Gamma Radiography, there must be one operator who is both CNSC - Certified Exposure Device Operator (CEDO) and NRCan - CGSB Level II certified.

XRF operators must be licensed by NRCan as at least a Level I XRF Operator.

All contractors must have an emergency plan that is accessible to the Base RadSO. Moreover, any contracted services intending to use ionizing radiation must inform the Base RadSO.

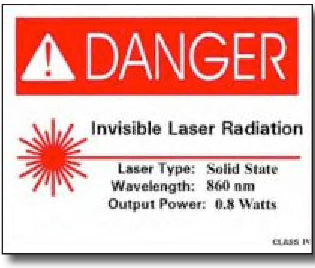
Report all known or suspected injuries to the appropriate authorities. **Accident Reporting (3)**

Exposure to high power laser light can be hazardous to eyes as well as skin. Lasers range from Class 1 to Class 4. Class 1 are not considered hazardous to skin, or eyes. Class 2 may be hazardous to the eyes but protection is normally afforded by the eye's natural aversion response to bright light. Class 3 lasers may be potentially harmful if under direct and specular viewing conditions. Class 4 lasers are capable of causing serious injury to both eye and skin, and could cause combustion of flammable materials.

Ships such as the Halifax Class contain a Class 4 laser system. Where a ship or unit has Class 3B or 4 laser systems, they will have a Unit Laser System Safety Officer (ULSSO) appointed who will ensure personnel are trained and briefed and that all laser safety policies, standards and procedures are adhered to. Contractor personnel should ensure they are familiar with these policies and procedures prior to commencement of work.

Area Control Where Laser Hazard Exists

Any area where a laser will be operated shall be well defined. In most situations, a laser warning sign such as the one shown here should be in place. All personnel must follow posted instructions and use appropriate Personal Protective Equipment (PPE) as required.



Optical Viewing Devices

Optical viewing devices such as binoculars, big eyes or telescopes shall not be carried or used in any controlled area without prior approval of the ULSSO. If laser operations are to be viewed with such devices, appropriate attenuating filters must be used in the optical viewing device.

Suspected or Confirmed Over Exposure

If there has been a suspected or confirmed over exposure involving laser radiation, the person **MUST be examined by a physician**. Ensure the medical authorities treating the person have been advised that there may have been a laser over exposure.

Report all known or suspected injuries to the appropriate authorities. **Accident Reporting (3)**

Spill Response and Reporting

All contractors who will have their own vehicles on DND property and/or will be using hazardous materials, must have response equipment, such as a spill kit, and personnel trained in their location and use. In the event of a spill, the contractor is responsible for immediately implementing spill response procedures. If a spill cannot be easily contained or cleaned up, the contractor must call the Base Fire Hall at **911**. Contractors must also report all spills to their contract authorities and the Formation Environment Officer at 250-363-5063, as soon as possible

Contractors are responsible for the cost of cleaning up a spill they generated.

Sick, Injured or Abandoned Wildlife

Do not touch or disturb wildlife on DND properties, including wildlife that appear dead or injured. If you encounter:

- ❒ dangerous animals, such as a bear or a cougar, report it to the Military Police at 250-363-4032 immediately; and
- ❒ sick, injured, abandoned or dead wildlife, report it to the Base CE Help Desk at 250-363-2009.

Waste Disposal

Contractors are responsible for removing and appropriately treating/disposing of all wastes in accordance with contract documentation. This includes all liquid wastes generated during project activities. Disposal of any waste in DND waste bins is prohibited. Disposal of untreated liquid wastes to the environment and/or storm/sanitary sewers is prohibited.

Archaeological Features

Contractor personnel should be aware of the mitigation measures prior to commencement of work and ensure they are being implemented throughout the duration of the project. Prior to commencing any land alteration activities, contractor personnel should receive an archaeological briefing which their contract authority will coordinate.

Contractors working on systems requiring lockout or tagout procedures will be expected to follow the existing policy as outlined in **Formation Safety and Environment Systems (FSEMS) Directive S14** The lockout / tagout procedures will be used in conjunction with other work safety standards (**Confined Space Entry (5), Burning and Welding (8)**) but not in lieu of their safety standards.

Approved Padlocks or Lockout Devices

Locks shall be sequentially numbered and will be identified as belonging to the contractor. The customer will have locks meeting the same standard and identified as belonging to them. The contractor must coordinate LOTO requirements with the applicable unit owning the equipment and keep a register of locks issued, including the date, person's name, contractor name, system worked on and the location of the lock or device.

Only one key shall be issued with a padlock and in the event of a lost key, the lock must be destroyed once it has been removed in accordance with procedures. Replacement keys will not be produced.

Zero Energy Checks must be completed before starting work to ensure the lockout is effective.

Removal of Locks

Normally the person who applied a lock is the only one who can remove it. In exceptional circumstances, the MSE and CSE Department Heads (or their delegates) may authorize the removal of the lock under the following circumstances:

- ❐ The machinery / equipment / system shall be verified safe to operate
- ❐ The owner identified on the tag shall be contacted for permission to remove his/her lock
- ❐ Details shall be entered in the Lockout Register

In the case of critical systems onboard the submarines, the owner of a lock will leave the key for his/her lock with the LOTO Coordinator if they leave the sub (ie, leave after working hours), and will draw the key prior to commencing work the following shift.

Contractor Responsibilities

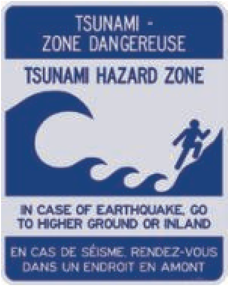
"The unit Contract Officer/Coordinator is to ensure the contractor is aware of the Lockout/Tagout procedures detailed in this Directive. Contractors shall report immediately to the relevant department to be provided a Point of Contact and to be briefed on the procedure to be followed while working onboard."
FSEMS Directive SD14

Due to the risk of a significant emergency occurring such as an earthquake or tsunami, the base has stood up a **Mass Notification System** to give warning to all personnel. In the event that the Tsunami Warning System has detected a tsunami threat, an audible warning system will sound throughout the base. Immediately head for higher ground. Look for signs to indicate tsunami evacuation routes:

There is more than one tsunami evacuation site; be sure you are familiar with the one closest, and most accessible to your location. It's important to remember that personnel are expected to travel to the evacuation sites by foot except in cases when an individual is physically unable to walk. Roads will become congested very quickly otherwise.

Tsunami Hazard Zones

Areas most at risk for a tsunami are indicated by warning signs. These signs are marking what is referred to as the inundation zones, or the areas of lower elevation most likely to be affected by a tsunami.



Mass Notification System

The **Mass Notification System** is also intended to deliver an audible signal to indicate other emergency situations such as an active aggressor. The Mass Notification System will be tested on the first Wednesday of each month for approximately 1 minute commencing at 11:00 am.

Threat of Violence or Terrorism

In the event there is a threat of violence requiring lock-down procedures:

- ❐ Escape or hide out; call **911**.
- ❐ Secure self and location; lock doors, windows.
- ❐ Mitigate vulnerabilities; close blinds, turn off lights.
- ❐ Stay put; wait for authorities to release you.
- ❐ Take action as a last resort.

Situations that may trigger a requirement to call Emergency Services can include medical, fire or even a threat of violence. CFB Esquimalt Emergency Services works with municipal Emergency Services to support all locations occupied by DND. In the event of an emergency, call **911. If calling from a cell phone, inform the dispatcher that you are calling from Canadian Forces Base (CFB) Esquimalt**. Provincial Dispatchers will notify and dispatch the appropriate Emergency Services in your area. Emergency procedures must be discussed with the contracting authority prior to commencing work and be included in the contractor's safety plan.

Major Disasters

There are protocols in place to deal with large scale emergencies such as earthquakes. It's important in such a situation to follow the directions of DND/CAF personnel on muster points and protocols to follow. A full accounting of all personnel is to be completed after buildings have been evacuated, and this includes registering non-DND personnel such as contractors and cleaners.

In the absence of clear instructions, look for the closest E-Box and proceed there. The E-Boxes are placed throughout DND property and can easily be identified by their **orange colour and letter E on the side.**

> **NOTE: Do not depart your location until you have registered with one of the base's E-Boxes. If you fail to do so, valuable time may be spent searching for you.**

Building Evacuations

All personnel, including contractors, should be familiar with the evacuation procedures for the site they are working in. Diagrams will be found in all buildings showing exits and locations of emergency equipment such as fire extinguishers and first aid kits. Take the time to review the diagrams and ask questions if you're unsure of local procedures.

Workplace violence constitutes any action, conduct, threat or gesture of a person towards an employee in their workplace that can reasonably be expected to cause harm, injury or illness to that employee. It includes, but is not limited to, the following:

Threatening behaviour - such as shaking fists, destroying property or throwing objects.

Verbal or written threats - any expression of an intent to inflict harm, including:

- **Direct threats** - clear and explicit communication which distinctly indicates that the potential offender intends to do harm, for example: “I am going to make you pay for what you did to me”.
- **Conditional threats** - involves a condition, for example: “If you don’t get off my back, you’ll regret it”.
- **Veiled threats** - usually involves body language or behaviours that leave little doubt in the mind of the victim that the perpetrator intends harm, for example: “Do you think anyone would care if someone beats up the boss?”

Harassment - any behaviour that demeans, embarrasses, humiliates, annoys, alarms, or verbally abuses a person and that is known to be, or would be expected to be unwelcome. This includes words, gestures, intimidation, bullying, or other inappropriate behaviours.

Verbal abuse - including swearing, insults, or condescending language.

Physical attacks - including hitting, shoving, pushing or kicking the victim, or inciting a dog to attack.

National Defence Policy

“The Canadian Forces and the Department of National Defence have a zero tolerance for all forms of work place violence.”

“Incidents of work place violence, should they occur, will be responded to promptly by responsible and competent authorities to ensure that the work place remains a respectful and safe environment for everyone.”

National Defence Occupational Health and Safety - Prevention of Violence in the Work Place Policy Statement.

Report all known or suspected injuries to the appropriate authorities. Accident Reporting (3)

This publication was produced for Contractors and their employees as a guide to Department of National Defence and CFB Esquimalt Safety and Environment programs. While every effort has been made to provide current and relevant information, Contractors must remain vigilant about ensuring they are fully informed of current legislation as it pertains to worker safety; occupational health and safety; and environmental controls.

This infoflip® is intended to be a quick reference and in many cases, Contractors will require access to the full directives or procedures to ensure they are compliant.

Produced under the authority of Formation Safety and Environment, CFB Esquimalt.

Recommendations for changes or improvements can be directed to:

Formation Safety and Environment
CFB Esquimalt
PO Box 17000 Stn Forces
+ESQ FSE Safety@FSE@Esquimalt (internal email)
250-363-7500

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Appendix C-4
Preliminary Job Hazard Analysis Check List

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Preliminary JOB HAZARD ANALYSIS CHECK LIST

August 2011

APPENDIX A

Project Title: Master. **Project No.**

Inspection Date:

Inspection/Job Hazard Analysis Conducted By:

Note:

1. This form is also intended for use as a checklist when making daily inspections of the worksite. Therefore some questions will not apply to the initial inspection/ job hazard analysis.

2. This form is intended as a guide only and does not necessarily cover every situation regulated by WORKSAFEBC or other jurisdictions. It is imperative that the Contractor be familiar with safety requirements and add anything that is relevant but not listed below. New items should be noted to the attention of the Project Manager for inclusion in future revisions. Contractors must finalize the JHA to reflect the methods/equipment etc. they will use to do the work.

3. Project Managers must review all items as part of creating preliminary JHA. Do not simply reuse this form from a previous project. Delete or add to "Hazard/action required" items as appropriate for your project and enter checkmarks or NA (not applicable) or TBD (to be determined with Contractor) under "Existing" column as appropriate.

4. CODES:

- **"*" indicates covered in Basic Site Orientation for Contractors presentation by PWGSC.**
- **"S" indicates item covered in startup meeting with Contractor and up to Contractor to carry out appropriate action. Not covered in EGD orientation session.**
- **"O" indicates item covered in EGD project specific orientation session. This does not relieve the contractor of responsibility for training workers with regards to this item.**

5. Column "WORKSAFEBC Ref." May also contain Canadian Occupational Safety & Health (COSH) regulation references.

Add brief description of work to be done:

Significant Risks include but are not limited to:

Project Title: Master. Project No.

	Cond. No.	Condition	Existing √	CODE	WORKSAFEBC Ref. #	Hazard/ Action Required

GENERAL	1.1	Notice of Project (NOP) given to WORKSAFEBC? Check regulations for conditions requiring notice:
		- Over $100,000.
		- All or part of works are required to be designed by P.Eng.
		- Asbestos removal
		- Disturb Lead coatings
		- Significant Risk of Occupational Disease
		- New construction, major alteration, structural repair or demolition of :
		  - Bldg over 2 stories (or 20ft.)
		  - Bridge
		  - Earth/water retaining structure over 10'
		  - Silo/chimney over 20'
		- Work in compressed air environment
		- Work in a caisson
		- Work in a tunnel (see 22.2)
		- Work on underground working (22.6)
		- Trenches 4' deep and 100' long or other type of excavation over 4' a worker must enter.
		- Diving Operations check 24.9
		- Aircraft involved? check 29.8
			√	S	20.2
					24.9
					22.6
					29.8
						Contractor to provide NOP to WORKSAFEBC and provide copy to Project Manager before pre-startup safety orientation meeting.
						Note that WORKSAFEBC NOP Form 52E49 is used for general construction work and when asbestos or lead is involved.
						Use WORKSAFEBC Form 52E48 for NOP when diving, underground workings or aircraft are involved.
						NOP should go to WORKSAFEBC 4-5 days before starting work if possible and MUST be submitted no less than 24 hrs before commencing work.
						The white copy is for the site and the canary and pink copies go to the WORKSAFEBC.
						Photocopies should be posted on the safety notice board, placed on the project file, contract file and sent to the Regional Safety Coordinator.
						Note also the requirement to provide written notice to WORKSAFEBC before commencing (under Part 19) if workers, equipment, machinery or materials could come in contact with energized high voltage conductors or other exposed electrical equipment.
						Note application to underground workings in WORKSAFEBC section 22.2

	1.2	Multiple Contractor Coordination. - 2 or more employers? - Overlapping work areas - Appoint qualified safety coordinator - Post construction procedures and JHA	√	S	Review WORK SAFEBC 20.3	Contractor to appoint Worker Safety Representative and Construction Superintendent. Coordination with EGD personnel and others on site will be through Project Manager. Post Final JHA and procedures.
	1.3	Building and other permits obtained?	√	S		Building permit required for new construction.
	1.4	Notice of Project Posted?	√	S		Contractor will post on safety notice board.

	1.5	Post emergency response plan and site plan? Workers trained in emergency response? Conduct risk assessment for: Work at high-angles Special needs individuals Others as required by 4.13 or identified in other sections below	√	*	4.13-4.18 20.3	Site plan and emergency response to be posted on safety notice board. Contractor to ensure all workers trained in emergency response for fire, earthquake, medical, bomb threats and hazardous materials accidents before starting work. Note the special rescue requirements for high-angle work and the need for written agreements to provide service.
	1.6	Regular Safety Meeting Minutes Posted?	√	*	3.2	Weekly safety meeting to be held. Contractor to provide minutes to Project Manager for posting.
	1.7	WORKSAFEBC Orders, Inspections or "Notice to Workers" Posted? Notification of compliance posted?	√	S	Div. 10 183	Contractor to provide any WORKSAFEBC inspections and/or orders to Project Manager and post any inspections and compliance reports.
	1.8	Regular Inspections carried out with Safety Rep and Posted? Conduct special inspection if required due to malfunction or accident.	√	S	3.5 3.7 3.8	Provide inspection reports to P.M. and post.
	1.9	Contractor's workers safety representative identified for each employer? Alternatively, a Joint Committee set up if required by WORKSAFEBC Div. 4?	√	S	20.3 Div4 125-140	Worker Safety representative if 9 or more workers.
	1.10	Insufficient lighting?	√	S	4.65	Contractor to ensure lighting levels are sufficient for work to be performed. Provide portable lighting where necessary.
	1.11	Workers informed of the hazards of the job and that they have the right to refuse work they consider too hazardous without discriminatory action?	√	*	Review 3.12	To be covered in orientation session and reinforced by Contractor
	1.12	Workers with physical or mental impairment that could affect work must inform their supervisor.	√	*	4.19	To be covered in orientation session and reinforced by Contractor. Do not work at heights if subject to dizziness or if worker has a fear of heights
	1.13	Workers informed no alcohol, drugs or other substance so as to endanger self or others?	√	*	4.20	To be covered in orientation session and reinforced by Contractor. Inform First Aid attendant of any medications being taken as they may be important in case of accident.
	1.14	Firearms of any kind are prohibited on site.	√	*		To be covered in orientation session and reinforced by Contractor
	1.15	Duties of Employers, Workers, Supervisors and Owners	√	*	Div.3 115-119	Review duties/responsibilities of parties involved. To be covered in orientation session.

	1.16	General Duty: In the absence of a specific requirement, all work must be carried out without undo risk of injury or disease to anyone.	√	*	2.2	To be covered in orientation session and reinforced by Contractor
	1.17	Do not remove or render inoperative any safeguard and ensure safeguards are in place before operating equipment.	√	*	4.11 4.12	To be covered in orientation session and reinforced by Contractor
	1.17a	All workers must be given adequate instruction in the fire prevention and emergency evacuation procedures applicable to their workplace	√	O	4.16	To be covered in orientation session and reinforced by Contractor
	1.18	Do not operate any EGD equipment. Only those trained and authorized by the contractor are to operate contractor's equipment.	√	*	4.10	
	1.19	Ensure equipment inspection & maintenance record (s) are readily available to equipment operators or inspectors.	√	*	4.9	To be covered in orientation session and reinforced by Contractor
	1.20	Workers must not engage in improper activity that could constitute a hazard to themselves or others including horseplay threats or physical force. Improper activity must be investigated.	√	*	4.24-4.31	To be covered in orientation session and reinforced by Contractor. Violence or harassment will not be tolerated. Contractor carry out risk assessment of injury from violence if there is potential for violence. Inform workers and prepare plans to minimize risk as required by 4.30
	1.21	Workers to restrict activity to designated areas of the site.	√	*		Restrictions to be discussed at pre-start-up safety orientation meeting.
	1.22	Workers informed of location of copy of WORKSAFEBC Regulations and Worker's Compensation Act.	√	*		Cover at orientation meeting. Contractor to ensure current copy of Regulations and the Act is available on site.
	1.23	Written work procedures developed? Provided to P.M. and workers?	√	S & O		Contractor to document work procedures and sequence of activities and provide to Project Manager and workers before starting work.
	1.24	Do not work on site outside of agreed working hours.	√	*		EGD must ensure an employee is on site anytime contractors are on site. Therefore notice is required.
	1.25	If work damages a utility it must be reported.	√	O	4.18	Immediately inform the Utility and then the Project Manager
	1.26	Wildlife, rodents may be encountered on the site.	√	O		Be aware of potential for encounters with wildlife on the site. Rodents may leave droppings in crawl spaces that could present a hazard if dust is breathed. Also, raccoons may be aggressive if cornered and deer may protect their young.

Project Title: Master. **Project No.**

FIRST AID & INVESTIGATIONS	2.1	**Has the Contractor carried out an assessment and identified the numbers of workers who may require first aid at any time; the types of injuries that might occur; barriers to first aid being provided to an injured worker; and time required to transport an injured worker to medical attention?**	√	*	3.16 & 3.17	**Contractor to provide <u>written</u> first aid assessment and written procedures for providing first aid to comply with first aid amendments effective 1 Feb/08**
	2.2	**Workers instructed to report ALL injuries or near misses, hazardous conditions?**	√	*	3.10	**To be covered at the pre-startup safety orientation meeting.**
	2.3	**Workers know where first aid is located and how to call for first aid? Communication between first aid attendant and ambulance service defined?**	√	*	3.17 & 3.18	**Contractor MUST have own F.A. Before starting work. Identify location & adequacy of Contractor's F.A. equipment. Cover procedures in orientation.**
	2.4	**First Aid qualified person(s) on contractor's crew? ORIGINAL Certificate(s) must be with person(s) on site. Provide photocopy to Project Manager.**	√	S	Part 3	**Required. Provide certificate(s) to Project Manager before orientation session.**
	2.5	**F.A. equipment on site where required? Must comply with "High" Hazard class 20 min or less travel to hospital.**	√	S	3.16	**Provide location and type.**
	2.6	**Provide immediate investigation & notice to WORKSAFEBC for: - serious injury/death - major structural failure of bldg., bridge, tower, crane, hoist, excavation, temp. construction support system. - major release of a hazardous substance - incident required to be reported.**	√	S	Div. 10 172	**To be covered in project startup meeting with Contractor. Do not disturb the accident site except to attend injured persons, prevent further injuries or protect property. Assist investigators every way possible.**
	2.7	**Provide emergency transport to hospital as required by WORKSAFEBC and written procedures for transport**	√	S	3.17	**Contractor to define procedures for provision of first aid, calling ambulance service etc. as required by regulation. Post them and ensure workers are informed.**
	2.8	**Is the first aid attendant available to render prompt service?**	√	S	3.18	**Do not assign activities that will interfere with the attendant's ability to receive and respond to call for first aid. Ensure coverage during lunch and other breaks. Provide backup first aid immediately for planned absences. About ½ shift absence is permissible for unplanned absence until replacement attendant is in place.**

Project Title: Master. **Project No.**

	2.9	Has the general contractor included all subs in determining the numbers or workers and first aid requirements	√	S	3.20	General Contractor's first aid assessment and procedures to include sub-contractors.
	2.91	Has the contractor assigned a person to manage first aid service?	√	S	3.17	Assign someone to ensure attendants, supplies, facilities and equipment are always available.
	2.92	Does the Contractor have New or Young Workers as defined by WorkSafeBC regulations?	√	S	3.22-3.25	Ensure New or Young workers receive special orientation and training as required by regulations and documentation is provided to the Project Manager. Ensure follow up observation and provide reinforcement training if required or requested by the worker.
	2.91	Has the contractor assigned a person to manage first aid service?	√	S	3.17	Assign someone to ensure attendants, supplies, facilities and equipment are always available.

CHEMICAL/ BIOLOGICAL - WHMIS	3.1a	Hazardous Substances Used? Provide details.	TBD	O	PART 5	Contractor to provide Material Safety Data (MSD) Sheets for all hazardous substances to be used including welding materials and gases. Sheets must be provided by the contractor at first meeting with the engineer in order to complete the Job Hazard Analysis and define safe work practices. Ensure effective written procedures are prepared and implemented to prevent exposure by any route that could cause an adverse health effect, and to address emergency and cleanup procedures in the event of a spill or release of the substance. Ensure the supervisor and the workers are trained in and follow the established procedures.
	3.1b	Environmental Assessment completed? Check identified hazards and measures to be taken.	TBD	S		Environmental Assessment to be provided to Contractor.
	3.1c	EGD Environmental Best Management Practices applicable?	TBD	O		Contractor to follow Best Management Practices provided by Environmental Services.
	3.2	Implementation Plan Checklist completed?	TBD	S	5.7	Contractor to follow Implementation plan checklist for hazardous substances. See WORKSAFEBC section 5.7
	3.3	Material Safety Data Sheets Available?	TBD	O	5.16	Contractor to provide MSD Sheets and make available at worksite to all workers.
	3.5	Emergency Response Defined?	TBD	O		Contractor to define emergency response as appropriate for hazardous substances.
	3.6	Training Checklist Completed?	TBD	S	5.7	Contractor to follow education & training checklist for hazardous substances provided by WORKSAFEBC. See 5.7
	3.7	Flammable/Combustible Substances?	TBD	O	5.27-5.35	

	3.8	Substances under pressure?	TBD		5.36-5.47	
	3.9	Controlling Worker Exposure	TBD	O	5.48-5.59	
	3.10	Ventilation controls?	TBD	O	5.60-5.71	
	3.11	Internal Combustion Engines operated in poorly ventilated areas?	TBD		5.72-5.75	
	3.12	Hazardous Wastes & Emissions	TBD	O	5.76-5.81	
	3.13	Personal Hygiene	√	O	5.82-5.84	Wash hands before eating or smoking or at breaks as required by regulation.
	3.14	Emergency Washing Facilities, eyewash required?	TBD	O	5.85-5.96	Contractor to provide emergency washing facilities where required due to hazardous substances.
	3.15	Emergency Procedures defined? Review First Aid, Fire, Spill Control.	TBD	O	5.97-5.102	Contractor to review emergency procedures with workers
	3.16	First Aid and Fire depts. aware of substance and quantities used and locations stored?	TBD	S	4.17	Contractor provide notice if required by regulations.
	3.17	Supervisor & Workers trained? General WHMIS instruction as well as substance specific training?	TBD	S		Contractor to ensure Workers and Supervisors have WHMIS training and training in dealing with specific substances.
	3.18	Substance specific requirements?	TBD	S	PART 6	Review Part 6 and ensure compliance as per MSD sheets. See also sections 25, 28 and 29 below.
	3.19	Evaluate worker understanding of substance specific requirements and emergency/spill procedures during inspections.	TBD	S		Inspection item.
	3.20	Ensure containers for hazardous substances are maintained to ensure secure containment. Keep covered when not in use.	TBD	S	5.20-5.22	Inspection item.
	3.21	Keep only enough for one shift, store balance of quantity in designated separate area. Ensure workplace/supplier labels are on EVERY container.	TBD	S	5.23	To reduce the risk of a major spill, fire etc. minimize quantities on site. Ensure workers can easily tell what is in every container. Inspection item.
	3.22	Store incompatible substances so that they can not mix in event of leakage, breakage etc.	TBD	S	5.24	Serious consequences can result from mixing certain substances. Ensure they cannot mix. Inspection item.
	3.23	Store hazardous substances so they can't fall, be damaged or exposed to extreme temperatures.	TBD	S	5.25	Inspection item.
	3.24	Ensure the designated storage area meets design requirements.	TBD	S	5.26	Inspection item.

Project Title: **Master.** **Project No.**

	3.25	Protective and spill equipment available?	TBD	O		Contractor to ensure all personal protective equipment and spill response equipment is readily available and workers are trained in spill response plan.
	3.26	Follow proper procedures in disposing of hazardous substances.	TBD	S		Follow MSD Sheet instructions.
	3.27	Other	TBD			
		Note: Refer to WHMIS Implementation Plan checklist when doing inspections for hazardous substances	TBD	S		Create inspection checklist where required.

WORKING ALONE	4.1	Working alone process defined for workers assigned to work alone? Note new guidelines Nov./08 for determining if working alone regs apply. Amongst other things a "person check" system alone is unlikely to meet the "readily available" test.	No working alone	*	4.21-4.23	There will generally be no working alone. Document special procedures and agree with Project Manager if working alone is necessary. Note regulation changes 1 Feb/08
	4.2	Working alone process followed?	√		4.21-4.23	Inspection item.
	4.3	Restricted Access area?	√	O		Contractor to ensure workers follow procedures for restricted access.

CONFINED SPACE	5.0	Confined Space Entry Control required?	NA	S		Considerable danger may exist if personnel enter designated confined spaces without proper ventilation and other controls/procedures being in place. No confined space identified on this project.
	5.1	Confined Space Entry Controlled and/or hazard identified?	√	S	9.3, 9.12	Project Manager to identify confined space and inform Contractor.
	5.2	Hazard Assessment Completed by Qualified Person?	√	S	9.9-9.11	Ensure space has been assessed by a Qualified Person. All known spaces have been assessed at EGD.
	5.3	Entry permits completed, signed and posted per regulations? Keep permit for 1 year.	√	S	9.13- 9.16	Inspection item.
	5.4	Confined Space Entry Program Defined?	√	S	9.5	Follow WORKSAFEBC regulations. Contractor will use own policy and forms. EGD CSE policy and forms to be used for EGD workers. Ensure emergency/rescue plans are coordinated and compatible.
	5.5	Person assigned to administer confined space program?	√	S	9.6	EGD confined space program coordinator is Kim Wilson

Project Title: Master. **Project No.**

	5.6	Confined Space Entry Program followed?	√	S		EGD workers will Follow the program outlined in the binder in the Pump House. Contactor will follow own program. Inspection item.
	5.7	Workers & Supervisors Trained?	√	O		Ensure workers are trained in written procedures for entry, monitoring air quality and rescue. Only trained workers may participate in the work, rescue, monitoring etc.
	5.8	Ventilation adequate?	√	O	9.31 – 9.33	Check ventilation considering work to be done and airborne contaminants etc. Each job must be separately assessed.
	5.9	Lockouts Performed when required?	√	O	9.17-920	Lockout may be required as part of the confined space entry procedure. Follow EGD lockout policy.
	5.10	Rescue Equipment condition checked.	√	S		Check equipment maintenance log.
	5.11	Standby worker requirements being followed?	√	O	9.34-9.36	Inspection item.
	5.12	Rescuer's trained and drills conducted?	√	O	9.37-9.38	Standby Rescuers to have performed drills in this area, otherwise conduct drill before starting work.
	5.13	Notify Rescue personnel before workers enter and again when workers complete work unless agreement is for 24 hour service. Ensure rescuers monitor the signalling system.	√	O	9.39 9.40	Follow agreed protocol with rescuers. Generally must have rescuers on standby at entrance with Fire Dept. considered backup.
	5.14	No cylinders of compressed gas inside confined space.	√	S	9.48	Inspection item.
	5.15	Welding/Cutting torches and hoses must be removed when not in use.	√	S	9.49	Inspection item.
	5.16	Ensure electrical tools & equipment meets WORKSAFEBC 9.50	√	S	9.50	Inspection item.
	5.17	Use only non-sparking tools if flammable/explosive gases, vapors or liquids are present.	√	S	9.51	Inspection item.
	5.18	Provide means of communication – radio for workers inside confined space.	√	O		Inspection item.
	5.19	Ensure rescue equipment is inspected by Qualified Person before each use.	√	S		Contractor to ensure inspection and document.
		Note: Follow Confined Space Entry program details as inspection guideline. These must be agreed with Rescuer personnel.	√	O		

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

APPENDIX A

Project Title: Master. **Project No.**

LOCK-OUT & ELECTRICAL	6.1	Has the EGD Lockout policy been reviewed and relevant sections complied with?	√	S		Policy to be reviewed by Contractor with workers as part of training.
	6.2	Each worker has own lock, no combination locks? Means of identifying lock owner?	√	O	PART 10	Every worker must have own lock and tag identifying worker and company.
	6.3	Lockout procedures documented for project?	√	O	PART 10	To be documented and agreed with J. Lezetc and permit issued before initiating lockout.
	6.4	Workers and Supervisors trained in lockout? Only certified electricians to do electrical work.	√	O	PART 10	Contractor to ensure all Workers and Supervisors are trained in the lockout procedure. Contractor to provide proof of certification to Project Manager before start of work.
	6.5	All isolation points identified?	√	S	PART 10	To be done in conjunction with J. Lezetc and documented in lockout procedure.
	6.6	Electrical ground hazard?	√	S		To be done in conjunction with J. Lezetc and documented in lockout procedure.
	6.7	Pneumatic Devices hazard?	√	S		Document if this type of hazard exists and controls required.
	6.8	Potential Energy hazards? All parts secured against inadvertent movement?	√	S		Document if this type of hazard exists and controls required.
	6.9	Kinetic Energy hazards? All parts secured against inadvertent movement?	√	S		Document if this type of hazard exists and controls required.
	6.10	Hydraulic Energy hazards?	√	S		Document if this type of hazard exists and controls required.
	6.11	Chemical Energy hazards (eg. Flammable, Combustible, corrosive) ?	√	S		Document if this type of hazard exists and controls required.
	6.12	Radiation hazards (eg microwave, lasers, Ultraviolet, infrared)	√	S		Document if this type of hazard exists and controls required.
	6.13	Thermal Energy hazards (eg, steam, hot water or other substances, refrigeration lines)	√	S		Document if this type of hazard exists and controls required.
	6.14	If over 750V follow H.V. guidelines in lockout policy.	√	O		Document if this type of hazard exists and controls required.
	6.15	No working NEAR energized H.V. equipment or conductors.	Not permitted	S	Lockout Policy	Not permitted.
	6.16	No working on <u>energized</u> lighting circuits.	Not permitted	S	Lockout Policy	Not permitted.
	6.17	Control the use of metal ladders, wire reinforced ladders,, metal scaffolds or work platforms.	√	S	19.10	Planned use of ladders, scaffolds etc. to be determined with Contractor and electrical risks assessed.
	6.18	No Qualified workers within 1 m. of uninsulated, energized parts.	Not permitted	S	Lockout Policy	Not permitted. Keep unqualified personnel at least 3 m. from energized parts.

	6.19	**If using an insulated aerial device has it been tested as required by WORKSAFEBC Reg. 19.9**	√	**S**	**19.9**	**Check plans to use aerial device & insure compliance.**
	6.20	**Is all portable electrical equipment either double insulated and so marked or effectively grounded? Workers trained to inspect?**	√	**S**	**19.14**	**Contractor to check any portable equipment and ensure workers trained in inspecting electrical equipment for safe operation.**
	6.21	**Is all portable electrical equipment used outdoors or in wet/damp conditions protected by Class A Type ground fault circuit interrupters?**	√	**S**	**19.15**	**Contractor to check any portable equipment and ensure workers trained in inspecting electrical equipment for safe operation.**
	6.22	**Ensure good access to electrical equipment and that no flammable materials are stored or placed close to electrical equipment.**	√	**O**	**19.7**	**Practice good housekeeping. Keep areas clear in front of electrical panels, fire alarms & extinguishers. No flammables inside work areas unless agree by Project Manager.**
	6.23	**Other, specify:**				
	6.24	**Are lockout points easily identifiable (e.g. By number) to prevent lockout errors and identify the equipment it serves?**	√	**S**	**19.13**	**All lockout points are labelled.**
	6.25	**Note that lockout of a panel door preventing access to other live breakers is unacceptable.**	√	**S**		**Generally there should be no other users of panels while the project work is underway. Confirm.**
	6.26	**Note lockout of Control Circuits is not sufficient for total isolation.**	√	**S**		**Reminder item**
	6.27	**Be SURE to understand what will happen if an energy source is activated.**	√	**S**		**Reminder item**
	6.28	**Consider severity of injury, frequency of doing the job and probability of injury in assessing tasks.**	√	**S**		**Reminder item**
	6.29	**Before the conclusion of the job and after energizing, have conspicuous signs been placed near the equipment stating "Danger – Energized Equipment"?**	√	**O**	**19.11 19.17**	**Place signs when finished.**
	6.30	**Ensure electrical instrumentation is functioning properly and has not been the subject of recall by the manufacturer.**	√			**Note that some Fluke Model 179 Multimeters have exhibited faulty readings and need to be replaced.**

Project Title: **Master.** **Project No.**

FALL PROTECTION	7.0	Fall Protection required?	√	S	11.2	1.Work over 7.5 ft. (CLC requirement) or shorter distance if risk of injury greater than fall to flat surface 2.Use guardrails or similar restraint if practicable. 3.Use other fall restraint if 2 not practicable. 4.If 3 not practicable use fall arrest system 5.If 4 not practicable ensure work procedures acceptable to WORKSAFEBC are used. Note changes to WORKSAFEBC regulations 1 Jan/05
	7.1	Fall Protection System defined in writing?	√	S&O	11.3	Contractor to define fall protection plan for any work over 7.5 ft. (CLC requirement) above ground on unguarded surfaces from which fall greater than 7.5m.(25ft) can occur or 11.2(5) applies.
	7.2	Workers & Supervisors Trained?	√	S&O	11.2(6)	Contractor to ensure all workers & supervisors trained in fall protection procedures before work starting and provide documentation to Project Manager.
	7.3	Workers trained & Fall Protection Procedures followed?	√		11.2(6)	Inspection item.
	7.4	Inspection of fall arresting equipment before each use by a qualified person being done?	√	S	11.9-	Qualified Person to perform inspection before use on each shift. Keep free from foreign substances & conditions that can contribute to deterioration & keep in good working order.
	7.5	Fall Protection System used?	√	S	11.2(7)	Ensure workers use system
	7.6	Safety Belts used for fall restraint only? Otherwise use body harness.	√	S	11.4	Follow written fall protection plan.
	7.7	Ensure equipment meets standards	√	S	11.5	Ensure components are suitable and compatible, sufficient to support the forces and meet and are used in accordance with standards.
	7.8	Ensure anchors meet standards	√	S	11.6	Check anchors meet WORKSAFEBC requirements. Changed 17 May/06
	7.9	Temporary horizontal lifeline system used?	√		11.7	Acceptable if 1) manufactured for commercial use and installed and used per written instructions and drawings (available on site) 2)designed, installed & used per written instruction and drawings (available on site) certified by P.Eng. 3) other acceptable to WORKSAFEBC Changed 17 May/06
	7.10	Need to remove from service?	√	s	11.10	If fall protection system has arrested fall of a worker remove from service until inspected and recertified safe by manufacturer or P.Eng.

Project Title: Master. **Project No.**

FIRE RELATED	8.1	Workers aware they generally do not fight fires? First priority is to raise the alarm and get selves and others to safety.	√	*		Workers to fight fires only if small (2'x2') and they have been trained in fire extinguisher use and they are confident they can extinguish the fire. To be reinforced at orientation meeting and reinforced by Contractor.
	8.2	Fire Extinguishers Available and accessible?	√	O		Contractor to ensure proper type and number of extinguishers available. Check monthly inspection and tags.
	8.3	Electrostatic Discharge	√	O		Contractor to determine risk of ignition due to discharge and take preventive measures.
	8.4	Ignition Sources eliminated or controlled if flammable gas or liquid used or stored?	√	O	5.27	No smoking on this project except in designated areas defined by Project Manager. Define any other ignition sources and controls required.
	8.5	Flammable gas concentrations	√	S&O		Ensure adequate ventilation to comply with WORKSAFEBC regulations. Monitor flammable gas concentrations and use forced ventilation if required.
	8.6	Combustible materials	√	O		Keep area clear of combustibles. Practice good housekeeping. Store oily rags in approved metal containers with tight fitting lids and empty daily. Burning of waste is prohibited.
	8.7	No smoking in buildings, on cranes, in caissons or tunnels. Define other restrictions. Rules being followed?	√	O	4.81	Contractor to enforce no smoking except in areas designated by the Project Manager.
	8.11	Do not use flammable liquids as a manual cleaning solvent.	√	S	5.32	Flammable fumes can collect on clothes and result in the worker being engulfed in flames should ignition occur. Also, these substances are often hazardous to health and can be absorbed through the skin. Contractor to reinforce with workers and monitor for compliance.
	8.12	Hot Work Permits issued and posted?	√	*		Obtain permit from Project Manager before starting any cutting, welding, brazing, soldering, grinding, heat-treating or other hot work like roof tarring, thawing pipe, hot riveting or using powder-driven fasteners.
	8.13	Fire Alarms explained?	√	*		To be covered at pre-startup meeting and worker orientation session.

Project Title: Master. **Project No.**

LADDERS/SCAFFOLDS & TEMP WORK PLATFORMS	9.0	Is work off ladders/scaffolds etc planned? Note new guidelines Nov/08 re suitable ladders, work platforms, and scaffoldings, and to specify that the top plate of interior or exterior walls, the top plate/top walers used in concrete formwork, or other elevated surfaces narrower than 50 cm (20 in) are not considered suitable work platforms or acceptable as elevated walkways.	NA	S		No work off ladders/scaffolds foreseen.
	9.1a	Workers trained and authorized to use temporary work platform?	√	S	COSH 3.5	Ensure all workers trained before authorizing use.
	9.1b	Weather conditions likely to be hazardous to use of temporary structure?	√	S	COSH 3.3	No work in rain, snow, hail or electrical/wind storm likely to be hazardous to worker safety
	9.2	Has Qualified Person inspected temporary structure before use each shift?	√	S	COSH 3.6	If defect found, do not use until remedied.
	9.3	Could temporary structure be contacted by person or vehicle?	√	S	COSH 3.7	Install hi-viz barricade around base or post a person.
	9.4	Ladder type and condition? Meet specifications per WORKSAFEBC?	√	S	PART 13	Contractor to ensure all ladders are in good condition and meet WORKSAFEBC requirements for the application. Ensure portable ladders are marked with grade of material and use for which ladder constructed.
	9.5	Ladder Inclination, Footing and Support and use according to WORKSAFEBC regulations	√	S	PART 13 COSH 3.11	Check for minimum ¼ maximum 1/3 inclination, solid footing and support. Projects at least 1m(3ft.) above upper landing to which it supplies access. Check extension overlap. Tie off if possible for stability during use.
	9.6	Contractor to ensure work off ladders meets regulations. If work cannot be done safely from a ladder provide work platform.	√	O	13.6	Follow safe ladder work practices
	9.7	Heavy/bulky objects or others that may make ascent or descent unsafe not to be carried up ladders	√	O	13.6	Use an assist to raise & lower tools.
	9.8	Scaffold or other work platforms to be designed and approved by a P.Eng.?	√	S	Check WORKS AFEBC PART 13 13.11	Contractor to provide P.Eng. certified scaffolding plan where required by regulation 13.11. Follow instructions including fall protection during erection/ dismantling and use of the system. Signed copy to be available on site.

Project Title: Master. Project No.

	9.9	Employer must ensure scaffold is in a safe condition regardless of who erected it. Ensure scaffold manufacturer's technical data & instructions for erection available on site.	√	O	13.13, 13.15 COSH 3.10	Ensure manufacturer's documentation is on site or follow P.Eng. instructions. Contractor ensure compatibility if different manufacturers of components used. Ensure qualified Person supervises erection, use and dismantling and scaffold capable of holding 4 times load likely to be imposed. (COSH)
	9.10	Guardrails and toe boards installed at every open edge of platform?	√	S	4.55-4.60 COSH 3.8	Ensure guardrails and toeboards installed
	9.11	Tools/equipment/materials arranged to prevent being accidentally knocked off platform?	√	S	COSH 3.4	Ensure safe arrangement on platform
	9.12	Check Scaffold Stability, Bracing, Access and all connections secure.	√	S	13.17 13.18	Ensure scaffold is stable, plumb and level and WORKSAFEBC requirements are met. If height 3 times min. base dimension or other circumstance requiring stability- bldg ties/guys required. Inspection item.
	9.13	Plank type & condition inspection. Planks secured?	√	S	13.14 13.16	Contractor Inspect planks regularly and secure to scaffold frame. Dimensions and guardrails meet requirements?
	9.14	Scaffold grounded if near high voltage or hazardous level of voltage likely to be induced in scaffold?	√	S	13.19	Ensure grounding. Inspection item
	9.15	Safe access provided to work platform?	√	S	13.7 COSH 3.9	Provide safe access. Temporary stairs have uniform steps, slope not exceeding 1.2 in 1; hand-rail between 90 and 110cm above stair level. Ensure temporary ramps securely fastened; safe footing, braced if necessary; slope l in 3 except in stairwells check COSH Inspection item
	9.16	Work platform strength sufficient for load and secured against separation form supporting equipment, structure or surface?	√	S	13.8	Ensure scaffold can support 4 times load likely to be imposed on it (COSH 3.10)
	9.17	Work platform subjected to sudden drop, contact with electrical conductors or showing signs of mechanical damage/wear?	√	S	13.12	Remove from service until certified safe by manufacturer or P.Eng.
	9.18	Ensure movable work platforms are clearly marked with rated capacity	√	S	13.20	Also check for marking on components (e.g. rigging capacity, counterweight, etc.) as required by regulations
	9.19	For elevating work platforms ensure operation manual, maintenance instructions, replacement parts information are reasonably available to workers.	√	S	13.21	If information is not available, equipment must not be used until obtained or written instructions provided by P.Eng.

	9.20	Employer must keep records regarding inspection, maintenance, repair or modification for each elevating work platform, swing stage, and permanent powered platform	√	S	13.22	If inspection and maintenance records other than pre-shift inspections not available, do not use until certified safe by manufacturer or P.Eng.
	9.21	Vehicle-mounted and self-propelled boom-supported elevating work platforms tested?	√	S	13.23	Inspect and certified by manufacturer or P.Eng. every 12 months. In 10th year after manufacture & every 5 years thereafter include structural inspection to verify integrity and stability. Dielectric test insulated units at least annually- certified by testing agency.
	9.22	If a movable work platform is not designed to be moved while a worker is on it, ensure it is secured before being accessed by the worker. Move platforms designed to be moved while occupied only as specified by the manufacturer.	√	S	13.24	Exceptions: If the height of the work platform of a rolling scaffold is: (a) not more than 1 1/2 times the least base dimension of the scaffold, the scaffold may be moved by the effort of the person occupying the platform or a person on the floor or other supporting surface, (b) more than 1 1/2 times the least base dimension of the scaffold, the scaffold must be moved only by the effort of a person on the floor. (c) more than 2 times the least base dimension of the scaffold, the scaffold must not be moved while the person is occupying the platform
	9.23	Elevating work platform meets requirements for warning devices and controls?			13.25 13.26	Ensure intermittent horn or flashing light and warning system for deviation from level are provided as required by regulation. Ensure controls including STOP are clearly marked. Clearly mark overriding lowering control to be used in emergency.
	9.24	Guardrails installed? Ensure temporary guardrails meet specs.	√	S	4.58	Contractor to ensure guardrails are installed and meet regulations. Inspection item.
	9.25	Forklift mounted work platform not to be used except as defined by WorkSafeBC regulation.	√	S	13.30	Check revised regulations 1 Feb/08. Inform Project Manager before using a forklift mounted platform.
	9.26	Work platforms suspended from a crane or hoist must be certified and loaded weight including rigging not over 50% of crane/hoist rated capacity at the working radius or configuration.	√	S	13.27-	Boom must be powered or fixed. No platform suspended from articulating boom crane unless approved by manufacturer. Secondary hoisting line must not be used when workers are on platform suspended from a crane.

	9.28	Hoisting and lowering work platforms done according to safe practices?			13.29	Operate as slowly as practicable. Lower under power if device powered. May not be controlled only by brakes. Ensure lower travel limit device is used where required. Carry out a trial lift before platform is occupied.
	9.29	Portable powered platform capable of raising/lowering by 2 or more separately controlled hoists?			13.31	Ensure controls located so one person can operate all hoists simultaneously.
	9.30	Ensure fall protection meeting WORKSAFEBC requirements is in place for suspended or elevating work platforms	√	S	13.33	Include in fall protection plan. Each person on a work platform attached to a crane boom must use a personal fall arrest system secured to an anchor on the boom or on the platform that is designated by the manufacturer, or a professional engineer.
	9.31	WORKSAFEBC approval obtained for high risk situations?	√	S	13.32	A swing stage, boatswain's chair and portable powered platform must not be used without prior permission of the Board if (a) one work platform will be used above or below any portion of another work platform, (b) a deck or planking will be used to span a gap between two independent work platforms, (c) the work platform will exceed 10 m (32 ft) in length, or (d) the suspension height will exceed 91 m (300 ft).
PROTECTIVE EQUIPMENT	10.1	Hard Hats Worn at all times. Chinstraps available for high wind/ bending over?	√	*	8.11-8.13	Contractor to monitor and enforce hardhat and chinstrap usage.
	10.2	High Visibility Clothes, correct type for the job.	√	O	8.24-8.25	Wear high viz vests when required. Traffic Control Persons will have special requirements.
	10.3	Approved Buoyancy Equipment (note change in acceptable standards G8.27-2)	NA	O	8.26-8.30	Required if working within 5 feet of water.
	10.4	Safety Footwear	√	*	8.22-8.33	Approved steel-toed footwear in good repair, required at all times meeting WORKSAFEBC requirements for the work to be performed.
	10.5	Approved Safety Eyewear/ Face Shields. Note new guidelines re acceptable standards Nov/08	√	O	8.14-8.18	Eye protection required when energizing and de-energizing breakers. Also when doing any other work where flying objects may be encountered. Also may be required when using hazardous substances (TBD).
	10.6	Wear Hearing Protection when required by WORKSAFEBC regulations.	√	O	7.1-7.9	Hearing protection required when in high noise situations exceeding WORKSAFEBC noise exposure limits. Implement and provide evidence of noise control and hearing conservation program where required by regulation. Post warning signs in high noise areas.

	10.7	Respiratory Protection & Fit	√	O	8.32-8.37	Wear approved respiratory protection considering the respirator protection factor and maximum use concentration, MSD Sheets, exposure to oxygen deficient atmosphere when selecting respirators for workers that may be exposed to dusts or hazardous fumes/mists above exposure limits.
	10.71	Respirator fit tests conducted?	√	O	8.38-8.41 8.44	Ensure proper fit tests per regulations and keep records. Workers must perform a positive or negative pressure user seal check in accordance with *CSA Standard before each use.*
	10.72	Worker's ability to use a respirator in doubt for medical reasons?	√	O	8.42	Ensure worker examined by a physician, and advice obtained re the ability of the worker to wear a respirator.
	10.73	Self Contained Breathing Apparatus (SCBA) used?	√	O	8.35 8.37 8.45	Ensure air quality complies with regulation 8.37. Ensure inspection and testing of compressed air cylinders must be done in accordance with *CSA Standard* and SCBA, including regulators, are serviced and repaired by qualified persons.
	10.8	Gloves, Aprons, leg protection	√	O	8.19-8.21	Wear protective clothing when performing work that could result in cuts, slivers, abrasions, etc. Check added requirements from MSD Sheets.
	10.9	Flame resistant clothing	√	O	8.31	Wear when welding or cutting or other hot work hazards
	10.10	Welding Goggles	√	O		Wear when welding or cutting
	10.11	Welding Clothes (e.g. leather aprons, face shields, leather gauntlet gloves etc.)	√	O		Wear when welding or cutting. Also those working nearby may need to wear protective clothing.
	10.12	Vibration Reduction	√	O	7.10-7.16; 5.54	Provide written exposure control plan where required by regulation and inform worker of hazards. Employer ensure equipment is labelled to identify hazard. Ensure hands and arms not exposed to cold if also exposed to vibration.
	10.13	Radiation Exposure Control	√	O	7.17-7.25	Provide written exposure control plan where required by regulation and inform worker of hazards.
	10.14	Personal clothing, rings, hair etc. OK	√	O	8.10	Ensure workers do not have loose clothing, long hair or rings which could become entangled if operating rotating power tools.
	10.15	Apply Sunscreen, to protect against sunburn on exposed skin.	√	O		Wear sunscreen when working outdoors.
	10.16	Safety belts, harnesses, lanyards & shock absorbers	√	O		Follow fall protection plan and use prescribed equipment.
	10.17	Employees must wear suitable personal clothing for the work they are doing to reduce risk of injury.	√	S		Contractor to ensure workers wear suitable clothing.

Project Title: Master. **Project No.**

		Note: Check all protective equipment for proper fit and condition.	√	S		Contractor responsible for ensuring proper fit and care of all protective equipment and documentation thereof.

HEAT STRESS	11.1	Heat Stress Control Required? Followed?	√	S	7.27	To be determined by Contractor's Superintendent based on section 7 WORKSAFEBC regulations (Jan/05), weather conditions, and worker proximity to heat sources and clothing worn.
	11.2	Check for heat stress if temp warrants.	√	S	7.28- 7.30	Contractor to monitor environmental conditions and take action accordingly if ACGIH standard requires. If required, conduct assessment and develop exposure control plan. Provide engineering controls if practicable, otherwise reduce exposure or provide admin controls or PPE.
	11.3	Potable drinking water nearby?	√	O	7.31	Contractor to supply adequate drinking water for Workers
	11.4	Workers & Supervisors trained to recognize?	√	O	7.32	Contractor to ensure Workers and Supervisor recognize symptoms and know proper response. Contractor's F.A. attendant to be instructed to monitor workers for signs. Remove workers exhibiting stress from exposure and provide First Aid or physician treatment.
COLD STRESS	12.1	Cold Stress Control Required? Followed?	√	S	7.33	Cold stress not likely to be a factor during summer months. Contractor to be aware of conditions under which cold stress could be a concern based on ACGIH standard (Jan /05)
	12.2	Check Table 7-4 for conditions	√	S	7.34- 7.37	Contractor to monitor for cold stress risk conditions and take appropriate action. if ACGIH standard requires. If required, conduct assessment and develop exposure control plan. Provide engineering controls if practicable, otherwise reduce exposure or provide admin controls or PPE.
	12.3	Workers & Supervisors trained to recognize?	√	O	7.38	Ensure workers trained. First Aid attendant may be asked to monitor for cold stress. Remove workers exhibiting stress from exposure and provide First Aid or physician treatment

Project Title: **Master.** **Project No.**

CRANES, HOISTS & RIGGING	13.1	Note WorkSafeBC definitions for “critical lift” “duty cycle work”, “load bearing component”, “sign truck” and “tandem lift”	√	S		Changes effective 1 Feb./08 to add clarity.
	13.1a	Only EGD Operators operate EGD Cranes/hoists or other equipment.	√	*		No plans to use any EGD equipment. Contractor to reinforce that only EGD workers are to operate EGD equipment.
	13.1b	Contractor supplied crane meets specifications and has required labelling etc per WORKSAFEBC regulation?			14.2-14.8	Ensure crane is marked with: a) Manufacturer, model, sr# b)rated capacity or load chart. c)boom angle, boom extension and load measure (where applicable) d) any modifications to the crane or components
	13.1c	Crane Hoist documentation available?			14.12	Ensure manufacturer’s crane/hoist manual, including instructions for assembly/disassembly, maintenance, and safe operation are readily available on site.
	13.1d	Inspection and maintenance carried out and documented including any modifications? Operator to carry out start of shift inspection and document.	√	S	14.13 to 14.16 14.35	(1) Each crane and hoist must be inspected and maintained at a frequency and to the extent required to ensure that every component is capable of carrying out its original design function with an adequate margin of safety. (2) A crane or hoist must not be used until any condition that could endanger workers is remedied. (3) Any repair to load bearing components of a crane or hoist must be certified by a professional engineer or the original equipment manufacturer.
	13.1e	Crane properly equipped?			14.17 to 14.33	Ensure crane/hoist meets all WORKSAFEBC requirements for stops, audible warnings, guards, controls, operator protection, etc. as per WORKSAFEBC regulations
	13.2	Weight lifted determined and communicated to operator and all others involved in lift?	√	O	14.36 14.38	Contractor to ensure that load weights are accurately determined and communicated to the crane operator and others involved. Crane operators must not lift if there is any doubt about the safety of the lift.
	13.3	Ensure crane operators meet the trade qualification specified by WORKSAFEBC	√	S	14.34	Provide proof of qualification to Project Manager before starting work.
	13.4	Ensure workers stay clear of swinging loads and equipment when swinging creates a hazard	√	O	14.40 14.41	Position equipment to ensure 2 ft. clearance or more between crane parts etc. and obstructions in any area accessible to workers.
	13.5	Multiple Crane lift? Follow WORKSAFEBC regs	NA	S	14.42	No multiple crane lifts planned.
	13.6	Travel with load? Follow WORKSAFEBC regs.	√	S	14.43	Follow safe practices.

	13.7	Prevent passing over workers with load	√	O	14.44	Contractor to ensure loads do not pass over workers.
	13.8	Load left suspended and unattended?	√	O	14.45	Do not leave loads suspended & unattended.
	13.9	Hook position over load to prevent side loading?	√	O	14.46	Ensure straight lifts are used. If lifts on an angle are necessary observe working load limit (WLL) reduction.
	13.10	Designated signalman? Use std signals? Use radio if possible.	√	O	14.47 to 14.49	Ensure trained workers use standard signals when communicating with crane operator. Use dedicated 2-way radio communication on UHF at power assigned and coordinated by the WORKSAFEBC whenever possible.
	13.11	High voltage in vicinity? Risk of induced charge? Review and follow WORKSAFEBC requirements.	√	O	14.51-14.52	No lifts planned near high voltage.
	13.12	Up-travel limit tested for bridge, gantry & OH traveling cranes? (crane operator daily check)	√	O	14.55	If crane/hoist is not EGD operated equipment, Contractor to ensure operator has tested limits.
	13.13 a	Ensure mobile cranes are on surface capable of supporting the load	√	S	14.69	Contractor to check before lift.
	13.13 b	Mobile cranes or boom trucks inspected at least annually?	√	S	14.71	Ensure mobile cranes or boom trucks are inspected at least annually. Provide proof to Project Manager.
	13.14	Rigging/slinging work done by or under direct supervision of qualified workers familiar with the rigging to be used.	√	S	15.2	Contractor to use trained riggers following accepted good practices when performing lifts and provide a list of trained individuals to the Project Manager.
	13.15	Ensure rigging is identified with the manufacturer and Working Load Limit (WLL) as well as any other information required by WORKSAFEBC and meets the WORKSAFEBC requirements for the work to be performed.	√	O	15.5 15.42 15.46 15.55 15.59	Do not use rigging without proper permanent identification. DO NOT EXCEED the designated WLL; also applies to below-the-hook lifting devices.
	13.16	Use only rigging permanently marked with an adequate working load limit considering the angle of lift, termination efficiencies, numbers of legs used, conditions for the lift, temperature restrictions and good rigging practices.	√	S	15.9	Follow good rigging practices. Ensure design factors comply with changes Jan/05.
	13.17	Ensure any attachments (rings, shackles, couplings etc) are designed for use with the rigging to which they are fastened.	√	S		Contractor to ensure compatibility in design.
	13.18	Slings & attachments must conform with specifications and be visually inspected before use on each shift.	√	S	15.30 15.31	Remove defective equipment from service immediately.
	13.19	Do not subject the rigging to dynamic loading.	√	S		Apply the load slowly & smoothly

Project Title: Master. **Project No.**

	13.20	Do not use rope/slings with evidence of wear or distortion, broken strands, kinking, bird-caging, corrosion, heat or arc damage that meets the rejection criteria specified by WORKSAFEBC.	√	S	15.25-15.27 15.48-.49	Remove equipment from service immediately if it meets rejection criteria.
	13.21	Do not use worn or damaged hooks that fail to meet WORKSAFEBC regulations.	√	S	15.29	Remove rejected hooks from service immediately.
	13.22	Protect slings from damage if passing over a sharp edge and store properly.	√	S	15.37 15.39	
	13.23	Follow WORKSAFEBC rules for slinging to prevent slipping or overstressing the sling and when lifting multiple piece lifts.	√	S	15.40 15.41	
	13.24	Hooks must have safety latches unless meeting the exemption of WORKSAFEBC 15.10(2)	√	S	15.10	
	13.25	Consider effect of wind on loads	√	S		Crane operator to use judgement and consider wind velocity in determining if lift can be safely made. Crane operator has final decision on making any lift.

MOBILE EQUIPMENT & TRANSPORT OF WORKERS	14.1	Does the contractor intend to use any mobile equipment on site other than trucks for transporting workers?	TBD	S	PART 16	To be determined. Define equipment to be used and any special requirements.
	14.2	Are contractor's vehicles safe for transport of worker's?	√	S	16.3	Contractor to ensure vehicles are properly equipped and maintained.
	14.3	Are workers obeying speed limits? Max speed 20kph	√	*	PART 16	Cover at start up orientation meeting.
	14.4	Are vehicles properly parked?	√	*	PART 16	Workers will be shown the designated parking areas. Do not park in areas where crane travels, Fire Lanes, blocking fire hydrants, fire/emergency alarm pull stations or fire extinguishers.
	14.5	Elevating work platform(s) operations manual and inspection certificate on site? Daily inspection log available?	√	S	PART 16	Requirements depend on contractor use of this type of equipment. TBD in final JHA
	14.6	Ensure seat belts used and roll over protection provided if required. Note guidelines Nov./08	√	O	PART 16	Requirements depend on contractor use of this type of equipment. TBD in final JHA
	14.7	Suspended work platforms/chairs used? Conform to specifications? Verify engineering design. Support structures in place?	NA	S	PART 16	Generally, not planned to be used. Check WORKSAFEBC regulations if suspended platforms to be used.

Project Title: **Master.** **Project No.**

	14.8	Do not leave delivery vehicles unattended for extended periods.	√	*		
	14.9	Do not hitch a ride on forklifts unless proper seats exist for this purpose.	√	*		Contractor to enforce.
	14.10	Ensure volatile, flammable, or hazardous materials transported in isolated compartment accessible only from outside & properly ventilated & drained	√	S	17.6	Contractor to ensure vehicles meet WORKSAFEBC requirements.
	14.11	Ensure tools/materials/ equipment are carried in separate designated area for that purpose.	√	S	17.5	Contractor to ensure workers cannot be injured by unsecured items in the vehicle.
	14.12	Equipment properly secured if elevated? No use of hydraulic or pneumatic lifts as blocks unless collapse not possible.	√	S	16.37	Ensure workers do not leave equipment parts unattended in an elevated condition or work under equipment unless properly secured.
	14.13	Loads secured according to regulations? Loads do not interfere with lift truck operation?	√	S	16.44-16.46	Contractor to ensure loads are properly secured.
	14.14	Workers have procedures, equipment and training for tire repairs?	√	S	16.47 16.48	Contractor to ensure workers have training & equipment if they will change tires.

TRAFFIC CONTROL	15.1	Is there any blocking of roadways, or aisles during the project? If so install signs, barricades etc.	√	S&O		Define road blocking and traffic control requirements. Contractor to ensure proper traffic control if temporary road blocking is required to deliver materials etc. Contractor to ensure non-project personnel are kept out of the work area as agreed with the P.M. before starting work.
	15.2	Will gantry crane travel through the work area? Coordinate with the crane supervisor.	√	*		Workers to be instructed regarding crane travel and alarms during pre-startup meeting as they may encounter them enroute to work location. Ensure work is planned and communicated to crane supervisor before start.
	15.3	Is there operations activity near the project site? Ensure coordination and minimize impact.	√	S&O		The Engineer will ensure all supervisors and contractors on site are aware of the work and schedule.
	15.4	Control boat traffic and ensure flags and markers are in place.	√	S&O		Provide controls if working near water.
	15.5	Is there a need to protect Public Roadways? Review WORKSAFEBC PART 18.	√	S&O	PART 18	Define need and document special traffic control measures. Ensure traffic control plan prepared by a qualified person is in place meeting MoTH requirements and WORKSAFEBC regulations. NOTE changes effective 1 Jan/07

Project Title: Master. Project No.

	15.4	Is there a defined inspection program for traffic control devices to ensure they are well maintained and effective under all weather and light conditions? Documentation of inspections & repairs made kept?	√	S&O		Contractor to define an inspection program including repair/replacement procedures, inventory of devices, Contractor to ensure documentation is maintained including follow-up to ensure work has been done.
	15.5	Are pavement markings clear and old markings removed?	√	S&O		Ensure markings are clear and not confusing. Remove old markings.
	15.6	Are markings removed/covered when not in use?	√	S&O		Contractor to ensure markings are removed/covered when not required.
	15.7	Is there an individual assigned supervisory responsibility for traffic control?	√	S&O		Contractor to assign an individual. Ensure all workers and supervisors are trained in safe work requirements and supervisors ensure workers follow prescribed procedures.
	15.8	Are Traffic Control Persons trained?	√	S&O		Contractor to ensure only trained individuals engage in traffic control and that they have written instructions. Provide proof of completion of MoTH approved course.
	15.9	Has the Contractor kept records of changes in traffic control?	√	S&O		Contractor to maintain records to assist investigation in event of an accident.
	15.10	Are there risks to workers due to vehicles/equipment operating on the construction work site?	√	S&O		Contractor to define risks to workers on the construction site due to vehicles and measures to minimize risks of injury. Risks to employees of other companies to be acknowledged, minimized and communicated to appropriate supervisors.

EVACUATION & RESCUE	16.1	Written procedures developed?	√	S&O	4.13	Contractor to ensure need for emergency rescue assessed and procedures for rescue documented. Call 911. Rescue will be by DND/Esquimalt Fire Dept. Ensure all workers understand process to call for assistance and have emergency numbers. Review emergency procedures at orientation session.
	16.2	Simulations/ Training completed?	NA		32.2	Fire Dept. Rescuers are trained.
	16.3	Equipment warranted or P.Eng. certified?	NA		32.3	Fire Dept. responsibility
	16.4	Rope suitable per std.?	NA		32.4	Fire Dept. responsibility
	16.5	Visual & physical inspection by qualified workers after use or training?	NA		32.5	Fire Dept. responsibility
	16.6	Maintenance per manufacturer & records kept?	NA		32.6	Fire Dept. responsibility
	16.7	At least 1 on rescue team Level 1 F.A. Certificate?	NA		32.7	Fire Dept. responsibility
	16.8	Communications between rescuers & support?	NA		32.8	Fire Dept. responsibility

	16.9	Rescue boat available? Buoy & rope? Sufficient rescuers?	NA		32.9	

DIVING/ MARINE OPERATIONS	17.0	Diving /Marine Operations?	NA	S		No diving or marine related work on this project.
	17.1	Wharf ladders & condition?	√	O	24.2	Ladders are available every 100 feet.
	17.2	Marine lifesaving equipment available & condition?	√	S	24.3	Contractor will supply own PFD's and other rescue equipment per Part 24 WORKSAFEBC regulations.
	17.3	Handrails, bullrails, & markings?	√	S	24.4-24.5	
	17.4	Notice of Project submitted for diving projects?	√	S	24.9	Required.
	17.5	Rescue boat available if required for rescue or evacuation?	√	S	24.6 24.31	Contractor will supply rescue boat and sufficient rescuers.
	17.7	Medical Certification for each diver available at dive site?	√	S	24.10	Required.
	17.8	Diving supervisor approves diver as being physically capable of diving?	√	S	24.11	Required.
	17.9	Divers, standby divers and tenders not fatigued or have consumed drugs/alcohol which could impair their ability to work safely	√	O	24.11	Sufficient divers available to prevent fatigue and ensure ability to work safely?
	17.10	All divers, diving supervisors and diving tenders trained in CPR, oxygen therapy and diving accident management?	√	S	24.12	Entire crew trained and certified?
	17.11	Certified competency documents available for each diver at the site?	√	S	24.13	Included in divers logs?
	17.12	Current chronological dive logs available on site for each diver?	√	S	24.14	Available for each diver?
	17.13	Dive site has list of hyperbaric chambers?	√	O	24.15	Available? Nearest is still at DND across the bay?
	17.14	Dive site has location of nearest hospital and phone # ?	√	O	24.15	Record on dive plan document.
	17.15	Dive site has Level 1 F.A. kit and an oxygen therapy unit of sufficient capacity to reach emergency services?	√	O	24.15	Required.
	17.16	Dive site has complete set of approved dive tables (not sport type)? Diving computers must not be used instead of tables.	√	O	24.15 24.21	Required

Project Title: Master. **Project No.**

	17.17	Dive site has copy of WORKSAFEBC reg. PART 24?	√	O	24.15	Required
	17.18	Is there an appropriate way of entering and leaving the water, including rescuing an incapacitated diver?	√	O	24.15	Contractor to document in rescue plans.
	17.19	Dive site has equipment for voice communication with emergency services personnel?	√	O	24.15	Radio supplied by EGD to supervisor for continuous contact to pumphouse for fast 911 call if required. Work will be 7a.m to 4 p.m. only unless agreed ahead of time with Doug Ferrier.
	17.20	Divers on a lifeline wear suitable harness? Lifelines not attached to weight belt, free of knots & splices.	√	S	24.16	Contractor has proper equipment and will ensure safe usage.
	17.21	Diver tender must tend lines at all times.	√	S	24.16	Agreed by contractor.
	17.22	Diving contractor has safety procedures documented and available at dive site?	√	S&O	24.17	Contractor's safety manual will be on site at all times.
	17.23	Diving supervisor's detailed plan presented in writing to EGD before work starting?	√	S	24.18	Dive plan to be presented to Doug Ferrier and posted.
	17.24	Diving supervisor must not leave the area during diving operations.	√	S	24.19	Entire crew qualified to act as supervisor. Sufficient divers and supervisors will always be in the area during diving operations or no divers will be in the water.
	17.25	Before each dive has the crew briefing been carried out? This will include discussion of hazards, planned duration and maximum depth, decompression procedures, location of other divers, work to be done, recall signals and emergency procedures.	√	O	24.19	A briefing will be carried out ahead of the dives.
	17.26	Divers made aware of their responsibilities under 24.20?	√	O	24.20	Divers responsibilities to be reviewed with them by contractor as part of pre-start meeting. Diving will be one day only.
	17.27	If decompression is required check compliance with WORKSAFEBC regs 24.22- 24.25	√	S		No decompression planned as part of dives. Depth less than 50 ft.
	17.28	Ensure breathing mediums and equipment comply with WORKSAFEBC reg 24.26 to 24.29	√	S		Contractor will ensure compliance.
	17.29	Ensure control of boat traffic and proper warning devices, flags etc.	√	O	24.30	Project manager to ensure ship engines will not be started during this project.
	17.30	If a hoisting device is used to raise or lower the diver dedicated for dive duration?	√	S	24.32	Needs to be defined.

	17.31	Hoist operator takes directions from diver, supervisor or tender only.	√	O	24.32	Needs to be defined.
	17.32	Standby diver required? If so, meets requirements and able to enter water in 1 min.?	√	O	24.33	Required.
	17.33	In event of an accident or incident comply with WORKSAFEBC regs for information and not tampering with equipment.	√	O	24.34	Contractor will comply.
	17.34	Are all hazardous mechanisms secured against inadvertent movement and locked out?	√	S	24.63	Project Manager will ensure no docking/undocking work will take place during this project and that any nearby ship will not start engines.
	17.35	If working near or in an intake /pipe/tunnel/duct comply with WORKSAFEBC reg 24.64	√	S	24.64	Project Manager will ensure no docking/undocking work will take place during this project.
	17.36	If there are exceptional hazards, additional dive team members with independent equipment and capable of effecting rescue must be on site.	NA	S	24.65	No exceptional hazards identified.
	17.37	If diving in contaminated environments comply with WORKSAFEBC reg 24.66	NA	S	24.66	

CONSTRUCTION, EXCAVATION & DEMOLITION	18.1	Protection from falling materials	√	S	20.9	Requirements to be determined in final JHA based on detailed construction plans.
	18.2	Safe access/ egress to worksite? Ramps at least 20” wide with guardrails & cleats.	√	S		Requirements to be determined in final JHA based on detailed construction plans.
	18.3	Temporary Floors	√	S	20.5-20.6	No temporary floors foreseen. Permanent floor will be built first.
	18.4	Fall prevention / protection required? See also group 7 checklist items.	√	O	20.9	Required for all work over 7.5ft on unguarded surfaces (CLC requirement). Fall protection plan required.
	18.5	Chutes	√	S	20.10	Requirements to be determined in final JHA based on detailed construction plans.
	18.6	Glass Panels	√	S	20.12	Requirements to be determined in final JHA based on detailed construction plans.

	18.7	Thrust out Crane landing platforms used?	√	S	20.13	P.Eng. must certify each thrust-out crane landing platform and certify that the building structure can adequately support loads to be imposed by use of the platform. Drawings and certification must be available on site, rated capacity clearly marked on platform and not be exceeded. Control measures acceptable to the Board must be implemented to ensure all loads placed on a thrust-out crane landing platform are safely supported, and can be safely attached to and detached from the rigging. Requirements to be determined in final JHA based on detailed construction plans.
	18.8	Temporary support of partially assembled components adequate?	√	S	20.14	Requirements to be determined in final JHA based on detailed construction plans. Ensure partially assembled components are properly supported and braced including for possible wind loading.
	18.9	All construction details available on site including drawings, erection procedures, temp. bracing, falsework	√	O	20.15	All drawings and specifications will be available on site at the project office. Contractor will also ensure his Superintendent has latest copies on site.
	18.10	Walkways /runways provided on structural members to prevent tripping?	√	S	20.16	Requirements to be determined in final JHA based on detailed construction plans.
	18.11	Plans & specs for Concrete Formwork & Falsework approved by P. Eng.?	√	S	20.17	Requirements to be determined in final JHA based on detailed construction plans.
	18.12	Qualified Supervisor for erection/use of formwork/ falsework? Workers trained in hazards & proper methods?	√	S	20.18	Contractor to ensure Superintendent qualified to install formwork and workers are trained in the hazards and proper methods.
	18.13	Erection drawings, design responsibility, continuity of engineering complies?	√	S	20.19-20.21	PWGSC will ensure continuity of design services.
	18.14	Protruding reinforcing steel removed or guarded?	√	O	20.23	Guard or remove during construction.
	18.15	Worker access restricted under formwork when steel or concrete has just been placed?	√	O	20.23	Requirements to be determined in final JHA based on detailed construction plans.
	18.16	Formwork inspected before pour?	√	O		No pouring until Qualified Supervisor has performed final inspection and OK given.
	18.17	Formwork exhibits any weakness, excess distortion, or undue settlement?	√	O	20.23	Superintendent to monitor and take appropriate action.
	18.18	No loads on uncured concrete except as per dwgs or specs.	√	S	20.23	Superintendent to ensure drawings/specifications followed regarding loading.

Project Title: Master. **Project No.**

	18.19	Erection and temporary bracing of pre-manufactured open web joists and trusses or laminated beams must be according to written instructions from a P.Eng. or the manufacturer detailing safe erection procedures.	√	O	20.72	Contractor to ensure documentation is on site and that all workers have been trained in the prescribed erection procedures before work starting.
	18.20	Ensure crawl boards/ladders used for roof work are securely fastened	√	O	20.74	
	18.21	Work on roofs having slope 8 vertical to 12 horizontal or greater require nailed toeboards in conjunction with personal fall protection or safety nets.	√	S	20.75	Toe-holds must be used if the roofing material allows for it. Note: Exposed horizontal roof strapping may be used as toe-holds as long as it provides safe footing.
	18.21a	Roof edge guarded?	√	S	20.76	The roof edge about a chute, bitumen spout and material hoist must have guardrails meeting the requirements of Part 4 (General Conditions) or barriers of at least equivalent strength to at least 2 m (6.5 ft) on each side of such a work area.
	18.22	Mechanical or powered equipment that has the potential to push or pull a worker over an unguarded roof edge, must not be used unless operated according to procedures acceptable to the Board.	√	S	20.77	Secure WORKSAFEBC approval of procedures if using this equipment.
	18.23	Loose insulation, polyethylene, roofs with smooth surfaces, asphalt and surfaces with water, snow, ice or frost increase the risk of losing footing.	√	S		Work under severe weather conditions will be under the control and advisement of their supervisor
	18.24	Avoid walking backwards on roofs.	√	S		Contractor's Supervisor will advise all workers of safe working practices

EXCAVATION /DEMOLITION	19.0	Excavation work to be carried out?	NA		S	No excavation on this project.
	19.1	Written instructions/ drawings by P.Eng. available for excavation work ?	√	O	20.78	Keep all instructions/ drawings readily available at the site. Train workers to follow instructions.
	19.2	All utilities accurately located & danger determined?	√	S&O	20.79	Contractor to get details on utility location and necessary approvals before digging.
	19.3	Utilities instructions followed regarding excavation?	√	S	20.79	Obtain necessary approvals and instructions.
	19.4	Nearby objects secured or removed if hazardous?	√	S&O	20.80	Ensure any objects are removed as required to meet regulations depending on depth of excavation etc.
	19.5	Sloping/shoring requirements met as defined by P.Eng. or Geoscientist ?	√	O	20.81-	Follow requirements of P.Eng. or Geoscientist

	19.6	Control of water addressed?	√	O		Ensure water in excavation is controlled to prevent possible trench wall collapse.
	19.7	Ladder provided in immediate work area extending min. 3’ above ground?	√	S		Requirements to be determined in final JHA based on detailed construction plans.
	19.8	Barricades in place to prevent fall into trench if over 7.5’ deep? If excavation is a hazard to workers, cover or guard it.	NA	O	20.88	No trenching over 7.5ft deep foreseen. Barricade work area and position flashing warning signs to prevent accidental falling into trench.
	19.9	End shoring in place equal to depth of excavation?	√	S		
	19.10	Loose excavated materials well back from slopes/ trenches in use?	√	O	20.90	Keep at least 2’ from excavation and 4’ from any other excavation
DEMOLITION/EXCAVATION	19.11	Are there soil contaminants expected or chance of encountering archeological materials?	√	O		Workers to be shown sample of archeological materials and instructed to stop excavating if they encounter possible archeological materials. Also provide workers with details of soil contaminants and potential risks. Stop work and immediately report to P.M. if anything is encountered including suspected soil contaminants.
	19.12	All Workers must be aware that soils on the site may contain hydrocarbons and metals such as arsenic, zinc, copper, lead.	√	O		All excavation and management of soils must be in compliance with the Interim Soil Management Plan for Munroe Head, Esquimalt Graving Dock and North Naden - stored fully contained, sampled, and disposed off-site if above federal industrial criteria. Project Manager to provide guidance for specific project.
	19.13	Ensure structure and adjoining structure are properly supported during demolition to the extent and manner prescribed by a P. Engineer IF Workers could be endangered by the demolition or adjoining structures could have their stability compromised.	√	S&O	20.111	Follow demolition/ temporary support procedures and detailed schedule as defined by an Engineer in writing. Copy of the plan must be available on site.
	19.14	Ensure hazardous materials are identified before beginning demolition or salvage of machinery, equipment, buildings or structures.	√	S	20.112	Hazardous substances will be defined in the Environmental Assessment as well as by inspection with the Contractor. Details will be available at the site and procedures identified for safe containment and removal.
	19.15	Stop all work if hazardous materials are discovered during demolition and not previously identified.	√	O		Report to Project Manager immediately.

	19.16	**Ensure all electric, gas, water and other services are disconnected**	√	**O**	**20.113**	**Contractor to ensure all services are properly disconnected before starting work.**
	19.17	**Glass must be removed from top to bottom and before other work commences.**	√	**S**	**20.114**	
	19.18	**Ensure floors are not overloaded by materials and equipment.**	√	**O**	**4.2**	
	19.19	**Protect workers from falling materials including covering floor or roof openings and barricading areas where materials will be dropped.**	√	**O**	**20.116 20.117**	
	19.20	**Dangerous or unstable walls must be adequately braced.**	√	**O**		**Follow Engineer's demolition plan.**
	19.21	**Do not let debris accumulate if it will in any way endanger workers**	√	**O**	**20.120**	**Follow Engineer's demolition plan.**
	19.22	**Stairways and handrails must be left intact until access to the level they serve is no longer required.**	√	**O**	**20.121**	**Follow Engineer's demolition plan.**
	19.30	**Restrict access to pile driver when hoisting piles**	√	**O**	**20.103**	**Only workers engaged in the operation to remain on superstructure or any area where pile could fall. Control general access to site with barricades and signs.**
	19.31	**Operator protected from falling objects, rigging failures & weather?**	√	**S**	**20.104**	**Contractor to ensure suitable roof or shelter.**
	19.32	**Any air or steam discharge controlled to prevent injury to workers or impair ability to see operation?**	√	**S**	**20.105**	**Contractor to control discharge.**
	19.33	**Chock suspended hammer securely when not in use.**	√	**O**	**20.106**	**Operator to ensure.**
	19.34	**Do not raise hammer with swinging/suspended leads until necessary.**	√	**O**	**20.106**	**Operator to ensure.**
	19.35	**Wooden piles properly prepared?**	√	**O**	**20.107**	**Cut wooden pile square, clean of debris, bark & slivers before driving. Trim pile to fit the follower or pile driving cap.**
	19.36	**Follower or pile driving cap being used correct size & type?**	√	**O**	**20.107**	**Ensure suitability for type of piling being driven.**
	19.37	**Do not use a cracked drop hammer.**	√	**O**	**20.108**	**Remove defective hammer from service immediately.**
	19.38	**Do not use spliced ropes to support a pile driver hammer.**	√	**O**	**20.109**	**Contractor to ensure.**

Project Title: **Master.** **Project No.**

HOUSEKEEPING; MATERIALS STORAGE	20.1	Refuse spills and waste materials not allowed to accumulate and create a hazard	√	O	4.41	Cover at start up orientation meeting.
	20.2	No use of compressed air to clean clothing of any potentially hazardous dusts etc.	√	O	4.42	Compressed air can penetrate skin, enter bloodstream and result in death. Do not use compressed air to clean work surfaces. Cover at start up orientation meeting.
	20.3	Check state of repair of floors, ramps, stairs and free of tripping and slipping hazards	√	O	4.39	Cover at start up orientation meeting.
	20.4	Material stacked securely and stable?	√	S	4.43	Check plans for stacking materials. Also Inspection item.
	20.5	Are areas free of risk of entrapment or falling materials? If not take appropriate measures per 4.44 and 4.45	√	S	4.44-4.45	Evaluate risks. Also Inspection item.
	20.6	Use metal containers with tight fitting lids for oily or painting rags & empty daily.	√	O		Oily or paint soaked rags can ignite through spontaneous combustion. Store properly. Also Inspection item
	20.7	Use proper containers for refuse.	√	O		Inspection item
	20.8	Are work areas free of protruding nails?	√	O		Ensure nails are either removed or bent over to eliminate the hazard of stepping on them.
	20.9	Are nuts/bolts etc. stored in containers to reduce tripping hazards?	√	O		Clean up components frequently to reduce risks.
	20.10	Returned tools to proper place after use.	√	O		Ensure tools are properly stored.

EQUIPMENT MAINTENANCE & USE	21.1	Equipment operator's manuals at site?	√	S		Keep manuals on site with equipment. Includes equipment like concrete pumping trucks
	21.2	Equipment operated by qualified persons?	√	S		Contractor to provide proof of qualification of equipment operators.
	21.3	Equipment maintained according to manufacturer's instructions?	√	S		Maintain equipment as specified by manufacturer and maintain a record of maintenance.
	21.4	Equipment inspection before use carried out?	√	S	16.34	Operators inspect equipment before use, record results (where required by WORKSAFEBC) and report any defects to Supervisor. Do not use defective equipment until defect is remedied.
	21.5	Explosive operated tools maintained, and used properly? Operator's trained? Equipment & shots stored in restricted area?	√	S		Provide proof of training to Project Manager for users of this equipment before starting work. Check with P.M. for Hot Work permit requirement also.
	21.6	Air operated nailing guns trigger mechanism working properly?	√	S		Ensure safety mechanisms working properly.

Project Title: Master. **Project No.**

	22.0	Follow safe lifting practices. Use mechanical lifting assist wherever feasible or get assistance.	√	S		Contractor to train all workers in safe lifting practices and monitor for compliance.

CONCRETE PUMPING	23.1	Placing boom certified safe within last 12 months?	√	S	20.47	Serious injury could result due to failure of components, couplings etc. if pressures or other loads are exceeded. Contractor provide certificate copy to P.M.
	23.2	Permanent equipment labels on pump, boom and mast per WORKSAFEBC requirements?	√	S	20.27	Inspection item.
	23.3	Outriggers used properly and within maximum extension and load?	√	S	20.40	Inspection item
	23.4	Ensure concrete delivery pipe meets boom manufacturer's specs and is rated at greater than maximum pressure pump can generate. Ensure pipe clamps are of proper rating and properly installed per regulations.	√	S	20.42 20.43 20.44	Inspection item.
	23.5	Ensure agitator guards meet WORKSAFEBC specifications & are properly used and maintained. Do not stand on the grill when agitator is running.	√	S	20.37	Inspection item
	23.6	Ensure discharge line couplings are guarded and attachments to placing boom restrained	√	S	20.45 20.46	Inadvertent disconnection could cause injury from flying concrete. Inspection item
	23.7	Weight of each removable section of placing boom marked?	√	S	20.49	Inspection item.
	23.8	Placement boom not to be used for hoisting loads	√	S	20.50	Contractor to instruct workers in proper use. Inspection item.
	23.9	Clean out operations are to be done off site	√	S	20.51	Excess concrete to be properly disposed of by Contractor off site unless agreed with Project Manager. If cleanout on site is agreed follow WORKSAFEBC restrictions
	23.10	Pumper operator must have full control and no other duties while operating or placing boom or mast.	√	S	20.52	Contractor to ensure control.
	23.11	If operating near H.V. lines or exposed energized conductors, comply with WORKSAFEBC PART 19	√	S	20.53 PART 19	No operation near electrical conductors foreseen.
	23.12	Operator must see hopper on concrete pump at all times or means of signalling a problem must be provided.	√	O	20.54	Contractor to enforce.

Project Title: **Master.** **Project No.**

	23.13	Wear eye protection at all times when pumping concrete. Wear gloves to protect against concrete.	√	O		Contractor to ensure protective equipment is used.
	23.14	Controls have functions identified and emergency shutoff to stop pumping?	√	S	20.31 20.36	Inspection item.
	23.15	Hydraulic valves have pressure relief and holding valves?	√	S	20.32	Inspection item.

	24.0	Blasting operations are not usually permitted at EGD.	√	S	PART 21	Use drilling and hoe-ram methods to break up rock.
	24.1	Ensure only competent workers trained in the proper methods of blasting, hazards of fire and mishandling and procedures to follow in event of fire or explosion are to be involved in blasting operations.			21.2, 21.7	Provide proof of formal training program and documentation of training session signed by workers trained and authorized to assist the Blaster of Record.
	24.2	Provide a qualified "Blaster of Record" who will exercise authority and visual supervision over all assistants or others involved during explosive loading, priming, fixing or firing.			21.5	Provide copy of blaster's certificate for anyone planned to conduct or direct blasting operations as the Blaster of Record. Ensure scope of the certificate is valid for the planned work. Keep ORIGINAL certificate at job site.
	24.3	Maintain records of blasting operation as required by regulations.			21.4	Blaster of Record maintain personal log of pre-blast loading details and results of post-blast inspection and log available for inspection at the site.
	24.4	Any dangerous incident, including unexpected result or problem with explosive products, or Blaster has failed to comply with regulations or safe practices, must be reported and all blasting operations and duties of the Blaster of Record will be suspended until agreed with Project Manager/WORKSAFEBC to continue.			21.3 21.13	Notify Project Manager and WORKSAFEBC immediately and complete required reports.
BLASTING	24.5	Comply with all other legislation besides WORKSAFEBC regulations including Explosives Act (Canada), Transportation of Dangerous Goods Act, 1992 (Canada) governing storage, handling and use of explosives.			21.6	Contractor to ensure understanding of regulations and comply with them.

	24.6	Keep explosives and detonation materials separated until the last practical moment before bringing them together.			21.16-21.17, 21.20 21.21	Contractor to ensure safe and secure storage of explosives and detonation materials.
	24.7	Ensure signage is in place to identify magazines, day boxes, vehicles containing explosives and that all workers are aware of the location of storage and restrictions on access and activities around explosives and detonators.			21.18	Contractor to provide signage meeting regulations and ensure effective communication.
	24.8	No passengers in explosive vehicles other than those assigned to assist in handling explosives.			21.22	
	24.9	Ensure vehicles meet the transport requirements with proper separation of flammables and detonation devices from explosives. Ensure exposed ferrous metal in a conveyance is prevented from contacting packages containing explosive			21.23 21.24 21.25 21.27 21.32	If transporting on a mobile drill rig, ensure special restrictions are met including attending by the Blaster of Record at all times. No trailers. If a semi-trailer is used, ensure power brakes can be operated from inside cab.
	24.10	Provide written procedures to address emergencies while transporting or working with explosives and ensure all workers are adequately instructed.			21.28	Provide documentation to Project Manager
	24.11	Operate vehicle transporting explosives according to regulations but not exceeding 90 km/h; do not exceed 80% of manufacturer's load rating; follow special railway crossing requirements; ensure vehicles have been serviced before loading.			21.29 21.30 21.33 21.34	
	24.12	Ensure vehicles containing explosives are parked away from habitation and bldgs containing flammables; premises are used for a purpose unlikely to cause an explosion or fire; vehicle is at all times attended by a qualified person.			21.35	Define overnight parking location(s) and ensure vehicles are attended.
	24.13	Follow manufacturer's recommended practices for storage, transport, handling and use of explosive materials. Do not use materials believed to be defective.			21.36 21.37	

Project Title: Master. **Project No.**

	24.14	No smoking or open flame ignition sources on this project work site. Dispose of empty containers as recommended by manufacturer.			21.40 21.41 21.42	Project manager will define designated smoking areas well away (min. 15m.) from where explosives are stored, handled or loaded into holes. Hot work permit required from Project Manager for this kind of work.
	24.15	Follow safe drilling procedures including location of utilities, stabilizing slopes to prevent slides and checking blasted areas for misfires before continuing.			21.42 21.43 21.44	Ensure hole sizes are adequate and don't drill within 6m. of a hole containing explosives or within 15cm of a bootleg
	24.16	Follow proper loading practices including making up primers just before use, no carrying explosive material in clothes, no removal of wrappers,			21.45- 21.48 21.67 21.68	Ensure tools are non-spark generating materials. Don't attach blasting circuit until just before being ready to fire and ensure logical sequence of detonation is used.
	24.17	If there is a sign of thunderstorm, suspend blasting			21.49	Lightning can result in an unplanned explosion. Suspend all blasting, clear the danger area and guard it.
	24.18	Loaded holes present a hazard in that someone could drive over them or tamper with them.			21.50	Do not leave loaded holes unattended overnight. Post a worker whose sole responsibility is the security of explosives.
	24.19	No driving vehicles over loaded holes an explosion could accidentally result.			21.51	
	24.20	Holes are hot after being "sprung" and could result in accidental explosion if loaded too soon.			21.52	Allow ample time for cool down.
	24.21	Accidental explosion could result if detonators are attached sooner than necessary			21.53 21.54	Don't interconnect detonating cords or attach detonators or detonator connectors until everything is in readiness for the blast.
	24.22	Static electricity or hazards from stray currents could result in accidental explosion if loading explosives pneumatically.			21.55 21.56	Define procedures and ensure equipment used will prevent this hazard. Use only safety fuse assemblies with antistatic protection.
	24.23	Inadequate or damaged fuse assemblies can result in faster than planned ignition.			21.56 21.57	Follow safe practices when lighting safety fuses.
	24.24	Stray currents or static electricity may cause unexpected detonation resulting in injury or death.			21.58 21.59 21.60	Follow safe practices to prevent unplanned detonation. Do not use electric detonators if extraneous current exceeds 50 milliamps.
	24.25	Radio frequency transmitters, including mobile units, can cause unplanned detonations.			21.61 to 21.65	Contractor to provide details demonstrating that all regulations are being met and get prior approval from Project Manager if electrical blasting circuits are to be used.

	24.26	Accessing the blasting area during a detonation could result in serious injury or death.			21.66	The Blaster of Record will ensure proper covers are used to control flying materials and that workers are posted at all necessary points to ensure no one enters the area and that a warning system is in place. Provide written warning procedures and blasting signals and post conspicuously. Ensure workers are trained in procedures and provide documentation to Project Manager. Project Manager will ensure all EGD occupants are made aware of the procedures and signals.
	24.27	Misfires or other hazards could injure workers if they enter the area after a blast. The Blaster may be hurt if entering the area as a result of electrical detonation of unexploded loads.			21.71 21.81	Ensure the area is inspected by the Blaster before allowing anyone to enter. Blasters must disconnect all circuits and short circuit leads, and ensured the blasting machine switch is locked open. In the event of misfire, follow standard practice including waiting at least 10 minutes before anyone enters the blast area. Contractor to provide written procedures for the standard handling of misfires and ensure all workers understand the process.
	24.28	Ensure procedures are well defined and regulations reviewed if blasting is to involve underwater blasting, or seismic blasting			21.82- 21.85	

ASBESTOS	25.1	Workers possibly exposed to potentially hazardous levels of asbestos? E.g. - workplace has asbestos-containing materials present or used - operation involves abatement of asbestos-containing materials - exposure to asbestos fibre in excess of 50% of exposure limits may occur	√	O	PART 6 6.2	Should the Contractor encounter any questionable situation involving asbestos, lead paints or other potentially hazardous substance, immediately stop work and report to Project Manager for direction.

Project Title: **Master.** **Project No.**

	25.0	Workers possibly exposed to potentially hazardous levels of asbestos? E.g. - workplace has asbestos-containing materials present or used - operation involves abatement of asbestos-containing materials - exposure to asbestos fibre in excess of 50% of exposure limits may occur	NA	O	PART 6 6.2	No exposure to asbestos is foreseen under this JOB ORDER. Should the Contractor encounter any questionable situation, immediately stop work and report to PWGSC Representative for direction.
	25.2	Workplace exposure monitoring done and results provided to workers	√	O	5.53	
	25.3	Contractor exposure control plan developed meeting WORKSAFEBC 5.54?	√	O	6.3	Plan to include: - Purpose & Responsibilities - Risk identification; assessment & control - Education & training - Written work procedures - Hygiene facilities & decontamination procedures, when required - Health monitoring, when required - Documentation, when required
	25.4	Qualified person prepare and keep current an inventory of all asbestos-containing materials; identify all such materials by signs, labels etc.	√	O	6.4 6.5	
	25.5	Qualified Risk assessment conducted by qualified person before any demolition, repair, etc work where asbestos-containing materials may be disturbed.	√	O	6.6	
	25.6	Procedures documented providing task-specific work direction addressing both hazards & controls and eliminating or minimizing the airborne release of asbestos fibres	√	O	6.7 6.8	WORKSAFEBC publication "Safe Work Procedures for Handling Asbestos" provides procedures acceptable to the Board.
	25.7	No use of pressure spraying to remove asbestos-containing materials from buildings/structures	√	O	6.9	
	25.8	No use of compressed air to clean up or remove asbestos-containing materials, dusts, fibres. Also no dry sweeping or dry mopping.	√	O	6.9	
ASBESTOS	25.9	Employer must substitute material less hazardous than asbestos where practicable	√	O	6.10	If not practicable, document why and make available to workers and health & safety representative

Project Title: Master. Project No.

	25.10	Workers trained in hazards, means of identification, procedures, correct use of protective equipment, operation of engineering controls, and purpose/significance of health monitoring	√	O	6.12	
	25.11	Monitoring carried out as req'd by PART5?	√	O	6.12	
ASBESTOS	25.12	Monitoring during high risk activities carried out and provided to workers within 24 hrs?	√	O	6.12	During high risk activities, provide regular sampling of workers, areas outside the containment area but nearby, clean room, contaminated area as required by regulations.
	25.13	Glove bags used for containment? Adhere to requirements of WORKSAFEBC 6.15	√	O	6.15 6.12(4)	If not, provide sampling as defined in WORKSAFEBC 6.12 (4)
	25.14	Work area boundary defined, all objects not required for the work removed, openings secured to prevent release of fibres?	√	O	6.13	Prepare area before starting work
	25.15	Signs posted restricting entry?	√	O	6.13	
	25.16	For HIGH RISK WORK provide maintain & inspect a containment and a decontamination facility	√	O	6.16	Not required if using glove bag containment. See detailed requirements in 6.16
	25.17	Ventilation airflow from clean area into contaminated area only?	√	O	6.17 6.18 6.19	Airflow through decontamination exhausted through containment area. Exhaust from containment thru effective HEPA filter. All ventilation exhaust thru HEPA filter tested maintained and used per manufacturer instructions.
	25.18	Is asbestos spread being controlled/	√	O	6.20 6.21 6.22 6.23	Use measures to keep work surfaces and other work areas adjacent to containment area, as free as practicable from dust accumulation. Wet asbestos containing material before and during work whenever practicable Repair damaged asbestos-containing materials
	25.19	Proper waste collection and disposal measures followed?	√	O	6.25	All asbestos waste and asbestos contaminated material including clothing, cleanup equipment etc. place din sealed containers identified as containing Asbestos.
	25.20	Clean up equipment.	√	O	6.26	Ensure exterior of waste containers, reusable equipment cleaned after work complete
	25.21	Work area cleaned?	√	O	6.27 6.28	Ensure work area is cleaned after each shift and at completion of work involving asbestos and dispose of containers promptly.

	25.22	Proper respiratory protection used? Fit checked?	√	O	6.29	No single-use respirators permitted. Ensure adequate protection and enforce usage.
	25.23	Proper protective clothing supplied and worn & maintained?			6.30	Ensure asbestos resistant clothing with proper coverage and fit is used. Repair/replace damaged clothing immediately. Clean clothing using HEPA filter vacuum before removal. Remove protective clothing/equipment before leaving designated work area. Protective clothing being sent to an acceptable laundry must be HEPA vacuum cleaned, placed in a soluble plastic bag, sealed and labelled before being sent.
	25.24	Workers to launder own clothing?			6.31	Ensure workers informed of hazards of asbestos and precautions required.
	25.25	Documentation maintained?			6.32	Employer to keep records of inventories, risk-assessments, inspections and air monitoring results at least 10 yrs. Keep records of corrective actions to control release, training/instruction to workers, work procedures and notification to WORKSAFEBC for at least 3 years.

TREE REMOVAL	26.1	Risk of injury due to tree falling practices	√			The hazards associated with removing large trees exist. To ensure workers and passers-by are not injured: - Coordinate with all concerned and barricade off all potential fall areas. - Document the tree falling plan Employ only qualified / experienced fallers to do this work - Define tree falling plan and agree with P.M. Drop in sections not entire tree. - Check trees for internal rot that could put persons at risk if scaling tree. - Clean up and remove trees from site immediately after falling and cutting up.
	26.2	Are workers trained to carry out tree removal?	√		26.3	Ensure workers meet WBC training requirements and provide documentation to the Project Manager.
	26.3	Are workers using all required PPE for tree removal operations?	√		26.7	Ensure workers using chainsaws use leg protective devices in addition to other PPE. Also ensure all PPE is checked for wear, fits the users and is in serviceable condition

	26.4	Have workers been trained in the hazards of operating chain saws?				Contractor to ensure workers are aware of hazards, safe working practices and protective equipment to be used.

WELDING & CUTTING	27.1	Are workers qualified to perform welding/cutting work and work performed according to standard?	√		12.112	Contractor to provide proof of qualification. Perform work according to CSA Standard W117.2-94 Safety in Welding, Cutting and Allied Processes or other standard acceptable to WORKSAFEBC and manufacturer's instructions for equipment being used.
	27.2	Workers must be aware of the health effects of exposure to welding smoke. The combination of base materials, coatings, shielding gases and other factors can create many different substances that can potentially have an adverse effect on almost any part of the body.	√		12.124	Contractor to identify the specific hazards associated with a particular welding operation and the environmental conditions and ensure workers understand the short-term and long-term health effects of exposure to welding smoke and how to protect him or herself. Undertake appropriate engineering controls or work practices to control/remove welding fumes. Ensure respirators are the correct type and fit-tested.
	27.3	Coatings must be removed from base metal before welding/cutting.	√	S	12.115 12.129	Coatings could emit harmful contaminants during welding or cutting. Remove coatings and wear protective equipment. Do not apply paint to materials about to be welded.
	27.4	Workers must be aware of the risk of burning due to contact with hot slag, metal chips, sparks and hot electrodes.	√		12.125	Contractors to ensure workers protect themselves and others against the risk of burns. Wear suitable protective clothing. Ensure recently welded or flame cut work is marked "HOT" or guarded to prevent accidental contact.
	27.5	Workers must be aware of the risks associated with exposure to ultraviolet or infrared light from welding which can damage the eye and result in skin burns.	√		12.122	Contractors to ensure workers understand the hazards of exposure to the welding arc and how to protect themselves. Be sure the lens shade number is adequate for the type of welding/cutting being performed. Hand-held screens are not acceptable. Use barriers of flame resistant non-reflective material to protect other people from exposure to the arc, heat, and hot spatter. Also use signs to warn of the dangers of looking at the arc.
	27.6	Workers must be aware that exposure to the noise of welding can permanently damage hearing, cause stress leading to increased blood pressure.	√			Contractor to ensure workers have regular hearing test and that wearing protective equipment is enforced.

	27.7	Workers must be aware of the risks of electrical shock especially in wet or cramped conditions. Even a small shock can lead to a fall or other accident. Brain damage or death can result from a large shock.	√			Ensure workers use dry gloves, rubber-soled shoes or an insulating layer. Ensure work piece and frame of electrically powered machines are grounded. Keep electrode holders and cables dry and in good condition. Electrodes should not be changed with bare hands, with wet gloves or if standing on grounded surfaces or wet floors.
	27.8	Workers must be aware of dangers of welding on containers, pipes or structures or in any place that has held flammable or combustible materials unless thoroughly cleaned.	√		12.116	Fires, explosions or release of toxic vapours can result. Containers with unknown contents should be assumed flammable or combustible. Ensure a qualified person has tested
	27.9	Beware of backfires and flashbacks when using compressed gases.	√		12.120	Do not ignore these warnings. Undertake immediate corrective action. Ensure safety devices are used to prevent reverse flow and arrest flashbacks on oxyfuel systems
	27.10	Ensure fire prevention and fighting capabilities before welding/cutting.	√		12.121	Suitable fire extinguishing equipment must be available close to the work. Use a firewatcher if work is being done where other than a minor fore might develop. Maintain the fire watch at least ½ hour after welding or cutting work is completed to detect smouldering fires. Keep areas clear of combustibles and cover those that cannot be removed with flame-resistant materials, Cover doorways, windows and cracks. Provide and use receptacles for electrode stubs.
	27.11	Welders must wear required personal protective equipment including flame resistant clothing, gauntlet gloves, etc.	√		12.123	Ensure welders wear all required special PPE
	27.12	Check Gas Cylinder Condition & Securing/Upright storage, & protection from sparks, flames, heat, physical damage or corrosion. Ensure pressure relief valves are present.	√	S	5.36	Cylinders of compressed gas can explode or become projectiles if exposed to excessive heat, or if the valve stem were to break should the tank be knocked over from a vertical position. Inspection item
	27.13	Ensure empty gas cylinders have regulator removed, capped & are tagged as empty.	√	S		Identify empty tanks. Inspection item
	27.14	Ensure Cylinders are identified re type of gas and valid testing.	√	S	5.37-5.39	Cylinders must be pressure tested to ensure ability to perform safely and the test date recorded. The cylinder must be identified regarding the type of gas in the cylinder to prevent confusion and potential accidents. Inspection item Do not use cylinders or contents for other than intended purpose.

Project Title: Master. **Project No.**

	27.15	Ensure Cylinder valves are closed when not used.	√	S		Do not rely on the welding torch or other device to control the release of gas other than when manned by an operator. Dangerous leakage could occur with gas building up inside buildings, vessels etc. with potential for explosion or other hazards. Inspection item

LEAD	28.1	Worker exposure to lead?	√	S	6.60 6.67	Develop and implement an exposure control plan meeting the requirements of section 5.54 if workers are or may be exposed to lead in excess of 50% of the exposure limits, or if exposure through any route of entry could result in elevated lead body-burdens. Develop and maintain a health protection program.
	28.2	Airborne exposure possible?	√	S	6.61	Provide monitoring per regulation.
	28.3	Warning signs	√	S	6.62	Post signs at the boundary of any work area where hazardous lead exposures could occur
	28.4	Contamination of exposed skin and/or clothing possible?	√	S	6.63 PART 5	Follow personal hygiene requirements
	28.5	Work surfaces protected?	√	S	6.64 6.65	Protect work surfaces from finely divided lead; prevent dispersal of finely divided lead into work area
	28.6	Workers trained?	√	S	6.66	Provide training in hazards of lead, written work procedures, correct operation and use of any required engineering controls and personal protective equipment, personal hygiene and decontamination procedures, and purpose and significance of any health monitoring.
	28.7	Records maintained?	√	S	6.68	Maintain records of risk assessments, worker exposures and worker training. Produce for Project Manager if requested.

NON-IONIZING RADIATION	29.0	Is there exposure to microwave radiation?	TBD	S		
						Get safety procedures from Rogers
						No approach within 3 meters

Project Title: **Master.** **Project No.**

ROCK DUST	29.1	Rock crushing, drilling, mucking, excavation, loading, transportation, road grading, road construction or conveying of rock or similar operations?	√	S	6.110 6.111	Ensure that dust concentrations to which a worker may be exposed are maintained at or below the established exposure limits, by one or a combination of (a) mechanical ventilation, (b) the use of water spray, (c) other equally effective methods.
	29.2	Access restricted?	√	S	6.112	Restrict access to area of exposure
	29.3	A rock drill, other than a manually-powered rock drill used?	√	S	6.113	Must be equipped with a dust suppression system, that uses water jet, spray, or other equally effective means to suppress drilling dust.
MUSCULOSKELETAL INJURY	30.1	Is there a risk of musculoskeletal injury?	TBD	S	4.47	Contractor to eliminate or control risk
	30.2	Are controls required?	TBD	S	4.50-4.52	Contractor to define control measures and train workers in risks and safe work procedures, use of PPE etc. Contractor to monitor for compliance and effectiveness.

Contractor's Superintendent: ______________________________ **Date:**_____________________.

Distribution:

EGD Operations Manager
EGD Supervisors
Engineer-of Record
Resident Engineer/Construction Coordinator
Project File

Appendix D
FSE Directives

Directive SE5

SPILL RESPONSE

REFERENCES

A. CFB Esquimalt Emergency Response Plan
B. Canadian Environmental Protection Act (CEPA), 1999, Environmental Emergency (E2) Regulations (SOR/2003-307)
C. A-GG-040-004/AG-001, General Safety Program – Hazardous Materials Safety and Management Manual
D. MARCORD 66-5 – Hazardous Material Management
E. ED 4003-9, Hazardous Materials Management Plan
F. Transportation of Dangerous Goods (TDG) Act, Clear Language Regulations – Part 8
G. Environmental Management Act (S.B.C. 2003, c. 53), Spill Reporting Regulation (B.C. Reg. 263/90)
H. Environmental Directive (ED) 4003-1/2003, Spill Reporting
I. DAOD 4003-1 – Hazardous Materials Management
J. MARCORD 4-12 – Environmental Program
K. FSEMS Directive SE1, Safety and Environmental Emergency Incident Reporting
L. FSEMS Directive E8, Storage Tanks

PURPOSE

1. This Directive details MARPAC spill response requirements discussed in references A through L. Units that have quantities of HazMat in excess of specified amounts in Directive SE1 (Annex DSE1B, Table 1) and/or 50 litres of POL shall have spill response plans. Base emergency response procedures are detailed in the CFB Esquimalt Emergency Response Plan (reference A).

SCOPE

2. This Directive applies to all MARPAC integral and lodger units identified in Part 2, Annex 1A.

DEFINITIONS

3. Hazardous Material (HAZMAT). As defined by reference I, HAZMAT is any material that if handled improperly can endanger human health and well-being or the environment or equipment. Some examples of HAZMAT are poisons, corrosive agents, flammable substances, ammunition and explosives.

4. Spill. As defined by reference M, the intentional or unintentional abandonment, deposit, discharge, dump, emission, empty, exhaust, throw, inject, leak, pour, place, release, seep, or spray of material into the environment. A minor spill is defined as a spill that the Unit can contain and clean-up in its entirety without assistance. A major spill is defined as a spill that the Unit cannot contain and/or clean-up without assistance.

5. Environmental Emergency Plan. As defined by reference B, means a plan respecting the prevention of, preparedness for, response to and recovery from an environmental emergency in respect of a substance.

RESPONSIBILITIES

6. A Unit Commanding Officer (CO) or Base Branch Head (BH) of a unit that has quantities of HazMat in excess of specified amounts in Directive SE1 (Annex DSE1B, Table 1) and/or 50 litres of POL

shall ensure that their organization has an established and exercised spill response plan; the plan and exercise records shall be reviewed during scheduled FSE program verifications. A CO shall ensure that FSE is informed of all spills.

7. The Formation Safety and Environment Officer (FSEO) reports to the Base Commander (BComd) and provides safety and environmental advice and support to the Formation.

8. The Joint Operations Centre (JOC) is responsible for having a spill call-out procedure to ensure that appropriate organizations are contacted in the event of a spill incident. Contact information for FSE is available on the FSE website and in Annex DSE1A (RDIMS 195921).

9. The Queen's Harbour Master (QHM) is the CO of the Port Operations and Emergency Services Branch (POESB) and is the port authority for both Esquimalt and Nanoose Harbours. POESB controls the Base Emergency Response Plan (reference A) and provides spill response for all 911 calls to the POESB Fire Hall that is beyond the capability of first level response; further, the QHM is responsible for second and third level marine spill response for DND spills in Esquimalt and Nanoose Harbours and their approaches. Queen's Harbour Master also has the capability to deploy outside Esquimalt Harbour to assist with DND generated spills and may in some circumstances be the preferred responder depending on the location of the spill and the availability of Coast Guard and commercial assets in the vicinity.

10. The Base Construction Engineering Officer (BCEO) is responsible for providing second level HazMat emergency response for land-borne spills through the BCE HazMat Emergency Response Team (BCE HERT). The BCE HERT may also provide assistance to HMC Ships in Esquimalt Harbour.

11. Formation Environment Management Committee (FEMC). The FEMC provides a forum to discuss spill response, reporting, incidents and investigations.

12. A Unit General Safety Officer (UGSO), Environment Officer (UEnvO) or Unit Safety and Environment Officer (USEO) acts on the behalf of the CO/BH and is responsible for the Unit's spill response plan.

13. Contractors. Department of National Defence personnel (military and civilian) who are responsible for contractors working on MARPAC properties shall ensure that the requirements of this Directive, which may apply to the contract, are written into the contract and followed throughout its duration.

14. All Canadian Forces and DND civilian personnel are responsible to respond to spill incidents in order to ensure the safety of others and the protection of the environment.

15. Environmental Emergencies (E2) Regulations. In the event MARPAC integral or lodger units require storage of substances listed in Reference B, Schedule 1, column 1, and quantities are equal to or exceed those set out in column 3 (or if the substance is stored in a container that has a maximum capacity equal to or greater than the quantity set out in column 3), Units shall comply with E2 regulations using the following process (Refer to RDIMS 204999 for the E2 regulations process map):

a. submit a written notice to FSE within 30 days that contains the information set out in Schedule 2 of reference B and a completed certification form (Schedule 3 of reference B);

b. resubmit the above notice and certification to FSE within 20 days after the occurrence of any of the following changes:

(1) any changes to the information reported IAW para 15a; or

(2) any increase of 10% or more in the maximum expected quantity of a substance reported IAW para 15a;

c. notify FSE and submit the certification form set out in Schedule 3 of reference B within 30 days if for 12 consecutive months the quantity of the substance in storage has been less than the quantity set out in column 3 of Schedule 1 of reference B;

d. if circumstances under subsection 4(1) of reference B apply, submit to FSE within 3 months an environmental emergency plan and fill in the certification form set out in Schedule 3. The plan shall meet subsections 4(2) and (3) of reference B and shall contain the information requested in Schedule 4;

e. implement and test the environmental emergency plan and submit a notice to FSE with the information requested in Schedule 5 of reference B within one year from the time the plan was written;

f. update and test the environmental emergency plan at least once a year to ensure that the plan continues to meet the requirements of subsections 4(2) and (3) of reference B;

g. keep copies of the plan readily available for the individuals responsible to implement it in the event of an emergency; and

h. keep with the plan, a record of the results from the annual updates and tests for a period of not less than five years.

DIRECTION

16. Spill Response Plan. All MARPAC Integral and Lodger Units that store quantities of HazMat in excess of specified amounts in Directive SE1 (Annex DSE1B, Table 1) and/or 50 litres of POL shall have established and exercised spill response plans. The General Safety Program, Hazardous Materials Safety and Management Manual (reference C) provides guidance for the creation of a spill response plan and should be consulted. MARPAC Units that are required to have a spill response plan shall exercise them once a year (reference D). Considerations for a response plan may include (Refer to RDIMS 205000 for the spill response plan process map):

a. determining high-risk locations where spills are probable;

b. identifying all tanks (defined in Directive E8) that the Unit has operational control of. Once determined these tanks shall be included in the Unit's Spill Response Plan. Note that Directive E8, Annex DE8A details mandatory information that shall be included in a Storage Tank Emergency Response Plan to respond to emergency situations, which includes but is not limited to spills;

c. posting the spill response plan or providing direction to it in high traffic areas (e.g., Safety and Environment Information Board);

d. reviewing records of previous spill reports;

e. identifying the most appropriate options and methods to improve performance and reduce risk (e.g., reducing the volume and range of HazMat, having secondary containment, etc.);

f. exercising the spill response plan at least annually and revising as necessary based on lessons learned; and

g. monitoring the number and volume of spills and comparing information at the annual SEMS Management Review highlighting both achievements and shortcomings, and identifying priorities for the next year by setting measurable and achievable targets.

17. Spill Response Kits. Store kits in close proximity to locations where HazMat is stored. Every spill response kit shall have an inventory of required contents located at the top of the kit. PPE shall be located at the top of the spill kit to ensure easy access for the spill responder. Spill kits should be closed with a safety seal affixed to indicate if the kit has been used or tampered with. It is recommended that MARPAC units obtain spill kits through the POESB environmental protection office.

RESPONDING TO SPILLS AND REQUESTING ASSISTANCE

18. Initial Response. The unit responsible for a spill shall respond immediately without jeopardizing the health or safety of personnel in accordance with the procedures detailed in its spill response plan. Following the immediate first level response action, spill containment and clean up shall escalate as quickly as possible to the level of response required.

19. Levels of Response. MARPAC has defined three levels of spill response. A call out procedure flow chart for spills is available at Directive SE1, Annex DSE1A. First level response is the unit that caused the spill (responsible unit), second level response involves assistance from either POESB (Fire Services or EPO) or BCE HERT, and third level involves assistance from an organization external to DND. The unit that is responsible for the spill is also responsible for the disposal of the spilled product and the clean-up materials. The levels of response and the unit/agency associated with that level are defined below:

a. First level response is the responsibility of the unit that causes or discovers the spill. First level responder duties shall include securing the area, assessing the situation and responding to the spill to the best of their ability and, if required, request second level responders. In the event the first level responders are unable to contain and clean up the spill they shall turn the scene over to the second level responders who shall assume I/C responsibilities. The first level responder retains responsibility for reporting the spill and the storage and disposal of all HazWaste generated by the incident;

b. Second level response:

(1) contact POESB QHM/EPO for marine spills in Esquimalt and Nanoose Harbours and their approaches;

(2) contact the JOC for marine spills outside of Esquimalt and Nanoose Harbours and their approaches. The JOC shall contact Coast Guard and potentially POESB QHM/EPO depending on the location of the spill and the availability of Coast Guard and commercial assets in the vicinity;

(3) contact the JOC for spills on non-DND land. The JOC shall contact the appropriate response organization;

(4) land-borne spills are divided into the following phases:

(a) Fire Services responds to 911 calls and shall secure and render the site safe. In specific instances Fire Services may commence site clean up if the I/C deems that such action is both within the capability and time constraints of Fire Services. The unit that caused the spill is responsible for the storage and disposal of all waste generated by the incident;

(b) in the event BCE HERT support is required, they shall commence the site clean up including the proper disposal of the contaminated material. The responsibility for paying for the disposal of material contaminated by the spill remains the responsibility of the unit that caused the spill;

(c) the I/C has the authority to use all available resources at the Base level through the responsible BH;

c. third level response consists of the appropriate second level response agency with assistance from an OGD, an outside mutual aid agency and/or a contracted resource. The BComd must provide authorization to request external resources to aid in third level response.

20. Abandoning Spills. Consider the following before abandoning a spill (Refer to RDIMS 205138 for the abandoning spills process map):

a. under no circumstance shall a land-borne spill be abandoned;

b. unless overridden by immediate operational concerns (determined by the CO/BH), self-generated marine spills of non-miscible (e.g., POL) substances shall not be abandoned unless all of the following criteria have been met:

(1) the slick poses no threat to any shoreline or Marine Protected Area (MPA);

(2) it is not possible to clean up the spill with the equipment available; and

(3) response assistance would arrive after the spill had broken up or dispersed.

TRAINING

21. Ensuring Competence. To ensure spill response team members competence, annual refresher drills, maintaining physical fitness and the ability to wear PPE are recommended (Annex A of reference E).

PROGRAM CHECKLIST

22. The program checklist is a tool used to perform self verifications to ensure compliance with environmental regulations. The checklists are posted on the FSE website or can found in RDIMS 213214.

RECORDS

23. The Unit shall keep the following records:

a. E2 spill response plans and exercises of these plans;

b. Unit level spill response plan exercises;

c. Spill responder training records; and

d. Spill reports (under Directive SE1).