

ESQUIMALT GRAVING DOCK

Phase 2 South Jetty Under-Pier Sediment
Remediation Project

Environmental Management Plan

Final

Submitted to:

Public Works and Government Services

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Limitations & Use of Report

This report was prepared for Public Works Government Services Canada and was prepared in accordance with the terms and conditions of the G3 Consulting Ltd.'s Task Authorization E0276-132639/001/VAN and workplans submitted to PWGSC for the preparation of this Environmental Management Plan.

Inferences concerning the Site conditions contained in this report are based on existing information, historical data and Phase 1 Project reports completed by Golder Associates. Information was also obtained from Public Works and Government Services Canada *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Demo-Remediation Specification*, Esquimalt Graving Dock Best Management Practices, discussions held with Public Works Government Services Canada and other Project Team members (PWGSC, 2010a, 2014).

In evaluating the subject Site, G3 Consulting has relied in good faith on information provided. G3 accepts no responsibility for any deficiency or inaccuracy contained in this report as a result of our reliance on the aforementioned information.

The findings, conclusions and recommendations in this report have been prepared for the specific application to this project and were developed in a manner consistent with that level of care normally exercised by environmental professionals currently practising under similar conditions in the jurisdiction.

With respect to regulatory compliance issues, regulatory statutes are subject to interpretation. These interpretations may change over time, and should be reviewed by those implementing recommendations made in this report.

If new information is discovered during future work, G3 should be requested to re-evaluate the conclusions of this report and to provide amendments, as required, prior to any reliance upon the information or recommendations presented herein.

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ABBREVIATIONS

AIA	Archaeological Impact Assessment
AWQCP	Aquatic Water Quality Control Plan
BCMOE	British Columbia Ministry of Environment
BMP	Best Management Practice
CCME	Canadian Council of Ministers of the Environment
CEAA	<i>Canadian Environmental Assessment Act</i>
CFSA	Canadian Forces Sailing Association
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRD	Capital Regional District
CSR	<i>Contaminated Sites Regulation</i>
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DPM	Deputy Project Manager
DR	Departmental Representative
DZCP	Dilution Zone Compliance Point
E	Endangered (COSEWIC and SARA designation)
EA	Environmental Assessment
EAP	Exterior Assessment Point
EBMP	Environmental Best Management Practice
EC	Environment Canada
EEE	Environmental Effects Evaluation
EGD	Esquimalt Graving Dock
EIR	Environmental Incident Report
EM	Environmental Monitor
EMP	Environmental Management Plan
EMIP	Environmental Monitoring Implementation Plan
EMS	Environmental Management System
ECP	Exterior Compliance Point
EPP	Environmental Protection Plan
FCSI	Federal Contaminated Sites Inventory
IAP	Internal Assessment Point
MSDS	Material Safety Data Sheet
MSSP	Materials Source Separation Program
NAR	Not at Risk (COSEWIC designation)
NPA	<i>Navigation Protection Act</i>
NWPA	<i>Navigable Waters Protection Act</i>
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCO	Project Coordination Officer
PCP	Pollution Control Plan
PEL	Probable Effects Level
PEP	Provincial Emergency Program
PPE	Personal Protective Equipment
PWGSC	Public Works and Government Services Canada
QEP	Qualified Environmental Professional
QHM	Queen's Harbour Master
RAO	Remedial Action Objectives
RFR	Request for Review

RMC	Residuals Management Cover
SAR	Species at Risk
SARA	<i>Species at Risk Act</i>
SC	Special Concern (COSEWIC and SARA designation)
SedQCTCS	Sediment Quality Criteria for Typical Contaminated Sites (<i>Contaminated Sites Regulation</i> Schedule 9)
SPM-O	Senior Project Manager – Operational
SPM-T	Senior Project Manager – Technical
SPW	Sheet Pile Wall
SWPPP	Stormwater Pollution Protection Plan
T	Threatened (COSEWIC and SARA designation)
TBT	Tributyltin
TCDDs	Dioxins
TDCFs	Furans
TESCP	Temporary Erosion & Sedimentation Control Plan
TRB	Temporary Re-suspension Barrier
TRBCA	Temporary Re-suspension Barrier Containment Area
VNHS	Victoria Natural History Society
WHMIS	Workplace Hazardous Materials Information System
WQMP	Water Quality Monitoring Plan
WWMDP	Wastewater Management and Disposal Plan
WRWP	Waste Reduction Work Plan

Units

h	hour
km	kilometre
kPa	kilopascal
m	metre
NTU	nephelometric turbidity unit

1.0 INTRODUCTION

This Environmental Management Plan (EMP) was prepared by G3 Consulting Ltd. (G3) on behalf of Public Works and Government Services Canada (PWGSC) for the Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project and was adapted in part from the Phase 1 EMP prepared by Golder Associates Ltd. (Golder, 2012a), *Canadian Environmental Assessment Act* (CEAA) Screening Environmental Assessment (Screening EA; Golder, 2012b) and the Phase 2 Environmental Effects Evaluation (EEE) prepared by G3 Consulting (G3, 2014a).

The contents of this EMP have been organized as follows:

- **Section 1.0: Introduction** – Provides an overview of the Project and purpose and organization of the EMP;
- **Section 2.0: Environmental Setting** – Provides a summary of the environmental setting of the Project Area;
- **Section 3.0: Roles & Responsibilities** – Describes roles, responsibilities and reporting relationships of PWGSC, Environmental Monitor (EM) and Contractor for implementing environmental management and mitigation measures;
- **Section 4.0: Regulatory Setting** – Outlines environmental legislation applicable to the work;
- **Section 5.0: Environmental Incidents** – Definitions and reporting procedures;
- **Section 6.0: Environmental Monitoring** – Describes the environmental monitoring and reporting activities to be undertaken to assess and document that environmental management goals set for the Project are being met;
- **Section 7.0: Best Management Practices (BMPs)** – Describes the BMPs for protection of environmental resources and have been organized by *General* and *Specific* activities; and,
- **Section 8.0: References** – Lists references associated with this document.

This EMP is intended to be read in conjunction with applicable environmental approvals and permits as well as contract requirements and the Contractor developed Environmental Protection Plan (EPP) for the Project. In the event of a discrepancy between the EMP and provisions set forth by legislation, regulations, or municipal bylaws, the more stringent provisions resulting in the higher degree of environmental protection and safety and lower discharge of contaminants should be followed.

1.1 Background

The Esquimalt Graving Dock (EGD) facility is located on the north shore of Constance Cove, in Esquimalt Harbour on the southern tip of Vancouver Island, British Columbia. The EGD is accessed via Admirals Road (Appendix 1, Figure A1), with the approximate centre of the Work Site being at 468208E 5364864N Universal Transverse Mercator Zone 10 (Lat/Long for EGD Centroid used for Federal Contaminated Sites Inventory [FCSI] #17410-007: LAT_WGS84: 48.436425 LONG_WGS84: -123.429211). The EGD is the largest non-military, solid-bottom dry dock on the west coast of North America and has been in operation since 1926 for the maintenance of private, government, and military vessels (PWGSC, 2009a). PWGSC owns and operates the EGD facility and leases portions of the facility to tenant companies undertaking maintenance work on vessels entering the graving dock (PWGSC, 2009a). The EGD facility consists of the graving dock, North Landing Wharf and South Jetty, as well as adjacent upland areas (Appendix 1, Figure A2).

Constance Cove and Esquimalt Harbour have a long history of naval and industrial activity dating back to the mid-1800s. Some of these naval and industrial activities, over time, resulted in the contamination of sediment within the EGD Waterlot as well as other areas of Esquimalt Harbour, in particular Constance Cove. PWGSC proposed to remediate EGD Waterlot sediments in a two phase project. Phase 1 of the Project (complete) included installation of a temporary sheet pile wall (SPW) around the South Jetty, dredging of contaminated sediment within the EGD Waterlot, an area around the EGD Waterlot and the intertidal zone at Munroe Head and construction of a compensatory habitat offset area at Dunn's Nook. Phase 2 consists of the demolition of the timber pile portions of the South Jetty and remediation of contaminated sediments beneath it (Appendix 1, Figure A2). PWGSC has made substantial improvements to the operations of the EGD and handling of wastes to mitigate additional contamination of sediments or surface water in Esquimalt Harbour. The EGD facility achieved ISO 14001 Environmental

Management System (EMS) certification in 2001 and has developed Environmental Best Management Practices (EBMPs) pertaining to site works (PWGSC, 2009a).

1.2 Project Description

PWGSC considered several options for the remediation and management of sediment contamination within the EGD Waterlot. The option ultimately chosen (the Project) involves removal of contaminated sediments, to the fullest extent practicable, which exceed numeric remedial action objectives (RAOs) selected for the Project. Project numeric RAOs for contaminants of potential concern are defined as the most conservative of the applicable Canadian Council of Ministers of the Environment (CCME) Probable Effects Level (PEL) guidelines (CCME, 1999) and British Columbia Ministry of Environment (BCMOE) *Contaminated Sites Regulation (CSR)* (1996) standards for marine sediment (typical contaminated sites [SedQCTCS]). Contaminated sediment is removed primarily using mechanical clamshell dredging methods, with specific areas targeted for alternative dredging techniques. The Phase 2 Work Area is within the EGD legal waterlot (owned by PWGSC; Appendix 1, Figure A2).

1.2.1 Project Schedule

The EGD Waterlot Sediment Remediation Project was to be undertaken in two main phases, Phase 1 (installation of temporary SPW, open water dredging and construction of habitat offset) which has been completed and Phase 2 (the current project).

Phase 2 of the Project is anticipated to commence in June 2015 and will consist of:

1. deconstruction of decking of the timber pile portion of the South Jetty;
2. re-driving sheet pile wall (SPW; originally installed during Phase 1A) deeper into the sediment to increase stability after the deck is removed;
3. installation of a Temporary Re-suspension Barrier (TRB) and any required support structures above and overlapping with the sheet pile wall to minimize re-suspended sediments from escaping the Phase 2 work area;
4. deconstruction of the timber pile portion, including timber pilings, of the South Jetty;
5. removal and remediation of sediments beneath the jetty;
6. installation of sand and rock armor to manage residual contamination;
7. removal of SPW, TRB and support structures; and,
8. any required contingency re-dredging or placement of residuals management cover outside the Temporary Re-suspension Barrier Containment Area (TRBCA).

1.2.2 Changes to Legislation

Since commencement of the Project, federal legislation (*Canadian Environmental Assessment Act [CEAA]*, *Fisheries Act*, *Navigable Waters Protection Act [NWP]*) has changed. This EMP reflects these changes.

Canadian Environmental Assessment Act (CEAA)

A Screening EA was prepared for Phase 1 and Phase 2 as it was known at the time and submitted to the Canadian Environmental Assessment Agency (Golder, 2012b) and the project was assessed under the provisions of CEAA (1992). The Project was deemed at that time not to require an Authorization under CEAA (1992). CEAA (1992) has since been repealed and replaced with CEAA (2012).

Under CEAA (2012), the Project is not listed as a 'designated project' (subsection 2[1]; *Regulations Designating Physical Activities* Schedule [Sections 2 to 4]) and as a result a Project Description was not required to be submitted to the Canadian Environmental Assessment Agency; however, Sections 67 to 72 of CEAA do apply. Sections 67 to 72 of CEAA outline the duties of a federal authority in relation to projects that are carried out on federal lands and states:

67. An authority must not carry out a project on federal lands, or exercise any power or perform any duty or function conferred on it under any Act of Parliament other than this Act that could permit a project to be carried out, in whole or in part, on federal lands, unless:
- (a) the authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects; or,
 - (b) the authority determines that the carrying out of the project is likely to cause significant adverse environmental effects and the Governor in Council decides that those effects are justified in the circumstances under subsection 69(3);
68. A federal authority must not carry out a project outside Canada, or provide financial assistance to any person for the purpose of enabling, in whole or in part, a project to be carried out outside Canada, unless:
- (a) the federal authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects; or,
 - (b) the federal authority determines that the carrying out of the project is likely to cause significant adverse environmental effects and the Governor in Council decides that those effects are justified in the circumstances under subsection 69(3);
69. (1) If the authority determines that the carrying out of a project on federal lands or outside Canada is likely to cause significant adverse environmental effects, the authority may refer to the Governor in Council the matter of whether those effects are justified in the circumstances. (2) When the determination is made by an authority other than a federal Minister, then the referral to the Governor in Council is made through the Minister responsible before Parliament for that authority. (3) When a matter has been referred to the Governor in Council, the Governor in Council must decide whether the significant adverse environmental effects are justified in the circumstances and must inform the authority of its decision;
70. Sections 67 and 68 do not apply to an authority in respect of a project that are not 'designated projects':
- (a) in relation to which there are matters of national security;
 - (b) that is to be carried out in response to a national emergency for which special temporary measures are being taken under the *Emergencies Act*; or,
 - (c) that is to be carried out in response to an emergency, and carrying out of the project without delay is in the interest of preventing damage to property or the environment or is in the interest of public health or safety;
71. (1) The federal authority must, at the end of each fiscal year, report on its activities under sections 67 to 69 during the previous fiscal year. (2) The information on its activities must be laid before each House of Parliament during the fiscal year after the fiscal year to which the information relates; and,
72. (1) The authority referred to in paragraph (b) of the definition "authority" in section 66 must, each year, report on its activities during the previous year under sections 67 and 69.

Given the scope and location of the Project, it was determined by the responsible federal authority, PWGSC, that an Environmental Effects Evaluation (EEE) was warranted for Phase 2. The EEE report has been generated as part of due diligence on behalf of PWGSC to ensure that Phase 2 of the Project, as defined in the *Phase 2 Demo-Remediation Specification* (PWGSC, 2014), is not likely to result in significant adverse environmental effects (*CEAA*, 2012, Section 67).

Fisheries Act

In September, 2012, Phase 1 of the Project obtained an Authorization from Fisheries and Oceans Canada (DFO) under subsection 35(2)(b) of the *Fisheries Act* for works undertaking or activities affecting fish habitat and Section 32(2)(c) Authorization for the harmful alteration, disruption and destruction of fish habitat and destruction of fish associated with the installation of sheet pile at the South Jetty, the dredging of contaminated sediment at the Esquimalt Graving Dock, Munroe Head and Pilgrim Cove and the creation of an offset area at Dunn's Nook. This Authorization stated

explicitly that it was only for Phase 1 and that a separate *Fisheries Act* review or Authorization may be required for Phase 2.

In November 2013, amendments were made to the *Fisheries Act* that combined section 32 and section 35 into a revised section 35. The previous *Fisheries Act* considered works, undertakings or activities likely to adversely affect fish habitat (section 35) and kill fish (section 32). The most recent *Fisheries Act* section 35 includes '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'. This change has implications for Phase 2 as the activities have the potential to impact fish, including herring and/or salmon, through potential temporary reduction in habitat, etc.

A Request for Review (RFR) was submitted to DFO, as required under the amended *Act* (February 26, 2014, DFO File #: 14-HPAC-00210), and after review it was determined that an Authorization for Phase 2 would not be required as long as the mitigation measures outlined in the RFR were adhered to (DFO, 2014a).

Navigable Waters Protection Act (NWP)

Phase 1 received Approval (8200-2003-500198 [8200-03-8256.3]) under *NWPA* for work that has potential to substantially interfere with navigation. The *NWPA* was replaced in April, 2014 by the *Navigation Protection Act (NPA)*. As Phase 2 work is to begin after this change occurs, all Phase 2 work must comply with the provisions of the *NPA*. A Notice of Works form must be submitted to the Minister for review prior to the commencement of Phase 2 works.

The environmental requirements of the *NPA* are limited; however, in accordance with the *NPA* no person shall throw or deposit "sawdust, edging, slabs, bark or the like rubbish of any description whatever that is liable to interfere with navigation in any water" or any "stone, gravel, earth, cinders, ashes or other material or rubbish that is liable to sink to the bottom in any water, any part of which is navigable or flows into any navigable water where there is not a minimum depth of 36 metres of water at all times".

1.3 Objective of EMP

The overall objective of this EMP is to provide a framework through which potential environmental risks will be managed during Phase 2 of the EGD Waterlot Remediation Project. Specifically, the EMP identifies:

- regulatory obligations that will govern project implementation;
- roles and responsibilities of PWGSC and its agents and Contractors that will undertake the work;
- mitigation measures, Best Management Practices (BMPs), established protocols and measurable environmental requirements to be applied;
- contribute to the development of a Water Quality Monitoring Plan (WQMP); and,
- monitoring to be undertaken to verify that the work is being carried out in accordance with regulatory and contractual obligations and to document PWGSC's exercise of due diligence.

This EMP addresses project risks identified in the Screening EA (Golder, 2012b) and Phase 2 EEE (G3, 2014a) as well as those identified through the engineering design process for Phase 2. Additionally, it provides for adaptive management should subsequent risks also be identified. This EMP addresses only Phase 2 activities as described in the *Phase 2 Demo-Remediation Specification* (PWGSC, 2014).

1.4 Environmental Protection Plan (EPP)

Prior to commencement of the Project, an Environmental Protection Plan (EPP) is to be prepared by Contractors implementing the work to document site and activity-specific details of planned work procedures and mitigation actions (including methods, equipment and approaches) to be implemented during the work to achieve compliance with regulatory approvals for the project, contract requirements, WQMP and EMP. The EPP will provide the following general information:

- organization chart and names of persons responsible for EPP implementation and compliance;

- names and qualifications of persons responsible for manifesting waste to be removed from site;
- contingency procedures in the event that environmental protection goals are not being met;
- methods for monitoring haul barges and vessels for leakage; and,
- site layout figures and supporting schematics (e.g., showing work and laydown areas).

The Contractor will be responsible for preparing an EPP specific to their assigned activities which could include the following components:

- Wastewater Management and Disposal Plan (WWMDP), including management and/or discharge of wastewater derived from construction activities and personal hygiene and decontamination facilities on-site;
- Pollution Control Plan (PCP);
- Stormwater Pollution Prevention Plan (SWPPP);
- Temporary Erosion and Sedimentation Control Plan (TESCP);
- Sustainable Remediation Efforts (e.g., equipment management, energy and air emissions, Waste Management Plan, energy reduction);
- Noise/Light Control;
- Aquatic Water Quality Control Plan (AWQCP), including proposed working practices and Temporary Re-suspension Barrier Control Plan;
- Waste Reduction Work Plan (WRWP); and,
- Materials Source Separation Program (MSSP) Plan.

An Environmental Monitoring Implementation Plan (EMIP) will be prepared for Phase 2 of the Project and is discussed in further detail in Section 6.1. A separate Phase 2 Water Quality Monitoring Plan (WQMP; G3, 2014c) has also been generated as a stand-alone document and is provided for reference in Appendix 4 of this report. The WQMP provides water quality monitoring criteria for implementation of management action, decision frameworks for Phase 2 specific activities and identifies monitoring locations and rationale. The EMIP provides specific methodology for all monitoring activities to meet the specifications of the WQMP, EMP and all government regulations.

2.0 ENVIRONMENTAL SETTING

This section provides a summary of the resources and uses of the Esquimalt Graving Dock (EGD) Waterlot Sediment Remediation Program Work Site. A more detailed description is provided in the Phase 2 Environmental Effects Evaluation (EEE; G3, 2014a) and CEAA Screening Environmental Assessment (Screening EA; Golder, 2012b).

2.1 Aquatic Resources

Intertidal areas associated with Phase 2 of the EGD Waterlot Sediment Remediation Project have been modified during Phase 1 work from their original conditions with the installation of the SPW and consist of shaded riprap and concrete structures beneath the South Jetty. Subtidal sediments in the EGD Waterlot were shown to be contaminated by metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), tributyltin (TBT), dioxins (TCDDs) furans (TCDFs) and organochlorine pesticides.

As a result of historic shoreline modifications and contamination (which this project seeks to address), biological communities are highly impacted and demonstrate low abundance and diversity of macroalgae and benthic invertebrate communities (Golder, 2012b). Kelp beds were identified in lower and upper subtidal areas nearby the Work Site; however, none have been observed within the Phase 2 Work Area. Neither eelgrass nor clam beds were identified in the overall work site.

Rockfish (*Sebastes* sp.), Pacific herring (*Clupea pallasii*) and several Pacific salmon species (*Oncorhynchus* sp.) have been observed in the EGD and surrounding waterlot; however, finfish observations have been infrequent and dominated by flounders and sculpins (Archipelago, 2009; unpublished EGD records).

Harbour seals (*Phoca vitulina richardsi*), northern river otter (*Lontra canadensis*) and California (*Zalophus californianus*) and Steller sea lions (*Eumetopias jubatus*) have been observed in Esquimalt Harbour; however, use of the Work Site appears to be transitory. Cetaceans such as resident and transient (Bigg's) killer whales (*Orcinus orca*), harbour porpoise (*Phocoena phocoena*) and Dall's porpoise (*Phocoenoides dalli*) are known to occur in coastal regions of southern Vancouver Island; however, they are unlikely to occur in Esquimalt Harbour.

2.2 Terrestrial Resources

Project works will be primarily marine-based, with terrestrial ecological resources potentially affected confined to birds and small vertebrates. Birds observed in and adjacent to Esquimalt Harbour during annual Christmas bird counts included loons, grebes, cormorants, herons, swans, geese, ducks, gulls and passerines, among others (VNHS, 2013). These birds may traverse and forage in the Work Site; however, most are unlikely to nest due to limited habitat.

Passerine birds may nest adjacent to the Project Area in trees and shrubs along the foreshore. Barn swallows (*Hirundo rustica*), a provincially blue-listed species, may nest under the South Jetty; however, as indicated below, no old or active nests were observed during a field assessment in 2010 (Golder, 2010).

An osprey (*Pandion haliaetus*) nest was located on a light stand near the western end of the South Jetty until February, 2012, at which time it was relocated to an upland area removed from the Project under a permit issued pursuant to the British Columbia *Wildlife Act* (Permit #NA 12-76959). Since this relocation no ospreys have returned to occupy the site.

Terrestrial wildlife, such as deer, raccoons and mink, has been observed within the EGD property. The area may be used as breeding or foraging grounds or for passage to other areas. Intertidal areas are often used by raccoons and other small vertebrates for foraging; however, the Phase 2 Project Area would provide a small portion of their diet given that the intertidal area is of low quality and highly disturbed.

2.3 Species at Risk

Within the Phase 2 Project Area species may occur that are federally or provincially designated as being at risk. The species potentially being at risk is dependent on a federal and/or provincial designation. Federal or provincial classifications which may apply to this Project are:

The federal Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designation:

- Endangered (E) - A wildlife species facing imminent extirpation or extinction;
- Threatened (T) - A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction;
- Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats; and,
- Not at Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

The federal *Species At Risk Act* (SARA) designation:

- 1-SC, 1-T and 1-E - Schedule 1 of the *Species at Risk Act* is the official list of wildlife species at risk in Canada. It includes species that are extirpated (extinct in Canada), endangered, threatened, and of special concern. Once a species is listed on Schedule 1, protection and recovery measures are developed and implemented.

The British Columbia Provincial Endangered Species and Ecosystems designation (BCMOE, 2013):

- Red List - Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia; and,
- Blue List - Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia.

Aquatic species listed as at risk under the above designations that could possibly occur at the Work Site are summarized in Table 7-1 and include:

- Cutthroat trout (*Oncorhynchus clarkii clarkii*);
- Northern abalone (*Haliotis kamtschatkana*);
- Olympia oyster (*Ostrea conchaphila*)
- Steller sea lion (*Eumetopia jubatus*);
- Harbour porpoise (*Phocoena phocoena*); and,
- Killer whale (*Orcinus orca*; Northeast Pacific southern resident population and West Coast transient [Bigg's] population).

Terrestrial species listed as at risk under the above designations that could possibly occur in the Project Area are summarized in Table 7-2 and include:

- Barn swallow (*Hirundo rustica*);
- Brandt's (*Phalacrocorax penicillatus*) and double-crested (*P. auritus*) cormorants;
- Caspian tern (*Hydroprogne caspia*);
- Common murre (*Uria aalge*);
- Great blue heron (*Ardea herodias fannini*);
- Marbled murrelet (*Brachyramphus marmoratus*); and,
- Purple martin (*Progne subis*).

2.4 Archaeological Resources

An archaeological overview assessment was conducted for the overall Project Area which included the area beneath the South Jetty (Golder, 2012d). In summary, the assessed archaeological potential for the Work Site was as follows:

- no potential was identified for a heritage wreck in the Project Area (Northern Maritime Research, 2002); and,
- potential was identified for intact archaeological materials located under the western part of the South Jetty.

An Archaeological Impact Assessment (AIA) was conducted in November 2014 and no historically significant material was identified (report pending).

In the event of an archaeological find, Chance Find Procedures shall be followed by the Contractor.

2.5 Navigation Resources

Esquimalt Harbour is administered by Department of National Defence (DND) and governed by the *Canada Marine Act*, *Natural and Man Made Harbour Regulations* (pursuant to the *Canada Marine Act*) and local Practices and Procedures (Government of Canada, 2014a). The harbour is open to the public within the limitations set out in an Order in Council with respect to Controlled Access Zones that provide for security zones around warships berthed or moving in the harbour. Vessels entering or departing Esquimalt Harbour are requested to contact Queens Harbour Master (QHM) Operations (Government of Canada, 2014a). Ship repair work at EGD may take place 24-hours-a-day, seven-days-a-week, 365-days-a-year (PWGSC, 2014). Given that ship repair may take place at all times, ships frequently navigate in and out of the area surrounding the Phase 2 Work Area. Emergency docking of ships at the graving dock may need to occur during the Project.

3.0 ROLES & RESPONSIBILITIES

This section describes the roles and responsibilities of Public Works and Government Services Canada (PWGSC), Esquimalt Graving Dock (EGD) staff, PWGSC's designated Environmental Monitor (EM), and Contractor implementing, inspecting and reporting on the effectiveness of the environmental protection and mitigation measures. These roles and responsibilities illustrated in the following diagram (Figure 3-1) with each group identified and defined in Table 3-1.

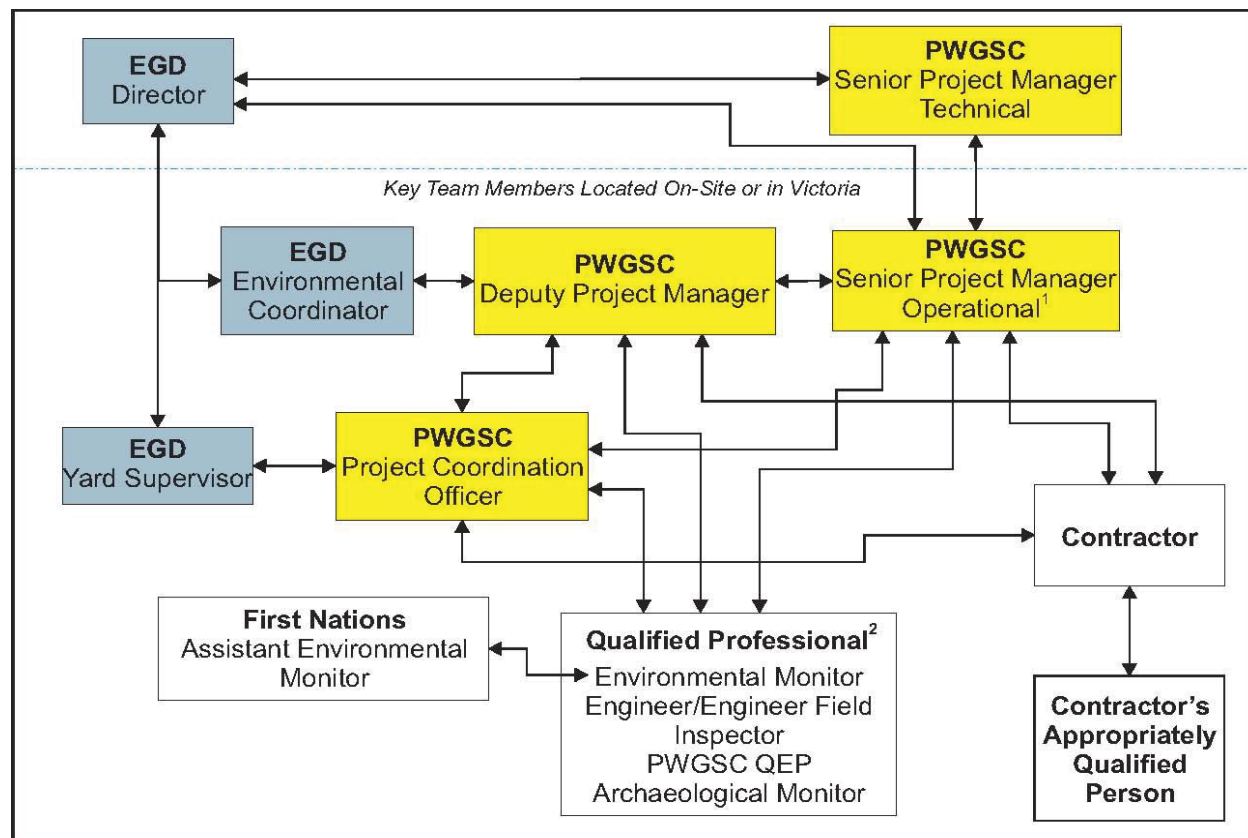


Figure 3-1: Communication Diagram

EGD – Esquimalt Graving Dock; PWGSC – Public Works and Government Services Canada; QEP – Qualified Environmental Professional

Note: This communication diagram focusses on communication regarding environmental management; additional communication may exist for other purposes.

¹The PWGSC Senior Project Manager – Operational is also the Departmental Representative (DR).

²Qualified Professionals may communicate with each other as necessary.

3.1 Public Works & Government Services Canada

As the proponent of the Project, PWGSC has overall responsibility for the Project and the following obligations:

- administration of contracts;
- construction management and confirmation of Contractor compliance with plans and contract requirements, including those related to environmental protection;
- verifying compliance with terms and conditions of regulatory permits, approvals and Authorizations as mandated under federal and provincial legislation;
- managing communications and relations with EGD Operations and tenants, public stakeholders, regulatory agencies and First Nations; and,
- coordinating review of the Contractor's Environmental Protection Plan (EPP).

Specific roles of PWGSC are summarized in Table 3-1.

Table 3-1: Summary of PWGSC Roles & Responsibilities for Environmental Management	
Role	Responsibility
Senior Project Manager – Technical (SPM-T)	<p>PWGSC staff member responsible for coordinating the delivery of the entire project, who will:</p> <ul style="list-style-type: none"> • interface with the senior management of PWGSC and participating departments (e.g., DND) and serve as senior PWGSC Environmental Specialist spokesperson for the project; • with other senior managers establish an appropriate organizational structure, and assign and detail roles and responsibilities to the project team; • be responsible for maintaining consistency between project implementation and previously defined objectives and decisions; • act as the senior project representative in meetings with First Nations or public; • attend project meetings as required; and, • be responsible for verifying that lessons learned are documented.
Senior Project Manager – Operational (SPM-O)	<p>PWGSC staff member responsible for delivery of all project components, who will:</p> <ul style="list-style-type: none"> • act as the primary on-site contact (Departmental Representative [DR]) for the Contractors, consultants, and EGD staff; • identify and resolve technical issues arising during the Project; • be responsible for project delivery and results meeting management objectives; • be responsible for verifying that all legislative and regulatory requirements are met and approvals obtained; • chair project meetings such as pre-construction/start-up meetings; and, • document lessons learned on a continuous basis.
Deputy Project Manager (DPM)	<p>PWGSC staff member responsible for on-site delivery of project components, who will:</p> <ul style="list-style-type: none"> • manage day-to-day implementation of project work on-site; • monitor progress of the Project; • liaise with Project Coordination Officer to coordinate work on-site; • attend and/or chair project meetings such as pre-construction/start-up meetings; • with Project Manager act as the primary authority to direct the Contractors and consultants carrying out the work; • be responsible for on-site liaison and coordination between client, design consultants and Contractors; • monitor and resolve issues related to on-site work; • be responsible for verifying that construction monitoring/quality assurance inspections (design consultants) and health and safety inspections are conducted and documented; • be responsible for verifying that environmental monitoring is conducted (environmental monitoring consultant); • conduct additional inspections as required to verify design consultant and environmental monitoring consultant reports; and, • document lessons learned on a continuous basis.
Project Coordination Officer (PCO)	<p>PWGSC staff member responsible for on-site project coordination for all project work, who will:</p> <ul style="list-style-type: none"> • liaise with the Deputy Project Manager and EGD Yard Supervisor. • make bookings and coordinate support for on-site project meetings, and attend project/construction meetings; • facilitate site access and egress for Contractor and consultants; • notify EGD Operations, tenants, and users of planned/on-going project work; • notify DND of planned/on-going project work in Esquimalt Harbour or work that may affect DND operations; • generally monitor on-site work; • prepare daily inspection/progress reports and photo logs of all work; • review Environmental Protection Plan prior to start of work; and, • monitor Contractor and consultant general compliance with EGD policies and procedures.

Con'd...

**Table 3-1: Summary of PWGSC Roles & Responsibilities
for Environmental Management (con'd)**

Role	Responsibility
EGD Director	<p>Primary EGD Operations representative, who will:</p> <ul style="list-style-type: none"> provide site-specific operational input, including specific site requirements or project restrictions, to project team as required; identify other projects or operations and maintenance that may conflict with Project work; delegate specific duties to the EGD Environmental Coordinator to facilitate implementation of the Project within site operational environment; and, be the: <ul style="list-style-type: none"> primary authority for design criteria and project decisions related to operational impacts; senior liaison with EGD personnel, tenants and users; primary contact for public questions/questions through the EGD hotline phone messaging centre.
EGD Yard Supervisor	<p>Secondary EGD Operations project representative, who will:</p> <ul style="list-style-type: none"> be the primary contact for day-to-day coordination with EGD Operations, site tenants, and users; have primary responsibility for managing tenant / user issues and / or conflicts, including vessel movement; liaise with the EGD Environmental Coordinator, PCO, and DPM; notify PCO of emergency dockings or other emergencies that may require changes to project work; in coordination with PCO direct changes to site operations to avoid or minimize conflict with project work, or identify required changes to project work or schedule; and, attend project meetings as required.
EGD Environmental Coordinator	<p>EGD senior project representative to EGD Operations, tenants, users, and clients, who will:</p> <ul style="list-style-type: none"> provide assistance to the EGD Director for project-related responsibilities; identify capital projects, operations and maintenance activities or client/user activities that may conflict with project work; and, assist DPM with resolution of major project coordination issues

DND – Department of National Defence; EGD – Esquimalt Graving Dock; PWGSC – Public Works and Government Services Canada

Note: Roles and responsibilities as identified by PWGSC (2013).

3.2 Contractors

The Contractor will be responsible for the actions of their agents, employees and sub-contractors and will undertake all reasonable actions to have environmental protection measures in place and working effectively throughout the Phase 2 Work Area (Appendix 1, Figure A2). The Contractor is responsible for:

1. adhering to requirements set forth in any regulatory document (e.g., legislation), and all contract requirements, including this Environmental Management Plan (EMP);
2. undertaking effective communication with work crews and sub-contractor 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;
3. retaining an appropriately qualified person to prepare the Environmental Protection Plan (EPP) and evaluate performance against the requirements outlined in regulatory documents and Best Management Practices, as well as environmental protection goals provided in this EMP and contract requirements;
4. implementing and conducting work activities in a manner that adheres to the water quality criteria detailed in the Water Quality Monitoring Plan (WQMP);
5. using equipment and implementing work procedures and controls to prevent and/or reduce work-related disturbance to environmental, social, heritage, archaeological and cultural resources;
6. implementing appropriate best management practices (BMPs): *General BMPs* as defined in Section 7.2 and *Activity Specific BMPs* as defined in Section 7.3;

7. implementing preventative and corrective measures in response to non-conformance with stated criteria (i.e., WQMP), regulatory documents and the contract requirements including this EMP;
8. responding immediately to emergencies and incidents as defined in Section 5 of this document;
9. quality assurance sampling; and,
10. reporting all water quality data collected (e.g., quality assurance, interior assessment point samples for modelling, barge dewatering, TRB function) in weekly reports to PWGSC.

3.3 Anchor QEA

Anchor QEA, the lead consultant and project engineer for remediation, is responsible for:

- technical review of Contractor submittals;
- field inspection to monitor compliance with contract requirements, ensuring that all work is completed in compliance with the *Phase 2 Demo-Remediation Specification* and contract;
- liaising with the PWGSC SPM-O during the Project; and,
- routine coordination with the EM in support of environmental monitoring and post-dredge confirmatory sampling.

3.4 Environmental Monitors (EM)

In addition to the Contractor's appropriately qualified person, PWGSC will retain an Environmental Monitor (EM) to confirm that environmental management measures and controls are implemented in accordance with regulatory documents, environmental components of the contract requirements, including this EMP and WQMP as well as the EPP prepared by the Contractor. Environmental monitoring tasks are to be conducted by, or under, the supervision of a Qualified Environmental Professional (QEP) following procedures outlined in the Environmental Monitoring Implementation Plan (EMIP). For the purposes of this EMP, a QEP is defined as an applied scientist specializing in the area of biology, who:

- is registered in British Columbia and in good standing with an appropriate professional organization; and,
- through suitable education, experience, accreditation and knowledge, may reasonably be relied upon to provide advice regarding environmental management of the Project.

It is anticipated that various personnel will be necessary to undertake different monitoring components for the Project (e.g., water quality, aquatic mammals, etc.) and the experience of the personnel used should reflect those needs.

The EM will:

1. prepare an EMIP that outlines the type and frequency of observations and data collection that will be made (including quality control sampling);
2. prepare and deliver environmental orientation sessions to work crews;
3. document work activities and evaluate them against regulatory documents, environmental components of the Contractor's Contract, this EMP and WQMP (as provided in Appendix 4);
4. the EM will advise PWGSC DR when work practices may need to be modified or improved to achieve the established environmental protection goals of the Project;
5. compile and maintain environmental monitoring data, including visual observations, and related documentation (including environmental monitoring reports); and,
6. assist in responding to emergencies and environmental incidents as defined in Section 5.

Different roles and types of monitoring personnel will be defined in the EMIP.

4.0 REGULATORY SETTING

This section provides a summary of federal and provincial environmental legislation and municipal bylaws. The regulations and bylaws provide the framework for the procedures described in Section 7 of this Environmental Management Plan (EMP). This section is not necessarily exhaustive or inclusive. It is the Contractor's responsibility to understand the regulatory context governing their activities and to conduct all activities in a manner which conforms to those regulations. Should clarification of any environmental issue be required, the Contractor should consult the original regulations or legislative documents and seek clarification with the Departmental Representative (DR) as needed.

Although provincial laws and municipal by-laws generally do not apply on federal lands, the Contractor will respect provincial laws and municipal by-laws and rules at the Esquimalt Graving Dock (EGD) Work Site.

Selected federal, provincial, regional and municipal legislation, regulations and bylaws applicable to the environmental scope of Phase 2 of the Project are listed in Appendix 2.

5.0 ENVIRONMENTAL INCIDENTS

An environmental incident is an event that has caused, or has the potential to cause, one or more of the below and should be fully understood by all Contractors conducting activities in the Project Area:

- damage to aquatic or terrestrial habitat that has not been granted Authorization;
- adverse/harmful effects to human health, fish, wildlife or other environmental resources;
- adverse publicity associated with impacts on the environment; and,
- violation of statutes, conditions of permits, regulations or environmental damage.

Examples of environmental incidents include, but are not limited to:

- spills of oil, fuel, or other potentially hazardous chemicals;
- discharges of deleterious substances into fish-bearing watercourse;
- water coming into contact with curing concrete and entering a watercourse;
- landslides, erosion, or floods with the potential to adversely affect environmental quality;
- harmful alteration, disruption, or destruction of fish habitat without prior written approval and Authorization; and,
- “serious harm to fish”, which is the death of fish or any permanent alteration to, or destruction of, fish habitat.

All environmental incidents are to be reported to the Public Works and Government Services Canada (PWGSC) Departmental Representative (DR) immediately. An Environmental Incident Report (EIR) is to then be prepared and submitted by the Contractor, sub-contractor or PWGSC’s designated EM to provide a timely and accurate internal written notification of environmental incidents to PWGSC. The deadline for submission of the EIR is within 24 hours following an incident. The EIR, an example of which is provided in Appendix 5, is to include the following:

1. date and time of the incident;
2. who or what activity generated the incident;
3. who reported and responded to the incident;
4. agencies notified or on-scene;
5. safety and/or environmental concerns;
6. substance spilled (if unknown describe appearance, odour);
7. estimated quantity spilled, the duration of the release and the basis for estimate;
8. location of spill;
9. polluter and/or source of spill;
10. location and estimates of size and media affected environment (marine, land, etc.);
11. consequences (fish kill, spill contained, evacuation, etc.);
12. actions taken to mitigate the incident and estimate of effectiveness; and,
13. preventative measures implemented following the incident.

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). In addition to formal EIR written reporting and Provincial Emergency Program (PEP) reporting (where required), PWGSC DR will be notified when an incident occurs. As well as internal reporting to PWGSC it may be necessary in some situations for PWGSC to notify regulatory agencies (Environment Canada [EC], DFO, BCMOE), local municipal environmental representatives (Township of Esquimalt, City of Colwood), owners of neighbouring properties (e.g., DND, QHM) of the environmental incidents. PWGSC will determine what reporting is warranted and undertake these actions as deemed necessary.

In the event that the incident is considered an emergency and PWGSC representatives are unavailable 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 the DR.

Contractors are to be aware of EGD spill prevention and response procedures (EGD Spill Contingency Plan; Appendix 8).

6.0 ENVIRONMENTAL MONITORING

Environmental monitoring describes the processes and activities that will take place to ensure all environmental commitments detailed in regulatory documents and Best Management Practices (BMPs) are implemented to maintain the quality of the environment and protect ecological and human health.

6.1 Environmental Monitoring Implementation Plan

An Environmental Monitoring Implementation Plan (EMIP) was developed as part of the Project to verify and document that the objectives of environmental legislation and terms and conditions of environmental contract requirements (which include this Environmental Management Plan [EMP]) are being met. The monitoring program is defined by this EMP and Water Quality Monitoring Plan (WQMP; Appendix 4; G3, 2014c). The EMIP is to be finalized prior to commencement of work and will include the following:

1. confirmation of roles and responsibilities of Project Authorities and Contractors;
2. contact instructions for all Project entities with pre-defined lines of communication;
3. type, method and frequency of monitoring observations, sampling locations, data collection, sample collection and analysis and handling and chain of custody procedures to be followed;
4. details of inspections of the Work Site (visual observations) including inspections of dredging equipment and dewatering barge and other construction equipment, fuel delivery, transfers and storage, emergency spill response and containment equipment and condition of the Temporary Re-suspension Barrier (TRB) and sheet pile wall (SPW);
5. assessments of non-hazardous waste management programs; and,
6. methodologies for the monitoring of water and effluent quality, air quality, underwater noise, surface noise, aquatic mammals and migratory birds.

6.2 Environmental Monitoring Reporting Procedure

Reporting will involve submission of daily and weekly environmental monitoring reports. Weekly reports will be of a quality suitable for submission to regulatory agencies, First Nations and public stakeholders, as required during the course of the project. Monitoring reports are to be prepared by the Environmental Monitor (EM) and include, at a minimum, the following information requirements (example templates for Environmental Monitoring reports are provided in Appendix 5):

1. a description of construction activities undertaken during the reporting period;
2. a description of environmental issues and corresponding mitigation measures implemented;
3. tracking of emerging and outstanding environmental issues;
4. results of monitoring and testing (e.g., water quality data, noise data, observations of aquatic mammals);
5. compliance assessments of the TRB;
6. compliance assessments and ongoing data summary of TRB opening activities and procedures; and,
7. photos documenting construction activities, environmental issues, corresponding mitigation measures and any adopted lessons learned.

The EM will also prepare an Environmental Completion Report one month following completion of the work. The report prepared following completion of Phase 2 work will provide an overall summary of the Project including, representative site photographs, a summary of monitoring data collected, a summary of construction activities, environmental management and issues during construction, how these issues were managed, mitigation measures and additive measures in response to lessons learned and recommendations.

6.3 Orientation & Meetings

Environmental requirements of the Project will be addressed in regular meetings to provide Contractor and their crews with information to carry out the obligations of regulatory documents and the environmental requirements of the contract, including this EMP.

6.3.1 Pre-Construction Meetings

The pre-construction meeting held between the Contractor and Public Works and Government Services Canada (PWGSC; and PWGSC's agents including the EM) will include an environmental agenda item that addresses, at a minimum, the following:

1. a review of environmental requirements of the contract;
2. transfer of further relevant information or precautions that PWGSC is aware of, and which pertain to the contract;
3. consequences of non-compliance with environmental law and other regulatory guidance and contract specific environmental requirements; and,
4. reporting of environmental incidents and emergencies.

6.3.2 Pre-Work Orientation Meetings

The EM will attend and document pre-work orientation meetings (which may be conducted in association with regular Contractor meetings) with field crews prior to the initiation of work to advise them of the site-specific environmental requirements of work at that location. Additional orientation meetings will be undertaken as necessary, for example when project conditions and/or activities change or new Contractors enter the site.

Contractors' staff will sign and date a Pre-Work Orientation Record confirming that they have received an orientation (a template for the record is provided in Appendix 5). The EM will maintain a registry of Contractors' employees who have attended pre-work orientation meetings, together with copies of meeting records. These records will be kept on file for auditing by PWGSC.

6.3.3 Tailgate Meetings

Environmental requirements will be addressed, as necessary, based on the nature of the work being conducted, in daily tailgate/health and safety meetings. These meetings will be used to review environmental requirements of the work and environmental precautions applicable to the work. The Contractor will keep a record of environmental requirements addressed in daily tailgate meetings and provide to PWGSC upon request.

7.0 ENVIRONMENTAL REQUIREMENTS & BEST MANAGEMENT PRACTICES

This section is an overview of environmental requirements of the Project and intended to be used in conjunction with legislation and other guidance documents (e.g., those listed Section 4), environmental permits and approvals issued for the Project (Section 7.1) and contract requirements specified for the Project. The environmental requirements defined are based on Project risks identified in the Phase 2 Environmental Effects Evaluation (EEE; G3, 2014a), CEAA Screening Environmental Assessment (Screening EA; Golder 2012b), applicable environmental legislation and relevant Best Management Practices (BMPs) provided within this Environmental Management Plan (EMP).

General and Activity Specific BMPs applicable to this Project are detailed within this section. *General BMPs* should be reviewed by all Contractors, sub-contractors, environmental monitors and any other individuals contributing to Phase 2 of this Project, while *Activity Specific BMPs* apply to activities identified in the Divisions of the *Phase 2 Demo-Remediation Specification*. Any Divisions or sections included in the *Phase 2 Demo-Remediation Specification* that have no activity specific BMPs are not included in the *Activity Specific BMPs* section.

It is the responsibility of the individual Contractor conducting the activity to familiarize themselves with all *General and Activity Specific BMPs*. The Public Works and Government Services Canada (PWGSC) designated Environmental Monitor (EM) and Contractor's appropriately qualified person should ensure that Phase 2 activities are being conducted consistent with applicable environmental legislation and relevant BMPs; however, ultimately the responsibility for compliance to BMPs, legislation and other environmental requirements resides with the Contractor and/or their assigned representative conducting the activity.

7.1 Environmental Authorizations, Permits & Approvals

Contractors are responsible for ensuring that all employees are trained and qualified to undertake specific work in an environmentally responsible manner and are aware of all environmental guidelines and criteria (e.g., contract specifications, EMP, WQMP, legislation) relevant to their activity.

For Phase 1 an Approval under the *Navigable Waters Protection Act (NWP)* was granted (8200-2003-500198 [8200-03-8256.3]). In April 2014 the *NWP* was repealed and replaced by the *Navigation Protection Act (NPA)*. As Phase 2 work will begin after this change occurs, all Phase 2 work must comply with the provisions of the *NPA*; however, an Authorization is not required.

In September, 2012, Phase 1 obtained *Fisheries Act* Authorization No. 11-HPAC-PA3-00016 pursuant to Section 35(2) for the harmful alteration, disruption or destruction of fish habitat and Section 32 for the killing of fish by means other than fishing (note – this approval was for Phase 1 only).

In November 2013, changes were made to the *Fisheries Act* that combined section 32 and section 35 into a revised section 35 that includes “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”. Under the revised *Act* a Request for Review (RFR) was submitted to Fisheries and Oceans Canada (DFO) (February 26, 2014; DFO File #: 14-HAPC-00210) and after review DFO determined that an Authorization for Phase 2 would not be required as long as the mitigation measures outlined in the RFR were followed (DFO, 2014a).

General BMPs

7.2 General BMPs

The following are *General Best Management Practices (BMPs)* for any and all activities undertaken in and about the Esquimalt Graving Dock (EGD) facility. They are a broad set of BMPs identifying a range of environmental goals and as such, should be used in conjunction with *Activity Specific BMPs* where applicable. These BMPs should be consulted at all times as to their application to a given activity. It is the responsibility of the individual conducting work activity at the EGD site to ensure compliance with all BMPs detailed below in addition to any additional *Activity Specific BMPs* that may apply.

The *General BMPs* apply to all Contractors conducting activities at the EGD site and are divided into the following categories:

- 7.2.1 Regulations
- 7.2.2 Marine Animal Interactions
- 7.2.3 Terrestrial Animal Interactions (Excluding Birds)
- 7.2.4 Bird Interactions
- 7.2.5 Noise & Lighting Control
- 7.2.6 Spill Prevention
- 7.2.7 Working In or About Water
- 7.2.8 Erosion & Sedimentation Control
- 7.2.9 Air Quality Management
- 7.2.10 Waste Management (Including Hazardous Waste)
- 7.2.11 Special Procedures for Contaminated Sites
- 7.2.12 Site Access

Environmental monitoring associated with this section (*General BMPs*) will be undertaken by PWGSC's EM to ensure compliance with all relevant BMPs, the WQMP and assessment criteria to verify that performance objectives are being met and enable management decisions in the event that the performance objectives are not met. It is the responsibility of the individual conducting the activity to ensure the application of all applicable BMPs are implemented in accordance with this EMP. The Contractor must also monitor works to ensure compliance.

The Contractor's appropriately qualified person shall ensure that all staff members acting on behalf of the Contractor are aware and have the necessary resources to implement the BMPs.

The Environmental Monitoring Implementation Plan (EMIP) will be used by the EM. The EMIP describes in detail how to undertake environmental monitoring during Phase 2 of the Project and ensure that work is completed in accordance with the requirements of the EMP, EGD Environmental BMPs (EBMPs), EGD Environmental Policy, Contractor's Environmental Protection Plan (EPP), environmental components of the Project Contract requirements and the WQMP.

7.2.1 Regulations

- BMP01** The Contractor shall comply with all local bylaws, rules, and regulations enforced at the location concerned. Although provincial laws and municipal by-laws generally do not apply on federal lands, Contractor shall respect and comply with provincial and municipal bylaws and rules at the EGD Project Area (Appendix 2).
- BMP02** Meet or exceed requirements of the contract documents, specified standards, codes, referenced documents and be prepared to demonstrate this through appropriate records.
- BMP03** In any case of conflict or discrepancy, the more stringent requirements shall apply.
- BMP04** Workplace Hazardous Materials Information System (WHMIS) guidelines and procedures must be followed by all workers. Material Safety Data Sheets (MSDS) must be available to all workers for all products used on-site.

7.2.2 Marine Animal Interactions

Contractors operating in and about the EGD Project Area may encounter a variety of marine animals during the course of work. Some of these animals might include Species at Risk (SAR) which are protected under the federal *Species at Risk Act*. It is an offense to disturb any species protected by the *Act* and is the responsibility of Contractor to be familiar with marine animals likely to be present in the Project Area (for listed marine animals see Table 7-1; for all SAR see Golder, 2012b and G3, 2014a).

Rockfish (*Sebastes* sp.), Pacific herring (*Clupea pallasii*) and several Pacific salmon species (*Oncorhynchus* sp.) have been observed in the Esquimalt Graving Dock and surrounding waterlot; however, finfish observations have been infrequent and dominated by flounders and sculpins (Archipelago, 2009; unpublished EGD records).

Aquatic mammals not classed as SAR observed in Esquimalt Harbour include Harbour seals (*Phoca vitulina richardsi*), northern river otters (*Lontra canadensis*) and California sea lions (*Zalophus californianus*); however, the Project Area use appears to be transitory. Cetaceans such as Dall's porpoises (*Phocoenoides dalli*) are also known to occur in the coastal regions of southern Vancouver Island but are unlikely to occur in Esquimalt Harbour.

Marine animals classified as at risk that may occur in the Work Area are cutthroat trout (*Oncorhynchus clarkii clarkii*), northern abalone (*Haliotis kamtschatkana*), Steller sea lion (*Eumetopia jubatus*), harbour porpoise (*Phocoena phocoena*) and killer whale (*Orcinus orca*; Northeast Pacific southern resident population and West Coast transient [Bigg's] population; Table 7-1).

In addition to BMPs for Noise and Lighting Control (Section 7.2.5) the following BMPs should be employed to mitigate marine animal interactions at the Work Site:

BMP01 All wildlife must be left alone.

BMP02 If abalone or cutthroat trout are observed or recovered within the Temporary Re-suspension Barrier Containment Area (TRBCA) during Phase 2 work the DR shall be notified immediately and management actions taken (i.e., stop-work and adhere to DFO abalone protocols for removal/recovery). The DR must contact DFO and abide by the *Fisheries Act* and *Species at Risk Act*.

BMP03 If any cetacean enters the Discretionary Cetacean Safety Zone (Appendix 1, Figure A3) during in-water activities, the observer will follow the appropriate communication pathway detailed in Section 3.0 for immediate communication to the DR. In-water work may be suspended by the DR at their discretion. The DR will assess the potential for activities inside and outside the TRB to disturb or interfere with the aquatic mammal. Low risk activities may continue within the TRB at the discretion of the DR. The Discretionary Cetacean Safety Zone is 500 m from the western most point of the Project Boundary.

If any cetacean enters the Cetacean Safety Zone during in-water activities, the observer will follow the appropriate communication pathway detailed in Section 3.0 for immediate communication to the DR whereby in-water work will be suspended if directed by the DR. The Cetacean Safety Zone is 500 m from the in-water works. The Cetacean Safety Zone border will slide east-west as in-water work progresses east-west.

If any pinniped enters the Discretionary Pinniped Safety Zone during in-water activities, the observer will follow the appropriate communication pathway detailed in Section 3.0 for immediate communication to the DR. In-water work may be suspended by the DR at their discretion. The DR will assess the potential for activities inside and outside the TRB to disturb or interfere with the aquatic mammal. Low risk activities may continue within the TRB at the discretion of the DR. The Discretionary Pinniped Safety Zone is 25 m from the Project Boundary.

BMP04 The DR will assess the potential for activities to disturb or interfere with the marine mammal and decisions on the impact of the activity on the marine mammal will be made.

- BMP05** If work is suspended, activities will not resume until the EM has confirmed to the DR that the marine mammal is outside the marine safety zone (as described in BMP03), or if a minimum of 10 minutes has elapsed since the animal was last sighted within the safety zone. If the mammal exits the safety zone but is still observed within the Discretionary Safety Zone the DR will follow BMP04.
- BMP06** In the event that a marine mammal becomes trapped within the TRBCA, the observer shall contact the DR immediately. Under no circumstances will any Contractor, EM or DR attempt to capture or molest any marine mammal.
- BMP07** If a marine mammal is unable to locate the exit of the TRBCA, the DR may, at their discretion, contact the Fisheries and Oceans Canada (DFO) Injured and Distressed Marine Mammal Reporting Hotline at 1-800-465-4336.
- BMP08** When work is occurring outside specified DFO Marine/Estuarine Fisheries Timing Windows (detailed in BMP12-14 of this section), the Phase 2 work area will be monitored for the presence of aggregations of herring or salmon. If fish or eggs are present the DR may notify DFO.
- BMP09** If aggregations of herring or salmon are observed anytime within or in close proximity to the Work Area, the DR must be notified immediately. The DR will assess the potential for activities to disturb or interfere with the fish, decide on appropriate management actions and notify the Contractor and EM. At their discretion the DR may also contact DFO.
- BMP10** Herring spawn may attach below the water line to equipment, piles, the sheet pile wall (SPW) and Temporary Re-suspension Barrier (TRB) or within the Phase 2 work area. Observed herring spawn should be communicated to the DR as soon as possible. The Contractor should be familiar with the appearance of herring spawn (Appendix 1, Figure A4). Unattended structures and equipment shall be inspected prior to removal or use should removal or use coincide with Fisheries Timing Windows.
- BMP11** The DR will assess/confirm any herring spawn identified by the Contractor or EM. Management actions or a stop-work-order may be enacted with operations not re-commencing until the eggs have hatched and detached from equipment.

DFO Marine/Estuarine Fisheries Timing Windows (DFO, 2014b)

- BMP12** With the exceptions of fender log removal, fender pile extraction, navigation marker pile installation, SPW re-drive, and installation of TRB systems, there shall be no in-water works (i.e. works conducted below the water surface) conducted outside of the TRBCA during the period in any year from:
1. February 16th to June 30th; and,
 2. October 2nd to November 30th.
- BMP13** In-water works within the TRBCA and opening the TRB are permitted year-round provided works can be conducted in a manner that does not result in the deposit of a deleterious substance into waters outside of the TRBCA and does not result in water quality guideline exceedances outside of the TRBCA.
- BMP14** Removal of TRB, SPW and related piles shall be timed to prevent overlapping with herring spawn.

Table 7-1: At Risk Aquatic Species with Potential to Occur in the Project Area

Listed Species Name	COSEWIC Status	SARA Status	BC Status	Habitat and Range Description	Comments
Steller sea lion (<i>Eumetopias jubatus</i>)	SC	1-SC	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 (<i>Phocoena phocoena</i>)	SC	1-SC	Blue	Coastal waters and adjacent offshore shallows; 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 (this species has not been observed in the Project Area during surveys).
Killer whale (Northeast Pacific Southern resident population) (<i>Orcinus orca</i>)	E	1-E	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 this whale. Killer whales frequent 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 during the planned work.
Killer whale (West Coast transient [Bigg's] population) (<i>Orcinus orca</i>)	T	1-T	Red		
Cutthroat trout (<i>Oncorhynchus clarkii clarkii</i>)	NAR	NAR	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 (<i>Haliotis kamtschatkana</i>)	T	1-T	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. Phase 1 surveys did not identify any abalone in the Project Area (Archipelago, 2009, 2012).

Con'd...

Table 7-1: At Risk Aquatic Species with Potential to Occur in the Project Area (con'd)

Listed Species Name	COSEWIC Status	SARA Status	BC Status	Habitat and Range Description	Comments
Olympia Oyster (<i>Ostrea conchaphila</i>)	SC	1-SC	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.

Notes:

COSEWIC Status:

Endangered (E) - A wildlife species facing imminent extirpation or extinction;

Threatened (T) - A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction;

Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats; and,

Not at Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

SARA Status:

1-SC, 1-T and 1-E - Schedule 1 of the *Species at Risk Act* is the official list of wildlife species at risk in Canada. It includes species that are extirpated (extinct in Canada), endangered, threatened, and of special concern. Once a species is listed on Schedule 1, protection and recovery measures are developed and implemented.

BC Status:

Red List - Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia; Blue List - Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia (BCMOE, 2013).

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Federal *Species at Risk Act*.
- Federal *Fisheries Act*.
 - *Marine Mammal Regulation*.
- G3 Consulting Ltd. (G3). 2014a. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Environmental Effects Evaluation*. Prepared for Public Works and Government Services Canada.
- Golder Associates Ltd. (Golder). 2012b. *Esquimalt Graving Dock Waterlot Sediment Remediation Project CEAA Screening Environmental Assessment*. Prepared for Public Works and Government Services Canada, August 24, 2012.
- Government of Canada. 2014b. *Species at Risk Public Registry*. [online] Available at: http://www.registrelep-SARAregistry.gc.ca/default_e.cfm.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP# 9 Fish and Wildlife Management.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.

- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

7.2.3 Terrestrial Animal Interactions (Excluding Birds)

Terrestrial wildlife, such as deer, raccoons and mink, has been observed within the EGD property. The area may be used as breeding or foraging grounds or for passage to other areas. Phase 2 works have the potential to impact terrestrial wildlife as work will be occurring in the intertidal zone, where animals may forage or pass through. Stockpiling of dredged materials at the Off-Site Offload Facility may also have an effect on terrestrial wildlife.

In addition to the BMPs for Off-Site Stockpiling (Section 7.3, 35 20 23.01) and Noise and Lighting Control (Section 7.2.5) the following BMPs should be followed to minimize the impact on terrestrial animals:

- BMP01** All wildlife must be left alone.
- BMP02** If injured or abandoned wildlife is observed contact the DR immediately. The DR will contact the EGD Environmental Services to decide on appropriate management actions. Injured or abandoned wildlife must not be handled by the Contractor, EM or DR without proper experience, equipment and authorization to do so.
- BMP03** Approval from EGD Environmental Services and appropriate government authorities (e.g., DFO, EC, BC MOE) prior to relocation or removal of wildlife.
- BMP04** If any change in behavior of any terrestrial organisms is observed, DR shall be notified as soon as possible.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP# 9 Fish and Wildlife Management.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

7.2.4 Bird Interactions

There are no known bird nests located in the Project Area; however, birds have been observed foraging in the area. Birds protected under the federal *Migratory Bird Convention Act* (1994) that may be found in the Project Area include swans, geese, ducks, shorebirds, gulls, loons, grebes, herons, and cormorants. Birds listed as 'at risk' may also occur in the Project Area (Table 7-2).

BMPs regarding Noise and Lighting Control (Section 7.2.5) and the release of deleterious substances must be abided by in addition to the following BMPs:

- BMP01** Ensure that all works are in compliance with the federal *Migratory Birds Convention Act*, *Migratory Birds Regulations* and the *BC Wildlife Act*.

- BMP02** If a Contractor, in the course of their work, identifies any nesting bird, nest or eggs within the EGD Project Area, they must inform the DR. The Contractor is not to disturb any nests or eggs. The DR will assess the potential for activities to disturb or interfere with the nest/nesting bird and appropriate management actions will be taken. If the nest or eggs are to be moved a permit may be required.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Federal *Migratory Birds Convention Act*.
 - *Migratory Birds Regulations*.
- BC *Wildlife Act*.
- British Columbia Ministry of Environment (BCMOE). 2005. *Best Management Practices for Raptor Conservation during Urban and Rural Land Development in British Columbia*. [online] Available at: http://www.env.gov.bc.ca/lower-mainland/electronic_documents/raptor_bmp_final.pdf.
- Government of Canada. 2014b. *Species at Risk Public Registry*. [online] Available at: http://www.registrelep-SARAregistry.gc.ca/default_e.cfm.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP# 9 Fish and Wildlife Management.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

Table 7-2: At Risk Migratory Birds with Potential to Occur in the Project Area					
Listed Species Name	COSEWIC Status	SARA Status	BC Status	Habitat and Range Description	Comments
Barn Swallow (<i>Hirundo rustica</i>)	T	N/A	Blue	Nests in barns or other buildings, under bridges, wharves, in caves or cliff crevices, usually on vertical surface close to ceiling. Commonly reuses old nests. Flies over open land and water and forages on insects. Usually forages within a few hundred meters of nest when breeding.	Known to nest under wharves; however, no old or active nests observed indicating South Jetty is not likely suitable habitat. May forage over the Project Area.
Brandt's Cormorant (<i>Phalacrocorax penicillatus</i>)	N/A	N/A	Red	Mainly inshore coastal zone, especially in areas having kelp beds; also around some offshore islands; less commonly, inshore on brackish bays; in winter, mostly round sheltered inlets and other quiet waters. Typically nests on flat or gently sloping surfaces on tops of rocky islands along coast.	May temporarily occur in the Project Area though not likely to nest.
Caspian Tern (<i>Hydroprogne caspia</i>)	NAR	N/A	Blue	Seacoasts, bays, estuaries, lakes, marshes, and rivers. Nests on sandy or gravelly beaches and shell banks along coasts or large inland lakes; sometimes with other water birds. Seasonal resident and probably breeds on Vancouver Island but does not overwinter there.	May temporarily occur in the Project Area though not likely to nest.
Common Murre (<i>Uria aalge</i>)	N/A	N/A	Red	Non-breeding: pelagic and along rocky seacoasts. Nests in the open or in crevices on broad and narrow cliff ledges, on stack (cliff) tops, and on flat, rocky, low-lying islands. Breeds on the northern tip of Vancouver Island and overwinters around Vancouver Island.	May temporarily occur in the Project Area but would not nest.
Double-Crested Cormorant (<i>Phalacrocorax auritus</i>)	NAR	N/A	Blue	Forage in all coastal areas of BC, utilising marine habitats such as bays, estuaries, and inlets and occasionally freshwater habitats such as lakes close to coastal areas and large rivers such as the Fraser River. Bare, rocky islands with sparse vegetation are the preferred nesting habitats.	May temporarily occur in the Project Area but would not nest.

Con'd...

Table 7-2: At Risk Migratory Birds with Potential to Occur in the Project Area (con'd)

Listed Species Name	COSEWIC Status	SARA Status	BC Status	Habitat and Range Description	Comments
Great Blue Heron (<i>Ardea herodias fannini</i>)	SC	1-SC	Blue	Nest in a wide variety of tree species Pacific population nests in quiet woodlots within 8 km (most within 3 km) of foraging habitats such as large eelgrass meadows, along rivers, and in estuarine and freshwater marshes.	No nests known to occur within or adjacent to Project area though not likely to nest.
Marbled Murrelet (<i>Brachyramphus marmoratus</i>)	T	1-T	Blue	Nests often are in mature/old growth coniferous forest near the coast: on large mossy horizontal branch, mistletoe infection, witches broom, or other structure providing a platform high in mature conifer (e.g., Douglas-fir, mountain hemlock). Most nesting occurs in large stands of old growth.	May temporarily occur in the Project Area but would not nest.
Purple Martin (<i>Progne subis</i>)	N/A	N/A	Blue	Breeds but does not overwinter on Vancouver Island. Nest in natural cavities and woodpecker holes in trees and snags, and in holes in buildings. In recent years they have been almost entirely restricted to nest boxes and artificial holes in pilings in estuaries, bays, and harbours. Now restricted to six sites on southeast Vancouver Island (Victoria Harbour, Esquimalt Harbour, Cowichan River Estuary, Nanaimo River Estuary, Newcastle Island, and Ladysmith Harbour). Birds presumably forage over areas immediately surrounding nest site, although no information on typical travel distance while foraging.	Nests approximately 1.5 km from the Project Area. May forage over the Project Area.

Notes:

COSEWIC Status:

Endangered (E) - A wildlife species facing imminent extirpation or extinction;

Threatened (T) - A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction;

Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats; and,

Not at Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

SARA Status:

1-SC, 1-T and 1-E - Schedule 1 of the *Species at Risk Act* is the official list of wildlife species at risk in Canada. It includes species that are extirpated (extinct in Canada), endangered, threatened, and of special concern. Once a species is listed on Schedule 1, protection and recovery measures are developed and implemented.

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7.2.5 Noise & Lighting Control

The EGD Environmental Policy (2014) makes a commitment to follow all applicable municipal laws and regulations; therefore, it is expected that daily operations at the EGD Project Area will adhere to criteria of the Corporation of the Township of Esquimalt Maintenance of Property and Nuisance Regulation (2014, No. 2826) and City of Colwood Noise Bylaw (1986, No. 38) as applicable, in addition to EGD EBMPs (Appendix 3) and Project-specific guidelines (Table 7-3).

Lighting

BMP01 Spotlights will be directed away from residential areas or fitted with shrouds to direct light to the immediate Phase 2 Work Area.

BMP02 Unnecessary lighting or interim lighting should be shut off when not in use.

Noise

BMP03 Contractor shall adhere to the Township of Esquimalt Maintenance of Property and Nuisance Regulation (No. 2826) and the City of Colwood Bylaw (No. 38) at the EGD Project Area boundary and EGD EBMP#12 as detailed in Table 7-3. A maximum allowable noise level of 85 dBA for the EGD Work Site is provided as a working guideline subject to change subsequent to receipt of any residential noise complaints. In this event, work activities must be modified to reduce noise generated.

BMP04 DR to report any complaints regarding to noise to EGD Security, Health and Safety Department where a Concern Document will be filed.

BMP05 Contractor shall undertake noisier work activities during daytime hours when possible and modify activities based on noise monitoring and resident feedback.

BMP06 All construction equipment shall be maintained in good working order and operated with exhaust systems in good repair to minimize noise and in accordance to the machines specification.

BMP07 Shut down equipment when not in use.

BMP08 Use noise barriers if applicable.

BMP09 EM shall monitor noise during construction activities at the Project boundary and EGD property boundary.

BMP10 Underwater noise during pile foundation and any other underwater activities should not exceed 30 kPa <2 m outside the TRB for the protection of aquatic life. The Contractor's appropriately qualified person will be required to monitor sound within 2 m of the activity in accordance with the WQMP.

The EM will monitor noise outside the TRB at a safe distance from any activities. In the event that underwater sound level exceeds 30 kPa <2 m outside the TRB, efforts shall be made to reduce the intensity of the sound generated. Exceedances will be noted and reported to the DR immediately.

Table 7-3: Regional & Municipal Noise Bylaws		
Legislation	Application to the Project	Authorization, Approval or Permit Issued
Township of Esquimalt “Maintenance of Property and Nuisance Regulation”, 2014, No. 2826	The Regulation prohibits the noise or sound which disturbs, tends to disturb or will likely disturb the quiet, peace, rest, enjoyment, comfort or convenience of persons in the neighbourhood or vicinity between: <ul style="list-style-type: none"> • 22:00 and 07:00 h Monday to Friday; and, • 22:00 and 09:00 h on a Saturday, Sunday or holiday. 	General provisions – no Authorization issued.
City of Colwood, 1986, Bylaw, No. 38	The Bylaw to Regulate Noise within the City of Colwood prohibits the disturbance of the quiet, peace, rest, enjoyment, comfort or convenience of the neighbourhood or of persons in the vicinity, and stipulates the following construction hours: <ul style="list-style-type: none"> • 07:00 to 19:00 h Monday to Saturday; and, • 08:00 to 17:00 h on Sundays and statutory holidays. 	General provisions – no Authorization issued.
Esquimalt Graving Dock, 2010, EBMP#12	Whenever possible schedule noisier activities between: <ul style="list-style-type: none"> • 07:00 and 23:00 h on weekdays; and, • 07:00 and 19:00 h on weekends and holidays. The noise level limit for a “Construction Zone” is 85 dBA day and night ¹ .	General provisions

¹ This is a working guideline and subject to change based on receipt of any residential noise complaints.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- City of Colwood. 1986 (amended 1992). *Bylaw No. 38 – A Bylaw to Regulate Noise within the City of Colwood*. [online] Available at: <https://colwood.civicweb.net/Documents/DocumentDisplay.aspx?ID=168>.
- Corporation of the Township of Esquimalt (Township of Esquimalt). 2014. *Maintenance of Property and Nuisance Regulation, 2014, No. 2686*. [online] Available at: http://www.esquimalt.ca/files/PDF/Bylaws/Bylaw_No._2826_Maintenance_of_Property_Bylaw_Revised_May_2014.pdf.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#11 Energy Conservation.
 - EBMP#12 Nuisance Pollution (Noise/Odour/Light).
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

7.2.6 Spill Prevention

An environmental spill is the release of a deleterious substance(s) which is dangerous to health or environmentally unfriendly. Spill response procedures shall be completed in accordance with the EGD Spill Contingency Plan (Appendix 8), environmental and industry standards including:

Regulations

- BMP01** All workers on-site must be familiar with WHMIS procedures and guidelines. Any handling, transport or storage of WHMIS “controlled products” must follow appropriate WHMIS guidelines.
- BMP02** Contractors shall be fully aware of the spill prevention and response procedures. Report all spills in accordance with the BC Spill Reporting Regulations, EBMPs, EGD Spill Contingency Plan, *Fisheries Act*, EMP and WQMP.
- BMP03** DR shall be immediately informed of all spills that occur at the EGD Project Area and at Contractor's Off-Site Offload Facility. All spills should be captured on the spill response form (EIR). Further information on dangerous goods emergency cleanup and precautions including a list of companies performing this work can be obtained from the Transport Canada 24-hour number (613) 996-6666.
- BMP04** Contractor shall immediately notify the DR, contain and assess the spill, and take necessary steps to prevent further discharge. Contractor is responsible for immediate cleanup of the spill and restoration of the area to the satisfaction of DR or other regulatory agencies, when involved.
- BMP05** Spill kits including: *Universal or General Purpose Kits*, made with grey absorbents to clean up both water based fluids and hydrocarbons; *Oil Only Kits*, made with white absorbents that repel water and float on water to clean up hydrocarbons only (e.g., motor oil, jet fuel, diesel, gasoline, hydraulic oil); and, *Hazmat Kits*, made with yellow absorbents to clean up aggressive fluids such as acids and solvents, must be kept at the EGD Project Area.
- BMP06** Contractor shall take due care to ensure no deleterious materials, including sediment- or concrete- laden runoff, paints, coatings or preservatives and fuel or oil, leave the EGD Project Area or Contractor's Off-Site Offload Facility or enter any surface water or stormwater at or near the EGD Project Area or Contractor Off-Site Offload Facility.

Spill Prevention

- BMP07** Do not refuel or service equipment within 30 m of any watercourse or surface water drainage. Do not place oil/fuel storage and transfer equipment near pathways to marine or freshwater environment (i.e. storm drains, edge of the dock etc.).
- BMP08** Machinery shall not be washed within the Project Area without proper containment.
- BMP09** The EGD Fuelling and Oil Transfer Policy and Checklist must be followed (Appendix 9).
EGD Fuel and Waste Oil Transfer Checklist must be submitted to the EGD Pumphouse and signed off before any fuelling or transfer operations occur.
All berthed vessels receiving fuel from a truck or a barge or transferring greater than 10 tonnes of oil per day require a containment boom. The specification of such a boom requires review and approval by the DR.
- BMP10** Ensure equipment and machinery are free of leaks, excess oil and grease.
- BMP11** If Contractor is planning to discharge any deleterious materials, including water discharge (effluent) or sediment-laden or concrete-laden runoff, leaving the EGD Project Area or Contractor's Off-Site Offload Facility, Contractor is responsible for ensuring that appropriate discharge permits are obtained and remain on-site at all times and discharge meets permit requirements and applicable WQMP compliance criteria.

- BMP12** Use of any paints, corrosion protective coatings, wood preservatives or any other potentially deleterious substances that may be applied to surfaces that could have potential contact with the marine environment or vector to the environment, shall be applied in accordance with the EGD BMPs and environmental protection measures outlined in the EPP.
- BMP13** Any equipment remaining on-site overnight shall have appropriately placed drip pans or other spill/leak containment measures and must be placed as far away from the marine environment as possible.
- BMP14** Measures for the containment of potentially harmful substances due to rinses, cleaning water, solvents for glues, wood preservatives and other potentially harmful or toxic substances shall be identified and implemented by Contractor in a manner to prevent leakage, loss or discharge into the sewers, storm drain system or marine environment. Any waste materials should be collected, stored and disposed of in an appropriate manner.
- BMP15** Prevent the application of fog seals, tack coats or other coatings during periods when rainfall is likely.
- BMP16** During the purging of tanks and associated lines, procedures must prevent the release of any fuels or other deleterious substances to the surface, surface water, catch basins or soils within.

Storage

- BMP17** All stored materials that have the potential to negatively impact the environment, infrastructure or workers must be appropriately labelled following WHMIS protocols, including the product name, first aid information and personal protective equipment (PPE) requirements.
- BMP18** Materials must be stored in storage areas that are suitable for the materials (e.g., protected from the weather, ventilated if necessary).
- BMP19** For long-term storage, appropriate secondary containment suitable for the quantity and nature of the product being stored must be present.
- BMP20** Short-term storage and working areas must be clearly labelled and located away from pathways to any watercourse on impervious surfaces protected from the weather.
- BMP21** During transport all materials must be secured appropriately.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Federal Fisheries Act.
- BC *Environmental Management Act*.
 - *Spill Reporting Regulation*.
 - *Industrial Non-hazardous Waste Landfills Code of Practice*.
- British Columbia Ministry of Water, Land and Air Protection, and BC Forestry Service. 2002. *A Field Guide to Fuel Handling, Transportation and Storage* 3rd Edition.
- Fisheries and Oceans Canada (DFO). 1993. *Land Development Guidelines for the Protection of Aquatic Habitat*. [online] Available at: <http://www.dfo-mpo.gc.ca/Library/165353.pdf>.
- Fisheries and Oceans Canada (DFO). 2008. *General BMPs & Standard Project Considerations – Standards and Best Practices for Instream Works*. Version 1.0. [online] Available at: <http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf>.
- Health Canada. 2014. Workplace Hazardous Materials Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-sem/occup-travail/whmis-simdut/index-eng.php>.

- Public Works and Government Services Canada (PWGSC). no date. *Esquimalt Graving Dock Oil Transfer Checklist*. Prepared by Public Works and Government Services Canada.
- Public Works and Government Services Canada (PWGSC). 2007. *Esquimalt Graving Dock Fueling and Oil Transfer Policy*. Prepared by Public Works and Government Services Canada, May 29, 2007.
- Public Works and Government Services Canada (PWGSC). 2009b. *Best Management Practices for Fire Prevention – For Works, Buildings, and Vessels within the Esquimalt Graving Dock*. Prepared by Public Works and Government Services Canada, January 26, 2009.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#3 Painting and Coating.
 - EBMP#4 Dry Dock Floor Management and Cleanup.
 - EBMP#5 Hazardous Materials Handling and Storage.
 - EBMP#6 Waste Management and Recycling.
 - EBMP#7 Fuelling and Oil Transfer.
 - EBMP#14 Spill Preparedness and Response.
 - EBMP#16 Housekeeping.
 - EBMP#17 Stormwater Management.
- Public Works and Government Services Canada (PWGSC). 2010b. *Esquimalt Graving Dock Spill Contingency Plan*. Version 03. Prepared by Public Works and Government Services Canada, February, 2010.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

7.2.7 Working In or About Water

Wastewater is defined as waters produced from construction activities and personal hygiene and decontamination facilities on-site and excludes barge dewatering effluent.

- BMP01** Ensure that equipment and machinery are in good operating condition, clean (power washed), free of leaks, excess oil and grease. Do not refuel or service equipment within 30 m of any watercourse or surface water drainage. Equipment shall not be washed within the Project Area without proper containment.
- BMP02** Ensure hydraulic machinery, if required, uses environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable.
- BMP03** Do not discharge dredged material effluent to EGD on-site sewer systems.
- BMP04** Barge dewatering and discharge at the EGD Project Area, where authorized, shall comply with this EMP and criteria detailed in the WQMP.
- BMP05** Do not discharge wastewater from personnel hygiene/decontamination facility or toilet facilities on-site. Dispose of these wastewaters off-site at a permitted Wastewater Treatment and Disposal Facility.
- BMP06** Wastewater produced at the Work Site (e.g., equipment decontamination wastewater) should be tested prior to discharge in the EGD Project Area to ensure compliance with applicable water quality performance objectives for where it is intended to be released.

If to be discharged outside of the TRBCA, water quality objectives for that area must be met as per the WQMP (Water Quality Performance Criteria for Activities within the TRBCA).

For discharge within the TRBCA, it must be ensured that water quality criteria outside the TRBCA are maintained.

If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility. No deleterious substances may be released into any watercourse.

BMP07 After dredging is completed and approved by the DR within the TRBCA any wastewater for discharge into the TRBCA must meet the criteria specified for outside the TRBCA (WQMP Water Quality Performance Criteria for Activities within the TRBCA) as the area would be considered remediated.

If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility.

BMP08 Do not dump excavated fill, waste material or debris in or near any waterways.

BMP09 Special care shall be exercised while working near the water's edge, including implementation of site-specific erosion and sediment control measures detailed in Section 7.2.8 and Contractor's Temporary Erosion and Sedimentation Control Plan. Silt fences or other appropriate control measures shall be used to minimize soil or intertidal sediment transport into marine or freshwater environment.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- *Federal Fisheries Act*.
- *BC Environmental Management Act*.
 - *Spill Reporting Regulation*.
- Fisheries and Oceans Canada (DFO). 2008. *General BMPs & Standard Project Considerations; Standards and Best Practices for Instream Works*. Version 1.0. [online] Available at: <http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf>.
- Public Works and Government Services Canada (PWGSC). no date. *Esquimalt Graving Dock Oil Transfer Checklist*. Prepared by Public Works and Government Services Canada.
- Public Works and Government Services Canada (PWGSC). 2007. *Esquimalt Graving Dock Fueling and Oil Transfer Policy*. Prepared by Public Works and Government Services Canada, May 29, 2007.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#14 Spill Preparedness and Response.
 - EBMP#16 Housekeeping.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

7.2.8 Erosion & Sedimentation Control

BMP01 Contractor shall prepare and submit a Temporary Erosion & Sedimentation Control Plan (TESCP) to PWGSC as part of the Environmental Protection Plan (EPP). The TESCP shall address potential erosion and sediment control measures as required for construction activities at the EGD Project Area.

BMP02 Plan to execute construction by methods to control surface drainage from cuts and fills, borrow and waste disposal areas, stockpiles, staging areas, and other Phase 2 areas.

- BMP03** Minimize amount of bare soil exposed at one time that may migrate to the marine environment. Stabilize disturbed soils as quickly as practical. Strip vegetation, re-grade, or otherwise develop to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and watercourses and repair damage caused by soil erosion and sedimentation as directed by DR.
- BMP04** Provide and maintain temporary measures which may include concrete blocks, silt fences, hay or straw bales, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, dikes, and other construction, required to prevent erosion and migration of silt, mud, sediment, and other debris to the marine environment, or to other areas of site where damage might result, or that might otherwise be required by laws and regulations. Sediment control measures (examples in BMP4.1 through 4.3) must be available as appropriate during construction.
- BMP4.1** Hay or straw bales should be wire-bound or string-tied; securely anchored by at least two (2) stakes or rebar driven through bale 300 mm to 450 mm into ground; chinked (filled by wedging) with hay or straw to prevent water from escaping between bales; and entrenched minimum of 100 mm into ground. Repair or replace damaged bales, end runs and undercutting beneath bales.
- BMP4.2** Silt fences should be assembled as a ready to install unit consisting of geotextile attached to drivable posts. Water escaping from silt fences should not be allowed enter the marine environment and should be treated and disposed of accordingly. Conditions may dictate that a heavy duty fence (with net backing) is required.
- BMP4.3** Geotextile should be uniform in texture and appearance, having no defects, flaws, or tears that would affect physical properties and containing sufficient ultraviolet ray inhibitors and stabilizers to provide minimum 2-year service life from outdoor exposure in a saline environment. If necessary, net backing should be industrial polypropylene mesh joined to geotextile at both top and bottom with double stitching of heavy-duty cord, with minimum width of 750 mm.
- BMP05** Install temporary barriers in and around storm sewers.
- BMP06** Plan construction procedures to avoid equipment encroachment onto marine environment or drainage ditch banks which may deposit into the marine environment. In event of damage, promptly notify DR and take action to mitigate effects; restore affected bank or water body to existing condition.
- BMP07** Check erosion and sediment control measures daily and after each rainfall to ensure operational integrity. Any failures should be addressed at once.
- BMP08** Unless otherwise directed by DR, remove temporary erosion and sediment control devices upon completion of work. Spread accumulated sediments to form a suitable surface for seeding or dispose of and shape area to permit natural drainage to satisfaction of the DR. Materials, once removed, become the property and responsibility of the Contractor.
- BMP09** Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- BMP10** Do not disturb existing embankments or embankment protection.
- BMP11** Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- BMP12** If soil and debris from site accumulate in low areas, storm sewers, roadways, gutters, ditches, or other areas where, in DR's determination, it is undesirable and has the potential to migrate to the marine environment, the Contractor must remove accumulation and restore area to original condition.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- BC *Environmental Management Act*.
- Capital Regional District (CRD). 2006. Capital Regional District (CRD) Sewer Use Bylaw No. 2922 (Consolidated). Available at: <https://www.crd.bc.ca/docs/default-source/source-control-pdf/regional-source-control-bylaw---crd-bylaw-2922.pdf?sfvrsn=4>.
- G3 Consulting Ltd. (G3). 2014c. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Water Quality Monitoring Plan*. Prepared for Public Works and Government Services Canada.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#17 Stormwater Management.
 - EBMP#18 Property and Infrastructure Maintenance, Modifications and Construction.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

7.2.9 Air Quality Management

- BMP01** Dust and airborne particulate containment should be large enough to adequately enclose or segregate the working area. To reduce potential dust emissions during hot, dry weather, if being left overnight or if there are strong winds, sediment on barges, in trucks, or stockpiled on land will be covered or wetted as required.
- BMP02** Ensure that dust arising from all Contractor operations, such as barge or truck transportation, material stockpiling and demolition work, is controlled by dust screens and/or water application if necessary.
- BMP03** Apply water as required for dust control, and when directed by DR. Dust control methods shall be chosen such that a minimal amount of water is required. Apply water with distributors equipped with spray system to ensure uniform application and with means of shut off.
- BMP04** Runoff from water used for dust control shall be collected and handled as other Project wastewater (Section 7.2.10, BMP15).
- BMP05** Temporary dust tight screens or partitions must be provided to localize dust generating activities, and for protection of workers, finished areas of work, marine environment and public.
- BMP06** Maintain and relocate dust screens as necessary and remove dust screens at completion of those portions of the work that may generate airborne dust.
- BMP07** Secure and cover material in open trucks hauling excavated material and re-use the covers.
- BMP08** If Contractor's dust and particulate control is not sufficient for controlling dust and particulates into atmosphere a stop-work-order may be enacted. Discuss with DR procedures to resolve the problem. Make necessary changes to operations prior to resuming excavation, handling, processing, or other work that may cause release of dust or particulates.

- BMP09** Spray coatings (e.g., paint, sealants) must not be applied under conditions that render containment ineffective.
- BMP10** The EGD has a hand-held particulate monitor used in the event of a large or nuisance airborne discharge. If particulate matter levels in the air exceed $100 \mu\text{g}/\text{m}^3$ corrective actions must be taken.
- BMP11** Nuisance-level H_2S , such as those that may be detected by sense of smell may occur during dredging activities. The Contractor should evaluate the potential for H_2S in the Health and Safety Plan. If H_2S concentrations in air exceed guidelines (10 parts per million, ceiling short-term exposure level 1) then appropriate safety equipment (e.g., respirators with applicable filters) will be issued to workers.
- BMP12** In the event that odours are noted or complaints are received, H_2S monitoring should be undertaken in and around the Phase 2 work area where personnel are or need to be actively working.
- BMP13** Contact the DR in the event of a nuisance odour or airborne discharge.
- BMP14** Vehicle idling should be avoided especially near building doorways or air intakes.
- BMP15** The Contractor should maintain equipment and vessels in good working order and use environmentally considerate fuels wherever possible.
- BMP16** Perform routine checks of exhaust systems to identify actual or potential deficiencies and correct them in a timely manner. Repair or change out chronically deficient or severely defective equipment.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Health Canada. 2014. Workplace Hazardous Material Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-sent/occup-travail/whmis-simut/index-eng.php>.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#2 Abrasive Blasting.
 - EBMP#3 Painting and Coating.
 - EBMP#10 Water Use.
 - EBMP#11 Energy Conservation.
 - EBMP#12 Nuisance Pollution (Noise/Odour/Light).
 - EBMP#18 Property and Infrastructure Maintenance, Modifications and Construction.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.
- WorkSafe BC. 2013. *Occupational Health & Safety Guideline. Table of exposure limits for chemical and biological substances*. [online] Available at: <http://www2.worksafebc.com/publications/ohsregulation/GuidelinePart5.asp?ReportID=32895>.

7.2.10 Waste Management (including Hazardous Waste)

Wastewater is defined as waters produced from construction activities and personal hygiene and decontamination facilities on-site and excludes barge dewatering effluent.

- BMP01** Disposal/recycling of waste generated during the project shall be done in compliance with federal, provincial and municipal legislation, regulations, and bylaws, as applicable. The facilities to be used must be reviewed and approved by DR.

Storage

- BMP02** Regularly inspect the Site for unidentified or improperly stored materials.
- BMP03** Ensure all containers (i.e., drums, totes, etc.) are in good condition and have a clean exterior at all times.
- BMP04** Store equipment decontamination facility wastewater in separate tanks from those used for wastewater from personnel hygiene/decontamination facility.
- BMP05** Provide, operate and maintain wastewater storage tanks when and where appropriate.
- BMP06** Store batteries in a manner that prevents leakage of acid to the environment. Dispose of dead batteries at an appropriate facility.
- BMP07** Ensure waste accumulation areas are organized and covered to reduce exposure to environment and wildlife.

Solid Waste

- BMP08** Recycle solid waste such as plastic, glass, aluminum, mixed paper and cardboard. Recycling areas should be conveniently located and easily identifiable.
- BMP09** Encourage the use of recyclable products to reduce the solid waste impact on the environment.
- BMP10** Segregate other solid waste, such as scrap metal, wood, electronics, polystyrene foam and soft plastics for recycling at an approved facility.
- BMP11** Clean debris from work areas immediately after any maintenance activity. Dispose of collected material appropriately.
- BMP12** Do not bury rubbish and/or waste materials on the EGD Project Area. Rubbish or waste generated on-site should be disposed of in appropriate manner and at an appropriate facility.

Non-Solid Waste

- BMP13** Do not dispose of waste or volatile materials, such as mineral spirits, oil, or paint thinner into waterways, storm sewers or sanitary sewers. Generated waste should be placed in waste specific containers and disposed of appropriately.
- BMP14** Do not discharge wastewater from personnel hygiene/decontamination facility or toilet facilities on-site. Disposal of these wastewaters must be at an off-site permitted Wastewater Treatment Facility.
- BMP15** Wastewater produced at the Work Site (e.g., equipment decontamination wastewater) should be tested prior to discharge in the EGD Project Area to ensure compliance with applicable water quality performance objectives for where it is intended to be released.

If to be discharged outside of the TRBCA, water quality objectives for that area must be met as per the WQMP (Water Quality Performance Criteria for Activities within the TRBCA).

For discharge within the TRBCA, it must be ensured that water quality criteria outside the TRBCA are maintained.

If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility. No deleterious substances may be released into any watercourse.

BMP16 After dredging is completed and approved by the DR within the TRBCA any wastewater for discharge into the TRBCA must meet the criteria specified for outside the TRBCA (WQMP Water Quality Performance Criteria for Activities within the TRBCA) as the area would be considered remediated.

If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility.

BMP17 Barge dewatering and effluent treatment barge discharge at the EGD Project Area, where authorized (see Section 35 20 23 – Barge Dewatering), shall comply with the EMP and WQMP (Appendix 4).

BMP18 Connect pumps, piping, valves, miscellaneous items and necessary utilities as required for operation of facilities; and protect tanks, valves, pumps, piping and miscellaneous items from freezing, leaks or systemic failure.

Hazardous Waste

BMP19 Hazardous waste should be segregated into separate containers. Ensure designated hazardous waste storage areas are away from active work areas. Does not apply to Hazardous Waste Quality Sediment.

BMP20 Hazardous waste/materials shall be transported in compliance with the *Transportation of Dangerous Goods Act* and *BC Hazardous Waste Regulation*.

BMP21 All Hazardous Waste Quality Sediment recovered during dredging must be transported to approved Hazardous Waste Treatment Facility.

Dewatering of Hazardous Waste Quality Sediment may occur within the TRBCA if water quality guidelines outside the TRBCA can be met (WQMP Water Quality Performance Criteria for Activities within the TRBCA) or outside the TRBCA if water quality criteria for barge dewatering are met.

BMP22 All means of containment and transport of hazardous waste, including Hazardous Waste Quality Sediment must comply with the safety standards of the *Transportation of Dangerous Goods Act* and display all applicable prescribed safety marks and labels.

BMP23 Do not dilute or mix hazardous waste with other hazardous or non-hazardous wastes.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- *Federal Canada Marine Act*.
- *Federal Fisheries Act*.
- *Federal Transportation of Dangerous Goods Act*.
 - *Transportation of Dangerous Goods Regulations*.
- *BC Environmental Management Act*.
 - *Hazardous Waste Regulation*.
 - *Industrial Non-hazardous Waste Landfills Code of Practice*.
- British Columbia Ministry of Water, Land and Air Protection, and BC Forestry Service. 2002. *A Field Guide to Fuel Handling, Transportation and Storage* 3rd Edition.
- Government of British Columbia. 2012. *British Columbia Fire Code*.
- Government of Canada. 2010. *National Fire Code of Canada*. [online] Available at: <http://www.nationalcodes.nrc.gc.ca/eng/nfc/>.
- Public Works and Government Services Canada (PWGSC). 2009b. *Best Management Practices for Fire Prevention – For Works, Buildings, and Vessels within the Esquimalt Graving Dock*. Prepared by Public Works and Government Services Canada, January 26, 2009.

- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#4 Dry Dock Floor Management and Cleanup.
 - EBMP#5 Hazardous Materials Handling and Storage.
 - EBMP#6 Waste Management and Recycling.
 - EBMP#16 Housekeeping.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.
- WorkSafe BC. 2013. *Occupational Health & Safety Guideline. Table of exposure limits for chemical and biological substances*. [online] Available at: <http://www2.worksafebc.com/publications/ohsregulation/GuidelinePart5.asp?ReportID=32895>.
- WorkSafe BC. 2014. *Guidelines for Workers Compensation Act and OHS Regulation- Part 5: Chemical Agents and Biological Agents*. [online] Available at: <http://www2.worksafebc.com/Publications/OHSRegulation/Guidelines.asp>.

7.2.11 Special Procedures for Contaminated Sites

Wastewater is defined as waters produced from construction activities and personal hygiene and decontamination facilities on-site and excludes barge dewatering effluent.

- BMP01** Activities associated with contaminated sites should be performed in accordance with regulations, construction standards, and/or any other code or bylaw of local application as relevant.
- BMP02** Contractor shall immediately notify the DR if any dredged material, outside of the Hazardous Waste Area, is identified as Hazardous Waste Quality Sediment. All Hazardous Waste Quality Sediment must be safely transported to and disposed of at the approved Hazardous Waste Management Facility following all relevant mitigation measures and criteria for the transport and disposal of dredged material (i.e., Division 35 20 23 – In-Water Transportation, Division 35 20 23.01 – Disposal).

Decontamination of Equipment & Vessels

- BMP03** Equipment and vessels must be decontaminated prior to leaving the EGD Project Area. Decontamination is to only be performed in designated areas with appropriate containment.
- BMP04** Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens as necessary.
- BMP05** Where possible, mechanically remove packed sediment, grit, and debris by scraping and brushing the equipment without using steam or high-pressure water to reduce the amount of water required and contaminated rinsate generated.
- BMP06** Terrestrial equipment shall be decontaminated prior to travel outside the EGD Project Area. The exteriors of any terrestrial equipment shall be inspected and decontaminated/cleaned to remove any materials that may accumulate on the exterior while in the Project Area before leaving the EGD Project Area.
- BMP07** Wastewater produced at the Work Site (e.g., equipment decontamination wastewater) should be tested prior to discharge in the EGD Project Area to ensure compliance with applicable water quality performance objectives for where it is intended to be released.
- If to be discharged outside of the TRBCA, water quality objectives for that area must be met as per the WQMP (Water Quality Performance Criteria for Activities within the TRBCA).

For discharge within the TRBCA, it must be ensured that water quality criteria outside the TRBCA are maintained.

If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility. No deleterious substances may be released into any watercourse.

- BMP08** After dredging is completed and approved by the DR within the TRBCA any wastewater for discharge into the TRBCA must meet the criteria specified for outside the TRBCA (WQMP Water Quality Performance Criteria for Activities within the TRBCA) as the area would be considered remediated.

If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility.

- BMP09** Decontaminate floating equipment that is used to dredge and/or haul contaminated sediment prior to subsequent work in clean areas or travel outside of the EGD Project Area. Watertight haul barges transporting contaminated sediment to the approved Off-Site Offload Facility do not need to be decontaminated during construction work, however, will need to be decontaminated once all contaminated dredging activities have been completed.

- BMP10** The exteriors of haul barges used to transport contaminated sediment off-site shall be inspected and cleaned to remove dredged materials that may accumulate on the exterior prior to transport off-site.

- BMP11** Wastewater arising from waterborne equipment decontamination activities shall be sampled in accordance with the approved Waste Water Management and Disposal Plan. The Contractor is responsible for meeting performance monitoring criteria and objectives identified in this document and the WQMP prior to discharge.

- BMP12** Collect contaminated wastewaters and sediments that accumulate within watertight barges used for decontamination, or on other floating equipment, transfer to Contractor-supplied drums, wastewater storage tanks or treatment facility.

- BMP13** Each structure or piece of equipment may be inspected by the EM and/or DR after decontamination and prior to removal from the site and/or travel on clean areas.

- BMP14** Any structures or items designated for re-use on-site (e.g., safety ladders, fender piles, cable trays, tug boat wharf piles) must be decontaminated prior to reinstallation.

Re-driving Sheet Pile Wall

- BMP15** Re-driving of the sheet pile wall should be in accordance with applicable BMPs (i.e., Division 31 61 13 – Pile Foundations General Requirements, Division 31 62 17 – Steel Sheet Piling) and the WQMP.

Installation of a Temporary Re-suspension Barrier (TRB)

- BMP16** Contractor shall thoroughly investigate and understand the implications of the tide, current, wind, and sea state in Esquimalt Harbour when installing, removing, adjusting, moving and monitoring the effectiveness of the TRB.

- BMP17** The TRB shall be designed such that its anchoring system does not pose a navigation hazard.

- BMP18** The TRB should be installed as soon as possible after the re-driving of the SPW.

If phased TRB installation has been proposed and approved by the DR, the TRB must be installed and properly supported as soon as possible after re-driving the SPW around the phase in which work will be occurring.

- BMP19** The TRB shall prevent waters from flowing over the top of the barrier during all marine conditions. The TRB shall extend to a distance below the water surface such that, in combination with the re-driven SPW, no physical gap remains between the top of the sheet pile wall and bottom of the TRB at any tidal stage and such that a sufficient overlap exists to effectively prevent re-suspended sediment from being transported out of the Phase 2 work area by natural events (e.g. tidal action or waves) or human-induced currents (e.g. thruster or propwash within or outside the EGD Work Site).
- BMP20** The interface between the TRB and SPW should be designed to prevent aquatic mammals and fish from entering the TRB.
- BMP21** The installation and anchoring design for the TRB shall accommodate the potential need to open and close the TRB for vehicle and equipment transport in and out of the TRBCA.
- BMP22** The TRB may require additional support (e.g., piles). Installation of such support structures should be in accordance with applicable BMPs (i.e., Division 31 61 13 – Pile Foundations General Requirements, Division 31 62 19 – Timber Piling) and the WQMP.

Temporary Re-suspension Barrier Opening

- BMP23** Contractor must notify the DR and EM of their intention to open the TRB by 14:00 h the day prior to the intended opening.
- BMP24** The Temporary Re-suspension Barrier shall not be opened until the Contractor's appropriately qualified person has verified that the criteria for opening the TRB have been met at the Internal Assessment Point (IAP) or otherwise instructed by DR. The Contractor's appropriately qualified person is responsible for determining the appropriate criteria at the IAP that will not lead to exceedances of criteria at Exterior Assessment Point at 25 m (EAP₂₅) and Exterior Compliance Point at 100 m (ECP) as defined in the WQMP.
- BMP25** The Contractor must provide evidence to the DR and EM that TRB opening criteria have been appropriately calculated and that the criteria are met at the IAP prior to opening the TRB.
- BMP26** Criteria for opening the TRB may need adjusted if criteria outside the TRB cannot be met as per the WQMP.
- BMP27** The TRB must only be opened at designated, pre-approved areas unless authorized by DR or in case of emergency.
- BMP28** The TRB is to be closed as soon as possible after opening to facilitate vessel passage in or out of the TRBCA to minimize any discharge of potential contaminants out of the TRBCA.

Sheet Pile Wall & Temporary Re-suspension Barrier Removal

- BMP29** Water quality criteria in the WQMP must be achieved within the TRBCA prior to removal of the TRB and/or SPW.

Water quality criteria during the removal process must also be complied with, as outlined in the WQMP.
- BMP30** SPW and TRB support piles must be removed using vibratory extraction equipment where feasible.
- BMP31** Prior to cleaning the TRB and sheet piles, they must be handled, stored and transported in the same manner as contaminated sediment.
- BMP32** SPW, TRB and support piles shall be decontaminated to remove sediment and encrusting organisms from surfaces, anchors, lines, and other appurtenances. All materials cleaned off the TRB and sheet piles shall be collected and disposed of at an appropriate facility.

- BMP33** Where possible, mechanically remove packed sediment, grit and debris by scraping and brushing the structures without using steam or high-pressure water to reduce the amount of water required and contaminated rinsate generated.
- BMP34** Prevent all removed material from the TRB and sheet piles from re-entering the marine environment and re-contaminating areas where dredging or engineered capping placement has been completed.
- BMP35** The TRB shall be disposed of in the same manner as contaminated materials.
- Contractor becomes owner of sheet piles after extraction and removal from the Work Site. Sheet piles must be transported from the EGD Work Site for appropriate disposal, recycling or re-use by waterborne transport.

Other

- BMP36** Results of wastewater chemical analyses are to be used to determine the appropriate disposal method (i.e., discharge to the marine environment or disposal at the Wastewater Treatment Facility) as defined in the WQMP.
- BMP37** Dispose of sediments and other materials at the permitted Disposal Facilities and/or Hazardous Waste Management Facility (if applicable) permitted for the work.
- BMP38** Stormwater runoff and erosion control shall be in place as part of dewatering operations on Contractor's waterborne equipment and at the staging and stockpile area(s) located at Contractor's Off-Site, Offload Facility (see Section 7.2.8 and TESCP).

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Federal *Canada Marine Act*.
- Federal *Fisheries Act*.
- Federal *Transportation of Dangerous Goods Act*.
 - *Transportation of Dangerous Goods Regulation*.
- Government of British Columbia. 2012. *British Columbia Fire Code*.
- Government of Canada. 2010. *National Fire Code of Canada*. [online] Available at: <http://www.nationalcodes.nrc.gc.ca/eng/nfc/>.
- Health Canada. 2014. Workplace Hazardous Materials Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>.
- Public Works and Government Services Canada (PWGSC). 2009b. *Best Management Practices for Fire Prevention – For Works, Buildings, and Vessels within the Esquimalt Graving Dock*. Prepared by Public Works and Government Services Canada, January 26, 2009.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#4 Dry Dock Floor Management and Cleanup.
 - EBMP#5 Hazardous Materials Handling and Storage.
 - EBMP#6 Waste Management and Recycling.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.
- WorkSafe BC. 2013. *Occupational Health & Safety Guideline. Table of exposure limits for chemical and biological substances*. [online] Available at: <http://www2.worksafebc.com/publications/ohsregulation/GuidelinePart5.asp?ReportID=32895>.

- WorkSafe BC. 2014. *Guidelines for Workers Compensation Act and OHS Regulation- Part 5: Chemical Agents and Biological Agents*. [online] Available at: <http://www2.worksafebc.com/Publications/OHSRegulation/Guidelines.asp>.

7.2.12 Site Access

- BMP01** Prevent contamination of access roads. Immediately scrape up debris or material on access roads that is suspected to be contaminated as determined by the DR and transport and place into designated areas identified or deemed acceptable by the DR. Clean access roads at least once per shift to a level which removes dust and fines and limits dust and air pollution.
- BMP02** Vehicle idling should be avoided especially near building doorways or air intakes.
- BMP03** Any large deliveries by truck must be approved by DR and EGD Operations before arriving on-site.
- BMP04** Contractor shall establish minimally-intrusive and well-designed traffic patterns for on-site activities and plans to minimize on-site impacts and reduce off-site traffic congestion. This plan should be reviewed and approved by PWGSC.
- BMP05** Traffic management measures (such as 'flag person') approved by the DR prior to implementation shall be in place if required at site access points to direct traffic.
- BMP06** Contractor shall clean all equipment prior to arrival at the EGD Project Area to ensure that no invasive vegetative species are present on the equipment and to prevent the introduction of deleterious material into the surrounding environment.
- BMP07** Employ temporary erosion and sediment control measures, as described in Section 7.2.8 and the Contractor's TЕСP.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Federal Canada Marine Act.
- Federal Canada Shipping Act and associated regulations.
- Federal Fisheries Act.
- Federal Transportation of Dangerous Goods Act.
- BC Environmental Management Act.
- Capital Regional District (CRD). 2006. *Capital Regional District (CRD) Sewer Use Bylaw No. 2922 (Consolidated)*. [online] Available at: <https://www.crd.bc.ca/docs/default-source/source-control-pdf/regional-source-control-bylaw---crd-bylaw-2922.pdf?sfvrsn=4>.
- G3 Consulting Ltd. (G3). 2014c. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Water Quality Monitoring Plan*. Prepared for Public Works and Government Services Canada.
- Public Works and Government Services Canada (PWGSC). 2010. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#8 Invasive Species (Ballast Tanks and Hulls).
 - EBMP#11 Energy Conservation.
- Public Works and Government Services Canada Environmental Services. 2010a. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.

Activity Specific BMPs

7.3 Activity Specific BMPs

In addition to *General BMPs* identified, specific BMPs for individual activities are detailed in this section. BMPs are divided into Division and Subdivision as per the *Phase 2 Demo-Remediation Specification* (PWGSC, 2014). Where appropriate, the BMPs may be further divided by activity within a given Division. This list should not be considered exhaustive and the Contractor is required to implement all industry standards surrounding specific activities. In addition, the Contractor must also implement all permitting and regulatory requirements associated with the activity. It is the responsibility of all Contractors to identify and implement all BMPs applicable to their activity. The Contractor's appropriately qualified person shall ensure that all personnel acting on behalf of the Contractor are also aware and have the necessary experience, training and resources to appropriately implement the BMPs. The Environmental Monitor (EM) shall conduct monitoring and ensure compliance with applicable BMPs relating to specific activities detailed in this section.

Division 2: Existing Conditions BMPs

Division 2 Monitoring

Environmental monitoring will be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

02 41 13 Selective Site Demolition

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may also apply:

BMP01 Any jetty attachments selected for re-use on-site (e.g., cable trays, safety ladders, chains, bolting materials, bull rails) must be cleaned and/or decontaminated at the designated on-site decontamination area prior to storage and reinstallation.

02 41 16.01 Structure Demolition

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may also apply:

BMP01 Remove the entire pile using a slow steady pull to minimize the disturbance of the substrate and avoid bringing contaminated sediments to the surface.

BMP02 Where appropriate vibratory methods should be employed for pile removal.

BMP03 All reasonable attempts should be made to remove the entire pile.

BMP04 Should the pile break below the biologically-active sediment zone, an assessment in conjunction with the DR should be conducted to assess the need and options for removal of the remaining structure.

BMP05 Removed piles should be stored in an area away from the water.

BMP06 Surface runoff that comes in contact with the treated piles should be directed away from the watercourse, captured, stored and treated as contaminated.

BMP07 Recovered materials and obstructions must be disposed of in an appropriate manner and in accordance with applicable federal, provincial and municipal laws and policies. Under no circumstances should any removed materials be returned to the marine environment.

BMP08 Minimize or prevent debris, dust, materials or sediment-laden waters from timber pile jetty demolition (including the concrete slab of the south and west concrete crane pads, high mast light foundation) from entering any drainage system, watercourse or marine environment.

BMP09 Do not allow buoyant items removed from their original location to float beyond the EGD Work Site.

02 41 16.02 Structure Relocation

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may also apply:

BMP01 Temporary location of the tug boat wharf, between relocation and reinstallation, should be within the Project Boundary and is subject to approval by DR.

02 55 10 Dust Control

Applicable BMPs associated with Dust Control can be found in Section 7.2.9 Air Quality Management.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Hutton, K.E. and Samis, S.C., 2000. Guidelines to protect fish and fish habitat from treated wood used in aquatic environments in the Pacific Region. *Canadian Technical Report of Fisheries and Aquatic Sciences*, 2314, pp.vi + 34.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EMBP#12 Nuisance Pollution (Noise/Odour/Light).
 - EMBP#16 Housekeeping.
 - EMBP#18 Property and Infrastructure Maintenance, Modification and Construction.
- WorkSafe BC. 2013. *Occupational Health & Safety Guideline. Table of exposure limits for chemical and biological substances*. [online] Available at: <http://www2.worksafebc.com/publications/ohsregulation/GuidelinePart5.asp?ReportID=32895>.
- WorkSafe BC. 2014. *Guidelines for Workers Compensation Act and OHS Regulation- Part 5: Chemical Agents and Biological Agents*. [online] Available at: <http://www2.worksafebc.com/Publications/OHSRegulation/Guidelines.asp>.

Division 3: Concrete General BMPs

Division 3 Monitoring

Environmental monitoring will be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

In addition to the General BMPs stated in Section 7.2 the following BMPs may apply:

BMP01 Ensure that all works involving use of concrete, cement, mortars and/or other cement or lime-containing construction materials will not deposit (directly or indirectly) sediments, debris, concrete, leachate, concrete fines or wash water into or about any watercourse.

BMP02 Immediately report to the DR spills of sediment, debris, concrete fines, wash or contact water of reportable quantities and begin clean-up. DR may contact PEP Environmental Emergency Management Plan Incident Reporting Hotline 1-800-663-3456 and Department of Fisheries and Oceans (DFO) Observe, Record and Report Hotline 1-800-465-4336.

BMP03 When grinding, cutting or demolishing cured concrete, dust and fines should be prevented from entering the water and water quality performance criteria in the WQMP must not be exceeded.

- BMP04** Monitoring of pH should be measured to an accuracy of +/- 0.2 pH units from the background level to ensure allowable ranges are maintained when performing any concrete works about water (e.g., grinding concrete where dust or fines may enter the water, pouring concrete, washing equipment). In the event that the levels change by more than 1.0 pH units or are outside the acceptable ranges (7.0 to 8.7 [BCMOE, 1991], outlined in the WQMP) the DR must be notified and preventative measures are to be introduced (e.g., catch basins to recover the runoff and neutralizing prior to disposal).
- BMP05** All equipment for concrete work must be properly sealed and have locked connections where present. Crews will ensure that concrete forms are not filled to overflowing. Excess or spilled concrete must be collected immediately and disposed of in an appropriate location.
- BMP06** Barriers will be used as appropriate to prevent splashing of the concrete over the forms and into the water or intertidal area during pouring.
- BMP07** Concrete washout water and solids will be collected and retained in leak proof containers, so that this caustic material does not reach the soil surface then migrate to surface waters, groundwater or adjacent watercourses. Collected water must be monitored for acceptable pH levels (as per EMIP). If the pH levels are outside the allowable limits then the runoff water must be contained until the pH is between 7.0 and 8.7 pH units and turbidity is < 25 nephelometric turbidity units (NTU), measured to an accuracy of +/- 2 NTU.
- BMP08** Equipment and tools that have come into contact with concrete will be washed down in a designated area away from the intertidal and drainages (e.g., streams and municipal drains) to prevent concrete products from entering watercourses (tidal waters, streams, drains).

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- BC *Environmental Management Act*.
- Capital Regional District (CRD). 2006. *Capital Regional District (CRD) Sewer Use Bylaw No. 2922 (Consolidated)*. [online] Available at: <https://www.crd.bc.ca/docs/default-source/source-control-pdf/regional-source-control-bylaw---crd-bylaw-2922.pdf?sfvrsn=4>.
- Fisheries and Oceans Canada (DFO). 2008. *General BMPs & Standard Project Considerations – Standards and Best Practices for Instream Works*. Version 1.0. [online] Available at: <http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf>.
- Health Canada. 2014. Workplace Hazardous Materials Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#5 Hazardous Materials Handling and Storage.
 - EBMP#17 Stormwater Management.
 - EBMP#18 Property and Infrastructure Maintenance, Modifications and Construction.
- US Environmental Protection Agency (USEPA). 2011. *Stormwater Best Management Practice Concrete Washout EPA 833-F-11-006*. [online] Available at: <http://www.chutewash.com/resources/EPA%20Guideline%20for%20Concrete%20Wash%20Out.pdf>.

Division 6: Wood, Plastic and Composites BMPs

Division 6 Monitoring

Environmental monitoring is to be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

06 05 73 Wood Treatment

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Timbers to be treated shall be cut to final length prior to treatment.
- BMP02** Field treatment of newly exposed timber components for re-use (e.g., cutting, cracking, holes) is to be done in a manner to prevent preservative from entering any watercourse.
- BMP03** Do not apply field treatment in conditions that render containment ineffective (i.e., raining).
- BMP04** Dispose of any unused preservative at a Hazardous Waste Facility and any treated timber waste (including sawdust) at a facility approved to dispose of treated timber material.

06 10 10 Timber

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** All structures for re-use (e.g., designated bull rails, timber chocks, dolphin and fender piles) shall be decontaminated prior to re-installation.
- BMP02** Any treated timber waste must be disposed of in accordance with federal, provincial and municipal laws and policies.
- BMP03** Timbers to be treated shall be cut to final length prior to treatment.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.

Division 9: Finishes BMPs

Division 9 Monitoring

Environmental monitoring will be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

09 97 19 Painting Exterior Metal Surfaces

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Use containment such as tarps, shrouds or portable structures to prevent airborne particles from entering the atmosphere and depositing on surface waters or surfaces leading to watercourse.
- BMP02** Airborne particle containment should be large enough to adequately enclose or segregate working areas.

- BMP03** Place containment beneath and around structures being painted to ensure overspray or runoff does not reach waters or surfaces leading to watercourse.
- BMP04** Do not paint during conditions that render containment ineffective (e.g., windy).
- BMP05** Ensure paint, solvents and other applicable materials are stored securely when working alongside structure and water edges.
- BMP06** Ensure any floor grates are covered to prevent spills from reaching waters or surfaces leading to watercourses.
- BMP07** Waste generated from grinding and hand tooling must be prevented from entering any watercourse.
- BMP08** Ensure empty paint cans and other associated wastes from painting are stored properly, protected from the weather and removed as soon as possible.
- BMP09** Left over paint and paint derived materials should be disposed of appropriately in accordance with manufactures guidelines and, where appropriate, at a registered facility.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Health Canada. 2014. Workplace Hazardous Materials Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#1 High Pressure/Ultrahigh Pressure Washing.
 - EBMP#2 Abrasive Blasting.
 - EBMP#3 Painting and Coating.
 - EBMP#5 Hazardous Materials Handling and Storage.
 - EBMP#6 Waste Management and Recycling.
 - EBMP#12 Nuisance Pollution (Noise/Odour/Light).
 - EBMP#14 Spill Preparedness and Response.
 - EBMP#16 Housekeeping.

Division 31: Earthworks BMPs

Division 31 Monitoring

Environmental monitoring will be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

31 23 10 Excavating, Trenching & Backfilling

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Design open excavations to protect against flooding and damage due to surface water run-off.
- BMP02** Dispose of water generated from earthworks activity in a manner not detrimental to any portion of work completed or under construction.
- BMP03** Work will be conducted in a manner that does not result in the deposit of a toxic or deleterious substance into waters. Water quality will be assessed in accordance with the relevant WQMP criteria.

- BMP04** Isolate work areas from all water, including flowing and standing, that can contact the watercourse to inhibit water transport of materials into the surrounding environment.
- BMP05** Stockpiles at the Off-Site Offload Facility are to be managed to prevent run-off or erosion that may affect water quality (e.g., sediment-laden water; Section 7.2.8; Section 7.3, 35 20 23.01). There will be no stockpiling of excavated/dredged material on-site.

Excavation in Intertidal Areas

- BMP06** For remediation using up-land based excavators, work will be conducted during periods of low tide whenever practicable.
- BMP07** Use of a barge-mounted derrick to remove contaminated materials from within the TRBCA may occur during any tidal condition.
- BMP08** Grounding of barges may need to occur at times; however, this shall only occur in areas where excavation/dredging and replacement of surficial substrate (engineered capping) are authorized.
- BMP09** Contractors operating marine vessels in the TRBCA should minimize re-suspension of sediments resulting from propwash by running propellers at minimal speed.
- BMP10** Measures are to be employed to minimize potential for infilling, water inundation and re-suspension/transport of contaminated sediments that could lead to adverse water quality impacts and/or recontamination of remediated areas.
- BMP11** Excavation in the intertidal area should be conducted in a manner that minimizes the release of contaminated sediment to meet the criteria set out in the WQMP.
- BMP12** There will be no stockpiling of excavated/dredged material on-site.
- BMP13** The Contractor's appropriately qualified person shall establish an effective Work Plan that considers location, timing and tidal influences to minimize impacts of sediment release.
- BMP14** Where possible, restrict the Work Area to as small an area as feasible and isolate it from the rest of the marine environment (e.g., using additional TRBs) to minimize re-introduction of sediments and contaminated material to the enclosed marine environment and the area outside the TRBCA.

31 24 15 General Fill

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Select appropriate fill material and placing methods, provide suitable equipment and sequence the work so that the specified quality of fill is produced.
- BMP02** Information regarding the source (e.g., supplier, location, environmental quality) of imported materials (e.g., RMC materials, slope filter material, slope armour materials) and appropriate certificates are to be provided by the supplier to PWGSC.
- BMP03** General fill used at in the Phase 2 work area shall consist of durable, natural granular material, free of organics, with no more than 8 % by weight passing the 75 µm (No. 200) sieve. Recycled materials from off-site sources, including but not limited to concrete, asphalt pavement and glass, shall not be used as fill. The maximum particle size shall not exceed 150 mm.
- BMP04** The presence of fines within imported armour rock material will be minimized. This may require pre-washing of the material.
- BMP05** Conduct ongoing quality control sampling and testing at the loading conveyor to confirm that the general fill materials conform to the Project requirements (detailed in BMP03 above). The material gradation testing rate for general fill shall be not less than one test for every 100 m³ placed in the work. All quality control test reports shall be submitted to DR for review and approval prior to placement of that material.

- BMP06** All general fill and sand fill shall be imported by road transport and unloaded directly within the Project Area.
- BMP07** The road must be swept at the end of each day, or more frequently if required, to remove any loose materials.
- BMP08** Contractor shall provide adequate flag-persons and/or traffic signal devices to prevent interference with emergency vehicles or traffic of other dock users and Contractors when transporting fill materials.

31 61 19.01 Geotextiles

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Geotextile is currently employed at overlapping joints of the sheet pile wall and should be adjusted and maintained to ensure the continued functionality for Phase 2 operations by preventing sediment-laden water from escaping the enclosed area through gaps in the SPW in accordance with the WQMP criteria.
- BMP02** Prior to re-driving the SPW, Contractor shall conduct an initial dive survey to document the existing "as-found" condition of the geotextile and its attachment to the sheet piles at the overlap joints (and for the SPW overlap joint at the northwest corner of the timber crib) and submit the "as found" condition survey results to DR.
- BMP03** Maintain and adjust the existing geotextile at overlap joints in the existing steel SPW (and at the northwest corner of the timber crib), during re-driving of the sheet piles, to provide a continuous and unbroken barrier for the full height of the re-driven sheet pile wall above mud-line.
- BMP04** Prevent any damage to geotextile during re-driving of the sheet piles by execution of Contractor's maintenance and adjustment procedures. After re-driving of sheet piles, carry out a final dive inspection and report any holes or other deficiencies to DR. Repair any damaged areas of geotextile to existing "as-found" condition (i.e., condition as documented in the initial and dive survey stipulated above), to the satisfaction of DR.

31 61 13 Pile Foundations General Requirements

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** All pile driving and extraction activities must comply with the criteria provided in the WQMP.
- BMP02** Pile cut-offs, waste or any miscellaneous unused materials will be recovered for disposal in a designated facility or placed in storage. Under no circumstances will materials be returned to the marine environment or stockpiled on-site.
- BMP03** Underwater noise during pile foundation activities should not exceed 30 kPa <2 m outside the TRB for the protection of aquatic life. The Contractor's appropriately qualified person will be required to monitor sound within 2 m of the activity in accordance with the WQMP.

The EM will monitor noise outside the TRB at a safe distance from any activities. In the event that underwater sound level exceeds 30 kPa <2 m outside the TRB, efforts shall be made to reduce the intensity of the sound generated. Exceedances will be noted and reported to the DR immediately.
- BMP04** Mitigation measures (e.g., avoiding multiple piles been driven at one time, deployment of a bubble curtain over the length of the wetted pile to reduce the shock waves, etc.) should be implemented as appropriate to mitigate effects of underwater noise on the surrounding environment.
- BMP05** Any fish kills occurring in the vicinity of pile driving activities (inside or outside of the TRBCA) will be reported immediately to the DR.

- BMP06** In the event that pile installation causes a fish kill, the DR shall issue a stop-work-order. The Contractor will be responsible for introducing effective means to reduce the level of shock waves or similar measures that will prevent fish from entering the potentially harmful shock wave area.
- BMP07** The use of vibratory pile driving and removal methods, where practical and feasible, is preferred over impact pile driving to minimize noise and sound pressure effects on aquatic life.
- BMP08** Coordinate pile activities to reduce potential impacts to the surrounding environment (e.g., avoid multiple piles being driven simultaneously, deployment of a bubble curtain over the length of the wetted pile to reduce the shock waves, etc.).

31 62 17 Steel Sheet Piling

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Prior to re-driving the SPW, Contractor shall conduct an initial dive survey to document the existing "as-found" condition of the geotextile and its attachment to the sheet piles at the overlap joints (and for the SPW overlap joint at the northwest corner of the timber crib) and submit the "as found" condition survey results to DR.
- BMP02** Maintain and adjust the existing geotextile at overlap joints in the existing steel SPW (and at the northwest corner of the timber crib), during re-driving of the sheet piles, to provide a continuous and unbroken barrier for the full height of the re-driven sheet pile wall above mud-line.
- BMP03** Prevent any damage to geotextile during re-driving and of the sheet piles by execution of Contractor's maintenance and adjustment procedures. After re-driving of sheet piles carry out a final dive inspection and report any holes or other deficiencies to DR.
- Repair any damaged areas of geotextile to existing "as-found" condition (i.e., condition as documented in the initial and dive survey stipulated above), to the satisfaction of DR.
- BMP04** Steel sheet piles will, when practical and feasible, be driven and extracted using vibratory methods rather than impact methods to minimize underwater sound levels.
- BMP05** Underwater noise during pile driving and extraction activities should not exceed 30 kPa <2 m outside the TRB for the protection of aquatic life. The Contractor's appropriately qualified person will be required to monitor sound within 2 m of the activity in accordance with the WQMP.
- The EM will monitor noise outside the TRB at a safe distance from any activities. In the event that underwater sound level exceeds 30 kPa <2 m outside the TRB, efforts shall be made to reduce the intensity of the sound generated. Exceedances will be noted and reported to the DR immediately.
- BMP06** Steel sheet pile activities should be implemented to mitigate effects on the surrounding environment (e.g., avoid multiple piles being driven simultaneously, deployment of a bubble curtain over the length of the wetted pile to reduce the shock waves, etc.).
- BMP07** Any fish kills occurring in the vicinity of pile activities (inside or outside of the TRBCA) will be reported immediately to the DR.
- BMP08** In the event that steel sheet pile installation causes a fish kill, the DR shall issue a stop-work-order and the Contractor will be responsible for introducing effective means to reduce the level of shock waves or similar measures that will prevent fish from entering the potentially harmful shock wave area.
- BMP09** Where the SPW is to be cut no debris shall enter the watercourse and waste material shall be disposed of in an appropriate manner (Section 7.2.10).

31 62 19 Timber Piling

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Fender and dolphin piles for re-use on-site are to be decontaminated prior to re-installation.
- BMP02** Extracted piles for re-use are to be handled as new material. Avoid damage to the surfaces of treated piles.
- BMP03** Additional preservation of re-used timber piles is not required unless they are to be cut.
- BMP04** Do not allow buoyant items to float beyond the EGD Work Site.
- BMP05** Use pile driving methods that are appropriate for substrate conditions and that minimize underwater sound levels.
- BMP06** Underwater noise during pile driving and extraction activities should not exceed 30 kPa <2 m outside the TRB for the protection of aquatic life. The Contractor's appropriately qualified person will be required to monitor sound within 2 m of the activity in accordance with the WQMP.
- The EM will monitor noise outside the TRB at a safe distance from any activities. In the event that underwater sound level exceeds 30 kPa <2 m outside the TRB, efforts shall be made to reduce the intensity of the sound generated. Exceedances will be noted and reported to the DR immediately.
- BMP07** Recovered materials and obstructions must be disposed of in an appropriate manner and in accordance with applicable federal, provincial and municipal laws and policies. Under no circumstances should any removed materials be returned to the marine environment.

Any treated timber waste is to be disposed of at approved Disposal Facility.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- British Columbia Marine and Pile Driving Contractors Association. 2003. *Best Management Practices for Pile Driving and Related Operations*. [online] Available at: https://buyandsell.gc.ca/cds/public/2013/07/11/8d33571afc47b088668fe82260609370/bc_marinepilingContractorspile_driving_bmp.pdf.
- Fisheries and Oceans Canada (DFO). 2008. *General BMPs & Standard Project Considerations – Standards and Best Practices for Instream Works*. Version 1.0. [online] Available at: <http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf>.
- Hutton, K.E. and Samis, S.C., 2000. Guidelines to protect fish and fish habitat from treated wood used in aquatic environments in the Pacific Region. *Canadian Technical Report of Fisheries and Aquatic Sciences*, 2314, pp.vi + 34.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#6 Waste Management and Recycling.
 - EBMP#12 Nuisance Pollution (Noise/Odour/Light).
 - EBMP#14 Spill Preparedness and Response.
 - EBMP#16 Housekeeping.
 - EBMP#18 Property and Infrastructure Maintenance, Modification and Construction.

Division 32: Exterior Improvement BMPs

Division 32 Monitoring

Environmental monitoring will be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

Wastewater is defined as waters produced from construction activities and personal hygiene and decontamination facilities on-site and excludes barge dewatering effluent.

32 11 23 Aggregate Base Courses

In addition to the General BMPs stated in Section 7.2 the following BMPs may apply:

BMP01 At the end of each working day, roadways shall be swept and made clear of debris, fallen rock and dust arising from rock deliveries to DR's satisfaction.

32 12 16 Asphalt Paving

In addition to the General BMPs stated in Section 7.2 the following BMPs may apply:

BMP01 Prevent discharge containing asphalt, grout, concrete or other waste materials from reaching storm drains, watercourse and/or marine environment. During rain events, portable asphalt mixing equipment should be covered by an awning or other simple structure to avoid direct contact with rainfall to inhibit mobilization of materials in rainwater.

BMP02 Prevent the application of fog seals, tack coats or other coatings, if required, during periods when rainfall is likely.

BMP03 Minimizing washing of sand or gravel from new asphalt, debris from drilling or cutting or other materials into storm drains watercourse and/or marine environment by sweeping or washing.

During Construction

BMP04 Use drip pans, ground cloths, heavy cardboard or plywood wherever concrete, asphalt, or asphalt emulsion chunks and drips are likely to fall unintentionally from mixing equipment (e.g., beneath extraction points) to minimize asphalt runoff into the surrounding environment.

BMP05 Accumulations of concrete runoff, aggregate chunks, and other solids must be collected for proper disposal prior to removing the containment or cover devices to prevent contamination of the surrounding environment.

BMP06 Provide catch basin covers, inlet protection or similarly effective containment devices over all nearby catch basins such that runoff from the construction activity does not enter the stormwater drainage system surface runoff or marine waters.

BMP07 Direct wash water exposed to aggregate to areas where sediments will be filtered and not drain to stormwater, watercourse or marine areas.

BMP08 If wastewater cannot be directed to suitable areas on-site, it should be contained, collected and disposed of in an approved manner.

Clean-up

BMP09 Designate a wash out area on-site where application and mixing equipment cleaning should be conducted. This washout area should also be used to contain excess material and slurry. The area should be designed to appropriately contain all waste generated.

- BMP10** Clean equipment off-site when practical and avoid any silt-laden discharge directly or indirectly into the watercourse. This includes trucks and equipment that can return to the batch plant for washing.
- BMP11** Sweep the pouring area at the end of each day, or more frequently as needed, to collect loose aggregate chunks and dust. Do not hose down the area to stormwater drains or intertidal area.

Saw Cutting

- BMP12** Slurry and sediment from saw cutting operations should be confined to the immediate work area by using temporary berms or diversion structures. Cover or barricade all nearby stormwater drains during saw cutting to prevent any materials from entering the stormwater drainage system.
- BMP13** Residue from cutting or grinding operations should be picked up and contained using a vacuum attached to the cutting machine. Residue should not flow across pavement or be left on the pavement surface. Street sweeping or washing down the area that collects and treats the water may be required.
- BMP14** Avoid saw cutting operations during rainfall events unless cuttings, sediment and wash water can be contained and disposed of appropriately.
- BMP15** Spills of chemicals used to expose aggregate, should be contained to prevent them from draining to streets, lanes or other areas where it may reach the marine environment or stormwater drainage system. Any spill of reportable quantities must be reported to DR immediately.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Government of Yukon. 2011. *Best Management Practices for Works Affecting Water in Yukon*. [online] Available at: http://www.env.gov.yk.ca/publications-maps/documents/bestpractes_water.pdf.
- Health Canada. 2014. Workplace Hazardous Materials Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#14 Spill Preparedness and Response.
 - EBMP#16 Housekeeping.

Division 35: Waterways & Marine Construction BMPs

Division 35 Monitoring

Environmental monitoring will be undertaken by the Contractor's appropriately qualified person, as deemed necessary, to ensure compliance with the EMP, WQMP and other regulations. In addition, PWGSC's EM will conduct monitoring in accordance with the WQMP and EMIP to ensure Contractor compliance with all relevant BMPs and other regulations. When necessary, management decisions will be made (i.e., when WQMP criteria are not met) by the DR.

Wastewater is defined as waters produced from construction activities and personal hygiene and decontamination facilities on-site and excludes barge dewatering effluent.

In addition to the General BMPs stated in Section 7.2 the following BMPs may apply:

General

- BMP01** All work must abide by the conditions of all applicable legislation and regulations.
- BMP02** Vessels and equipment will be well maintained and kept in good working order.
- BMP03** Contractors operating marine vessels inside or outside the TRBCA should minimize re-suspension of sediments resulting from propwash or thrusters by operating at minimal speed whenever possible.
- BMP04** Grounding of barges may need to occur; however, this shall only occur in areas where excavation/dredging and replacement of surficial substrate (engineered capping) are authorized.
- BMP05** The Contractor assumes ownership of any soil, sediment or other material once it is loaded on to a barge or other vessel for transport from the Work Site for disposal.
- BMP06** Contractor shall be responsible for the safe overwater and terrestrial transport of all waste materials (including all dredged sediment, debris, and associated runoff and debris) in accordance with federal, provincial, regional/municipal laws and regulations and all Project specific documents (e.g., EMP, WQMP).
- BMP07** Ensure hydraulic machinery, if required, uses environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable.
- BMP08** Wastewater produced at the Work Site (e.g., equipment decontamination wastewater) should be tested prior to discharge in the EGD Project Area to ensure compliance with applicable water quality performance objectives for where it is intended to be released.
- If to be discharged outside of the TRBCA, water quality objectives for that area must be met as per the WQMP (Water Quality Performance Criteria for Activities within the TRBCA).
- For discharge within the TRBCA, it must be ensured that water quality criteria outside the TRBCA are maintained.
- If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility. No deleterious substances may be released into any watercourse.
- BMP09** After dredging is completed and approved by the DR within the TRBCA any wastewater for discharge into the TRBCA must meet the criteria specified for outside the TRBCA (WQMP Water Quality Performance Criteria for Activities within the TRBCA) as the area would be considered remediated.
- If criteria cannot be met wastewater shall be treated at an authorized Wastewater Treatment Facility.
- BMP10** Work will be conducted in a manner that minimizes induced turbidity outside the TRBCA and does not result in exceedance of water quality criteria outside the TRBCA as per the WQMP.

DFO Marine/Estuarine Fisheries Timing Windows (DFO, 2014b)

- BMP11** With the exceptions of fender log removal, fender pile extraction, navigation marker pile installation, SPW re-drive, and installation of TRB systems, there shall be no in-water works (i.e. works conducted below the water surface) conducted outside of the TRBCA during the period in any year from:
1. February 16th to June 30th; and,
 2. October 2nd to November 30th.
- BMP12** In-water works within the TRBCA and opening the TRB are permitted year-round provided works can be conducted in a manner that does not result in the deposit of a deleterious substance into waters outside of the TRBCA and does not result in water quality guidelines exceedances outside of the TRBCA (WQMP Water Quality Performance Criteria for Activities within the TRBCA).

- BMP13** Unattended structures shall be inspected for herring spawn by divers prior to removal should removal coincide with herring spawning period or outside timing windows.
- BMP14** Removal of TRB, SPW and related piles shall be timed to prevent overlapping with herring spawn.

35 20 23 Dredging, Barge Dewatering & In-Water Transportation

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

Dredging

- BMP01** All dredging, excluding potential contingency re-dredging, will be completed within the TRBCA to reduce the potential for release of re-suspended sediment into the water column outside the Work Area.
- BMP02** “No Dredge Zones” and “Dredge Setback Distances” per the contract requirements, will be identified within the Work Site and delineated to avoid impacts associated with dredging activities.
- BMP03** Dredging should be undertaken in a manner that minimizes disruption, disturbance and re-suspension of sediments. It is the Contractor’s responsibility to conduct dredging in a manner that minimizes re-suspension of sediments. The success of these measures will be assessed by the EM who will monitor water quality criteria as defined in the WQMP.
- BMP04** Dredging of the Hazardous Waste Area shall be sequenced and completed such that no recontamination of previously dredged areas occurs.
- BMP05** It is the responsibility of the Contractor to ensure compliance with the water quality criteria by conducting their own monitoring and by operating in manner in keeping with the criteria set forth in the WQMP.
- BMP06** The dredge material barge is to be loaded in such a way as to prevent loss of sediment over side rails or as a result of barge listing.
- BMP07** Measures to prevent spills and catch materials from falling into the marine environment during loading should be implemented and approved by the DR and assessed as deemed necessary by the EM. Contractors should conduct monitoring as requested to ensure compliance.
- BMP08** Sediment contamination levels will be measured prior to placement of engineered capping (within TRBCA) or residuals management cover (outside TRBCA) to assess if contingency re-dredging is required.
- BMP09** Follow contract specification operational controls to minimize disturbance of substrates (e.g., making additional dredge passes rather than dragging a bucket or beam to level the dredge surface, not stockpiling material underwater, controlling the rate of ascent and descent of the bucket).
- BMP10** Contractor shall immediately notify the DR if any dredged material, outside of the Hazardous Waste Area, is identified as Hazardous Waste Quality Sediment. All Hazardous Waste Quality Sediment must be safely transported to and disposed of by the contractor at the approved Hazardous Waste Management Facility following all relevant mitigation measures and criteria in the EMP for transport and disposal of dredged material (i.e., Division 35 20 23 – In-Water Transportation, Division 35 20 23.01 – Disposal of Dredged Material).
- BMP11** For areas remediated using upland-based excavators or a barge-mounted derrick see Section 7.3, 31 23 10 – Excavating, Trenching and Backfilling.
- BMP12** Dredging activities will avoid impacting hard substrates, where possible, to prevent disturbance to attached organisms.

- BMP13** For contingency re-dredging outside the TRBCA, the open-water dredging decision framework and criteria, outlined in the Phase 1B Water Quality Monitoring Plan (Golder, 2012c), should be followed.

Barge Dewatering

- BMP14** Do not discharge any dredged material or dewatering effluent to EGD on-site sewer systems.

- BMP15** Barge dewatering may occur without treatment within the TRBCA if criteria outlined in the WQMP for outside the closed TRB can be maintained. If criteria cannot be met, water will be collected from the barge for treatment prior to discharge or for disposal at an appropriate off-site facility.

Once dredging is complete and accepted by the DR any discharge within the TRBCA must meet the criteria for outside the closed TRB as the area will be considered remediated.

- BMP16** There will be no discharge of effluent from the dewatering of materials dredged within the TRBCA outside the TRBCA without treatment to meet the dewatering barge effluent criteria outlined in the WQMP (monitored in accordance with the EMIP). If criteria cannot be met, water will be collected from the barge for treatment prior to discharge or for disposal at an appropriate off-site facility.

- BMP17** The EM shall have access to whole effluent (after treatment, prior to discharge) for required barge dewatering monitoring.

- BMP18** There is to be no passive dewatering from the Hazardous Waste Area. All effluent from the Hazardous Waste Area must be treated and may only be released if water quality criteria for barge dewatering are met (for dewatering outside TRBCA) or water quality criteria for outside the closed TRB can be maintained (for dewatering within the TRBCA). It must be demonstrated to the DR and EM that the prescribed criteria can be achieved prior to discharge.

- BMP19** All barge effluent must pass through a filter to decrease TSS prior to release regardless of the location of discharge.

- BMP20** If dewatering barge effluent does not meet the Dilution Zone Compliance Point performance criteria within 100 m of the point of discharge as outlined in the WQMP, the EM will notify the DR. The DR will notify the Contractor as appropriate. Management actions will be considered which could include decreasing the performance criteria for discharge, stopping discharge or other actions as appropriate.

- BMP21** For contingency re-dredging within the TRBCA discharge of barge dewatering effluent within the TRBCA must meet the criteria for outside the closed TRB as the area will be considered remediated.

Discharge of effluent from dredging within the TRBCA outside the TRBCA must be treated and meet the dewatering barge effluent criteria outlined in the WQMP.

If criteria cannot be met, water will be collected from the barge for treatment prior to discharge or for disposal at an appropriate off-site facility.

- BMP22** For contingency re-dredging outside the TRBCA barge dewatering effluent can be released within or outside of the TRBCA if criteria are met.

For dewatering within the TRBCA passive or treated dewatering may occur if criteria for outside the closed TRB can be maintained as most of the area would be considered remediated.

For dewatering outside the TRBCA barge dewatering criteria, outlined in the Phase 1B Water Quality Monitoring Plan (Golder, 2012c), should be followed. Passive barge dewatering will only be permitted if Phase 1B barge dewatering water quality performance criteria can be met.

If water quality performance criteria cannot be met effluent is to be treated prior to discharge until meeting criteria or collected and stored for off-site treatment and/or disposal.

BMP23 There will be no barge dewatering during transport; collect, store, treat water as necessary. Discharge or dispose of effluent from barge in such a manner that meets the water quality criteria as stipulated in the WQMP.

BMP24 In the event that additives are used to facilitate dewatering of the dredged material, the decant water will be tested prior to discharge to verify that the added constituents will not be harmful to the receiving environment.

Water quality criteria established for work within the TRBCA are based on BCMOE (2014) criteria using ambient levels outside the TRBCA whereas contingency re-dredging (and associated dewatering) and residuals management cover (RMC) placement outside the TRBCA are subject to criteria developed during Phase 1B operations. The two sets of criteria are based on the potential risk associated with each activity. Criteria for work occurring within the TRBCA are conservative and designed to assess and ensure the effectiveness of the TRB and SPW as potentially high levels of contamination could occur within the TRBCA. The BCMOE (2014) criteria account for conditions in the surrounding ambient environment (near-field reference) at the time of monitoring and were adopted for this situation as confounding ambient conditions may limit the ability to detect materials escaping from within the TRBCA.

Conditions under which contingency re-dredging and RMC placement outside of the TRBCA would be occurring entail lower risk as the area was previously remediated during Phase 1B. As this is an open water area, containment of suspended material is more challenging. Based on the findings from Phase 1B, TSS and turbidity levels are likely to be greater than what can be expected for outside the TRBCA during the enclosed Phase 2 work.

In-water Transportation

BMP25 Dredged material will be transported by barge to a contractor-provided Off-Site Offloading Facility.

BMP26 Contractors shall be responsible for the safe transport of all waste materials (including all dredged sediment and debris) in accordance with federal, provincial and regional/municipal laws and regulations and conditions as set forth in the permits and contract terms.

BMP27 Contractor shall assume liability for misplaced waste and debris material arising out of their activities, and is required to notify and coordinate with appropriate authorities if material is misplaced or lost during transport to the certified Off-Site Offload Facility or during completion of offloading, transport and disposal activities.

BMP28 Transport of dredge material and debris shall be performed using a watertight barge with sidewalls of sufficient height to fully contain the dredge material, water, and debris.

BMP29 Contractor is responsible for detailing the methods for monitoring haul barges for leakage during transport of dredged material and contingency actions should a leak be observed. If leakage is observed, however minor, barge transport operations shall be halted and not restarted until repairs are made and approved. The DR must be notified of any leaks.

BMP30 Provide registration, licencing and certificates of seaworthiness for each haul barge to be used on the Project. In addition, material transportation by barge will require the Contractor to obtain an Authorization from Transport Canada Harbour Master pursuant to the *Canada Marine Act* and from DND QHM. If vessels undergo any repairs certificates must be re-submitted.

35 20 23.01 Offloading, Upland Transportation & Disposal

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

Off-Site Offloading

- BMP01** The Off-Site Offload Facility shall have in place all necessary federal, provincial and regional/municipal permits and approvals for work activities anticipated to occur at the facility including permissions for offloading, handling, and transport of Hazardous Waste Quality Material to a Hazardous Waste Management Facility.
- BMP02** Copies of all applicable permits should be on all vessels and at the Off-Site Offload Facility at all times.
- BMP03** Contractor shall offload in-water transportation barges at the designated Off-Site Offload Facility in a manner that prevents spillage of any waste or runoff to water. A spill apron (or equivalent spill prevention measure) shall be used during all offloading activities and compliance to the applicable water quality criteria of that facility must be stated and adhered to.
- BMP04** Spilled material will be cleaned up promptly.
- BMP05** Contractor is responsible for all misplaced waste and debris material and are required to notify and coordinate with appropriate authorities if material is misplaced during transport to the Off-Site Offload Facility or during completion of offloading, transport, and disposal activities.

Off-Site Stockpiling

- BMP06** Any material stockpiled at the Upland Staging Area at the Off-Site Offload Facility shall be contained to prevent any loss or run-off to the surrounding environment.
- BMP07** The operation of the Upland Staging Area will consider the need for containment, coverage of stockpiles, use of erosion and sedimentation controls, and management of water runoff.
- BMP08** Stockpiles, where practical and feasible, must be located 30 m or greater away from watercourses (the space available is limited and constrained by operational requirements).
- BMP09** Construct stockpile areas using berms or other barrier devices to prevent uncontrolled spreading of debris and/or contaminated sediment.
- BMP10** Cover stockpiles to prevent erosion during periods of rain and/or wind.
- BMP11** Collect and treat/dispose of water draining from stockpile areas.
- BMP12** Stockpiled material should be prevented from freezing.
- BMP13** Materials must not be stockpiled for extended periods of time unless approved by DR.
- BMP14** Upon completion of work, Contractor will return the Off-Site Stockpiling area to pre-project condition.

Upland Transportation

- BMP15** Both IL+ (exceeding industrial land use standards) waste and Hazardous Waste Quality Materials are to be transported by licensed haulers for such waste classes within the province of British Columbia.
- BMP16** Dredged material will be transported to an approved disposal facility by an appropriately licensed hauler, in accordance with applicable federal (e.g., *Transportation of Dangerous Goods Act*), provincial (e.g., *Environmental Management Act*, *Hazardous Waste Regulation*) statutes and regulations and regional/municipal bylaws, regulations and protocols.

- BMP17** Once offloaded, the material may be safely transported to the appropriate, approved Treatment, Hazardous Waste Management or Disposal Facility in accordance with federal, provincial and regional/municipal laws and regulations, *Phase 2 Demo-Remediation Specification*.
- BMP18** Waste transported from Contractor's Off-Site Offload Facility will be covered with a tarp and adequately secured in watertight containers to minimize release of odours and dust and ensure no spillage.
- BMP19** Haulers must use only designated routes for transport of the material (e.g., designated truck routes; Appendix 6 for Esquimalt Truck Routes).
- BMP20** Contractor is responsible for all misplaced waste and debris material and is required to notify and coordinate with appropriate authorities if material is misplaced during transport to the Off-Site Offload Facility or during completion of offloading, transport, and disposal activities.

Disposal of Dredged Material

- BMP21** Some dredge debris, such as anchors, chains, cables, rebar and wood, may not be accepted with dredged material by Disposal Facilities. Contractor must coordinate with the Disposal Facility to determine if debris needs to be screened and sorted prior to upland transport and disposal.
- BMP22** The location of the Treatment, Hazardous Waste Management or Disposal Facility shall not change without notification, review and acceptance by the DR.
- BMP23** Contractor shall not move waste from one Disposal Facility/Hazardous Waste Management Facility to another once the Certificate of Disposal has been submitted.
- BMP24** Treatment and/or destruction of soil or other waste materials must be completed in accordance with the EMP, *Phase 2 Demo-Remediation Specification* and applicable federal, provincial and regional/municipal regulations, guidance, procedures, and protocols.
- BMP25** Disposal and/or treatment of any sediment, soil, debris, water or other waste material will only occur at licensed and approved Disposal, Treatment or Hazardous Waste Management Facilities.
- BMP26** Contractor must provide appropriate information to be able to track all material from the Work Site to the Treatment, Hazardous Waste Management or Disposal Facility.
- BMP27** Soil or other material sent to a Disposal Facility or Hazardous Waste Management Facility must be permanently stored at that facility.

35 37 10 Engineered Capping

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Employ operational controls, as required, for engineered capping placement to minimize disturbance of substrates (e.g., controlling the rate of ascent and descent of the bucket) to minimize re-suspension of sediment.
- BMP02** Contractor is responsible for recovery and appropriate disposal of any misplaced material during engineered capping placement.

35 37 10.01 Residuals Management Cover Placement

In addition to the *General BMPs* stated in Section 7.2 the following BMPs may apply:

- BMP01** Employ operational controls, as required, for contingency re-dredging and RMC placement to minimize disturbance of substrates (e.g., controlling the rate of ascent and descent of the bucket) to re-suspension of sediment.

- BMP02** During contingency re-dredging and placement of RMC outside the TRBCA the Phase 1B Water Quality Monitoring Plan (Golder, 2012c) criteria must be followed.
- BMP03** Contractor is responsible for recovery and appropriate disposal of any misplaced material during residuals management cover placement.

Source Documents

- All contract documents.
- Public Works and Government Services Canada (PWGSC). 2014. *Phase 2 Demo-Remediation Specification*.
- Federal *Canada Shipping Act* and associated regulations.
- Federal *Fisheries Act*.
- BC *Environmental Management Act*.
- Capital Regional District (CRD). 2006. *Capital Regional District (CRD) Sewer Use Bylaw No. 2922 (Consolidated)*. [online] Available at: <https://www.crd.bc.ca/docs/default-source/source-control-pdf/regional-source-control-bylaw---crd-bylaw-2922.pdf?sfvrsn=4>.
- Corporation of the Township of Esquimalt (Township of Esquimalt). 2005 (amended to 2014). *Streets and Traffic Regulation Bylaw, 2005, No. 2678*. [online] Available at: http://www.esquimalt.ca/files/PDF/Bylaws/Bylaw_2607_-_Streets_and_Traffic_Regulation_2014.pdf.
- G3 Consulting Ltd. (G3). 2014c. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Water Quality Monitoring Plan*. Prepared for Public Works and Government Services Canada.
- Health Canada. 2014. Workplace Hazardous Materials Information System (WHMIS). [online] Available at: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>.
- Hutton, K.E. and Samis, S.C., 2000. Guidelines to protect fish and fish habitat from treated wood used in aquatic environments in the Pacific Region. *Canadian Technical Report of Fisheries and Aquatic Sciences*, 2314, pp.vi + 34.
- PIANC. 2009. Report nr. 100: *Dredging Management Practices for the Environment/A Structured Selection Approach*. Brussels, Belgium. pp. 2.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada, October 6, 2010.
 - EBMP#6 Waste Management and Recycling.
 - EBMP#7 Fuelling and Oil Transfer.
 - EBMP#9 Fish and Wildlife Management.
 - EBMP#12 Nuisance Pollution (Noise/Odour/Light).
 - EBMP#14 Spill Preparedness and Response.
 - EBMP#16 Housekeeping.
 - EBMP#17 Stormwater Management.
- WorkSafe BC. 2013. *Occupational Health & Safety Guideline. Table of exposure limits for chemical and biological substances*. [online] Available at: <http://www2.worksafebc.com/publications/ohsregulation/GuidelinePart5.asp?ReportID=32895>.
- WorkSafe BC. 2014. *Guidelines for Workers Compensation Act and OHS Regulation- Part 5: Chemical Agents and Biological Agents*. [online] Available at: <http://www2.worksafebc.com/Publications/OHSRegulation/Guidelines.asp>.

8.0 REFERENCES

8.1 Legislation & Bylaws

8.1.1 Federal Acts

- *Canada Marine Act*, 1998 (amended 2014)
 - *Natural and Man-made Harbour Navigation and Use Regulations*
- *Canada Shipping Act*, 2001 (amended 2013)
 - *Collision Regulations*
- *Canadian Environmental Assessment Act*, 2012 (amended 2013)
 - *Regulations Designating Physical Activities*
- *Canadian Environmental Protection Act*, 1999
- *Fisheries Act*, 1985 (amended 2013)
 - *Marine Mammals Regulations*
- *Migratory Birds Convention Act*, 1994
 - *Migratory Birds Regulations*
- *Navigable Waters Protection Act*, 1985
- *Navigation Protection Act*, 2014
- *Species At Risk Act*, 2003
- *Transportation of Dangerous Goods Act*, 1992 (amended 2009)
 - *Transportation of Dangerous Goods Regulations*

8.1.2 Provincial Acts

- *Environmental Management Act*, 2003
 - *Contaminated Sites Regulation*
 - *Hazardous Waste Regulation*
 - *Spill Reporting Regulation*
 - *Industrial Non-hazardous Waste Landfills Code of Practice*
- *Heritage Conservation Act*, 1996
- *Wildlife Act*, 1996

8.1.3 Regional & Municipal Bylaws

Capital Regional District (CRD). 2006. *Capital Regional District (CRD) Sewer Use Bylaw No. 2922 (Consolidated)*. [online] Available at: <https://www.crd.bc.ca/docs/default-source/source-control-pdf/regional-source-control-bylaw---crd-bylaw-2922.pdf?sfvrsn=4>.

City of Colwood. 1986 (amended 1992). *Bylaw No. 38 – A Bylaw to Regulate Noise within the City of Colwood*. [online] Available at: <https://colwood.civicweb.net/Documents/DocumentDisplay.aspx?ID=168>.

Corporation of the Township of Esquimalt (Township of Esquimalt). 2005 (amended to 2014). *Streets and Traffic Regulation Bylaw, 2005, No. 2678*. [online] Available at: http://www.esquimalt.ca/files/PDF/Bylaws/Bylaw_2607_-_Streets_and_Traffic_Regulation_2014.pdf.

Corporation of the Township of Esquimalt (Township of Esquimalt). 2007. *Official Community Plan*. [online] Available at: <http://www.esquimalt.ca/businessDevelopment/officialCommunityPlan/>.

Corporation of the Township of Esquimalt (Township of Esquimalt). 2014. *Maintenance of Property and Nuisance Regulation, 2014, No. 2686*. [online] Available at: http://www.esquimalt.ca/files/PDF/Bylaws/Bylaw_No._2826_Maintenance_of_Property_Bylaw_Revised_May_2014.pdf.

8.2 Documents & Websites

Archipelago Marine Research Ltd. (Archipelago). 2009. *Esquimalt Graving Dock and CFSA/Munroe Head Marine Habitat Assessments Esquimalt Harbour-Rev B-FINAL*. Prepared for Public Works and Government Services Canada. 50 pp. + Appendices. November 16, 2009.

Archipelago Marine Research Ltd. (Archipelago). 2012. *Esquimalt Graving Dock Abalone Habitat Survey*. Prepared for Public Works and Government Services Canada. 25 pp. + Appendices. November 16, 2009.

British Columbia Ministry of Environment (BCMOE). 1991. *Ambient Water Quality Criteria From pH: Technical Appendix*. [online] Available at: <http://www.env.gov.bc.ca/wat/wq/BCguidelines/phtech.pdf>.

British Columbia Ministry of Environment (BCMOE). 1997. *Ambient Water Quality Criteria for Dissolved Oxygen: Overview Report*. [online] Available at: http://www.env.gov.bc.ca/wat/wq/BCguidelines/do/do_over.html.

British Columbia Ministry of Environment (BCMOE). 2005. *Best Management Practices for Raptor Conservation during Urban and Rural Land Development in British Columbia*. [online] Available at: http://www.env.gov.bc.ca/lower-mainland/electronic_documents/raptor_bmp_final.pdf.

British Columbia Ministry of Environment (BCMOE). 2010. *Fisheries Information Summary System (FISS)*. [online] Available at: <http://a100.gov.bc.ca/pub/fidq/fissReport.do>.

British Columbia Ministry of Environment (BCMOE). 2013. *Conservation Data Centre Endangered Species and Ecosystems: Provincial Red and Blue Lists*. [online] Available at: <http://a100.gov.bc.ca/pub/eswp/>.

British Columbia Ministry of Environment (BCMOE). 2014. *Water Quality Guidelines (Criteria) Reports Approved Water Quality Guidelines*. [online] Available at: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html.

British Columbia Ministry of Water, Land and Air Protection, and BC Forestry Service. 2002. *A Field Guide to Fuel Handling, Transportation and Storage* 3rd Edition.

British Columbia Marine and Pile Driving Contractors Association. 2003. *Best Management Practices for Pile Driving and Related Operations*. [online] Available at: https://buyandsell.gc.ca/cds/public/2013/07/11/8d33571afc47b088668fe82260609370/bc_marine_pilingContractorspile_driving_bmp.pdf.

Canadian Council of Ministers of the Environment (CCME). 1999 (updated to 2014). *Canadian Environmental Quality Guidelines (for sediment and water)*. Canadian Council of Ministers of the Environment, Winnipeg. [online] Available at: <http://ceqg-rcqe.ccme.ca/>.

Fisheries and Oceans Canada (DFO). 1993. *Land Development Guidelines for the Protection of Aquatic Habitat*. [online] Available at: <http://www.dfo-mpo.gc.ca/Library/165353.pdf>.

- Fisheries and Oceans Canada (DFO). 2008. *General BMPs & Standard Project Considerations – Standards and Best Practices for Instream Works*. Version 1.0. [online] Available at: <http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf>.
- Fisheries and Oceans Canada (DFO). 2014a. *Implementation of mitigation measures to avoid and mitigate serious harm to fish*. Letter Prepared for Public Works and Government Services Canada. 2 pp. May 13, 2014.
- Fisheries and Oceans Canada (DFO). 2014b. *British Columbia Marine/Estuarine Timing Windows for the Protection of Fish and Fish Habitat – South Coast and Lower Fraser Areas*. [online] Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/bc-s-eng.html#area-19>.
- G3 Consulting Ltd. (G3). 2014a. *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Environmental Effects Evaluation*. Prepared for Public Works and Government Services Canada.
- G3 Consulting Ltd. (G3). 2014b. *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Water Quality Monitoring Plan*. Prepared for Public Works and Government Services Canada. 46 pp. + Appendices.
- Golder Associates Ltd. (Golder). 2010. *Stage 1 Preliminary Site Investigation, Esquimalt Graving Dock Waterlot*. Prepared for PWGSC. December 16, 2010.
- Golder Associates Ltd. (Golder). 2012a. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Final Environmental Management Plan*. Prepared for Public Works and Government Services Canada. 50 pp. + Appendices. December 6, 2012.
- Golder Associates Ltd. (Golder). 2012b. *Esquimalt Graving Dock Waterlot Sediment Remediation Project CEAA Screening Environmental Assessment*. Prepared for Public Works and Government Services Canada. 122 pp. + Appendices. August 24, 2012.
- Golder Associates Ltd. (Golder). 2012c. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Final Water Quality Monitoring Plan*. Prepared for Public Works and Government Services Canada. 39 pp. + Appendices. December 6, 2012.
- Golder Associates Ltd. (Golder). 2012d. *Esquimalt Graving Dock Waterlot Sediment Remediation Project – Archaeological Overview Assessment*. Prepared for Public Works and Government Services Canada, May 24, 2012.
- Government of British Columbia. 2012. *British Columbia Fire Code*.
- Government of Canada. 2010. *National Fire Code of Canada*. [online] Available at: <http://www.nationalcodes.nrc.gc.ca/eng/nfc/>.
- Government of Canada. 2014a. *Esquimalt Harbour*. [online] Available at: <http://www.navy-marine.forces.gc.ca/en/about/structure-marpac-poesb-home.page>.
- Government of Canada. 2014b. *Species at Risk Public Registry*. [online] Available at: http://www.registrelep-SARAreistry.gc.ca/default_e.cfm.
- Government of Yukon. 2011. *Best Management Practices for Works Affecting Water in Yukon*. [online] Available at: http://www.env.gov.yk.ca/publications-maps/documents/bestpractes_water.pdf.
- Health Canada. 2014. *Workplace Hazardous Materials Information System (WHMIS)*. [online] Available at: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>.
- Hutton, K.E. and Samis, S.C., 2000. Guidelines to protect fish and fish habitat from treated wood used in aquatic environments in the Pacific Region. *Canadian Technical Report of Fisheries and Aquatic Sciences*, 2314, pp.vi + 34.

- Northern Maritime Research. 2002. *Northern Shipwrecks Database*. Database on CD-ROM, Bedford, NS.
- PIANC. 2009. Report nr. 100: *Dredging Management Practices for the Environment/A Structured Selection Approach*. Brussels, Belgium. 2 pp.
- Public Works and Government Services Canada (PWGSC). no date. *Esquimalt Graving Dock Oil Transfer Checklist*. Prepared by Public Works and Government Services Canada. 1 p.
- Public Works and Government Services Canada (PWGSC). 2007. *Esquimalt Graving Dock Fueling and Oil Transfer Policy*. Prepared by Public Works and Government Services Canada. 2 pp. May 29, 2007.
- Public Works and Government Services Canada (PWGSC). 2009a. *Esquimalt Graving Dock*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/pac/cse-egd/index-eng.html>.
- Public Works and Government Services Canada (PWGSC). 2009b. *Best Management Practices for Fire Prevention – For Works, Buildings, and Vessels within the Esquimalt Graving Dock*. Prepared by Public Works and Government Services Canada. 11 pp. January 26, 2009.
- Public Works and Government Services Canada (PWGSC). 2010a. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada. 47 pp. October 6, 2010.
- Public Works and Government Services Canada (PWGSC). 2010b. *Esquimalt Graving Dock Spill Contingency Plan*. Version 03. Prepared by Public Works and Government Services Canada. 22 pp. February 2010.
- Public Works and Government Services Canada (PWGSC). 2013. *EGD Waterlot Remediation Project R.018400.001 Project Roles and Responsibilities*.
- Public Works and Government Services Canada (PWGSC). 2014. *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Demo-Remediation Specification*. Prepared by Anchor QEA. December 2014.
- Public Works and Government Services Canada Environmental Services. 2010. *Esquimalt Graving Dock Environmental Policy*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/programme-program-eng.html>.
- Public Works and Government Services Canada Environmental Services. 2014. *Esquimalt Graving Dock Environmental Policy Statement*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/env/politique-policy-eng.html>.
- US Environmental Protection Agency (USEPA). 2011. *Stormwater Best Management Practice Concrete Washout EPA 833-F-11-006*. [online] Available at: <http://www.chutewash.com/resources/EPA%20Guideline%20for%20Concrete%20Wash%20Out.pdf>.
- Victoria Natural History Society (VNHS). 2013. *Victoria Christmas Bird Count Maps and Lists: Area 8 – Esquimalt Harbour*. [online] Available at: <http://www.vicnhs.bc.ca/cbc/HistoryArea8.mht>.
- WorkSafe BC. 2013. *Occupational Health & Safety Guideline. Table of exposure limits for chemical and biological substances*. [online] Available at: <http://www2.worksafebc.com/publications/ohsregulation/GuidelinePart5.asp?ReportID=32895>.
- WorkSafe BC. 2014. *Guidelines for Workers Compensation Act and OHS Regulation- Part 5: Chemical Agents and Biological Agents*. [online] Available at: <http://www2.worksafebc.com/Publications/OHSRegulation/Guidelines.asp>.

APPENDICES

- Appendix 1:** Figures
- Appendix 2:** Tables
- Appendix 3:** Esquimalt Graving Dock Environmental Best Management Practices (PWGSC, 2010a)
- Appendix 4:** Water Quality Monitoring Plan (G3, 2014b)
- Appendix 5:** Example Reporting Templates
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Appendix 1

Figures

Figure A1: Esquimalt Graving Dock Waterlot Sediment Remediation Project Area Map

Figure A2: Site Boundaries and Adjacent Properties

Figure A3: Marine Mammal Safety Zones

Figure A4: Photograph of Herring Spawn

Figure A1: Esquimalt Graving Dock Waterlot Sediment Remediation Project Area Map



Date: June 20, 2014
 Coordinate System: NAD83 UTM Zone 10
 Adapted from Golder, 2012a; Reference Department of natural Resources.
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Adapted From:

PROJECT PUBLIC WORKS GOVERNMENT SERVICES CANADA
 EGD WATERLOT SEDIMENT REMEDIATION PROJECT
 ENVIRONMENTAL ASSESSMENT
 ESQUIMALT, B.C.



PROJECT	10-1475-0002	FILE	No1014750002000-10-01
DESIGN	VC	24 FEB 11	SCALE AS SHOWN REV. 0
CADD	AW	9 MAR 11	
CHECK	VC	23 AUG 12	
REVIEW	TM	23 AUG 12	

Figure A2: Site Boundaries and Adjacent Properties

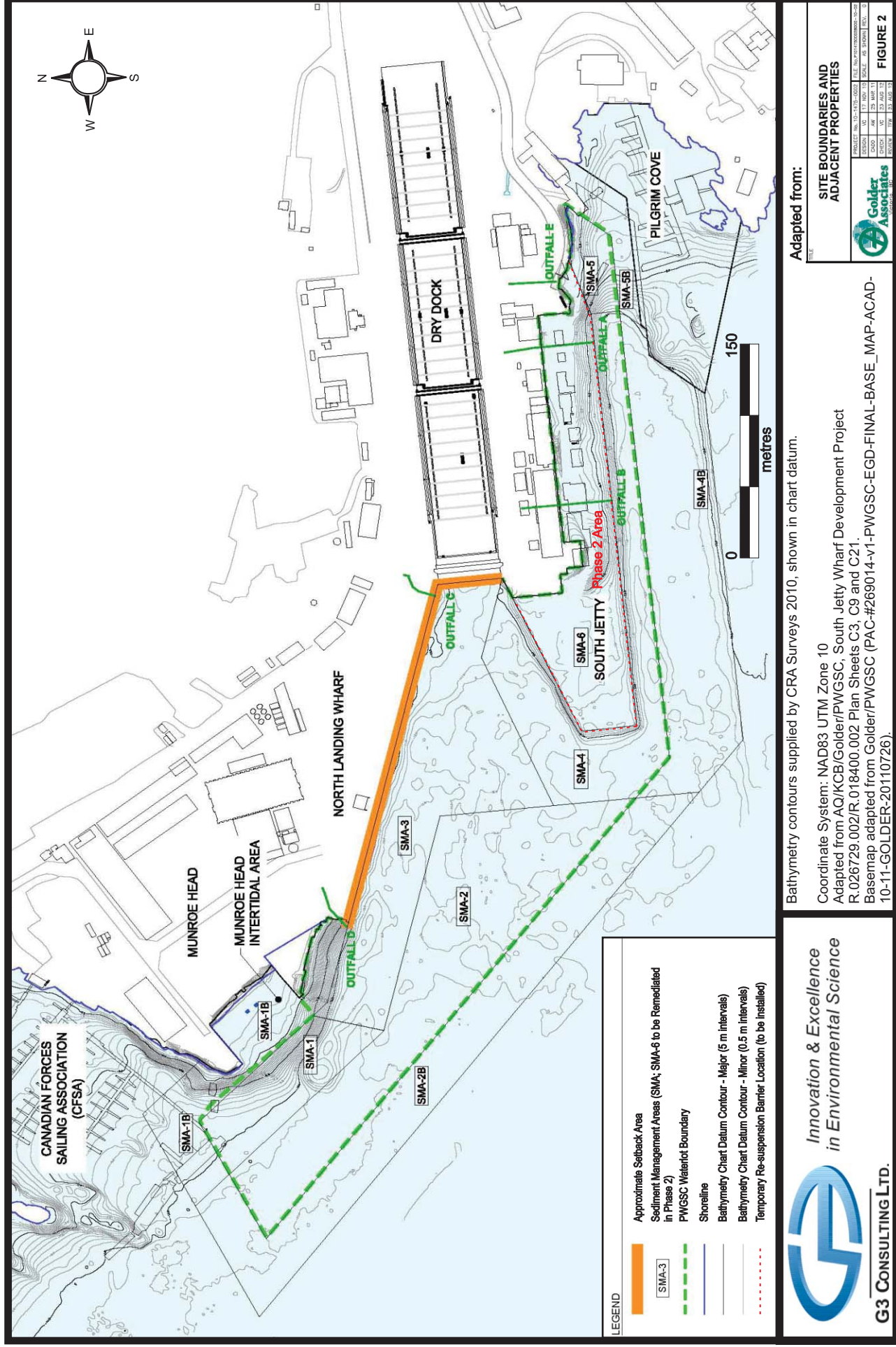


Figure A3: Marine Mammal Safety Zones

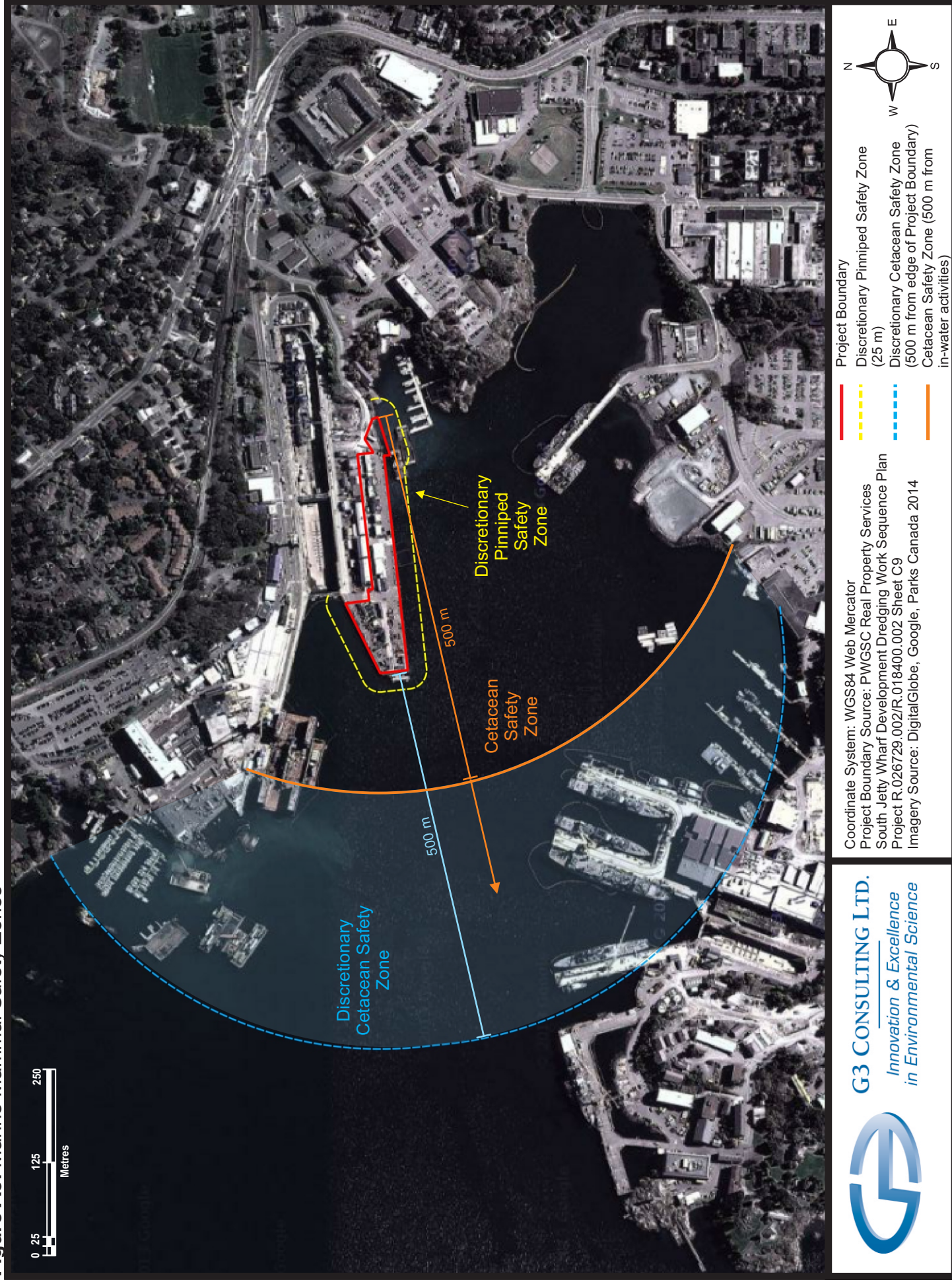




Figure A4: Photograph of herring spawn (Photo by: Mandy Lindeberg, Auke Bay Laboratories, Alaska Fisheries Science Center).

Appendix 2

Tables

Table B1: Selected Federal Legislation

Table B2: Selected Provincial Legislation

Table B3: Regional & Municipal Legislation

Table B1: Selected Federal Legislation

Legislation	Application to the Project	Authorization, Approval or Permit Issued
Canadian Environmental Assessment Act (CEAA) (1992) Repealed	CEAA (1992) required a federal agency that wished to exercise a function, such as the granting of a permit or authorization (e.g., <i>Fisheries Act</i>), as the proponent of a project, that makes use of federal land or money for project work to conduct an environmental assessment of the proposed project. A screening environmental assessment for Phase 1 was prepared and submitted to federal agencies (Golder, 2012b). (Phase 1 of this project was assessed under the provisions of CEAA (1992) which has since been repealed and replaced with CEAA (2012)).	Phase 1 CEAA Reference No. 11-01-59873
Canadian Environmental Assessment Act (CEAA) (2012)	Under CEAA (2012), the Project is not defined as a “designated project” (subsection 2[1]; Regulations Designating Physical Activities Schedule [Sections 2 to 4]) and as a result a Project Description is not required to be submitted to the Canadian Environmental Assessment Agency; however, Sections 67-72 of CEAA apply. Sections 67-72 of CEAA outline the duties of a federal authority in relation to projects that are carried out on federal lands that are not “designated projects”. Given the scope and location of the Project, it was determined by the responsible federal authorities, PWGSC and DND, that an Environmental Effects Evaluation (EEE) was warranted for Phase 2. The EEE is due diligence on behalf of PWGSC and DND to ensure that Phase 2 of the Project is not likely to result in any adverse environmental effects (CEAA, 2012, Section 67).	No Approval Required
Navigable Waters Protection Act (NWP) (1985; Amended 2009)	Regulates works that that may result in permanent or temporary obstacle or navigational hazards in all navigable Canadian waters, including Esquimalt Harbour. Transport Canada has evaluated the Project for the potential to “substantially interfere with navigation” and has issued an approval for Phase 1 of the Project.	Phase 1 Approval: 8200-2003-500198 (8200-03-8256.3)
Navigation Protection Act (NPA) (2014)	The <i>Navigable Waters Protection Act (NWP)</i> relates strictly to Phase 1 work as the <i>NWP</i> was replaced in April 2014 by the <i>Navigation Protection Act (NPA)</i> . As Phase 2 work is to begin after this change occurs, all Phase 2 work must comply with the provisions of the new <i>NPA</i> .	Phase 2 work will abide by the conditions of the <i>Navigation Protection Act</i>
Fisheries Act (1985; Amended 1992)	In September, 2012, Phase 1 obtained an authorization under subsection 35(2)(b) of the <i>Fisheries Act</i> for works, undertakings or activities affecting fish habitat and Section 32(2)(c) authorization for killing fish. This authorization stated explicitly that it was only for Phase 1 and that a separate <i>Fisheries Act</i> review or Authorization may be required for Phase 2.	Phase 1 Authorization No. 11-HPAC-PA3-00016
Fisheries Act (1985; Amended 2013)	<u>Section 35(1)</u> - Prohibits any person from carrying 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. The installation of the sheet pile wall around the South Jetty and the dredging of the EGD Waterlot and buffer area in Phase 1 caused a temporary disruption to fish habitat and required an authorization from DFO and included the creation of offsetting habitat at Dunn's Nook. A Request for Review (RFR) was submitted to DFO as required under the <i>Act</i> (February 26, 2014, DFO File #: 14-HPAC-00210) and after review it was determined that an Authorization for Phase 2 would not be required as long as the mitigation measures outlined in the RFR are abided by (A. Silverstein, pers. comm., May 13, 2014).	No Authorization Required
	<u>Section 36(3)</u> - Prohibits the deposit of a deleterious substance in waters frequented by fish. Performance objectives have been developed to help meet the intent of this section. Deleterious means any substance that, if added to water, would degrade or form part of a process of degradation of water quality or fish habitat; or, any water that contains any prescribed substance in excess of established concentrations or subjected to any designated treatment or process.	General Prohibition – No Authorization Issued

Con'd...

Table B1: Selected Federal Legislation (con'd)		
Legislation	Application to the Project	Authorization, Approval or Permit Issued
Fisheries Act (con'd) (1985; Amended 2013)	<p><u>Section 38(4)</u> – Duty of every person to notify an inspector, fisheries officer or prescribed authority of a serious harm to fish part of or supporting a commercial, recreational or Aboriginal fishery not authorized under the <i>Act</i>, or a serious and imminent danger of such an occurrence.</p> <p><u>Section 38(5)</u> – Duty of every person to notify an inspector, fisheries officer or prescribed authority of the deposit or imminent danger of deposit, of a deleterious substance in waters frequented by fish and detriment to fish habitat or fish or to the use by humans of fish results or may reasonably be expected to result from the occurrence.</p> <p><u>Section 38(6)</u> – Duty to take all reasonable measures consistent with safety and with the conservation of fish and fish habitat to prevent the occurrence of or counteract, mitigate or remedy any adverse effects to fish and/or fish habitat resulting from any occurrence or that could be expected to result from it.</p> <p>The Deposit out of the Normal Course of Events Notification Regulations specify the BC Provincial Emergency Program as the 24-hr emergency telephone service for notification.</p> <p>The requirements of these sections are to be considered in the development of a spill response plan.</p>	General Provisions – No Authorization Issued
Marine Mammal Regulations (pursuant to the <i>Fisheries Act</i>) (1993; Amended 2011)	<p><u>Section 7</u> – Prohibition against disturbing marine mammals unless fishing for them under the authority of the Regulation.</p> <p><u>Section 10</u> – Requires a person who kills or wounds a marine mammal to make a reasonable effort to retrieve the animal and prohibits abandoning the animal.</p> <p>Aquatic mammals occur near the Work Site, potentially including species at risk (see below). If any marine mammal enters the marine mammal safety perimeter all in-water activities must cease until such time as the mammal has been visually confirmed as outside the marine safety perimeter, a minimum of 10 minutes has elapsed since the animal was last sighted within the safety perimeter or it can be safely removed from the area by the appropriate authorities (Section 7.2.2).</p>	No Authorization Required
Species at Risk Act (SARA) (2003)	<p><u>Section 32</u> – Prohibition against killing, harming, harassing, capturing or taking an individual of a species listed as extirpated, endangered, or threatened.</p> <p><u>Section 33</u> – Prohibition against damaging or destroying the residence of individuals of a species listed as extirpated, endangered, or threatened.</p> <p>Aquatic species at risk that have been identified as having the potential to occur in the Work Site are listed in Section 7.2.2 and terrestrial species at risk are listed in Table 7-1.</p>	General Prohibition – No Authorization Issued
Migratory Birds Convention Act (MBCA) (1994)	<p><u>Section 5(1) and 5(2)</u> – Prohibits the deposition of a substance, or combination of substances, that is harmful to migratory birds, in waters or an area frequented by migratory birds by a person or vessel.</p> <p>Migratory birds may be present in Esquimalt Harbour during the Project.</p>	General Prohibition – No Authorization Issued
Migratory Birds Regulations (pursuant to the <i>MBCA</i>) (1994; Amended 2014)	<p><u>Section 6</u> – 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.</p> <p>Migratory birds may be present in Esquimalt Harbour during the Project.</p>	General Prohibition – No Authorization Issued

Con'd...

Table B1: Selected Federal Legislation (con'd)

Legislation	Application to the Project	Authorization, Approval or Permit Issued
<i>Canada Marine Act</i> (1998; Amended 2014)	The <i>Act</i> and series of regulations and orders pursuant to the <i>Act</i> (e.g., <i>Natural and Man-made Harbour Navigation and Use Regulations</i>) 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 (QHM) is the designated Authority for Esquimalt Harbour.	General Provisions – No Authorization Issued
<i>Canada Shipping Act (CSA)</i> (2001; Amended 2013)	The <i>Act</i> and a series of regulations and orders pursuant to the <i>Act</i> (e.g., the <i>Collision Regulation</i> ; Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals), promote safety in marine transportation, recreational boating, and protection of the marine environment from damage due to navigation and shipping activities (e.g., from discharges).	General Provisions – No Authorization Issued
<i>Transportation of Dangerous Goods Act</i> (1992; Amended 2009)	Regulates the transport of all 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. It also established requirements regarding emergency response assistance plans. Any hazardous materials associated with the project are to be transported in accordance with this <i>Act</i> .	General Provisions – No Authorization Issued
Esquimalt Graving Dock Regulations (PWGSC, 2010)	Pursuant to the <i>Department of Public Works and Government Services Act</i> , regulates the use of dry dock property.	General Provisions – No Authorization Issued

Table B2: Selected Provincial Legislation

Legislation	Application to the Project	Authorization, Approval or Permit Issued
Wildlife Act (1996)	<p><u>Section 29</u> – Prohibits attempts to capture wildlife unless authorized.</p> <p><u>Section 34</u> – Prohibits the possession, removal, injury or destruction of a bird or its egg, or the nest when it is occupied by a bird or its egg.</p> <p>Wildlife and birds may occur in Esquimalt Harbour during the Project.</p>	General Prohibition – No Authorization Issued
Environmental Management Act (EMA) (2003)	<p>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.</p> <p>EMA prohibits causing pollution which is defined in the <i>Act</i> 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 (WQMP, Appendix D).</p>	Contractors should apply for permits as required for their proposed activities.
Hazardous Waste Regulation (pursuant to EMA) (1988; Amended 2009)	Hazardous wastes are wastes that could harm human health or the environment if not properly handled and disposed of. The <i>Hazardous Waste Regulation</i> includes the identification, handling, transport, disposal and treatment of hazardous wastes.	General Provisions – No Authorization Issued
Contaminated Sites Regulation (CSR, pursuant to EMA) (1996; Amended 2014)	<p>The BC <i>CSR</i> provides a process for identifying and tracking the movement and deposition of soils from contaminated sites and is relevant to the characterization, transportation and disposal of dredged materials.</p> <p>Schedule 7 is applicable to the assessment of soils/sediments being relocated or disposed in BC.</p> <p>If waste is transported to or through any other jurisdiction, the Contractor is responsible for ensuring that waste transport adheres to any applicable legislation within those jurisdictions.</p>	Soil relocation agreement required to transport material to land-based receiving facility.
Spill Reporting Regulation (pursuant to EMA) (1990; Amended 2008)	<p>The regulation defines a "spill" as an unauthorized release or discharge of a listed substance into the environment in an amount exceeding the listed quantity and specifies reporting to the Provincial Emergency Program (PEP).</p> <p>The requirements of the Regulation are to be considered in the development of a spill response plan.</p>	General Provisions – No Authorization Issued
Heritage Conservation Act (1996)	<p>The <i>Act</i> encourages and facilitates the protection and conservation of heritage property in British Columbia, including all archaeological sites on provincial Crown or private land that predate 1846 AD. The <i>Act</i> prohibits, except as authorized by a permit or order, removal heritage objects from British Columbia, and the damage, desecration or alteration of specified sites and objects.</p> <p>Archaeological potential was identified for intact archaeological materials under the western part of the South Jetty (Appendix A, Figure A3).</p>	General Provisions – No Authorization Issued

Table B3: Regional and Municipal Legislation

Legislation	Application to the Project	Authorization, Approval or Permit Issued
Township of Esquimalt “Maintenance of Property and Nuisance Regulation”, 2014, No. 2826	The Regulation prohibits the noise or sound which disturbs, tends to disturb or will likely disturb the quiet, peace, rest, enjoyment, comfort or convenience of persons in the neighbourhood or vicinity between: <ul style="list-style-type: none"> • 22:00 and 07:00 h Monday to Friday; and, • 22:00 and 09:00 h on a Saturday, Sunday or holiday. 	General Provisions – No Authorization Issued
City of Colwood Bylaw No. 38	The <i>Bylaw to Regulate Noise within the City of Colwood</i> prohibits the disturbance of the quiet, peace, rest, enjoyment, comfort or convenience of the neighbourhood or of persons in the vicinity, and stipulates the following construction hours: <ul style="list-style-type: none"> • 07:00 to 19:00 h Monday to Saturday; and, • 08:00 to 17:00 h on Sundays and statutory holidays. 	General Provisions – No Authorization Issued
Township of Esquimalt “Street and Traffic Regulation Bylaw, 2005, No. 2678”	The Bylaw and Schedule B “Road Network for the Corporation of the Township of Esquimalt Official Community Plan”, identify roads that are acceptable for truck movements within Esquimalt. As specified in Section 4.1.2 of the Official Community Plan (Corporation of the Township of Esquimalt, 2007b), roads not highlighted in Schedule B are designed to serve local traffic only (Corporation of the Township of Esquimalt, 2005). Admirals Road and Tillicum Road are acceptable trucking routes for the project. Acceptable truck routes are provided in Appendix F.	General Provisions – No Authorization Issued
Capital Regional District (CRD) Bylaw No. 2922 (Consolidated)	The “Bylaw to regulate the discharge of waste into sewers connected to a sewage discharge facility operated by the Capital Regional District” specifies the conditions under which a waste discharge permit or authorization for discharges to CRD sanitary sewers may be issued. In the event that the Contractor wishes to discharge waste into sewers, such as barge dewatering effluent, the Contractor will apply for permits / authorizations for such a discharge.	General Provisions – No Authorization Issued

Appendix 3

Esquimalt Graving Dock Environmental Best Management Practices (PWGSC, 2010a)



Esquimalt Graving Dock

Environmental Best Management Practices



Prepared By:
Public Works and Government Services Canada
Environmental Services

Date: October 6, 2010
Version: 04



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Overview

The **Esquimalt Graving Dock (EGD)** is a federal-government-operated, multi-user ship repair and maintenance facility located in Esquimalt, British Columbia. The facility has been in operation since 1925, and provides service to local, Federal, and international vessels. The vessel repair and maintenance work at the EGD is carried out by privately owned shipyards that rent the required sections of the drydock and lease upland work space from the government, and pay a fee for services such as cranes, compressed air, water and power.

Industrial ship maintenance and repair operations have the potential to result in significant environmental issues and impacts. To help identify and manage these potential impacts, the EGD has implemented an **Environmental Management System (EMS)** certified under the internationally recognized standard **ISO 14001**. The EMS provides the framework for identifying potential impacts, and ensures adequate controls are in place to effectively manage them.

This manual contains a series of recommended **Environmental Best Management Practices (EBMPs)** to reduce potential environmental impacts of common activities and operations at the Esquimalt Graving Dock. The manual contains guidance for those operating at the EGD, and is intended to complement existing environmental legislation. It does not remove the responsibility of all contractors and companies operating at the facility to abide by all applicable regulatory requirements and industry standards. All users of the facility are expected to follow the EBMPs.



For further information on environmental rules and standards contact the EGD Environmental Department.

Environmental Policy




It is the goal of the
Esquimalt Graving Dock,
in partnership with the ship
repair industry, to be the premier
ship repair, construction and
maintenance facility on the
west coast of North America.


The Esquimalt Graving Dock and
its Users realize that environmental
management is an integral part of
attaining that goal. Through the
implementation of an ISO 14001
Environmental Management System,
we are committed to managing the
actual and potential environmental
impacts of our operations.

To meet our commitment we will:

- *Protect the natural environment and prevent pollution.*
- *Meet or exceed applicable federal, provincial and municipal legislation and regulations; uphold departmental policies; and abide by industry standards, practices and other requirements related to our identified environmental aspects.*
- *Establish and review our programs, objectives and targets to ensure we are meeting our environmental commitments.*
- *Communicate openly with our employees, Users, tenants, contractors, suppliers, neighbours and other stakeholders regarding our Environmental Management System and the nature of our operations.*
- *Educate our employees and the Users of our facility to ensure they are aware of and understand their roles and responsibilities in protecting the environment.*
- *Meet the evolving needs and expectations of our industry and community through the continual improvement of our systems, programs and procedures.*


Bonnie MacKenzie
Director General
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JULY 2009



Public Works
Gouvernement du Canada

Travaux publics et Services
gouvernementaux Canada

ISO 14001
EMS-011
QCSB



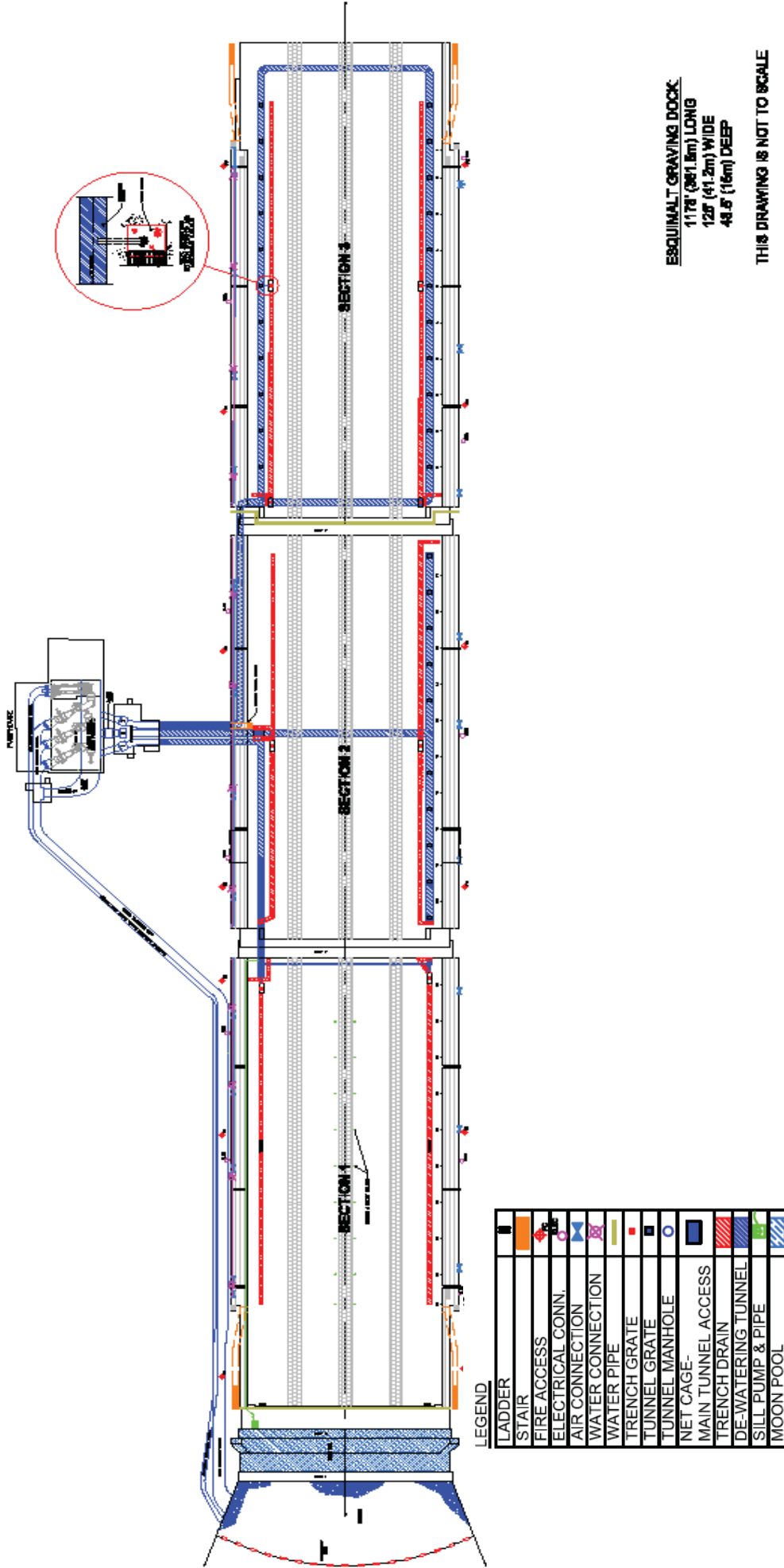
Canada

Esquimalt Graving Dock



ESQUIMALT GRAVING DOCK DRAINAGE PLAN

Note: It is intended that this drawing be printed in colour.
If printed in black and white some detail will be lost.



High Pressure/ Ultrahigh Pressure Washing

One of the first activities to occur on a dry-docked vessel is the high pressure washing of the vessel hull to remove salts and marine growth prior to surface preparation or painting. This typically involves pressure washing the hull and/or super structure with water at 2,000 – 3,500 psi, which may produce large volumes of paint contaminated wastewater. Shipyards may use an Ultra High Pressure (UHP) washing process (from 40,000 – 55,000 psi) to completely remove all paints, eliminating the need for further surface preparation prior to painting. This operation generates even larger volumes of wastewater and solids, which will need to be managed.

Management of Wastewater on the Graving Dock Floor

- Ensure all wastes and wastewater discharges resulting from hull washing activities are collected and disposed properly.
- Coordinate high pressure washing operations to ensure effective collection of wastewater.
- Close all sump well valves in the floor collection system prior to and during high pressure washing operations.
- Divert contaminated wastewater that falls outside of the dock floor containment area away from the tunnel drains.
- Direct non-contaminated water (i.e. ballast water, cooling water) away from contaminants on the dock floor.
- Collect and dispose of stormwater that comes into contact with contaminants.
- Do not use environmentally harmful detergents or additives in wash water.

All wastewater containing paint contaminants must be directed to the collection drains and sumps on the drydock floor, collected, and sent for treatment.



Antifoulant contaminated wash water entering the trench drain sump wells on dock bottom.

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Page 1	

Section 1 Considerations – Caisson Leakage and Sediment

Diversion of sill water away from pressure washing areas

Water leaking into Section 1 of the graving dock from the caisson can be diverted from the work area by using a sump pump hooked to the PVC pipe installed along the north wall of the graving dock (Section 1).

Managing Entrained Sediment

Harbour sediment may become trapped in section 1, and accumulate in the corners, trenches and sumps. The users of the section will need to be aware of this. This sediment will have to be removed if it becomes contaminated with pressure washing wastewater, sandblast grit, paint chips, paint overspray, or other contaminants.



The sill diversion pump removes clean saltwater from the pool at the front of Section 1 (moon pool) and discharges to the tunnel drains through a hard pipe on the dock wall.



Sediment from the harbour often settles on dock bottom after dewatering. This may become contaminated with paint, etc. and must be disposed of.

Ultra High Pressure (UHP) Washing

Ultra high pressure washing generates significant volumes of wastewater and sludge that may pose a challenge for collection and disposal.

- Prepare in advance for the management of the UHP waste.
- Remove all water, sludge and debris generated from UHP washing from the dock.
- Ensure the sludge is disposed of at an appropriately permitted facility.



The hull of a cruise ship being ultra high pressure washed. Inset: sludge produced during ultra high pressure washing.

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Management of Small Vessel High Pressure Wastewater in the Upland Areas

- Perform pressure washing only in designated areas where wastewater management can be effectively achieved.
- Completely block off all drains prior to use for collecting wastewater from pressure washing.
- Ensure sufficient equipment is available for the timely collection and removal of wash water.
- Clean up work area and drains prior to removal of collection equipment. (i.e. filter cloth, plugs, tarps)



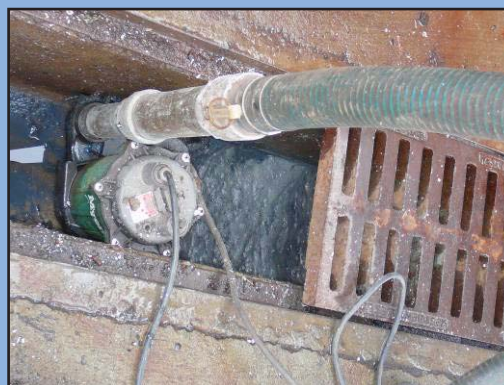
A small vessel is power washed on the North Landing Wharf (NLW).



The trench drain is blocked and a sump pump is installed to collect wash water into a tote.



Example of styrofoam blocks used as a drain blocker on the NLW.



Example of a pump set up used to collect wash water on the NLW.

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BMP #2

Abrasive Blasting

Abrasive blasting is a common operation performed at the Esquimalt Graving Dock (EGD) to prepare vessel surfaces for painting. However, this operation creates challenges with respect to controlling air emissions and the waste materials generated.

Fugitive emissions from blasting operations have the potential to negatively affect employees, facility users, neighbours, equipment and infrastructure. The dust from blasting may contain harmful environmental pollutants which may enter the harbour directly or via stormwater runoff.

Waste grit may be contaminated with antifouling paint which poses a risk to marine life if not handled properly.

Dust Control

- Cover all blast media (new and used) during transport.
- Use containment such as tarps, shrouds or portable structures to prevent airborne particles from entering the atmosphere and surface waters.
 - Containment should be large enough to adequately enclose or segregate the working area.
 - Ensure containment devices are connected so there are no gaps.
 - Ensure that containment reaches the dock floor or walls



- Where physical containment techniques are not sufficient to prevent fugitive emissions water curtains may be used to mitigate dust emissions in problem areas.
- Do not abrasive blast during conditions that render containment ineffective (i.e. during windy conditions)
- Minimize dust emissions by ensuring blast nozzles are angled close to perpendicular and aimed slightly downward during blasting.
- No abrasive blasting of vessels shall be performed while vessels are docked at the North Landing Wharf or South Jetty

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Air Quality Alarm

The Esquimalt Graving Dock has an onsite PM₁₀ monitor in partnership with the Ministry of Environment.

If particulate matter levels in the air exceed 100µg/m³ an alarm sounds in the Pumphouse, at which time corrective actions must be taken.



Waste Grit Management

- Remove waste grit from work areas as soon as possible.
- Store all waste grit in appropriate containers to prevent stormwater and wind impacts.
- Cover all skips, storage bins, tanks, and hoppers to prevent dust emissions.
- Dispose of waste grit in accordance with applicable provincial regulations.



Store all waste grit away from drains, to prevent contaminated water migrating into the marine environment.



Sweep waste grit under the vessel to prevent it from being washed down the drain.



Store waste grit in appropriate containers, protected from inclement weather.



Remove waste grit from work areas as soon as possible.

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Keel/Bilge Blocks

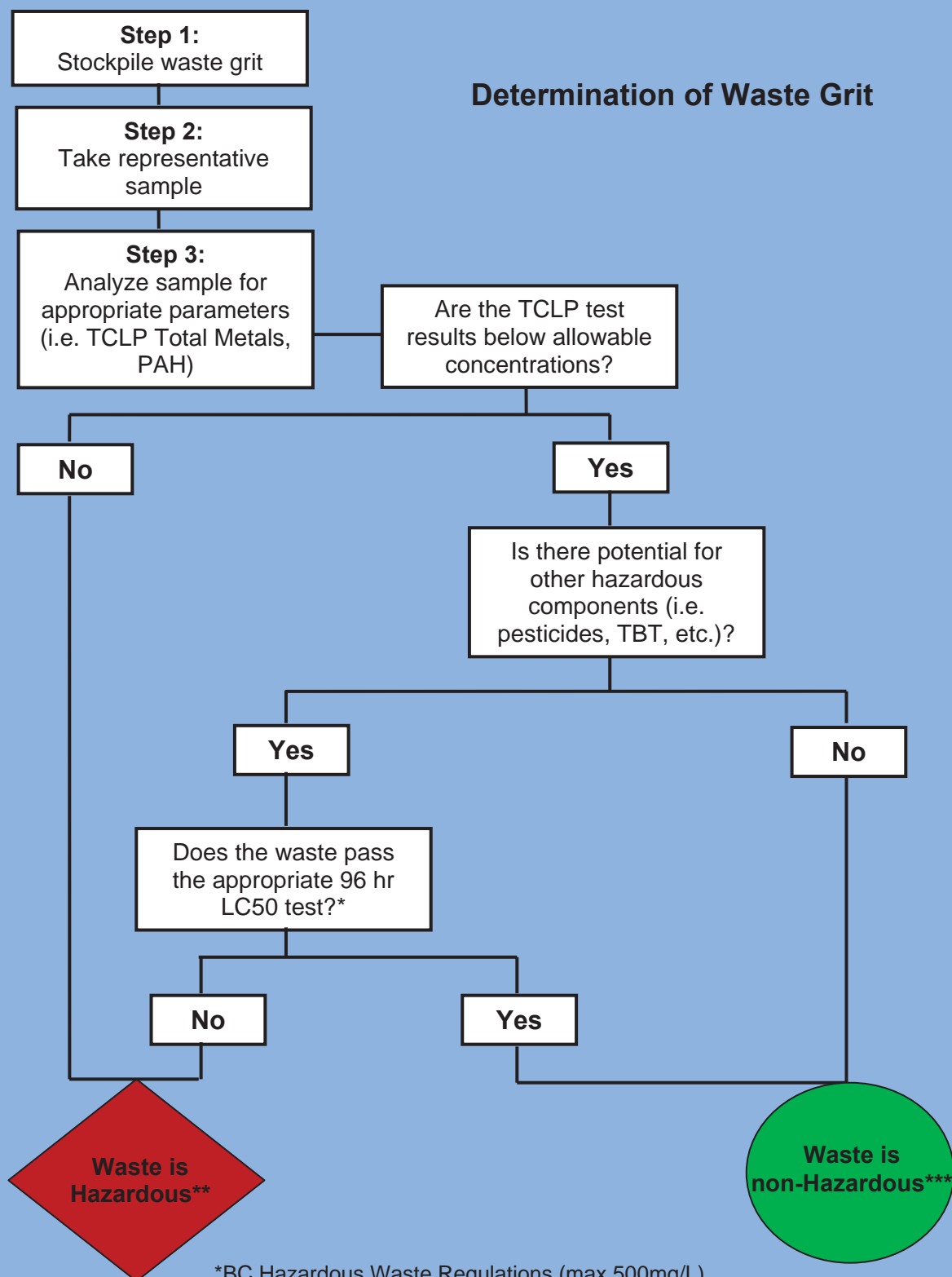
Keel and bilge blocks on dock bottom present a challenge for clean up of spent waste grit.

Excess blocks stored in dock bottom may be moved prior to sandblasting, or covered to prevent grit from collecting between the blocks.



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Determination of Waste Grit



*BC Hazardous Waste Regulations (max 500mg/L).

**Waste must be disposed of at a permitted facility.

***non-Hazardous waste may be considered "Controlled" and must be disposed of at an approved facility.

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BMP #3

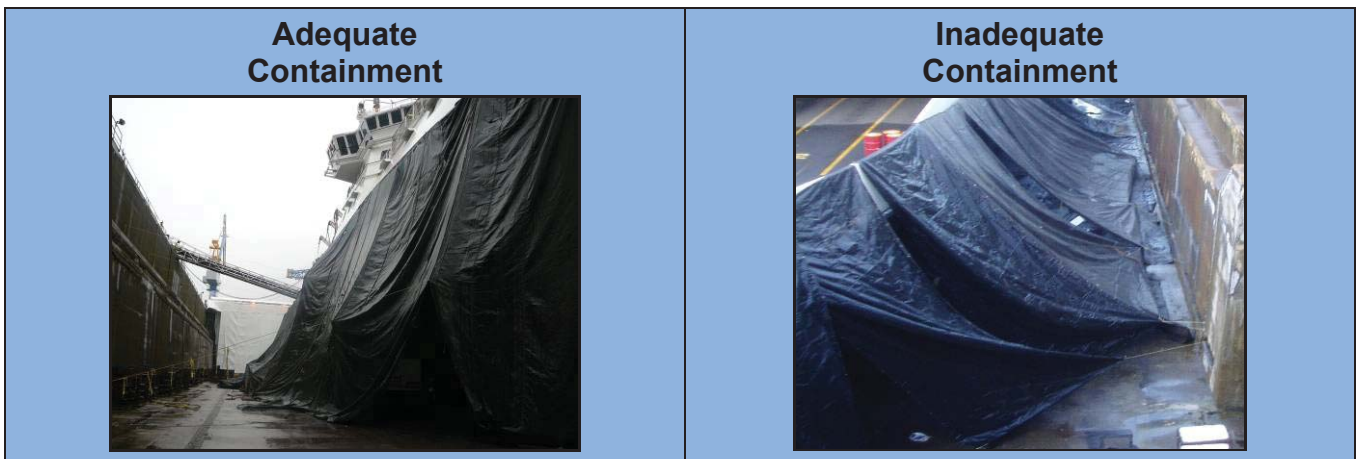
Painting and Coating

Ship repair and maintenance often requires painting and coating of vessel surfaces to protect from corrosion or to inhibit growth of marine life. The industrial nature of marine paints, in particular antifouling paints, may result in negative impacts to the environment and surrounding infrastructure if not properly managed.

Paint Overspray

Paint overspray has the potential to impact the marine environment, soils, neighbouring residences, and nearby equipment and infrastructure.

- Use containment such as tarps, shrouds or portable structures to prevent airborne particles from entering the atmosphere and surface waters.
 - Containment should be large enough to adequately enclose or segregate the working area.
 - Ensure containment is secured so there are no gaps.
 - Ensure that containment reaches the dock floor or walls.



- Do not spray paint during conditions that render containment ineffective (i.e. windy).
- Place containment beneath and around structures being painted on dock floor and in work areas to ensure overspray does not reach the surrounding area (i.e. during painting of anchor chains, grates, etc.).
- Manage overspray on the graving dock floor to prevent safety hazards (e.g. slippage).



For vessels docked in **Section 1** ensure that overspray does not reach the sill water. Avoid docking vessels so they extend over sill area.

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Painting Dockside

- Do not spray paint vessels docked at the North Landing Wharf or South Jetty.
- Use rollers and brushes to paint vessels dockside
- Ensure tarps are in place below work areas, as well as in between the vessel and the dock to prevent spills and drips from entering the water.
- Ensure paint cans are stored securely when working alongside vessel edges.
- Ensure floor grates of manlifts are covered to prevent spills to the marine environment
- Waste generated from grinding and hand tooling must be prevented from entering the marine environment.



Ensure tarps are in place to prevent overspray impacting the surrounding work area.



While painting vessels berthed at the North Landing Wharf and the South Jetty do not spray paint, and take measures to prevent paint from entering the marine environment.

Temporary Paint Storage/Mixing Areas

- Must be under cover to protect from inclement weather
- Only in designated areas
- Must be on secondary containment (a tarp at minimum)
- Ensure empty paint cans and other associated wastes from painting are stored properly, protected from the weather, and removed from dock bottom as soon as possible.



In **rare** situations (i.e. shape of the vessel combined with ideal weather conditions) containment may not be necessary to prevent overspray from escaping the area.

In this situation, the User must notify PWGSC **prior** to beginning the work, and obtain approval, **in writing**, to paint without completely enclosing the vessel. Restrictions and monitoring requirements will be applied.

To this date this has only been allowed in three situations:

- painting underneath a flat bottom barge
- painting the underwater hull portion of the midsection of a cruise ship
- painting of a C-class ferry underwater hull area during calm wind conditions

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Dry Dock Floor Management and Cleanup

Drain Management

- All sump well valves must be closed prior to and during power washing operations.
- Cover all tunnel drains and net cages during sandblasting, painting and power washing to prevent contaminants from entering the marine environment.
- In the case of a spill or release on dock bottom all sump well valves must be closed and all contaminated material contained and removed from dock bottom.
- Direct all contaminated water to the trench drain system, to avoid entering the tunnel drains.
- Collect and properly dispose of all contaminated water. Ensure sufficient equipment is available for contaminated water collection.
- Ensure all non-contaminated water is directed away from work areas and into the tunnel drain system. (i.e. ballast water, cooling water, caisson sill water).



Sediment Management



- Segregate any marine sediment which may enter the dock during vessel transfer from pollutants generated from vessel repair in order to reduce the amount of wastes requiring disposal.
- Collect and properly dispose of marine sediment that becomes contaminated with waste generated from vessel repair.
- Remove all contaminants and residues from the trench drains and sump wells prior to flooding at the end of work period.

Hazardous Materials Management

- Store hazardous materials (i.e. fuel, paint, waste oils) away from the drains on dock bottom.
- Store hazardous materials to the inside of the trench drains so that any spills or releases can be captured.
- Store hazardous materials in areas protected from the weather, water curtains and other water sources.
- Ensure adequate spill response equipment is in close proximity to hazardous material transfer operations. At a minimum one spill kit is required per section of the graving dock.

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Housekeeping

- Remove waste sandblast grit from the work area as soon as possible to prevent migration of grit contaminants into tunnel drain system.
- Store wastes collected from the dock floor in appropriate secondary containment and removed from dock bottom as soon as possible.



Residual paint in the cans, may drip out of the skip and enter the marine environment through the drain systems.



Leaving garbage around the work site attracts wildlife such as seagulls, racoons, and rats.



When cleaning dock bottom, skips of waste sandblast grit may leak contaminated water and should be removed as soon as possible.



All hazardous materials must be stored in appropriate containment and away from tunnel drain system.

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Inspection and Cleanliness

- Prior to flooding, the drydock must be cleaned to meet the Esquimalt Graving Dock (EGD) Standard of Cleanliness, as determined by the EGD undocking supervisor.
- Users must ensure that the dock floor is free of deleterious substances prior to flooding.
- Water may be used to clean the dock floor; however, any wastewater generated must be collected and disposed of properly.
- If a vessel occupies a shared portion of a dock section each User must clean the trench drains up to and including the section sump well.



Example of a dock floor that would pass inspection.



Example of a dock floor that would not pass inspection.

EGD Standard of Cleanliness

Due to the importance of drydock cleanliness prior to flooding, and since quantitative testing is impractical due to time and cost restrictions, the following guidelines will be used to assess cleanliness of drydock surfaces.

- All drydock surfaces, including stairwells and sills must meet the standard for **“residue free”** prior to flooding of the drydock. **“Residue free”** is considered met when a person of normal visual acuity, while standing, is unable to detect visible accumulations of potential pollutants.
- This includes, but is not restricted to, the removal of abrasive grit, paint residues, cutting and grinding wastes, oil and grease, food and drink containers, ear plugs, dust masks, rope, cigarette packs, or any other refuse that may have been deposited during the work period.
- Debris of natural origin that may have been deposited during the previous flooding of the drydock, such as wood, sand, silt, seaweed, or marine life may be exempt from these requirements, as long as it will not contaminate the environment upon reintroduction.

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Important Locations	Acceptable	Not Acceptable
Ramps		
Sills		
Keel Blocks		
Trench Drains		
Sump Wells		

BMP #5

Hazardous Materials Handling and Storage

A variety of materials are used, stored and transported by the Users at the Esquimalt Graving Dock (EGD). If not handled appropriately, these materials have the potential to negatively impact worker health and safety, infrastructure or the environment.

Long Term Storage

Users must have designated storage areas suitable for the materials they use on site. These areas must:

- Have appropriate secondary containment suitable to the quantity and nature of the material in that area
- Ensure materials are stored in accordance with compatibility requirements
- Be protected from the weather
- Have placards and ventilation (where applicable)
- Have controlled access



Short Term Storage and Working Areas

These areas must be:

- Clearly identified and labelled
- Located away from pathways to the marine environment
- Located on impervious surfaces (i.e. concrete, asphalt)
- Protected from the weather



Materials must be:

- Stored in containers appropriate for the nature of the material
- Labelled appropriately with product name, first aid information, and PPE requirements.
- Secured appropriately during transport



MSDS for all products stored on site must be available to all employees.



Empty containers must be labelled "Empty".



Inspect all valves and storage containers for rust or damage before use.

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Federal Regulation for Fuel Storage Tanks

As the EGD is a Federal facility, any storage tanks onsite may fall under the Petroleum and Allied Petroleum Products *Storage Tanks Regulations* (2008). Tenants may be required to register their tanks with Environment Canada.

National Fire Code

This code outlines the containment, labelling and location requirements for flammable liquid storage.



Areas to Avoid Storing Containers of Hazardous Materials

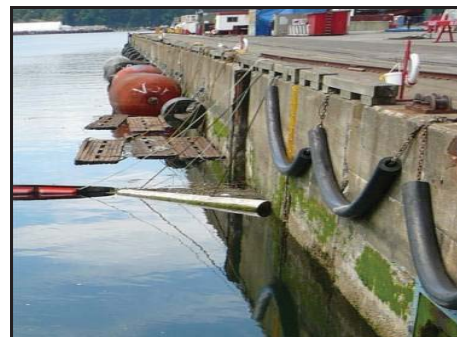
Drains: Although the trench drains provide the opportunity to collect accidentally released materials, if a tote or drum is placed directly over top or beside a drain the material will flow directly into it and the spill may not be noticed until it is too late.



Fire Holes: On the South Jetty the fire holes flow directly into the harbour. If any containers fail near the fire holes, the material will not be able to be recovered once it is in the harbour..



South Jetty and North Landing Wharf Edges: Any containers placed near the edge of the jetties have the potential to spill directly into the harbour as there are no berms or secondary containment available.



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Waste Management and Recycling

Operations at the Esquimalt Graving Dock (EGD) generate a variety of waste streams including hazardous waste, international wastes, and general refuse and recyclables.

Hazardous Waste

Hazardous wastes generated at the EGD may include waste oil and oil filters, antifreeze, batteries, paint and solvents, oily rags and absorbent materials, spent grit, solids generated during power washing, and asbestos. Appropriate management of hazardous waste will reduce environmental liability associated with inappropriate disposal and storage as well as reduce the risk of human injury and environmental impact.

Hazardous waste storage shall be segregated from new product storage.

- Ensure designated storage areas are away from active work areas.
- Ensure areas are covered to reduce exposure to environment and wildlife.
- Ensure that waste accumulation areas are organized.

Hazardous waste should be segregated into separate containers.

- Ensure containers used are appropriate for the type of waste (i.e. separate drums for waste oil, oil filters, antifreeze, batteries, paint and solvents, oily rags and absorbent material, spent grit)
- Store batteries in a manner that prevents leakage of acid to the environment.
- Properly dispose of contaminated clean-up materials (i.e. absorbents, rags, etc.)
- Do not dilute or mix hazardous waste other hazardous or non-hazardous wastes.
- Cover waste containers to prevent exposure to weather (i.e. rain)

Clearly label all hazardous waste containers.

- Labels should include: type of waste, generator/company name, and contact information

Asbestos

All asbestos containers and asbestos-containing materials must be identified by signage and labelling in accordance with applicable legislation.

Companies which engage in asbestos related work at the EGD must be qualified to do so.



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Biological Waste

Marine life removed from vessel hulls may contain paint contaminants. This waste may be considered a controlled or hazardous waste and would need to be handled and disposed of accordingly.



Recycling

All Users of the EGD are responsible for collecting and disposing of the solid waste they generate from their activities, properties and vessels they are responsible for.

- Recycle solid waste such as plastic, glass, aluminum, mixed paper and cardboard. Recycling areas should be conveniently located and easily identifiable.
- Segregate other solid waste, such as scrap metal, wood, electronics, polystyrene foam and soft plastics for recycling at an approved facility.
- Leaf and yard waste collected on property should be composted at designated sites located on dock property.
- Construction and demolition waste should be reused or recycled wherever cost effective and technically feasible.
- Encourage the use of recyclable products to reduce the solid waste impact on the environment.

International Waste

Like hazardous waste, International Wastes may pose a threat to human health and the environment.

Dunnage from vessels has been known to carry invasive insects to local areas. Foreign dunnage must be identified, stored, and disposed of at an approved facility.

Food wastes may carry pathogenic organisms that could cause illness to those handling it. Food wastes shall be kept in separate, closed containers. The Canadian Food Inspection Agency (CFIA) will inspect foreign vessels and issue directions on disposal.



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Fuelling and Oil Transfer

At the Esquimalt Graving Dock (EGD) the transfer of oil and fuel is a common activity. An accidental release during these operations has the potential to negatively impact the environment, and health and safety of those at the facility.

- Prior to any fuelling or oil transfer operations an emergency plan must be in place, adequate spill response equipment must be available, and employees aware of spill response procedures must be on hand.
- All transfer and storage equipment must be in good condition, tested, and properly connected.
- Do not place storage and transfer equipment near pathways to the marine environment (i.e. storm drains, edge of the dock).
- Berthed vessel fuelling operations involving trucks and barges as well as bulk oil transfers exceeding 10 tonnes (10,000 L) per day must comply with the **EGD Fuelling and Oil Transfer Policy and Checklist**.

Vessel Fuelling and Bulk Oil Transfer

Definition of Oil: as described in the **Canada Shipping Act** oil is considered **petroleum in any form, including: crude oil, fuel oil, sludge, oil refuse, and refined products.**

- All berthed vessels receiving fuel from a truck or a barge require a containment boom.
- Transfers of greater than 10 tonnes of oil per day to/from a berthed vessel require a containment boom.
- An **EGD Oil Transfer Checklist** must be filled out and signed by representatives from the truck and the vessel and submitted to EGD representatives in the pumphouse prior to fuelling or oil transfer operations.
- Transfer operations must comply with the *Canada Shipping Act, Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals Subdivision 5*.

Containment Boom Rental

The Esquimalt Graving Dock has a boom and deployment equipment available for rent. To arrange for booking or rental contact the EGD Operations Manager.



An orange containment boom surrounds the vessel while being fuelled

The EGD boom reel and containment boom



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Example Scenario Requirements

Scenario 1: Fuelling a berthed vessel



- Completed and signed EGD Oil Transfer Checklist submitted to EGD Pumphouse
- Containment boom adequately secured at both ends.
- Emergency response plan in place.
- Adequate spill response equipment and qualified personnel available.

Scenario 2: Fuelling a vessel or bulk oil transfer (greater than 10 tonnes a day) in the drydock



- Completed and signed EGD Oil Transfer Checklist submitted to EGD Pumphouse.
- Pumphouse operator on site prepared to shut down auxiliary pumps in case of an emergency.
- Receiving containers located away from pathways to the harbour (i.e. tunnel drains).
- Adequate spill response equipment and qualified personnel available.
- Emergency response plan in place.

Scenario 3: Bulk oil transfer from berthed vessel (greater than 10 tonnes a day)



- Completed and signed EGD Oil Transfer Checklist submitted to EGD Pumphouse.
- Containment boom adequately secured at both ends.
- Receiving containers located away from pathways to the harbour (i.e. storm drains, edge of dock).
- Emergency response plan in place.
- Adequate spill response equipment and qualified personnel available.

Scenario 4: Onshore oil transfer between containers



- All containers located away from pathways to the harbour (i.e. storm drains, edge of dock).
- Emergency response plan in place.
- Adequate spill response equipment and qualified personnel available.

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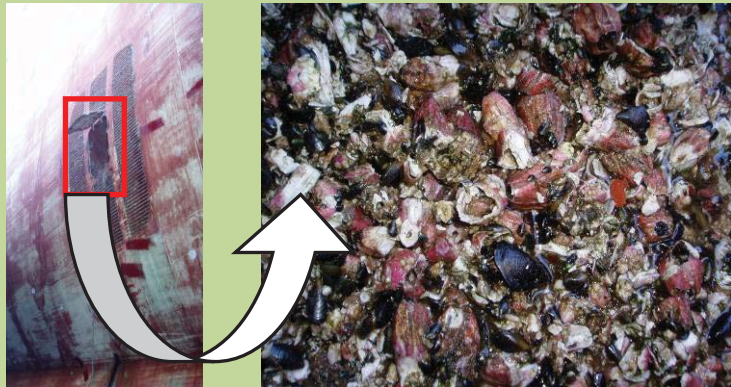
Invasive Species (Ballast Tanks and Hulls)

Invasive species are a significant threat to the marine ecosystems of British Columbia and Esquimalt Harbour. In 2000 a Fisheries and Oceans sponsored study of invasive species found that Esquimalt Harbour had a disproportionately high number of non-indigenous species. It has been widely recognized that the primary source of non-indigenous marine species in local waters are the ballast tanks and hull surfaces of transoceanic vessels.

Marine growth removed from vessel hulls must not be allowed to enter the harbour through the graving dock drainage system.

- Ballast Water
 - Vessels must follow Transport Canada Ballast Water Control and Management Regulations
- Ballast Tank Sediment
 - Shipyards must follow Transport Canada Ballast Water Control and Management Regulations
 - Sediments removed from the ballast tanks at the EGD must be contained, collected and disposed of at an authorized facility.
 - **Sediments must not be allowed to enter the harbour.**
- Anchor chain-growth
 - All biological material removed from anchor chains must be contained, collected and disposed of appropriately.
- Sea chests
 - All biological material removed from sea chests must be contained, collected and disposed of appropriately.





Sea chests such as this one from a cruise ship docked at the EGD often contain a significant amount of marine life. If not managed appropriately this marine life has the potential to negatively impact the local ecosystem of the harbour

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Fish and Wildlife Management

The daily operations and activities of the Esquimalt Graving Dock (EGD) have the potential to negatively impact wildlife which frequents the property.

Fish

Fish and other marine life have the potential to become stranded in the graving dock during normal vessel docking/undocking operations. This may include, but is not limited to: salmon, octopus, other fish species, and seals.

- The bubble curtain must be employed during vessel transfer into and out of the graving dock.
- EGD employees must monitor the graving dock for stranded fish and/or other marine life during dewatering.
- Whenever possible, EGD employees must retrieve fish and marine life and safely return them to the Esquimalt Harbour.
- Users are prohibited from removing fish and marine life from the graving dock.



Report all instances of fish and marine life interaction with the Graving Dock to EGD Environmental Services

Authorization for the Destruction of Fish (Section 32)

The EGD has received authorization for the destruction of fish associated with normal operation of the graving dock from the Department of Fisheries and Oceans.

Conditions of the Authorization:

- ▶ Take all reasonable precautions to prevent the trapping and mortality of fish
- ▶ Monitor the success of preventative measures and retrieval success
- ▶ Report to the DFO annually

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Wildlife

A variety of wildlife is known to occupy areas of the EGD property. In some cases wildlife may use the facility as a nesting/breeding ground, while others are present for short periods of time to pass to another location or to feed. Activities and operations at the EGD have the potential to impact the well being of wildlife at the facility.

Such wildlife includes: deer, raccoon, mink, river otter, great blue heron, osprey, raven, cormorants and a variety of other common nesting and song birds.

- All wildlife must be left alone
- Injured or orphaned wildlife must not be handled without proper experience and equipment.
- Dispose of dead wildlife appropriately.
- Prior approval from EGD Environmental Services is required for the relocation or removal of nesting wildlife.

In all cases, call EGD Environmental Services for wildlife related incidents

EGD Wildlife Management Plan Contact Information

Conservation Officer

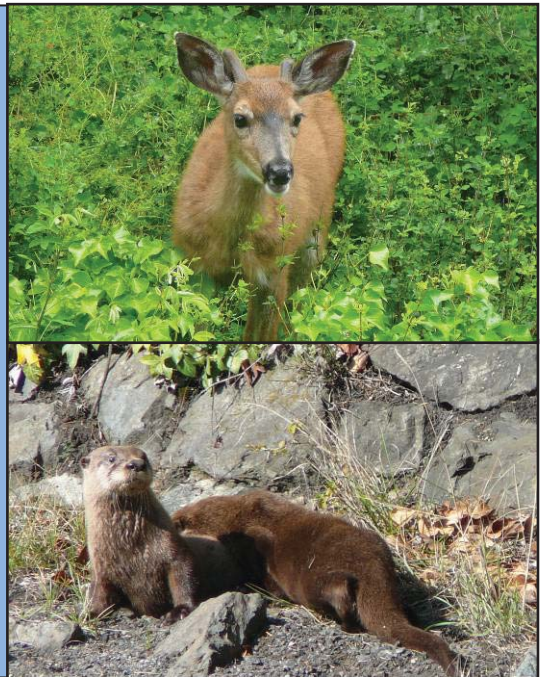
T: (250) 391-2225 (daytime)
1-800-663-9453 (after hours call centre-will take
messages and pass along to the Conservation Officer)

BC SPCA Wild ARC

(Animal Rehabilitation Centre)
T: (250) 478-9453

Vancouver Aquarium Rehabilitation/Rescue

T: (604) 258-7325



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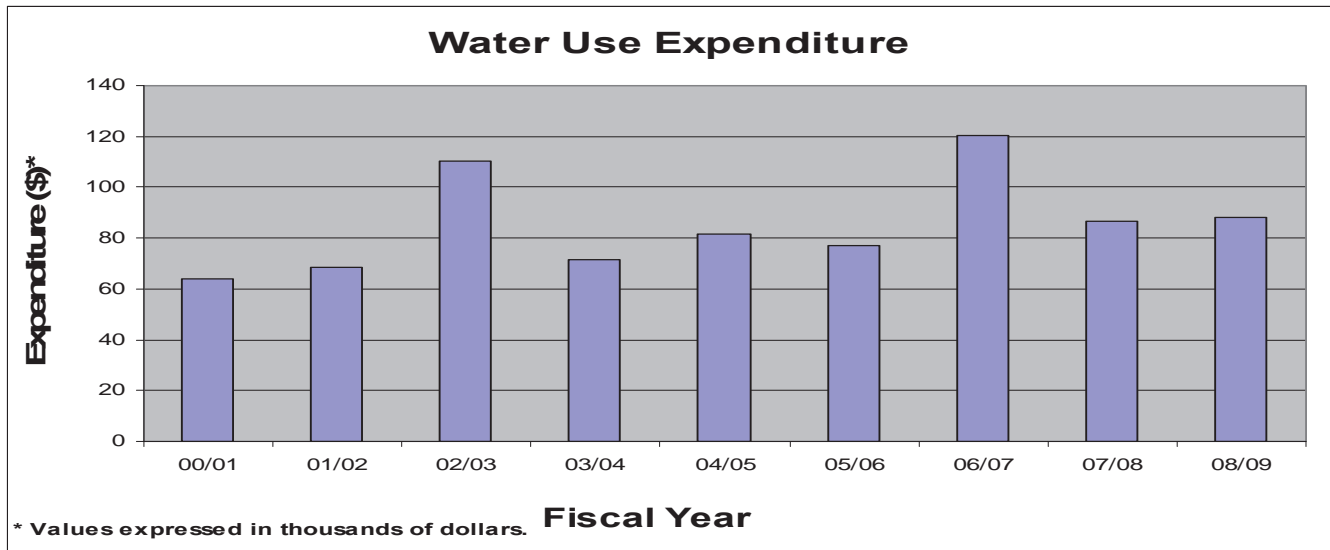
BMP #10

Water Use

Water consumption and the quality of water are considerations of the environmental management system at the Esquimalt Graving Dock (EGD).

Water Consumption

Large volumes of water are used during normal operations at the facility; because of this the EGD is considered a high volume user of fresh water in the Capital Region.



Significant Water Consuming Activities



Water Curtains

Water curtains are used to mitigate the escape of dust from sandblasting operations in dock bottom



Ultra High Pressure Washing

Ultra high pressure washing uses large amounts of water at high pressure to scour paint and biological material from the hulls of ships

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In order to reduce the amount of water consumed onsite:

- Only use water curtains when all other attempts to contain particulate emissions from sandblasting have failed.
- Avoid use of freshwater to clean work areas (e.g. graving dock bottom, wharves, jetties).
- Maintain fittings in buildings and on equipment to prevent leakages.

Metered Water Use at the Esquimalt Graving Dock

- Users must ensure that water is accessed from a metered line when connecting to the water distribution system
- Portable meters are to be used where necessary.
- Pumphouse must be contacted for proper access to the water distribution system.



The EGD maintains the water distribution system.

- Flushing of the entire system is conducted on an annual basis.
- Collection and analysis of water in comparison to drinking water quality guidelines is conducted regularly.

The water distribution system at the EGD was originally designed as a firefighting system; therefore, the water in certain areas of the system may not be considered potable.

- Users are responsible for ensuring that the water they use meets guidelines for the purpose intended.



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BMP #11

Energy Conservation

The Esquimalt Graving Dock (EGD), as a facility, is a major energy consumer. Inefficient energy use may result in a negative economical and environmental impact. Economical impacts are associated with inefficient electrical usage (i.e. cost). Environmental impacts include those associated with the consumption of fuel (i.e. air emissions).

Electrical Consumption

There are a number of opportunities to increase the efficiency of electrical usage at the EGD:

- Turn off lights when not in use (flood lights, office buildings)
- Turn off equipment when not in use
- Use energy efficient equipment whenever possible
- Stagger equipment start-up to decrease load on electrical system



Fuel Consumption and Emissions

The second largest source of greenhouse gas emissions from the dock is employee commuting and fuel consumption. Some opportunities to decrease the amount of fuel consumed by day to day activities are:

- Use energy efficient vehicles
- Use alternative fuels/energy sources if possible
- Avoid idling vehicles
- Use shore power whenever possible
- Encourage staff to find alternative means for commuting to work (i.e. carpool, public transit, cycling)

Idling Vehicles

Idling Vehicles produce unnecessary air emissions and noise.

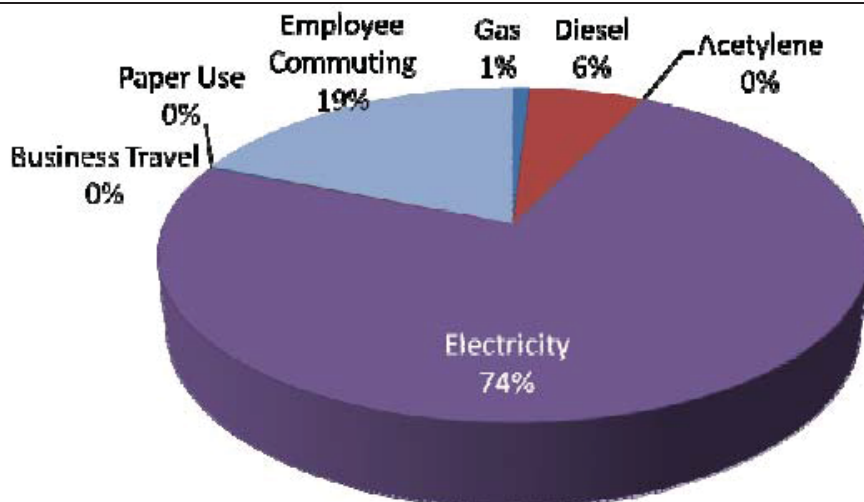
- Do not idle vehicles near building doorways or air intakes
- Vehicles must be turned off if idling for more than 3 minutes in a 60 minute period



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Greenhouse Gas Emissions:

Energy consumption results in the production and release of greenhouse gas emissions through the combustion of fossil fuels. Every aspect of work at the EGD results in the release of greenhouse gases whether it is running the cranes or printing a report. It is important to minimize energy consumption wherever possible to mitigate the release of harmful greenhouse gases.



**Figure 1: Emissions Source Contributions
2006/2007**

The Royal Roads University (RRU) Greenhouse Gas Audit determined that the largest source of carbon emissions at the EGD was electricity use. Employee commuting was the second largest greenhouse gas producer.



Shore Power

When vessels are moored at the North Landing Wharf or the South Jetty it is important that they utilize shore power. With shore power the generator can be turned off thereby saving fuel and preventing the release of harmful air pollutants.

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Nuisance Pollution (Noise/Odour/Light)

The daily operations of the Esquimalt Graving Dock (EGD) tenants have the potential to negatively impact the work and living environment of neighbouring businesses and homes. Nuisance pollution is often created by noise, odour and light.

Noise

- The main sources of noise at the EGD include sandblasting, drilling, hammering, compressors, generators and the crane warning bell. Even general shop repair activities generate large amounts of noise.
- Whenever possible schedule noisy activities for daytime hours 0700 hrs to 2300 hrs on weekdays, and from 0700 hrs to 1900 hrs on weekends and holidays. Through worker education and good practice the generation of high-level intermittent or non-continuous noises can be minimized.
- The EGD Environmental Policy makes a commitment to follow all applicable municipal laws and regulations, therefore it is expected that the daily operations at the EGD will meet the Esquimalt Noise Control Bylaw (2677).



The EGD is considered an “Activity Zone” and the neighbouring area is considered a “Quiet Zone”. Building and infrastructure related projects at the EGD may fall under the definition of a “Construction Zone” as per the Esquimalt Noise Control Bylaw.

Esquimalt Noise Control Bylaw		Noise Receiver Zone	
		Quiet	
		Day	Night
Noise Source Zone	Activity	60 dBA	55 dBA

Construction Zone

Building and infrastructure related projects at the EGD may fall under the definition of a “Construction Zone” as per the Esquimalt Noise Control Bylaw. The definition of a construction zone according to the Esquimalt Noise Control Bylaw is:

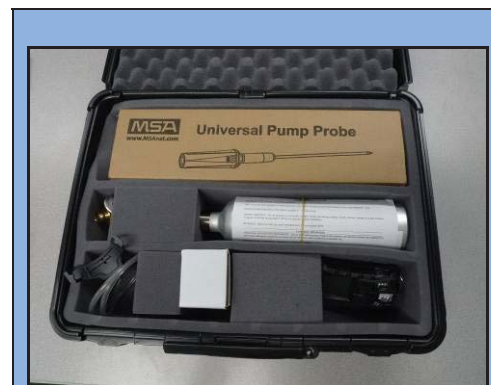
- the erection, alteration, repair, relocation, dismantling, demolition and removal of a building;
- structural maintenance, power-washing, painting, land clearing, earth moving, grading excavating, the laying of pipe and conduit, concrete placement, and the installation, or removal of construction equipment, components and materials in any form or for any purpose;
- any work being done in connection with any of the work listed in paragraphs (a) or (b);

The noise level limit for a “Construction Zone” is **85 dBA** day and night.

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Odour

- Daily dock operations often create strong and unpleasant odours whether from the release of VOCs, H₂S, organic materials, or chemicals an offensive smell can reduce the quality of the work environment for neighbouring tenants and home owners.
- In the event that odours are negatively affecting other tenants or stakeholders odour mitigating measures may be required.
- Contact EGD Environmental Services in the event of a nuisance odour from an unknown source.



H₂S Meter

The EGD utilizes an H₂S meter to ensure that any emissions released from the sanitary sewer system that create nuisance odours are not hazardous to adjacent work areas.

Light

- Night time dock operations require spotlights to provide a safe work environment. However for residential neighbours strong spotlights can be a significant intrusion.
- Utilizing spotlights only when absolutely necessary will help prevent disturbing the neighbours as well as provide a more energy efficient work environment.
- Changing the direction of the lights may reduce the effect they have on the neighbours.
- Turn off or report to your supervisor any unnecessary lights left on.



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BMP #13

Sanitary Waste Management and Sewer Use

The Esquimalt Graving Dock is authorized by the Capital Regional District (CRD) as a ship and boat waste disposal facility.

Discharge to the sanitary sewer at any location other than at the LS#15, LS#11 or the four vessel connections at the Graving Dock is prohibited.



The EGD is authorized to discharge to the sanitary sewer at the:

- Lift Station #15 (LS#15),
- Lift Station #11 (LS#11) and
- And the four vessel connections in the graving dock.

Permitted wastes include:

- sanitary waste
- grey water
- treated superchlorinated water*

Prohibited wastes include:

- bilge and ballast water
- wastewater sludge
- fuel and oil, paint, paint thinner, solvents, and products containing toxic chemicals

***Superchlorinated Water:** must not be discharged to the sanitary sewer unless it has been dechlorinated to less than 5 ppm chlorine.

- Users must notify the Pumphouse before conducting any discharges to the sanitary sewer. Typical methods of discharge are: large (connection to a vessel), and small (portable discharges from totes).
- Users must complete a Sanitary Sewage Discharge Form and provide it to the Pumphouse prior to discharging to the sanitary sewer.
- Pumphouse Operators will ensure that sanitary sewer discharges are in accordance with applicable regulations and authorizations.
- Pumphouse Operators will provide all completed Sanitary Sewer Discharge Forms to EGD Environmental Services, who will submit quarterly reports to the CRD.
- Users must ensure a sample collection point is accessible at the point of discharge.

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Spill Preparedness and Response

The Esquimalt Graving Dock (EGD) is committed to the protection of human health and the environment. Safety and environmental management programs have been implemented at the EGD to reduce the potential for accidents and spills. Emphasis is placed on the prevention of spills, and although the potential for spills can be reduced through these programs, spills do happen.

All Users operating at the EGD must have the capability to effectively manage spills resulting from their activities and operations.

- User employees must have adequate training in spill response
- User employees must have access to appropriate spill response equipment and materials
- Users must have plans and procedures in place to respond to spills



For spills which are beyond the capability of the User or are not being effectively responded to by the User, the EGD will provide assistance. The EGD has additional resources available, including:

- Spill kits and response materials for land and water based spills
- Spill response boom, deployment reels and boat
- Staff trained to deal with land and water based spills

For access to the EGD spill response resources, contact EGD Management or Commissionaires.

For spills beyond the capability of the facility to manage, the DND, Port Operations and Emergency Services Branch (DND POESB) will provide support for response to land and water based spills.

**ALL Spills Must Be Reported to
EGD Management**

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Trench Drains: The EGD has installed trench drains throughout the site. These drains are easily accessible and allow for rapid containment and recovery of materials spilled on the property or in the drydock.



Environmental Emergency Contacts (24 Hours):

EGD Commissionaires	250-363-3784
Provincial Emergency Program (PEP)	1-800-663-3456
DND POESB/QHM	250-363-2160 or VHF Channel 10
Canadian Coast Guard	1- 800-889-8852 or VHF Channel 12
Environment Canada	604-666-6100

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In-water Hull Cleaning and Maintenance

The cleaning of the underwater hull in water has the potential to release harmful contaminants into the marine environment.

In-water Hull Cleaning

- In-water hull cleaning of vessel hulls that are coated with antifouling paint is prohibited at the Esquimalt Graving Dock.
- Vessels coated in non-biocide containing paints (such as silicone based), may be considered on a case by case basis and must be approved by EGD Management prior to the commencement of hull cleaning activities.



Vessel berthed at the North Landing Wharf for in-water hull washing. In-water hull washing must not release antifouling paint. Discoloured water is an indication that you may be harming the environment.

Did you know?

Antifouling paints and their residues contain heavy metals, such as copper, that are toxic to aquatic organisms, including salmon and shellfish. Wash water and solid residues from the washing, scraping, sanding, and blasting of antifouling paints from boat hulls are considered “deleterious substances” under the *Fisheries Act*. Releasing these wastes to fish bearing waters is a violation of the Act.

In-water Hull Maintenance

- Users must receive approval from EGD Management prior to commencement of hull maintenance.
- Cleaning of the anodes, inlets, props, transducers, etc.
- Underwater maintenance required for operational and inspection purposes is permitted at the Esquimalt Graving Dock.

For inquiries regarding in-water hull washing please contact the Esquimalt Graving Dock Management at (250) 363-8056

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BMP #16

Housekeeping

An organized, clean facility provides an environment that reduces the potential for pollutants to enter surface and ground water through spills and accidents. General cleanliness will lead to more organized and consistent handling of hazardous materials and waste products.

Clean-Up

- Clean debris from work areas immediately after any maintenance activity. Dispose of collected material appropriately.
- Ensure garbage and recycling containers are available in all leased areas and are emptied regularly.
- Do not use running water to clean the work areas where the contaminated water could enter the storm drainage system.
- Ensure trench and storm drains within designated leased areas are kept clean and free of debris.
- Sweep and/or clean the active working area of the yard on a regular basis.



Storage

- Do not store material/equipment outside of identified boundaries of leased areas.
- Regularly inspect the lease areas for unidentified or improperly stored materials.
- Place a drip pan underneath vehicles and equipment when performing maintenance. Promptly transfer the used fluids to the proper waste or recycling drums.
- Ensure all containers (i.e. drums, totes, etc.) are in good condition and have a clean exterior at all times.



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BMP #17

Stormwater Management

Stormwater has been identified as one of the primary pathways of contaminant loading to the harbour from daily Esquimalt Graving Dock (EGD) operations. Common contaminants found in stormwater samples include cadmium, copper, chromium, arsenic, tributyltin (TBT), extractable petroleum hydrocarbons (LEPH/HEPH), and total suspended solids (TSS). Five stormwater catchment areas terminate into the harbour from the EGD property.

A stormwater monitoring program has been implemented at the EGD. The stormwater outfalls will be sampled semi-annually in the spring and fall. Waste grit separators have been installed upstream of the five stormwater outfalls. These help to remove contaminants or debris that enter the storm drain system from daily operations at the EGD, in particular they remove: fuel or oil, paint, sandblast grit, general debris.

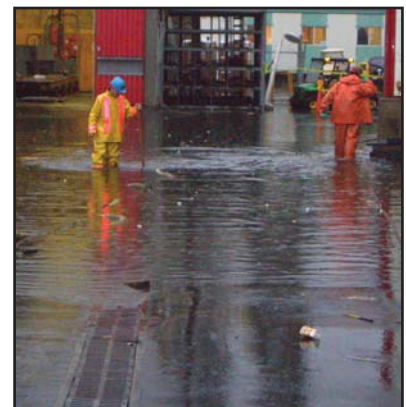
Materials Storage:

- Store hazardous materials away from storm drains and trenches.
- Store hazardous materials away from the South Jetty fire holes. These holes lead directly to the marine environment.
- Ensure totes, drums and pails containing hazardous materials are protected from the weather.



Storm Drains:

- Ensure storm drains are kept clear of debris to prevent flooding during heavy stormwater events.
- When using trench drains for secondary containment, ensure the containment system is monitored and removed in a stormwater event. A blocked trench drain may cause flooding of the area.
- Conduct regular inspections of trench drains in lease areas to ensure they are kept clear of debris.



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During heavy rain events in dock bottom:

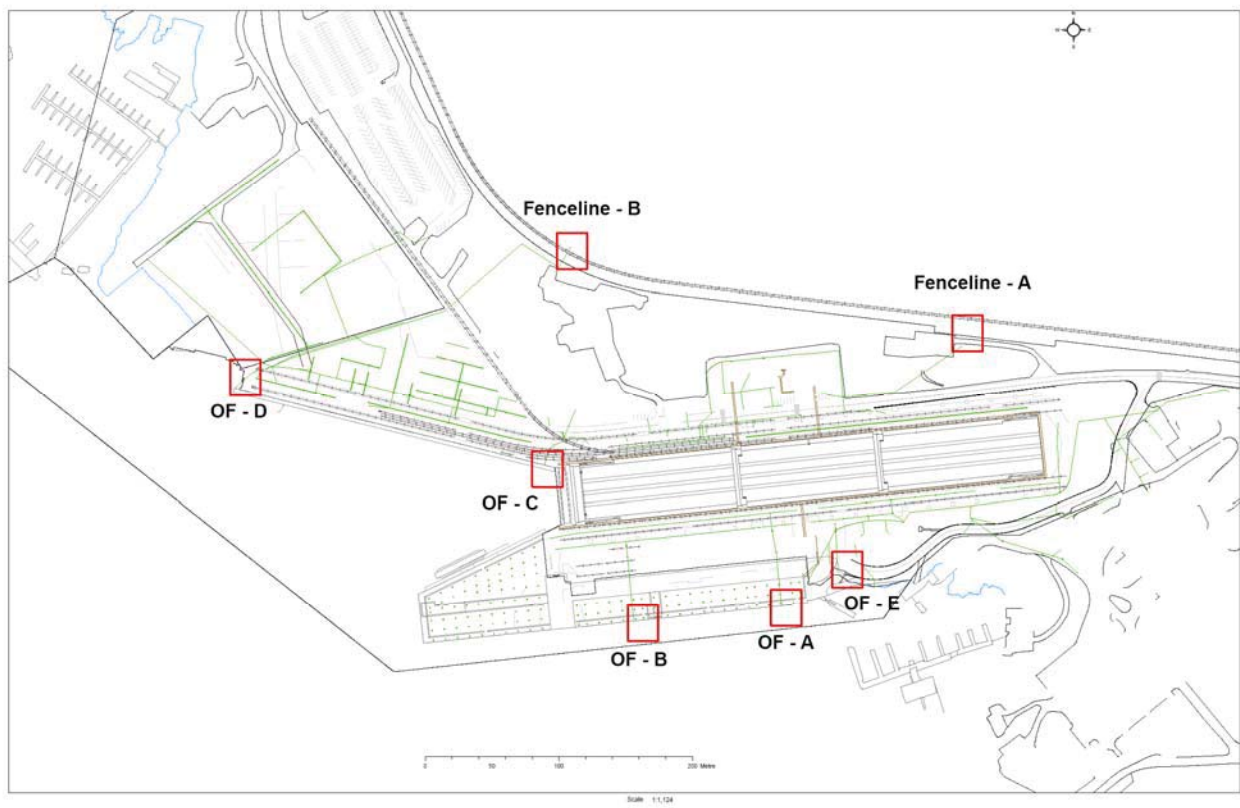
Stormwater has the potential to mix with wash water during power washing operations in dock bottom. To reduce the amount of wash water requiring treatment it is good practice to stop power washing operations until storm water can be controlled.

- Sump well valves may be opened to allow storm water to drain in to the tunnel drains if the area is clear of contaminants and debris.
- Sump wells containing visibly contaminated material must be pumped out and cleaned prior to opening the valves.
- Ensure there is capacity in the trench drain/sump well system to manage the expected stormwater volume to prevent flooding of the dock floor.

Stormwater Monitoring Program

- Stormwater sampling is conducted semi-annually in the spring and fall by EGD Environmental Services.
- Stormwater samples are tested for: total metals, total suspended solids, tributytin, LEPH/HEPH and microbiological parameters.

EGD Stormwater Monitoring Program Sample Sites



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BMP #18

Property and Infrastructure Maintenance, Modifications and Construction

There are significant environmental issues and potential impacts related to the management of Esquimalt Graving Dock properties and infrastructure. Any new construction or modifications to the infrastructure at the EGD must consider environmental issues in the project planning.

Infrastructure Maintenance

Maintenance and repair of the aging EGD infrastructure often results in waste generation and other environmental issues which need to be addressed.

Minor Concrete Work

- Contain dust from cutting and drilling.
- Prevent runoff to the storm drains.

Use of Preserved Wood

- Avoid use of creosote preserved timbers where possible.
- Follow applicable guideline for use of preserved wood products.
- Creosote wood waste may be considered a hazardous, restricted or controlled waste.

Demolition/Renovation

- Ensure structures are assessed for the presence of hazardous materials (i.e. lead paint, asbestos) prior demolition or renovation.



Infrastructure Modification and Construction

All construction projects taking place at the EGD need to be assessed for environmental impacts, and plans put in place to mitigate these impacts.

Environmental Impact Assessment

- Any significant changes to infrastructure, changes to an existing lease or application for a new lease, must be approved by EGD Management.
- Prior to the approval of an infrastructure project, a CEAA Environmental Impact Assessment may be required.
- An Environmental Approval Form must be filled out for new lease applications and changes to existing leases.

*****The Environmental Impact Assessment and Environmental Approval Form outlines specific environmental protection and mitigation measures required*****

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Common project related aspects that require management include: noise, dust, hazardous materials, storm water runoff, and prevention and management of accidental releases and spills. Requirements for the operational aspects are identified in previous sections of these EBMPs.

Significant non-operational aspects related to construction projects may include:

- Loss of Green Space and Vegetation
- Management of Archaeological Impacts
- Soil Management



Loss of Green Space and Vegetation

The EGD property includes an area of vegetation that provides many benefits. It is home to a number of sensitive native plant species, provides habitat for wildlife, and acts as a buffer between the industrial operations of the drydock and ship repair operations and the neighbouring residential area.

All projects which have the potential to impact vegetation must be reviewed and approved by EGD Management.



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Archaeological Considerations

The EGD property and surrounding area has a rich First Nations history. There are four Provincially Registered Archaeological Sites listed within the property boundaries of the EGD.

- All excavation projects must be reviewed and approved by EGD management prior to work beginning
- Depending on the scale of the project a detailed Archaeological Impact Assessment may be required.

Esquimalt Graving Dock Archaeological Overview Assessment

An Archaeological Overview Assessment was carried out in 2010 which outlines the archaeologically sensitive areas on the EGD property and identifies areas of high archaeological potential. Archaeological significant materials found during excavation projects at the facility include artefacts, shell midden, faunal and human remains.



Soil Management

The EGD has undergone significant capital and operation and maintenance projects in recent years. Extensive investigations into the soil conditions (chemical contamination and structure), utility mapping and identification of archaeological conditions have taken place. The industrial history of the facility has resulted in the contamination of the soil and in-fill material used on site. The primary contaminants commonly found at levels exceeding industrial soil standards include: arsenic, cadmium, copper, lead, mercury, zinc, and polycyclic aromatic hydrocarbons (PAH).

Requirements for Excavations at the EGD

Planning Excavation

1. Consult with EGD Facility Management to identify:
 - Project area and excavation boundaries.
 - Known utilities, structures, and historical information regarding the proposed excavation area.
 - Known contaminated soil locations, the nature and level of contaminants potentially in the soils to be excavated.
 - Archaeologically significant areas, requirements for mitigation archaeological impacts, and dealing with unanticipated archaeological finds.

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2. Prepare a plan for management, stockpiling, and sampling of soils to be excavated. Key issues to be identified include:
 - Turnaround times for samples may be up to 2 weeks.
 - Parameters to be sampled may vary depending area of excavation. Common parameters include total metals, leachable metals, PAHS, and hydrocarbons (LEPH, HEPH).
 - Stockpile areas must be approved by EGD Management.
 - Soils which exceed the CCME Industrial Levels or BC CSR Industrial levels must be disposed of off site at an approved location.
 - Soils which are below industrial standards may remain on site if geotechnically suitable, approved by EGD Management, and there is an identified use for the soil.
3. Ensure contractors and employees are aware of the health and environmental risks associated with the suspected contaminated soils and have procedures in place to mitigate these risks. This includes adequate Personal Protective Equipment (PPE) and hygiene practices (i.e. no smoking, wear gloves)

Conducting Excavation

1. Ensure appropriate PPE and hygienic precautions are in place to prevent exposure to contaminants in the soils.
2. Monitor all excavations for visible soil contamination or archaeologically significant material.
3. Ensure soil is stockpiled, sampled and analysed in accordance with the BC MOE Technical Guidance on Contaminated Sites (January 2009).
4. Ensure soils suspected of contamination are stockpiled on an impervious surface and covered with a minimum 6 mil PVC or plastic liner to prevent exposure to wind, storm water runoff or people.
5. Imported fill material must be certified clean by the supplier.



After Excavation

1. Ensure all soil is disposed of at approved facilities.
2. Obtain disposal certificates from the receivers of contaminated soils.
3. Report to EGD Management on the volume, analysis of results, excavation details and dimensions.
4. Provide all as-builts and project drawings to EGD management in the format compatible with the EGD drawing standards.

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Requirements for Small Excavations (less than 10m³)

In areas of suspect contamination: soil must be removed, stockpiled and sampled. Soil cannot go back into the excavation or used elsewhere on site until it is determined through analysis to contain contaminants less than industrial soil standards. The EGD management must give approval for any reuse of excavated soil on site.

In areas of non-suspect contamination: soil may go back into the excavation if geotechnical suitable. The EGD management must give approval for any reuse of excavated soil on site.

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Appendix 4

Water Quality Monitoring Plan (G3, 2014c)

ESQUIMALT GRAVING DOCK

Phase 2 South Jetty Under-Pier Sediment
Remediation Project

Water Quality Monitoring Plan

Final

Submitted to:

Public Works and Government Services

401-1230 Government Street

Victoria, BC

V8W 3X4

Prepared by:

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December 5, 2014

Limitations & Use of Report

This report was prepared for Public Works Government Services Canada and was prepared in accordance with the terms and conditions of the G3 Consulting Ltd.'s Task Authorization E0276-132639/001/VAN and workplans submitted to PWGSC for the preparation of this Water Quality Monitoring Plan.

Inferences concerning the Site conditions contained in this report are based on existing information, historical data and Phase 1 Project reports completed by Golder Associates. Information was also obtained from Public Works Government Services Canada *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Demo-Remediation Specification*, Esquimalt Graving Dock Best Management Practices, discussions held with Public Works Government Services Canada and other Project Team members (PWGSC, 2010, 2014).

In evaluating the subject Site, G3 Consulting has relied in good faith on information provided. G3 accepts no responsibility for any deficiency or inaccuracy contained in this report as a result of our reliance on the aforementioned information.

The findings, conclusions and recommendations in this report have been prepared for the specific application to this project and were developed in a manner consistent with that level of care normally exercised by environmental professionals currently practising under similar conditions in the jurisdiction.

With respect to regulatory compliance issues, regulatory statutes are subject to interpretation. These interpretations may change over time, and should be reviewed by those implementing recommendations made in this report.

If new information is discovered during future work, G3 should be requested to re-evaluate the conclusions of this report and to provide amendments, as required, prior to any reliance upon the information or recommendations presented herein.

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**Appendix 3: Phase 1 Open-water Dredging & Barge Dewatering Decision Framework
(adapted from Golder, 2012c)**

Appendix 4: Water Quality Modelling Results (Anchor, 2014)

Appendix 5: Phase 1 Barge Dewatering Assessment (Golder, 2012b)

ABBREVIATIONS

ATM	Automated Turbidity Monitor
AZ	Activity Zone
BCMOE	British Columbia Ministry of Environment
BCMWLAP	British Columbia Ministry of Water, Land and Air Protection
CALA	Canadian Association for Laboratory Accreditation
CAZ	Controlled Access Zones
CCME	Canadian Council of Ministers of the Environment
CD	Chart Datum
CMA	<i>Canada Marine Act</i>
CP	Compliance Point
CRM	Certified Reference Materials
CSR	<i>Contaminated Sites Regulation</i>
DFO	Fisheries and Oceans Canada
DGPS	Differential Global Positioning System
DND	Department of National Defence
DO	Dissolved Oxygen
DPM	Deputy Project Manager
DQO	Data Quality Objective
DR	Department Representative from Public Works and Government Services Canada
DU	Dredge Unit
DZCP	Dilution Zone Compliance Point
EAP	Exterior Assessment Point
EC	Environment Canada
ECP	Exterior Compliance Point
EEE	Environmental Effects Evaluation
EGD	Esquimalt Graving Dock
EM	Environmental Monitor
EMIP	Environmental Monitoring Implementation Plan
EMP	Environmental Management Plan
EPP	Environmental Protection Plan
EWP	Early Warning Point
FFR	Far-Field Reference
HHWLT	Higher High Water Large Tide
HHWMT	Higher High Water Mean Tide
IAP	Interior Assessment Point
LC50	Lethal Concentration (mortality of 50% of sample population)
LLWLT	Lower Low Water Large Tide
LLWMT	Lower Low Water Mean Tide
MDL	Method Detection Limit
NFR	Near-field Reference
NMHR	Natural and Man Made Harbour Regulations
NOAA	National Ocean and Atmospheric Administration
NOEL	No Observed Effects Level
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PCO	Project Coordination Officer
POD	Point of Discharge
POP	Persistent Organic Pollutant
PWGSC	Public Works and Government Services Canada
QA/QC	Quality Assurance/Quality Control
QEP	Qualified Environmental Professional
QHM	Queen's Harbour Master

QSAR	Quantitative Structure-Activity Relationship
RAO	Remedial Action Objective
RMC	Residuals Management Cover
RPD	Relative Percent Difference
SedQCTCS	Sediment Quality Criteria For Typical Contaminated Sites (<i>Contaminated Sites Regulation</i> Schedule 9)
SMA	Sediment Management Area
SPL	Sound Pressure Level
SPM-O	Senior Project Manager - Operational
SPM-T	Senior Project Manager - Technical
SPW	Sheet Pile Wall
TAT	Turnaround Time
TBT	Tributyltin
TCDD	Dioxins
TCDF	Furans
TRB	Temporary Re-suspension Barrier
TRBCA	Temporary Re-suspension Barrier Containment Area
TSS	Total Suspended Solids
USEPA	U.S. Environmental Protection Agency
WAAS	Wide Area Augmentation System
WQG	Water Quality Guideline
WQMA	Water Quality Management Area
WQMP	Water Quality Monitoring Plan

Units

h	hour
km	kilometre
kPa	kilopascal
m	metre
m/s	metres per second
mg/L	milligram per litre
NTU	nephelometric turbidity units
µg/L	micrograms per litre

1.0 INTRODUCTION

G3 Consulting Ltd. (G3) was retained by Public Works and Government Services Canada (PWGSC) to develop the following Water Quality Monitoring Plan (WQMP), to be implemented during the Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project to provide water quality criteria for Project activities. The Project activities include: dredging, barge dewatering, contingency re-dredging, engineered capping placement, residuals management cover placement, operational activities associated with the opening and closing the Temporary Re-suspension Barrier (TRB) and demolition of the timber pile portion of the existing South Jetty. The WQMP also includes decision frameworks for the implementation of management actions if necessary based on water quality monitoring.

1.1 Background

PWGSC is in the process of remediating contaminated sediment in the Esquimalt Graving Dock (EGD) Waterlot and adjacent “buffer” areas (Appendix 1, Figure A1). Remediation involves removal of sediments that are contaminated above numeric remedial action objectives (RAOs) based on the remedial options analysis described in Anchor QEA (2009). Project numeric RAOs for contaminants of potential concern are defined as the most conservative of the applicable Canadian Council of Ministers of the Environment (CCME) *Canadian Environmental Quality Guidelines (for water)* (CCME, 2014) and British Columbia Ministry of Environment (BCMOE) *Contaminated Sites Regulation (CSR)* standards for marine sediment (typical contaminated sites [SedQCTCS]; BCMOE, 1996). Work is being undertaken in two main phases, of which Phase 1 (which includes Phase 1A, 1B and 1C) has now been completed (Appendix 1, Figure A2):

- Phase 1A consisted of the installation of a temporary sheet pile wall (SPW) around the South Jetty structure to minimize erosion and re-suspension of contaminated under-jetty sediments into areas of the Waterlot and adjacent buffer zones that were remediated as part of Phase 1B of the Project;
- Phase 1B involved dredging and excavation of contaminated sediments in an open-water work area outside the South Jetty and Munroe Head intertidal zone. Phase 1B also involved placement of sand and armour rock as part of the management of residual contamination following dredging, and to provide erosion protection and stability of existing structures. Set-backs from sensitive infrastructure were implemented in some areas with residual contamination managed using engineered capping;
- Phase 1C consisted of the construction of a compensation area at Dunn’s Nook (as required as per the Phase 1 *Fisheries Act* Authorization [No.11 HPAC PA3 00016]) and described in the Phase 1 *Environmental Management Plan* (EMP; Golder, 2012a); and,
- Phase 2 of the Project (anticipated to commence in 2015), will consist of:
 1. re-driving of the sheet pile wall to zero (0) chart datum (CD);
 2. installation of a TRB and any associated support structures;
 3. deconstruction of the timber pile portion of the South Jetty;
 4. removal and remediation of sediments beneath the South Jetty;
 5. installation of sand and rock armor to manage missed inventory and/or residual contamination; and,
 6. removal and decontamination of the SPW and TRB.

This WQMP, as a part of the larger *Environmental Management Plan* (EMP; G3, 2014a), outlines the scope of monitoring to be undertaken during project activities and identifies appropriate parameters and assessment criteria. An *Environmental Effects Evaluation* (EEE) outlines potential effects of the project (G3, 2014b) and the *Environmental Monitoring Implementation Plan* (EMIP) describes specific methods to monitor the effects.

1.2 Objectives

The objectives of this WQMP are to:

- confirm that the Contractor is meeting discharge quality requirements and that activities will not result in the deposition of deleterious substance(s) outside of the enclosed Phase 2 Work Area;
- ensure that there is no “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” (*Fisheries Act*) taking place;
- provide data to support implementation of the Contractor’s Environmental Protection Plan (EPP) through field-acquired data that may be used to revise work practices (e.g., decreases or increases in dredge cycle time, control of discharge water);
- support environmental reporting requirements that may be specified by environmental agencies; and,
- provide a basis to enable the Contractor to verify their work is conducted in accordance with regulatory and contractual obligations.

1.3 Report Format

This WQMP was written for Phase 2 activities only and 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);
- roles and responsibilities of PWGSC, Environmental Monitor (EM) and Contractor for implementing environmental management and mitigation measures (Section 3.0);
- parameters to be monitored and threshold limits that, if exceeded, would trigger Management Actions and methodology for *in situ* water quality monitoring for real-time assessment (Sections 4.0);
- Quality Assurance/Quality Control (QA/QC) procedures to be undertaken to verify data precision and accuracy (Section 5.1);
- handling and data management procedures for monitoring results (Section 5.2); and,
- requirements for Contractors and Environmental Monitors (EMs) to collect and report monitoring results (Section 6.0).

This WQMP is intended to be read in conjunction with the EMP (G3, 2014a), EEE (G3, 2014b), EMIP and any environmental requirements for the Project. Electronic copies of these documents may be obtained by an approved Contractor from the Departmental Representative (DR).

A summary of applicable federal and provincial legislation is provided in the EMP (G3, 2014a) and EMIP for this Project. The intent of this WQMP is to provide direction to PWGSC, Environmental Monitor (EM) and Contractor that is consistent with the provisions for environmental protection contained in legislation; however, it is the responsibility of the Contractor to be aware of all legislation and regulations associated with their activities. Should further clarification of any environmental issue be required, the appropriate regulation or legislative document should be consulted or advice sought from PWGSC.

2.0 PROJECT LOCATION & EXISTING CONDITIONS

The Esquimalt Graving Dock (EGD) facility is located on the north shore of Constance Cove, in Esquimalt Harbour on the southern tip of Vancouver Island, British Columbia. The Project is located within the Coastal Douglas Fir Biogeoclimatic Zone. Constance Cove is approximately 0.5 km wide at its entrance, sheltered and subject to the marine tidal regime of Esquimalt Harbour, BC (Appendix 1, Figure A1). Water depth within the Work Area ranges from 3 m above chart datum (CD) and 9 m below CD.

The mean tide in Esquimalt Harbour is 1.9 m (relative to CD). The higher high water mean tide (HHWMT) is 2.5 m and higher high water large tide (HHWLT) is 3.4 m. The lower low water mean tide (LLWMT) is 0.7 m and the lower low water large tide (LLWLT) is 0.1 m (Golder, 2012d).

Tides and wind-waves generate currents within Constance Cove, which are typically low during the ebb and flood phases of the tide and are variable in direction. There is a net drift of water out of Constance Cove from east to west (away from the project site) across the area of the EGD Waterlot. In Constance Cove measured maximum currents are 0.12 m/s and average 0.05 m/s with slower average currents beneath the South Jetty (0.04 m/s on average and less than 0.06 m/s 90% of the time; Golder, 2011).

Project effects are described in the *Environmental Effects Evaluation* (EEE; G3, 2014b)

2.1 Surface Water Quality

Existing surface water quality and water quality during Phase 1B activities is relevant to the Project water quality monitoring given that:

- it provides a characterization of pre-project water quality conditions;
- it provides existing conditions against which monitoring data will be compared, such that interpretation (by a Qualified Environmental Professional [QEP]) of water quality monitoring results is better supported;
- activity within the harbour surrounding the Phase 2 Work Area has the potential to increase turbidity and, as such, a need to establish accurate ambient values; and,
- activities similar to those during Phase 1B will be occurring during Phase 2.

For the purposes of this WQMP, and within the context of monitoring during activities, the term 'ambient' should be taken to mean conditions considerate of specific local conditions within and specific to Constance Cove (to account for localized influences such as prop-wash, vessel activity, blowing ballast tanks, etc.). For the purpose of this report, the term 'background' should be taken to mean levels reflective of the greater Esquimalt Harbour accounting for influences that affect the entire harbour (e.g., seasonality).

A brief overview of existing contaminant data is provided below with additional information on turbidity data as this parameter is a substantial aspect of the water quality monitoring program. In the event that further interpretation is required refer to the original reports referenced below. Prior to Phase 1 several surface water samples at varying depths were collected in 2005 by Golder (Golder, 2006a, b) and SLR Consulting Inc. (SLR, 2009). Metals were generally found to be below or at federal (CCME, 2014) and provincial (BCMOE, 2014) water quality guidelines (WQGs) except some samples collected near Outfall D (Appendix 1, Figure A2) in 2005. Concentrations of tributyltin (TBT) were 2 to 10 times the federal WQG in some samples collected near the outfall in 2005 (Golder, 2006a, b); however, not in 2008 (SLR, 2009). The dataset is limited and conditions should not be taken to necessarily be a representation of ambient or background concentrations at the time of Project implementation.

During Phase 1B water samples were collected surrounding Project activities and within Constance Cove and Esquimalt Harbour. Metals were generally found to be within CCME (2014) and BCMOE (2014) guidelines with 4.9% of analyzed samples (58 of 1,178 samples) exceeding guidelines (SLR, 2014). Of the 58 exceedances 12 occurred in background and ambient samples and 46 were down current from Project activities (e.g., dredging). Not all exceedances down current from Project activities were associated with increased total suspended solids (TSS)/turbidity. The majority of the exceedances were for copper (52 of 58 metal exceedances).

There were no exceedances of polycyclic aromatic hydrocarbons (PAH) guidelines (guidelines are found in the Phase 1 EMP; Golder, 2012c) in any of the 1,240 samples analyzed for total and/or dissolved PAHs (SLR, 2014). At the outset of Phase 1B, in areas of known high polychlorinated biphenyl (PCB) concentrations, water samples were collected during dredging. Of the eight samples collected, all indicated values were below detection limits for PCBs (SLR, 2014).

It is noted that available water quality data does not include conditions after the completion of Phase 1B (i.e., dredging and placement of engineered capping materials) to provide current or post-remediation conditions prior to starting of Phase 2.

All of Esquimalt Harbour is contained within Fisheries and Oceans Canada (DFO) Sanitary Shellfish Closure 19.1 which reduces the potential for risks to human health through consumption.

2.1.1 Turbidity

Turbidity is a measure of light reflectance within a sample of water and is reported in Nephelometric Turbidity Units (NTU). For the purposes of Phase 2, turbidity will be used as a real-time proxy estimate measurement of TSS. TSS is measured in the laboratory and is determined through centrifugation of samples and provides the actual weight of the particulate material in the sample. TSS and turbidity are not analogous in all situations, and the relationship must be calibrated independently for each sediment type. In addition, the relationship between turbidity and TSS varies temporally due to naturally-occurring variations in local conditions.

Turbidity monitoring program was conducted between October 18 and December 15, 2010 using automated turbidity monitors (ATMs), to determine ambient turbidity at designated monitoring locations in Constance Cove and at a reference site at the entrance of Esquimalt Harbour prior to the commencement of the remedial dredging program. On average, background turbidity in Esquimalt Harbour was low, with mean values typically being less than 5 NTU at most stations and median turbidity being <1 NTU.

Turbidity values ranged between 0 – 817 nephelometric turbidity units (NTU), with peaks of up to approximately 400 NTU for short periods (Appendix 2, Table B1). The 99th percentile of all NTU values observed in the field was 6.4 NTU. The short duration peaks in turbidity observed may have been due to sensor obstruction, sediment re-suspension caused by operational activities including boat/tug activity, propwash, or by natural re-suspension of sediments caused by wind-waves and tidal currents.

Monitoring of turbidity was conducted during Phase 1B in areas surrounding Project activities and at reference sites within Constance Cove and Esquimalt Harbour. The turbidity measurements from all monitoring locations ranged from 0.07 NTU to 115.39 NTU (SLR, 2014). Out of the 11,310 turbidity measurements collected during Phase 1B, 1.45% (164 samples) exceeded Project specific or ambient water quality guidelines (SLR, 2014). The ATMs installed in Constance Cove and Esquimalt Harbour generated a larger range of turbidity values within the harbour, 0.001 NTU to 1,225 NTU. High levels were likely associated with intermittent sensor obstruction (SLR, 2014). Highest turbidity levels and prolonged exceedances were most often recorded in areas in close proximity to the sheet pile wall (SPW) surrounding the South Jetty as the SPW acted as a barrier to current flow, effectively slowing dissipation of suspended materials.

Short duration transient events (i.e., propwash from ship passage) have been recorded as influencing turbidity readings by as much as two (2) orders of magnitude. For this reason, turbidity performance criteria for all activities (and associated TSS performance criteria) must be represented as increases over current ambient levels. Appropriate and ongoing measurements of ambient conditions are critical to Phase 2 works as they aid in assessing if turbidity measurements indicate a potential release of materials from the Phase 2 TRB containment area (TRBCA); or if, turbidity measurements are a result of normal transient events associated with existing conditions at the EGD facility.

As Phase 2 will be enclosed and all areas will be in proximity to the SPW and/or TRB complete dissipation of suspended materials may not always occur and, therefore, higher turbidity values could be expected within the TRBCA.

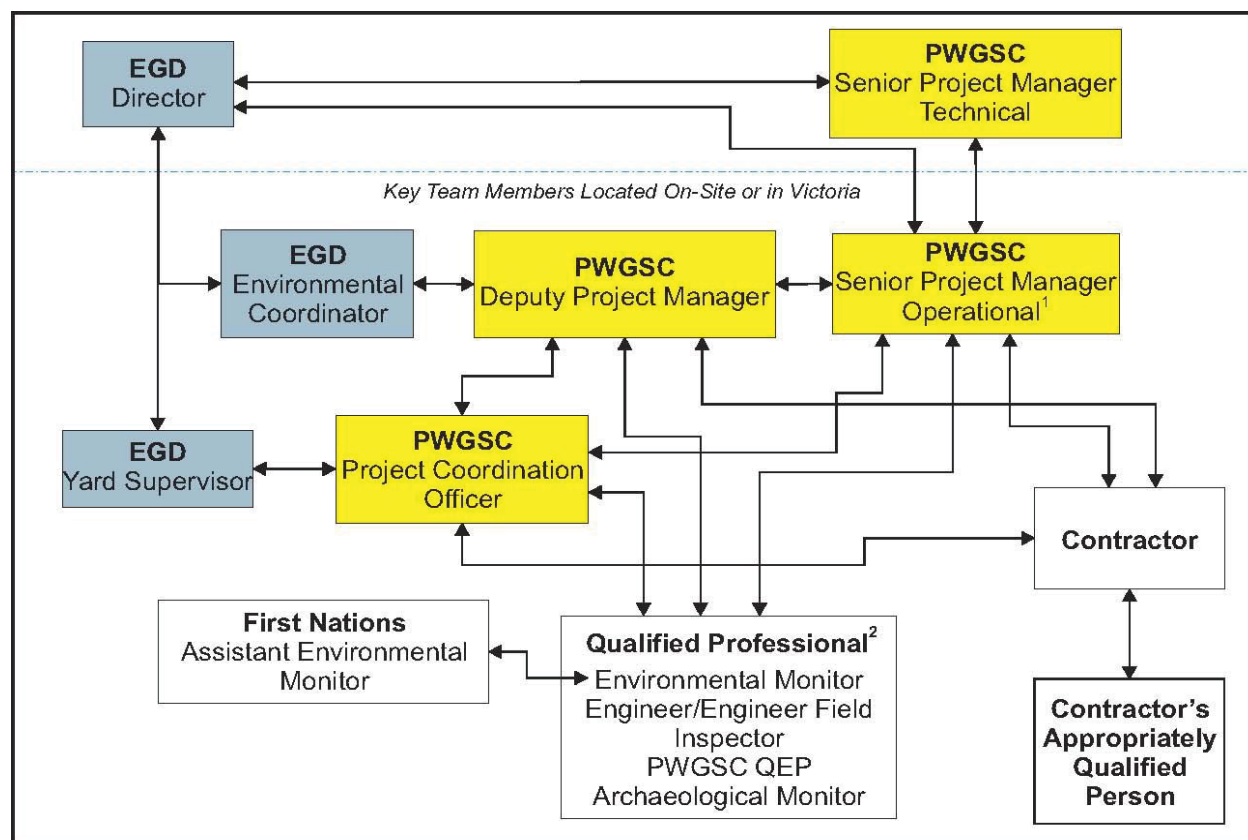
The following two WQMP considerations are raised by these observations:

- based on visual observations and *in situ* turbidity data collected during operations, the EM may recommend a greater number of reference stations and/or samples than recommended here to the DR to account for shifts in ambient turbidity unrelated to Project activities; and,
- given the characteristics of ambient and background turbidity (short duration, relatively high magnitude transient events), an appropriate response to a single high turbidity value is to resample and identify and document reasons for that increase. The Decision Management Frameworks (Appendix 1, Figures A4 to A5) outline the process of resampling prior to implementing more stringent operational controls or stop-work orders.

2.2 Navigation Resources

Esquimalt Harbour is administered by Department of National Defence (DND) and governed by the *Canada Marine Act* (CMA; 1998), the *Natural and Man Made Harbour Regulations* (NMHR; pursuant to the *Canada Marine Act*), and local Practices and Procedures (Government of Canada, 2014). The harbour is open to the public within the limitations set out in an Order in Council regarding Controlled Access Zones (CAZ) that provide for security around warships berthed or moving in the harbour. Vessels entering or departing Esquimalt Harbour are requested to contact the Queen's Harbour Master (QHM) of Operations (Government of Canada, 2014). Ship repair work at EGD may take place 24-hours-a-day, seven-days-a-week, 365-days-a-year (PWGSC, 2014a). Given that ship repair may take place at all times, ships frequently navigate in and out of the Project Area, and emergency docking of ships at the graving dock may need to occur during the Project.

This section describes the roles and responsibilities of Public Works and Government Services Canada (PWGSC), Esquimalt Graving Dock (EGD) staff, PWGSC's designated Environmental Monitor (EM), and Contractor implementing, inspecting and reporting on the effectiveness of the environmental protection and mitigation measures. This is illustrated in the following diagram (Figure 3-1) with each group identified and defined in Table 3-1.



EGD – Esquimalt Graving Dock; PWGSC – Public Works and Government Services Canada; QEP – Qualified Environmental Professional

¹ The PWGSC Senior Project Manager – Operational is also the Departmental Representative (DR).

² Qualified Professionals may communicate with each other as necessary.

As the proponent of the Project, PWGSC has overall responsibility for the Project and the following obligations:

- administration of contracts;
- construction management and confirmation of Contractor compliance with plans and contract requirements, including those related to environmental protection;
- verifying compliance with terms and conditions of regulatory permits, approvals, and Authorizations, as mandated under federal and provincial legislation;
- managing communications and relations with EGD Operations and tenants, public stakeholders, regulatory agencies and First Nations; and,
- coordinating review of the Contractor's Environmental Protection Plan (EPP).

Specific roles of PWGSC are summarized in Table 3-1.

Table 3-1: Summary of PWGSC Roles & Responsibilities for Environmental Management	
Role	Responsibility
Senior Project Manager – Technical (SPM-T)	<p>PWGSC staff member responsible for coordinating the delivery of the entire project, who will:</p> <ul style="list-style-type: none"> • interface with the senior management of PWGSC and participating departments (e.g., DND) and serve as senior PWGSC Environmental Specialist spokesperson for the project; • with other senior managers establish an appropriate organizational structure, and assign and detail roles and responsibilities to the project team; • be responsible for maintaining consistency between project implementation and previously defined objectives and decisions; • act as the senior project representative in meetings with First Nations or public; • attend project meetings as required; and, • be responsible for verifying that lessons learned are documented.
Senior Project Manager – Operational (SPM-O)	<p>PWGSC staff member responsible for delivery of all project components, who will:</p> <ul style="list-style-type: none"> • act as the primary on-site contact (Departmental Representative [DR]) for the Contractors, consultants, and EGD staff; • identify and resolve technical issues arising during the Project; • be responsible for project delivery and results meeting management objectives; • be responsible for verifying that all legislative and regulatory requirements are met and approvals obtained; • chair project meetings such as pre-construction/start-up meetings; and, • document lessons learned on a continuous basis.
Deputy Project Manager (DPM)	<p>PWGSC staff member responsible for on-site delivery of project components, including construction of compensatory habitat, who will:</p> <ul style="list-style-type: none"> • manage day-to-day implementation of project work on-site; • monitor progress of the Project; • liaise with Project Coordination Officer to coordinate work on-site; • attend and/or chair project meetings such as pre-construction/start-up meetings; • with Project Manager act as the primary authority to direct the Contractors and consultants carrying out the work; • be responsible for on-site liaison and coordination between client, design consultants and Contractors; • monitor and resolve issues related to on-site work; • be responsible for verifying that construction monitoring/quality assurance inspections (design consultants) and health and safety inspections are conducted and documented; • be responsible for verifying that environmental monitoring is conducted (environmental monitoring consultant); • conduct additional inspections as required to verify design consultant and environmental monitoring consultant reports; and, • document lessons learned on a continuous basis.
Project Coordination Officer (PCO)	<p>PWGSC staff member responsible for on-site project coordination for all project work, who will:</p> <ul style="list-style-type: none"> • liaise with the Deputy Project Manager and EGD Yard Supervisor. • make bookings and coordinate support for on-site project meetings, and attend project/construction meetings; • facilitate site access and egress for Contractor and consultants; • notify EGD Operations, tenants, and users of planned/on-going project work; • notify DND of planned/on-going project work in Esquimalt Harbour or work that may affect DND operations; • generally monitor on-site work; • prepare daily inspection/progress reports and photo logs of all work; • review Environmental Protection Plans prior to start of work; and, • monitor Contractor and consultant general compliance with EGD policies and procedures.

Con'd...

Table 3-1: Summary of PWGSC Roles & Responsibilities for Environmental Management (con'd)	
Role	Responsibility
EGD Director	<p>Primary EGD Operations representative, who will:</p> <ul style="list-style-type: none"> provide site-specific operational input, including specific site requirements or project restrictions, to project team as required; identify other projects or operations and maintenance that may conflict with Project work; delegate specific duties to the EGD Environmental Coordinator to facilitate implementation of the Project within site operational environment; and, be the: <ul style="list-style-type: none"> primary authority for design criteria and project decisions related to operational impacts; senior liaison with EGD personnel, tenants and users; primary contact for public questions/questions through the EGD hotline phone messaging centre.
EGD Yard Supervisor	<p>Secondary EGD Operations project representative, who will:</p> <ul style="list-style-type: none"> be the primary contact for day-to-day coordination with EGD Operations, site tenants, and users; have primary responsibility for managing tenant / user issues and / or conflicts, including vessel movement; liaise with the EGD Environmental Coordinator, PCO, and DPM; notify PCO of emergency dockings or other emergencies that may require changes to project work; in coordination with PCO direct changes to site operations to avoid or minimize conflict with project work, or identify required changes to project work or schedule; and, attend project meetings as required.
EGD Environmental Coordinator	<p>EGD senior project representative to EGD Operations, tenants, users, and clients, who will:</p> <ul style="list-style-type: none"> provide assistance to the EGD Director for project-related responsibilities; identify capital projects, operations and maintenance activities or client/user activities that may conflict with project work; and, assist DPM with resolution of major project coordination issues

DND – Department of National Defence; EGD – Esquimalt Graving Dock; PWGSC – Public Works and Government Services Canada

Note: Roles and responsibilities as identified by PWGSC (2013).

3.2 Contractors

The Contractor will be responsible for the actions of their agents, employees and sub-contractors and will undertake all reasonable actions to have environmental protection measures in place and working effectively throughout the Phase 2 Work Area (Appendix 1, Figure A2). The Contractor is responsible for:

1. adhering to requirements set forth in any regulatory document (e.g., legislation), and all contract requirements, including this Water Quality Monitoring Plan (WQMP);
2. undertaking effective communication with work crews and sub-contractor 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;
3. retaining an appropriately qualified person to prepare the EPP and evaluate performance against the requirements outlined in regulatory documents and Best Management Practices, as well as environmental protection goals provided in the *Environmental Management Plan* (EMP) and contract requirements;
4. implementing and conducting work activities in a manner that adheres to the water quality criteria detailed in this WQMP;
5. using equipment and implementing work procedures and controls to prevent and/or reduce work-related disturbance to environmental, social, heritage, archaeological and cultural resources;
6. implementing preventative and corrective measures in response to non-conformance with stated criteria (i.e., EMP), regulatory documents and the contract requirements including this WQMP;

7. responding immediately to emergencies and incidents;
8. quality assurance sampling; and,
9. reporting all water quality data collected (e.g., quality assurance, interior assessment point samples for modelling, barge dewatering, TRB function) in weekly reports to PWGSC.

3.3 Anchor QEA

Anchor QEA (Anchor), the lead consultant and project engineer for remediation, is responsible for:

- technical review of Contractor submittals;
- field inspection to monitor compliance with Contract requirements, ensuring that all work is completed in compliance with the *Phase 2 Demo-Remediation Specification* and contract;
- liaising with the PWGSC SPM-O during the Project; and,
- routine coordination with the EM in support of environmental monitoring and post-dredge confirmatory sampling.

3.4 Environmental Monitors (EM)

In addition to the Contractor's appropriately qualified person, PWGSC will retain an EM to confirm that environmental management measures and controls are implemented in accordance with regulatory documents, environmental components of the contract requirements, including the EMP and this WQMP as well as the EPP prepared by the Contractor. Environmental monitoring tasks are to be conducted by, or under, the supervision of a Qualified Environmental Professional (QEP) following procedures outlined in the EMIP. For the purposes of this WQMP, a QEP is defined as an applied scientist specializing in the area of biology, who:

- is registered in British Columbia and in good standing with an appropriate professional organization; and,
- through suitable education, experience, accreditation and knowledge, may reasonably be relied upon to provide advice regarding environmental management of the Project.

It is anticipated that various personnel will be necessary to undertake different monitoring components for the Project (e.g., water quality, aquatic mammals, etc.) and the experience of the personnel used should reflect those needs.

The EM will:

1. prepare an Environmental Monitoring Implementation Plan (EMIP) that outlines the type and frequency of observations and data collection that will be made (including quality control sampling);
2. prepare and deliver environmental orientation sessions to work crews;
3. document work activities and evaluate them against regulatory documents, environmental components of all contract documents, EMP and this WQMP;
4. the EM will advise PWGSC DR when work practices may need to be modified or improved to achieve the established environmental protection goals of the Project;
5. compile and maintain environmental monitoring data and related documentation (including environmental monitoring reports); and,
6. assist in responding to emergencies and environmental incidents.

Different roles and types of monitoring personnel are defined in the EMIP.

4.0 WATER QUALITY MONITORING

4.1 Sources of Decreased Water Quality

This section describes components of the water quality monitoring program that are used to verify that environmental controls put in place for this project are adequate to protect the receiving environment and provide environmental management data used to identify when additional controls or management actions may be necessary, including temporary cessation of Project activities as deemed appropriate by the DR. See Figure A3 (Appendix 1) for a summary of the Phase 2 monitoring plan for water quality.

Water quality in and adjacent to the Phase 2 Work Area may be affected by Project activities through:

- induced suspension of solids/turbidity (e.g., during dredging, placement of engineered capping/residuals management cover (RMC) and intertidal excavation);
- release of contaminants from re-suspension of contaminated sediments during dredging under the South Jetty;
- release of re-suspended solids and potential contaminants during opening and closing of the TRB;
- release of re-suspended solids and potential contaminants in the event of poor functioning or failure of the TRB;
- release of re-suspended solids during TRB/sheet pile wall removal/relocation;
- release of cementitious (alkaline) material from concrete works near watercourse;
- release of creosote from South Jetty pilings during removal and storage (before disposal); and,
- introduction of debris, air emissions, runoff, dewatering and other potential vectors.

Anchor (2011) used a modelling program called DREDGE (Hayes and Je, 2000) to assess the potential for sediment re-suspension and dispersion of contaminants during active dredging for a number of scenarios with various assumptions regarding particle size and density, dredge bucket size and cycle time. For Phase 2 work, Anchor updated the model to reflect the concentrations of contaminants known to be present in Phase 2 sediments (Appendix 4; Anchor, 2014). The model predicted that contamination associated with TSS would be at or below the performance criteria when TSS was below 68 mg/L and turbidity was less than 34 NTU. Performance criteria used for modelling were based on federal (CCME, 2014) and provincial (BCMOE, 2014) water quality guidelines (WQGs) and published studies.

To prevent recontamination of areas remediated as a part of Phase 1 works, the Phase 2 Project Area (South Jetty under-pier area) was enclosed by a sheet pile wall during Phase 1A. At the beginning of Phase 2 the SPW will be re-driven (or cut in designated areas) to 0 m chart datum (CD). An impermeable TRB will be installed above, and overlapping with, the re-driven SPW and extending to the shoreline at the east end of the South Jetty to enclose the work area. The TRB will be designed to minimize the potential for re-contamination of previously dredged areas outside the sheet pile wall. TRB design shall account for potential re-contamination outside the Phase 2 Work Area during opening and closing of the TRB (for the purpose of equipment and vessel movement inside and outside the TRB work area). Within the Phase 2 Project Area there is an area which has been identified as hazardous waste quality material. Dredging of the Hazardous Waste Area shall be sequenced and completed such that no recontamination of previously dredged areas occurs.

Specific water quality measurements within the TRBCA related to the handling of creosote-treated timber are not planned, as relevant analyses cannot be conducted in a timely manner to facilitate management of Project activities. Monitoring of pile removal activities within the TRBCA will rely on visual inspections by the Contractor and PWGSC designated EM as required and detailed in the EMP as well as monitoring outside the TRBCA. Monitoring of TRB/SPW and associated pile removal will follow the framework and criteria in Sections 4.6.9 and 4.7.

4.2 Monitoring Locations

Regulatory compliance is typically evaluated at the point at which an operator is no longer able to exercise control over a discharge; in the case of this project, the point at which the Contractor no longer

exercises control is dependent on the activity and locations and for Phase 2, those locations are (Appendix 1, Figures A6 through A9):

1. dredging and/or dewatering inside the TRBCA: the outer face of the TRB;
2. opening and closing the TRB: Interior Assessment Point;
3. dewatering outside TRBCA: end of pipe (treatment barge only);
4. contingency re-dredging or placement of residuals management cover materials outside the TRBCA: centre of the dredge or equipment placing materials;
5. removal of TRB/SPW: the line of the removed structure; and,
6. offloading of material at Contractor's Off-Site Offloading Facility: point of deposit/discharge.

Monitoring procedures are described briefly in Section 4.2.1 (for summary see tables 4-1 to 4-3) and in detail in the EMIP. The parameters measured and location specific performance criteria are outlined in Tables 4-4 to 4-9. Monitoring will be conducted by the PWGSC designated EM (unless otherwise noted) at the following locations:

1. Early Warning Point(s) (EWP): All points located 25 m from the outer face of the TRB and no closer than 25 m from any active equipment. Assessed daily, during peak activity (Appendix 1, Figures A6 and A7);
2. Compliance Point(s) (CP): All points located 100 m from the outer face of the TRB (Appendix 1, Figures A6 and A7);
3. Interior Assessment Point (IAP): Point inside the TRB closest to any proposed opening. Assessed by the Contractor's appropriately qualified person prior to opening the TRB (Appendix 1, Figure A8);
4. Exterior Assessment Point (EAP₂₅): Point 25 m outside the TRB opening used to monitor potential releases of suspended sediment and contaminant laden waters from inside the TRB upon opening (Appendix 1, Figure A8);
5. Exterior Compliance Point (ECP): Point 100 m from the opening of the TRB (direction based on flow). Used to assess compliance with water quality performance criteria (Figure A8, Appendix 1);
6. Whole Effluent: prior to discharge (final, treated effluent) from a dewatering barge if dewatering at the Work Site (Appendix 1, Figure A9). EM shall have access to whole effluent (after treatment, prior to discharge) for required barge dewatering monitoring;
7. Dilution Zone Compliance Point (DZCP): 100 m from the dewatering barge point of discharge (POD) if dewatering at the Work Site (Appendix 1, Figure A9);
8. Near-Field Reference Point (NFR): Reference stations situated within Constance Cove (Appendix 1, Figures A6 to A8), further than 100 m from active operations and within the Discretionary Cetacean Zone (Appendix 1, Figure A10). This is a reference point for 'ambient' conditions (i.e., conditions specifically within Constance Cove) and should be in an open area that is not visibly different from surrounding areas (e.g., removed from obvious plumes, freshwater inputs, confounding sources, etc.) and is not in close proximity to areas of high activity (e.g., active dock, vessel undergoing ballast activity) at the discretion of the EM; and,
9. Far-Field Reference Point (FFR): Reference station situated within Esquimalt Harbour, not including Constance Cove (Appendix 1, Figures A6 to A8), and outside of the Discretionary Cetacean Zone (Appendix 1, Figure A10). This is a reference point for 'background' conditions (i.e., within Esquimalt Harbour yet outside of Constance Cove) and should be in an open area that is not visibly different from surrounding areas (e.g., removed from obvious plumes, freshwater inputs, confounding sources, etc.) and is not in close proximity to areas of high activity (e.g., active dock, vessel undergoing ballast activity) at the discretion of the EM.

At each monitoring location samples will be taken at three (3) depths unless otherwise specified. The depths for sampling are:

1. surface of the water column: 1 m below the surface;
2. bottom of the water column: 2 m above the seabed;
3. mid-water column: approximately half-way between surface and bottom of water column when not stratified or just below density barrier (i.e., thermocline or halocline) when/if stratified. If a visible plume is present (e.g., barge dewatering, TRB opening) the mid-water sample should be collected from the centre of the plume, where possible.

Sampling locations will be adjusted throughout the Project depending on the location of dredging activity, TRB opening and/or tides and prevailing currents at the time of sampling, etc. Sampling locations will be documented using wide area augmentation system (WAAS) corrected Differential Global Positioning System (DGPS) receivers. Selection of specific monitoring locations will be refined on the basis of the final dredging plan, local and site-specific conditions and ongoing assessment of monitoring results. A conceptual layout of sampling locations are provided in Figures A6 and A7 (Appendix 1) for dredging, Figure A8 (Appendix 1) for TRB opening and Figure A9 (Appendix 1) for barge dewatering. Conceptual layout of sampling locations for dredging activities can be applied during monitoring of other Project activities (e.g., debris removal, sheet-pile wall installation, contingency re-dredging and cover materials placement).

4.2.1 Water Quality Sampling

Water quality will be monitored at specific locations within the Phase 2 Project Area, ambient sites and background sites using a combination of *in situ* profiling and water collections for analytical testing.

4.2.1.1 In Situ Monitoring

In situ monitoring of water quality will be conducted daily at each compliance and reference point location (described in Section 4.3). Water quality monitoring will be conducted using a YSI EXO-2 Sonde (or similar) to collect continuous depth profiles (minimum one measurement per metre depth) for temperature, dissolved oxygen (DO), pH, conductivity, salinity, resistivity and turbidity at each station. Data will be stored in flash memory on the device and backed up on conventional media (e.g., external hard drive) each evening. Each probe must be calibrated daily or as necessary. *In situ* monitoring will occur concurrent with collection of water samples for laboratory analysis to facilitate direct comparisons and from which to generate calibration curves.

During daily *in situ* and all other monitoring the EM will be visually inspecting the TRB and water surrounding the TRBCA outside of the TRB for any obvious water perturbations or other evidence of TRB failure.

4.2.1.2 Laboratory Water Quality Monitoring

Water samples will be collected for laboratory analysis of turbidity, pH, TSS, total metals and total PAHs. Samples should be collected using a Beta-type Niskin Sampler (or similar sampler appropriate for organic testing and solvent rinsing). Total metals and total PAH analysis will be conducted only on a subset (approximately 50%) of samples as specified in Tables 4-1 to 4-3. Specific sampling methodology is provided in the EMIP.

For laboratory testing of final whole effluent from the dewatering treatment barge TSS, turbidity, pH and total metals and total PAH analysis must be performed regularly (Table 4-3) while the barge is actively discharging to ensure compliance with Water Quality Performance Criteria (Table 4-6).

The laboratory will archive samples for the duration of their appropriate hold times for potential additional PAH and metals testing, as required, as per Tables 4-1 to 4-3.

4.3 Monitoring Parameters

This WQMP includes measurement of various parameters that provide information to manage potential effects associated with Project activities. The Contractor is responsible for submitting all water quality data collected by the Contractor or their appropriately qualified person for any purpose in weekly reports to PWGSC. Background information on these various parameters is provided below.

4.3.1 Total Suspended Solids (TSS)

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. Suspended particles may damage fish gill structures and contain contaminants that may be up-taken by fish, benthic invertebrates and predators which depend on these organisms (i.e., aves and mammalia).

The measurement of TSS requires the collection and submission of sample to a laboratory. Analysis is done by filtering the sample onto a glass fibre filter and drying the sample at a specified temperature. Data from this analysis can be available on a 24 h 'rush' turnaround. TSS will also be estimated using *in situ* turbidity data as derived using a relationship calculated based on Phase 1B data (Appendix 4) which is to be updated as Phase 2 TSS/turbidity data becomes available.

Results of modelling studies must be confirmed with laboratory results for metals and PAHs for *in situ* conditions. Given that the relationships between TSS, turbidity, metal and PAH concentrations are complex, performance criteria should be evaluated and adjusted based on a weight of evidence approach considerate of both historical and current data in conjunction with the DR.

TSS/turbidity performance criteria have been designed to detect and prevent the release of contaminants from the Phase 2 Work Area. Due to variable ambient conditions, measurement of TSS and turbidity may not be adequate to detect project impacts in all ambient conditions.

The Contractor's appropriately qualified person is responsible for determining TSS/turbidity criteria within the TRBCA that will ensure adherence to all performance criteria.

The EM will monitor at designated locations (Appendix 1, Figures A6 to A9) for a variety of parameters (Tables 4-4 to 4-9). Contractor's adherence to performance criteria measurable *in situ* (i.e., turbidity) does not preclude their responsibility to ensure compliance with performance criteria requiring laboratory analysis.

4.3.1.1 Monitoring during Construction Activities (TRB Closed)

Phase 2 TSS performance criteria are based on CCME (2014) and BCMOE (2014) water quality guidelines (WQGs) for the protection of aquatic life from the physical effects of particulates. Monitoring criteria are applied at both the early detection level (EWP; 25 m from the TRB) and regulatory compliance level (CP; 100 m from the TRB). A stop work order, at the discretion of the Departmental Representative (DR), may occur if concentrations at 100 m are in exceedance of designated performance criteria.

Measured turbidity and associated estimated and measured TSS values are to be correlated to measured levels of metals and PAH concentrations and applied to the day-to-day management of dredging and associated Phase 2 activities by the EM and Contractor's appropriately qualified person independently. Specified TSS/turbidity limits within the TRBCA (measured *in situ* as turbidity outside the TRBCA at the CP and EWP) apply to all activities occurring within the TRBCA including management of dredging, jetty demolition, pile driving, SPW re-drive, TRB/SPW and associated pile removal, intertidal excavation under the South Jetty and engineered capping placement (Section 4.6.1 and Table 4-4).

4.3.1.2 Temporary Re-suspension Barrier Opening

The TRB shall not be opened until the Contractor's appropriately qualified person has verified and demonstrated to the DR and EM that the criteria for opening the TRB have been met at the IAP. The Contractor's qualified person is responsible for determining the appropriate turbidity threshold value necessary at the IAP to ensure criteria defined in Table 4-5 are not exceeded at EAP₂₅ and ECP.

Performance criteria assessed by the EM at EAP₂₅ and ECP following TRB opening are based on results of modelling conducted by Anchor (2014; Appendix 4) using data collected from Phase 2 sediments and established toxicity benchmarks (Golder, 2012b). Contaminant concentrations in under-pier sediment samples were used to estimate corresponding water column concentrations and determine corresponding TSS levels where waters would meet the performance criteria for release from the TRB (Appendix 4; Anchor, 2014).

4.3.1.3 Barge Dewatering

Phase 1B TSS performance criteria, developed by Golder (2012b), were based on a risk-based assessment of potential contaminants (e.g., metals and PAHs) that would desorb from suspended particles after suspension in a barge dewatering modelling assessment (Appendix 5). Phase 1 performance criteria were based on the Phase 1B Project Area and did not include the South Jetty under-pier area. The results of the modelling report for the Phase 2 Work Area (i.e., Sediment Management Area 6 [SMA-6], Dredge Units [DU] 34, 39 and 44 as sampled by Golder based on the 30% design specification DU numbering) indicated that there is no TSS value in barge dewatering effluent at which concentrations of potential contaminants would not pose a risk of acute lethality to fish and other marine life. For this reason, there can be no discharge of dewatered effluent from dredging within the TRBCA outside the TRBCA without treatment. Treated dewatering barge effluent from dredging within the TRBCA may be discharged outside of the TRBCA provided that all barge dewatering performance criteria have been met (Table 4-6).

Notwithstanding the above, passive barge dewatering may occur within the TRBCA provided that performance criteria are maintained outside the TRBCA (Table 4-4). There is to be no passive dewatering from the Hazardous Waste Area and all barge effluent must pass through a filter to decrease TSS prior to release, regardless of the location of discharge.

For contingency re-dredging, dewatering outside of the TRBCA must follow the criteria established for Phase 1B (Appendix 3). Barge dewatering effluent from contingency re-dredging may be discharged within the TRBCA in which case the criteria for dewatering within the TRBCA would apply.

In the event that additives are used to facilitate dewatering of the dredged material, this decanted water must be tested prior to discharge to verify that the added constituents will not be harmful to the receiving environment.

4.3.2 Dissolved Oxygen (DO)

DO analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen dissolves into water by diffusion from the surrounding air, by aeration (rapid movement) and as a product of photosynthesis (Poppe, 1988). DO is an important component of water that facilitates self-purification and maintenance of aquatic organisms utilizing aerobic respiration. DO levels <5 mg/L can stress organisms while sustained DO levels of <3 mg/L can result in fish kills (USEPA, 2000). Hypoxia (i.e., $DO < 2$ mg/L) increases stress from other factors (e.g., contaminants) on marine organisms, whereas anoxic conditions (i.e., $DO < 0.1$ mg/L) produce toxic hydrogen sulphide (H_2S) which may be lethal to marine biota. In Esquimalt Harbour, DO concentrations ranged from 6.23 mg/L to 7.98 mg/L during fall 2010 assessments. Concentrations were variable between locations and were lower at depth than at the surface (Appendix 2, Table B2; Golder, 2012d).

Dredging of marine sediments may re-suspend sediments with high oxygen demand (e.g., biological or chemical) which can reduce DO concentrations in the water column to harmful levels. The content of DO in water can also be affected by natural processes such as photosynthesis by algal blooms.

DO will be measured *in situ* by the EM (described in EMIP). Real-time data will be used to manage day to day operations and assist in interpreting whether changes in DO are project-related or related to natural processes.

4.3.3 pH

pH is a measure of the hydrogen ion concentration (or acidity) in water reported on a scale from 1 to 14. A pH of 7 is considered neutral. Values lower than 7 are considered acidic, while values higher than 7 are basic (alkaline). Many important chemical and biological reactions are strongly affected by pH. In turn, chemical reactions and biological processes (e.g., photosynthesis and

respiration) may also influence pH. When water becomes either too alkaline or acidic, it can become inhospitable to many species of aquatic life. Typical pH values in seawater tend to be slightly alkaline. In fall 2010, pH values of 7.86 to 8.17 pH units were measured in Esquimalt Harbour (Appendix 2, Table B2; Golder, 2012d). Seawater chemistry has the ability to buffer minor changes in hydrogen ion concentration; however, this buffering ability can be overcome when such changes are substantial. pH can also be influenced by natural processes such as photosynthesis during algal blooms, which can result in elevated pH (i.e., > 9.0 pH units).

Contact of water with curing concrete can result in harmful pH levels (i.e., >9.0 pH units); whereas, dredging alone is not likely to result in harmful changes in pH. In addition to direct effects from higher or lower pH, pH changes can also affect the toxicity of other substances (e.g., nutrients).

pH will be measured *in situ* and results will be available daily. Monitoring of pH will be conducted concurrently with construction activities by both the Contractor's appropriately qualified person (near activities) and EM (at safety perimeter [25 m], ambient and background environment; as described in the EMIP).

4.3.4 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are a broad group of compounds present in hydrocarbon products, vessel exhaust and creosote used to treat timber for marine construction (EC, 1994). PAHs may be adsorbed onto sediments and released from those sediments during dredging. Water quality performance criteria for PAHs were established by Golder (2012c) for Phase 1B and were based on lowest available toxicity values for effluents (where applicable) and 1/10th of the lowest available toxicity values for ambient conditions. Modelling results indicated the presence of PAH concentrations exceeding established toxicity values for Anthracene, Benz(a)anthracene, Naphthalene and Pyrene (Golder, 2012c); however, during Phase 1B monitoring no PAH exceedances were measured (SLR, 2014).

More recent modelling conducted by Anchor (2014) determined that PAH toxicity levels would be reached at 64 mg/L TSS (34 NTU); however, these values are subject to change based on Phase 2 data.

Water samples are to be collected as indicated in Section 4.3.1 and Tables 4-1 to 4-3 for submission to an analytical laboratory. Analytical sampling by the Contractor's appropriately qualified person is to be conducted with the objective to establish an appropriate *in situ* relationship between TSS and/or turbidity and PAH concentrations in the enclosed Phase 2 Work Area. PAH analysis can be conducted with a minimum 'rush' 24 hour turnaround time (TAT) and will initially be sampled in higher volumes and frequency to establish concentration calibration curves associated with TSS with a concomitant reduction in frequency as reliability increases. Ongoing laboratory results for PAH will be used to provide feedback to dredge and other operations.

Performance criteria for the discharge of metals and PAHs were developed based on research conducted by Golder (2012c). Release criteria were based on the lowest available toxicity endpoints, using LC₅₀ concentrations for salmonids, where available. Many of the PAHs listed are not well studied and levels were therefore based on no observed effects levels (NOELs) for the most relevant organisms for which data was available. Ambient criteria were taken from published WQGs (CCME, 2014; BCMOE, 2014) and include a safety factor of 10x. This safety factor was removed to establish meaningful release criteria that if maintained would not constitute the release of a deleterious substance.

4.3.5 Metals

Marine biota require varying amounts of metals (such as copper and zinc) as trace dietary minerals for proper enzyme functionality and cellular respiration. Molluscs and crustaceans use copper to bind oxygen in their blood pigment hemocyanin. Zinc is an essential mineral to all life and has an important role in RNA transcription. Zinc is also a Lewis acid and has an important role in enzyme reactions and carbon dioxide regulation as a catalyst. While at low concentrations these and other

metals can be advantageous, high concentrations are toxic due to accumulations in filtration structures.

Marine sediments in the Phase 2 Project Area are expected to be high in copper and zinc (Golder 2012d) and there were exceedances of both copper and zinc during Phase 1B (SLR, 2014). Water samples will be collected by the EM as per Tables 4-1 through 4-3 and submitted to an analytical laboratory for total metals as indicated in Tables 4-1 to 4-3. Metal analysis requires a maximum 24 hour turnaround time and would be used to provide ongoing feedback to the efficient management of dredge operations and water quality performance criteria. Measured concentrations would be related to turbidity and TSS measurements (*in situ* and laboratory) to assess whether performance criteria continue to be protective of marine life and compliance with water quality criteria.

4.3.6 PCBs, TBT & Other Organochlorides

Prior to 1979, polychlorinated biphenyls (PCBs) were manufactured and distributed to a wide market. PCBs were never manufactured in Canada but were widely used until their import, manufacture or sale was banned in 1977. PCB pollution continued in Canada until their release to the environment was banned in 1985. PCBs are classified as persistent organic pollutants (POPs) and are readily absorbed by marine life and bioaccumulate in larger organisms.

Tributyltin (TBT) is a POP that was widely used in marine antifouling paint. TBT has been linked to imposex (development of male genitalia in female organisms) in some gastropods and other molluscs.

Dioxins (TCDDs) and furans (TCDFs) are colourless crystalline solids that are formed as a by-product of herbicide manufacturing, certain bleaching processes previously used in the pulp and paper industry and by-products of combustion. Dioxins and furans can be associated with creosote timber treatment processes and are likely to be found in sediments beneath the South Jetty and released during extraction and dredging. Dioxins and furans are sequestered and accumulate in fatty tissues of animals and are taken up when consuming contaminated food sources (Health Canada, 2005; USEPA, 2011). Dioxins and furans are human carcinogens, they disrupt hormones in humans and animals and exposure at high doses may result in chloracne (Health Canada, 2005; USEPA, 2011).

Given potential concentrations of PCBs, TBT, TCDDs TCDFs in Phase 2 sediments and predictions based on modelling conducted by Anchor for Phase 2 (2014), environmental and project operations should be considerate of the potential for Phase 2 works to liberate and disperse these contaminants. PCBs, TBT, TCDDs and TCDFs are not proposed for regular monitoring, as laboratory assessments of these compounds typically have prolonged turnaround times (relative to metals and PAHs) and are costly. It is expected that these contaminants will co-occur with metals and PAHs within the Project Area and monitoring of metals and PAHs will provide sufficient information regarding potential contaminants for the purposes of day-to-day monitoring.

4.3.7 Underwater Noise

Sound travels through water as pressure waves. Elevated sound pressure levels (SPLs) may cause marine mammals to avoid an area, disrupt echolocation, cause habitat abandonment, mask predators and conspecifics, cause aggression, pup/calf abandonment hearing loss and tissue damage (Vagle, 2003). In a review by the National Ocean and Atmospheric Administration (NOAA, 2013) dual acoustic threshold levels for groups of cetaceans and pinnipeds were proposed based on the behaviour of the source of the sound. Sound sources were defined as impulsive (e.g., impact pile driving and explosions) and non-impulsive (e.g., octave band noise and sonar) as they can result in differing results in the receiving animal. The BC Marine and Pile Driving Contractors Association developed sound specific BMPs for pile driving and related operations.

BMPs for underwater noise are outlined in the EMP (G3, 2014a) and monitoring procedures to ensure compliance with established BMPs are outlined in the EMIP. Based on these BMPs,

pressure from underwater noise during pile driving, extraction and related activities should not exceed 30 kPa at a distance of <2 m from the activity or <2 m from the TRB (30 kPa is typically specified in authorizations issued by DFO). The Contractor will monitor sound within 2 m of the activity generating the noise and PWGSC's EM will monitor outside the TRBCA at the safest point closest to the noise generating activity (no closer than 25 m to an active area) with hydrophones as appropriate. Exceedances may require the contractor to implement additional mitigation techniques, as outlined in the EMP (including modification to activities; G3, 2014a).

4.4 Phase 2 Monitoring Schedule

The PWGSC designated EM will collect samples and conduct *in situ* profiling as outlined in Tables 4-1 to 4-3. Analytical results will be used by the EM to validate the modelled TSS/turbidity relationship and modelled metal and PAH toxicity correlations to TSS (Appendix 4).

A higher frequency of monitoring (Tables 4-1 to 4-3) will occur at the beginning of each operation (e.g., structure demolition, dredging, initial TRB opening, placement of engineered capping materials, contingency re-dredging/residuals management cover placement). Monitoring frequency may be progressively reduced over the first few weeks if water quality performance criteria are consistently met. If an exceedance is observed during any stage of the Project, the frequency of laboratory sample submission may increase (in accordance with Tables 4-1 to 4-9) until the issue has been addressed and results indicate compliance with water quality criteria. The management of day-to-day Project activities will rely on both *in situ* monitoring and analytical results.

In addition to activity specific monitoring, NFR (i.e., ambient) and FFR (i.e., background) samples will be collected outside of the area of project influence to obtain appropriate comparative reference measurements. Non-project related activities with potential to directly affect monitoring results need to be identified and accounted for in Project monitoring results (e.g., harbour activity, hydrological conditions, vessels berthing at EGD, etc.). The EM will adjust sampling plans, as required, to ensure that current ambient conditions are accurately considered when water quality performance criteria are assessed.

The Contractor and their appropriately qualified person are responsible for any quality assurance sampling which may be required and the EM is responsible for quality control sampling. The Contractor must report all data (for any purpose) to PWGSC in weekly reports.

4.5 Pre- & Post- Monitoring

Ambient (i.e., within the Constance Cove Discretionary Cetacean Safety Zone, no closer than 100 m to the TRB) and background (i.e., within Esquimalt Harbour, outside of Constance Cove) monitoring of POPs should be conducted as part of Phase 2 works. Baseline conditions should be established prior to commencement of in-water works and again following completion of Phase 2 works to establish baseline POP levels in the area prior to Project works occurring and to verify that POPs did not transit from the Phase 2 Project Area to surrounding areas.

Pre/post monitoring should be undertaken as a due diligence measure to evaluate potential releases of contamination through the course of regular dredging, TRB opening, potential reduced TRB function or failure and removal of the TRB and SPW at the end of the project. Monitoring should continue until concentrations have been demonstrated to be consistent with ambient conditions.

Table 4-1: Sampling Frequency for Regular Monitoring

Monitoring Station	Location of Sample	Resp ⁴ Party	Sample Collection	Initial Sampling Frequency (Week 1) ¹	Reduced Sampling Frequency (Weeks 2-3) ^{1,2}	Further Reduced Sampling Frequency (Weeks 4+) ²
Early Warning Point (EWP)	One (1) location As close to the active dredge as possible, on the outside of the TRB, not within 25 m of any active equipment or the TRB	EM	<i>In situ</i> water column profiling Grab samples collected from three (3) depths ³ and coinciding with periods of peak dredge activity	<i>In situ</i> monitoring daily and at time of sample collection All samples collected and submitted daily for 'RUSH' analysis for TSS, turbidity, pH, metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection All samples collected daily. Submitted for analysis for TSS, turbidity, pH, metals and PAHs (total) once every three (3) days with remaining samples archived and tested in the event of an exceedance	<i>In situ</i> monitoring daily and at time of sample collection All samples collected for three (3) consecutive days each week. Submitted for analysis for TSS, turbidity, pH, metals and PAHs (total) once per week with remaining samples archived and tested in the event of an exceedance
Compliance Point(s) (CP)	Three (3) locations 100 m from the outer edge of the TRB ⁷	EM	<i>In situ</i> water column profiling Grab samples collected from three (3) depths ³ at each CP	<i>In situ</i> monitoring daily and at time of sample collection All samples collected daily. Submitted daily for 'RUSH' analysis of TSS, turbidity and pH. 50% of samples tested for metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection All samples collected once every three (3) days. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection All samples collected once per week. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)
Near Field Reference (Ambient) (NFR)	Two (2) locations Constance Cove Ambient Conditions >100 m from the outer edge of the TRB within the 500 m Discretionary Cetacean Zone	EM	<i>In situ</i> water column profiling Grab samples collected from three (3) depths ³	<i>In situ</i> monitoring daily and at time of sample collection Samples collected three (3) days per week. Submitted daily for 'RUSH' analysis of TSS, turbidity and pH, 50% of samples tested for metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection Samples collected once every three (3) days. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection Samples collected once per week. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)
Far Field Reference (Background) ⁵ (FFR)	One (1) location Esquimalt Harbour background conditions beyond the 500 m Discretionary Cetacean Zone	EM	<i>In situ</i> water column profiling Grab samples collected from three (3) depths ³	<i>In situ</i> monitoring daily and at time of sample collection Samples collected three (3) days per week. Submitted daily for 'RUSH' analysis of TSS, turbidity and pH, 50% of samples tested for metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection Samples collected once every three (3) days. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)	<i>In situ</i> monitoring daily and at time of sample collection Samples collected once per week. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)
Discretionary Sampling ⁶	Additional sampling conducted if a visual plume of turbidity is observed	EM	Discretionary	Discretionary	Discretionary	Discretionary

CP – Compliance Point; EM – Environmental Monitor; EWP – Early Warning Point; FFR – Far-Field Reference; NA – not applicable; NFR – Near-Field Reference; PAH – Polycyclic Aromatic Hydrocarbon; TAT – Turnaround Time; TRB – Temporary Re-suspension Barrier; TSS – Total Suspended Solids

Notes:

- (1) Sampling frequency may be reduced if site has been active for at least one (1) week and compliance point water quality performance criteria have been met for the three most recent samplings or with agreement of DR, if criteria for a parameter is exceeded at NFR (ambient; or FFR [background], see note 5) and the exceedance is unrelated to project operations, as assessed by the EM or DR, it may be omitted from evaluation of results for decreasing the sampling frequency at the discretion of the DR and EM.
- (2) Sampling frequency may increase to daily if water quality performance criteria are not met or with agreement of DR, if criteria for a parameter is exceeded at NFR (ambient; or FFR [background], see note 5) and the exceedance is unrelated to project operations, as assessed by the EM or DR, it may be omitted from evaluation of results for decreasing the sampling frequency at the discretion of the DR and EM.
- (3) Water samples collected at 1 m below surface (depth "A"), mid-water column (depth "B") and 2 m above seafloor (depth "C").
- (4) PWGSC Designated Environmental Monitor (EM) is responsible for Quality Control sampling. Any Quality Assurance sampling which may be required is the responsibility of the Contractor and their retained appropriately qualified person.
- (5) FFR (background) is to be used in comparison if/when NFR (ambient) conditions are confounded by vessel activity.
- (6) DR must be notified of discretionary sampling prior to it occurring.

- (7) The first CP should be located perpendicular to the activity occurring within the TRBCA with the second CP between 25 m and 100 m (at discretion of EM based on depth of entrainment) upcurrent from the first CP (still 100 m away from the TRB) and the third CP 25 m to 100 m (at discretion of EM based on depth of entrainment) downcurrent from the first CP (still 100 m away from the TRB). See Appendix 1, Figures A6 and A7 for conceptual layouts.

Table 4-2: TRB Opening Water Quality Criteria Compliance Sampling					
Monitoring Station	Location of Sample	Responsible Party	Sample Collection	Initial Laboratory TAT (Week 1-3)	Reduced Laboratory TAT (Weeks 4 +) ^{1,2}
Interior Assessment Point (IAP)	At least one (1) location Point inside the TRB closest to the opening	Contractor's appropriately qualified person	To be determined by Contractor's appropriately qualified person	To be determined by Contractor's appropriately qualified person	To be determined by Contractor's appropriately qualified person
Exterior Assessment Point (25 m; EAP₂₅)	One (1) location Point 25 m from the opening of the TRB down gradient of prevailing current	EM	<i>In situ</i> water column profiling Grab samples collected from three (3) depths ⁴	All samples collected and submitted following each opening ^{3,8} of the TRB for RUSH analysis for TSS, turbidity, pH, metals and PAHs (total)	All samples collected and submitted following each opening ^{3,8} of the TRB for standard TAT analysis for TSS, turbidity, pH, metals and PAHs (total)
Exterior Compliance Point (ECP)	One (1) location Point 100 m from the opening of the TRB down gradient of prevailing current	EM	<i>In situ</i> water column profiling Grab samples collected from three (3) depths ⁴	All samples collected and submitted following each opening ^{3,8} of the TRB for RUSH analysis for TSS, turbidity, pH, metals and PAHs (total)	All samples collected and submitted following each opening ^{3,8} of the TRB for standard TAT analysis for TSS, turbidity, pH, metals and PAHs (total)
Near Field Reference (Ambient) (NFR)	Two (2) locations Constance Cove Ambient Conditions >100 m from the outer edge of the TRB within the 500 m Discretionary Cetacean Zone	EM	Sample collection conducted during regular monitoring. No additional collections proposed	NA	NA
Far Field Reference (Background)⁶ (FFR)	One (1) location Esquimalt Harbour background conditions beyond the 500m Discretionary Cetacean Zone	EM	Sample collection conducted during regular monitoring. No additional collections proposed	NA	NA
Discretionary Sampling	Additional discretionary sampling will be conducted if a visual plume of turbidity observed. Samples will only be collected beyond 25 m from the TRB to assist in contaminant tracking.	EM	Discretionary	Discretionary	Discretionary

EAP₂₅ – Exterior Assessment Point (25 m from opening); ECP – Exterior Compliance Point; EM – Environmental Monitor; FFR – Far-Field Reference; IAP – Interior Assessment Point; NA – not applicable; NFR – Near-Field Reference; PAH – Polycyclic Aromatic Hydrocarbon; POD – Point of Discharge; TAT – Turnaround Time; TRB – Temporary Re-suspension Barrier; TSS – Total Suspended Solids

Notes:

- Opening of the TRB for new activities (e.g., demolition, dredging) restarts the Laboratory Turnaround Time.
- (1) Sampling TAT may be reduced if all Exterior Assessment Point and Exterior Compliance Point Water Quality Performance Criteria are met for three (3) consecutive measurements. If criteria for a parameter is exceeded at NFR (ambient; or FFR [background], see note 6) and the exceedance is unrelated to project operations, as assessed by the EM or DR, it may be omitted from evaluation of results for decreasing the sampling frequency at the discretion of the DR and EM.
- (2) Sampling frequency may need to be increased if Exterior Assessment Point and Exterior Compliance Point Water Quality Performance Criteria are not met. If criteria for a parameter is exceeded at NFR (ambient; or FFR [background], see note 6) and the exceedance is unrelated to project operations, as assessed by the EM or DR, it may be omitted from evaluation of results for decreasing the sampling frequency at the discretion of the DR and EM.
- (3) Multiple TRB openings within a short period of time (e.g., one hour) would constitute a single event
- (4) Water samples shall be collected at a 1 m below surface (depth "A"), mid-water column (depth "B"), and 2 m above seafloor (depth "C").
- (5) PWGSC Designated Environmental Monitor (EM) is responsible for Quality Control sampling; Contractor to collect samples for submission to EM for Quality Control testing. Any other Quality Assurance sampling which may be required is the responsibility of the Contractor and their retained appropriately qualified person.

- (6) FFR (background) is to be used in comparison if/when NFR (ambient) conditions are confounded by vessel activity.
 (7) DR must be notified of discretionary sampling prior to it occurring.
 (8) TRB is to be opened and closed as soon as possible to enable vessel transit in or out of the TRBCA to minimize the discharge of potential contaminants out of the TRBCA. If TRB is to be opened for extended periods of time sampling will occur while the TRB is open (sampling frequency to be based on length of time the TRB will be open) in addition to after it has been closed.

Table 4-3: Barge Dewatering Effluent Compliance Monitoring

Monitoring Station	Location of Sample	Resp ⁵ Party	Sample Collection	Initial Sampling Frequency (Week 1) ¹	Reduced Sampling Frequency (Weeks 2-3) ^{1,2}	Further Reduced Sampling Frequency (Weeks 4 +) ²
Final Whole Effluent	One (1) location Treatment Barge	EM	Grab whole final effluent immediately prior to discharge ³	All samples collected and submitted daily for 'RUSH' analysis for TSS, turbidity, pH, metals and PAHs (total)	All samples collected daily. Submitted for analysis for TSS, turbidity, pH, metals and PAHs (total) once every three (3) days with remaining samples archived and tested in the event of an exceedance.	All samples collected for three (3) consecutive days each week. Submitted for analysis for TSS, turbidity, pH, metals and PAHs (total) once per week with remaining samples archived and tested in the event of an exceedance.
Dilution Zone Compliance Point (DZCP)	Three (3) locations 100 m from the point of discharge (POD)	EM	<i>In situ</i> water column profiling Samples collected from three (3) depths ⁴ at each CP	<i>In situ</i> profiling at time of sample collection. All samples collected daily. Submitted for TSS, turbidity and pH at RUSH, 50% of samples tested for metals and PAHs (total)	<i>In situ</i> profiling at time of sample collection. All samples collected once every three (3) days. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)	<i>In situ</i> profiling at time of sample collection. All samples collected once per week. Submitted for TSS, turbidity and pH (standard TAT), 50% of samples tested for metals and PAHs (total)
Near Field Reference (Ambient) (NFR)	Two (2) locations Constance Cove Ambient Conditions >100 m from the outer edge of the TRB within the Discretionary Cetacean Zone	EM	Sample collection conducted during regular monitoring. No additional collections proposed.	NA	NA	NA
Far Field Reference (Background) ⁶ (FFR)	One (1) location Esquimalt Harbour background conditions beyond the Discretionary Cetacean Zone	EM	Sample collection conducted during regular monitoring. No additional collections proposed.	NA	NA	NA
Discretionary Sampling ⁷	Additional discretionary sampling will be conducted if a visual plume of turbidity observed	EM	Discretionary	Discretionary	Discretionary	Discretionary

DZCP – Dilution Zone Compliance Point; FFR – Far-Field Reference; NA – not applicable; NFR – Near-Field Reference; POD – Point of Discharge; TAT – Turnaround Time; TRB – Temporary Re-suspension Barrier; TSS – Total Suspended Solids

Notes:

- Sampling frequency may be reduced if all DZCP water quality performance criteria are met for two (2) consecutive weeks or three (3) consecutive measurements. If criteria for a parameter is exceeded at NFR (ambient; or FFR [background], see note 6) and the exceedance is unrelated to project operations, as assessed by the EM or DR, it may be omitted from evaluation of results for decreasing the sampling frequency at the discretion of the DR and EM.
- Sampling frequency may be increased if DZCP water quality performance criteria are not met. If criteria for a parameter is exceeded at NFR (ambient; or FFR [background], see note 6) and the exceedance is unrelated to project operations, as assessed by the EM or DR, it may be omitted from evaluation of results for decreasing the sampling frequency at the discretion of the DR and EM.
- There is to be no discharge without treatment outside of the TRBCA. Passive dewatering may occur within the TRBCA if water quality performance criteria outside the TRBCA are maintained (Table 4-4).
- Water samples shall be collected at 1 m below surface (depth "A"), mid-water column (depth "B"), and 2 m above seafloor (depth "C").
- PW/GSC Designated Environmental Monitor (EM) is responsible for Quality Control sampling. Any Quality Assurance sampling which may be required is the responsibility of the Contractor and their retained appropriately qualified person.
- FFR (background) is to be used in comparison if/when NFR (ambient) conditions are confounded by vessel activity.
- DR must be notified of discretionary sampling prior to it occurring.

4.6 Decision Frameworks

Specific parameters and points of compliance are generally determined by agreement at the project level through the process of environmental review and consultation with responsible regulatory agencies to meet the general provisions of the environmental statutes. The decision criteria and management actions provided in this section have been designed to provide continuous feedback for day-to-day management of project works and are based on conservative endpoint values measured at appropriate distances from Phase 2 Work Area activities.

For the purposes of Phase 2 of the Project, site-specific performance criteria for select parameters were designated to protect aquatic systems and guide management actions as deemed appropriate. Exceedances of performance criteria at the following stations may result in management actions (e.g., modified dredge frequency, modified performance criteria, TRB inspection/maintenance, re-evaluation of performance criteria and other actions determined by the DR with input from the EM and Contractor):

- Early Warning Point (EWP) for general and dredging activities;
- Exterior Assessment Point (EAP₂₅) for the TRB opening activities;
- Interior Assessment Point (IAP) to assess if the TRB can be opened under current conditions; and,
- Dewatering barge whole effluent to assess suitability prior to discharge.

Sites at 100 m from project activities were established to monitor for exceedances that will result in management actions, including temporary work stoppage, modification of activities or modification to timing of activities, to reduce the risk of Project activities generating potentially harmful conditions in the receiving environment:

- Compliance Point (CP) 100 m from the edge of the TRB for general and dredging activities;
- Exterior Compliance Point at 100 m (ECP) for TRB opening activities; and,
- Dilution Zone Compliance Point (DZCP) for barge dewatering final effluent discharge.

Day-to-day activities will be managed on the basis of *in situ* and laboratory results. The TSS/turbidity relationship and corresponding turbidity performance criteria are subject to change, at any time, based on field and laboratory results. Phase 1 design work conducted by Golder (2012d) determined that Water Quality Management Area A (WQMA-A; the area that contains the Phase 2 Work Site), and more specifically Sediment Management Area 6 (SMA-6; the area of focus in Phase 2) was high in metals and/or PAH concentrations relative to the majority of other areas in Phase 1.

Water quality performance criteria for activities in Phase 2 are provided in Tables 4-4 through 4-9. In all cases where water quality is assessed relative to ambient conditions, ambient is defined as the surrounding area of Constance Cove (measured at the Near-Field Reference location [NFR]).

4.6.1 Decision Framework for Activities Enclosed within the Temporary Re-suspension Barrier Containment Area (TRBCA)

The decision framework for implementing management actions during activities within the TRBCA (e.g., dredging) was designed to allow for adaptive management procedures responsive to environmental protection goals without unnecessary disruption to operational needs of the Project. Enclosed activities have four (4) sampling locations used to assess TRB performance and adherence to the water quality performance criteria: the Early Warning Point (EWP); and, three Compliance Points (CPs). These monitoring locations are compared to ambient (Constance Cove specific Near-Field Reference; NFR) and background (Esquimalt Harbour, general Far-Field Reference; FFR) reference points (Table 4-4 and Appendix 1, Figures A6 and A7). Far-field reference is to be used in comparison if/when NFR (ambient) conditions are confounded (e.g., vessel activity) and identify system-wide events that may not be related to specific activities within Constance Cove. Performance criteria were selected to enable early detection of defects or reduced/ineffective operation of the TRB or sheet pile wall.

The daily decision making framework for activities occurring within the TRBCA is illustrated in Figure A4 (Appendix 1). The steps are as follows:

1. through the course of regular monitoring the PWGSC EM will collect water samples and assess turbidity and other *in situ* water quality measurements using a multi-parameter *in situ* meter (Sonde) at each monitoring location (i.e., EWP, CPs [3], NFR [2] and FFR);
2. EM will estimate TSS concentration (mg/L) from *in situ* turbidity using a calibrated model specific to Phase 2 (initially following the model developed by Anchor, 2014 [Appendix 4]) to assess if suspended sediments from within the TRBCA may be exiting the worksite and determine if induced TSS is influenced by Project conditions relative to ambient water quality;
3. in the event that any water quality parameter exceeds the water quality criteria at any monitoring location (i.e., EWP, CPs; Table 4-4), then the EM is to:
 - a) notify DR of exceedance;
 - b) for *in situ* monitoring, immediately re-take measurement to ensure exceedance was not related to instrumentation error;
 - c) proceed with confirmatory sampling as soon as possible. For *in situ* measurements the instrument should be re-calibrated and the site re-tested; this may take up to 3 hours as all sites would require additional *in situ* measurements. Confirmatory measurements will be made and/or samples collected at three (3) depths at the NFR and monitoring station(s) where the exceedance(s) was noted;
4. following confirmatory sampling, if the exceedance is confirmed, the EM will notify the DR and assess if the exceedance is a result of EGD or DND activity (e.g., propwash). The need for management action(s) will be evaluated and courses of action discussed;
5. management actions (e.g., changes to dredge operations, adjustment/repair of TRB) must then be implemented by the Contractor as required;
6. following management actions (and an appropriate passage of time as assessed by the EM based on the incident and activities involved), applicable water quality stations will be re-assessed to determine if the issue has been resolved;
7. if no further exceedances are detected, monitoring will revert to the regular monitoring schedule; however, if:
 - a) the original issue has been detected at EWP and has spread further to CP, the EM will confirm the finding then notify the DR and proceed with the appropriate pathway as per Step 4;
 - b) the original issue detected at the EWP remains an issue after confirmatory sampling and has not spread to CP the EM will notify the DR and proceed with appropriate pathway as per Step 4; and/or,
 - c) the issue as previously detected at CP remains an issue after confirmatory testing, despite management actions, the EM must notify the DR and further management actions including a stop work order and/or change in activity(s) will be implemented until the problem is resolved through corrective actions;

8. if a stop work order is issued, following the cessation of activity, the Contractor shall implement any corrective actions determined to be necessary by the EM and/or DR. Once in place these actions must be inspected and approved by the DR and EM (if applicable). Work may resume once the water quality performance criteria have been met at the CP(s) with increased monitoring frequency (per Table 4-1).

4.6.2 Decision Framework for TRB Opening

Specific performance criteria for opening the TRB to permit vessel and equipment to transit was modelled by Anchor (2014; Appendix 4) based on concentrations of metals and PAHs that would meet or exceed established water quality guidelines (Table 4-5) within 100 m of the TRB opening and not result in serious harm to organisms at any point outside of the TRB.

Opening of the TRB will be at the discretion of the Contractor, based on turbidity monitoring conducted by the Contractor's appropriately qualified person at the Interior Assessment Point (IAP). The Contractor must provide evidence to the DR and EM that TRB opening criteria have been appropriately calculated and that the criteria are met at the IAP prior to opening the TRB.

The decision framework for opening the TRB includes frequent feedback processes to enable adaptive management of activities responsive to environmental protection goals without unnecessary disruption to the operational needs of the Project and is summarized in Figure A-5 (Appendix 1).

For TRB opening, water quality performance criteria would be evaluated at three (3) points:

1. Interior Assessment Point (IAP): monitoring conducted by Contractor's appointed appropriately qualified person prior to opening the TRB based on the methodology and criteria the developed by the appropriately qualified person;
2. Exterior Assessment Point (EAP₂₅): monitoring conducted by PWGSC's designated EM prior to and following each opening of the TRB; and,
3. Exterior Compliance Point (ECP): monitoring conducted by PWGSC's designated EM prior to and following each opening of the TRB.

The framework for TRB opening activities is illustrated in Figure A5 (Appendix 1). The steps are as follows:

1. Contractor will notify the EM by 14:00 h the day before of their intention open the TRB such that the EM can ensure that monitoring personnel and supplies are in place. If opening is to be daily or routine, this should be scheduled with the DR and EM;
2. EM will assess conditions at NFR to establish ambient TSS/turbidity concentrations (if not already available as part of other Project monitoring), collect water samples at the EAP₂₅ and ECP and notify the DR (to relay to the Contractor) if any adjustments to the TSS/turbidity criteria are necessary based on exterior turbidity;
3. Contractor's appropriately qualified person, using their IAP criteria, will assess conditions at the IAP and notify the DR and EM if the IAP is compliant;
4. Contractor is to notify the EM and DR of their intent to open the TRB and will establish an appropriate Activity Zone (AZ) around the TRB opening and ensure that all non-Contractor personnel have exited the AZ prior to opening the TRB and related vessel activity. As soon as practical, the Contractor will close the TRB;
5. Contractor will ensure that the EGD Work Site outside of the TRB opening is safe for the EM to enter and conduct sampling and notify the EM when it is safe to conduct compliance monitoring;
6. EM will assess *in situ* water quality after the TRB has been re-closed at the EAP₂₅, ECP and NFR and collect samples at three (3) depths at each station (Tables 4-8);
7. EM will review the data when available to determine if contaminants had been released in quantities above the modelled scenario at 25 m and/or exceeded water quality criteria at 100 m and provide the results in a data summary report to the DR;

8. if criteria are exceeded at ECP the DR must be notified and management actions taken to prevent exceedances at the next TRB opening. If criteria are exceeded at EAP₂₅ no management actions are necessary; however, the EM must still notify the DR of the exceedance (who will notify the Contractor);
9. the criteria for TRB opening must be re-assessed by the EM, DR and Contractor after an exceedance at any location; and,
10. prior to next TRB opening the Contractor or Contractor's appropriately qualified person must demonstrate to the DR and EM that actions have been taken to prevent another exceedance.

Note: The TRB is to be opened and closed as soon as possible to facilitate vessel passage in or out of the TRBCA to minimize any discharge of potential contaminants out of the TRBCA. If TRB is to be opened for extended periods of time sampling will occur while the TRB is open (sampling frequency to be based on length of time the TRB will be open) in addition to after it has been closed.

4.6.3 Decision Framework for Barge Dewatering

Passive (direct) dewatering of sediment, dredged within or outside (contingency re-dredging) the TRBCA, may occur only within the TRBCA and only if water quality performance criteria can be maintained outside the TRBCA (Table 4-4). At no time is there to be passive dewatering from the Hazardous Waste Area. All effluent from the Hazardous Waste Area must be treated and may only be released if water quality criteria for barge dewatering are met and demonstrated to the DR and EM.

No direct discharge from a barge loaded with sediments collected from the Phase 2 Work Area will occur outside the TRBCA without treatment and only if the effluent meets the criteria outlined in Table 4-6. Effluent does not have to be held for laboratory results if capabilities of the treatment barge are demonstrated to the DR and EM to meet the dewatering performance criteria by design.

To demonstrate compliance of barge discharge to water quality criteria, whole effluent will be collected prior to discharge and a sample collected at a point 100 m down gradient from the point of discharge (POD; defined as the end of pipe of the dewatering barge). If dewatered barge effluent does not meet the performance criteria within 100 m of the point of discharge, the EM will notify the DR. Management actions will be considered, including decreasing the performance criteria for discharge and ceasing discharge.

During contingency re-dredging within the TRBCA passive dewatering may occur within the TRBCA if effluent meets criteria specified for outside the TRBCA (Table 4-4) as most of the area would be considered remediated.

During contingency re-dredging outside the TRBCA dewatering outside the TRBCA may occur if effluent meets all Phase 1B water quality performance criteria for discharge of barge effluent (Appendix 3). If water quality performance criteria cannot be met effluent is to be treated to meet criteria or collected and stored for off-site treatment and/or disposal.

Water quality criteria established for work within the TRBCA (Section 4.6.1) are based on BCMOE (2014) criteria using ambient levels outside the TRBCA whereas contingency re-dredging (Section 4.6.6), associated de-watering and residuals management cover (RMC) placement (Section 4.6.5) outside the TRBCA are subject to criteria developed during Phase 1B operations. The two sets of criteria are based on the potential risk associated with each activity. Criteria for work occurring within the TRBCA are conservative and designed to assess and ensure the effectiveness of the TRB and SPW as potentially high levels of contamination could occur within the TRBCA. The BCMOE (2014) criteria account for conditions in the surrounding ambient environment (near-field reference) at the time of monitoring and were adopted for this situation as confounding ambient conditions may limit the ability to detect materials escaping from within the TRBCA.

Conditions under which contingency re-dredging and RMC placement outside of the TRBCA would be occurring have lower risk as area was previously remediated during Phase 1B. As this is an

open water area, containment of suspended material is more challenging. Based on the findings from Phase 1B, TSS and turbidity levels in the open water area are likely to be greater than what can be expected for outside the TRBCA during the enclosed Phase 2 work.

There is to be no dewatering during transport.

4.6.4 Decision Framework for Demolition

During the demolition of the South Jetty the EM will conduct inspections of any activities and/or equipment specified in the EMP to ensure BMPs are being followed and conduct visual observations to determine if materials generated from the demolition activities have the potential to enter surrounding waters either directly or indirectly. Contractor operations should not permit any materials generated from demolition to enter any waterway outside the criteria stipulated in this WQMP and the EMP. If inspections by the EM indicate that materials are being deposited in a watercourse, the EM will communicate with the DR and the Contractor may be required to develop mitigation measures or actions to prevent further deposition of materials. Any agreed upon mitigation measures or decisions will be provided to the DR in writing by the EM or Contractor.

During demolition and any in-water activities, the EM will conduct underwater acoustic monitoring to ensure that sound pressure levels resulting from pile driving and other demolition activities are within the criteria outlined in the EMP (G3, 2014a). If inspections, conducted by the EM indicate that sound pressure levels exceed the required maximums the EM will notify the DR and management actions will be implemented. Any agreed upon mitigation measures or decisions will be provided to the DR in writing by the EM or Contractor.

4.6.5 Decision Framework for Material Placement

During placement of engineered capping materials within the TRBCA, the EM will conduct “regular monitoring” at the EWP and CPs, as described in Section 4.2.1 and Figures A6 or A7 (Appendix 1) based on barge location. The decision framework for *in situ* monitoring will be followed during placement of engineered capping materials (Appendix 1, Figure A4).

For placement of residuals management cover outside of the TRBCA, the monitoring framework and criteria for Phase 1B (Section 4.2.4 and Decision Framework 3.2.1 in the Phase 1B WQMP [Golder, 2012c], provided in Appendix 3) must be followed. At the DR’s discretion, performance criteria may be re-evaluated to account for differential toxicity of suspended sediments associated with clean capping material relative to removed contaminated sediments.

4.6.6 Decision Framework for Contingency Re-dredging

Contingency re-dredging may be required within the TRBCA or in open-water areas recontaminated by TRB failure, TRB opening or TRB/SPW removal. During contingency re-dredging inside the TRBCA, the decision framework for *in situ* monitoring (Section 4.6.1; Appendix 1, Figure A4), monitoring locations (Appendix 1, Figures A6 or A7 based on the location of the barge) and performance criteria (Table 4-4) should be followed. Barge dewatering for contingency re-dredging within the TRBCA must follow the framework outlined in Section 4.6.3.

For contingency re-dredging outside the TRBCA, the open-water dredging decision framework and criteria and barge dewatering criteria, outlined in the Phase 1B Water Quality Monitoring Plan, should be followed (Appendix 3; Golder 2012c).

4.6.7 Decision Framework for Concrete Works

Whenever concrete work is occurring near an aquatic environment there is potential for changes to the pH of surrounding waters. The normal range of pH in the marine environment is 7.0 to 8.7 pH units (BCMOE, 2014).

During concrete works, the Contractor will monitor the pH of waters immediately adjacent to the wet or curing concrete with a calibrated, submersible pH probe. To prevent unnecessary work stoppages, the probe should be able to report to two decimals places. Monitoring should be conducted:

- continuously while concrete is being poured;
- one hour after pouring has completed;
- four hours after pouring has completed; and,
- twice daily thereafter, for 72 hours or until concrete has cured.

Probes should be calibrated once every 12 hours, or as necessary, to ensure accuracy and prevent unnecessary work stoppages. The PWGSC designated EM will monitor *in situ* water quality at a safe distance (i.e., approximately 25 m) from active equipment, as deemed necessary and appropriate.

If pH in adjacent waters is found to exceed 8.7 or at any point >0.5 pH units above measured ambient conditions the Contractor will immediately notify the DR and undertake mitigation measures to prevent further release of concrete and implement mitigation measures until pH is within the acceptable range. Appropriate management actions will then be taken for source control (i.e., proper sealing of pipe or delivery system, plugging of catch basins, collection of wash water, etc.).

4.6.8 Decision Framework for Storm Sewer & Wastewater Discharge at the EGD Work Site

Storm sewers should be protected from deleterious materials including concrete containing wash water, chemical spills, sediment-laden water and other potentially deleterious materials. The EM will inspect erosion and sediment control BMPs prescribed by the EMP and Contractor's EPP.

Wastewater is defined as waters produced from construction activities and personal hygiene and decontamination facilities on-site and excludes barge dewatering effluent. Wastewater from personal hygiene/decontamination facilities is not to be discharged on-site and it must be disposed of off-site at a permitted Wastewater Treatment/Disposal Facility. Wastewater produced at the Work Site (e.g., equipment decontamination wastewater) must be collected and tested prior to release to ensure water quality criteria will be met based on discharge location. If criteria cannot be met water is to be transported to an approved Wastewater Treatment Facility.

The EM will monitor storm sewer and wastewater discharge points within the Work Site to the receiving environment, where accessible (i.e., not discharging within the TRBCA) to ensure that water quality performance criteria (Table 4-4) are being met. For discharge within the TRBCA it must be ensured that water quality performance criteria outside the TRBCA are maintained (Table 4-4). After dredging within the TRBCA is completed and approved by the DR any discharge into the TRBCA must meet the criteria specified for outside the TRBCA (Table 4-4) as the area would be considered remediated. Any deficiencies will be included in the inspection report and submitted in writing to the DR and Contractor.

In the event of any exceedances or there is a visible sheen, the EM will immediately notify the DR and perform confirmatory sampling, including water entering storm sewers. The EM, DR and Contractor will assess the source and area of exceedance and determine if management actions (e.g., barriers around storm sewers, containment of contaminant source such as concrete run-off) or emergency spill response is required. Specific field forms associated with spill response and reporting are provided in the EMIP.

4.6.9 Decision Framework for TRB/SPW Removal and/or Relocation

The Contractor will notify the EM of their intention to remove or relocate the TRB and/or SPW in advance of planned activities. The Contractor will establish a safe working area within the TRBCA for the EM to conduct water sampling (can occur concurrently with PWGSC sampling activities to

ensure completion of work). The EM will assess interior water quality *in situ* and collect 4 to 6 samples which will be submitted to the laboratory for analysis ('rush' turnaround time) and compared to criteria stipulated in Table 4-7. Based on laboratory results, the EM will notify the DR if interior water quality is sufficient for removal of the TRB and/or SPW. Criteria were established to ensure that water quality conditions within the TRBCA are comparable to those outside the TRBCA and within Constance Cove prior to TRB/SPW removal.

During TRB/SPW and support pile removal, the EM will conduct underwater acoustic monitoring to ensure that sound pressure levels resulting from pile removal and other underwater activities are within the criteria outlined in the EMP (G3, 2014a). If inspections, conducted by the EM indicate that sound pressure levels exceed the required maximums the EM will notify the DR and management actions will be implemented. Any agreed upon mitigation measures or decisions will be provided to the DR in writing by the EM or Contractor.

For removing the TRB/SPW and support piles the water quality criteria that apply are the same as those for activities occurring within the TRBCA (Table 4-4) and the Decision Framework for Activities within the TRBCA would be followed (Section 4.6.1), with monitoring locations being 25 m (EAP₂₅) and 100 m (ECP) from the activity that is occurring rather than the TRB or barge.

4.7 Water Quality Performance Criteria

Table 4-4: Water Quality Performance Criteria Activities within the TRBCA ¹		
Parameter	Early Warning Point (EWP) (25 m outside of TRB)	Compliance Point (CP) (100 m from TRB)
Total Suspended Solids (mg/L)	<5 mg/L over NFR when NFR is between 0-25 mg/L ^{2,3} <10 mg/L over NFR when NFR is ≤100 mg/L ^{2,3} Increase of <10% over NFR when NFR is >100 mg/L ^{2,3} TSS exceedances at the EWP correlated with Project activities within the TRBCA may result in management actions to better contain silt.	<5 mg/L over NFR when NFR is between 0-25 mg/L ^{2,3} <10 mg/L over NFR when NFR is ≤100 mg/L ^{2,3} Increase of <10% over NFR when NFR is >100 mg/L ^{2,3} TSS exceedances at the CP correlated with Project activities within the TRBCA may result in work stoppage until the problem has been addressed.
Turbidity ⁴ (NTU)	Maximum increase of 8 NTU over NFR ⁴ for a short-term exposure (e.g. <24 hours) and 2 NTU for longer term exposure (e.g. 30 day) when NFR turbidity is <8 NTU Maximum increase of the greater of 8 NTU or 10% over NFR when NFR Turbidity is >8 NTU	Maximum increase of 8 NTU over NFR ⁴ for a short-term exposure (e.g. 24 hours) and 2 NTU for longer term exposure (e.g. 30 day) when NFR turbidity is <8 NTU Maximum increase of the greater of 8 NTU or 10% over NFR when NFR turbidity is >8 NTU
Dissolved Oxygen (mg/L) ⁵	Instantaneous minimum (acute): 5 mg/L Mean concentration (chronic): 8 mg/L	Instantaneous minimum (acute): 5 mg/L Mean concentration (chronic): 8 mg/L
pH ^{2,6}	7.0-8.7 pH exceedances at the EWP correlated with Project activities would require corrective actions by the contractor	7.0-8.7 pH exceedances at the CP correlated with Project activities would require corrective actions by the contractor
Metals – various (mg/L)	See 'Release Criteria' in Table 4-8	See 'Compliance Criteria' in Table 4-8
PAHs – various (µg/L)	See 'Release Criteria' in Table 4-9	See 'Compliance Criteria' in Table 4-9

CP – Compliance Point; mg/L – milligrams per litre; µg/L – micrograms per litre; NFR – Near-Field Reference; NTU – nephelometric turbidity units; EWP – Early Warning Point; TRB – Temporary Re-suspension Barrier; TSS – Total Suspended Solids.

Notes:

- Refer to Figure A4 (Appendix 1) for decision-making framework for exceedances of water quality performance criteria for *in situ* monitoring.
- (1) Includes sheet pile wall re-drive and removal, TRB removal, TRB support pile installation and removal.
- (2) Based on *Canadian Environmental Quality Guidelines Water Quality for the Protection of Aquatic Life Marine* (CCME, 2014).
- (3) Based on *BCMOE Ambient Water Quality Guidelines for Marine Turbidity, Benthic and Suspended Sediments* (BCMOE, 2014).
- (4) Turbidity is to be used as an *in situ* approximation of TSS. The TSS/turbidity relationship will be evaluated and adjusted as necessary based on samples collected in the field. The interim values presented in this table should be used unless values are adjusted from field data. The baseline monitoring program indicated that ambient turbidity in Esquimalt Harbour is relatively low (mean = 3.8 NTU; Golder, 2012c); however, intermittent increases to 400 NTU were observed related to vessel operations and storm events. Turbidity will be evaluated for the Project as induced turbidity above ambient as measured at the time of sampling per Golder (2012c) and SLR (2013).
- (5) Based on *BCMOE Ambient Water Quality Guidelines for Marine Dissolved Oxygen* (BCMOE, 2014).
- (6) The range of pH specified for protection of marine waters is 7.0 – 8.7 unless it can be demonstrated that existing pH levels are the result of natural processes (BCMOE, 2014; CCME, 2014).

**Table 4-5: Water Quality Performance Criteria
Opening of the Temporary Re-Suspension Barrier**

Parameter	Interior Assessment Point ¹ (IAP) (prior to opening TRB)	Receiving Environment After TRB closed ¹¹ Distance from TRB	
		25 m (EAP ₂₅) ³	100 m (ECP) ¹²
Total Suspended Solids ² (mg/L)	To be determined by Contractor. TSS criteria to open TRB to be based on modelling of expected metal and PAH concentrations. Must not be acutely lethal.	68 mg/L	<5 mg/L over NFR when NFR is between 0-25 mg/L ^{2,4} <10 mg/L over NFR when NFR is ≤100 mg/L ^{2,4} Increase of <10% over NFR when NFR is >100 mg/L ^{2,4}
Turbidity ⁶ (NTU)	To be determined by Contractor. Turbidity criteria to open TRB to be based on modelling of expected metal and PAH concentrations. Must not be acutely lethal.	34 NTU	Maximum increase of 8 NTU over NFR ⁵ for a short-term exposure (e.g. 24 hours) and 2 NTU for longer term exposure (e.g. 30 day) when NFR turbidity is <8 NTU Maximum increase of the greater of 8 NTU or 10% over NFR when NFR turbidity is >8 NTU
Dissolved Oxygen ⁷ (mg/L)	≥5 mg/L	≥5 mg/L	≥5 mg/L
pH ^{8,9}	7.0-8.7	7.0-8.7	7.0-8.7
Metals – various (mg/L)	See 'Release Criteria' in Table 4-8 ¹⁰	See 'Release Criteria' in Table 4-8	See 'Compliance Criteria' in Table 4-8
PAHs – various (µg/L)	See 'Release Criteria' in Table 4-9 ¹⁰	See 'Release Criteria' in Table 4-9	See 'Compliance Criteria' in Table 4-9

EAP₂₅ – Exterior Assessment Point, 25 m; ECP – Exterior Compliance Point; IAP – Interior Assessment Point; mg/L – milligrams per litre; µg/L – micrograms per litre; NFR – Near-Field Reference; NTU – nephelometric turbidity units; PAH – Polycyclic Aromatic Hydrocarbon; TRB – Temporary Re-suspension Barrier; TSS – Total Suspended Solids.

Notes:

- Refer to Figure A5 (Appendix 1) for decision-making framework for exceedances of water quality performance criteria for opening the TRB.
- (1) Turbidity, dissolved oxygen and pH assessments to be made using *in situ* methods; *in situ* PAH and metals determination may be used if desired. Laboratory tests will be used to provide feedback after the fact for future TRB openings.
- (2) TSS values may need to be revised in the field to account for other Water Quality Parameters.
- (3) Exceedances at EAP₂₅ to be modelled to 100 m to calculate likelihood of exceeding ECP performance criteria and recommend management actions, if required.
- (4) Based on *Canadian Environmental Quality Guidelines Water Quality for the Protection of Aquatic Life Marine* (CCME, 2014).
- (5) Based on *BCMOE Ambient Water Quality Guidelines for Turbidity, Benthic and Suspended Sediments* (BCMOE, 2014).
- (6) The baseline monitoring program indicated that ambient turbidity in Esquimalt Harbour is relatively low (mean = 3.8 NTU; Golder, 2012c); however, intermittent increases to 400 NTU were observed related to vessel operations and storm events. Turbidity will be evaluated for the Project as induced turbidity above ambient as measured at the time of sampling per Golder (2012c) and SLR (2013). Turbidity is to be used as an *in situ* approximation of TSS. The TSS/turbidity relationship will be verified and adjusted as necessary based on laboratory data. These values should be used until field verification is possible.
- (7) Based on *BCMOE Ambient Water Quality Guidelines For Dissolved Oxygen* (BCMOE, 2014).
- (8) Based on *Canadian Environmental Quality Guidelines Water Quality for the Protection of Aquatic Life Marine* (CCME, 2014).
- (9) The range of pH specified for protection of marine waters is 7.0 – 8.7, unless it can be demonstrated that such pH is a result of natural processes (BCMOE, 2014; CCME, 2014).
- (10) Contractor must demonstrate that IAP water meets criteria established by the Contractor's appropriately qualified person prior to TRB opening.
- (11) TRB is to be closed as soon as possible after vessel passage to minimize the discharge of potential contaminants out of the TRBCA. If TRB is to be opened for extended periods of time sampling will occur while the TRB is open (sampling frequency to be based on length of time the TRB will be open) in addition to after it has been closed.
- (12) ECP TSS and turbidity modelled based on 10x safety factor of acute toxicity levels.

Table 4-6: Water Quality Performance Criteria Dewatering Barge Effluent Outside TRBCA from Dredged Material within TRBCA		
Parameter	Barge Effluent ¹	Dilution Zone Compliance Point (DZCP) 100 m from Point of Discharge
Total Suspended Solids	TSS values as compliance limits for discharge are not commonly specified ²	5 mg/L over NFR when NFR is between 0-25 mg/L ^{3,4} <10 mg/L over NFR when NFR is 26 to ≤100 mg/L ^{3,4} Increase of <10% over NFR when NFR is >100 mg/L ^{3,4}
Turbidity⁵	Turbidity values as compliance limits for discharge are not commonly specified ²	Maximum increase of 2 NTU over NFR when NFR turbidity is <8 NTU Maximum increase of the greater of 8 NTU or 10% over NFR when NFR turbidity is >8 NTU
Dissolved Oxygen	≥5 mg/L ⁶	≥ 5mg/L
pH	7.0-8.7 ^{7,8}	7.0-8.7 ^{7,8}
Metals – various	See 'Release Criteria' in Table 4-8 ⁹	See 'Compliance Criteria' in Table 4-8 ¹⁰
PAHs – various	See 'Release Criteria' in Table 4-9 ⁹	See 'Compliance Criteria' in Table 4-9 ¹⁰

DZCP – Dilution Zone Compliance Point; mg/L – milligrams per litre; µg/L – micrograms per litre; NFR – Near-Field Reference; NTU – nephelometric turbidity units; PAH – Polycyclic Aromatic Hydrocarbon; TRBCA – Temporary Re-suspension Barrier Containment Area; TSS – Total Suspended Solids

Notes:

- Refer to Figure A4 (Appendix 1) for decision-making framework for exceedances of water quality performance criteria for *in situ* monitoring.
- (1) There is to be no discharge without treatment outside of the TRBCA. Passive dewatering may occur within the TRBCA if water performance criteria outside the TRBCA are maintained (Table 4-4).
- (2) Discharge not subject to turbidity or TSS criteria; however, may not influence TSS or turbidity at any nearby monitoring locations (i.e., those within 100 m of discharge).
- (3) Based on *Canadian Environmental Quality Guidelines Water Quality for the Protection of Aquatic Life Marine* (CCME, 2014).
- (4) Based on *BCMOE Ambient Water Quality Guidelines for Turbidity, Benthic and Suspended Sediments* (BCMOE, 2014).
- (5) The baseline monitoring program indicated that ambient turbidity in Esquimalt Harbour is relatively low (mean = 3.8 NTU; Golder, 2012c); however, intermittent increases to 400 NTU were observed related to vessel operations and storm events. Turbidity will be evaluated for the Project as induced turbidity above ambient as measured at the time of sampling per Golder (2012c) and SLR (2013).
- (6) Based on *BCMOE Ambient Water Quality Guidelines For Dissolved Oxygen* (BCMOE, 2014).
- (7) Based on *BCMOE Ambient Water Quality Guidelines For Dissolved pH* (BCMOE, 2014).
- (8) The range of pH specified for protection of marine waters is 7.0 – 8.7, unless it can be demonstrated that such pH is a result of natural processes (BCMOE, 2014; CCME, 2014).
- (9) Effluent exceeding these criteria may not be discharged.
- (10) Exceedances of these criteria will result in stoppage of discharge and management actions to prevent further releases.

**Table 4-7: Water Quality Performance Criteria
Prior to Decommissioning Temporary Re-Suspension Barrier & Sheet Pile Wall
(within TRBCA)¹**

Parameter	Inside TRBCA
Total Suspended Solids (mg/L)	<5 mg/L over NFR when NFR is between 0-25 mg/L ^{1, 2} <10 mg/L over NFR when NFR is ≤100 mg/L ^{1, 2} Increase of <10% over NFR when NFR is >100 mg/L ^{1, 2} TSS exceedances at the CP correlated with Project activities within the TRBCA may result in work stoppage until the problem has been addressed
Turbidity ³ (NTU)	Maximum increase of 8 NTU over NFR ³ for a short-term exposure (e.g. 24 hours) when NFR turbidity is <8 NTU Maximum increase of the greater of 8 NTU or 10% over NFR when NFR turbidity is >8 NTU
Dissolved Oxygen (mg/L)	minimum: 5 mg/L ⁴
pH	7.0-8.7 ^{2, 5}
Metals – various (mg/L)	See 'Compliance Criteria' in Table 4-8 Results to be confirmed analytically
PAHs – various (µg/L)	See 'Compliance Criteria' in Table 4-9 Results to be confirmed analytically

mg/L – milligrams per litre; µg/L – micrograms per litre; NFR – Near-Field Reference; NTU – nephelometric turbidity units; PAH – Polycyclic Aromatic Hydrocarbon; SPW – Sheet Pile Wall; TRB – Temporary Re-suspension Barrier; TRBCA – Temporary Re-suspension Barrier Containment Area

Notes:

- (1) The TRB and/or SPW will not be decommissioned until these criteria are met within the TRBCA and can be demonstrated to the DR and EM.
- (2) Based on *Canadian Environmental Quality Guidelines Water Quality for the Protection of Aquatic Life Marine* (CCME, 2014).
- (3) The baseline monitoring program indicated that ambient turbidity in Esquimalt Harbour is relatively low (mean = 3.8 NTU; Golder, 2012c); however, intermittent increases to 400 NTU were observed related to vessel operations and storm events. Turbidity will be evaluated for the Project as induced turbidity above ambient as measured at the time of sampling per Golder (2012c) and SLR (2013).
- (4) Based on BCME Ambient Water Quality Guidelines for Marine Dissolved Oxygen (BCMOE, 2014).
- (5) The range of pH specified for protection of marine waters is 7.0 – 8.7 unless it can be demonstrated that existing pH levels are the result of natural processes (BCMOE, 2014; CCME, 2014).

**Table 4-8: Water Quality Performance Criteria
Total Metals**

Parameter (as total) ¹	Release Criteria ^{2, 3} (25 m from point of release)	Compliance Criteria ^{4, 5} (100 m from point of release)
Arsenic (µg/L)	125	12.5
Copper (µg/L)	30	3
Zinc (µg/L)	100	10

CP – Compliance Point; EAP₂₅ – Exterior Assessment Point, 25 m; ECP – Exterior Compliance Point; EWP – Early Warning Point; IAP – Interior Assessment Point; µg/L – micrograms per litre; TRB – Temporary Re-suspension Barrier.

Notes:

- (1) The selection of this subset of metals is discussed in Golder (2012c).
- (2) The performance criteria for release are based on 10x ambient water quality guidelines.
- (3) At EWP or EAP₂₅ based on if the TRB is opened or closed at time of measurement.
- (4) Compliance performance criteria are based on ambient water quality guidelines (BCMOE, 2014).
- (5) At CP or ECP based on if the TRB is opened or closed at time of measurement.

**Table 4-9: Water Quality Performance Criteria
Total Polycyclic Aromatic Hydrocarbons**

PAH Congeners ¹	Release Criteria ^{2, 3} (25 m from point of release)	Compliance Criteria ^{4, 5} (100 m from point of release)
Acenaphthene (µg/L)	510	51
Anthracene (µg/L)	5	0.5
Benzo(a)anthracene (µg/L)	1.8	0.18
Benzo(b)fluoranthene (µg/L)	8.6	0.86
Benzo(a)pyrene (µg/L)	5.6	0.56
Benzo(g,h,i)perylene (µg/L)	1	0.1
Chrysene (µg/L)	8.6	0.86
2-Methylnaphthalene (µg/L)	58	5.8
Naphthalene (µg/L)	100	10
Phenanthrene (µg/L)	40	4
Pyrene (µg/L)	12.8	1.28

CP – Compliance Point; EAP₂₅ – Exterior Assessment Point, 25 m; ECP – Exterior Compliance Point; EWP – Early Warning Point; IAP – Interior Assessment Point; µg/L – micrograms per litre; TRB – Temporary Re-suspension Barrier.

Notes:

- (1) The selection of this subset of PAHs is discussed in Golder (2012c).
- (2) The values are based on a combination of literature review and quantitative structure-activity relationship (QSAR) as described in Golder (2012b).
- (3) At EWP or EAP₂₅ based on if the TRB is opened or closed at time of measurement.
- (4) Compliance Criteria are based on the Release Criteria with a 10-fold safety factor applied.
- (5) At CP or ECP based on if the TRB is opened or closed at time of measurement.

4.8 Management Actions

Management actions are additional mitigation measures agreed upon by the EM, DR and Contractor which may allow work to proceed following initial exceedances of performance criteria. Management actions may include checking the TRB functionality, slowing the dredging cycle, repairing the TRB or SPW, changing the dredge bucket or other mitigation techniques deemed appropriate. Performance criteria measured at sites proximal to the TRB (i.e., 25 m) are designed to provide early detection of potential issues to prevent any work stoppages from occurring when performance criteria are exceeded at the 100 m monitoring locations. Any agreed upon Management Actions will be documented and submitted to the DR.

4.9 TSS/Turbidity Relationship

The TSS/turbidity relationship, upon which the decision framework for management actions during Phase 2 activities is based, was generated using site specific TSS/turbidity sample data. This relationship will be further examined during the first few weeks of Phase 2 work.

Throughout the program samples will be analyzed in the laboratory for metals, PAHs and TSS and results paired with *in situ* field measurements. Results will be used to generate correlations between multiple parameters and assess the relationships as modelled.

The turbidity and TSS values used in the decision framework (Section 4.6) and Tables 4-4 through 4-7 may need to be adjusted if the results obtained during the work differ significantly from the model predicted analyses (Appendix 4; Anchor, 2014). A modified set of criteria for opening the TRB may be required if Phase 2 analytical results do not support the modelled data.

5.0 QA/QC & DATA MANAGEMENT

5.1 Quality Assurance / Quality Control (QA/QC)

Quality assurance (QA) is the process or set of processes used to measure and assure the quality of a product or service while quality control (QC) is the process of meeting products and services to consumer expectations. Field sampling and QA/QC procedures are summarized below and described in detail in the Phase 2 EMIP.

5.1.1 Field

The following general guidelines will apply to field sampling activities:

- sampling equipment will be prepared as detailed in the EMIP between sampling periods and stations where applicable (i.e., sampling for analysis of contaminants);
- samples will be collected in such a way as to minimize the introduction of contamination to the sample and loss of sample prior to analysis;
- sample media will be collected in pre-treated laboratory supplied containers and preserved as necessary with supplies and instructions for each analysis provided by the analytical laboratory;
- all samples will be placed in darkness, kept cold (4°C) and handled according to established chain-of-custody, transfer and storage protocols. Samples will be analyzed upon receipt at the lab, according to EM instructions;
- 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, storage conditions, sample continuity, shipping and sample arrival/integrity;
- field duplicates, equipment rinsates, travel blanks and spiked samples will constitute 10% to 15% of samples submitted; and,
- relative percent difference (RPD) will be calculated for field duplicates to provide a measure of method precision:

$$RPD = \frac{|Sample - Duplicate|}{((Sample + Duplicate)/2)} * 100\%$$

In accordance with the *BC Field Sampling Manual* (BCMWLAP, 2003), an RPD value of $\pm 20\%$ for values ≥ 5 times the method detection limit (MDL) will be used to identify notable differences between original and duplicate samples. RPDs are not calculated for values < 5 times the MDL due to increased variability near analytical detection limits.

Paired sampling of TSS/turbidity will be undertaken to validate the established TSS/turbidity relationship throughout the Project (Section 4.9).

5.1.2 Laboratory

Chemical analyses will be conducted in accordance with well-established, published laboratory protocols by a Canadian Association for Laboratory Accreditation (CALA) accredited laboratory. QA/QC procedures would include method blanks, laboratory samples, analysis of commercially prepared standards, field blanks (equipment rinsates) and travel blanks to check for sources of potential contamination, sample handling/storage issues and to assess variability. Approximately 10%-15% of samples submitted to the lab will be duplicated and/or replicated. Rigorous QA/QC procedures will be applied to avoid contamination during handling, storage and shipping of samples and to ensure samples are properly identified.

Field duplicates will be submitted blind to the laboratory to assess laboratory and subsample variability. Laboratory duplicates (minimum of 10% of samples collected) would also be analyzed in accordance with laboratory QA/QC protocols.

Prior to entry into the data management system (Section 3.6), laboratory data will be reviewed to verify that results are reliable and analyses were conducted and reported according to established protocols. For example, this review may include checking the following:

- each sample has a unique sample reference indicating date, time and location the sample was collected;
- sample control numbers from the chain of custody sheets and laboratory reports match;
- results are provided for samples submitted and analyses requested;
- method blanks are below method detection limits;
- results of duplicate samples and certified reference materials (CRMs) are within an acceptable range;
- hold times are not exceeded;
- no transcription errors are observed;
- preservatives are added;
- samples are stored, transferred and tested at appropriate temperature; and,
- appropriate units of measurement are reported.

5.2 Data Management

An electronic data management system will be required given the large amount of data that will be collected during the remediation project and the need for timely reporting of analytical results and statistical data following laboratory analyses and processing of the field data. The EM in consultation with the DR for PWGSC will decide best how to capture, store, report and make this data available.

Data (laboratory chemistry and field measurements) will be entered into the data management system following confirmation that laboratory and field data quality objectives (DQOs) were met. A number of different platforms are available for data management. The specific platform for data management will be selected by the EM in consultation with PWGSC and considerate of the system and protocols used in Phase 1.

6.0 REPORTING

6.1 General

Reporting will involve submission of daily and weekly environmental monitoring reports of a quality suitable for submission to regulatory agencies, First Nations and public stakeholders, submitted to the DR for distribution as appropriate. Monitoring reports are to be prepared by the EM and include, at a minimum, the following information requirements (templates for Environmental Monitoring reports are provided in Appendix 5 of the EMP; G3, 2014a):

1. a description of construction activities undertaken during the reporting period;
2. a description of environmental issues and corresponding mitigation measures implemented;
3. tracking of emerging and outstanding environmental issues;
4. results of monitoring and testing (e.g., water quality data, noise data, observations of aquatic mammals);
5. compliance assessments of the TRB;
6. compliance assessments and ongoing data summary of TRB opening activities and procedures; and,
7. photos documenting construction activities, environmental issues, corresponding mitigation measures and any adopted lessons learned.

Laboratory data will be reported in the next applicable monitoring report following receipt of the Certificate of Analysis from the analytical laboratory.

Detailed field notes will be collected and maintained in project specific notebooks and field forms. Notes will include site locations, date and time of sampling, names of field crews, descriptions of habitat parameters, (i.e., biota, substrates, water), ambient weather conditions and any notable observations (e.g., turbidity generating activities, etc.). Sampling methods and QA/QC procedures applied (i.e., field duplicates and/or travel blanks) would be recorded, in duplicate, by all field staff.

Field and laboratory data will be reported in tabular format. Raw data would be summarized with mean, maximum and minimum values with range, standard deviation and 95% confidence intervals reported as measures of variance.

Data will be graphed, where appropriate, and applicable test statistics tabularized for comparison within and between stations and to assess if the data is normalized. Reports would include a summary of adherence to data quality objectives, standard operating procedures and identification of any QA/QC issues (i.e., method detection limits, hold times, duplicate analysis, etc.).

The EM will also prepare an Environmental Completion Report one month following completion of the work. The report prepared following completion of Phase 2 work will provide an overall summary of the Project including, representative site photographs, a summary of monitoring data collected, a summary of construction activities, environmental management and issues during construction, how these issues were managed, mitigation measures and additive measures in response to lessons learned and recommendations.

6.2 Exceedances

The Environmental Monitor (EM) undertaking the monitoring as outlined in this WQMP will report exceedances and other non-compliance events to the DR as soon as possible. The DR may request corrective actions by the Contractor to address issue(s) as deemed necessary. Based on the severity of the event, the DR may be required to report exceedances to regulatory agencies (e.g., DFO) or other parties, based on regulatory obligations.

7.0 REFERENCES

- Anchor QEA L.L.C. (Anchor). 2009. *Esquimalt Graving Dock Waterlot Preliminary Remedial Action Plan/Risk Management Plan Update*. Prepared for Public Works and Government Services Canada. December 10, 2009.
- Anchor QEA L.L.C. (Anchor). 2011. *Dredging water quality evaluation, Esquimalt Graving Dock Waterlot Remediation Project*. Memorandum prepared for Public Works and Government Services Canada. February 25, 2011.
- Anchor QEA L.L.C. (Anchor). 2014. Water Quality Modelling Results.
- British Columbia Marine and Pile Driving Contractors Association. 2003. Best Management Practices for Pile Driving and Related Operations. [online] Available at: https://buyandsell.gc.ca/cds/public/2013/07/11/8d33571afc47b088668fe82260609370/bc_marine_pilingcontractorspile_driving_bmp.pdf.
- British Columbia Ministry of Environment (BCMOE). 1996 (amended 2014). *Environmental Management Act Contaminated Sites Regulation*. B.C. Reg. 375/96. [online] Available at: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_00.
- British Columbia Ministry of Environment (BCMOE). 2014. *Water Quality Guidelines (Criteria) Reports Approved Water Quality Guidelines*. [online] Available at: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html.
- British Columbia Ministry of Water, Land and Air Protection (BCMWLAP). 2003. *British Columbia field sampling manual – for continuous monitoring and the collection of air, air–emission, water, wastewater, soil, sediment, and biological samples*. Queens Printer, Victoria, British Columbia. 294 pp. + Appendices.
- Canadian Council of Ministers of the Environment (CCME). 1999 (updated to 2014). *Canadian Environmental Quality Guidelines (for water)*. Canadian Council of Ministers of the Environment, Winnipeg. [online] Available at: <http://ceqg-rcqe.ccme.ca/>.
- Environment Canada (EC). 1994. *Polycyclic aromatic hydrocarbons. Canadian Environmental Protection Act. Priority Substances List Assessment Report*. Environment Canada. Health Canada. Ottawa, Ontario. 61pp. + Appendices.
- G3 Consulting Ltd. (G3). 2014a. *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Environmental Management Plan*. Prepared for Public Works and Government Services Canada. 73 pp. + Appendices.
- G3 Consulting Ltd. (G3). 2014b. *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Environmental Effects Evaluation*. Prepared for Public Works and Government Services Canada.
- Golder Associates Ltd. (Golder). 2006a. *Interim Data Report Supplemental Field Investigation*. Esquimalt Graving Dock Waterlot. Prepared for Public Works and Government Services Canada.
- Golder Associates Ltd. (Golder). 2006b. *Detailed Quantitative Ecological and Human Health Risk Assessment and Updated Risk Management Plan, PWGSC Graving Dock Waterlot, Esquimalt BC*. Prepared for Public Works and Government Services Canada.
- Golder Associates Ltd. (Golder). 2011. *Baseline Turbidity and Current Monitoring Draft Report. EGD Waterlot Sediment Remediation Project*. Prepared for Public Works and Government Services Canada.

- Golder Associates Ltd. (Golder). 2012a. *Esquimalt Graving Dock Waterlot Remediation Project: Environmental Management Plan*. Prepared for Public Works and Government Services Canada. December 6, 2012. 50 pp. + Appendices.
- Golder Associates Ltd. (Golder). 2012b. *Esquimalt Graving Dock Waterlot Remediation Project: assessment of predicted quality of discharge water during barge dewatering*. Letter submitted to Public Works and Government Services Canada. 14 pp. + Appendices. March 21, 2012.
- Golder Associates Ltd. (Golder). 2012c. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Final Water Quality Monitoring Plan*. Prepared for Public Works and Government Services Canada. 39 pp. + Appendices. December 6, 2012.
- Golder Associates Ltd. (Golder). 2012d. *Esquimalt Graving Dock Waterlot Sediment Remediation Project CEAA Screening Environmental Assessment*. Prepared for Public Works and Government Services Canada. 122 pp. + Appendices. August 24, 2012.
- Government of Canada. 2014. *Esquimalt Harbour*. Available at: <http://www.navy-marine.forces.gc.ca/en/about/structure-marpac-poesb-home.page>.
- Hayes, D.F. and C.-H. Je. 2000. *DREDGE Module user's guide (draft)*. Department of Civil and Environmental Engineering, University of Utah. 27 pp.
- Health Canada. 2005. *Dioxins and Furans*. [online] Available at: <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/enviro/dioxin-eng.php>.
- Minister of Justice. 1985 (amended 2013). *Fisheries Act*. [online] Available at: <http://laws-lois.justice.gc.ca/PDF/F-14.pdf>.
- Minister of Justice. 1998 (amended 2014). *Canada Marine Act*. [online]. Available at: <http://laws-lois.justice.gc.ca/PDF/C-6.7.pdf>.
- Minister of Justice. 2005. *Canada Marine Act Natural and Man-made Harbour navigation and Use Regulations*. SOR2005-73. [online] Available at: <http://laws-lois.justice.gc.ca/PDF/SOR-2005-73.pdf>.
- National Oceanic and Atmospheric Administration (NOAA). 2013. *Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals*. December 23, 2013. [online] Available at: http://www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf.
- Poppe, W. L. 1988. Dissolved oxygen in streams and reservoirs. *Journal (Water Pollution Control Federation)*. 61(6): 959-961.
- Public Works and Government Services Canada (PWGSC). 2010. *Esquimalt Graving Dock Environmental Best Management Practices*. Version 04. Prepared by Public Works and Government Services Canada. 47 pp. October 6, 2010.
- Public Works and Government Services Canada (PWGSC). 2013. *EGD Waterlot Remediation Project R.018400.001 Project Roles and Responsibilities*.
- Public Works and Government Services Canada (PWGSC). 2014a. *Esquimalt Graving Dock*. [online] Available at: <http://www.tpsgc-pwgsc.gc.ca/biens-property/cse-egd/index-eng.html>.
- Public Works and Government Services Canada (PWGSC). 2014b. *Esquimalt Graving Dock Waterlot Phase 2 South Jetty Under-Pier Sediment Remediation Project Demo-Remediation Specification*. Prepared by Anchor QEA. December 2014.
- SLR Consulting [Canada] Inc. (SLR). 2009. 2008/2009 *Supplemental Site Investigation, Esquimalt Harbour Sediment Management*. Prepared for Public Works and Government Services Canada and Department of National Defense. February 18, 2009.

- SLR Consulting [Canada] Inc. (SLR). 2013. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Phase 1B Environmental Monitoring Implementation Plan*. Prepared for Public Works and Government Services Canada. 79 pp. + Appendices.
- SLR Consulting [Canada] Inc. (SLR). 2014. *Esquimalt Graving Dock Waterlot Sediment Remediation Project Phase 1B Environmental Monitoring Completion Report*. Prepared for Public Works and Government Services Canada. July 2014. 62 pp. + Appendices.
- United States Environmental Protection Agency (USEPA). 2000. *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras*. Office of Science and Technology. Washington, DC. 49 pp. + Appendices.
- United States Environmental Protection Agency (USEPA). 2011. *Dioxins and Furans*. Persistent Bioaccumulative and Toxic (PBT) Chemical Program. [online]. Available at: <http://www.epa.gov/pbt/pubs/dioxins.htm>.
- Vagle, S. 2003. *On the Impact of Underwater Pile Driving Noise on Marine Life*. Fisheries and Oceans Canada. Institute of Ocean Sciences. 41 pp.

APPENDICES

Appendix 1: Figures

Appendix 2: Tables

Appendix 3: Phase 1 Open-water Dredging & Barge Dewatering Decision Framework (adapted from Golder, 2012c)

Appendix 4: Water Quality Modelling Results (Anchor, 2014)

Appendix 5: Phase 1 Barge Dewatering Study (Golder, 2012b)

Appendix 1

Figures

- Figure A1:** Esquimalt Graving Dock Waterlot Sediment Remediation Project Area Map
- Figure A2:** Site Boundaries and Adjacent Properties
- Figure A3:** Elements of the Water Quality Monitoring Plan for the Esquimalt Graving Dock Waterlot Remediation Project
- Figure A4:** Decision Framework for Monitoring during Activities Enclosed within the TRBCA
- Figure A5:** Decision Framework for TRB Opening Monitoring
- Figure A6:** Conceptual Layout of Monitoring Locations for Activity Inside the Temporary Re-Suspension Barrier Containment Area
- Figure A7:** Conceptual Layout of Monitoring Locations for Activity Inside the Temporary Re-Suspension Barrier Containment Area when Additional Activities Occurring Outside
- Figure A8:** Conceptual Layout of Monitoring Locations for Opening the Temporary Re-Suspension Barrier Containment Area (TRBCA)
- Figure A9:** Conceptual Layout of Dewatering Treatment Barge Effluent Sampling
- Figure A10:** Marine Mammal Safety Zones



Figure A1: Esquimalt Graving Dock Waterlot Sediment Remediation Project Area Map
 Date: June 20, 2014
 Coordinate System: NAD83 UTM Zone 10
 Adapted from: Golder, 2012a; Reference Department of natural Resources.
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Adapted From:

**PROJECT PUBLIC WORKS GOVERNMENT SERVICES CANADA
 EGD WATERLOT SEDIMENT REMEDIATION PROJECT
 ENVIRONMENTAL ASSESSMENT
 ESQUIMALT, B.C.**

PROJECT	10-1475-0002	FILE	No:1014750002000-10-01
DESIGN	VC	24 FEB 11	SCALE AS SHOWN REV. 0
CADD	AW	9 MAR 11	
CHECK	VC	23 AUG 12	
REVIEW	TM	23 AUG 12	

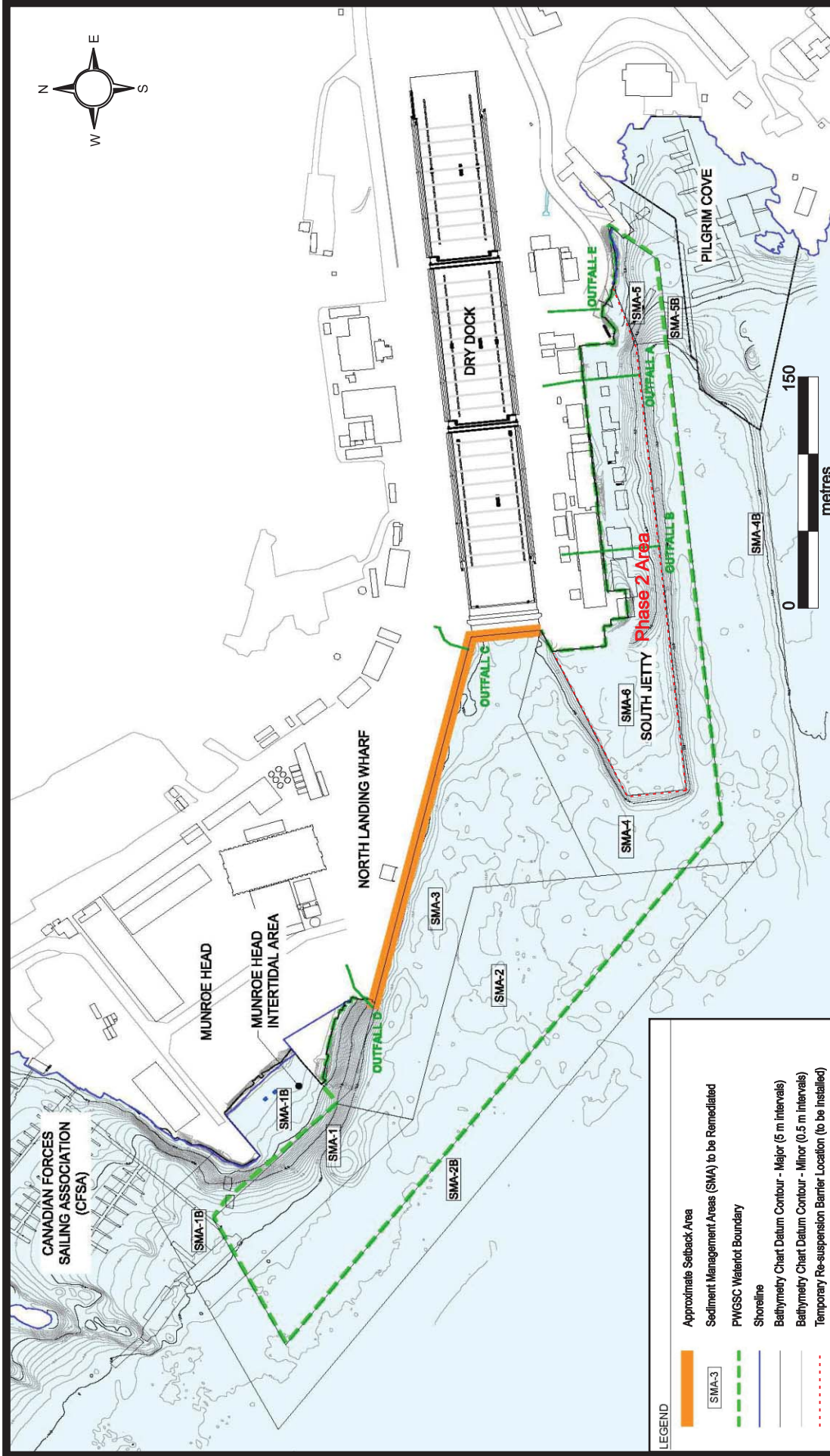


Figure A2: Site Boundaries and Adjacent Properties

Bathymetry contours supplied by CRA Surveys 2010, shown in chart datum.

Coordinate System: NAD83 UTM Zone 10

Adapted from AQ/KCB/Golder/PWGSC, South Jetty Wharf Development Project R.026729.002/R.018400.002

Plan Sheets C3, C9 and C21.

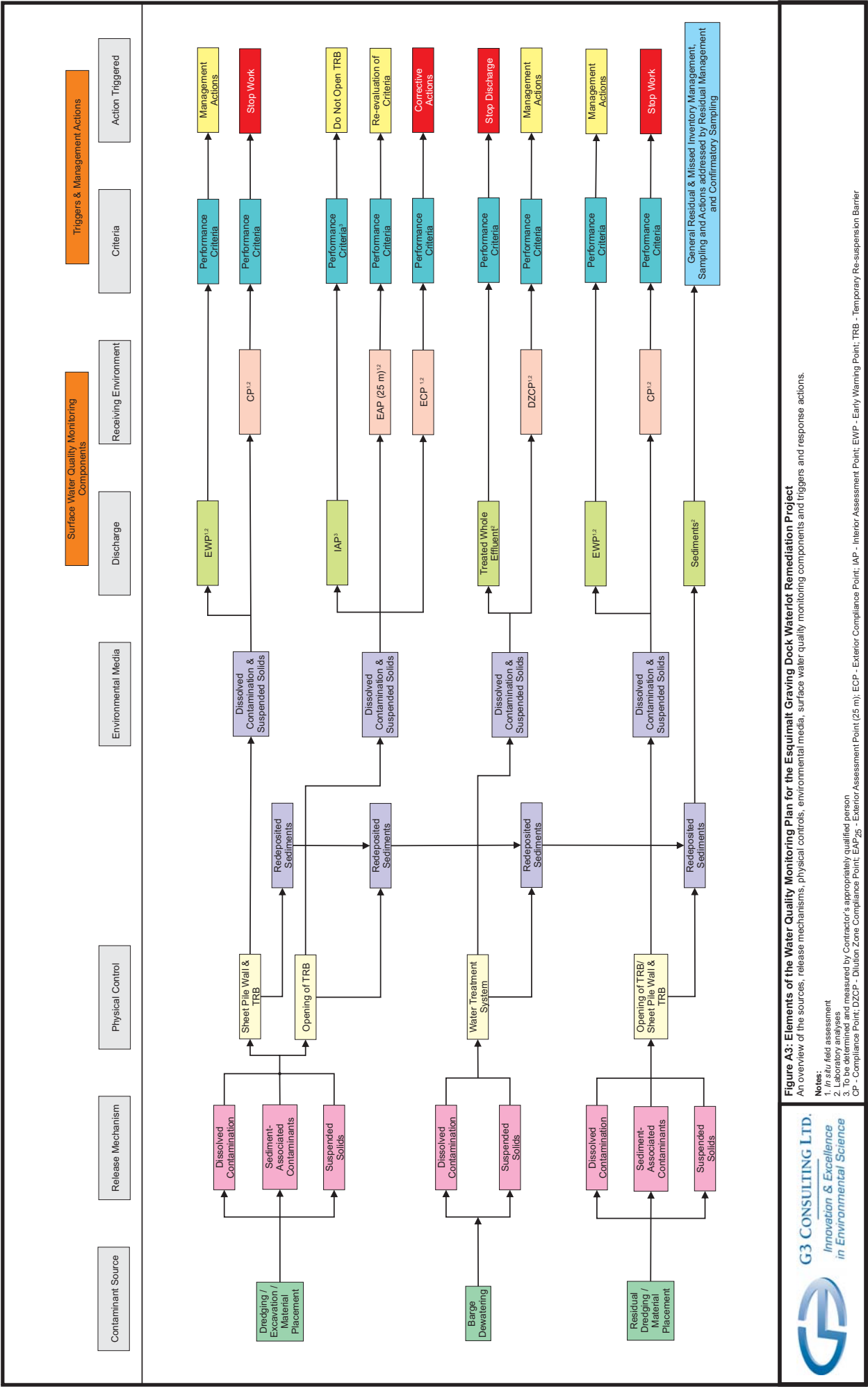
Basemap adapted from Golder/PWGSC (PAC-#269014-v1-PWGSC-EGD-FINAL-BASE_MAP-ACAD-10-11-GOLDER-20110726).

Adapted from:

**SITE BOUNDARIES AND
ADJACENT PROPERTIES**



FIGURE 2



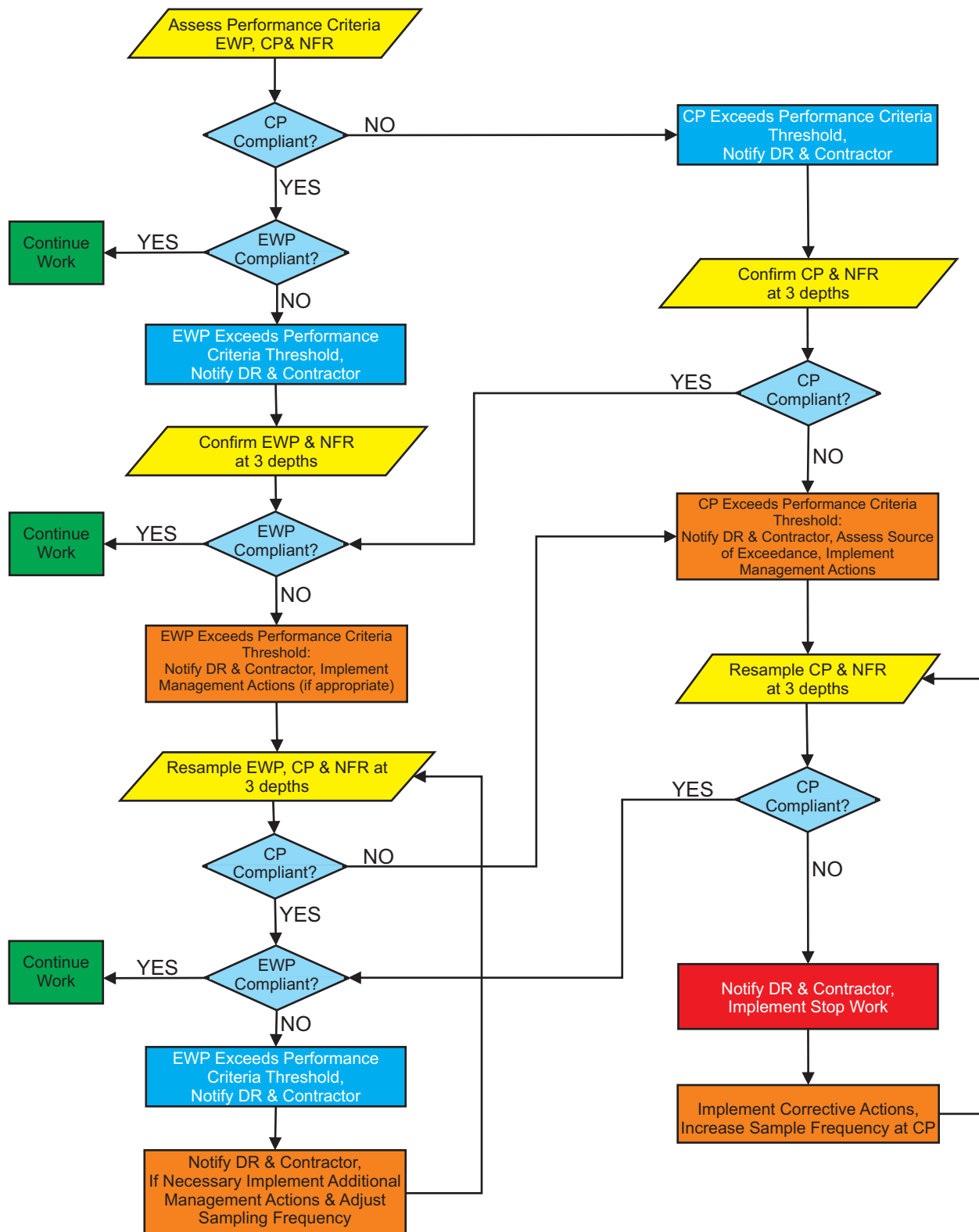


Figure A4: Decision Framework for Monitoring during Activities Enclosed within the TRBCA

The steps and measures to be followed for normal *in situ* water quality monitoring outside of Temporary Re-suspension Barrier Containment Area (TRBCA) during Project activities (e.g., dredging, placement on engineered capping material) within TRBCA.

CP - Compliance Point; DR - Departmental Representative; EWP - Early Warning Point; NFR - Near-Field Reference



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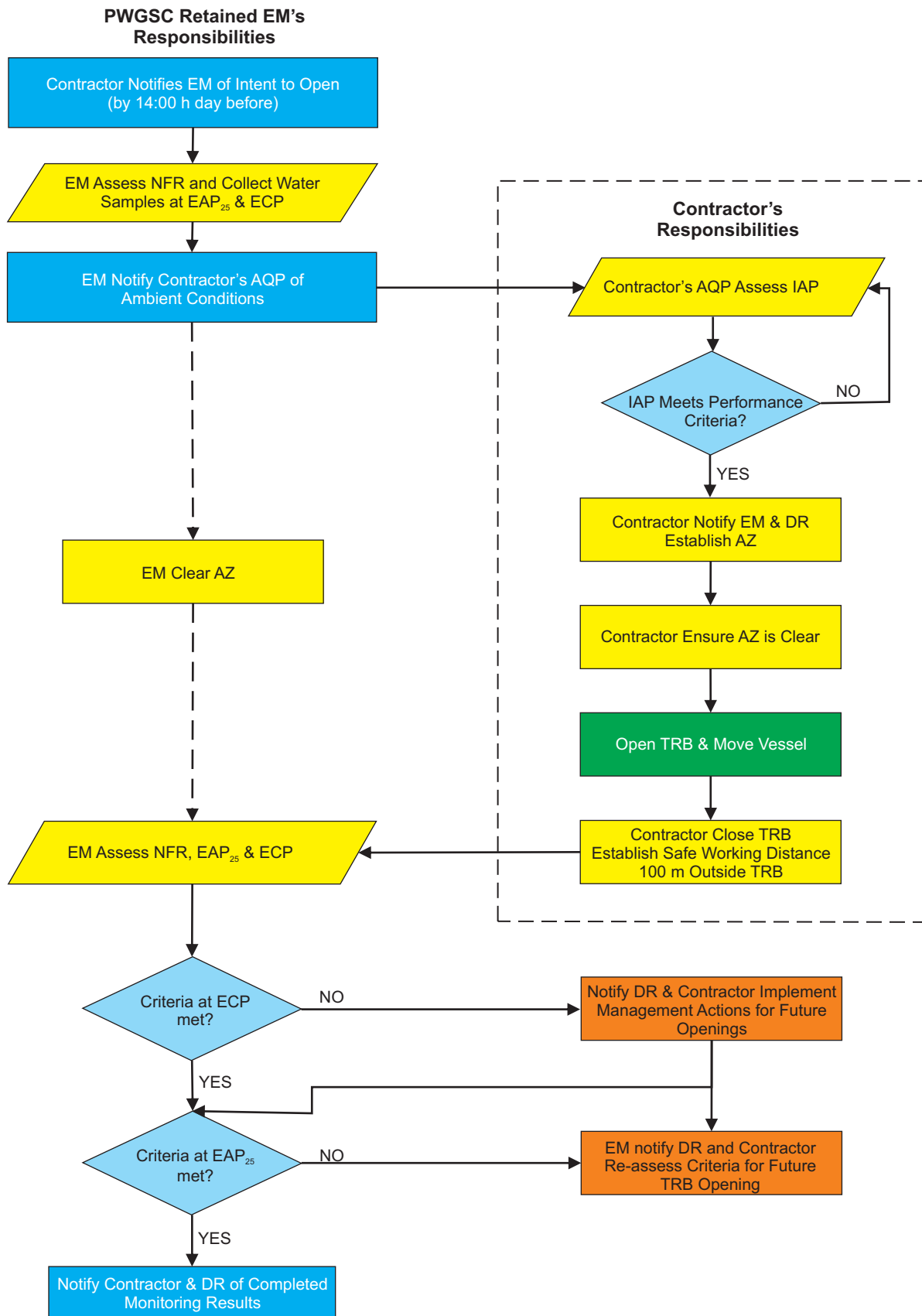


Figure A5: Decision Framework for TRB Opening Monitoring

The steps and measures to be followed to monitor water quality during the opening of the Temporary Re-Suspension Barrier (TRB).

AQP - Contractor's Appropriately Qualified Person; AZ - Activity Zone; DR - Department Representative; EAP₂₅ - Exterior Assessment Point (25 m); ECP - Exterior Compliance Point; EM - Environmental Monitor; IAP - Interior Assessment Point; NFR - Near-Field Reference



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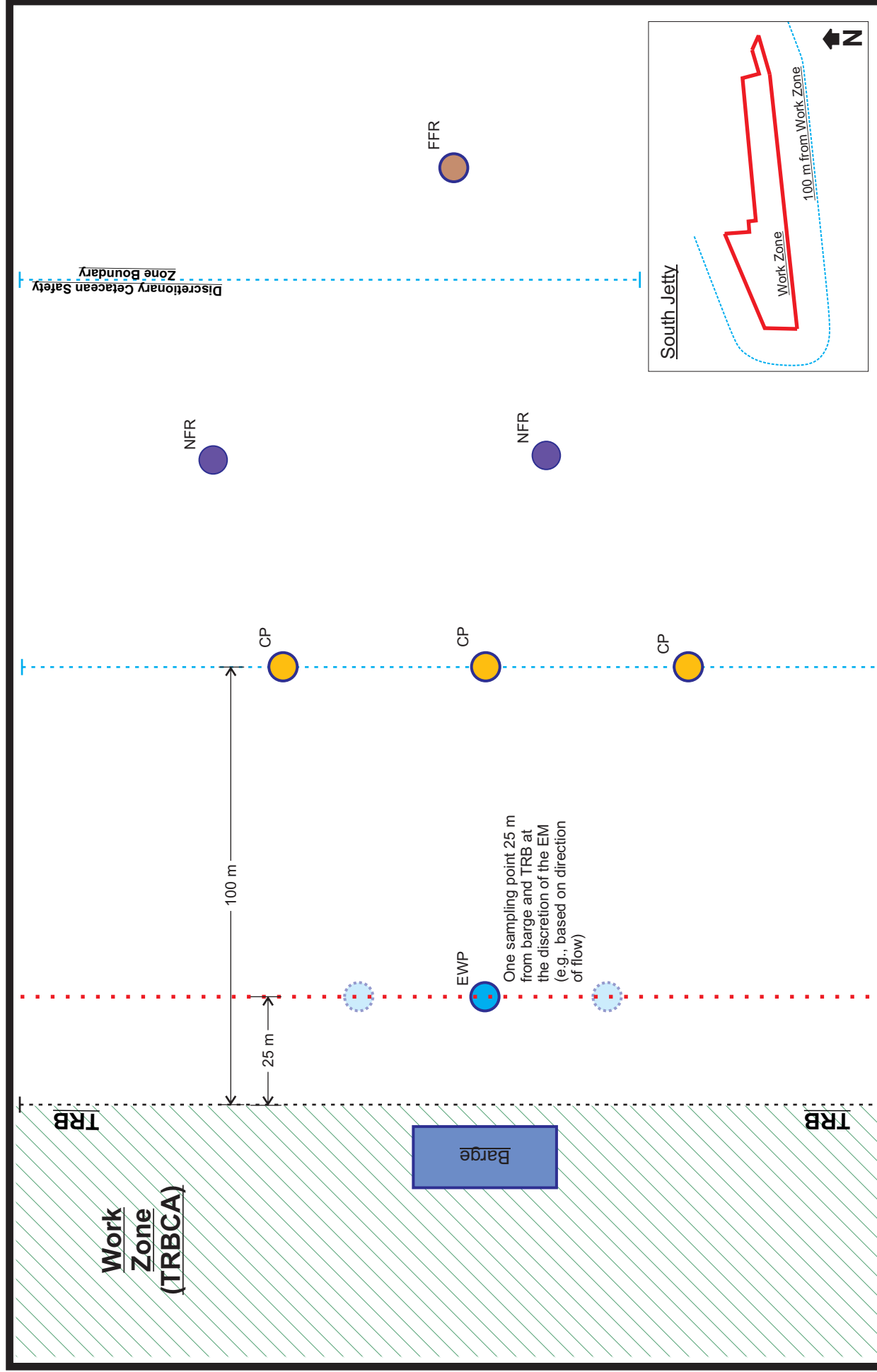


Figure A6: Conceptual Layout of Monitoring Locations for Activity Inside the Temporary Re-Suspension Barrier
Containment Area (TRBCA)
Inset: 100 m monitoring perimeter surrounding the South Jetty Work Zone.
CP - Compliance Point; EWP - Early Warning Point (Potential Location); FFR - Far-Field Reference Point (background, Esquimalt Harbour); NFR - Near-Field Reference Point (ambient, Constance Cove); TRB - Temporary Re-Suspension Barrier; TRBCA - Temporary Re-Suspension Barrier Containment Area

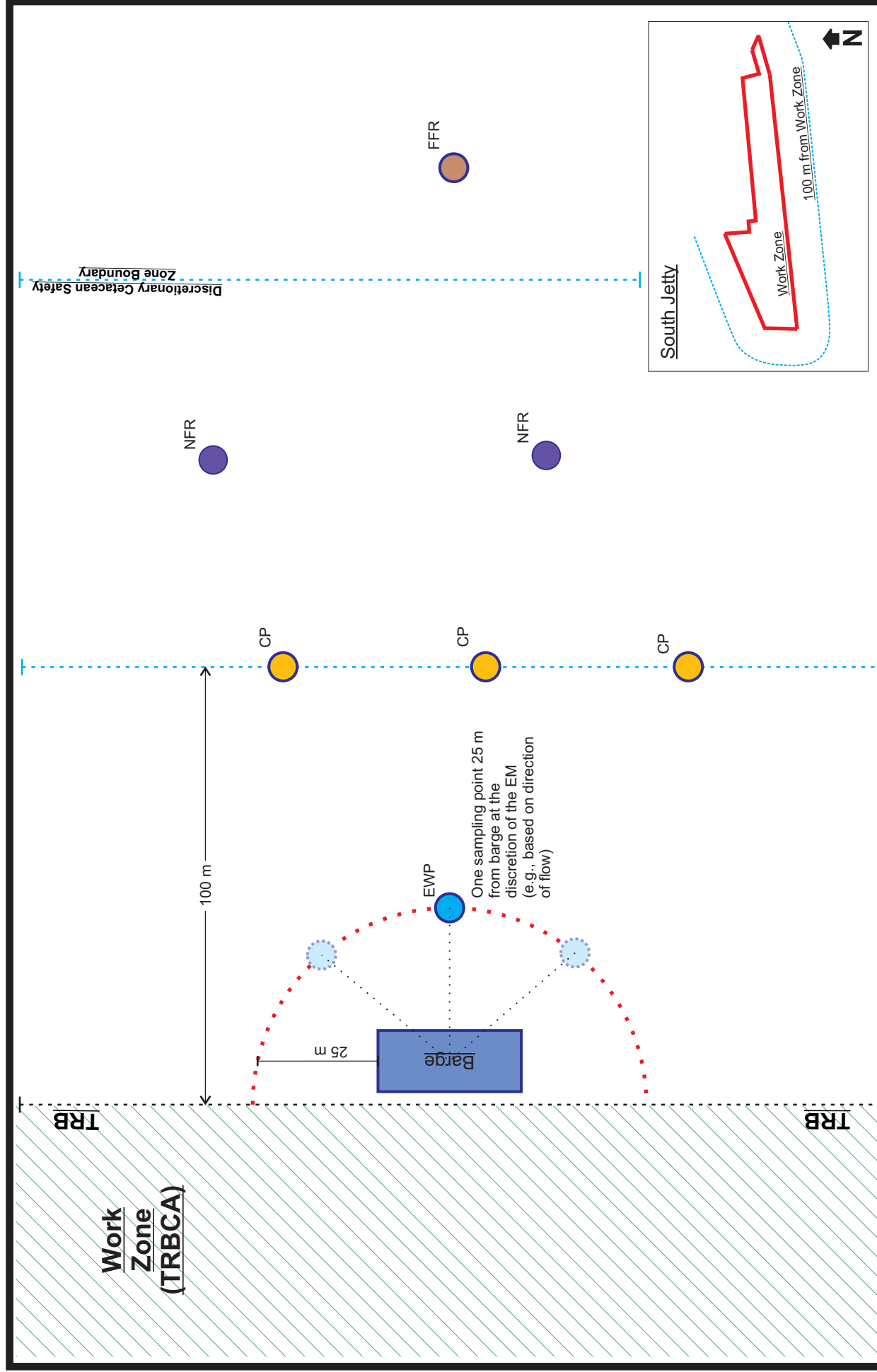


Figure A7: Conceptual Layout of Monitoring Locations for Activity Inside the Temporary Re-Suspension Barrier Containment Area (TRBCA) When Additional Activities Occurring Outside

Inset: 100 m monitoring perimeter surrounding the South Jetty Work Zone.

CP - Compliance Point; EWP - Early Warning Point (Potential Location); FFR - Far-Field Reference Point (background, Esquimalt Harbour); NFR - Near-Field Reference Point (ambient, Constance Cove); TRB - Temporary Re-Suspension Barrier; TRBCA - Temporary Re-Suspension Barrier Containment Area

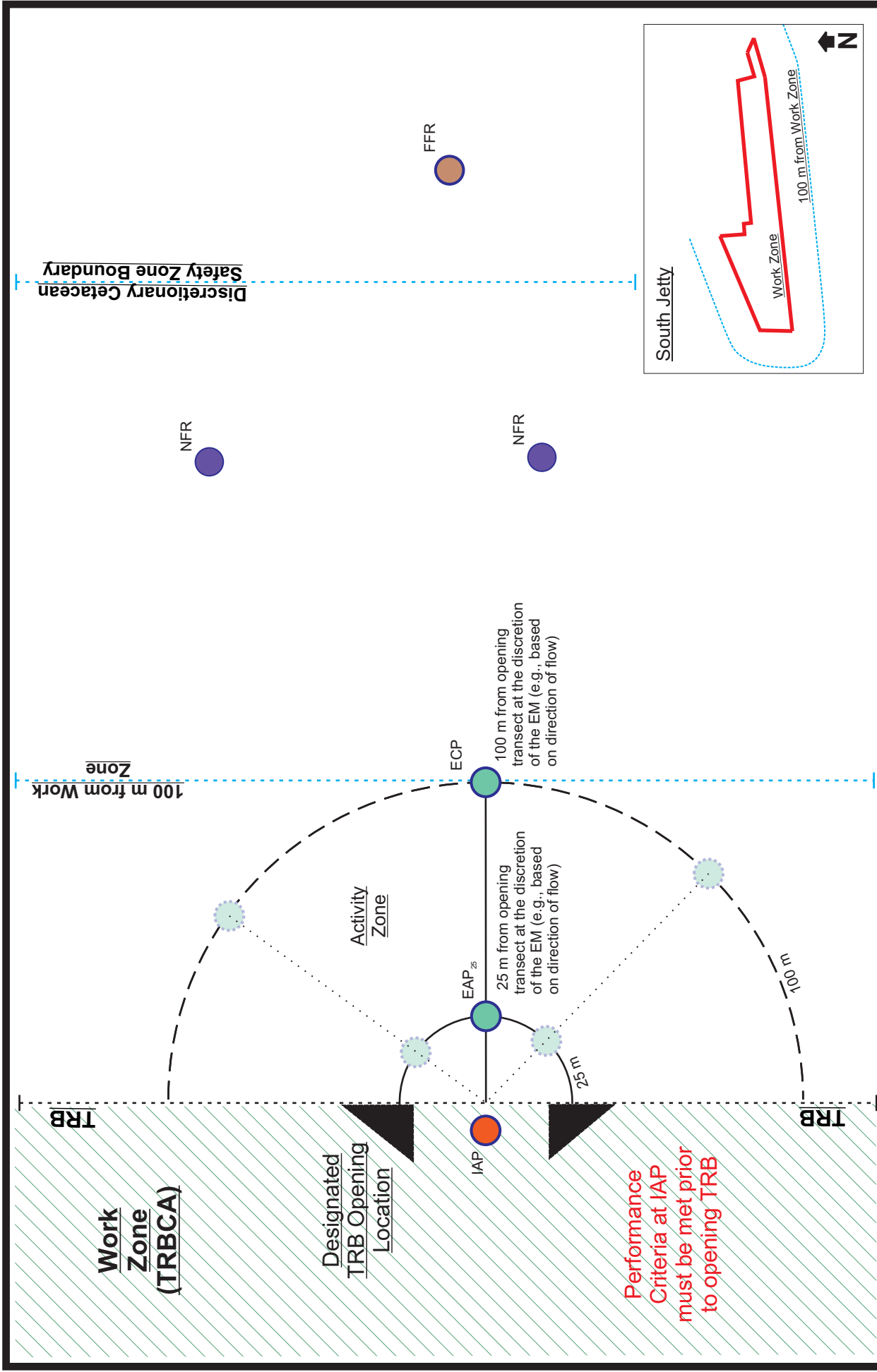


Figure A8: Conceptual Layout of Monitoring Locations for Opening the Temporary Re-Suspension Barrier

Containment Area (TRBCA)

Inset: 100 m monitoring perimeter surrounding the South Jetty Work Zone.

EAP - Exterior Assessment Point; ECP - Exterior Compliance Point; FFR - Far-Field Reference Point (background, Esquimalt Harbour); IAP - Interior Assessment Point; NFR - Near-Field Reference Point (ambient, Constance Cove); TRB - Temporary Re-Suspension Barrier

EAP₂₅ sample collected 25 m from opening and assessed for compliance with water quality guidelines; ECP sample collected 100 m from opening and assessed for compliance with water quality guidelines.

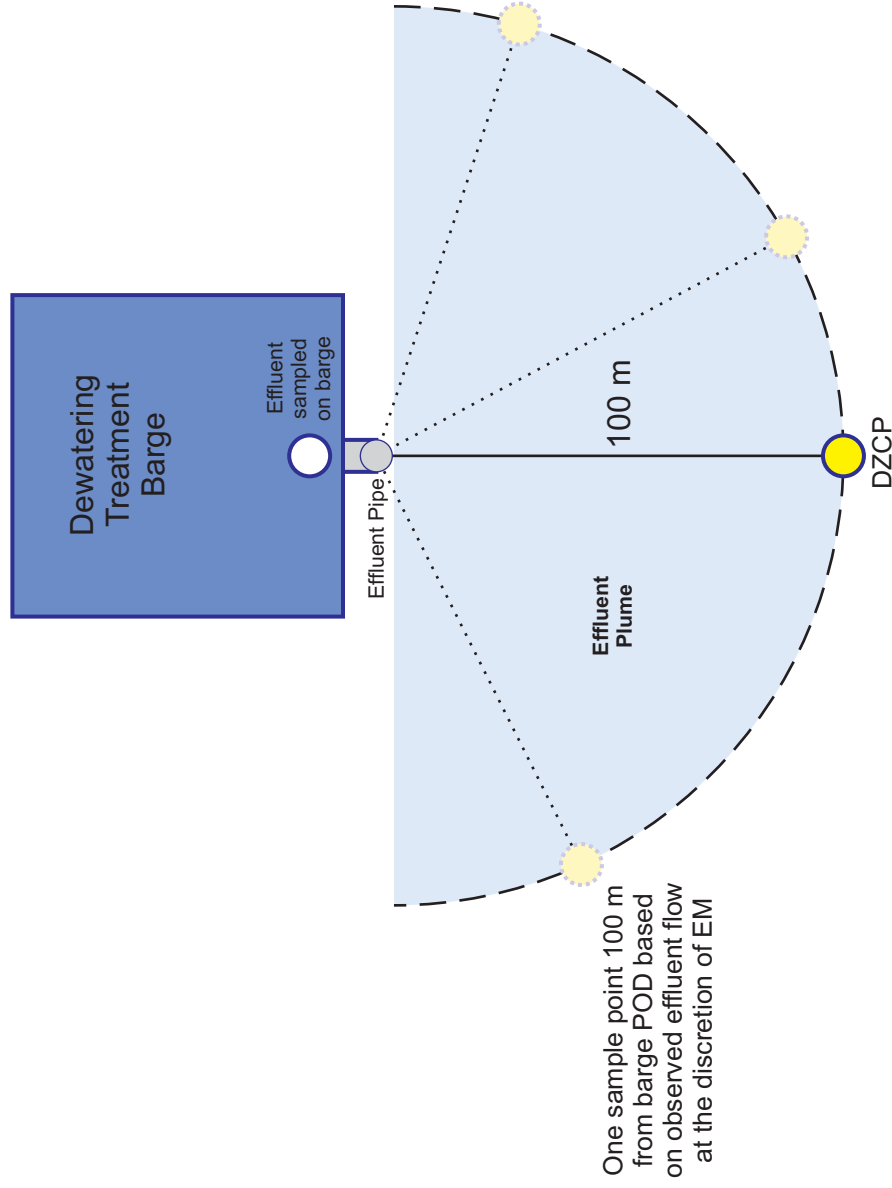
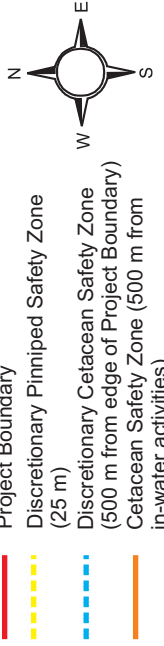
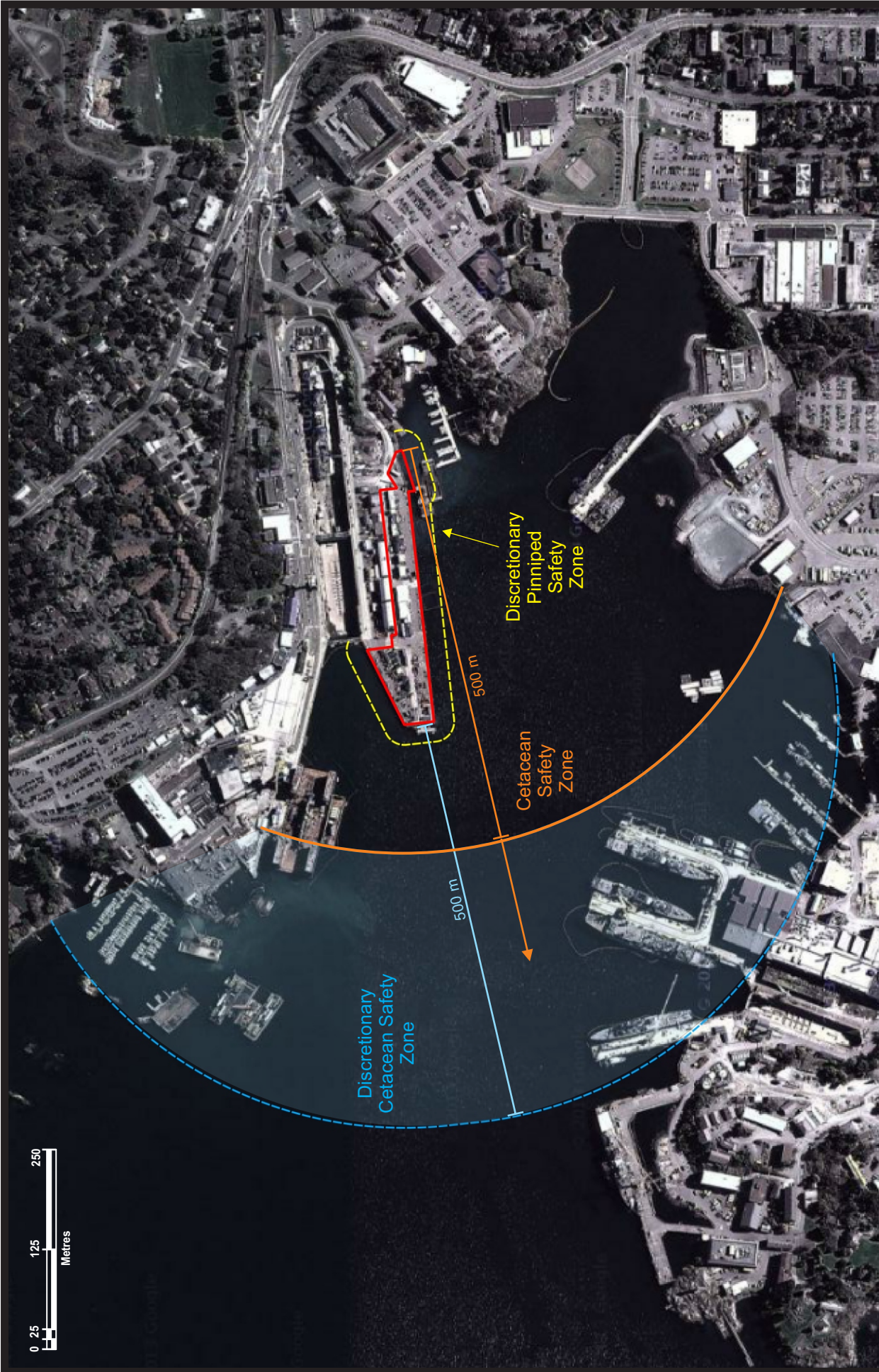


Figure A9: Conceptual Layout of Dewatering Treatment Barge Effluent Sampling

DZCP - Dilution Zone Compliance Point; POD - Point of Discharge.



- Project Boundary**
- Discretionary Pinniped Safety Zone (25 m)
 - Discretionary Cetacean Safety Zone (500 m from edge of Project Boundary)
 - Cetacean Safety Zone (500 m from in-water activities)

Figure A10: Marine Mammal Safety Zones
 Project Boundary Source: PWGSC Real Property Services
 South Jetty Wharf Development Dredging Work Sequence Plan
 Project R.026729.002/R.018400.002 Sheet C9.
 Imagery Source: DigitalGlobe, Google, Parks Canada 2014.
 Date: March 9, 2015.
 Coordinate System: WGS84 Web Mercator.



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Appendix 2

Tables

Table B1: Summary Statistics for Turbidity Data Collected by Automated Data Loggers in Esquimalt Harbour – October/November 2010 (adapted from Golder, 2012c)

Table B2: Vertical Profile Data (Collected Manually) for Turbidity, Temperature, Dissolved Oxygen, Chlorophyll a, and pH – October/November 2010 (adapted from Golder, 2012c)

Table B1: Summary Statistics for Turbidity Data Collected by Automated Data Loggers in Esquimalt Harbour – October/November 2010 (adapted from Golder, 2012c)

Parameter	Turbidity Values (NTU)						
	Combined Data	TB01	TB02	TB03	TB04	TB05	TB06 (ref)
Mean	3.8	4.6	2.5	0.1	11.6	2.4	1.6
Median	0	0.10	0	0.04	0.1	0	0
Range	0 – 817	0 - 388	0 - 513	0 - 12	0 - 665	0 - 817	0 - 165
95th Percentile	6.4	3.9	0	0.4	32	15	9
No. samples (n)	59,352	7,608	10,244	10,352	9,869	10,803	10,471

Table B2: Vertical Profile Data (Collected Manually) for Turbidity, Temperature, Dissolved Oxygen, Chlorophyll a, and pH – October/November 2010 (adapted from Golder, 2012c)

Parameter	Depth	Mean Values									
		TB01	TB02	TB03	TB04	TB05	TB06 (ref.)	TB07	TB08	TB09	TB10
Turbidity (NTU)	Shallow (0-4 m)	0.26	0.26	0.76	0.53	0.51	0.50	0.57	0.16	0.29	0.32
	Mid-water (4-8 m)	0.39	0.44	0.57	0.63	0.48	0.43	0.45	0.30	0.30	0.38
	Deep (8 m+)	0.57	0.56	0.59	-	0.60	0.54	0.68	-	0.36	0.52
	Overall	0.36	0.40	0.64	0.55	0.54	0.49	0.59	0.17	0.32	0.40
Temp. (°C)	Shallow (0-4 m)	8.58	8.38	7.78	8.51	7.88	7.53	8.68	9.42	9.45	9.42
	Mid-water (4-8 m)	8.71	8.19	7.70	8.00	7.94	8.54	8.85	9.33	9.35	9.40
	Deep (8 m+)	8.89	8.63	7.51	-	7.79	8.44	8.63	-	9.34	9.36
	Overall	8.68	8.35	7.69	8.42	7.86	8.08	8.71	9.41	9.38	9.39
Dissolved Oxygen (mg/L)	Shallow (0-4 m)	7.21	7.33	7.53	7.27	7.59	7.98	7.78	7.04	6.87	6.83
	Mid-water (4-8 m)	7.02	7.27	7.31	7.25	7.36	7.14	7.32	7.02	6.74	6.65
	Deep (8 m+)	6.82	7.05	7.37	-	7.38	6.99	7.21	-	6.47	6.23
	Overall	7.07	7.24	7.40	7.27	7.45	7.44	7.41	7.03	6.68	6.58
Chlorophyll a (µg/L)	Shallow (0-4 m)	1.04	1.03	1.00	1.24	1.08	0.74	0.94	0.73	1.22	1.38
	Mid-water (4-8 m)	0.68	0.80	1.08	0.65	0.91	1.06	0.87	1.42	2.10	1.50
	Deep (8 m+)	0.79	1.11	0.74	-	1.01	1.05	0.71	-	0.75	0.88
	Overall	0.86	0.95	0.98	1.13	1.00	0.92	0.82	0.79	1.27	1.26
pH	Shallow (0-4 m)	8.05	8.09	7.93	8.07	8.14	8.14	8.11	7.97	7.90	7.90
	Mid-water (4-8 m)	8.05	8.13	8.03	8.15	8.13	8.06	8.11	7.95	7.90	7.89
	Deep (8 m+)	8.03	8.09	8.07	-	8.17	8.08	8.11	-	7.89	7.86
	Overall	8.04	8.11	8.00	8.08	8.15	8.10	8.11	7.97	7.90	7.88

Notes:

°C – degrees Celsius; m – metre; mg/L – milligrams per litre; µg/L – micrograms per litre; NTU – nephelometric turbidity units

Appendix 3

**Phase 1 Open-water Dredging &
Barge Dewatering Decision
Framework** (adapted from Golder, 2012c)

3.2 Decision Criteria and Management Actions

There are presently no sector-specific regulations pertaining to discharge from dredging projects, nor are there provincial discharge standards applicable to the point of discharge from a dredging project. 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, often called the “end of pipe”⁸. In a dredging operation, there is no pipe terminus and control ends at the point at which turbidity is no longer controlled. In the case of this project, that is the edge of the silt curtain for the dredging (Figure 5) and intertidal excavation (Figure 6) components, and at the point of discharge (POD) for the dewatering barge (Figure 7). In order to evaluate the controls over the dredging project, the Project must meet pre-specified criteria at the POD. For safety reasons, however, if the silt curtain is configured adjacent to/around the dredge bucket, the operational compliance point for dredging may be 25 m from the edge of the silt curtain.

If a different silt curtain configuration is used, the location of the compliance point may need to be re-evaluated.

To verify that these controls are sufficient to protect the surrounding environmental values, additional assessment is carried out approximately 100 m away (assessment point) where water quality should meet ambient WQGs or a pre-specified change from ambient conditions.

⁸ This reasonable operational concept is adapted from the *Metal Mining Effluent Regulation* (MMER), a regulation made pursuant to the *Fisheries Act*. Although the remedial dredging project is obviously not a metal mine and the regulations do therefore not apply, the definition of a discharge point contained in the MMER is a contemporary workable definition for the present purpose and one intended to have conformity with the parent legislation, the *Fisheries Act*. The MMER defines a discharge point as being the point at which the operator ceases to have control over the effluent. This definition provides a workable parallel to prevailing environmental statutes and enables an assessment of ecological risks within the context of federal and provincial regulatory requirements.

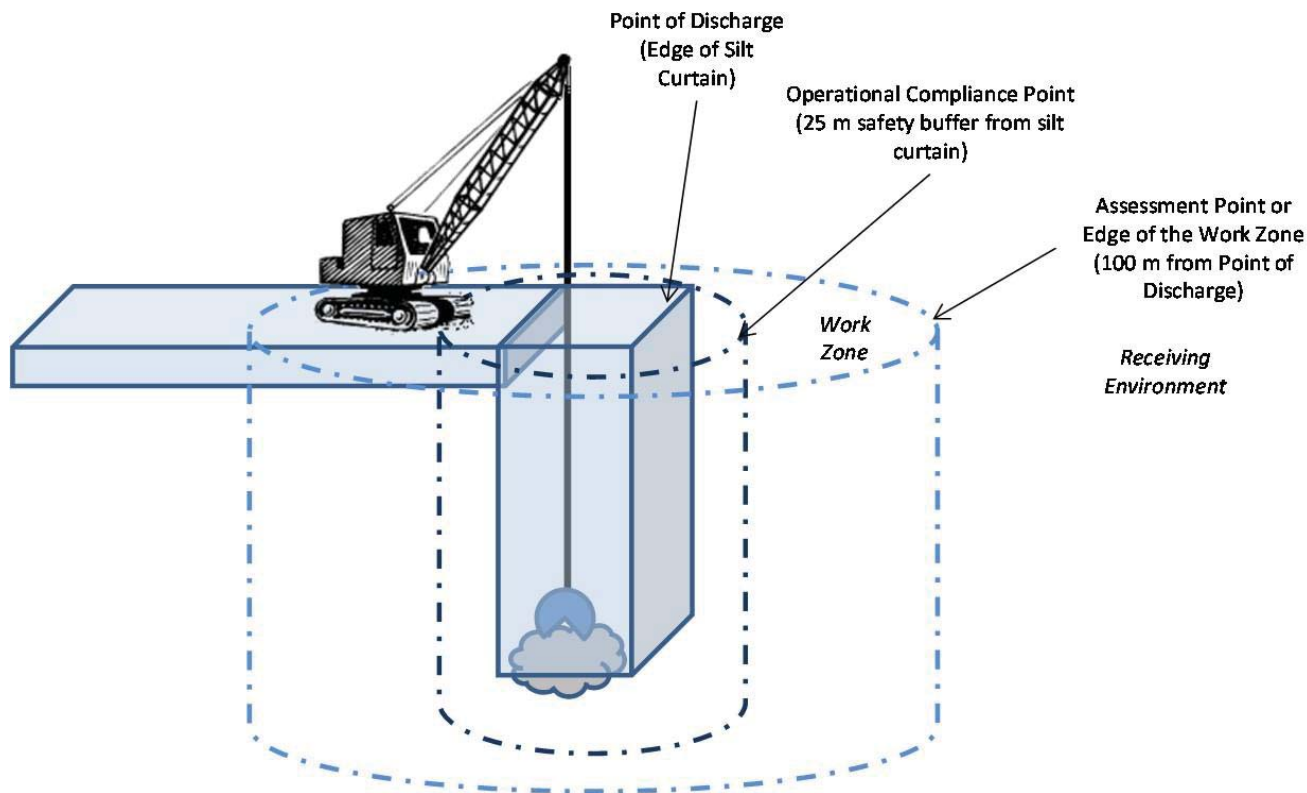


Figure 5: Schematic diagram showing the point of discharge, operational compliance point, and assessment point for a remedial dredging operation.

For the purposes of the EGD Waterlot project, site-specific benchmarks were developed for select parameters. The objective of the development and application of these benchmarks was two-fold:

- That lethal conditions (to fish) do not exist at the POD or the immediately surrounding work zone. The potential for acute lethality was evaluated against the proposed benchmarks.
- That chronic sub-lethal conditions (to fish) do not exist outside the work zone, which has been defined as 100 m away from the point of discharge (also called the assessment point). Ambient WQG or the proposed benchmark divided by 10, depending on how the WQG is derived, will be used to screen data from the edge of the work zone.

Decision criteria in Table 3 are provided for both the POD (e.g., the operational compliance point is considered to be 25 m from the edge of silt curtain for dredging and intertidal excavation) and the assessment point as represented by the outer boundary of the work zone. Parameter limits for TSS for the POD are provided for three portions of the Project Area (shown in Figure 3):

- **WQMA-A** – This management area has been identified in the barge dewatering assessment to have sufficiently high metals and/or PAH concentrations to warrant more conservative mitigation to protect against acute effects from contaminants associated with the sediments being remediated. Direct barge dewatering may not be suitable without treatment, and dredging will need to be conducted to minimize

re-suspension of seabed sediments. A TSS value of 40 mg/L (or 20 NTU as described in Section 3.1.2 will be used to manage dredging activities in WQMA-A.⁹

- **WQMA-C** – The metals and PAH concentrations in seabed sediments in the remainder of the Project Area are sufficiently low that they are not predicted to result in potentially acute effects at TSS values of 75 mg/L (or a turbidity of 25 NTU as described in Section 3.1.2). The management consideration for this area, WQMA-C, is related to the control of particulates.

Water quality parameters listed in Tables 3 to 5 are based on previously accepted¹⁰ limits for remedial dredging projects as well as the assessment of barge dewatering effluent quality (Golder 2012b). It is proposed that the day-to-day dredging activities be managed on the basis of real-time turbidity measurements (Figure 8). *In situ* measurements will also include dissolved oxygen, temperature, pH and salinity, and samples will be collected for laboratory analysis of TSS, metals, and PAHs on a specified schedule or as necessary in the event of exceedance of turbidity criteria.

⁹ The suitability of barge dewatering in the under jetty area of WQMA-A will be re-assessed for Phase 2 when the engineering design of this component of the project is further advanced.

¹⁰ By federal regulators for remedial dredging projects in Vancouver Harbour.

Table 3: General Water Quality Requirements for the Project

Parameter	Point of Discharge ¹			Receiving Environment at Edge of Work Zone ²
Total Suspended Solids	<i>Barge Dewatering</i>	WQMA-A: No discharge without treatment	WQMA-C: 75 mg/L ⁴	<10 mg/L over ambient ⁵ at any given time (<24 h duration) when ambient ⁵ is <100 mg/L;
	<i>Open-water Dredging</i>	WQMA-A: 40 mg/L ³	WQMA-C: 75 mg/L ⁴	<10% of ambient ⁵ when ambient ⁵ is >100 mg/L
Turbidity ⁶	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 using sediment and sea water from the EGD Waterlot will be used (Section 3.1; APPENDIX A). The TSS/turbidity relationship will be verified and re-calibrated as necessary based on real-time data collected during the Project			< 5 NTU over ambient ⁵ when ambient ⁵ is <50 NTU; < 10% of ambient ⁵ when ambient ⁵ is > 50 NTU
Dissolved Oxygen	≥ 5 mg/L ⁷			≥ 8 mg/L
pH	6.5 to 9.0 ⁸			7.0-8.7
Metals – various	See Table 4			See Table 4
PAHs – various	See Table 5			See Table 5
Toxicity ¹⁰	<i>Barge dewatering:</i> 96h LC ₅₀ ≥ 100%			n/a

Notes:

¹ Point of Discharge (POD) taken to be the established set-back or safe working distance from active dredging operations (e.g., 25 m from the edge of the silt curtain). For the dewatering barge, the POD is considered to be the discharge from the barge.

² Receiving environment taken to be the edge of the work zone or assessment point (i.e., 100 m from the edge of the silt curtain).

³ Based barge dewatering assessment (Golder 2012b).

⁴ Originates from DFO and MELP (1992) and is based on freshwater systems during wet weather; however, this number is frequently applied to marine discharges as well. This concentration is based on the release of clean suspended particulate matter, such as may occur during the dredging of uncontaminated materials.

⁵ Ambient is defined as the conditions within Constance Cove.

⁶ The baseline monitoring program indicated that 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 the Project as induced turbidity above ambient measured at the time of sampling.

⁷ Based on MOE ambient water quality guidelines for dissolved oxygen (MOE 1997).

⁸ The range of pH specified for protection of marine waters is 7.0 – 8.7 to protect mollusk embryo development, based on MOE ambient water quality guidelines for pH (MOE 1991). However, for the purposes of concrete work, 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 environments.

⁹ Based on MOE ambient water quality guidelines for pH (MOE 1991).

¹⁰ Based on a test using a salt-water acclimated salmonid. All dewatering effluents are expected to be non-acutely lethal at the point of discharge; see Section 3.2.3 for discussion of when toxicity testing is to be conducted.

h – hour; mg/L – milligrams per litre; NTU – nephelometric turbidity units; POD – point of discharge; TSS – total suspended solids; WQMA-Water Quality Management Area (see Figure 3).

Table 4: Proposed Discharge Criteria for Metals

Parameter (as total)	Monitoring Criteria (µg/L) ¹	
	Point of Discharge ²	Receiving Environment at Edge of Work Zone ³
Arsenic	125	12.5
Copper	30	3
Zinc	100	10

Notes:

¹ The selection of this subset of metals is discussed in Golder (2012b).

² Compliance for the Point of discharge (POD) will be at an established set-back or safe working distance from active dredging/excavation operations (e.g., 25 m from the edge of the silt curtain). For the dewatering barge, the POD is considered to be the discharge from the barge. These values apply to all Water Quality Management Areas (see Figure 3). The values are based on 10 x ambient WQG.

³ Receiving environment taken to be the edge of the work zone (i.e., 100 m from the POD). Values are based on ambient WQG (CCME 1999c; Singleton 1987; Nagpal 1999)

Table 5: Proposed Discharge Criteria for Polycyclic Aromatic Hydrocarbons

Parameter	Monitoring Criteria (µg/L) ¹	
	Point of Discharge ²	Receiving Environment at Edge of Work Zone ³
Acenaphthene	510	51
Anthracene	5.0	0.5
Benzo(a)anthracene	1.8	0.18
Benzo(b)fluoranthene	8.6	0.86
Benzo(a)pyrene	5.6	0.56
Benzo(g,h,i)perylene	1	0.1
Chrysene	8.6	0.86
2-Methylnaphthalene	58	5.8
Naphthalene	100	10
Phenanthrene	40	4.0
Pyrene	12.8	1.28

Notes:

¹ The selection of this subset of PAHs is discussed in Golder (2012b).

² Point of discharge (POD) taken to be the established set-back or safe working distance from active dredging/excavation activities (e.g., 25 m from the edge of the silt curtain). For the dewatering barge, the POD is considered to be the discharge from the barge. These values apply to all Water Quality Management Areas (see Figure 3). The values are based on a combination of literature review and quantitative structure-activity (QSAR) relationship evaluations as described in Golder (2012b).

³ Receiving environment taken to be the edge of the work zone (i.e., 100 m from the POD). The values are based on the POD values with a 10-fold safety factor applied.

3.2.1 Decision Framework for Open-water Dredging

The decision framework for implementing management actions during **open-water dredging** is comprised of a series of steps to allow for adaptive management of dredging that will be responsive to environmental protection goals without unnecessary disruption to the operational needs of the Project. The framework for dredging in WQMA-A is illustrated in Figure 8. The steps are as follows (turbidity values for WQMA-A are used in this example; for dredging in WQMA-C, the applicable turbidity values should replace the ones below):

- 1) Regular monitoring (Section 3.3) is undertaken to evaluate potential for induced turbidity (*i.e.*, the change in turbidity greater than ambient) at the edge of the work zone (*i.e.*, the assessment point) during dredging (Figure 5).
- 2) If turbidity is observed to be less than the ambient WQG (*i.e.*, <5 NTU above ambient), 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) Confirmatory sampling will be conducted (*i.e.*, when induced turbidity is between 5 and 20 NTU above ambient for dredging in WQMA-A). Confirmatory turbidity measurements will be made at three locations along the assessment point (100 m from the silt curtain) at three depths (1 m below surface, mid-water column, and 2 m above the seabed).
 - b) Implementation of management actions is warranted (when induced turbidity at the assessment point is >20 NTU above ambient for dredging in WQMA-A), followed by confirmatory sampling 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, the level of exceedance determines whether confirmatory sampling 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 <20 NTU (in WQMA-A) and confirmatory sampling will include collection of turbidity measurements at 3 depths and 5 locations along the compliance point (25 m from the silt curtain or closer depending on configuration of the silt curtain relative to the dredge head) as well as at the assessment point (100 m from the silt curtain). The purpose of the additional monitoring locations is to collect information about the behavior of the turbidity plume that can be used by a Qualified Registered Professional to evaluate the potential for environmental effects (which is determined in part by a combination of duration and magnitude). The QRP will need to take into account ambient (within Constance Cove) and background (within Esquimalt Harbour, outside of Constance Cove) conditions, visual observations, and level of accuracy of field instrumentation when assessing which course of action should be taken.
 - b) Dredging will be stopped if induced turbidity is >20 NTU (in WQMA-A). After corrective actions are implemented, dredging 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 <20 NTU for WQMA-A) or is >20 NTU at the compliance point (for WQMA-A), dredging will be stopped and corrective actions will be implemented. Dredging and regular turbidity monitoring may then resume.

The same process will be followed for dredging in WQMA-C; however, a different turbidity trigger value will be used (*i.e.*, 25 NTU rather than 20 NTU).

In the event that validation of the TSS-turbidity relationship indicates that a different turbidity is associated with the TSS values applied as limits, the turbidity trigger values may be modified accordingly.

3.2.3 Decision Framework for Barge Dewatering

For **barge dewatering** the compliance point is the point of discharge from the barge, and the assessment point is 100 m from the barge outlet (Figure 7). Both points will be monitored regularly, and if the dewatering discharge is found to contain a TSS concentration >40 mg/L in WQMA-B or >75 mg/L in WQMA-C, management actions (*e.g.*, cease loading of dredged material on the barge) will be implemented and confirmatory monitoring conducted on the water in the barge (*e.g.*, toxicity testing) and at the assessment point to evaluate the potential for environmental impacts. No direct discharge from the barge will occur without treatment or other mitigation in WQMA-A unless testing indicates that it is suitable for discharge (*i.e.*, is not acutely lethal using a salt-water acclimated salmonid).

3.2.4 Decision Framework for Placement of Material

During **placement of sand and armour rock material**, turbidity measurements will be taken at three depths in the water column down-current at a suitable safety distance (25 m) from the activity (the compliance point), as well as 100 m from the activity (the assessment point), and the decision framework for WQMA-C outlined in Section 3.2.1 generally be followed.

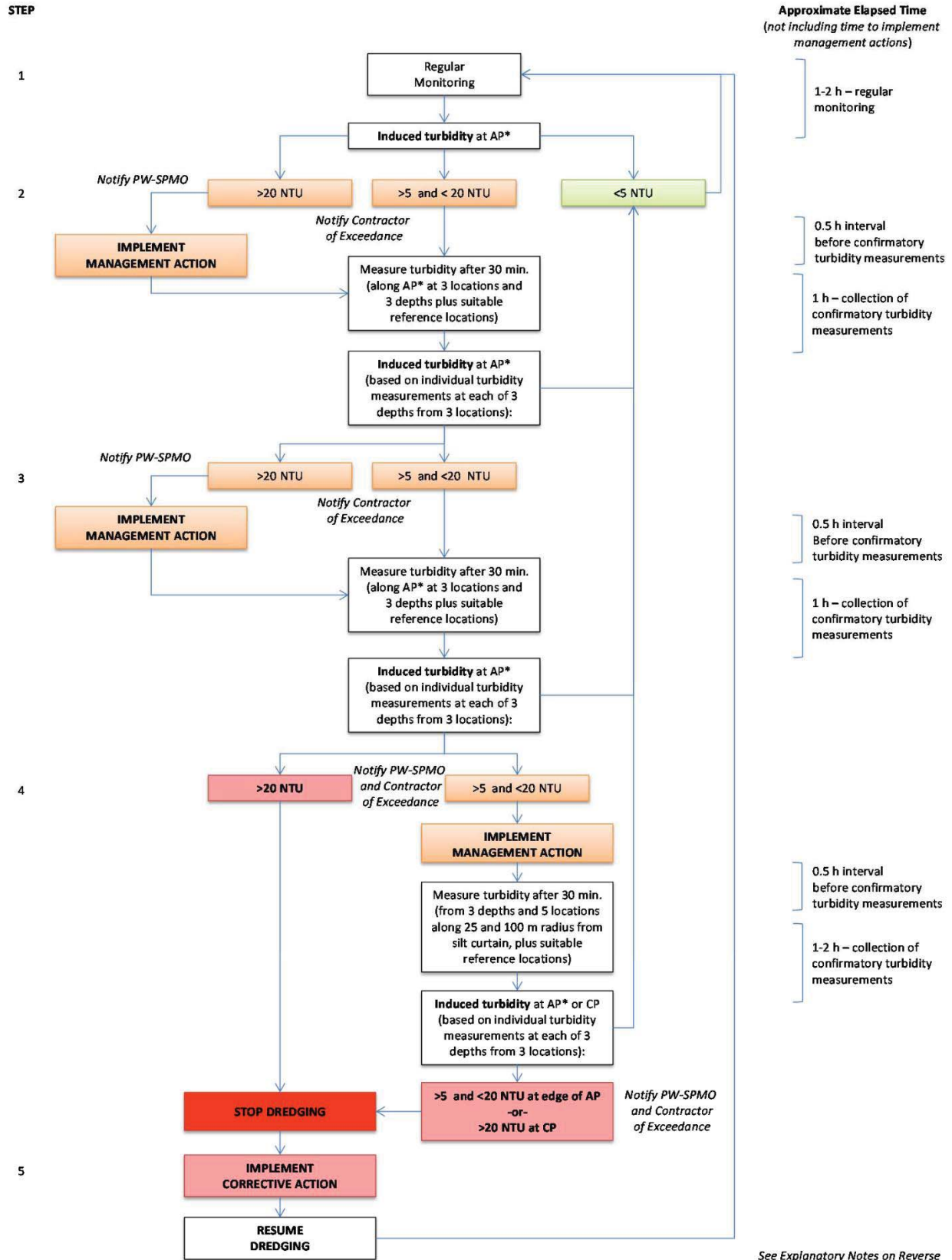


Figure 8: Decision Framework for implementing management actions during open-water dredging of water quality management areas a and b based on real-time monitoring of turbidity.

Notes for Figure 8:

IMPLEMENT MANAGEMENT ACTION – this may include: checking the silt curtain; slowing dredge cycle; changing bucket.

STOP DREDGING – Re-assess dredging to determine cause and define corrective actions prior to re-commencing dredging.

Induced turbidity is the level of change in turbidity greater than ambient. The value used for triggering management actions is dependent on the WQMA in which the work is being conducted. For dredging in WQMA-A, the turbidity limit is 20 NTU, and for dredging in WQMA-C, the turbidity limit is 25 NTU.

Ambient conditions – the conditions within Constance Cove.

Turbidity values triggering confirmatory sampling and/or implementation of management actions may change as the TSS-turbidity relationship is verified and recalibrated based on data collected during dredging.

A Qualified Registered Professional will evaluate potential for exceedances of performance objectives to cause environmental impact.

* Measurements based on real-time monitoring (collection of discrete samples in three locations in the water column). Additional sampling for metals and PAHs may need to be conducted in the event of exceedances of these induced turbidity values.

** Measurements made at 25 m from the silt curtain (or closer based on the configuration of the silt curtain relative to the dredge head) will be used to evaluate plume behaviour and potential for effects from exceedance of performance objectives.

Abbreviations:

AP – assessment point (100 m from POD; also called the edge of the work zone).

CP – compliance point (25 m safety buffer from silt curtain assuming that it is relatively close to the dredge bucket – the location of the compliance point will be re-evaluated based on the configuration of the silt curtain relative to the dredge head and may be at the edge of the silt curtain or at some distance within 25 m from the silt curtain).

m – metres.

min. – minutes.

NTU – nephelometric turbidity units.

PAH – polycyclic aromatic hydrocarbon.

PW-SPMO – Public Works Senior Project Manager (Operations).

TSS – total suspended solids.

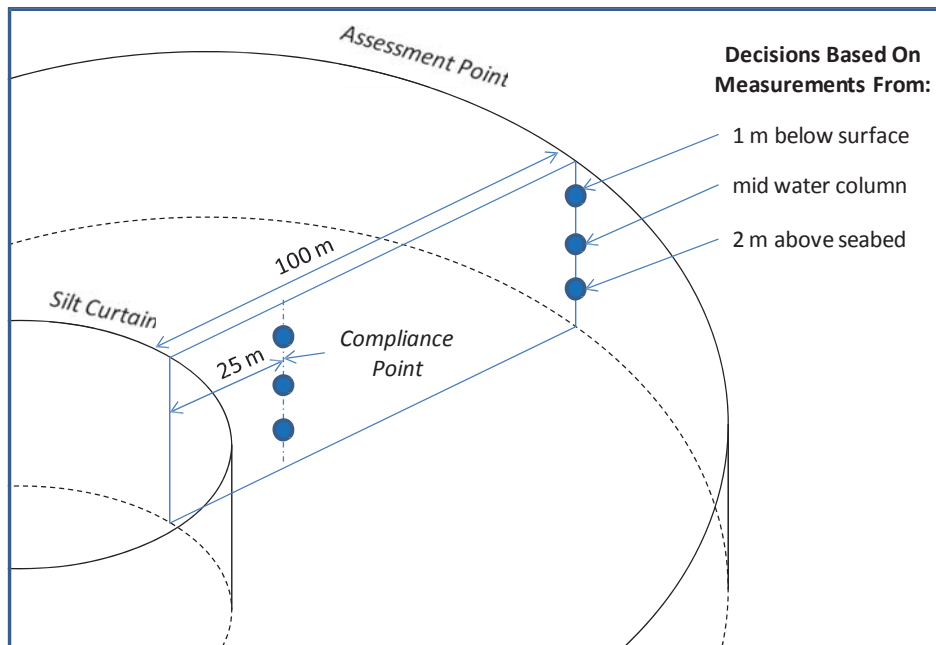


Figure 9: Conceptual layout of location of turbidity measurements in the water column.

3.3 Manual (“Real-time”) Water Quality Monitoring

3.3.1 Monitoring Locations

The focus of the manual water quality monitoring program will be turbidity measurements, although *in situ* measurements of pH and dissolved oxygen will also be made occasionally to evaluate the effect of the Project activities on these parameters. The assumed number of sampling locations is described below and summarized in Table 6; 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 8]). Water samples will also be collected for chemical analysis; samples for analysis of TSS will be collected as noted in Table 6, whereas metals and PAH analysis (for both total and dissolved¹¹ fractions for both sets of parameters) will be conducted only on a subset (approximately 50%) of samples to be determined at the time of sampling, at least initially. Samples for analysis of TSS will be relatively high initially to facilitate validation of the TSS-turbidity relationship (see also Section 3.5). If the environmental management measures for the Project are demonstrated to be consistently effective at the start of dredging, the frequency of collection of samples for laboratory analysis may be reduced (frequency is discussed further in Section 3.3.2).

Sampling stations will be located both up-current and down-current of the works, and will be adjusted throughout the event depending on the location of the dredging 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 sampling 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 the final dredging plan and site-specific conditions. A conceptual layout of the sampling locations is provided in Figure 10 for dredging, in Figure 11 for excavation activities at Munroe Head, and Figure 12 for barge dewatering, and described below. The conceptual layout of sampling locations for dredging activities can be applied to turbidity measurements during monitoring of other Project activities (e.g., debris removal, sheet-pile wall installation, and sand cover placement).

■ Compliance Samples

- **Dredging location, 25 m from the edge of the silt curtain¹²** – this will consist of measurements collected down-current from the dredging in the water column outside the silt curtain as safety permits. 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).

¹¹ Samples for analysis of dissolved metals will be filtered through a 0.45 µm filter, and samples for dissolved PAH analysis will be prepared by centrifugation. Dissolved PAH analysis will only be conducted initially to evaluate the potential for presence of the soluble fraction).

¹² The safety distance assumes that the silt curtain will be placed relatively close to the dredge bucket. The distance of the CP from the silt curtain may need to be re-evaluated if a different silt curtain configuration is used.

- 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.

- **Assessment Samples** – samples will be collected at a distance of 100 m from the point at which the operator no longer exercises control over the discharge material (*e.g.*, from the edge of the silt curtain). 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.

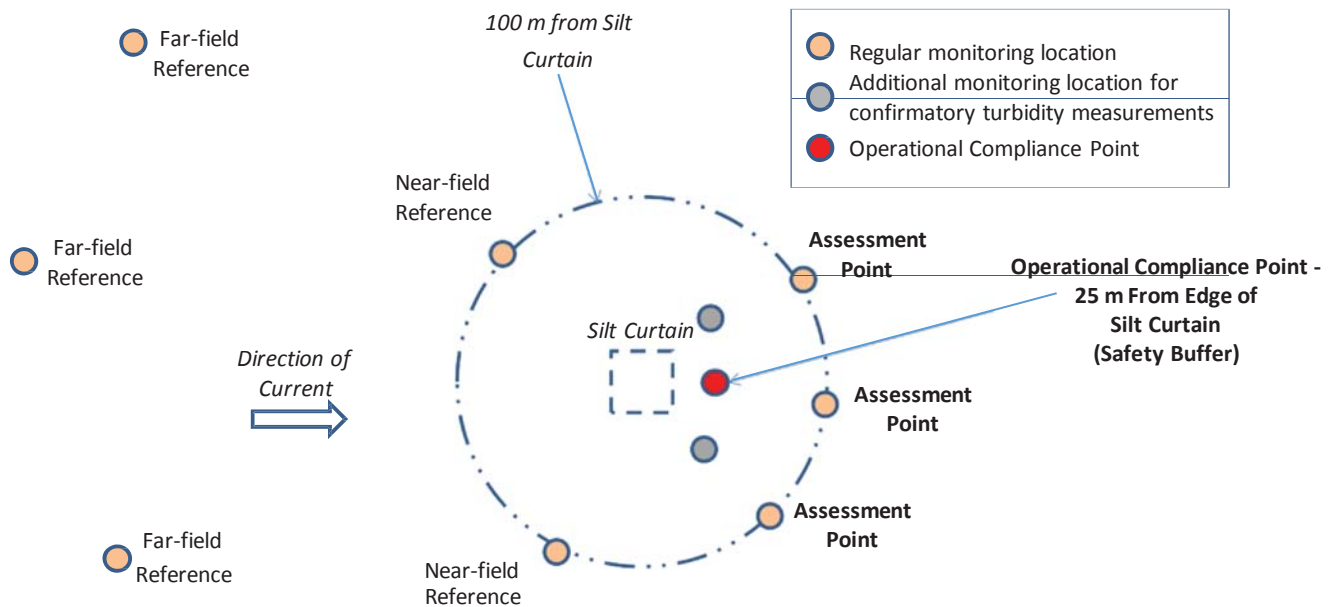


Figure 10: Conceptual layout of monitoring locations for dredging activities

Appendix 4

Water Quality Modelling Results (Anchor, 2014)

MEMORANDUM

To: Andrew Mylly, Public Works and Government Services Canada
Date: July 30, 2014

From: Greg Brunkhorst and Dan Berlin, Anchor QEA
Project: 120553-02.24

Cc: Greg Thomas, G3 Consulting Ltd.

Re: DRAFT - Anticipated Relationship between Contaminant Concentrations, Total Suspended Solids, and Turbidity During Phase 2 Dredging of Esquimalt Graving Dock

PURPOSE

This memorandum summarizes available data and calculations used to estimate the relationship between contaminant concentrations in water, total suspended solids (TSS), and turbidity in support of development of water quality criteria for the Esquimalt Graving Dock (EGD) Phase 2 remediation activities. This is intended as an attachment to the Phase 2 Water Quality Monitoring Plan developed by G3 Consulting Ltd. (G3 Consulting), which describes chemical water quality, TSS, and turbidity criteria that are intended to prevent adverse impact to the environment during remediation activities, including the opening and closing of the temporary resuspension barrier (TRB).

WATER QUALITY CRITERIA

Table 1 presents the water quality criteria for a subset of contaminants that are representative of all contaminants present in sediment to be dredged during Phase 2 remediation. These 11 polycyclic aromatic hydrocarbons (PAHs) and three metals also have the highest concentrations in sediment relative to the cleanup criteria. As described in the Water Quality Monitoring Plan, the water quality criteria were developed for monitoring locations 25 meters (m) and 100 m from the project site. The criteria at the 25-m monitoring point are 10x the criteria at the 100-m monitoring point.¹ The water quality criteria were

¹ The main text of the Phase 2 Water Quality Monitoring Plan (G3 Consulting 2014) has several different designations for the 25- and 100-m monitoring points depending on the purpose of monitoring (e.g., monitoring during standard operations versus monitoring during TRB openings). For clarity, this memorandum refers to these monitoring points simply as the “25-m monitoring point” and the “100-m monitoring point.”

generally based on no observed effects levels (NOELs) associated with chronic exposures over time (e.g., 48- or 72-hour tests of sublethal and/or lethal effects).

Table 1 also presents average background concentrations from 280 measurements collected as part of the Phase 1B EGD remediation project between June 2013 and March 2014 from Esquimalt Harbour (SLR 2014). Results were non-detect for nearly all PAH samples, and 1/2 the detection limit was used to calculate the average background concentration. Copper had the highest background concentrations relative to water quality criteria, with an average of 1.1 micrograms per liter ($\mu\text{g/L}$) compared to the criterion of 3.0 $\mu\text{g/L}$. Copper exceeded the criterion in 7 of 280 background measurements (2.5% of samples).

TOTAL SUSPENDED SOLIDS TO ACHIEVE WATER QUALITY CRITERIA

The maximum TSS concentrations that achieve water quality criteria were estimated assuming that suspended solids have the same contaminant concentrations in bulk sediment from the Phase 2 remediation area targeted for dredging. The contaminant concentrations in sediment being dredged were estimated based on the average of all samples in the dredge prism (Table 1). Use of the average concentration of all sediment targeted for dredging is appropriate considering that sediment will be resuspended and mixed in the water column as the dredging is conducted within the Phase 2 area. Any suspended sediment released when the TRB is opened will be a mixture of previously dredged sediment.

This exercise uses a conservative approach to estimate the concentration sorbed to suspended sediment particles. Partitioning of contamination into the dissolved phase is not explicitly calculated; however, the total mass of contamination is accounted for in the calculations and assumes that dissolved phase contamination would move with suspended solids through the water column. This approach is reasonable for this analysis because the modeled contaminants have high partitioning coefficients and therefore tend to remain in the particulate phase. Settling is not incorporated into this analysis, which provides an additional layer of conservatism to the evaluation that may serve to reduce concentrations remaining in the water column.

The maximum TSS concentrations that achieve water quality criteria were calculated using the following formula:

$$TSS = \frac{WQC - B}{CS} \quad (1)$$

where:

TSS = total suspended solids
WQC = water quality criterion
B = background
CS = average concentration in sediment

As shown by the formula, the calculation accounts for average background concentrations when evaluating potential exceedances. As noted above, background conditions alone can periodically result in water quality exceedances in Esquimalt Harbour, therefore, these calculations would apply to average conditions.

Based on these calculations, the lowest TSS concentration that would exceed water quality criterion is for copper, which is 68 milligrams per liter (mg/L) at the monitoring point of 25 m and 4.4 mg/L at the monitoring point of 100 m.

TURBIDITY – TSS RELATIONSHIP

Turbidity is commonly used to provide real-time measurements of water quality impacts during construction. TSS and chemical analyses can take several days, which does not support real-time modification of work activities for compliance with water quality criteria. For this analysis, the TSS and turbidity data from the Phase 1B EGD remediation project was used to predict the relationship between turbidity and TSS likely to be observed in the field. A relationship was also considered that was previously developed by Golder Associates Ltd. using sediment from the Phase 1B area during bench-scale testing (Golder 2012; see Figure 1). However, the Phase 1B field monitoring results were determined to be more representative of conditions expected to be observed during Phase 2 remediation activities.

Figure 1 shows a scatter-plot of 2,548 samples where TSS and turbidity were measured in paired samples. Two aberrant data points were removed as outliers. The figure indicates a

relatively wide scattering of results, particularly at low levels of TSS (e.g., less than 20 mg/L) and turbidity (e.g., less than 10 Nephelometric Turbidity Units [NTU]). At higher levels of TSS and turbidity, most of the data points fall within a range of the following linear relationships:

$$\text{turbidity (NTU)} = 1.0 \times \text{TSS (mg/L)}^2 \quad (2)$$

$$\text{turbidity (NTU)} = 0.25 \times \text{TSS (mg/L)}^3 \quad (3)$$

The central tendency of all data can be described using the following regression equation using a least squares curve fit:

$$y = 0.48 \times x - 0.97 \quad (4)$$

where:

y = turbidity (NTU)

x = TSS (mg/L)

Based on the distribution of points, the coefficient of determination for the least squares curve fit (R^2) is 0.55. This regression equation can be generally described using the following equation:

$$y = 0.5 \times x \quad (5)$$

where:

y = turbidity (NTU)

x = TSS (mg/L)

The latter relationship was used to estimate turbidity values for specific Phase 2 TSS thresholds presented in Table 1.

This relationship between TSS and turbidity from the Phase 1B EGD remediation project dredging is generally consistent with observed TSS and turbidity measurements from other

² Shown as $y = x$ on Figure 1.

³ Shown as $y = 0.25x$ on Figure 1.

dredging sites. Use of turbidity during the Phase 1B EGD remediation project was effective as a real-time warning for potential water quality exceedances. However, turbidity measurements should be further evaluated alongside other laboratory measurements (TSS and chemical concentrations) to confirm that the TSS/turbidity relationship provided in this memorandum is appropriate to estimate when potential environmental impacts may occur. In addition, the TSS-turbidity relationship should only be re-evaluated with a large number of data points.

REFERENCES

- SLR (SLR Consulting (Canada) Ltd.), 2014. Draft Phase 1B Environmental Monitoring Completion Report. Prepared for PWGSC. April.
- Golder (Golder Associates Ltd.), 2012. Final Water Quality Monitoring Plan – Appendix A: Total Suspended Solids/Turbidity Relationship. Esquimalt Graving Dock Waterlot Remediation Project. Prepared for PWGSC. December 6, 2012.
- G3 Consulting (G3 Consulting Ltd.), 2014. Phase 2: Water Quality Monitoring Plan for the Esquimalt Graving Dock South Jetty Redevelopment/Waterlot Under-pier Phase 2 Remediation Project. Draft. Prepared for PWGSC. March 31, 2014.
-

ATTACHMENTS

Table 1

Approximate Total Suspended Solids and Estimated Turbidity to Achieve Monitoring Water Quality Criteria

Analyte	Monitoring Water Quality Criteria (µg/L)			Average of all Samples in Dredge Prism			
	100 m	25 m	Background	Sediment Concentration (mg/kg dw)	Approximate TSS Concentration to Achieve Monitoring Criteria (mg/L)		Approximate Turbidity Measurement to Achieve Monitoring Criteria (NTU) ¹
					TSS at 100 m	TSS at 25 m	
Acenaphthene	51	510	0.025	8.6	5,900	59,000	3,000
Anthracene	0.50	5.0	0.0050	12	41	420	21
Benzo(a)anthracene	0.18	1.8	0.0050	19	9.2	95	4.6
Benzo(a)pyrene	0.56	5.6	0.0045	18	31	310	15
Benzo(b)fluoranthene	0.86	8.6	0.025	23	37	380	18
Benzo(g,h,i)perylene	0.10	1.0	0.025	11	7	89	3
Chrysene	0.86	8.6	0.025	8	100	1,100	52
2-Methylnaphthalene	5.8	58	0.050	3.6	1,600	16,000	800
Naphthalene	10	100	0.051	10	970	9,800	490
Phenanthrene	4.0	40	0.026	58	69	690	34
Pyrene	1.28	12.8	0.011	51	25	250	12
Arsenic	12.5	125	1.98	82	130	1,500	64
Copper	3.0	30	1.12	425	4.4	68	2.2
Zinc	10	100	2.15	570	14	170	7

Notes:

1. For the calculation above, the turbidity - TSS relationship of turbidity (NTU) = 0.5*TSS (mg/L) was used. This equation is accurate to approximately +100% and -50%.

Highlighted cells represent the lowest measurements that would result in an exceedance.

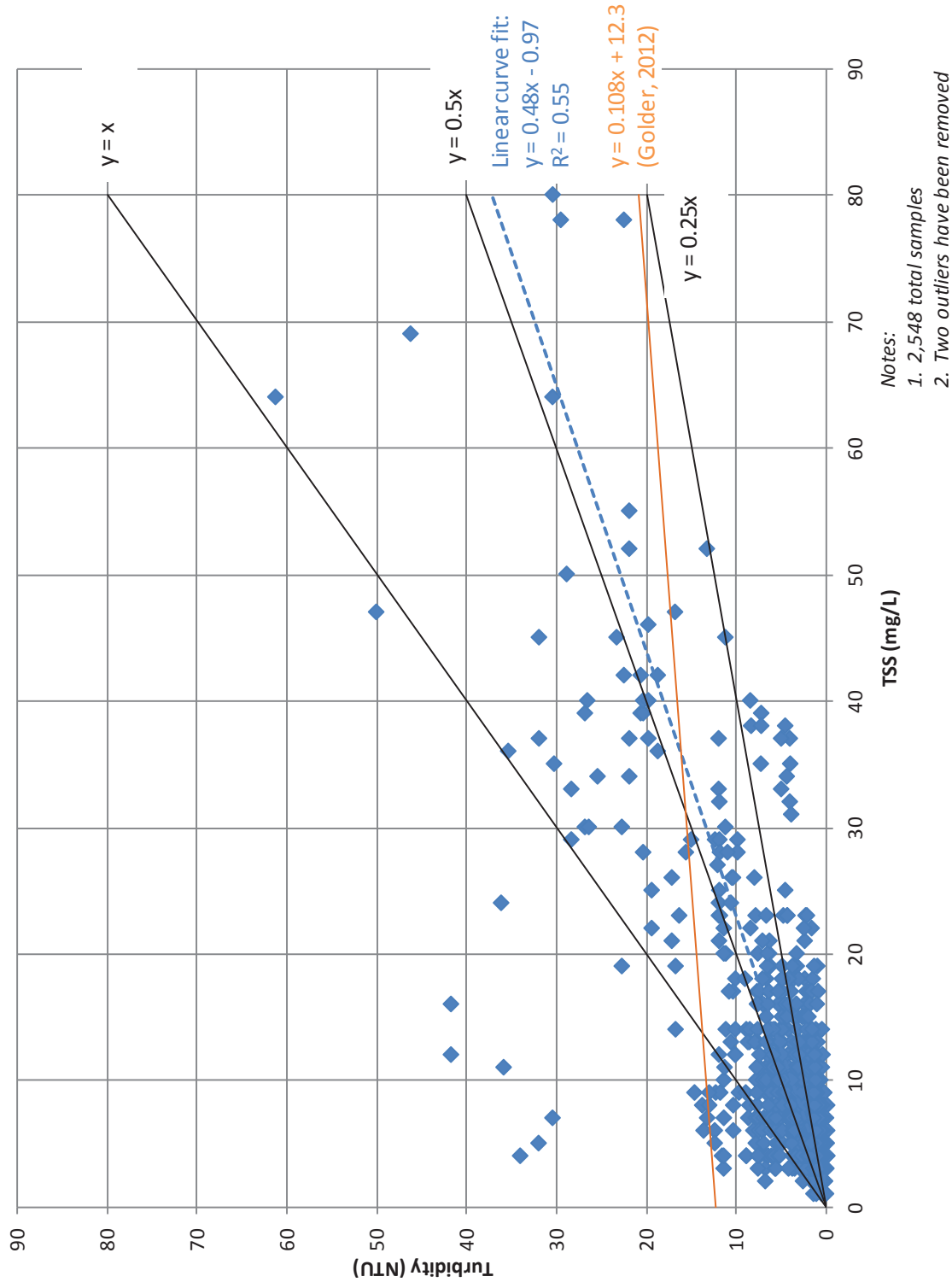


Figure 1
Turbidity - TSS Relationship for 2013-2014 Phase 1B EGD Dredging
Memorandum: Anticipated Relationship between Total Suspended Solids and Turbidity During Phase 2 Dredging
Esquimalt Graving Dock

Appendix 5

Phase 1 Barge Dewatering Assessment (Golder, 2012b)



APPENDIX E

Barge Dewatering Assessment

March 21, 2012 (FINAL DRAFT)

Project No. 10-1475-0002/10000/2000
E/12/0311

Mr. Andrew Mylly
Public Works and Government Services Canada
641 - 800 Burrard Street
Vancouver, BC
V6Z 2V8

ESQUIMALT GRAVING DOCK WATERLOT REMEDIATION PROJECT: ASSESSMENT OF PREDICTED QUALITY OF DISCHARGE WATER DURING BARGE DEWATERING

Dear Mr. Mylly,

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Public Works and Government Services Canada (PWGSC) to provide engineering and site assessment support for the Esquimalt Graving Dock Waterlot Remediation Project. The proposed remediation project involves the removal of contaminated sediments within the EGD Waterlot and adjacent “buffer” zones (herein referred to as the Project Area), that exceed numeric Remedial Action Objectives (RAOs) for the Project¹.

The design team for the remedial dredging includes Anchor QEA LLC (Anchor) of Seattle, Washington and Golder. The objective for the remediation is to reduce financial liability for PWGSC associated with historical contamination.

The remedial action plan, proposes the dredging of contaminated sediments within the Project Area primarily by clamshell dredging methods, with smaller areas adjacent to sensitive facility infrastructure targeted for suction dredging (potentially diver assisted). Dredged sediment will then be placed on a hopper barge for transportation to an off-loading facility prior to transportation overland to a permitted uplands disposal site.

Dredged material will require dewatering prior to overland transport, to enable appropriate handling and transportation. To support the assessment of dewatering requirements for the dredged material, this letter provides an assessment of the potential viability of discharge of water from dredged sediments to the marine environment during barge dewatering activities.

¹ Project numeric RAOs for contaminants of potential concern defined as the most conservative of the applicable Canadian Council of Ministers of the Environment (CCME) Probable Effects Level (PEL) guidelines (CCME, 1999) and British Columbia Ministry of Environment (BC MoE) Contaminated Sites Regulation (CSR) Generic Numerical Sediment Criteria for marine sediment (typical sites [SedQC_{TS}]) (BC MoE, 1996. With updates to 2010).



2.0 BACKGROUND AND OBJECTIVES

Discharges posing a potentially unacceptable risk could trigger a shutdown of dredging operations by regulatory agencies and it is therefore desirable to identify potential controls to be employed during the dredging as part of project planning and then develop additional controls as needed, before dredging begins.

The assessment provided below will assist the design team in identifying if specification of (for example) sealed barges for the project is required, resulting in the need for appropriate collection and treatment of the dewatering effluent prior to disposal. Alternatively, if discharge to the marine environment is acceptable, appropriate controls will need to be implemented to manage concentrations of total suspended solids (TSS) in the discharge water.

Golder will use the results of this assessment to support the development of the Water Quality Monitoring Plan for the Project, which will include proposed environmental performance monitoring and assessment criteria during remediation activities.

In accordance with Golder's final workplan "*Esquimalt Graving Dock Waterlot Sediment Remediation Project: Fiscal Year 2010-2011 Input to Dredge Effects Assessment*" dated November 18, 2010 (Golder, 2010a), Golder undertook an analysis of the potential for release of chemical substances in bedded sediment from the dewatering of the dredged material placed on a barge, to provide planning-level estimates of the potential water chemistry (total and dissolved) and an understanding of how concentrations of TSS affect the associated potential water quality impacts.

The assessment is based on the current understanding of the relevant chemical fate processes and sediment chemistry data available for the Project Area.

3.0 MODELLING OVERVIEW

The model used in the present analysis estimated the potential release of sediment-associated substances during dewatering of dredged material. The model evaluated a scenario of re-suspension of sediment particles into overlying seawater on the dredging barge, and desorption of organic substances from the particulate-associated phase into the dissolved phase prior to discharge from the barge.

The output of the model consists of predicted chemical concentrations in dewatering effluent (including both particulate and dissolved phases) at the time of discharge.

4.0 MODEL THEORY AND FRAMEWORK: ORGANICS

Organic chemicals in sediment typically undergo some degree of desorption following sediment re-suspension. The dynamics of desorption of organic chemicals from sediment is generally well described, and has been shown by many investigators to be biphasic, with a portion occurring as "rapid phase" desorption and the remainder, often a substantial portion, occurring as "slow phase" desorption (e.g., Karickhoff 1980; Kan et al. 1998; Alexander 2000). "Slow phase" desorption is thought to be due to long-term physical or chemical changes in the conformation of sediment organic matter, resulting in entrapment of a portion of sorbed chemicals (Chen et al. 2000). The extent of entrapment is related to the residence time of the chemicals in the sediment, and historically-contaminated sediments often exhibit very low rates of chemical desorption (Chen et al. 1999).

The potential release of organic chemicals from historically-contaminated sediment is therefore best modelled as a function of chemical concentrations in the sediment, the amount of sediment released, and the duration of contact between re-suspended sediment and the water column (Sanchez et al. 2002; Thibodeaux 2005a, Thibodeaux et al. 2005b).

For this analysis, we constructed a dynamic, time-dependent, multimedia model of organic chemical release during a re-suspension event (Thibodeaux et al. 2005b). This type of model gives a more accurate prediction of the short-term fate of sediment-associated chemicals than do equilibrium models. The model was specified to include two sediment-associated chemical compartments (rapid-desorbing and slowly-desorbing) and a dissolved compartment. For each time step, the model calculated the exchange of chemical between suspended sediment and water, according to the following set of mass-balance equations:

$$\Delta X_R / \Delta t = D_R f_W - D_R f_R \quad (1)$$

$$\Delta X_S / \Delta t = D_S f_W - D_S f_S \quad (2)$$

$$\Delta X_W / \Delta t = D_S f_S + D_R f_R - (D_S + D_R) f_W \quad (3)$$

Where:

X is the mass of chemical in a compartment,

D is a transport parameter for solid-water exchange, and

f is the fugacity of chemical in the compartment; subscripts denote the rapidly-desorbing sediment fraction (R), slowly-desorbing sediment fraction (S), and water (W).

This model is specified in fugacity format, to take into account the relative capacities of resuspended sediment and water to adsorb contaminants. Fugacity is calculated as the chemical concentration in a compartment normalized to the compartment's sorptive capacity for that chemical. Sorptive capacity of resuspended sediment is calculated as a function of the material's organic carbon content. Sorptive capacity of water is a function of the chemical's Henry's Law Constant.

The model was run through a number of time steps to represent the period of sediment suspension prior to discharge of water from dredged sediments placed on a barge. The model therefore evaluated the redistribution of chemicals from the bedded sediment following re-suspension of the dredged material on the barge, constrained by the duration of time actually available for this redistribution to take place (on the barge).

Model predictions were generated for a range of assumed suspended sediment concentrations (5 to 75 mg/L).

5.0 MODEL THEORY AND FRAMEWORK: METALS

Release of metals from sediment following re-suspension is generally much lower than that observed for organic substances, and the release of metals is governed by much more complex and less-well understood processes than those involved in desorption of organic contaminants (Eggleton and Thomas 2004).

A change in the chemical properties of the sediment-metal complexes during dredging can cause mobilization of metals, principally from sulphide-bound complexes (Calmano et al. 1993). However, in situations where sediment redox potential and pH do not change dramatically (*i.e.*, in partially oxidized sediments such as those

present in Esquimalt Harbour), the release of metals is generally negligible (Forstner et al. 1989; Reible et al. 2002). For example, Pieters et al. (2002) observed low metal mobilisation during dredging, although metal mobility differed between dredging techniques and was different for every metal examined. Van den Berg et al. (2001) and De Groote et al. (1998) also observed low mobilisation of metal contaminants into the dissolved phase during dredging, which was thought to be due to the rapid scavenging of sulphide liberated metals by newly formed iron and manganese oxides/hydroxides.

This is in agreement with simulated dredging studies, where low or no metal contaminants were released and concentrations returned to background levels within hours (Bonnet et al. 2000). It is also in agreement with the results of dredging elutriate testing (DRET) of sediment samples from the EGD Waterlot (Golder 2010b), in which metals concentrations in filtered samples were generally observed to be lower than concentrations in unfiltered samples (e.g., copper concentrations in filtered samples were on average 4.2% of those in unfiltered samples).

For this model, release of metals from the solid phase into the dissolved phase during dredge dewatering was assumed to be negligible relative to the contribution of particulate-phase metals to total metals concentrations. Concentrations of chemical substances in the discharged water were therefore calculated from reported chemical concentrations in sediment (normalized to percent fines) and assumed concentrations of suspended sediment in the discharged water (ranging from 5 to 75 mg/L TSS).

When predicted total metals concentrations exceeded screening values, a further analysis was undertaken to evaluate dissolved metals concentrations. The rationale for this further analysis was that water quality guidelines are generally based on toxicity testing with soluble metal salts, and therefore the screening values derived from these water quality guidelines are most relevant to the evaluation of dissolved metals concentrations.

The results of DRET testing (Golder 2010b) were used to estimate the fraction of sediment metals expected to be in the dissolved phase following discharge. The dissolved fraction from DRET results was used to calculate a dissolved-phase concentration, which was then evaluated relative to the selected screening values.

6.0 MODEL ASSUMPTIONS

For the purposes of this modelling analysis, the following assumptions were made:

- The available sediment chemistry data were assumed to provide an accurate characterization of the sediment to be dredged;
- Depth-weighted average contaminant concentrations for each dredge unit (DU) provided by Anchor² were assumed to be representative of sediment contaminant conditions on a barge during dredging of that DU;
- Measured organic chemicals were assumed to be in dissolved or particulate-associated phases, *i.e.*, the volume of sediment to be dredged contains no non-aqueous phase liquid (NAPL);
- Measured organic chemicals were assumed to have the potential for release into the dissolved phase, *i.e.*, none is associated with non-desorbing (permanently sequestered) phases;
- Pre-dredging concentrations of substances in overlying seawater were assumed to be negligible;

² Depth-weighted average concentrations provided by Anchor for sediment dredge units by email dated January 12, 2011.

- The time available for desorption to occur (*i.e.*, between the time of placement of material on the barge and the time of discharge of the overlying water) was assumed to be 1 hour;
- The mean suspended sediment concentration of the dredged material suspension (sediment and entrained seawater) during the desorption period was assumed to be 500 mg/L;
- As noted above, release of metals from the solid phase into the dissolved phase prior to effluent discharge was assumed to be negligible; and,
- Metals and PAHs were assumed to be associated with the fines (< 0.075 mm) fraction of the sediment (*i.e.*, measured concentrations in sediment were normalized to percent fines), and the TSS in dredge discharge water was assumed to be entirely composed of this fines fraction.

7.0 WATER QUALITY SCREENING

Predicted total concentrations of select³ chemical substances in the discharged water were screened against numerical values representative of concentrations that would, in our opinion, ordinarily be considered acceptable for discharge into the marine environment, summarized in Table 1.

The benchmarks for evaluating PAHs have previously been accepted in Vancouver Harbour for other dredging projects. For convenience, the rationale for the selected concentrations are provided in the summary table. Predicted concentrations of metals were screened against benchmarks selected in the following order of priority:

- 10× CCME marine water quality guidelines⁴.
- 10× BC marine water quality guidelines⁵.
- 10× CCME freshwater quality guidelines⁴.
- 10× BC freshwater quality guidelines⁵.
- 10× US EPA acute marine water quality criteria⁶.

Where available, acute guidelines were selected over chronic guidelines.

WQG are not intended to be effluent limits, particularly for larger bodies of water such as Esquimalt Harbour, for several reasons, such as:

- WQG are often derived from conservative endpoints (*e.g.*, lowest observed effects concentrations or LOECs), and the most sensitive species for which toxicity test data are available, and
- Safety factors, often 10 times, are often applied to add conservatism.

³ Based on a preliminary screening exercise using the highest maximum sediment concentrations observed by sediment management areas, a subset of parameters was selected for more detailed analysis on the basis of smaller dredge units.

⁴ Canadian Council of Ministers of the Environment (CCME), "Canadian Water Quality Guidelines for the Protection of Aquatic Life", updated 2007 (CCME 1999).

⁵ BC Ministry of Environment, "A Compendium of Working Water Quality Guidelines for British Columbia", updated August 2006; and BC Ministry of Environment, "British Columbia Approved Water Quality Guidelines", updated January 2010 (BC MoE 2010).

⁶ U.S. Environmental Protection Agency, "National Recommended Water Quality Criteria", updated 2011 (US EPA, 2011). Accessed online at: <http://water.epa.gov/scitech/swguidance/standards/current/index.cfm>

A common approach to defining effluent limits, therefore, is to multiply a given WQG by ten.

The speciation of chromium in dredge discharge water is not known, and chromium was therefore evaluated relative to benchmarks based on the CCME water quality guidelines for both Cr (VI) and Cr (III). Tributyltin was not screened because only a chronic effects benchmark was available, which is not an appropriate basis for assessing potential effects of an acute exposure for this substance.

8.0 MODEL INPUTS

A preliminary series of model analyses was conducted to focus the investigation on substances with the potential to result in unacceptable discharge water quality. These analyses were based on the maximum fines-normalized concentration of each substance across SMAs, to provide a conservative evaluation of worst-case conditions across the proposed dredging area. This scenario estimated the discharge water quality that would result if the holding vessel contained suspended solids only from the area in which the highest concentration of a particular parameter was reported. This is not necessarily a realistic estimate of conditions that will result if a larger area is dredged (*i.e.*, containing some sediment with lower parameter concentrations), but was undertaken to give a high-level screening assessment of each parameter. If this evaluation resulted in predicted discharge water concentrations of a parameter that did not exceed the selected assessment benchmarks, this indicated that discharge water quality would be acceptable for that parameter for any portion of the dredging area.

Subsequent model analyses were based on average concentrations of substances in sediment within each Dredge Unit (DU) designated by Anchor as part of the remedial dredge plan. Estimated depth-weighted average sediment concentrations of arsenic, copper, zinc, and total PAHs in each DU were provided by Anchor. Concentrations of 10 individual PAHs were estimated by multiplying the total PAH concentration for each DU by the average fraction of total PAHs that each individual PAH represented in the sediment (based on reference to chemistry screening tables prepared by Golder as part of the Detailed Site Investigation for the Project). Individual PAH fractions were calculated for each SMA and applied to all DUs within that SMA.

Grain size and average total organic carbon were calculated by querying data available for the Project Area from the Esquimalt Harbour Access Database managed by SLR. Average total organic carbon and percent fines were calculated for each SMA and applied to all DUs within that SMA.

9.0 RESULTS

The modelling evaluation based on maximum fines-normalized concentrations across the SMAs resulted in predicted discharge water concentrations exceeding the screening values for arsenic, copper, zinc, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(ghi)perylene, chrysene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene. Predicted maximum discharge water concentrations of chromium exceeded the screening value for chromium (VI), but not for chromium (III). Given the absence of information about chromium speciation in dewatering effluent, and given that chromium concentrations in all but three sediment samples were less than the PEL, it was assumed that modelling the remaining substances would provide an appropriately conservative evaluation of effluent water quality. The remaining substances were evaluated further by modelling discharge water quality for each DU.

Predicted total concentrations of the modelled substances in discharge water for each DU are presented in Table 2a-n. Predicted concentrations exceeding the screening value are highlighted. The following substances exhibited one or more predicted total concentrations in excess of the screening value:

- **Copper:** Predicted total copper concentrations in discharge water exceeded the screening value at one or more TSS concentrations for 26 DUs. However, the majority of discharged copper is expected to be in the particulate phase, and therefore these predicted total copper concentrations do not necessarily represent a potential for adverse effects to marine life. Based on the results of DRET testing (Golder 2010b), the dissolved fraction of total copper was on average 4.2% (minimum 0.2%; maximum 16%; $n = 41$). Conservatively assuming the maximum fraction dissolved that was observed in DRET testing (*i.e.*, 16%), predicted dissolved copper exceeded the screening value only in DU19B (at TSS > 20 mg/L), DU20B (at TSS > 30 mg/L), and DU21 and DU49 (at TSS > 40 mg/L). DUs 19B, 20B, and 49 are along the eastern-most project boundary in Pilgrim Cove, and DU21 is along the North Landing Wharf (NLW; Figure 1). Assuming the average fraction dissolved observed in DRET testing (*i.e.*, 4.2%), predicted dissolved copper did not exceed the screening value in any of the DUs.
- **Zinc:** Predicted total zinc concentrations in discharge water exceeded the screening value at one or more TSS concentrations for 10 DUs. However, a fraction of discharged zinc is expected to be in the particulate phase, and therefore these predicted total zinc concentrations do not necessarily represent a potential for adverse effects to marine life. Based on the results of DRET testing (Golder 2010b), the dissolved fraction of total zinc was on average 14% (minimum 1%; maximum 58%; $n = 41$). Conservatively assuming the maximum fraction dissolved that was observed in DRET testing (*i.e.*, 58%), predicted dissolved zinc exceeded the screening value only in DU19B and DU20B (at TSS > 20 mg/L), DU49 (at TSS > 30 mg/L), DU21 (at TSS > 40 mg/L) and DU22 (at TSS > 70 mg/L). DUs 19B, 20B and 49 are along the eastern-most project boundary in Pilgrim Cove, and DUs 21 and 22 are along the NLW (Figure 1). Assuming the average fraction dissolved observed in DRET testing (*i.e.*, 14%), predicted dissolved zinc did not exceed the screening value in any DU.
- **PAHs:** Predicted concentrations in discharge water of one or more individual PAHs exceeded their respective screening values at one or more TSS concentrations for 9 DUs (DUs 18B, 19B, 20B, 32, 34, 39, 44, 48, and 49) (Figure 1). The DUs exhibiting predicted exceedances of screening values were those in SMA-5 and 5B (DUs 18B, 19B, 20B, 48, and 49 at the east end of the South Jetty), SMA-6 (DUs 34, 39, and 44 in the South Jetty under pier area), and SMA-3 (at the mouth of the Graving Dock; DU32 only). Predicted concentrations of anthracene exceeded the screening value at all modelled TSS concentrations in all nine of these DUs. Other PAHs exhibiting one or more predicted exceedances of screening values were naphthalene, benzo(a)anthracene, pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, phenanthrene, pyrene, benzo(a)pyrene, chrysene, and 2-methylnaphthalene.

10.0 INTERPRETATION

Under the assumptions of the model stated above, and based on the available sediment chemistry data, the modelling analysis predicted that discharge water from dewatering of dredged sediment on the barges in the majority of the site would likely be considered acceptable for discharge to the marine environment, subject to suitable control of TSS.

The following portions of the site were identified as requiring mitigation to avoid potential adverse effects to marine life:

- Nearshore areas adjacent to the South Jetty (SMA-5, -5B, -6 and -3): Predicted concentrations of one or more individual PAHs in discharge water exceeded screening values for most of the DUs within SMA-5 and -5B (DUs 18B, 19B, 20B, and 21B) and -6 (DUs 34, 39, and 44), and for DU32 in SMA-3. For several individual PAHs, predicted dissolved concentrations exceeded screening values, indicating that even strict TSS control may not be sufficient to prevent adverse effects. In addition, predicted concentrations of dissolved copper and dissolved zinc in discharge water exceed the screening values in several DUs within SMA-5 and -5B when the assumed TSS in discharge water was greater than 20 mg/L. The predicted concentrations of PAHs and dissolved metals indicate a potential for acute toxicity to marine life under the evaluated conditions. Dewatering effluent from these areas is likely to be unsuitable for discharge to the marine environment, therefore potentially requiring additional treatment and/or management methods prior to disposal.
- Nearshore areas adjacent to the North Landing Wharf (SMA-3): Predicted concentrations of dissolved copper and dissolved zinc in discharge water exceeded the screening values in DU21 and DU22 when the assumed TSS in discharge water was greater than 40 mg/L. Dewatering effluent from these areas is likely to be suitable for discharge to the marine environment with commonly applied controls (e.g., settling, filtration through fabric) to reduce TSS.
- Some additional DUs had total copper concentrations exceeding the screening value at one or more TSS concentrations. These areas were in SMA-3, -4 and -4B, and tended to be adjacent to the areas identified above. Given the results of DRET testing, dissolved copper concentrations in dewatering effluent from these DUs are not expected to exceed the screening value, and therefore it is unlikely that adverse effects to marine life will result. However, actual dissolved copper concentrations in dewatering effluent will not be known until dredging is underway. Monitoring of dredge dewatering effluent quality will be required to confirm these modelling results.

11.0 LIMITATIONS

This report was prepared for PWGSC, and is intended to provide an evaluation of potential discharge water quality during dredging. The findings and conclusions documented in this report have been prepared for the specific application to this project and have been developed in a manner consistent with that level of care normally exercised by environmental professionals currently practising under similar conditions in the jurisdiction. Golder makes no other warranty, expressed or implied.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Golder accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.

If new information is discovered during future work it is recommended that Golder be requested to re-evaluate the conclusions of this report and to provide amendments as required prior to any reliance upon the information presented herein.

12.0 CLOSURE

This assessment has been undertaken to support the identification of environmental mitigation measures for the Project and development of the Water Quality Monitoring plan for implementation during the dredging. We look forward to discussing the results further with the Project Team next fiscal year. Please contact the undersigned at your convenience should you have questions or comments.

Yours very truly,

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Attachments: Table 1 - Summary of Proposed Screening Benchmarks for Dredged Material Dewatering
Table 2 - Predicted Discharge Water Quality Results
Figure 1 – Location of Sediment Management Areas and Dredge Units in the Esquimalt Graving
Dock Waterlot and Buffer Areas

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13.0 REFERENCES

- Alexander M. (2000). "Aging, bioavailability, and overestimation of risk from environmental pollutants". Environ Sci Technol 34: 4259-4265.
- Black JA, Birge WJ, Westerman AG, Francis PC. (1983). "Comparative toxicology of aromatic hydrocarbons." Fundam Appl Toxicol 3: 353-358. Cited in CCME 1999.
- Bonnet C, Babut M, Ferard J-F, Martel L, Garric J. (2000). "Assessing the potential toxicity of re-suspended sediment". Environ Toxicol Chem 19: 1290-1296.
- Canadian Council of Ministers of the Environment (1999). Canadian Environmental Quality Guidelines (for sediment and water), updated to 2007. <<http://st-ts.ccme.ca/>>
- Calmano W, Hong J, Forstner U. (1993). "Binding and mobilisation of heavy metals in contaminated sediments affected by pH and redox potential". Water Sci Technol 28:223-235.
- Chen W, Kan AT, Fu G, Tomson M. (2000). "Factors affecting the release of hydrophobic organic contaminants from natural sediments". Environ Toxicol Chem 19: 2401-2408.
- Chen W, Kan AT, Fu G, Vignona C, Tomson M. (1999). "Adsorption-desorption behaviors of hydrophobic organic compounds in sediments of Lake Charles Louisiana, USA". Environ Toxicol Chem 18: 1610-1616.
- De Groote J, Dumon G, Vangheluwe M, Jansen C. (1998). "Environmental monitoring of dredging operations in the Belgian nearshore zone". Terra et Aqua 70: 21-25.
- DiToro DM, McGrath JA, Hansen DJ. 2000. Technical basis for narcotic chemicals and polycyclic aromatic hydrocarbon criteria. I. Water and tissue. Environ Toxicol Chem 19(8): 1951-1970.
- Eggleton J, Thomas KV. (2004). "A review of factors affecting the release and bioavailability of contaminants during sediment disturbance events". Environ Int 30: 973– 980.
- Forstner U, Ahlf W, Calmano W. (1989). "Studies on the transfer of heavy metals between sedimentary phases with a multi-chamber device: combined effects of salinity and redox potential". Mar Chem 28: 145–158.
- Golder Associates Ltd. (2010a) Esquimalt Graving Dock Waterlot Sediment Remediation Project, Fiscal Year 2010-2011 Input to Dredge Effects Assessment, dated November 18, 2010.
- Golder Associates Ltd. (2010b) Draft Letter on Preliminary Screening of Dredging Elutriate Test Results, dated December 23, 2010.
- Kan AT, Fu G, Hunter M, Chen W, Ward CH, Tomson MB. (1998). "Irreversible adsorption of neutral organic hydrocarbons-Experimental observations and model predictions". Environ Sci Technol 32: 892-902.
- Karickhoff SW. (1980). "Sorption kinetics of hydrophobic pollutants in natural sediments. In: Baker R.A., ed. Contaminants and sediments". Ann Arbor, MI: Ann Arbor Science Publ, pp. 193-205.
- Nagpal NK. 1993. Ambient water quality criteria for polycyclic aromatic hydrocarbons (PAHs). Ministry of Environment, Lands and Parks, Province of British Columbia.
- Nagpal NK. 1999. Ambient water quality criteria for zinc. Ministry of Environment, Lands and Parks, Province of British Columbia.

- Oris, JT, Giesy JP. (1987). "*The photoinduced toxicity of polycyclic aromatic hydrocarbons*". *Chemosphere* 16: 1395-1404. Cited in CCME 1999.
- Pieters A, Van Parys M, Dumon G, Speelers L. (2002). "*Chemical monitoring of maintenance dredging operations at Zeebrugge*". *Terra et Aqua* 86.
- Province of BC. Ministry of Environment. Contaminated Sites Regulation (1996). BC Reg. 375/96 O.C. 1480/96 and M271/2004 including amendments up to BC Reg. 286/2010, Schedule 9: Generic Numerical Sediment Criteria, updated to October 4, 2010.
<http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_00>
- Province of BC. Ministry of Environment (2010). Approved Water Quality Guidelines (updated to January 2010) and A Compendium of Working Water Quality Guidelines for British Columbia (updated to August 2006), Science and Information branch, Environmental Protection Division.
<http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html>
- Reible DD, Fleegeer JW, Pardue J, Tomson M, Kan A, Thibodeaux L. (2002). "*Contaminant release during removal and re-suspension*". <http://www.hsrc.org/hsrc/html/ssw/ssw-contaminant.html>.
- Saethre LG, Falk-Petersen IB, Sydnese LK, Lonning S, Naley AM. 1984. "*Toxicity and chemical reactivity of naphthalene and methylnaphthalenes*". *Aquat Toxicol* 5: 291-306.
- Sanchez FF, Thibodeaux LJ, Valsaraj KT, Reible DD. (2002). "*Multimedia chemical fate model for environmental dredging*". *Pract Periodical Haz Toxic Radioactive Waste Mgmt* 6: 120-128.
- Singleton HJ. 1987. Water quality criteria for copper: technical appendix. Ministry of Environment and Parks, Province of British Columbia.
- Thibodeaux LJ. (2005a). "*A Recent advances in our understanding of sediment-to-water contaminant fluxes-The soluble release fraction*". *Aquat Ecosyst Health Mgmt* 8: 1-9.
- Thibodeaux LJ, Birdwell J, Reible DD. (2005b). "*Soluble contaminant release during bed sediment removal and resuspension-chemodynamic model predictions*". Platform Presentation, "*Society of Environmental Toxicology and Chemistry North America 26th Annual Meeting*", 13-17 November 2005, Baltimore, MD, USA.
- Van Den Berg GA, Meijers GGA, Van Der Heijdt LM, Zwolsman JJG. (2001). "*Dredging-related mobilisation of trace metals: A case study in the Netherlands*". *Wat Res* 35: 1979-1986.

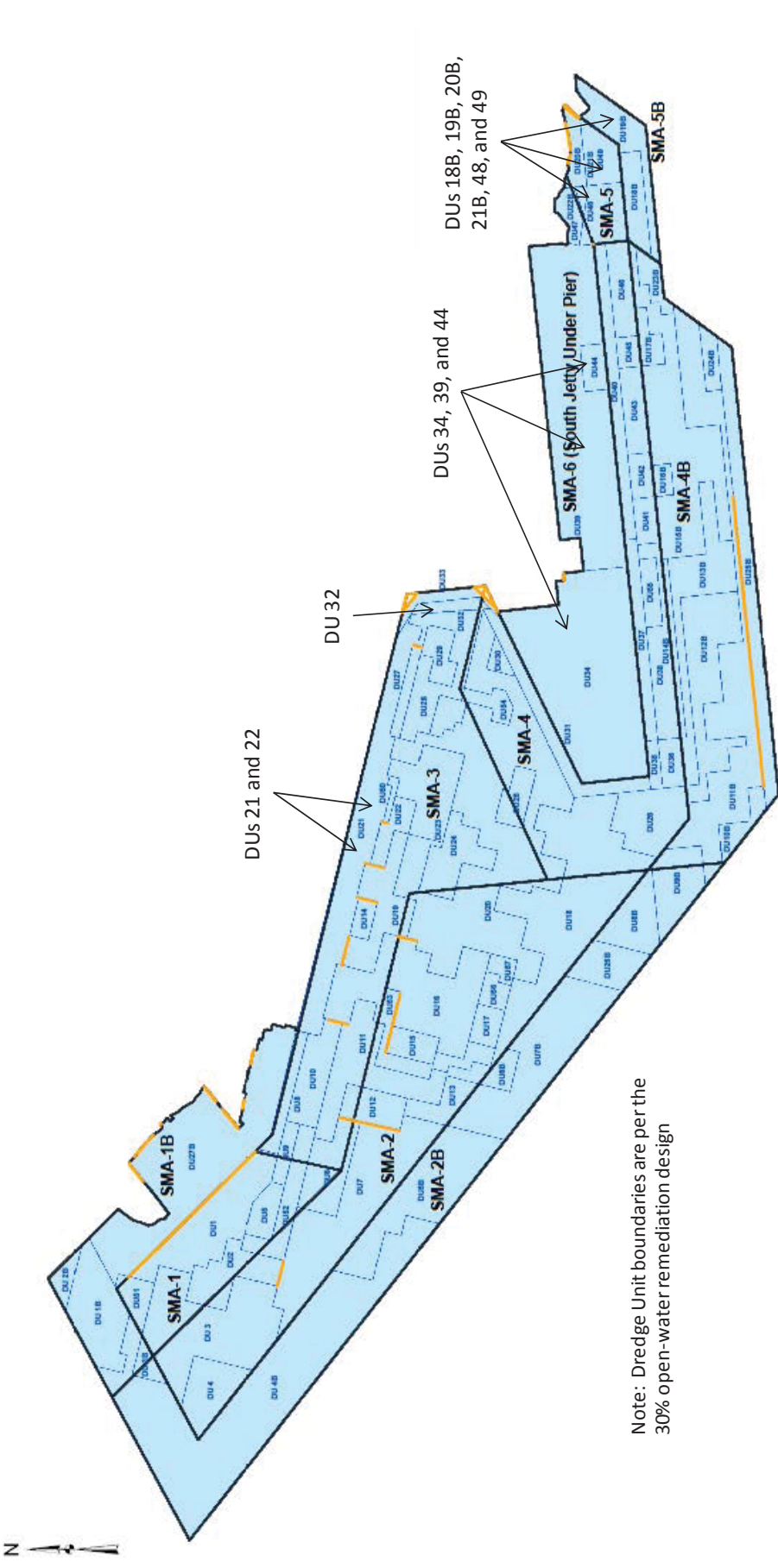


Figure 1: Location of Sediment Management Areas and Dredge Units in the Esquimalt Graving Dock Waterlot and Buffer Areas

Table 1: Summary of Proposed Dredge Discharge Benchmarks for Select Parameters

Parameter	Proposed Benchmark (µg/L)	Approach	Rationale
<i>Polycyclic Aromatic Hydrocarbons</i>			
Anthracene	5.0	Literature review*	The lowest available toxicity data point (a 96-h LC ₀ for fathead minnow fry; Oris and Giesy 1987, cited in CCME 1999) without a safety factor because the data point represents a no-effect level.
Benzo(a)anthracene	1.8	Literature review	The lowest available toxicity data point (a 96-h LC ₀ for fathead minnow fry; Oris and Giesy 1987, cited in CCME 1999) without a safety factor because the data point represents a no-effect level.
Benzo(b)fluoranthene	8.6	QSAR **	Based on methods of DiToro et al. (2000).
Benzo(a)pyrene	5.6	Literature review	The lowest available toxicity data point (a 96-h LC ₀ for fathead minnow fry; Oris and Giesy 1987, cited in CCME 1999) without a safety factor because the data point represents a no-effect level. Further weight of evidence assessment of available toxicity data indicated that the value is similar to the results of guppy and Japanese medaka tested in a 6-h acute toxicity test and thus would be protective of shorter term discharges. Other endpoints were determined not to apply.
Benzo(g,h,i)perylene	1	QSAR	Based on methods of DiToro et al. (2000).
Chrysene	8.6	QSAR	Based on methods of DiToro et al. (2000).
2-Methylnaphthalene	58	Literature review	The lowest available toxicity data point (a 96-h LC ₂₇ for cod embryos; Saethre et al. 1984) with a 10-fold safety factor. The safety factor was applied to address uncertainty introduced by the number of studies available and species assessed.
Naphthalene	100	Literature review	The lower 95% CL of the lowest available toxicity data point (a 96-h LC ₅₀ for rainbow trout embryos; Black et al. 1983, cited in CCME 1999) without a safety factor. A safety factor was not applied because the results of 24-h LC ₅₀ tests were greater than the selected benchmark, suggesting that acute toxicity to site-specific fin-fish at the point of discharge would be unlikely.
Phenanthrene	40	Literature review	The lower 95% CL of the second lowest available toxicity data point (a 96-h LC ₅₀ for rainbow trout embryos; Black et al. 1983; cited in CCME 1999) without a safety factor. The lowest available toxicity data point was not used because it was not considered to be directly applicable (<i>i.e.</i> , it was for a 27-d rainbow trout embryo LC ₅₀).
Pyrene	12.8	Literature review	The lowest available toxicity data point (a 96-h LC ₀ for fathead minnow fry; Oris and Giesy 1987, cited in CCME 1999) with a 2-fold safety factor. Although the selected data point represented a no-effect level, the 2-fold safety factor was considered necessary because only one data point was available.

Parameter	Proposed Benchmark (µg/L)	Approach	Rationale
Metals			
Arsenic	125	CCME marine WQG, X by 10	The WQG was derived based on the application of a 10-times safety factor to the LOEC of the most sensitive species for which toxicity data were available (a marine diatom, <i>Skeletonema costatum</i>). The screening value is lower than the maximum authorized monthly mean concentration specified in the MMER for discharges from metal mines (i.e., 500 µg/L).
Copper	30	BC marine maximum WQG X by 10	The WQG was derived based on acute toxicity to oyster and mussel larvae (96-h LC ₅₀ = 5.3-5.8 µg/L) (Singleton 1987). Adult stages of invertebrates are less sensitive to copper, as are fish. The screening value is lower than the maximum authorized monthly mean concentration specified in the MMER for discharges from metal mines (i.e., 300 µg/L).
Zinc	100	BC marine maximum WQG X by 10	The WQG was derived based on the application of a 5-times safety factor applied to chronic toxicity to two marine diatoms (Nagpal 1999). The screening value is lower than the maximum authorized monthly mean concentration specified in the MMER for discharges from metal mines (i.e., 500 µg/L).

Notes:

* The literature review included a search of available electronic databases (e.g., BIOSIS), on-line toxicological databases (e.g., USEPA ECOTOX) and data compilations used for regulatory purposes (e.g., CCME 1999, Nagpal 1993). Lethal concentration values resulting in 50% mortality (LC₅₀) were obtained for both freshwater and marine fish species as the expectation of the *Fisheries Act* is that at the point of discharge, the dewatering effluent with non-acutely lethal, operationally defined by Environment Canada and MOE as 96-h LC₅₀ ≥ 100% for rainbow trout. Invertebrates were excluded from the literature search because by nature dredging will be removed by the physical activity of the dredging.

** The Target Lipid approach is based on a QSAR for PAH compounds developed by DiToro et al. (2000). The underlying principle of the Target Lipid approach is that the target lipid is the site of PAH action in the organism and that the target lipid has the same lipid-octanol linear free energy relationship irrespective of species. DiToro et al. (2000) derived a method for developing water quality criteria for narcotic chemicals (Type 1) and specifically for PAHs, based on using a single universal slope for the log LC₅₀ versus log K_{ow} (octanol-water partitioning coefficient) QSAR for all species.

CCME – Canadian Council of Ministers of the Environment; CL – confidence limit; LOEC – lowest observed effects concentration; MMER – Metal Mining Effluent Regulation; QSAR – Quantitative Structure-Activity Relationship; WQG – water quality guideline.

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Anthracene								
TSS (mg/L) ==>	5	10	20	30	40	50	60	70	75
1	0.806	0.808	0.811	0.814	0.817	0.82	0.823	0.827	0.828
2	0.144	0.145	0.145	0.146	0.146	0.147	0.148	0.148	0.148
3	0.522	0.523	0.525	0.527	0.529	0.531	0.532	0.534	0.535
4	0.0988	0.099	0.0993	0.0997	0.100	0.100	0.101	0.101	0.101
5	1.19	1.19	1.2	1.2	1.21	1.21	1.22	1.22	1.22
6	1.09	1.09	1.10	1.10	1.11	1.11	1.12	1.12	1.13
7	0.115	0.115	0.115	0.116	0.116	0.117	0.117	0.117	0.118
8	0.573	0.574	0.577	0.58	0.582	0.585	0.588	0.591	0.592
9	1.92	1.93	1.94	1.94	1.95	1.96	1.97	1.98	1.99
10	0.123	0.123	0.124	0.125	0.125	0.126	0.126	0.127	0.127
11	0.151	0.152	0.152	0.153	0.154	0.154	0.155	0.156	0.156
12	0.116	0.116	0.116	0.117	0.117	0.118	0.118	0.118	0.119
13	0.0707	0.0708	0.0711	0.0713	0.0716	0.0718	0.0721	0.0724	0.0725
14	0.659	0.66	0.663	0.667	0.67	0.673	0.676	0.679	0.681
15	0.121	0.121	0.122	0.122	0.123	0.123	0.124	0.124	0.124
16	0.141	0.141	0.142	0.142	0.143	0.143	0.144	0.144	0.145
17	0.0903	0.0904	0.0908	0.0911	0.0914	0.0917	0.0921	0.0924	0.0925
18	0.0865	0.0867	0.087	0.0873	0.0876	0.0879	0.0883	0.0886	0.0887
19	0.528	0.529	0.531	0.534	0.536	0.539	0.542	0.544	0.545
20	0.301	0.302	0.304	0.305	0.307	0.308	0.309	0.311	0.312
21	1.03	1.03	1.03	1.04	1.04	1.05	1.05	1.06	1.06
22	0.358	0.359	0.361	0.363	0.365	0.366	0.368	0.37	0.371
23	0.221	0.222	0.223	0.224	0.225	0.226	0.227	0.228	0.229
24	0.0895	0.0897	0.0902	0.0906	0.091	0.0914	0.0919	0.0923	0.0925
25	0.106	0.106	0.107	0.107	0.108	0.108	0.109	0.11	0.11
26	0.107	0.107	0.108	0.109	0.109	0.11	0.11	0.111	0.111
27	0.279	0.28	0.281	0.282	0.284	0.285	0.286	0.288	0.288
28	2.03	2.04	2.05	2.06	2.07	2.08	2.09	2.10	2.10
29	1.57	1.57	1.58	1.59	1.60	1.60	1.61	1.62	1.62
30	1.83	1.84	1.85	1.86	1.87	1.88	1.89	1.9	1.9
31	0.933	0.935	0.94	0.946	0.951	0.956	0.961	0.966	0.969
32	5.23	5.24	5.26	5.29	5.31	5.34	5.36	5.39	5.4
34	12.2	12.3	12.3	12.4	12.5	12.5	12.6	12.7	12.7
35	0.254	0.255	0.256	0.258	0.259	0.26	0.262	0.263	0.264
36	0.251	0.252	0.253	0.255	0.256	0.258	0.259	0.26	0.261
38	1.77	1.77	1.78	1.79	1.8	1.81	1.82	1.83	1.84
39	16.5	16.6	16.7	16.8	16.9	17	17.1	17.2	17.2
40	1.29	1.29	1.3	1.31	1.31	1.32	1.33	1.33	1.34
41	0.857	0.86	0.864	0.869	0.874	0.879	0.883	0.888	0.891
42	0.0784	0.0786	0.0791	0.0795	0.0799	0.0804	0.0808	0.0812	0.0815
43	1.69	1.69	1.7	1.71	1.72	1.73	1.74	1.75	1.76
44	7.88	7.91	7.95	8	8.05	8.1	8.14	8.19	8.21
45	1.22	1.22	1.23	1.23	1.24	1.25	1.25	1.26	1.26
46	0.339	0.339	0.341	0.343	0.345	0.347	0.349	0.351	0.352
48	36.6	36.7	36.8	36.9	37	37.1	37.2	37.3	37.4
49	42	42.1	42.2	42.4	42.5	42.6	42.8	42.9	42.9
50	0.724	0.726	0.73	0.733	0.737	0.74	0.744	0.747	0.749
51	0.13	0.13	0.131	0.131	0.132	0.132	0.133	0.133	0.133
52	0.972	0.974	0.978	0.981	0.985	0.989	0.993	0.996	0.998
53	0.497	0.498	0.501	0.503	0.506	0.508	0.51	0.513	0.514
54	1.35	1.36	1.36	1.37	1.38	1.39	1.39	1.4	1.4
55	2.9	2.91	2.92	2.94	2.96	2.97	2.99	3	3.01
56	0.0903	0.0904	0.0908	0.0911	0.0914	0.0917	0.0921	0.0924	0.0925
57	0.0903	0.0904	0.0908	0.0911	0.0914	0.0917	0.0921	0.0924	0.0925
1B	1.69	1.69	1.7	1.7	1.71	1.72	1.72	1.73	1.73
2B	1.89	1.89	1.9	1.91	1.91	1.92	1.93	1.94	1.94
3B	0.0712	0.0714	0.0718	0.0722	0.0726	0.073	0.0734	0.0738	0.074
4B	0.0955	0.0957	0.0963	0.0968	0.0973	0.0978	0.0984	0.0989	0.0992
5B	0.0459	0.0461	0.0463	0.0466	0.0468	0.0471	0.0473	0.0476	0.0477
6B	0.0385	0.0386	0.0388	0.039	0.0392	0.0394	0.0397	0.0399	0.04
7B	0.046	0.0461	0.0463	0.0466	0.0469	0.0471	0.0474	0.0476	0.0477
8B	0.34	0.341	0.343	0.345	0.347	0.349	0.351	0.352	0.353
9B	0.349	0.35	0.352	0.354	0.356	0.358	0.36	0.362	0.363
10B	0.0137	0.0137	0.0138	0.0138	0.0139	0.014	0.0141	0.0141	0.0142
11B	0.0956	0.0959	0.0964	0.0969	0.0973	0.0978	0.0983	0.0988	0.099
12B	0.342	0.343	0.345	0.346	0.348	0.35	0.351	0.353	0.354
13B	0.43	0.431	0.433	0.435	0.437	0.44	0.442	0.444	0.445
14B	0.976	0.979	0.984	0.989	0.994	0.998	1	1.01	1.01
15B	0.435	0.436	0.438	0.44	0.443	0.445	0.447	0.449	0.45
16B	0.0809	0.0811	0.0815	0.0819	0.0824	0.0828	0.0832	0.0836	0.0838
17B	0.0342	0.0343	0.0344	0.0346	0.0348	0.0349	0.0351	0.0353	0.0354
18B	7.21	7.23	7.27	7.31	7.35	7.39	7.43	7.48	7.5
19B	8.14	8.16	8.21	8.26	8.31	8.35	8.4	8.45	8.47
20B	39.2	39.3	39.4	39.5	39.7	39.8	39.9	40	40.1
23B	0.298	0.299	0.301	0.302	0.304	0.305	0.307	0.308	0.309
24B	0.0149	0.0149	0.015	0.0151	0.0152	0.0152	0.0153	0.0154	0.0154
25B	0.164	0.164	0.165	0.166	0.167	0.167	0.168	0.169	0.17
26B	0.526	0.527	0.53	0.533	0.536	0.539	0.542	0.545	0.546
27B	1.76	1.76	1.77	1.77	1.78	1.79	1.79	1.8	1.8

Screening benchmark = 5 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Benzo(a)anthracene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.0804	0.0838	0.0908	0.0977	0.105	0.112	0.118	0.125	0.129
2	0.0144	0.015	0.0163	0.0175	0.0187	0.02	0.0212	0.0225	0.0231
3	0.0466	0.0485	0.0523	0.056	0.0598	0.0636	0.0674	0.0711	0.073
4	0.00882	0.00917	0.00989	0.0106	0.0113	0.012	0.0127	0.0135	0.0138
5	0.119	0.124	0.134	0.144	0.154	0.165	0.175	0.185	0.19
6	0.106	0.112	0.123	0.134	0.145	0.157	0.168	0.179	0.185
7	0.0102	0.0107	0.0115	0.0123	0.0131	0.014	0.0148	0.0156	0.0161
8	0.0556	0.0586	0.0646	0.0705	0.0764	0.0824	0.0883	0.0942	0.0972
9	0.187	0.197	0.217	0.236	0.256	0.276	0.296	0.316	0.326
10	0.012	0.0126	0.0139	0.0151	0.0164	0.0177	0.019	0.0202	0.0209
11	0.0147	0.0155	0.017	0.0186	0.0202	0.0217	0.0233	0.0249	0.0257
12	0.0103	0.0107	0.0116	0.0124	0.0133	0.0141	0.0149	0.0158	0.0162
13	0.00631	0.00656	0.00708	0.00759	0.0081	0.00861	0.00912	0.00964	0.00989
14	0.064	0.0674	0.0742	0.0811	0.0879	0.0947	0.102	0.108	0.112
15	0.0108	0.0113	0.0121	0.013	0.0139	0.0148	0.0156	0.0165	0.017
16	0.0126	0.0131	0.0141	0.0151	0.0162	0.0172	0.0182	0.0192	0.0197
17	0.00805	0.00838	0.00904	0.00969	0.0103	0.011	0.0116	0.0123	0.0126
18	0.00772	0.00804	0.00866	0.00929	0.00992	0.0105	0.0112	0.0118	0.0121
19	0.0513	0.054	0.0595	0.0649	0.0704	0.0759	0.0813	0.0868	0.0896
20	0.0293	0.0309	0.034	0.0371	0.0402	0.0434	0.0465	0.0496	0.0512
21	0.0998	0.105	0.116	0.126	0.137	0.148	0.158	0.169	0.174
22	0.0348	0.0367	0.0404	0.0441	0.0478	0.0516	0.0553	0.059	0.0608
23	0.0215	0.0226	0.0249	0.0272	0.0295	0.0318	0.0341	0.0364	0.0375
24	0.0087	0.00916	0.0101	0.011	0.0119	0.0129	0.0138	0.0147	0.0152
25	0.00847	0.00899	0.01	0.011	0.0121	0.0131	0.0141	0.0152	0.0157
26	0.00858	0.0091	0.0101	0.0112	0.0122	0.0133	0.0143	0.0154	0.0159
27	0.0271	0.0286	0.0314	0.0343	0.0372	0.0401	0.043	0.0459	0.0474
28	0.197	0.208	0.229	0.25	0.271	0.292	0.313	0.334	0.345
29	0.153	0.161	0.177	0.193	0.209	0.226	0.242	0.258	0.266
30	0.147	0.156	0.173	0.191	0.209	0.227	0.245	0.263	0.272
31	0.0747	0.0792	0.0883	0.0974	0.107	0.116	0.125	0.134	0.138
32	0.508	0.535	0.589	0.643	0.697	0.751	0.806	0.86	0.887
34	0.845	0.9	1.01	1.12	1.23	1.35	1.46	1.57	1.62
35	0.0203	0.0216	0.0241	0.0265	0.029	0.0315	0.034	0.0364	0.0377
36	0.0201	0.0214	0.0238	0.0263	0.0287	0.0312	0.0336	0.0361	0.0373
38	0.142	0.15	0.168	0.185	0.202	0.219	0.237	0.254	0.262
39	1.14	1.22	1.37	1.52	1.67	1.82	1.97	2.12	2.2
40	0.103	0.109	0.122	0.135	0.147	0.16	0.172	0.185	0.191
41	0.0686	0.0728	0.0812	0.0895	0.0979	0.106	0.115	0.123	0.127
42	0.00628	0.00666	0.00743	0.00819	0.00895	0.00972	0.0105	0.0112	0.0116
43	0.135	0.144	0.16	0.177	0.193	0.209	0.226	0.242	0.251
44	0.545	0.581	0.653	0.725	0.796	0.868	0.94	1.01	1.05
45	0.0973	0.103	0.115	0.127	0.139	0.151	0.162	0.174	0.18
46	0.0271	0.0288	0.0321	0.0354	0.0387	0.042	0.0453	0.0486	0.0502
48	3.34	3.45	3.69	3.92	4.16	4.4	4.63	4.87	4.99
49	3.83	3.96	4.24	4.51	4.78	5.05	5.32	5.59	5.72
50	0.0704	0.0741	0.0816	0.0892	0.0967	0.104	0.112	0.119	0.123
51	0.0129	0.0135	0.0146	0.0157	0.0169	0.018	0.0191	0.0202	0.0208
52	0.0969	0.101	0.109	0.118	0.126	0.134	0.143	0.151	0.155
53	0.0483	0.0509	0.056	0.0612	0.0663	0.0715	0.0767	0.0818	0.0844
54	0.108	0.115	0.128	0.141	0.154	0.168	0.181	0.194	0.2
55	0.232	0.246	0.275	0.303	0.331	0.359	0.388	0.416	0.43
56	0.00805	0.00838	0.00904	0.00969	0.0103	0.011	0.0116	0.0123	0.0126
57	0.00805	0.00838	0.00904	0.00969	0.0103	0.011	0.0116	0.0123	0.0126
1B	0.118	0.123	0.134	0.144	0.154	0.164	0.175	0.185	0.19
2B	0.132	0.138	0.15	0.161	0.172	0.184	0.195	0.207	0.212
3B	0.0081	0.00859	0.00958	0.0106	0.0116	0.0125	0.0135	0.0145	0.015
4B	0.0109	0.0115	0.0128	0.0142	0.0155	0.0168	0.0181	0.0194	0.0201
5B	0.00522	0.00554	0.00618	0.00681	0.00745	0.00808	0.00872	0.00936	0.00967
6B	0.00438	0.00464	0.00517	0.00571	0.00624	0.00677	0.0073	0.00784	0.0081
7B	0.00523	0.00554	0.00618	0.00682	0.00745	0.00809	0.00872	0.00936	0.00968
8B	0.0387	0.041	0.0457	0.0504	0.0551	0.0599	0.0646	0.0693	0.0716
9B	0.0397	0.0421	0.047	0.0518	0.0566	0.0615	0.0663	0.0711	0.0736
10B	0.00131	0.00139	0.00153	0.00168	0.00183	0.00197	0.00212	0.00227	0.00234
11B	0.00919	0.0097	0.0107	0.0118	0.0128	0.0138	0.0148	0.0159	0.0164
12B	0.0329	0.0347	0.0384	0.042	0.0457	0.0494	0.053	0.0567	0.0586
13B	0.0413	0.0436	0.0482	0.0528	0.0575	0.0621	0.0667	0.0713	0.0736
14B	0.0938	0.099	0.11	0.12	0.13	0.141	0.151	0.162	0.167
15B	0.0418	0.0441	0.0488	0.0535	0.0581	0.0628	0.0675	0.0721	0.0745
16B	0.00777	0.00821	0.00908	0.00995	0.0108	0.0117	0.0126	0.0134	0.0139
17B	0.00328	0.00347	0.00383	0.0042	0.00457	0.00493	0.0053	0.00567	0.00585
18B	0.7	0.744	0.833	0.921	1.01	1.1	1.19	1.28	1.32
19B	0.79	0.84	0.941	1.04	1.14	1.24	1.34	1.44	1.49
20B	3.57	3.7	3.95	4.21	4.46	4.71	4.96	5.22	5.34
23B	0.0287	0.0303	0.0335	0.0367	0.0399	0.0431	0.0463	0.0495	0.0511
24B	0.00143	0.00151	0.00167	0.00183	0.00199	0.00215	0.00231	0.00247	0.00255
25B	0.0157	0.0166	0.0184	0.0201	0.0219	0.0236	0.0254	0.0272	0.028
26B	0.0598	0.0634	0.0707	0.078	0.0853	0.0925	0.0998	0.107	0.111
27B	0.123	0.128	0.139	0.15	0.16	0.171	0.182	0.192	0.198

Screening benchmark = 1.8 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Benzo[a]pyrene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.0704	0.0744	0.0825	0.0905	0.0986	0.107	0.115	0.123	0.127
2	0.0126	0.0133	0.0148	0.0162	0.0177	0.0191	0.0206	0.022	0.0227
3	0.0354	0.0373	0.0411	0.0449	0.0487	0.0526	0.0564	0.0602	0.0621
4	0.00669	0.00706	0.00778	0.0085	0.00922	0.00995	0.0107	0.0114	0.0118
5	0.104	0.11	0.122	0.134	0.146	0.157	0.169	0.181	0.187
6	0.1	0.107	0.122	0.136	0.15	0.164	0.178	0.193	0.2
7	0.00777	0.00819	0.00903	0.00987	0.0107	0.0115	0.0124	0.0132	0.0136
8	0.0528	0.0565	0.064	0.0714	0.0789	0.0863	0.0938	0.101	0.105
9	0.177	0.19	0.215	0.24	0.265	0.29	0.315	0.34	0.352
10	0.0113	0.0121	0.0137	0.0153	0.0169	0.0185	0.0201	0.0217	0.0225
11	0.0139	0.0149	0.0169	0.0188	0.0208	0.0228	0.0248	0.0267	0.0277
12	0.00784	0.00826	0.00911	0.00996	0.0108	0.0116	0.0125	0.0133	0.0138
13	0.00479	0.00505	0.00557	0.00608	0.0066	0.00712	0.00763	0.00815	0.00841
14	0.0607	0.065	0.0736	0.0821	0.0907	0.0993	0.108	0.116	0.121
15	0.00821	0.00866	0.00954	0.0104	0.0113	0.0122	0.0131	0.014	0.0144
16	0.00956	0.0101	0.0111	0.0121	0.0132	0.0142	0.0152	0.0163	0.0168
17	0.00612	0.00645	0.00711	0.00777	0.00843	0.00909	0.00975	0.0104	0.0107
18	0.00587	0.00618	0.00681	0.00745	0.00808	0.00871	0.00935	0.00998	0.0103
19	0.0486	0.052	0.0589	0.0658	0.0727	0.0795	0.0864	0.0933	0.0967
20	0.0278	0.0297	0.0337	0.0376	0.0415	0.0454	0.0494	0.0533	0.0553
21	0.0947	0.101	0.115	0.128	0.141	0.155	0.168	0.182	0.188
22	0.033	0.0354	0.04	0.0447	0.0494	0.054	0.0587	0.0634	0.0657
23	0.0204	0.0218	0.0247	0.0276	0.0305	0.0333	0.0362	0.0391	0.0405
24	0.00825	0.00883	0.01	0.0112	0.0123	0.0135	0.0147	0.0158	0.0164
25	0.00857	0.00926	0.0106	0.012	0.0134	0.0148	0.0162	0.0175	0.0182
26	0.00868	0.00938	0.0108	0.0122	0.0136	0.015	0.0164	0.0178	0.0185
27	0.0257	0.0275	0.0312	0.0348	0.0384	0.0421	0.0457	0.0493	0.0511
28	0.187	0.2	0.227	0.253	0.28	0.306	0.333	0.359	0.372
29	0.145	0.155	0.175	0.196	0.216	0.237	0.257	0.277	0.288
30	0.148	0.16	0.184	0.208	0.232	0.256	0.28	0.303	0.315
31	0.0756	0.0817	0.0938	0.106	0.118	0.13	0.142	0.155	0.161
32	0.481	0.515	0.583	0.652	0.72	0.788	0.856	0.924	0.958
34	0.622	0.676	0.783	0.891	0.999	1.11	1.21	1.32	1.38
35	0.0206	0.0222	0.0256	0.0289	0.0322	0.0355	0.0388	0.0421	0.0438
36	0.0204	0.022	0.0253	0.0286	0.0318	0.0351	0.0384	0.0417	0.0433
38	0.143	0.155	0.178	0.201	0.224	0.247	0.27	0.293	0.305
39	0.841	0.914	1.06	1.21	1.35	1.5	1.64	1.79	1.86
40	0.104	0.113	0.13	0.146	0.163	0.18	0.197	0.214	0.222
41	0.0695	0.0751	0.0862	0.0974	0.109	0.12	0.131	0.142	0.148
42	0.00636	0.00687	0.00789	0.00891	0.00993	0.011	0.012	0.013	0.0135
43	0.137	0.148	0.17	0.192	0.214	0.236	0.258	0.28	0.291
44	0.401	0.436	0.506	0.575	0.645	0.714	0.784	0.854	0.889
45	0.0985	0.106	0.122	0.138	0.154	0.17	0.186	0.201	0.209
46	0.0274	0.0296	0.034	0.0385	0.0429	0.0473	0.0517	0.0561	0.0583
48	3.01	3.15	3.44	3.72	4	4.29	4.57	4.85	5
49	3.46	3.62	3.95	4.27	4.6	4.92	5.25	5.57	5.74
50	0.0667	0.0715	0.0809	0.0903	0.0997	0.109	0.119	0.128	0.133
51	0.0113	0.012	0.0133	0.0146	0.0159	0.0172	0.0185	0.0198	0.0204
52	0.0848	0.0897	0.0994	0.109	0.119	0.129	0.138	0.148	0.153
53	0.0458	0.049	0.0555	0.062	0.0685	0.0749	0.0814	0.0879	0.0911
54	0.11	0.118	0.136	0.154	0.171	0.189	0.206	0.224	0.233
55	0.235	0.254	0.292	0.329	0.367	0.405	0.443	0.481	0.5
56	0.00612	0.00645	0.00711	0.00777	0.00843	0.00909	0.00975	0.0104	0.0107
57	0.00612	0.00645	0.00711	0.00777	0.00843	0.00909	0.00975	0.0104	0.0107
1B	0.0924	0.0977	0.108	0.119	0.129	0.14	0.151	0.161	0.167
2B	0.103	0.109	0.121	0.133	0.145	0.157	0.169	0.18	0.186
3B	0.0075	0.0081	0.00931	0.0105	0.0117	0.0129	0.0141	0.0153	0.0159
4B	0.01	0.0109	0.0125	0.0141	0.0157	0.0173	0.0189	0.0206	0.0214
5B	0.00484	0.00523	0.006	0.00678	0.00756	0.00834	0.00911	0.00989	0.0103
6B	0.00405	0.00438	0.00503	0.00568	0.00633	0.00698	0.00763	0.00829	0.00861
7B	0.00484	0.00523	0.00601	0.00678	0.00756	0.00834	0.00912	0.0099	0.0103
8B	0.0358	0.0387	0.0444	0.0502	0.056	0.0617	0.0675	0.0732	0.0761
9B	0.0368	0.0397	0.0456	0.0516	0.0575	0.0634	0.0693	0.0752	0.0782
10B	0.0013	0.0014	0.00159	0.00178	0.00198	0.00217	0.00236	0.00256	0.00265
11B	0.00912	0.00979	0.0111	0.0125	0.0138	0.0152	0.0165	0.0179	0.0186
12B	0.0326	0.035	0.0398	0.0447	0.0495	0.0543	0.0591	0.0639	0.0663
13B	0.041	0.044	0.0501	0.0561	0.0622	0.0682	0.0743	0.0804	0.0834
14B	0.0931	0.0999	0.114	0.127	0.141	0.155	0.169	0.183	0.189
15B	0.0415	0.0445	0.0507	0.0568	0.0629	0.069	0.0752	0.0813	0.0844
16B	0.00771	0.00828	0.00942	0.0106	0.0117	0.0128	0.014	0.0151	0.0157
17B	0.00326	0.0035	0.00398	0.00446	0.00494	0.00542	0.00591	0.00639	0.00663
18B	0.797	0.864	0.997	1.13	1.26	1.4	1.53	1.66	1.73
19B	0.9	0.976	1.13	1.28	1.43	1.58	1.73	1.88	1.95
20B	3.23	3.38	3.68	3.99	4.29	4.59	4.9	5.2	5.35
23B	0.0284	0.0305	0.0348	0.039	0.0432	0.0474	0.0516	0.0558	0.0579
24B	0.00142	0.00152	0.00173	0.00194	0.00215	0.00236	0.00257	0.00278	0.00289
25B	0.0156	0.0168	0.0191	0.0214	0.0237	0.026	0.0283	0.0306	0.0318
26B	0.0554	0.0598	0.0687	0.0776	0.0865	0.0954	0.104	0.113	0.118
27B	0.0961	0.102	0.113	0.124	0.135	0.146	0.157	0.168	0.173

Screening benchmark = 5.6 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Benzo[b]fluoranthene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.179	0.185	0.197	0.209	0.221	0.233	0.245	0.257	0.263
2	0.032	0.0331	0.0352	0.0374	0.0396	0.0417	0.0439	0.0461	0.0471
3	0.0895	0.0923	0.098	0.104	0.109	0.115	0.121	0.126	0.129
4	0.0169	0.0175	0.0185	0.0196	0.0207	0.0218	0.0228	0.0239	0.0245
5	0.264	0.272	0.29	0.308	0.326	0.344	0.362	0.379	0.388
6	0.242	0.252	0.272	0.293	0.313	0.333	0.354	0.374	0.384
7	0.0197	0.0203	0.0215	0.0228	0.024	0.0253	0.0265	0.0278	0.0284
8	0.127	0.133	0.143	0.154	0.164	0.175	0.186	0.196	0.202
9	0.427	0.444	0.48	0.516	0.552	0.588	0.623	0.659	0.677
10	0.0273	0.0285	0.0308	0.033	0.0353	0.0376	0.0399	0.0422	0.0433
11	0.0336	0.035	0.0378	0.0406	0.0434	0.0462	0.049	0.0519	0.0533
12	0.0198	0.0205	0.0217	0.023	0.0242	0.0255	0.0268	0.028	0.0287
13	0.0121	0.0125	0.0133	0.014	0.0148	0.0156	0.0164	0.0171	0.0175
14	0.146	0.152	0.165	0.177	0.189	0.201	0.214	0.226	0.232
15	0.0208	0.0214	0.0228	0.0241	0.0254	0.0267	0.028	0.0294	0.03
16	0.0242	0.0249	0.0265	0.028	0.0295	0.0311	0.0326	0.0342	0.0349
17	0.0155	0.016	0.0169	0.0179	0.0189	0.0199	0.0209	0.0219	0.0224
18	0.0148	0.0153	0.0162	0.0172	0.0181	0.0191	0.02	0.021	0.0214
19	0.117	0.122	0.132	0.142	0.152	0.161	0.171	0.181	0.186
20	0.0669	0.0697	0.0754	0.081	0.0866	0.0922	0.0978	0.103	0.106
21	0.228	0.238	0.257	0.276	0.295	0.314	0.333	0.352	0.362
22	0.0796	0.0829	0.0896	0.0963	0.103	0.11	0.116	0.123	0.126
23	0.0491	0.0512	0.0553	0.0594	0.0635	0.0676	0.0718	0.0759	0.0779
24	0.0199	0.0207	0.0224	0.024	0.0257	0.0274	0.029	0.0307	0.0315
25	0.0222	0.0232	0.0253	0.0275	0.0296	0.0317	0.0338	0.036	0.037
26	0.0225	0.0235	0.0257	0.0278	0.03	0.0321	0.0343	0.0364	0.0375
27	0.062	0.0646	0.0698	0.0749	0.0801	0.0853	0.0905	0.0957	0.0983
28	0.451	0.47	0.508	0.546	0.584	0.622	0.659	0.697	0.716
29	0.349	0.363	0.392	0.422	0.451	0.48	0.509	0.538	0.553
30	0.384	0.402	0.439	0.476	0.512	0.549	0.586	0.623	0.641
31	0.195	0.205	0.223	0.242	0.261	0.28	0.298	0.317	0.326
32	1.16	1.21	1.31	1.4	1.5	1.6	1.7	1.79	1.84
34	1.62	1.71	1.88	2.04	2.21	2.38	2.55	2.72	2.8
35	0.0532	0.0558	0.0609	0.066	0.0711	0.0762	0.0813	0.0864	0.0889
36	0.0527	0.0552	0.0602	0.0653	0.0703	0.0754	0.0804	0.0855	0.088
38	0.371	0.388	0.424	0.459	0.495	0.53	0.566	0.601	0.619
39	2.2	2.31	2.54	2.77	3	3.22	3.45	3.68	3.79
40	0.27	0.283	0.309	0.335	0.36	0.386	0.412	0.438	0.451
41	0.18	0.188	0.205	0.223	0.24	0.257	0.274	0.291	0.3
42	0.0164	0.0172	0.0188	0.0204	0.0219	0.0235	0.0251	0.0267	0.0275
43	0.354	0.371	0.405	0.439	0.473	0.507	0.541	0.575	0.592
44	1.05	1.1	1.21	1.32	1.43	1.54	1.65	1.75	1.81
45	0.255	0.267	0.291	0.316	0.34	0.364	0.389	0.413	0.425
46	0.0709	0.0743	0.0811	0.0879	0.0947	0.102	0.108	0.115	0.118
48	10.1	10.3	10.9	11.4	12	12.6	13.1	13.7	14
49	11.5	11.9	12.5	13.1	13.8	14.4	15.1	15.7	16
50	0.161	0.168	0.181	0.195	0.208	0.222	0.235	0.248	0.255
51	0.0288	0.0298	0.0317	0.0336	0.0356	0.0375	0.0395	0.0414	0.0424
52	0.215	0.223	0.237	0.252	0.266	0.281	0.295	0.31	0.317
53	0.11	0.115	0.124	0.134	0.143	0.152	0.161	0.171	0.175
54	0.283	0.297	0.324	0.351	0.378	0.405	0.432	0.46	0.473
55	0.608	0.637	0.695	0.753	0.811	0.87	0.928	0.986	1.02
56	0.0155	0.016	0.0169	0.0179	0.0189	0.0199	0.0209	0.0219	0.0224
57	0.0155	0.016	0.0169	0.0179	0.0189	0.0199	0.0209	0.0219	0.0224
1B	0.209	0.216	0.23	0.245	0.259	0.273	0.287	0.301	0.308
2B	0.234	0.242	0.258	0.274	0.29	0.305	0.321	0.337	0.345
3B	0.0177	0.0186	0.0203	0.022	0.0237	0.0254	0.0271	0.0288	0.0296
4B	0.0237	0.0249	0.0272	0.0294	0.0317	0.034	0.0363	0.0385	0.0397
5B	0.0114	0.012	0.0131	0.0142	0.0153	0.0164	0.0174	0.0185	0.0191
6B	0.00957	0.01	0.0109	0.0119	0.0128	0.0137	0.0146	0.0155	0.016
7B	0.0114	0.012	0.0131	0.0142	0.0153	0.0164	0.0175	0.0185	0.0191
8B	0.0846	0.0886	0.0968	0.105	0.113	0.121	0.129	0.137	0.141
9B	0.0869	0.0911	0.0994	0.108	0.116	0.124	0.133	0.141	0.145
10B	0.00336	0.00351	0.0038	0.0041	0.00439	0.00469	0.00498	0.00528	0.00543
11B	0.0235	0.0245	0.0266	0.0287	0.0307	0.0328	0.0349	0.0369	0.038
12B	0.084	0.0877	0.0951	0.102	0.11	0.117	0.125	0.132	0.136
13B	0.106	0.11	0.12	0.129	0.138	0.147	0.157	0.166	0.171
14B	0.24	0.25	0.272	0.293	0.314	0.335	0.356	0.377	0.387
15B	0.107	0.112	0.121	0.13	0.14	0.149	0.159	0.168	0.173
16B	0.0199	0.0208	0.0225	0.0243	0.026	0.0277	0.0295	0.0312	0.0321
17B	0.0084	0.00877	0.0095	0.0102	0.011	0.0117	0.0125	0.0132	0.0136
18B	2.13	2.24	2.45	2.66	2.88	3.09	3.3	3.52	3.62
19B	2.41	2.53	2.77	3.01	3.25	3.49	3.73	3.97	4.09
20B	10.8	11.1	11.7	12.3	12.9	13.5	14.1	14.7	15
23B	0.0733	0.0766	0.083	0.0894	0.0959	0.102	0.109	0.115	0.118
24B	0.00366	0.00382	0.00414	0.00446	0.00478	0.0051	0.00543	0.00575	0.00591
25B	0.0402	0.042	0.0455	0.0491	0.0526	0.0561	0.0597	0.0632	0.065
26B	0.131	0.137	0.15	0.162	0.175	0.187	0.2	0.212	0.219
27B	0.218	0.225	0.24	0.255	0.269	0.284	0.299	0.313	0.321

Screening benchmark = 8.6 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Benzo[g,h,i]perylene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.0099	0.0124	0.0173	0.0223	0.0273	0.0322	0.0372	0.0422	0.0446
2	0.00177	0.00222	0.00311	0.004	0.00489	0.00577	0.00666	0.00755	0.008
3	0.00467	0.00579	0.00802	0.0102	0.0125	0.0147	0.0169	0.0192	0.0203
4	0.000884	0.0011	0.00152	0.00194	0.00236	0.00278	0.00321	0.00363	0.00384
5	0.0146	0.0183	0.0256	0.0329	0.0402	0.0476	0.0549	0.0622	0.0659
6	0.0138	0.0179	0.026	0.0342	0.0423	0.0505	0.0586	0.0668	0.0708
7	0.00103	0.00127	0.00176	0.00225	0.00274	0.00323	0.00372	0.00421	0.00446
8	0.00726	0.0094	0.0137	0.018	0.0222	0.0265	0.0308	0.0351	0.0372
9	0.0244	0.0315	0.0459	0.0603	0.0746	0.089	0.103	0.118	0.125
10	0.00156	0.00202	0.00294	0.00386	0.00478	0.0057	0.00662	0.00754	0.008
11	0.00192	0.00248	0.00361	0.00474	0.00587	0.007	0.00813	0.00926	0.00983
12	0.00104	0.00128	0.00178	0.00227	0.00277	0.00326	0.00375	0.00425	0.0045
13	0.000633	0.000784	0.00109	0.00139	0.00169	0.00199	0.00229	0.0026	0.00275
14	0.00835	0.0108	0.0157	0.0207	0.0256	0.0305	0.0354	0.0403	0.0428
15	0.00109	0.00134	0.00186	0.00238	0.0029	0.00342	0.00393	0.00445	0.00471
16	0.00126	0.00156	0.00217	0.00277	0.00337	0.00397	0.00458	0.00518	0.00548
17	0.000808	0.001	0.00139	0.00177	0.00216	0.00254	0.00293	0.00331	0.00351
18	0.000775	0.00096	0.00133	0.0017	0.00207	0.00244	0.00281	0.00318	0.00336
19	0.00669	0.00866	0.0126	0.0165	0.0205	0.0244	0.0284	0.0323	0.0343
20	0.00382	0.00495	0.0072	0.00946	0.0117	0.014	0.0162	0.0185	0.0196
21	0.013	0.0169	0.0245	0.0322	0.0399	0.0476	0.0553	0.0629	0.0668
22	0.00455	0.00589	0.00856	0.0112	0.0139	0.0166	0.0193	0.022	0.0233
23	0.0028	0.00363	0.00528	0.00694	0.00859	0.0102	0.0119	0.0135	0.0144
24	0.00114	0.00147	0.00214	0.00281	0.00348	0.00415	0.00481	0.00548	0.00582
25	0.00112	0.00148	0.00221	0.00293	0.00366	0.00439	0.00511	0.00584	0.0062
26	0.00113	0.0015	0.00224	0.00297	0.00371	0.00444	0.00518	0.00591	0.00628
27	0.00354	0.00458	0.00667	0.00875	0.0108	0.0129	0.015	0.0171	0.0181
28	0.0258	0.0334	0.0486	0.0637	0.0789	0.0941	0.109	0.124	0.132
29	0.0199	0.0258	0.0375	0.0492	0.061	0.0727	0.0844	0.0962	0.102
30	0.0194	0.0256	0.0382	0.0508	0.0634	0.0759	0.0885	0.101	0.107
31	0.00986	0.0131	0.0195	0.0259	0.0323	0.0387	0.0451	0.0515	0.0547
32	0.0663	0.0858	0.125	0.164	0.203	0.242	0.281	0.32	0.34
34	0.0835	0.112	0.169	0.227	0.284	0.341	0.398	0.456	0.484
35	0.00269	0.00356	0.0053	0.00705	0.00879	0.0105	0.0123	0.014	0.0149
36	0.00266	0.00352	0.00525	0.00697	0.0087	0.0104	0.0121	0.0139	0.0147
38	0.0187	0.0248	0.0369	0.0491	0.0612	0.0734	0.0855	0.0976	0.104
39	0.113	0.152	0.229	0.307	0.384	0.462	0.539	0.617	0.656
40	0.0136	0.018	0.0269	0.0357	0.0446	0.0534	0.0623	0.0711	0.0755
41	0.00907	0.012	0.0179	0.0238	0.0297	0.0355	0.0414	0.0473	0.0503
42	0.000829	0.0011	0.00164	0.00218	0.00271	0.00325	0.00379	0.00433	0.0046
43	0.0179	0.0237	0.0353	0.0469	0.0585	0.0701	0.0817	0.0933	0.0991
44	0.0539	0.0724	0.109	0.146	0.183	0.22	0.257	0.294	0.313
45	0.0128	0.017	0.0254	0.0337	0.042	0.0504	0.0587	0.0671	0.0712
46	0.00358	0.00474	0.00707	0.00939	0.0117	0.014	0.0164	0.0187	0.0198
48	0.474	0.575	0.778	0.98	1.18	1.38	1.59	1.79	1.89
49	0.544	0.66	0.893	1.13	1.36	1.59	1.82	2.06	2.17
50	0.00919	0.0119	0.0173	0.0227	0.0281	0.0335	0.039	0.0444	0.0471
51	0.0016	0.002	0.0028	0.00359	0.00439	0.00519	0.00599	0.00679	0.00719
52	0.0119	0.0149	0.0209	0.0269	0.0329	0.0389	0.0448	0.0508	0.0538
53	0.0063	0.00816	0.0119	0.0156	0.0193	0.023	0.0267	0.0305	0.0323
54	0.0143	0.0189	0.0282	0.0375	0.0468	0.056	0.0653	0.0746	0.0792
55	0.0307	0.0406	0.0605	0.0804	0.1	0.12	0.14	0.16	0.17
56	0.000808	0.001	0.00139	0.00177	0.00216	0.00254	0.00293	0.00331	0.00351
57	0.000808	0.001	0.00139	0.00177	0.00216	0.00254	0.00293	0.00331	0.00351
1B	0.0105	0.0131	0.0184	0.0237	0.0289	0.0342	0.0395	0.0447	0.0474
2B	0.0118	0.0147	0.0206	0.0265	0.0324	0.0383	0.0442	0.0501	0.053
3B	0.00127	0.00168	0.0025	0.00332	0.00414	0.00496	0.00578	0.0066	0.00701
4B	0.00169	0.00225	0.00335	0.00445	0.00555	0.00665	0.00775	0.00885	0.0094
5B	0.000816	0.00108	0.00161	0.00214	0.00267	0.0032	0.00373	0.00426	0.00452
6B	0.000683	0.000905	0.00135	0.00179	0.00224	0.00268	0.00312	0.00357	0.00379
7B	0.000816	0.00108	0.00161	0.00214	0.00267	0.0032	0.00373	0.00426	0.00452
8B	0.00604	0.008	0.0119	0.0158	0.0198	0.0237	0.0276	0.0315	0.0335
9B	0.0062	0.00822	0.0122	0.0163	0.0203	0.0243	0.0283	0.0324	0.0344
10B	0.000206	0.000269	0.000395	0.00052	0.000646	0.000772	0.000898	0.00102	0.00109
11B	0.00144	0.00188	0.00276	0.00364	0.00452	0.0054	0.00628	0.00716	0.0076
12B	0.00516	0.00673	0.00988	0.013	0.0162	0.0193	0.0225	0.0256	0.0272
13B	0.00648	0.00846	0.0124	0.0164	0.0203	0.0243	0.0282	0.0322	0.0342
14B	0.0147	0.0192	0.0282	0.0372	0.0462	0.0551	0.0641	0.0731	0.0776
15B	0.00656	0.00856	0.0126	0.0166	0.0206	0.0246	0.0286	0.0326	0.0346
16B	0.00122	0.00159	0.00234	0.00308	0.00383	0.00457	0.00531	0.00606	0.00643
17B	0.000515	0.000672	0.000987	0.0013	0.00162	0.00193	0.00224	0.00256	0.00271
18B	0.113	0.15	0.226	0.301	0.376	0.451	0.527	0.602	0.639
19B	0.127	0.17	0.255	0.34	0.425	0.51	0.595	0.68	0.722
20B	0.508	0.616	0.833	1.05	1.27	1.48	1.7	1.92	2.03
23B	0.0045	0.00587	0.00862	0.0114	0.0141	0.0169	0.0196	0.0223	0.0237
24B	0.000225	0.000293	0.00043	0.000567	0.000704	0.000841	0.000978	0.00111	0.00118
25B	0.00247	0.00322	0.00473	0.00623	0.00774	0.00925	0.0108	0.0123	0.013
26B	0.00934	0.0124	0.0184	0.0245	0.0305	0.0366	0.0427	0.0487	0.0518
27B	0.0109	0.0137	0.0192	0.0246	0.0301	0.0356	0.0411	0.0465	0.0493

Screening benchmark = 1 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Chrysene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.105	0.109	0.117	0.125	0.133	0.141	0.149	0.157	0.161
2	0.0188	0.0195	0.0209	0.0224	0.0238	0.0253	0.0267	0.0282	0.0289
3	0.0608	0.063	0.0674	0.0718	0.0762	0.0806	0.085	0.0894	0.0917
4	0.0115	0.0119	0.0128	0.0136	0.0144	0.0153	0.0161	0.0169	0.0173
5	0.154	0.16	0.172	0.184	0.196	0.208	0.22	0.232	0.238
6	0.14	0.146	0.16	0.173	0.186	0.2	0.213	0.226	0.233
7	0.0134	0.0138	0.0148	0.0158	0.0167	0.0177	0.0187	0.0197	0.0201
8	0.0734	0.0769	0.0839	0.0909	0.0979	0.105	0.112	0.119	0.122
9	0.246	0.258	0.281	0.305	0.328	0.352	0.376	0.399	0.411
10	0.0158	0.0165	0.018	0.0195	0.021	0.0225	0.024	0.0256	0.0263
11	0.0194	0.0203	0.0221	0.024	0.0258	0.0277	0.0295	0.0314	0.0323
12	0.0135	0.014	0.0149	0.0159	0.0169	0.0179	0.0188	0.0198	0.0203
13	0.00823	0.00853	0.00913	0.00972	0.0103	0.0109	0.0115	0.0121	0.0124
14	0.0844	0.0884	0.0965	0.105	0.113	0.121	0.129	0.137	0.141
15	0.0141	0.0146	0.0156	0.0167	0.0177	0.0187	0.0197	0.0208	0.0213
16	0.0164	0.017	0.0182	0.0194	0.0206	0.0218	0.023	0.0242	0.0248
17	0.0105	0.0109	0.0117	0.0124	0.0132	0.0139	0.0147	0.0155	0.0158
18	0.0101	0.0104	0.0112	0.0119	0.0126	0.0134	0.0141	0.0148	0.0152
19	0.0676	0.0708	0.0773	0.0837	0.0902	0.0967	0.103	0.11	0.113
20	0.0386	0.0405	0.0442	0.0478	0.0515	0.0552	0.0589	0.0626	0.0645
21	0.132	0.138	0.15	0.163	0.176	0.188	0.201	0.213	0.22
22	0.0459	0.0481	0.0525	0.0569	0.0613	0.0657	0.0701	0.0745	0.0767
23	0.0283	0.0297	0.0324	0.0351	0.0378	0.0405	0.0432	0.0459	0.0473
24	0.0115	0.012	0.0131	0.0142	0.0153	0.0164	0.0175	0.0186	0.0191
25	0.012	0.0127	0.014	0.0153	0.0166	0.0179	0.0192	0.0206	0.0212
26	0.0122	0.0128	0.0142	0.0155	0.0168	0.0182	0.0195	0.0208	0.0215
27	0.0357	0.0374	0.0409	0.0443	0.0477	0.0511	0.0545	0.058	0.0597
28	0.26	0.273	0.298	0.323	0.347	0.372	0.397	0.422	0.435
29	0.201	0.211	0.23	0.249	0.268	0.288	0.307	0.326	0.336
30	0.208	0.219	0.242	0.265	0.288	0.31	0.333	0.356	0.367
31	0.106	0.112	0.123	0.135	0.146	0.158	0.17	0.181	0.187
32	0.669	0.701	0.765	0.829	0.893	0.957	1.02	1.09	1.12
34	1.14	1.21	1.34	1.48	1.61	1.75	1.88	2.02	2.09
35	0.0289	0.0304	0.0336	0.0367	0.0399	0.043	0.0462	0.0494	0.0509
36	0.0286	0.0301	0.0332	0.0364	0.0395	0.0426	0.0457	0.0488	0.0504
38	0.201	0.212	0.234	0.256	0.278	0.3	0.322	0.344	0.355
39	1.55	1.64	1.82	2	2.19	2.37	2.55	2.73	2.82
40	0.146	0.154	0.17	0.186	0.202	0.218	0.234	0.25	0.258
41	0.0974	0.103	0.113	0.124	0.135	0.145	0.156	0.167	0.172
42	0.00891	0.0094	0.0104	0.0113	0.0123	0.0133	0.0143	0.0152	0.0157
43	0.192	0.203	0.224	0.244	0.265	0.286	0.307	0.328	0.339
44	0.737	0.78	0.867	0.955	1.04	1.13	1.22	1.3	1.35
45	0.138	0.146	0.161	0.176	0.191	0.206	0.221	0.236	0.244
46	0.0385	0.0406	0.0448	0.049	0.0532	0.0574	0.0616	0.0658	0.0679
48	5.67	5.85	6.21	6.56	6.92	7.28	7.64	8	8.18
49	6.51	6.71	7.13	7.54	7.95	8.36	8.77	9.18	9.39
50	0.0928	0.0972	0.106	0.115	0.124	0.133	0.142	0.15	0.155
51	0.0169	0.0175	0.0188	0.0201	0.0214	0.0227	0.024	0.0253	0.026
52	0.126	0.131	0.141	0.151	0.16	0.17	0.18	0.19	0.194
53	0.0637	0.0667	0.0728	0.0789	0.085	0.0911	0.0972	0.103	0.106
54	0.154	0.162	0.179	0.195	0.212	0.229	0.246	0.263	0.271
55	0.329	0.347	0.383	0.419	0.455	0.491	0.527	0.563	0.581
56	0.0105	0.0109	0.0117	0.0124	0.0132	0.0139	0.0147	0.0155	0.0158
57	0.0105	0.0109	0.0117	0.0124	0.0132	0.0139	0.0147	0.0155	0.0158
1B	0.155	0.161	0.173	0.184	0.196	0.208	0.22	0.232	0.238
2B	0.173	0.18	0.193	0.206	0.22	0.233	0.247	0.26	0.267
3B	0.0104	0.011	0.0121	0.0133	0.0144	0.0156	0.0167	0.0178	0.0184
4B	0.014	0.0147	0.0163	0.0178	0.0193	0.0208	0.0224	0.0239	0.0247
5B	0.00673	0.0071	0.00783	0.00857	0.0093	0.01	0.0108	0.0115	0.0119
6B	0.00564	0.00594	0.00656	0.00717	0.00779	0.00841	0.00902	0.00964	0.00994
7B	0.00673	0.0071	0.00783	0.00857	0.0093	0.01	0.0108	0.0115	0.0119
8B	0.0498	0.0525	0.058	0.0634	0.0689	0.0743	0.0797	0.0852	0.0879
9B	0.0512	0.054	0.0595	0.0651	0.0707	0.0763	0.0819	0.0875	0.0903
10B	0.0019	0.002	0.00219	0.00238	0.00257	0.00276	0.00295	0.00314	0.00323
11B	0.0133	0.014	0.0153	0.0166	0.018	0.0193	0.0206	0.022	0.0226
12B	0.0476	0.0499	0.0547	0.0595	0.0642	0.069	0.0738	0.0785	0.0809
13B	0.0598	0.0628	0.0688	0.0748	0.0808	0.0867	0.0927	0.0987	0.102
14B	0.136	0.143	0.156	0.17	0.183	0.197	0.211	0.224	0.231
15B	0.0605	0.0635	0.0696	0.0756	0.0817	0.0878	0.0938	0.0999	0.103
16B	0.0113	0.0118	0.0129	0.0141	0.0152	0.0163	0.0175	0.0186	0.0191
17B	0.00475	0.00499	0.00547	0.00594	0.00642	0.00689	0.00737	0.00785	0.00808
18B	1.06	1.12	1.24	1.36	1.48	1.6	1.72	1.85	1.91
19B	1.2	1.27	1.4	1.54	1.68	1.81	1.95	2.08	2.15
20B	6.07	6.27	6.65	7.03	7.42	7.8	8.19	8.57	8.76
23B	0.0415	0.0436	0.0477	0.0519	0.0561	0.0602	0.0644	0.0685	0.0706
24B	0.00207	0.00217	0.00238	0.00259	0.0028	0.003	0.00321	0.00342	0.00352
25B	0.0228	0.0239	0.0262	0.0285	0.0308	0.033	0.0353	0.0376	0.0387
26B	0.077	0.0812	0.0896	0.098	0.106	0.115	0.123	0.132	0.136
27B	0.161	0.167	0.179	0.192	0.204	0.217	0.229	0.242	0.248

Screening benchmark = 8.6 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for 2-Methylnaphthalene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	2.15	2.15	2.15	2.16	2.16	2.16	2.16	2.16	2.16
2	0.385	0.386	0.386	0.386	0.386	0.387	0.387	0.387	0.388
3	1.71	1.71	1.71	1.71	1.71	1.72	1.72	1.72	1.72
4	0.323	0.324	0.324	0.324	0.324	0.325	0.325	0.325	0.325
5	3.17	3.18	3.18	3.18	3.18	3.19	3.19	3.19	3.19
6	1.94	1.94	1.94	1.94	1.94	1.95	1.95	1.95	1.95
7	0.376	0.376	0.376	0.376	0.377	0.377	0.377	0.378	0.378
8	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
9	3.41	3.42	3.42	3.42	3.43	3.43	3.43	3.44	3.44
10	0.219	0.219	0.219	0.219	0.219	0.22	0.22	0.22	0.22
11	0.269	0.269	0.269	0.269	0.27	0.27	0.27	0.27	0.271
12	0.379	0.379	0.379	0.38	0.38	0.38	0.38	0.381	0.381
13	0.231	0.232	0.232	0.232	0.232	0.232	0.232	0.233	0.233
14	1.17	1.17	1.17	1.17	1.17	1.18	1.18	1.18	1.18
15	0.397	0.397	0.397	0.398	0.398	0.398	0.399	0.399	0.399
16	0.462	0.462	0.462	0.463	0.463	0.463	0.464	0.464	0.464
17	0.296	0.296	0.296	0.296	0.296	0.297	0.297	0.297	0.297
18	0.283	0.283	0.284	0.284	0.284	0.284	0.285	0.285	0.285
19	0.937	0.938	0.939	0.94	0.941	0.942	0.943	0.944	0.944
20	0.536	0.536	0.536	0.537	0.538	0.538	0.539	0.539	0.54
21	1.83	1.83	1.83	1.83	1.83	1.83	1.84	1.84	1.84
22	0.637	0.637	0.638	0.639	0.639	0.64	0.641	0.641	0.642
23	0.393	0.393	0.394	0.394	0.394	0.395	0.395	0.396	0.396
24	0.159	0.159	0.159	0.159	0.16	0.16	0.16	0.16	0.16
25	0.109	0.109	0.109	0.109	0.11	0.11	0.11	0.11	0.11
26	0.11	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111
27	0.496	0.496	0.497	0.497	0.498	0.498	0.499	0.499	0.499
28	3.61	3.61	3.62	3.62	3.62	3.63	3.63	3.64	3.64
29	2.79	2.79	2.79	2.8	2.8	2.8	2.8	2.81	2.81
30	1.89	1.89	1.89	1.89	1.9	1.9	1.9	1.9	1.9
31	0.962	0.962	0.963	0.965	0.966	0.967	0.968	0.969	0.97
32	9.28	9.29	9.3	9.31	9.32	9.33	9.34	9.35	9.35
34	26.2	26.2	26.2	26.2	26.3	26.3	26.3	26.4	26.4
35	0.262	0.262	0.262	0.263	0.263	0.263	0.264	0.264	0.264
36	0.259	0.259	0.26	0.26	0.26	0.261	0.261	0.261	0.261
38	1.82	1.83	1.83	1.83	1.83	1.83	1.84	1.84	1.84
39	35.4	35.4	35.5	35.5	35.6	35.6	35.7	35.7	35.7
40	1.33	1.33	1.33	1.33	1.33	1.34	1.34	1.34	1.34
41	0.884	0.885	0.886	0.887	0.888	0.889	0.89	0.891	0.891
42	0.0809	0.0809	0.081	0.0811	0.0812	0.0813	0.0814	0.0815	0.0815
43	1.74	1.74	1.75	1.75	1.75	1.75	1.75	1.76	1.76
44	16.9	16.9	16.9	16.9	17	17	17	17	17
45	1.25	1.25	1.26	1.26	1.26	1.26	1.26	1.26	1.26
46	0.349	0.349	0.35	0.35	0.35	0.351	0.351	0.352	0.352
48	57.4	57.4	57.4	57.5	57.5	57.6	57.6	57.6	57.7
49	65.9	65.9	65.9	66	66	66.1	66.1	66.2	66.2
50	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.3	1.3
51	0.347	0.347	0.347	0.347	0.348	0.348	0.348	0.349	0.349
52	2.59	2.59	2.6	2.6	2.6	2.6	2.6	2.61	2.61
53	0.883	0.884	0.885	0.886	0.887	0.888	0.888	0.889	0.89
54	1.39	1.39	1.4	1.4	1.4	1.4	1.4	1.4	1.41
55	2.99	2.99	3	3	3	3.01	3.01	3.01	3.01
56	0.296	0.296	0.296	0.296	0.296	0.297	0.297	0.297	0.297
57	0.296	0.296	0.296	0.296	0.296	0.297	0.297	0.297	0.297
1B	6.51	6.51	6.52	6.53	6.53	6.54	6.54	6.55	6.55
2B	7.29	7.29	7.3	7.3	7.31	7.31	7.32	7.33	7.33
3B	0.169	0.169	0.169	0.169	0.169	0.169	0.17	0.17	0.17
4B	0.226	0.226	0.226	0.226	0.227	0.227	0.227	0.228	0.228
5B	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.11	0.11
6B	0.091	0.0911	0.0912	0.0913	0.0914	0.0915	0.0916	0.0917	0.0918
7B	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.11	0.11
8B	0.805	0.805	0.806	0.807	0.808	0.809	0.81	0.811	0.811
9B	0.826	0.827	0.828	0.829	0.83	0.831	0.832	0.833	0.833
10B	0.0104	0.0104	0.0104	0.0104	0.0104	0.0104	0.0104	0.0104	0.0105
11B	0.0726	0.0726	0.0727	0.0728	0.0729	0.0729	0.073	0.0731	0.0731
12B	0.26	0.26	0.26	0.26	0.261	0.261	0.261	0.261	0.262
13B	0.326	0.326	0.327	0.327	0.328	0.328	0.328	0.329	0.329
14B	0.741	0.741	0.742	0.743	0.744	0.745	0.745	0.746	0.747
15B	0.33	0.33	0.331	0.331	0.331	0.332	0.332	0.332	0.333
16B	0.0614	0.0615	0.0615	0.0616	0.0617	0.0617	0.0618	0.0619	0.0619
17B	0.0259	0.0259	0.026	0.026	0.026	0.0261	0.0261	0.0261	0.0261
18B	7.42	7.43	7.44	7.44	7.45	7.46	7.47	7.48	7.49
19B	8.38	8.39	8.4	8.41	8.42	8.43	8.44	8.45	8.46
20B	61.5	61.5	61.5	61.6	61.6	61.7	61.7	61.8	61.8
23B	0.226	0.227	0.227	0.227	0.227	0.228	0.228	0.228	0.228
24B	0.0113	0.0113	0.0113	0.0113	0.0113	0.0114	0.0114	0.0114	0.0114
25B	0.124	0.124	0.124	0.125	0.125	0.125	0.125	0.125	0.125
26B	1.24	1.24	1.25	1.25	1.25	1.25	1.25	1.25	1.25
27B	6.77	6.78	6.78	6.79	6.79	6.8	6.81	6.81	6.81

Screening benchmark = 58 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Naphthalene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	5.52	5.52	5.52	5.53	5.53	5.53	5.53	5.53	5.54
2	0.989	0.99	0.99	0.99	0.991	0.991	0.991	0.992	0.992
3	8.87	8.87	8.88	8.88	8.88	8.88	8.89	8.89	8.89
4	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
5	8.15	8.15	8.15	8.16	8.16	8.16	8.17	8.17	8.17
6	5.08	5.08	5.08	5.08	5.08	5.09	5.09	5.09	5.09
7	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95
8	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.68
9	8.95	8.95	8.96	8.96	8.96	8.97	8.97	8.97	8.97
10	0.573	0.573	0.573	0.574	0.574	0.574	0.574	0.575	0.575
11	0.704	0.704	0.705	0.705	0.705	0.706	0.706	0.706	0.706
12	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97
13	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
14	3.07	3.07	3.07	3.07	3.07	3.07	3.08	3.08	3.08
15	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
16	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
17	1.53	1.53	1.53	1.54	1.54	1.54	1.54	1.54	1.54
18	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
19	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46
20	1.4	1.4	1.41	1.41	1.41	1.41	1.41	1.41	1.41
21	4.79	4.79	4.79	4.79	4.79	4.79	4.8	4.8	4.8
22	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
23	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
24	0.417	0.417	0.417	0.417	0.418	0.418	0.418	0.418	0.418
25	1.14	1.14	1.14	1.14	1.14	1.15	1.15	1.15	1.15
26	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
27	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
28	9.47	9.47	9.47	9.48	9.48	9.48	9.49	9.49	9.49
29	7.31	7.31	7.32	7.32	7.32	7.33	7.33	7.33	7.33
30	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
31	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
32	24.3	24.3	24.4	24.4	24.4	24.4	24.4	24.4	24.4
34	224	224	224	224	224	225	225	225	225
35	2.74	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
36	2.72	2.72	2.72	2.72	2.72	2.72	2.72	2.72	2.72
38	19.1	19.1	19.1	19.1	19.1	19.2	19.2	19.2	19.2
39	303	303	304	304	304	304	304	304	304
40	13.9	13.9	13.9	13.9	13.9	13.9	14	14	14
41	9.26	9.26	9.27	9.27	9.28	9.28	9.28	9.29	9.29
42	0.847	0.847	0.848	0.848	0.849	0.849	0.849	0.85	0.85
43	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3
44	145	145	145	145	145	145	145	145	145
45	13.1	13.1	13.1	13.1	13.1	13.2	13.2	13.2	13.2
46	3.66	3.66	3.66	3.66	3.66	3.66	3.67	3.67	3.67
48	270	270	270	270	270	270	271	271	271
49	310	310	310	310	310	311	311	311	311
50	3.37	3.38	3.38	3.38	3.38	3.38	3.38	3.38	3.38
51	0.89	0.89	0.89	0.891	0.891	0.891	0.892	0.892	0.892
52	6.66	6.66	6.66	6.66	6.66	6.67	6.67	6.67	6.67
53	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32
54	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
55	31.3	31.3	31.3	31.4	31.4	31.4	31.4	31.4	31.4
56	1.53	1.53	1.53	1.54	1.54	1.54	1.54	1.54	1.54
57	1.53	1.53	1.53	1.54	1.54	1.54	1.54	1.54	1.54
1B	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
2B	18.4	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
3B	0.513	0.513	0.514	0.514	0.514	0.514	0.514	0.515	0.515
4B	0.688	0.688	0.688	0.688	0.689	0.689	0.689	0.69	0.69
5B	0.331	0.331	0.331	0.331	0.331	0.332	0.332	0.332	0.332
6B	0.277	0.277	0.277	0.278	0.278	0.278	0.278	0.278	0.278
7B	0.331	0.331	0.331	0.331	0.332	0.332	0.332	0.332	0.332
8B	2.45	2.45	2.45	2.45	2.45	2.46	2.46	2.46	2.46
9B	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52
10B	0.0628	0.0629	0.0629	0.0629	0.0629	0.063	0.063	0.063	0.063
11B	0.44	0.44	0.44	0.44	0.44	0.441	0.441	0.441	0.441
12B	1.57	1.57	1.57	1.57	1.57	1.58	1.58	1.58	1.58
13B	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98
14B	4.49	4.49	4.49	4.49	4.49	4.5	4.5	4.5	4.5
15B	2	2	2	2	2	2	2	2	2.01
16B	0.372	0.372	0.372	0.372	0.373	0.373	0.373	0.373	0.373
17B	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.158
18B	32.7	32.7	32.7	32.8	32.8	32.8	32.8	32.8	32.8
19B	37	37	37	37	37	37	37.1	37.1	37.1
20B	289	289	290	290	290	290	290	290	290
23B	1.37	1.37	1.37	1.37	1.37	1.37	1.38	1.38	1.38
24B	0.0684	0.0685	0.0685	0.0685	0.0685	0.0686	0.0686	0.0686	0.0686
25B	0.753	0.753	0.753	0.754	0.754	0.754	0.754	0.755	0.755
26B	3.79	3.79	3.79	3.79	3.79	3.8	3.8	3.8	3.8
27B	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2

Screening benchmark = 100 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Phenanthrene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	2.23	2.23	2.24	2.25	2.26	2.27	2.28	2.29	2.29
2	0.399	0.4	0.402	0.403	0.405	0.407	0.408	0.41	0.411
3	1.52	1.52	1.53	1.53	1.54	1.54	1.55	1.56	1.56
4	0.287	0.288	0.289	0.29	0.291	0.292	0.293	0.295	0.295
5	3.29	3.3	3.31	3.32	3.34	3.35	3.36	3.38	3.38
6	3.65	3.66	3.68	3.7	3.72	3.74	3.76	3.77	3.78
7	0.334	0.334	0.336	0.337	0.338	0.34	0.341	0.342	0.343
8	1.92	1.92	1.93	1.94	1.95	1.96	1.97	1.98	1.99
9	6.44	6.46	6.49	6.52	6.56	6.59	6.62	6.65	6.67
10	0.412	0.413	0.416	0.418	0.42	0.422	0.424	0.426	0.427
11	0.507	0.508	0.511	0.513	0.516	0.518	0.521	0.524	0.525
12	0.337	0.337	0.339	0.34	0.341	0.342	0.344	0.345	0.346
13	0.206	0.206	0.207	0.208	0.208	0.209	0.21	0.211	0.211
14	2.21	2.21	2.22	2.24	2.25	2.26	2.27	2.28	2.29
15	0.353	0.353	0.355	0.356	0.357	0.359	0.36	0.361	0.362
16	0.41	0.411	0.413	0.414	0.416	0.417	0.419	0.421	0.421
17	0.263	0.263	0.264	0.265	0.266	0.267	0.268	0.269	0.27
18	0.252	0.252	0.253	0.254	0.255	0.256	0.257	0.258	0.259
19	1.77	1.77	1.78	1.79	1.8	1.81	1.82	1.83	1.83
20	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.05
21	3.44	3.45	3.47	3.49	3.51	3.52	3.54	3.56	3.57
22	1.2	1.2	1.21	1.22	1.22	1.23	1.24	1.24	1.24
23	0.741	0.743	0.747	0.751	0.755	0.759	0.762	0.766	0.768
24	0.3	0.301	0.302	0.304	0.305	0.307	0.308	0.31	0.311
25	0.214	0.215	0.216	0.218	0.219	0.22	0.221	0.223	0.223
26	0.217	0.218	0.219	0.22	0.222	0.223	0.224	0.226	0.226
27	0.935	0.938	0.942	0.947	0.952	0.957	0.962	0.967	0.969
28	6.81	6.83	6.86	6.9	6.93	6.97	7	7.04	7.06
29	5.26	5.27	5.3	5.33	5.36	5.38	5.41	5.44	5.45
30	3.71	3.72	3.74	3.77	3.79	3.81	3.83	3.85	3.87
31	1.89	1.9	1.91	1.92	1.93	1.94	1.95	1.96	1.97
32	17.5	17.6	17.6	17.7	17.8	17.9	18	18.1	18.1
34	22.8	22.9	23	23.2	23.3	23.5	23.6	23.8	23.8
35	0.515	0.516	0.519	0.523	0.526	0.529	0.532	0.535	0.536
36	0.509	0.511	0.514	0.517	0.52	0.523	0.526	0.529	0.531
38	3.59	3.6	3.62	3.64	3.66	3.68	3.7	3.72	3.73
39	30.9	31	31.2	31.4	31.6	31.8	32	32.2	32.3
40	2.61	2.62	2.63	2.65	2.67	2.68	2.7	2.71	2.72
41	1.74	1.74	1.75	1.76	1.77	1.78	1.79	1.8	1.81
42	0.159	0.159	0.16	0.161	0.162	0.163	0.164	0.165	0.166
43	3.43	3.44	3.46	3.48	3.5	3.52	3.54	3.56	3.57
44	14.7	14.8	14.9	14.9	15	15.1	15.2	15.3	15.4
45	2.46	2.47	2.48	2.5	2.51	2.53	2.54	2.56	2.56
46	0.686	0.688	0.692	0.696	0.7	0.704	0.708	0.713	0.715
48	91.6	91.8	92.1	92.4	92.7	93	93.3	93.6	93.8
49	105	105	106	106	106	107	107	108	108
50	2.43	2.43	2.45	2.46	2.47	2.48	2.5	2.51	2.52
51	0.359	0.36	0.361	0.363	0.364	0.366	0.367	0.369	0.37
52	2.69	2.69	2.7	2.71	2.73	2.74	2.75	2.76	2.76
53	1.67	1.67	1.68	1.69	1.7	1.71	1.71	1.72	1.73
54	2.74	2.75	2.76	2.78	2.8	2.81	2.83	2.84	2.85
55	5.88	5.9	5.93	5.96	6	6.03	6.07	6.1	6.12
56	0.263	0.263	0.264	0.265	0.266	0.267	0.268	0.269	0.27
57	0.263	0.263	0.264	0.265	0.266	0.267	0.268	0.269	0.27
1B	6.29	6.3	6.33	6.36	6.38	6.41	6.43	6.46	6.47
2B	7.04	7.06	7.08	7.11	7.14	7.17	7.2	7.23	7.24
3B	0.216	0.217	0.218	0.219	0.22	0.222	0.223	0.224	0.225
4B	0.289	0.29	0.292	0.294	0.295	0.297	0.299	0.301	0.301
5B	0.139	0.14	0.141	0.141	0.142	0.143	0.144	0.145	0.145
6B	0.117	0.117	0.118	0.118	0.119	0.12	0.12	0.121	0.122
7B	0.139	0.14	0.141	0.141	0.142	0.143	0.144	0.145	0.145
8B	1.03	1.03	1.04	1.05	1.05	1.06	1.06	1.07	1.07
9B	1.06	1.06	1.07	1.07	1.08	1.09	1.09	1.1	1.1
10B	0.0353	0.0354	0.0356	0.0358	0.0359	0.0361	0.0363	0.0365	0.0366
11B	0.247	0.248	0.249	0.25	0.252	0.253	0.254	0.256	0.256
12B	0.883	0.885	0.89	0.895	0.899	0.904	0.909	0.914	0.916
13B	1.11	1.11	1.12	1.12	1.13	1.14	1.14	1.15	1.15
14B	2.52	2.53	2.54	2.55	2.57	2.58	2.59	2.61	2.61
15B	1.12	1.13	1.13	1.14	1.14	1.15	1.16	1.16	1.16
16B	0.209	0.209	0.211	0.212	0.213	0.214	0.215	0.216	0.217
17B	0.0882	0.0884	0.0889	0.0894	0.0898	0.0903	0.0908	0.0913	0.0915
18B	21.1	21.2	21.3	21.5	21.6	21.7	21.8	22	22
19B	23.9	23.9	24.1	24.2	24.4	24.5	24.7	24.8	24.9
20B	98.2	98.4	98.7	99	99.3	99.7	100	100	100
23B	0.77	0.772	0.776	0.78	0.785	0.789	0.793	0.797	0.799
24B	0.0384	0.0385	0.0387	0.0389	0.0391	0.0394	0.0396	0.0398	0.0399
25B	0.423	0.424	0.426	0.428	0.431	0.433	0.435	0.437	0.439
26B	1.59	1.6	1.61	1.62	1.63	1.64	1.65	1.66	1.66
27B	6.55	6.56	6.59	6.61	6.64	6.67	6.69	6.72	6.73

Screening benchmark = 40 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Pyrene								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	1.08	1.09	1.11	1.13	1.15	1.17	1.18	1.2	1.21
2	0.194	0.196	0.199	0.202	0.206	0.209	0.212	0.215	0.217
3	0.521	0.525	0.533	0.541	0.549	0.558	0.566	0.574	0.578
4	0.0986	0.0993	0.101	0.102	0.104	0.105	0.107	0.109	0.109
5	1.6	1.61	1.64	1.67	1.69	1.72	1.75	1.77	1.79
6	1.43	1.45	1.48	1.51	1.54	1.57	1.6	1.63	1.64
7	0.114	0.115	0.117	0.119	0.121	0.123	0.124	0.126	0.127
8	0.753	0.761	0.776	0.792	0.808	0.823	0.839	0.855	0.862
9	2.53	2.55	2.6	2.66	2.71	2.76	2.81	2.87	2.89
10	0.162	0.163	0.167	0.17	0.173	0.177	0.18	0.184	0.185
11	0.199	0.201	0.205	0.209	0.213	0.217	0.221	0.226	0.228
12	0.115	0.116	0.118	0.12	0.122	0.124	0.125	0.127	0.128
13	0.0705	0.0711	0.0722	0.0733	0.0744	0.0755	0.0766	0.0777	0.0783
14	0.866	0.875	0.893	0.911	0.929	0.947	0.965	0.983	0.992
15	0.121	0.122	0.124	0.126	0.128	0.129	0.131	0.133	0.134
16	0.141	0.142	0.144	0.146	0.148	0.151	0.153	0.155	0.156
17	0.0901	0.0908	0.0922	0.0936	0.095	0.0964	0.0978	0.0992	0.0999
18	0.0863	0.087	0.0884	0.0897	0.0911	0.0924	0.0938	0.0951	0.0958
19	0.694	0.701	0.715	0.73	0.744	0.758	0.773	0.787	0.794
20	0.396	0.4	0.409	0.417	0.425	0.433	0.442	0.45	0.454
21	1.35	1.36	1.39	1.42	1.45	1.48	1.5	1.53	1.55
22	0.471	0.476	0.486	0.496	0.506	0.515	0.525	0.535	0.54
23	0.291	0.294	0.3	0.306	0.312	0.318	0.324	0.33	0.333
24	0.118	0.119	0.121	0.124	0.126	0.129	0.131	0.134	0.135
25	0.129	0.13	0.133	0.136	0.139	0.142	0.146	0.149	0.15
26	0.13	0.132	0.135	0.138	0.141	0.144	0.147	0.151	0.152
27	0.367	0.371	0.378	0.386	0.393	0.401	0.409	0.416	0.42
28	2.67	2.7	2.75	2.81	2.87	2.92	2.98	3.03	3.06
29	2.06	2.08	2.13	2.17	2.21	2.26	2.3	2.34	2.36
30	2.23	2.25	2.31	2.36	2.41	2.47	2.52	2.57	2.6
31	1.13	1.15	1.17	1.2	1.23	1.26	1.28	1.31	1.32
32	6.87	6.94	7.08	7.23	7.37	7.51	7.65	7.8	7.87
34	9.75	9.88	10.1	10.4	10.6	10.9	11.1	11.4	11.5
35	0.309	0.313	0.32	0.327	0.335	0.342	0.349	0.357	0.361
36	0.306	0.309	0.317	0.324	0.331	0.338	0.346	0.353	0.357
38	2.15	2.18	2.23	2.28	2.33	2.38	2.43	2.49	2.51
39	13.2	13.4	13.7	14.1	14.4	14.7	15.1	15.4	15.6
40	1.57	1.59	1.62	1.66	1.7	1.73	1.77	1.81	1.83
41	1.04	1.06	1.08	1.1	1.13	1.15	1.18	1.2	1.22
42	0.0954	0.0965	0.0988	0.101	0.103	0.106	0.108	0.11	0.111
43	2.06	2.08	2.13	2.18	2.23	2.28	2.33	2.37	2.4
44	6.3	6.38	6.54	6.7	6.87	7.03	7.19	7.36	7.44
45	1.48	1.5	1.53	1.57	1.6	1.64	1.67	1.71	1.72
46	0.412	0.417	0.426	0.436	0.446	0.456	0.466	0.476	0.48
48	38.7	39	39.5	40.1	40.6	41.1	41.6	42.2	42.4
49	44.5	44.8	45.4	46	46.6	47.2	47.8	48.4	48.7
50	0.952	0.962	0.982	1	1.02	1.04	1.06	1.08	1.09
51	0.175	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.195
52	1.31	1.32	1.34	1.36	1.38	1.4	1.43	1.45	1.46
53	0.654	0.66	0.674	0.688	0.701	0.715	0.728	0.742	0.749
54	1.64	1.66	1.7	1.74	1.78	1.82	1.86	1.9	1.92
55	3.53	3.57	3.65	3.74	3.82	3.91	3.99	4.07	4.12
56	0.0901	0.0908	0.0922	0.0936	0.095	0.0964	0.0978	0.0992	0.0999
57	0.0901	0.0908	0.0922	0.0936	0.095	0.0964	0.0978	0.0992	0.0999
1B	1.32	1.33	1.35	1.38	1.4	1.42	1.44	1.47	1.48
2B	1.48	1.49	1.52	1.54	1.57	1.59	1.61	1.64	1.65
3B	0.0922	0.0933	0.0955	0.0977	0.0999	0.102	0.104	0.107	0.108
4B	0.124	0.125	0.128	0.131	0.134	0.137	0.14	0.143	0.144
5B	0.0595	0.0602	0.0616	0.063	0.0644	0.0659	0.0673	0.0687	0.0694
6B	0.0498	0.0504	0.0516	0.0528	0.054	0.0552	0.0564	0.0575	0.0581
7B	0.0595	0.0602	0.0616	0.063	0.0645	0.0659	0.0673	0.0687	0.0694
8B	0.44	0.446	0.456	0.467	0.477	0.488	0.498	0.509	0.514
9B	0.452	0.458	0.468	0.479	0.49	0.501	0.512	0.522	0.528
10B	0.0177	0.0179	0.0183	0.0187	0.0191	0.0195	0.0198	0.0202	0.0204
11B	0.124	0.125	0.128	0.131	0.133	0.136	0.139	0.142	0.143
12B	0.443	0.448	0.458	0.467	0.477	0.487	0.496	0.506	0.511
13B	0.557	0.563	0.575	0.588	0.6	0.612	0.624	0.636	0.642
14B	1.27	1.28	1.31	1.33	1.36	1.39	1.42	1.44	1.46
15B	0.564	0.57	0.582	0.594	0.607	0.619	0.631	0.644	0.65
16B	0.105	0.106	0.108	0.111	0.113	0.115	0.117	0.12	0.121
17B	0.0443	0.0448	0.0457	0.0467	0.0477	0.0486	0.0496	0.0506	0.051
18B	11.6	11.8	12.1	12.4	12.6	12.9	13.2	13.5	13.7
19B	13.1	13.3	13.6	14	14.3	14.6	14.9	15.3	15.4
20B	41.5	41.8	42.4	42.9	43.5	44.1	44.6	45.2	45.5
23B	0.387	0.391	0.399	0.408	0.416	0.425	0.433	0.442	0.446
24B	0.0193	0.0195	0.0199	0.0203	0.0208	0.0212	0.0216	0.022	0.0222
25B	0.212	0.215	0.219	0.224	0.228	0.233	0.238	0.242	0.245
26B	0.681	0.689	0.705	0.721	0.738	0.754	0.77	0.786	0.794
27B	1.38	1.39	1.41	1.43	1.46	1.48	1.5	1.52	1.54

Screening benchmark = 12.8 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Arsenic								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.0603	0.121	0.241	0.362	0.482	0.603	0.723	0.844	0.904
2	0.0459	0.0917	0.183	0.275	0.367	0.459	0.55	0.642	0.688
3	0.0974	0.195	0.39	0.584	0.779	0.974	1.17	1.36	1.46
4	0.0193	0.0386	0.0771	0.116	0.154	0.193	0.231	0.27	0.289
5	0.0743	0.149	0.297	0.446	0.595	0.743	0.892	1.04	1.11
6	0.0777	0.155	0.311	0.466	0.621	0.777	0.932	1.09	1.17
7	0.0543	0.109	0.217	0.326	0.435	0.543	0.652	0.761	0.815
8	0.878	1.76	3.51	5.27	7.02	8.78	10.5	12.3	13.2
9	0.377	0.754	1.51	2.26	3.02	3.77	4.53	5.28	5.66
10	0.313	0.626	1.25	1.88	2.5	3.13	3.75	4.38	4.69
11	0.0996	0.199	0.398	0.597	0.797	0.996	1.19	1.39	1.49
12	0.0408	0.0815	0.163	0.245	0.326	0.408	0.489	0.571	0.612
13	0.0512	0.102	0.205	0.307	0.409	0.512	0.614	0.716	0.767
14	0.23	0.46	0.919	1.38	1.84	2.3	2.76	3.22	3.45
15	0.0411	0.0823	0.165	0.247	0.329	0.411	0.494	0.576	0.617
16	0.104	0.209	0.418	0.627	0.836	1.04	1.25	1.46	1.57
17	0.0377	0.0754	0.151	0.226	0.301	0.377	0.452	0.528	0.565
18	0.0776	0.155	0.311	0.466	0.621	0.776	0.932	1.09	1.16
19	1.73	3.47	6.94	10.4	13.9	17.3	20.8	24.3	26
20	0.143	0.286	0.571	0.857	1.14	1.43	1.71	2	2.14
21	6.12	12.2	24.5	36.7	49	61.2	73.5	85.7	91.8
22	4.17	8.33	16.7	25	33.3	41.7	50	58.3	62.5
23	0.167	0.333	0.666	0.999	1.33	1.67	2	2.33	2.5
24	0.0816	0.163	0.326	0.49	0.653	0.816	0.979	1.14	1.22
25	0.0756	0.151	0.302	0.454	0.605	0.756	0.907	1.06	1.13
26	0.131	0.263	0.526	0.789	1.05	1.31	1.58	1.84	1.97
27	0.431	0.862	1.72	2.59	3.45	4.31	5.17	6.04	6.47
28	0.44	0.88	1.76	2.64	3.52	4.4	5.28	6.16	6.6
29	1.33	2.65	5.31	7.96	10.6	13.3	15.9	18.6	19.9
30	0.165	0.331	0.661	0.992	1.32	1.65	1.98	2.32	2.48
31	0.16	0.32	0.641	0.961	1.28	1.6	1.92	2.24	2.4
32	0.18	0.361	0.721	1.08	1.44	1.8	2.16	2.52	2.7
34	0.834	1.67	3.34	5.01	6.67	8.34	10	11.7	12.5
35	0.133	0.266	0.532	0.798	1.06	1.33	1.6	1.86	2
36	0.0918	0.184	0.367	0.551	0.734	0.918	1.1	1.29	1.38
38	0.309	0.617	1.23	1.85	2.47	3.09	3.7	4.32	4.63
39	0.906	1.81	3.63	5.44	7.25	9.06	10.9	12.7	13.6
40	1.03	2.07	4.14	6.2	8.27	10.3	12.4	14.5	15.5
41	0.311	0.621	1.24	1.86	2.49	3.11	3.73	4.35	4.66
42	0.104	0.208	0.415	0.623	0.831	1.04	1.25	1.45	1.56
43	0.695	1.39	2.78	4.17	5.56	6.95	8.34	9.73	10.4
44	0.535	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.02
45	1.24	2.47	4.95	7.42	9.9	12.4	14.8	17.3	18.6
46	1.19	2.38	4.75	7.13	9.5	11.9	14.3	16.6	17.8
48	0.313	0.626	1.25	1.88	2.5	3.13	3.75	4.38	4.69
49	0.164	0.328	0.656	0.985	1.31	1.64	1.97	2.3	2.46
50	2.2	4.41	8.82	13.2	17.6	22	26.4	30.9	33.1
51	0.0762	0.152	0.305	0.457	0.609	0.762	0.914	1.07	1.14
52	0.0811	0.162	0.324	0.486	0.648	0.811	0.973	1.13	1.22
53	0.315	0.629	1.26	1.89	2.52	3.15	3.78	4.4	4.72
54	0.208	0.416	0.831	1.25	1.66	2.08	2.49	2.91	3.12
55	0.684	1.37	2.74	4.11	5.47	6.84	8.21	9.58	10.3
56	0.037	0.0739	0.148	0.222	0.296	0.37	0.443	0.517	0.554
57	0.034	0.0681	0.136	0.204	0.272	0.34	0.409	0.477	0.511
1B	0.0222	0.0445	0.0889	0.133	0.178	0.222	0.267	0.311	0.333
2B	0.0211	0.0422	0.0845	0.127	0.169	0.211	0.253	0.296	0.317
3B	0.0624	0.125	0.25	0.374	0.499	0.624	0.749	0.873	0.936
4B	0.0549	0.11	0.219	0.329	0.439	0.549	0.658	0.768	0.823
5B	0.0602	0.12	0.241	0.361	0.481	0.602	0.722	0.842	0.902
6B	0.0396	0.0792	0.158	0.238	0.317	0.396	0.475	0.554	0.594
7B	0.0439	0.0878	0.176	0.264	0.351	0.439	0.527	0.615	0.659
8B	0.0974	0.195	0.39	0.584	0.779	0.974	1.17	1.36	1.46
9B	0.0915	0.183	0.366	0.549	0.732	0.915	1.1	1.28	1.37
10B	0.0318	0.0637	0.127	0.191	0.255	0.318	0.382	0.446	0.478
11B	0.0714	0.143	0.286	0.429	0.571	0.714	0.857	1	1.07
12B	0.0544	0.109	0.218	0.327	0.436	0.544	0.653	0.762	0.817
13B	0.097	0.194	0.388	0.582	0.776	0.97	1.16	1.36	1.45
14B	0.183	0.365	0.731	1.1	1.46	1.83	2.19	2.56	2.74
15B	0.214	0.428	0.856	1.28	1.71	2.14	2.57	3	3.21
16B	0.067	0.134	0.268	0.402	0.536	0.67	0.803	0.937	1
17B	0.407	0.814	1.63	2.44	3.26	4.07	4.89	5.7	6.11
18B	0.165	0.329	0.659	0.988	1.32	1.65	1.98	2.31	2.47
19B	0.165	0.329	0.658	0.988	1.32	1.65	1.98	2.3	2.47
20B	0.189	0.377	0.754	1.13	1.51	1.89	2.26	2.64	2.83
23B	0.796	1.59	3.18	4.77	6.36	7.96	9.55	11.1	11.9
24B	0.0416	0.0832	0.166	0.25	0.333	0.416	0.499	0.583	0.624
25B	0.068	0.136	0.272	0.408	0.544	0.68	0.817	0.953	1.02
26B	0.108	0.216	0.432	0.648	0.864	1.08	1.3	1.51	1.62
27B	0.0931	0.186	0.372	0.559	0.745	0.931	1.12	1.3	1.4

Screening benchmark = 125 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Copper								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.564	1.13	2.26	3.38	4.51	5.64	6.77	7.89	8.46
2	0.451	0.902	1.8	2.7	3.61	4.51	5.41	6.31	6.76
3	1.06	2.11	4.23	6.34	8.46	10.6	12.7	14.8	15.9
4	0.167	0.335	0.669	1	1.34	1.67	2.01	2.34	2.51
5	0.679	1.36	2.72	4.08	5.43	6.79	8.15	9.51	10.2
6	0.651	1.3	2.6	3.9	5.2	6.51	7.81	9.11	9.76
7	0.486	0.971	1.94	2.91	3.88	4.86	5.83	6.8	7.28
8	3.36	6.72	13.4	20.2	26.9	33.6	40.3	47.1	50.4
9	1.82	3.64	7.28	10.9	14.6	18.2	21.8	25.5	27.3
10	1.46	2.92	5.85	8.77	11.7	14.6	17.5	20.5	21.9
11	0.815	1.63	3.26	4.89	6.52	8.15	9.78	11.4	12.2
12	0.355	0.711	1.42	2.13	2.84	3.55	4.27	4.98	5.33
13	0.629	1.26	2.52	3.77	5.03	6.29	7.55	8.8	9.43
14	1.39	2.78	5.56	8.34	11.1	13.9	16.7	19.5	20.9
15	0.381	0.762	1.52	2.29	3.05	3.81	4.57	5.33	5.72
16	0.743	1.49	2.97	4.46	5.95	7.43	8.92	10.4	11.1
17	0.405	0.81	1.62	2.43	3.24	4.05	4.86	5.67	6.08
18	0.787	1.57	3.15	4.72	6.3	7.87	9.44	11	11.8
19	5.29	10.6	21.1	31.7	42.3	52.9	63.4	74	79.3
20	1.11	2.22	4.43	6.65	8.86	11.1	13.3	15.5	16.6
21	18.8	37.6	75.3	113	151	188	226	263	282
22	11.8	23.7	47.4	71.1	94.8	118	142	166	178
23	1.3	2.61	5.21	7.82	10.4	13	15.6	18.2	19.5
24	0.646	1.29	2.59	3.88	5.17	6.46	7.76	9.05	9.7
25	0.811	1.62	3.24	4.87	6.49	8.11	9.73	11.4	12.2
26	2.48	4.96	9.92	14.9	19.8	24.8	29.8	34.7	37.2
27	2.53	5.06	10.1	15.2	20.2	25.3	30.3	35.4	37.9
28	2.65	5.29	10.6	15.9	21.2	26.5	31.7	37	39.7
29	7.68	15.4	30.7	46.1	61.4	76.8	92.2	108	115
30	1.04	2.08	4.16	6.23	8.31	10.4	12.5	14.5	15.6
31	1.92	3.83	7.67	11.5	15.3	19.2	23	26.8	28.8
32	1.42	2.84	5.67	8.51	11.3	14.2	17	19.8	21.3
34	6.63	13.3	26.5	39.8	53.1	66.3	79.6	92.9	99.5
35	2.58	5.17	10.3	15.5	20.7	25.8	31	36.2	38.8
36	1.79	3.58	7.15	10.7	14.3	17.9	21.5	25	26.8
38	4.28	8.55	17.1	25.7	34.2	42.8	51.3	59.9	64.1
39	9.77	19.5	39.1	58.6	78.2	97.7	117	137	147
40	5.12	10.2	20.5	30.7	41	51.2	61.5	71.7	76.8
41	2.36	4.73	9.46	14.2	18.9	23.6	28.4	33.1	35.5
42	1.28	2.56	5.12	7.67	10.2	12.8	15.3	17.9	19.2
43	4.08	8.16	16.3	24.5	32.7	40.8	49	57.2	61.2
44	7.45	14.9	29.8	44.7	59.6	74.5	89.4	104	112
45	5.77	11.5	23.1	34.6	46.1	57.7	69.2	80.7	86.5
46	5.77	11.5	23.1	34.6	46.2	57.7	69.2	80.8	86.5
48	2.76	5.52	11	16.6	22.1	27.6	33.1	38.7	41.4
49	21.7	43.4	86.8	130	174	217	260	304	325
50	10.2	20.3	40.7	61	81.4	102	122	142	153
51	0.766	1.53	3.06	4.6	6.13	7.66	9.19	10.7	11.5
52	0.654	1.31	2.61	3.92	5.23	6.54	7.84	9.15	9.81
53	1.58	3.17	6.34	9.5	12.7	15.8	19	22.2	23.8
54	1.33	2.66	5.31	7.97	10.6	13.3	15.9	18.6	19.9
55	6.83	13.7	27.3	41	54.6	68.3	82	95.6	102
56	0.394	0.788	1.58	2.36	3.15	3.94	4.73	5.52	5.91
57	0.373	0.745	1.49	2.24	2.98	3.73	4.47	5.22	5.59
1B	0.166	0.332	0.664	0.996	1.33	1.66	1.99	2.32	2.49
2B	0.151	0.302	0.603	0.905	1.21	1.51	1.81	2.11	2.26
3B	0.62	1.24	2.48	3.72	4.96	6.2	7.44	8.68	9.3
4B	0.448	0.895	1.79	2.69	3.58	4.48	5.37	6.27	6.71
5B	0.49	0.98	1.96	2.94	3.92	4.9	5.88	6.86	7.35
6B	0.42	0.841	1.68	2.52	3.36	4.2	5.04	5.89	6.31
7B	0.446	0.892	1.78	2.68	3.57	4.46	5.35	6.24	6.69
8B	0.905	1.81	3.62	5.43	7.24	9.05	10.9	12.7	13.6
9B	0.932	1.86	3.73	5.59	7.46	9.32	11.2	13	14
10B	0.334	0.668	1.34	2	2.67	3.34	4.01	4.68	5.01
11B	0.681	1.36	2.72	4.09	5.45	6.81	8.17	9.53	10.2
12B	0.502	1	2.01	3.01	4.02	5.02	6.02	7.03	7.53
13B	1.04	2.08	4.16	6.24	8.32	10.4	12.5	14.6	15.6
14B	2.05	4.09	8.18	12.3	16.4	20.5	24.5	28.6	30.7
15B	1.81	3.62	7.23	10.9	14.5	18.1	21.7	25.3	27.1
16B	0.935	1.87	3.74	5.61	7.48	9.35	11.2	13.1	14
17B	2.04	4.09	8.17	12.3	16.3	20.4	24.5	28.6	30.7
18B	0.864	1.73	3.46	5.18	6.91	8.64	10.4	12.1	13
19B	34.5	69.1	138	207	276	345	414	484	518
20B	30.6	61.1	122	183	244	306	367	428	458
23B	3.72	7.45	14.9	22.3	29.8	37.2	44.7	52.1	55.8
24B	0.335	0.669	1.34	2.01	2.68	3.35	4.02	4.68	5.02
25B	0.671	1.34	2.68	4.03	5.37	6.71	8.05	9.4	10.1
26B	1.03	2.05	4.1	6.15	8.2	10.3	12.3	14.4	15.4
27B	0.418	0.837	1.67	2.51	3.35	4.18	5.02	5.86	6.28

Screening benchmark = 30 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Dissolved Concentrations (µg/L) for Copper (based on maximum observed dissolved fraction - 16% - in DRET testing)								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.090	0.181	0.362	0.541	0.722	0.902	1.08	1.26	1.35
2	0.072	0.144	0.288	0.432	0.578	0.722	0.866	1.01	1.08
3	0.170	0.338	0.677	1.01	1.35	1.70	2.03	2.37	2.54
4	0.027	0.054	0.107	0.160	0.214	0.267	0.322	0.374	0.402
5	0.109	0.218	0.435	0.653	0.869	1.09	1.30	1.52	1.63
6	0.104	0.208	0.416	0.624	0.832	1.04	1.25	1.46	1.56
7	0.078	0.155	0.310	0.466	0.621	0.778	0.933	1.09	1.16
8	0.538	1.08	2.14	3.23	4.30	5.38	6.45	7.54	8.06
9	0.291	0.582	1.16	1.74	2.34	2.91	3.49	4.08	4.37
10	0.234	0.467	0.936	1.40	1.87	2.34	2.80	3.28	3.50
11	0.130	0.261	0.522	0.782	1.04	1.30	1.56	1.82	1.95
12	0.057	0.114	0.227	0.341	0.454	0.568	0.683	0.797	0.853
13	0.101	0.202	0.403	0.603	0.805	1.006	1.21	1.41	1.51
14	0.222	0.445	0.890	1.33	1.78	2.224	2.67	3.12	3.34
15	0.061	0.122	0.243	0.366	0.488	0.610	0.731	0.853	0.915
16	0.119	0.238	0.475	0.714	0.952	1.189	1.43	1.66	1.78
17	0.065	0.130	0.259	0.389	0.518	0.648	0.778	0.907	0.973
18	0.126	0.251	0.504	0.755	1.01	1.26	1.51	1.76	1.89
19	0.846	1.70	3.38	5.07	6.77	8.46	10.1	11.8	12.7
20	0.178	0.355	0.709	1.06	1.42	1.78	2.13	2.48	2.66
21	3.01	6.016	12.0	18.1	24.2	30.1	36.2	42.1	45.1
22	1.89	3.79	7.58	11.4	15.2	18.9	22.7	26.6	28.5
23	0.208	0.418	0.834	1.25	1.66	2.08	2.50	2.91	3.12
24	0.103	0.206	0.414	0.621	0.827	1.03	1.24	1.45	1.55
25	0.130	0.259	0.518	0.779	1.04	1.30	1.56	1.82	1.95
26	0.397	0.794	1.59	2.38	3.17	3.97	4.77	5.55	5.95
27	0.405	0.810	1.62	2.43	3.23	4.05	4.85	5.66	6.06
28	0.424	0.846	1.70	2.54	3.39	4.24	5.07	5.92	6.35
29	1.23	2.46	4.91	7.38	9.82	12.3	14.8	17.3	18.4
30	0.166	0.333	0.666	0.997	1.33	1.66	2.00	2.32	2.50
31	0.307	0.613	1.227	1.840	2.45	3.07	3.68	4.29	4.61
32	0.227	0.454	0.907	1.362	1.81	2.27	2.72	3.17	3.41
34	1.06	2.13	4.24	6.37	8.50	10.6	12.7	14.9	15.9
35	0.413	0.827	1.65	2.48	3.31	4.13	4.96	5.79	6.21
36	0.286	0.573	1.14	1.71	2.29	2.86	3.44	4.00	4.29
38	0.685	1.37	2.74	4.11	5.47	6.85	8.21	9.58	10.3
39	1.56	3.12	6.26	9.38	12.5	15.6	18.7	21.9	23.5
40	0.819	1.63	3.28	4.91	6.56	8.19	9.84	11.5	12.3
41	0.378	0.757	1.51	2.27	3.02	3.78	4.54	5.30	5.68
42	0.205	0.410	0.819	1.23	1.63	2.05	2.45	2.86	3.07
43	0.653	1.31	2.61	3.92	5.23	6.53	7.84	9.15	9.79
44	1.19	2.38	4.77	7.15	9.54	11.9	14.3	16.6	17.9
45	0.923	1.84	3.70	5.54	7.38	9.23	11.1	12.9	13.8
46	0.923	1.84	3.70	5.54	7.39	9.23	11.1	12.9	13.8
48	0.442	0.883	1.76	2.66	3.54	4.42	5.30	6.19	6.62
49	3.47	6.94	13.9	20.8	27.8	34.7	41.6	48.6	52.0
50	1.63	3.25	6.51	9.76	13.0	16.3	19.5	22.7	24.5
51	0.123	0.245	0.490	0.736	0.981	1.23	1.47	1.71	1.84
52	0.105	0.210	0.418	0.627	0.837	1.05	1.25	1.46	1.57
53	0.253	0.507	1.01	1.52	2.03	2.53	3.04	3.55	3.81
54	0.213	0.426	0.850	1.28	1.70	2.13	2.54	2.98	3.18
55	1.09	2.19	4.37	6.56	8.74	10.9	13.1	15.3	16.3
56	0.063	0.126	0.253	0.378	0.504	0.630	0.757	0.883	0.946
57	0.060	0.119	0.238	0.358	0.477	0.597	0.715	0.835	0.894
1B	0.027	0.053	0.106	0.159	0.213	0.266	0.318	0.371	0.398
2B	0.024	0.048	0.096	0.145	0.194	0.242	0.290	0.338	0.362
3B	0.099	0.198	0.397	0.595	0.794	0.992	1.19	1.39	1.49
4B	0.072	0.143	0.286	0.430	0.573	0.717	0.859	1.00	1.07
5B	0.078	0.157	0.314	0.470	0.627	0.784	0.941	1.10	1.18
6B	0.067	0.135	0.269	0.403	0.538	0.672	0.806	0.942	1.010
7B	0.071	0.143	0.285	0.429	0.571	0.714	0.856	0.998	1.070
8B	0.145	0.290	0.579	0.869	1.16	1.45	1.74	2.03	2.18
9B	0.149	0.298	0.597	0.894	1.19	1.49	1.79	2.08	2.24
10B	0.053	0.107	0.214	0.320	0.427	0.534	0.642	0.749	0.802
11B	0.109	0.218	0.435	0.654	0.872	1.09	1.31	1.52	1.63
12B	0.080	0.160	0.322	0.482	0.643	0.803	0.963	1.12	1.20
13B	0.166	0.333	0.666	0.998	1.33	1.66	2.00	2.34	2.50
14B	0.328	0.654	1.31	1.97	2.62	3.28	3.92	4.58	4.91
15B	0.290	0.579	1.16	1.74	2.32	2.90	3.47	4.05	4.34
16B	0.150	0.299	0.598	0.898	1.20	1.50	1.79	2.10	2.24
17B	0.326	0.654	1.31	1.97	2.61	3.26	3.92	4.58	4.91
18B	0.138	0.277	0.554	0.83	1.11	1.38	1.66	1.94	2.08
19B	5.52	11.1	22.1	33.1	44.2	55.2	66.2	77.4	82.9
20B	4.90	9.78	19.5	29.3	39.0	49.0	58.7	68.5	73.3
23B	0.595	1.19	2.38	3.57	4.77	5.95	7.15	8.34	8.93
24B	0.054	0.107	0.214	0.322	0.429	0.536	0.643	0.749	0.803
25B	0.107	0.214	0.429	0.645	0.859	1.07	1.29	1.50	1.62
26B	0.165	0.328	0.656	0.984	1.31	1.65	1.97	2.30	2.46
27B	0.067	0.134	0.267	0.402	0.536	0.669	0.803	0.938	1.00

Screening benchmark = 30 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Total Concentrations (µg/L) for Zinc								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.564	1.13	2.26	3.38	4.51	5.64	6.77	7.89	8.46
2	0.451	0.902	1.8	2.7	3.61	4.51	5.41	6.31	6.76
3	1.06	2.11	4.23	6.34	8.46	10.6	12.7	14.8	15.9
4	0.167	0.335	0.669	1	1.34	1.67	2.01	2.34	2.51
5	0.679	1.36	2.72	4.08	5.43	6.79	8.15	9.51	10.2
6	0.651	1.3	2.6	3.9	5.2	6.51	7.81	9.11	9.76
7	0.486	0.971	1.94	2.91	3.88	4.86	5.83	6.8	7.28
8	3.36	6.72	13.4	20.2	26.9	33.6	40.3	47.1	50.4
9	1.82	3.64	7.28	10.9	14.6	18.2	21.8	25.5	27.3
10	1.46	2.92	5.85	8.77	11.7	14.6	17.5	20.5	21.9
11	0.815	1.63	3.26	4.89	6.52	8.15	9.78	11.4	12.2
12	0.355	0.711	1.42	2.13	2.84	3.55	4.27	4.98	5.33
13	0.629	1.26	2.52	3.77	5.03	6.29	7.55	8.8	9.43
14	1.39	2.78	5.56	8.34	11.1	13.9	16.7	19.5	20.9
15	0.381	0.762	1.52	2.29	3.05	3.81	4.57	5.33	5.72
16	0.743	1.49	2.97	4.46	5.95	7.43	8.92	10.4	11.1
17	0.405	0.81	1.62	2.43	3.24	4.05	4.86	5.67	6.08
18	0.787	1.57	3.15	4.72	6.3	7.87	9.44	11	11.8
19	5.29	10.6	21.1	31.7	42.3	52.9	63.4	74	79.3
20	1.11	2.22	4.43	6.65	8.86	11.1	13.3	15.5	16.6
21	18.8	37.6	75.3	113	151	188	226	263	282
22	11.8	23.7	47.4	71.1	94.8	118	142	166	178
23	1.3	2.61	5.21	7.82	10.4	13	15.6	18.2	19.5
24	0.646	1.29	2.59	3.88	5.17	6.46	7.76	9.05	9.7
25	0.811	1.62	3.24	4.87	6.49	8.11	9.73	11.4	12.2
26	2.48	4.96	9.92	14.9	19.8	24.8	29.8	34.7	37.2
27	2.53	5.06	10.1	15.2	20.2	25.3	30.3	35.4	37.9
28	2.65	5.29	10.6	15.9	21.2	26.5	31.7	37	39.7
29	7.68	15.4	30.7	46.1	61.4	76.8	92.2	108	115
30	1.04	2.08	4.16	6.23	8.31	10.4	12.5	14.5	15.6
31	1.92	3.83	7.67	11.5	15.3	19.2	23	26.8	28.8
32	1.42	2.84	5.67	8.51	11.3	14.2	17	19.8	21.3
34	6.63	13.3	26.5	39.8	53.1	66.3	79.6	92.9	99.5
35	2.58	5.17	10.3	15.5	20.7	25.8	31	36.2	38.8
36	1.79	3.58	7.15	10.7	14.3	17.9	21.5	25	26.8
38	4.28	8.55	17.1	25.7	34.2	42.8	51.3	59.9	64.1
39	9.77	19.5	39.1	58.6	78.2	97.7	117	137	147
40	5.12	10.2	20.5	30.7	41	51.2	61.5	71.7	76.8
41	2.36	4.73	9.46	14.2	18.9	23.6	28.4	33.1	35.5
42	1.28	2.56	5.12	7.67	10.2	12.8	15.3	17.9	19.2
43	4.08	8.16	16.3	24.5	32.7	40.8	49	57.2	61.2
44	7.45	14.9	29.8	44.7	59.6	74.5	89.4	104	112
45	5.77	11.5	23.1	34.6	46.1	57.7	69.2	80.7	86.5
46	5.77	11.5	23.1	34.6	46.2	57.7	69.2	80.8	86.5
48	2.76	5.52	11	16.6	22.1	27.6	33.1	38.7	41.4
49	21.7	43.4	86.8	130	174	217	260	304	325
50	10.2	20.3	40.7	61	81.4	102	122	142	153
51	0.766	1.53	3.06	4.6	6.13	7.66	9.19	10.7	11.5
52	0.654	1.31	2.61	3.92	5.23	6.54	7.84	9.15	9.81
53	1.58	3.17	6.34	9.5	12.7	15.8	19	22.2	23.8
54	1.33	2.66	5.31	7.97	10.6	13.3	15.9	18.6	19.9
55	6.83	13.7	27.3	41	54.6	68.3	82	95.6	102
56	0.394	0.788	1.58	2.36	3.15	3.94	4.73	5.52	5.91
57	0.373	0.745	1.49	2.24	2.98	3.73	4.47	5.22	5.59
1B	0.166	0.332	0.664	0.996	1.33	1.66	1.99	2.32	2.49
2B	0.151	0.302	0.603	0.905	1.21	1.51	1.81	2.11	2.26
3B	0.62	1.24	2.48	3.72	4.96	6.2	7.44	8.68	9.3
4B	0.448	0.895	1.79	2.69	3.58	4.48	5.37	6.27	6.71
5B	0.49	0.98	1.96	2.94	3.92	4.9	5.88	6.86	7.35
6B	0.42	0.841	1.68	2.52	3.36	4.2	5.04	5.89	6.31
7B	0.446	0.892	1.78	2.68	3.57	4.46	5.35	6.24	6.69
8B	0.905	1.81	3.62	5.43	7.24	9.05	10.9	12.7	13.6
9B	0.932	1.86	3.73	5.59	7.46	9.32	11.2	13	14
10B	0.334	0.668	1.34	2	2.67	3.34	4.01	4.68	5.01
11B	0.681	1.36	2.72	4.09	5.45	6.81	8.17	9.53	10.2
12B	0.502	1	2.01	3.01	4.02	5.02	6.02	7.03	7.53
13B	1.04	2.08	4.16	6.24	8.32	10.4	12.5	14.6	15.6
14B	2.05	4.09	8.18	12.3	16.4	20.5	24.5	28.6	30.7
15B	1.81	3.62	7.23	10.9	14.5	18.1	21.7	25.3	27.1
16B	0.935	1.87	3.74	5.61	7.48	9.35	11.2	13.1	14
17B	2.04	4.09	8.17	12.3	16.3	20.4	24.5	28.6	30.7
18B	0.864	1.73	3.46	5.18	6.91	8.64	10.4	12.1	13
19B	34.5	69.1	138	207	276	345	414	484	518
20B	30.6	61.1	122	183	244	306	367	428	458
23B	3.72	7.45	14.9	22.3	29.8	37.2	44.7	52.1	55.8
24B	0.335	0.669	1.34	2.01	2.68	3.35	4.02	4.68	5.02
25B	0.671	1.34	2.68	4.03	5.37	6.71	8.05	9.4	10.1
26B	1.03	2.05	4.1	6.15	8.2	10.3	12.3	14.4	15.4
27B	0.418	0.837	1.67	2.51	3.35	4.18	5.02	5.86	6.28

Screening benchmark = 100 µg/L

**Table 2: Draft Predicted Discharge Water Quality Results
Esquimalt Graving Dock Waterlot Remediation Project**

Dredge Unit:	Predicted Discharge Water Dissolved Concentrations (µg/L) for Zinc (based on maximum observed dissolved fraction - 58% - in DRET testing)								
TSS (mg/L) =>	5	10	20	30	40	50	60	70	75
1	0.327	0.655	1.31	1.96	2.62	3.27	3.93	4.58	4.91
2	0.262	0.523	1.04	1.57	2.09	2.62	3.14	3.66	3.92
3	0.615	1.22	2.45	3.68	4.91	6.15	7.37	8.58	9.22
4	0.097	0.194	0.388	0.580	0.777	0.969	1.17	1.36	1.46
5	0.394	0.789	1.58	2.37	3.15	3.94	4.73	5.52	5.92
6	0.378	0.754	1.51	2.26	3.02	3.78	4.53	5.28	5.66
7	0.282	0.563	1.13	1.69	2.25	2.82	3.38	3.94	4.22
8	1.95	3.90	7.77	11.7	15.6	19.5	23.4	27.3	29.2
9	1.06	2.11	4.22	6.32	8.47	10.6	12.6	14.8	15.8
10	0.847	1.69	3.39	5.09	6.79	8.47	10.2	11.9	12.7
11	0.473	0.945	1.89	2.84	3.78	4.73	5.67	6.61	7.08
12	0.206	0.412	0.824	1.24	1.65	2.06	2.48	2.89	3.09
13	0.365	0.731	1.46	2.19	2.92	3.65	4.38	5.10	5.47
14	0.806	1.61	3.22	4.84	6.44	8.06	9.69	11.3	12.1
15	0.221	0.442	0.882	1.33	1.77	2.21	2.65	3.09	3.32
16	0.431	0.864	1.72	2.59	3.45	4.31	5.17	6.03	6.44
17	0.235	0.470	0.940	1.41	1.88	2.35	2.82	3.29	3.53
18	0.456	0.911	1.83	2.74	3.65	4.56	5.48	6.38	6.84
19	3.07	6.15	12.2	18.4	24.5	30.7	36.8	42.9	46.0
20	0.644	1.29	2.57	3.86	5.14	6.44	7.71	8.99	9.63
21	10.9	21.8	43.7	65.5	87.6	109	131	153	164
22	6.84	13.7	27.5	41.2	55.0	68.4	82.4	96.3	103
23	0.754	1.51	3.02	4.54	6.03	7.54	9.05	10.6	11.3
24	0.375	0.748	1.50	2.25	3.00	3.75	4.50	5.25	5.63
25	0.470	0.940	1.88	2.82	3.76	4.70	5.64	6.61	7.08
26	1.44	2.88	5.75	8.64	11.5	14.4	17.3	20.1	21.6
27	1.47	2.93	5.86	8.82	11.7	14.7	17.6	20.5	22.0
28	1.54	3.07	6.15	9.22	12.3	15.4	18.4	21.5	23.0
29	4.45	8.93	17.8	26.7	35.6	44.5	53.5	62.6	66.7
30	0.603	1.206	2.41	3.61	4.82	6.03	7.25	8.41	9.05
31	1.11	2.22	4.45	6.67	8.87	11.1	13.3	15.5	16.7
32	0.824	1.65	3.29	4.94	6.55	8.24	9.86	11.5	12.4
34	3.85	7.71	15.4	23.1	30.8	38.5	46.2	53.9	57.7
35	1.50	3.00	5.97	8.99	12.0	15.0	18.0	21.0	22.5
36	1.04	2.08	4.15	6.21	8.29	10.4	12.5	14.5	15.5
38	2.48	4.96	9.92	14.9	19.8	24.8	29.8	34.7	37.2
39	5.67	11.3	22.7	34.0	45.4	56.7	67.9	79.5	85.3
40	2.97	5.92	11.9	17.8	23.8	29.7	35.7	41.6	44.5
41	1.37	2.74	5.49	8.24	11.0	13.7	16.5	19.2	20.6
42	0.742	1.48	2.97	4.45	5.92	7.42	8.87	10.4	11.1
43	2.37	4.73	9.45	14.2	19.0	23.7	28.4	33.2	35.5
44	4.32	8.64	17.3	25.9	34.6	43.2	51.9	60.3	65.0
45	3.35	6.67	13.4	20.1	26.7	33.5	40.1	46.8	50.2
46	3.35	6.67	13.4	20.1	26.8	33.5	40.1	46.9	50.2
48	1.60	3.20	6.38	9.63	12.8	16.0	19.2	22.4	24.0
49	12.6	25.2	50.3	75.4	101	126	151	176	189
50	5.92	11.8	23.6	35.4	47.2	59.2	70.8	82.4	88.7
51	0.444	0.887	1.77	2.67	3.56	4.44	5.33	6.21	6.67
52	0.379	0.760	1.51	2.27	3.03	3.79	4.55	5.31	5.69
53	0.916	1.84	3.68	5.51	7.37	9.16	11.0	12.9	13.8
54	0.771	1.54	3.08	4.62	6.15	7.71	9.22	10.8	11.5
55	3.96	7.95	15.8	23.8	31.7	39.6	47.6	55.4	59.2
56	0.229	0.457	0.916	1.37	1.83	2.29	2.74	3.20	3.43
57	0.216	0.432	0.864	1.30	1.73	2.16	2.59	3.03	3.24
1B	0.096	0.193	0.385	0.578	0.771	0.963	1.15	1.35	1.44
2B	0.088	0.175	0.350	0.525	0.702	0.876	1.05	1.22	1.31
3B	0.360	0.719	1.44	2.16	2.88	3.60	4.32	5.03	5.39
4B	0.260	0.519	1.04	1.56	2.08	2.60	3.11	3.64	3.89
5B	0.284	0.568	1.14	1.71	2.27	2.84	3.41	3.98	4.26
6B	0.244	0.488	0.974	1.46	1.95	2.44	2.92	3.42	3.66
7B	0.259	0.517	1.03	1.55	2.07	2.59	3.10	3.62	3.88
8B	0.525	1.05	2.10	3.15	4.20	5.25	6.32	7.37	7.89
9B	0.541	1.08	2.16	3.24	4.33	5.41	6.50	7.54	8.12
10B	0.194	0.387	0.777	1.16	1.55	1.94	2.33	2.71	2.91
11B	0.395	0.789	1.58	2.37	3.16	3.95	4.74	5.53	5.92
12B	0.291	0.580	1.17	1.75	2.33	2.91	3.49	4.08	4.37
13B	0.603	1.21	2.41	3.62	4.83	6.03	7.25	8.47	9.05
14B	1.19	2.37	4.74	7.13	9.51	11.9	14.2	16.6	17.8
15B	1.05	2.10	4.19	6.32	8.41	10.5	12.6	14.7	15.7
16B	0.542	1.08	2.17	3.25	4.34	5.42	6.50	7.60	8.12
17B	1.18	2.37	4.74	7.13	9.45	11.8	14.2	16.6	17.8
18B	0.501	1.00	2.01	3.00	4.01	5.01	6.03	7.02	7.54
19B	20.0	40.1	80.0	120	160	200	240	281	300
20B	17.7	35.4	70.8	106	142	177	213	248	266
23B	2.16	4.32	8.64	12.9	17.3	21.6	25.9	30.2	32.4
24B	0.194	0.388	0.777	1.17	1.55	1.94	2.33	2.71	2.91
25B	0.389	0.777	1.55	2.34	3.11	3.89	4.67	5.45	5.86
26B	0.597	1.19	2.38	3.57	4.76	5.97	7.13	8.35	8.93
27B	0.242	0.485	0.969	1.46	1.94	2.42	2.91	3.40	3.64

Screening benchmark = 100 µg/L

Appendix 5

Example Reporting Templates

Public Works and Government Services Canada
EGD Environmental Management System Manual:
Form A - Environmental Incident Report

Pre-Work Orientation Record

Environmental Monitoring Report – Water Quality

Environmental Monitoring Report – Noise Monitoring

Environmental Monitoring Report – Aquatic Mammals

Form A Environmental Incident Report Form	Public Works and Government Services Canada Esquimalt Graving Dock <i>Environmental Management System Manual</i>	
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IR #:

LOCATION OF INCIDENT:	
Attached: <input type="checkbox"/> Photographs <input type="checkbox"/> Supporting Information	
BRIEF DESCRIPTION OF INCIDENT:	
Date:	
Time:	
CAUSE OF INCIDENT:	
<i>User/Contractor:</i>	<i>Vessel:</i>
<i>Spilled or Released Materials:</i>	<i>Quantity of Spilled or Released Materials:</i>
AFFECTED ENVIRONMENT: <input type="checkbox"/> Marine <input type="checkbox"/> Atmosphere <input type="checkbox"/> Other (specify) _____ <input type="checkbox"/> Ground <input type="checkbox"/> Groundwater	
INCIDENT REPORTED BY:	
Name/Organization:	Contact Information:
PERSONNEL RESPONDING TO INCIDENT:	
ACTIONS TAKEN TO MITIGATE INCIDENT:	
ACTIONS TAKEN FOR PREVENTATIVE MEASURES:	

Issue Date: July 1, 2007	Version: 1
Approved By: Environmental Coordinator	Last printed: 10/3/2007 8:36:00 AM
This document is only valid at time of printing; any copies made are considered uncontrolled.	

Form A Environmental Incident Report Form	Public Works and Government Services Canada Esquimalt Graving Dock <i>Environmental Management System Manual</i>	
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<i>This Section For Environmental Services Office Use Only</i>
NOTIFICATION:
Notified User/Agent/Vessel: <input type="checkbox"/> yes <input type="checkbox"/> no if yes, indicate which:
Notified External Agency: <input type="checkbox"/> yes <input type="checkbox"/> no if yes, indicate which Agency:
Any changes in the documented procedures resulting from the corrective and preventative action? <input type="checkbox"/> yes <input type="checkbox"/> no if yes, provide details:
Is follow up required? <input type="checkbox"/> yes <input type="checkbox"/> no If yes, provide details of follow-up actions required:
REPORT FORM COMPLETED BY:
Name:
Date:

PHOTOGRAPHS:	
Photo #:	Photo #:
Photo #:	Photo #:
Photo #:	Photo #:
Photo #:	Photo #:
Photo #:	Photo #:

PRE-WORK ORIENTATION RECORD

Date:		Orientation Delivered By:
Work / Area:		
Issues addressed:		

By signing this record, the person is acknowledging that they have received orientation on the noted date.

[illegible]

ENVIRONMENTAL MONITORING REPORT - WATER QUALITY	
Date/Time:	General Site Conditions (weather, vessel traffic):
Monitor:	
Work being undertaken:	

Water Quality Measurements					
Date:	Time:	Location	Depth	Turbidity (NTU)	Action Required (Y/N)*

* Note in issues tracking table

Summary of laboratory data as applicable:

Append photos and laboratory reports as applicable

ENVIRONMENTAL MONITORING REPORT – NOISE MONITORING	
Date:	General Site Conditions (weather, vessel traffic):
Monitor:	
Work being undertaken:	

Noise Measurements				
Date	Time	Location	Sound Level (dBA)	Action Required (Y/N)*

* Note in issues tracking table

Summary of noise monitoring data as applicable:

ENVIRONMENTAL MONITORING REPORT – AQUATIC MAMMALS	
Date:	General Site Conditions (weather, vessel traffic):
Monitor:	
Work being undertaken:	

Noise Measurements				
Date	Time	Location	Sound Level (kPA)	Action Required (Y/N)*

* Note in issues tracking table

Summary of noise monitoring data as applicable:

Append photos as applicable.

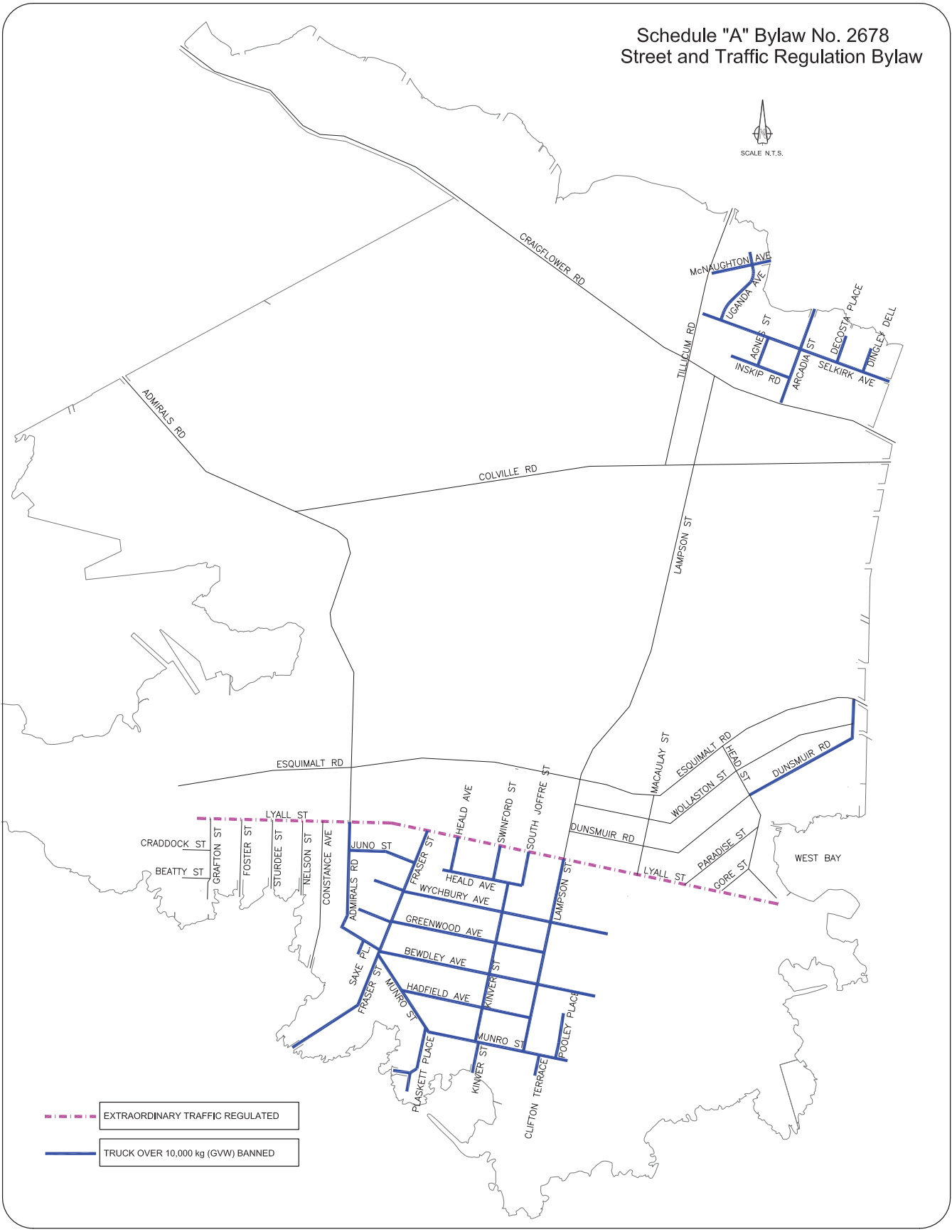
Appendix 6

Township of Esquimalt Truck Routes (Corporation of the Township of Esquimalt, 2007)

Schedule "A" Bylaw No. 2678
Street and Traffic Regulation Bylaw



- EXTRAORDINARY TRAFFIC REGULATED
- TRUCK OVER 10,000 kg (GVW) BANNED



SECTION 4

A CONNECTED COMMUNITY — TRANSPORTATION

Transportation issues, whether within Esquimalt or as part of the regional network are critical to our community's ongoing sustainability. This section sets out a variety of transportation issues within our community, including roads, parking, public transit, cycling and walking, and how we connect to the regional network.

- To improve mobility and access for local travel and to adjacent municipalities.
- To minimize intrusion of major traffic flows into neighbourhoods.
- To promote the safe use of the road network by pedestrians and bicyclists.
- To improve the network and infrastructure for safe cycling;
- To provide convenient routing for transit service, together with good local access routes for pedestrians to transit service, particularly in higher density areas, parks and recreation facilities.
- To avoid or mitigate the negative impacts of parking on aesthetics, livability, and the environment.
- To ensure the continued availability of sufficient parking.

4.1 Roads

Esquimalt's road system serves a variety of purposes and users. In addition to allowing residents to move between their homes, places of work, shopping and recreational facilities, it is also part of a larger regional network, which provides for the movement of private and commercial vehicles, as well as DND traffic.

4.1.2 Roads Policies

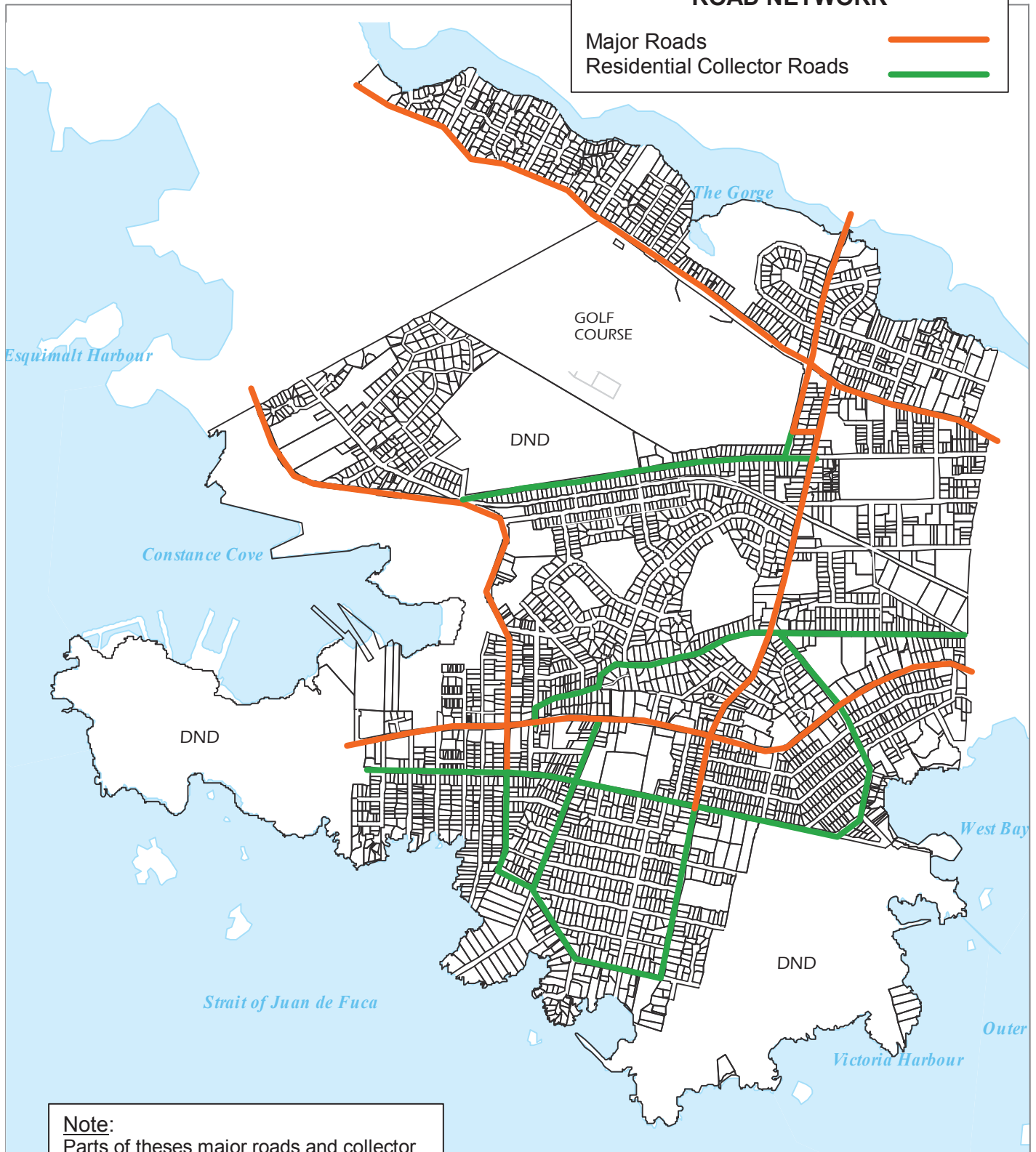
- a) Major Roads and Residential Collector Roads are shown on "Schedule B". All roads not highlighted on "Schedule B" are designed to serve local traffic only.
- b) Craigflower Road and Esquimalt Road will continue to serve as the municipality's principal east/west through-traffic routes. Through-traffic will be encouraged to use these routes rather than local streets.
- c) Encourage multi-modal street design and accessibility for pedestrians, cyclists, transit users and motorists.
- d) All roads, including all major collector roads, should become bicycle-accommodating.
- e) The Township is pursuing potential funding from other levels of government in order to assist with improvements to Craigflower Road.
- f) Major and local roads within Esquimalt are considered to be a "community resource" for the benefit of all users of the road. They increase opportunities for personal

Corporation of the Township of Esquimalt
OFFICIAL COMMUNITY PLAN

Schedule B₁
ROAD NETWORK

Major Roads

Residential Collector Roads



Note:

Parts of these major roads and collector roads are also part of the Bicycle Network [see Cycling Routes map]. Cycling is a recognized form of transportation and is permitted on all municipal roads.

Appendix 7

**Best Management Practices for Fire
Prevention – For Works, Buildings,
and Vessels within the Esquimalt
Graving Dock (PWGSC, 2009b)**

Best Management Practices for Fire Prevention

For Works, Buildings, and Vessels within the Esquimalt Graving Dock

Prepared for:

Public Works and Government Services Canada
Esquimalt Graving Dock

Date: Revised January 26, 2009

**PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
ESQUIMALT GRAVING DOCK**

Best Management Practices for Fire Prevention

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1. Introduction

Best Management Practices (BMP) are ways of lowering the Fire Risk/Fire losses through good Fire Prevention Practices, Fire and Building Code Compliance of the National, Provincial, Municipal Bylaws, NFPA Standards, and the Fire Commissioner of Canada Standards. BMP also include Indoor and Outdoor Storage of Combustible Products and Dangerous Goods the Storage and Handling of Flammable and Combustible Liquids, Hazardous Processes and Spray Operations

The benefits derived from implementing BMPs include:

Code Compliance

Safer working environment

Lower the Risk of Loss of Life due to Fire and Explosion

Lower the Risk of Fire losses due to Fire or Explosion

1.a Authority Having Jurisdiction

The Authority Having Jurisdiction for The Esquimalt Graving Dock is the General Manager of the Dock or his/her designate.

Note. Authority Having Jurisdiction (AHJ) (Definition by National Fire Protection Association)

The phrase "authority having jurisdiction" used in this document is in a broad manner, since jurisdictions and approval agencies vary, as to their responsibilities. Where public safety is primary, the authority having jurisdiction may be federal, provincial, municipal, or other regional department or individual such as a fire chief; chief of a fire prevention bureau, or other having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurers company representative may be the authority having jurisdiction. In many circumstances, the property owner or his/her designated agent assumes the role of authority having jurisdiction; at government installations; the commanding officer or department official may be the authority having jurisdiction.

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1.0 Scope

This document shall apply to all contractor facilities and equipment used to repair, service, construct, store, haul, and fuel vessels and small craft within the property owned or managed by the Esquimalt Graving Dock (PWGSC).

These Best Management Practices are for the Fire Prevention in Works, Buildings, and Vessels in the Esquimalt Graving Dock (PWGSC) area. The Esquimalt Graving Dock (PWGSC) provides specific guidelines that shall be followed by all individuals who conduct activities on property owned or managed by the Esquimalt Graving Dock (PWGSC). The purpose of this Best Management Practice document is to compliment existing Codes, Standards, Lease Agreements, Municipal Bylaws, Public Works Act, Occupation Health & Safety Regulation (BC), Canada Labour Code Part II, and WCB Regulations.

1.0.1 Purpose

This document is intended to provide a minimum acceptable level of safety to life and property from fire and other hazards at the Esquimalt Graving Dock (PWGSC).

Every reasonable means of preventing fire shall be provided and supplemented by means of detection, protection equipment that permits the prompt discovery, retard the spread, and permit extinguishment of any fire before it has passed the incipient stage. These fire-fighting methods shall include fire watching, fire extinguisher training, co-ordination and co-operation with the Esquimalt Graving Dock (PWGSC) primary emergency responder.

Nothing in this document shall be construed as prohibiting the immediate dry docking of a vessel whose safety is imperil, as by sinking condition or by being seriously damaged. In such cases, all necessary precautionary measures shall be taken as soon as practical.

1.0.2 Abbreviations/Acronyms

FC	Fire Commissioner of Canada Standards adopted by the Treasury Board of Canada
BCFC	British Columbia Fire Code 1998
NFC	National Fire Code of Canada 1995
NFPA	National Fire Protection Association
CEC	Canadian Electrical Code
BCEC	British Columbia Electrical Code
BCBC	British Columbia Building Code 1998
NBC	National Building Code of Canada
CSA	Canadian Standards Association
ULC	Underwriters Laboratories of Canada
TC	Transport Canada
ISPS	International Ship & Port Security Code
EGD	Esquimalt Graving Dock
PWGSC	Public Works and Government Services Canada

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1.0.3 Definitions

<i>“Approved”</i>	- acceptable to the authority having jurisdiction. (As applied to the Esquimalt Graving Dock (PWGSC) see 1.a page 3)
<i>“Authority Having Jurisdiction”</i>	- the organization, office, or individual responsible for approving equipment, installation, or a procedure
<i>“Contractor”</i>	- any company, firm, shipyard, corporation, government department, vessel using/ leasing the Esquimalt Graving Dock (PWGSC) or areas within the Esquimalt Graving Dock (PWGSC) for repairs, construction, conversion, lay-up of vessels, or a shiprepair related business.
<i>“Building”</i>	- any structure used or intended for supporting or sheltering any use or occupancy.
<i>“Combustible Liquid”</i>	- a liquid that has a close-cup flash point at or above 37.8 degrees C.
<i>“Flammable Liquid”</i>	- a liquid that has a close-cup flash point that is below 37.8 degrees C. and the maximum of vapor pressure of 40 psi (2068mm Hg) at 37.8 degrees C.
<i>“Hot Work”</i>	- the use of any equipment involving open flames or producing heat or sparks, including, without being limited to, cutting, welding, soldering, brazing, grinding, gouging, adhesive bonding, thermal spraying and thawing pipes.
<i>“Shall”</i>	- a mandatory requirement
<i>“Should”</i>	- a recommendation or that which is advised but not a mandatory requirement.

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1.1 Fire and Emergency Response Plans

All contractors within the Esquimalt Graving Dock (PWGSC) area shall have Fire, Emergency, and Earthquake Response Plans in place. A copy of these plans shall be given to the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator for review. These plans are to be reviewed on an annual basis by the contractor and Esquimalt Graving Dock (PWGSC) Best Practices Coordinator or his/her representative.

1.2 Emergency Response Drills

All contractors will participate in emergency response drills on an annual basis in accordance with Occupational Health & Safety Regulation (BC) Emergency Procedures Training and Drills. Drills will be held at the least disruptive times to minimize the impact of work stoppage to the contractor.

1.3 Hot Work Permits

All contractors within the Esquimalt Graving Dock (PWGSC) area shall have written hot work procedures and permits in place. A copy of the procedures and permits shall be given to the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator. These procedures and permits are to be reviewed on an annual basis by the contractor and Esquimalt Graving Dock Best (PWGSC) Practices Coordinator or his/her representative. If any contractor does not have written hot work procedures and permits in place, the contractor shall be subject to article 1.3.a of this document. Contractors written hot work procedures and permits do not apply to common areas of the yard. All contractors shall obtain a hot work permit issued by the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator, or his/her representative for all common areas within the Esquimalt Graving Dock areas

1.3.a. Hot work permits will be issued by Esquimalt Graving Dock (PWGSC) Best Practices Coordinator or his/her representative for all areas other than shipboard work and work on leased property. Permits shall be posted in the area of hot work. All hot work shall comply with the National Fire Code of Canada, British Columbia Fire Code 1998, CSA W117.2, "Safety in Welding, Cutting, and Allied Processes", NFPA 51B Standard for Fire Prevention in Use of Cutting and Welding Processes. 2003 Edition. FC 302 Standard for Welding and Cutting June 1982.

1.4 Flammable and Combustible Liquids

All contractors, sub-contractors, and agents shall comply with Part 4 of the National Fire Code of Canada, British Columbia Fire Code 1998.

1.5 Spray Coating Operations

All contractors who are involved in spray coating operations other than on board a ship in the dry dock or a ship berthed alongside, the contractor shall comply with Section 5.4. Spray Coating Operations in the British Columbia Fire Code 1998, and the National Fire Code of Canada 1995.

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1.6 Fire Protection

All contractors shall comply the following:

- British Columbia Fire Code Part 2 Section 2.16. Part 3, Part 4, Part5, and Part 6 2005
- National Fire Code of Canada Part 3, Part4, Part 6, 2006
- NFPA Standard 1 Uniform Fire Code 2003 Edition
- NFPA Standard 10 Standard for Portable Fire Extinguishers 2006 Edition
- NFPA Standard 51 B Standard for Fire Prevention During Welding, Cutting, and Other Hot Work 2006 Edition
- NFPA Standard 101 Life Safety Code 2003 Edition
- NFPA 303 Standard for Fire Protection of Marinas and Boatyards 2006 Edition
- NFPA Standard 306 Standard for the Control of Gas Hazards on Vessels 2006 Edition
- NFPA Standard 307 Standard for the Construction and Fire Protection of Marine Terminals, Piers and Wharves 2006 Edition
- NFPA Standard 312 Standard for Fire Protection of Vessels During Construction, Repair, and Lay-up 2006 Edition
- CSA C22.1 Electrical Installations, British Columbia Electrical Act and pursuant Regulations
- CSA W117.2 Safety in Welding, Cutting, and Allied Processes
- FC 302 Standard for Welding and Cutting June 1982
- Transport Canada TP3177E Standard for the Control of Gas Hazards in Vessels to be Repaired or Altered
- Workers` Compensation Board of British Columbia Occupational Health Safety Regulation

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1.6. Continued

All contractors in conjunction with the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator or his/her representative, shall do a post docking inspection of the vessel if the vessel is over 30.5M (100ft). The contractor or their representative shall complete a post docking inspection form along with the vessels fire control plans and crew list within 24 hours of the vessels arrival at the Esquimalt Graving Dock (PWGSC) facility. These forms and fire control plans will be given to Esquimalt Graving Dock (PWGSC) Best Practices Coordinator to be kept in the Esquimalt Graving Dock (PWGSC) Incident Command Post in the Esquimalt Graving Dock (PWGSC) administration building.

All contractors shall comply with NFPA Standard 312 Fire Protection of Vessels during Construction, Repair and Lay-up 2006 Edition and shall apply to all vessels, with the exceptions of vessels 30.5M (100ft) or less in length.

While vessels are at berths or in dry dock, temporary fire hoses supplied from shore connections to Esquimalt Graving Dock (PWGSC) Fire Equipment Boxes and a Portable Foam Units, shall be placed aboard the vessel and shall be connected and ready for use. The ratio shall be at least one hose for each 200 ft (62 m) of vessel length. This shall apply to all vessels, with the exceptions of vessels 30.5M (100ft) or less in length. Vessels 30.5M (100ft) or less in length and deemed vulnerable by the AHJ, may be required to have readily available, a temporary fire hose supplied from a shore connection to an Esquimalt Graving Dock (PWGSC) Fire Equipment Box and a Portable Foam Unit.

All contractors shall sign out the required fire equipment from the Esquimalt Graving Dock (PWGSC) stores person in the operation building.

If the contractor is unable to place the fire equipment onboard the vessel, the contractor or their representative shall inform an EGD representative the rationale and sign a non-compliance form. A copy of the non-compliance form shall be given to the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator kept on file with the post docking inspection reports.

(A non-compliance form can be obtained from the Esquimalt Graving Dock stores person in the operations building)

On vessels under repair, the vessel's fire system piping, where the system is intact and capable of being used, shall be connected to water supplies from the yard by means of temporary shore-to-ship connections.

All contractors engaged in the breaking-up of vessels shall comply, to all required codes and regulations.

Smoking is permitted in contractors designated smoking areas only. Smoking is not permitted on board vessels in for repair or refit. All contractors shall post no smoking signs on all gangways to vessels in the EGD area.

1.7 Building Construction

All building construction whether permanent or temporary shall be built and located in accordance with the British Columbia Building Code 1998, British Columbia Fire Code 1998, National Building Code of Canada 2006, National Fire Code of Canada 2006, Municipal by-laws & Permits, plus any other applicable codes and standards.

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1.7.1 Building Construction Compliance

All structures built, erected, or relocated on property owned or managed by Esquimalt Graving Dock (PWGSC) shall comply with Article 1.7 of this document.

1.8 Building Construction

Prior to any type of construction, major renovation, placement of trailers or temporary buildings, permits must be obtained from the Municipality of Esquimalt. The plans and copies of the permits shall be submitted to the contractor to the Operations Coordinator of the dock or his/her representative for approval. Plans and permits should be submitted well in advance of the planned project as this would expedite the approval process.

1.9 Building /Site Inspections by AHJ or Emergency Responder

As per the signed lease agreement Art. 11.02 the tenant agrees to comply with all requests and orders from the AHJ , primary emergency responder or Esquimalt Graving Docks (PWGSC) Representative

1.10 Compliance with Laws, Rules, and Regulations

Pursuant to any signed lease agreement the tenant shall comply with this document.

1.11 Marine Transportation Security Act / International Ship & Port Facility Security Code

All contractors shall be compliant to the Marine Transportation Security Act / International Ship & Port Security Code Codes when required.

1.12 Orientation of Subcontractors

Contractors are required to give to all visitors, or sub-trades/contractors hired by them to perform work within the Esquimalt Graving Dock (PWGSC) area, or on vessels within the Esquimalt Graving Dock (PWGSC) area, an orientation in the Esquimalt Graving Dock (PWGSC) Safety Regulations, and Emergency Procedures.

NOTE: For all 911 emergency calls the caller must state to the operator that you are calling from the Esquimalt Graving Dock and give your exact location in the dock area. Then the caller must call the main gate at 363-3784 and inform them that emergency services are on their way to the Esquimalt Graving Dock and give them your exact location in the dock area.

1.13 Flammable Material, and Dangerous Cargo Vessels

All work on vessels, barges, rigs and similar floating structures shall comply with Transport Canada TP3177E Standards for the Control of Gas Hazards in Vessels to be Repaired or Altered.

Vessels that carry explosives or other dangerous cargo such as flammable gases, hazardous chemicals, and flammable liquids, but excluding fuel and storage in specifically designated spaces, shall not be permitted to enter

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the EGD until materials are removed and spaces have been certified as gas free. The gas free certificates are to be posted and a copy given to the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator

1.14 Code Compliance

All contractors working and leasing space within the Esquimalt Graving Dock (PWGSC) areas shall comply with all required codes in this document, all contractors shall supply their own copies of all required codes and regulations pertaining to this document. Failure to comply with the Esquimalt Graving Dock (PWGSC) Best Management Practices for fire prevention and all required codes could mean immediate denial of dock services.

1.15 Reporting of Fires.

All fire regardless of size once extinguished shall be reported to the responding fire department and to the Esquimalt Graving Dock (PWGSC) Best Practices Coordinator immediately.

Reference Publications

This document or portions thereof, are referenced within this document and shall be considered part of the requirements of this document.

- NFPA Standard 1 Uniform Fire Code 2003 Edition
- NFPA Standard 10 Standard for Portable Fire Extinguishers
- NFPA Standard 51 B Standard for Fire Prevention During Welding, Cutting, and Other Hot Work 2006 Edition
- NFPA Standard 101 Life Safety Code 2003 Edition
- NFPA 303 Standard for Fire Protection of Marinas and Boatyards 2006 Edition
- NFPA Standard 306 Standard for the Control of Gas Hazards on Vessels 2006 Edition
- NFPA Standard 307 Standard for the Construction and Fire Protection of Marine Terminals, Piers and Wharves 2006 Edition
- NFPA Standard 312 Standard for Fire Protection of Vessels During Construction, Repair, and Lay-up 2006 Edition
- CSA C22.1 Electrical Installations, British Columbia Electrical Act and pursuant Regulations
- CSA W117.2 Safety in Welding, Cutting, and Allied Processes
- FC 302 Standard for Welding and Cutting June 1982
- Transport Canada TP3177E Standard for the Control of Gas Hazards in Vessels to be Repaired or Altered

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- Workers` Compensation Board of British Columbia Occupational Health Safety Regulation
- NFPA 303 Standard for Fire Protection of Marinas and Boatyards 2006 Edition
- NFPA Standard 306 Standard for the Control of Gas Hazards on Vessels 2006 Edition
- Transport Canada TP3177E Standard for the Control of Gas Hazards in Vessels to be Repaired or Altered
- Workers` Compensation Board of British Columbia Occupational Health Safety Regulation
- National Fire Code of Canada 2006
- British Columbia Fire Code 1998

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Appendix 8

Esquimalt Graving Dock
Spill Contingency Plan (PWGSC, 2010b)



Esquimalt Graving Dock Spill Contingency Plan



Prepared By:
Public Works and Government Services Canada
Environmental Services

Date: February 2010
Version: 03



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1.0 Introduction

1.1 Purpose

The Esquimalt Graving Dock (EGD) is committed to the protection of human health and the environment. Extensive safety and environmental management programs have been implemented at the EGD to reduce the potential for accidents and spills. Although the potential for spills can be reduced through these programs, spills do happen. The EGD Spill Contingency Plan was developed for those occasions when spills occur.

Specifically, the purpose of the EGD Spill Contingency Plan is to act as both policy and as a resource guide during spill events that occur within the Esquimalt Graving Dock and adjacent waters.

1.2 Scope

The EGD Spill Contingency Plan is intended to provide guidance to PWGSC Employees, EGD Users, and can be used as a resource for external spill response teams, in the event of a spill on land and/or the marine environment, generated at the Esquimalt Graving Dock property or water lot. The scope is intended primarily for 1st and 2nd level response, but provides notification requirements in the event that a 3rd level spill occurs.

2.0 Roles and Responsibilities

2.1 PWGSC Employees

PWGSC employees are responsible for understanding the information provided in both the EGD Spill Contingency Plan and the EGD Emergency Response Plan Handbook. PWGSC employees are expected to be able to appropriately respond to all PWGSC generated Level 1 and 2 spills.

Communication with external stakeholders, including the media, will be handled in accordance with the Public Works and Government Services Canada's protocol including Departmental Policy - 009, Critical Incident Reporting.

2.2 Esquimalt Graving Dock Users

Users are responsible for understanding the information provided in the EGD Spill Contingency Plan and the EGD Emergency Response Plan Handbook. In addition, each of the Users are responsible

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	Public Works and Government Services Canada Esquimalt Graving Dock <i>Spill Contingency Plan</i>	
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for developing Level 1 spill contingency plans, practicing those plans, and having the appropriate spill kits on site.

In the event of a spill, Users are responsible for reporting spills in accordance with applicable legislation as well as to PWGSC Environmental Services.

3.0 Spill Response Procedures

3.1 Definition of a Spill

For the purposes of the EGD Spill Contingency Plan, a spill can be defined as the abandonment, deposition, discharge, dumping, emission, escape, exhaust, throwing, injection, leakage, pouring, placement, release seepage, and/or spraying of a deleterious or hazardous material. This can occur during storage, handling, use, and/or transport.

3.2 Six Steps to Spill Response

There are six steps to follow when responding to a spill:

1. Assess the Risk
2. Protect Yourself and Others
3. Stop the Source/Contain the Spill
4. Clean the Spill
5. Dispose of Waste
6. Report the Spill

1. Assessing the Risk

Determine what hazards associated with the product that has spilled. Gather as much information as possible about the product and how it should be handled and cleaned up. Specific product information can be obtained from the product label, hazard symbol, or the Material Data Safety Sheet (MSDS) located on the site and location map in appendix IV. Once the product information is assessed, the level of response required can be determined. There are 3 levels of response, depending on the nature of a spill. The level is determined during the first step to responding to a spill: assessing the risk.

a) Level 1 Response – Generator/Discoverer Responds

A level 1 response is where the generator or discoverer of the spill is capable of adequately responding to the spill himself or herself. This applies to both PWGSC staff and EGD Users.

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b) Level 2 Response – PWGSC Response Team and Resources Deployed

A level 2 response is a where the generator or discoverer of a spill does not have the capability for responding to the spill and/or assistance is required.

c) Level 3 Response – External Agencies Call in for Assistance

A level 3 response is required when the spill is assessed to be out of the capability of the generator or discoverer and external response organizations, are required to assist or manage the incident.

2. Protecting Yourself and Others

It is important to protect yourself and others in the event of a spill. Notifications should be made to a number of personnel including employees, supervisors, safety representatives, tenants of the facility and the site commissionaires, who may be affected by the incident. Use of proper personal protective equipment (PPE) is also required. There are 4 levels of PPE:

- A** – full membrane and respiratory protection
- B** – full respiratory and limited membrane protection
- C** – limited respiratory and membrane protection
- D** – normal work safety gear (hard hat, safety glasses, etc.)

Most spills at the Esquimalt Graving Dock require level D protection.

3. Stopping the Source and Containing the Spill

It is important to ensure that the risk has been assessed prior to attempting to stop the source and contain the spill. For example, products may be flammable; therefore, need to be handled in an appropriate manner (e.g. no smoking in the immediate area). There are a number of ways to stop the source and contain a spill.

4. Cleaning the Spill

There are three types of spill supplies that can be found at the Esquimalt Graving Dock: oil only, universal, and hazardous material. The oil only products are meant for use in aqueous environments as well as on land (with the exception of loose absorbent type products). The oil only pads and absorbent socks will float on water and should be used for any oil based marine spills in the harbour.

The universal pads will pick up both oil and water based products, but are meant to be used for land based spills only. As the universal pads and absorbent socks absorb water based products, these supplies would sink if used in the marine environment.

There are spill supplies designed for chemical spills such as acids, bases, and oxidizers. These response supplies are specially designed to be inert and not react chemically with the product being cleaned up.

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	Public Works and Government Services Canada Esquimalt Graving Dock <i>Spill Contingency Plan</i>	
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Three large yellow spill kits are available; one in the fuel storage area, one in the pump house, and one in front of the operations center compound. These spill kits contain both oil only and universal spill response supplies.

A spill supply shed is located adjacent to the Operations Centre building, and contains a large variety and quantity of spill supplies. Personnel should become familiar with the contents of the spill supply shed, and the uses of the various types of supplies.

Refer to Appendix IV for site and location map with specific spill kit locations.

5. Disposing of Waste

Waste generated from the cleanup of a spill needs to be disposed of properly. Open top drums and hazardous materials bags are available for disposal of waste. Waste of different origins should not be mixed for disposal. All waste containers need to be labeled prior to filling. Waste containers should be visibly stored in designated areas with secondary containment, such as the EGD hazardous materials storage vault located adjacent to the Operations Centre building.

6. Notification and Reporting the Spill

Notification of a spill to the proper authorities will depend on the severity of the spill, once the risk has been assessed.

For example:

- In the event of the discovery of a minor spill or sheen on water, the alert may be made by two way VHF radio on Channel 4. Dock employees will stand by and await further direction from the Incident Commander
- If a spill occurs on water that is not within the capability of the generator/discoverer or EGD personnel and resources, the Provincial Emergency Program (PEP), DND Pollution Control, the Canadian Coast Guard, or an external contractor will be contacted immediately.
- In the event of the discovery of a major spill (land or water), the general alarm can be activated at one of the stations indicated on the site plan (Appendix IV). This will ensure that all available resources are made available to respond to the spill.
- If a spill occurs after hours, the discoverer will contact the Incident Commander. The Incident Commander will activate a recall of key personnel as required. Emergency contact numbers are located in Section 4.0.
- Internal emergency alerting procedures are also described in the EGD Emergency Response Plan Handbook.

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All spills are reportable to PWGSC EGD Environmental Services. Any spills on land that exceed the limits outlined in Appendix I, shall be immediately reported to the Provincial Emergency Program (PEP). All marine spills will immediately be reported to PEP.

Environmental Incident Reports will be documented for all spills. These reports will be maintained by EGD Environmental Services location of the incident.

Notification and Reporting requirements are illustrated in the Environmental Spill or Incident Flow Chart in Appendix III.

4.0 Emergency Contact Numbers

PWGSC Esquimalt Graving Dock Contacts

Contact Person	Company/Organization	Phone Number
Dave Latoski	EGD Operations Manager	(250) 889-5808 (c)
Bob Desmarais	EGD Yard Supervisor	(250) 888-0141 (c)
Wyatt Wright	EGD Pumphouse Supervisor	(250) 213-5154 (c)
Jack Gale	EGD Crane Supervisor	(250) 213-9683 (c)
Kim Wilson	EGD Risk Management	(250) 213-6540 (c)
Daryl Lawes	EGD Environmental Coordinator	(250) 213-7242 (c)
Melissa Piasta	EGD Environmental Officer	(250) 888-7357 (c)
Alanna Morbin	EGD Environmental Officer	(250) 889-3566 (c)

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User Contacts

Company	Office #	After Hrs. Contact	After Hrs. #
Victoria Shipyards Ltd.	(250) 380-1602	Malcolm Barker	(250) 727-2912 (h)
Jenkins Marine	(250) 383-6440	John Jenkins	(250) 478-2605 (h)
Esquimalt Drydock Company	(250) 386-4172	Joe Sansalone	(604) 202-5454 (c)
Hazco (formerly PWWS)	(250) 380-0436	Peter Lehman	(250) 380-8143 (h)
Intercon Marine	(250) 389-0391	Tom Whyte	(250) 480-8064 (c)
Nanaimo Shipyard	(250) 753-1151	Ron Van Wachem	(250) 753-4751 (h)

Other Stakeholder Contacts

Organization	Phone Number
DND Emergency Response (Call for all level 3 land and waterborne spills)	911 (from PWGSC government phones)
Port Operations and Emergency Services Branch – DND	Working Hrs: 363-2160 or VHF Channel 10 After Working Hrs: 911 or VHF Channel 10
QHM Pollution Control – Office Only	Bob Pope: 363-5428 (Pollution Control Officer) Lyle Fairly: 363-2911(A/Pollution Control Officer Dave Buchanan: 363-5429 (A/ Pollution Control Officer)
Environment Canada Spill Reporting line	(604) 666-6100
Canadian Coast Guard Emergency Line	24 hr Emergency 1-800-889-8852 (604) 666-6011or Maritime Communication and Traffic Services (MCTS) VHF Channel 12

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	Senior Response Officer (Victoria) (250) 363-3806
BC Provincial Emergency Program (PEP) Spill Reporting/Emergency Coordination Line	(800) 663-3456
Burrard Clean	24 hr Emergency (604) 294-9116 Non-Emergency (604) 294-6001 Fax (604) 294-6003
Canadian Forces Sailing Association	(250) 385-2646
Songhees First Nations Office	(250) 386-1043

5.0 Training

PWGSC EGD employees will receive appropriate spill response training. Training will include, but is not limited to:

- Policy, Legislation and Liabilities
- Basics of Spill Response
- Spill Prevention Strategies
- Resources Available at the EGD
- Hands on Exercises

Users of the Esquimalt Graving Dock will ensure that their employees receive appropriate spill response training.

6.0 Records

The controlled copy of this plan is held with the EGD Environmental Services. Uncontrolled copies will be distributed as requested.

Spill response training records for EGD personnel will be documented and retained on file with EGD Environmental Services.

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Appendix I

Responding to a Spill on Land

Responding to a Spill on Land

For all spills on land (including the wharves or in the Graving Dock), every effort shall be made to prevent the spill from reaching the marine environment. This can be achieved by placing absorbent material (e.g. sock/boom, pad, bagged universal absorbent) on the spill and also between the spill and the water.

Level 1:

If there is a land based spill, and it is within the capability of the generator or discoverer to respond to the spill, the generator/discoverer will proceed to clean up the spill using the appropriate PPE and spill supplies. The waste shall be properly labeled and disposed of in accordance with EGD policy. The waste shall not be abandoned or disposed of in the garbage or a dumpster. Once the spill has been cleaned up, the responder will immediately report the spill to their supervisor and to PEP if applicable (refer to Appendix I for reportable quantities on land). An Environmental Incident Report, or information for a report, will also be submitted to Environmental Services for tracking purposes.

Level 2:

If there is a land based spill and the generator/discoverer requires assistance with clean up, the generator/discoverer will immediately notify the Incident Commander and Environmental Services. The Incident Commander or Environmental Services will determine if the spill is within the capability of PWGSC staff and resources. Dock employees will stand by and await further direction from the Incident Commander or Environmental Services. If within PWGSC capability clean up will commence using appropriate PPE and spill supplies. The waste will be properly labeled and disposed of in accordance with EGD policy. The waste shall not be abandoned or disposed of in the garbage or a dumpster. Once the spill has been cleaned up, the responder will report the spill to PEP if applicable (refer to Appendix I for reportable quantities on land). An Environmental Incident Report, or information for a report, will also be submitted to Environmental Services for tracking purposes.

Level 3:

If there is a land based spill, and the Incident Commander and/or Environmental Services have deemed the spill not within the capability of PWGSC staff/resources, the DND Fire Department will be called in to assist or manage the spill. PWGSC personnel and resources may still be utilized during cleanup, therefore; dock employees will stand by and await further direction from the Incident Commander or Environmental Services. Once the spill has been cleaned up, PWGSC Environmental Services will report the spill to PEP if applicable (refer to Appendix I for reportable quantities on land). Environmental Services for tracking purposes will also file a report. An Environmental Incident Report, or information for a report, will also be submitted to Environmental Services for tracking purposes.

Reportable Quantities for Land Spills

Federal Regulations for the Transportation of Dangerous Goods

<i>Substance Spilled</i>	<i>Reportable Limit</i>
Explosives of Class 1 as defined in section 2.9 of the Federal Regulations	Any amount that could pose a danger to public safety or is greater than 50kg
Gases of Class 2 as defined in section 2.13 of the Federal Regulations	Any quantity that could pose a danger to public safety or any sustained release of 10 minutes or more
Flammable liquids of Class 3 as defined in section 2.18 of the Federal Regulations	200 L
Flammable solids of Class 4 as defined in section 2.20 of the Federal Regulations	25 kg
Products or substances that are oxidizing substances of Division 1 of Class 5 as defined in section 2.23 and 2.24 (a) of the Federal Regulations	50 kg or 50 L
Products or substances that are organic peroxides that contain the bivalent “-O-O-” structure of Division 2 of Class 5 as defined in sections 2.23 and 2.24 (b) of the Federal Regulations	1 kg or 1 L
Products or substances that are toxic and substances of Division 1 of Class 6 as defined in section 2.26 and 2.27 (a) of the Federal Regulations	5 kg or 5L
Infectious Substances defined in sections 2.26 and 2.27 (b) of the Federal Regulations	Any amount
Radioactive materials of Class 7 as defined by section 2.37 of the Federal Regulations and section 20 of the Packaging and Transport of Nuclear Substances Regulations	Any amount or any emission that is: (a) 10 mSv/h on the external surface of a package that is being transported under exclusive use, 2 mSv/h on the surface of the conveyance, and 0.1 mSv/h at a distance of 2 m from the surface of the conveyance; and (b) 2 mSv/h on the external surface of a package that is not being transported under exclusive use, 0.1 mSv/h at a distance of 1 m from the package, 2 mSv/h on the surface of the conveyance, and 0.1 mSv/h at a distance of 2 m from the surface of the conveyance.
Corrosive products or substances of Class 8 as defined by section 2.40 of the Federal Regulations	5 kg or 5 L

Miscellaneous products or substances of Class 9 as defined by section 2.43 of the Federal Regulations	25 kg or 25 L
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Appendix II

Responding to a Spill on Water

Responding to a Spill on Water

For spills on water it is often difficult to determine the source. The priority is to determine the size of the spill and the direction it is moving. A solid boom is the most effective means of containing a spill on water. The only readily available boom material at EGD is permanently in the water providing containment for the Dock main discharge port. If necessary, this boom may be disconnected and moved to contain a spill on the water as an interim measure. In addition, absorbent booms and pads may be placed on the water to absorb oil.

In the event of the discovery of a minor spill or sheen on the water, the alert will be made by two-way VHF radio on Channel 4 and Channel 10. Dock employees will stand-by and await further direction from the Incident Commander or Environmental Services.

Level 1:

If there is a spill that reached the marine environment, and it is within the capability of the generator or discoverer to respond to the spill, the generator/discoverer will proceed to clean up the spill using the appropriate PPE and Spill Kits (Hydrocarbon). The waste shall be properly labeled and disposed of in accordance with EGD policy. The waste shall not be abandoned or disposed of in the garbage or a dumpster. Once the spill has been cleaned up, the responder will immediately report the spill to their supervisor and to Environmental Services regardless of size. Environmental Services will report the spill to PEP. An Environmental Incident Report will also be submitted by the generator/discoverer to Environmental Services for tracking purposes. An Environmental Incident Report template can be located in Appendix II.

Level 2:

If there is a spill that reaches the marine environment, and the generator/discoverer requires assistance with clean up, the generator/discoverer will immediately notify the Incident Commander and Environmental Services (Contact numbers are located in Appendix III). The Incident Commander or Environmental Services will determine if the spill is within the capability of PWGSC staff and resources. If within PWGSC capability, clean up will commence using appropriate PPE, permanent boom, and spill response resources. The waste will be properly labeled and disposed of in accordance with EGD policy. The waste shall not be abandoned or disposed of in the garbage or a dumpster. Once the spill has been cleaned up, the responder will immediately report the spill to Environmental Services (if not previously notified). Environmental Services will report the spill to PEP. An Environmental Incident Report will also be submitted by the generator/discoverer to Environmental Services for tracking purposes. An Environmental Incident Report template can be located in Appendix II.

Level 3:

If there is a spill that reaches the marine environment and the Incident Commander and/or Environmental Services have deemed the spill not within the capability of PWGSC staff/resources,

DND Pollution Control, the Canadian Coast Guard, or an external contractor will be immediately notified and brought in to assist or manage the spill. PWGSC personnel and resources may still be utilized during cleanup. Once the spill has been cleaned up, PWGSC Environmental Services will report the spill to PEP. Environmental Services will also file a report internally for tracking purposes. Environmental Services, the Incident Commander, or Environment Canada may investigate the incident.

Oil Spills on Water

Environmental Impacts

The environmental implications of an oil spill are dependent on a number of variables including the product spilled, the quantity spilled, the location of the spill, and the habitat or wildlife impacted.

Spilled oil and certain cleanup operations can threaten different types of marine habitats and animals in different ways. For example, exposed sandy, gravel or cobble beaches are usually cleaned by manual techniques. Although oil can soak into sand and gravel, few organisms live full-time in this habitat, so the risk to animal life or the food chain is less than in other habitats, such as tidal flats.

Sheltered beaches have very little wave action to encourage natural dispersion. If the cleanup effort is not timely, oil may remain stranded on these beaches for years. Tidal flats are broad, low-tide zones, usually containing rich plant, animal, and bird communities. Deposited oil may seep into the muddy bottoms of these flats, creating potentially harmful effects on the ecology of the area. Finally, salt marshes host a variety of plants, bird and mammal life. Marsh vegetation; especially the root systems are easily damaged by fresh light oils.

In open water, marine organisms such as fish and whales have the ability to swim away from a spill by going deeper in the water or further out to sea. However, marine animals that live close to shore have a higher risk of being adversely affected as a result of an oil spill. Further, if one species in a food chain is adversely affected as a result of contamination, the entire food chain suffers.

Properties of Various Oil Types

<i>Oil Type</i>	<i>Representative Oils</i>	<i>Diagnostic Properties</i>	<i>Physical/Chemical Properties</i>
Light volatile oils	Distillate fuel, and most light crude oils	Highly fluid, usually transparent but can be opaque, strong odour, rapid spreading, can be rinsed from plant sample by simple agitation	<ul style="list-style-type: none"> • May be flammable • High rate of evaporative loss of volatile components • Assumed to be highly toxic to marine biota when fresh • Tend to form unstable emulsions • May penetrate sediments
Non-sticky oils	Medium to heavy paraffin-based refined and crude oils	Moderate to high viscosity, waxy or oily feel, can be rinsed from surfaces by low pressure water flushing	<ul style="list-style-type: none"> • Generally removable from surfaces • Penetration of substrates variable • Toxicity variable • Includes water in oil emulsions
Heavy sticky oils	Residual fuel oil; medium to heavy asphalt and mixed base crudes	Typically opaque brown or black, sticky or tarry, viscous, cannot be rinsed from plant by agitation	<ul style="list-style-type: none"> • High viscosity • Hard to remove from surfaces • Tend to form stable emulsions • High specific gravity and potential for sinking after weathering • Low substrate penetration • Low toxicity (biological effects due to smothering) • Will interfere with many types of recovery equipment
Non-fluid oils (at ambient temperature)	Residual and heavy crude oils (all types); asphalt	Tarry or waxy lumps	<ul style="list-style-type: none"> • Non-spreading • Cannot be recovered from water surfaces using most conventional clean-up equipment • Cannot be pumped without preheating or slurring • Initially relatively nontoxic • May melt and flow when stranded in sun

Reference: QHM Pollution Contingency Plan, Department of National Defence, December 2000.

Note: One of the most common substances spilled is dirty bilge water, which can be spilled during pumping operations. Bilge water is composed of a wide variety of substances, the majority of which include seawater, freshwater and numerous petroleum products (e.g. lubricants and fuels).

Estimating the Size of a Spill

When oil is spilled a working estimate of the volume of a spill on the water surface can be made by visual assessment of its surface area and thickness. When making a visual estimate of quantity, consideration should be given to slick thickness which can vary considerably even in a single slick. In general, dark brown or black patches indicate higher concentrations of oil, while coloured or silvery bands, such as those often seen at slick edges indicate extremely thin areas. The following table summarizes the appearance of oil on water as it is related to thickness.

Thickness (µm)*	Quantity (L/km ²)	Appearance
0.04	40	Barely visible under very good light conditions
0.08	90	Visible as a silvery sheen on water
0.15	175	First trace of colour may be observed
0.3	350	Bright bands of colour
1.0	1200	Colours begin to turn dull
2.0	2300	Colours are much darker
1000	10 x 10 ⁶	Dark brown, black; emulsions may be present

Reference: QHM Pollution Contingency Plan, Department of National Defence, December 2000.

*1000 µm = 1.0 mm

Fate of Spilled Oil

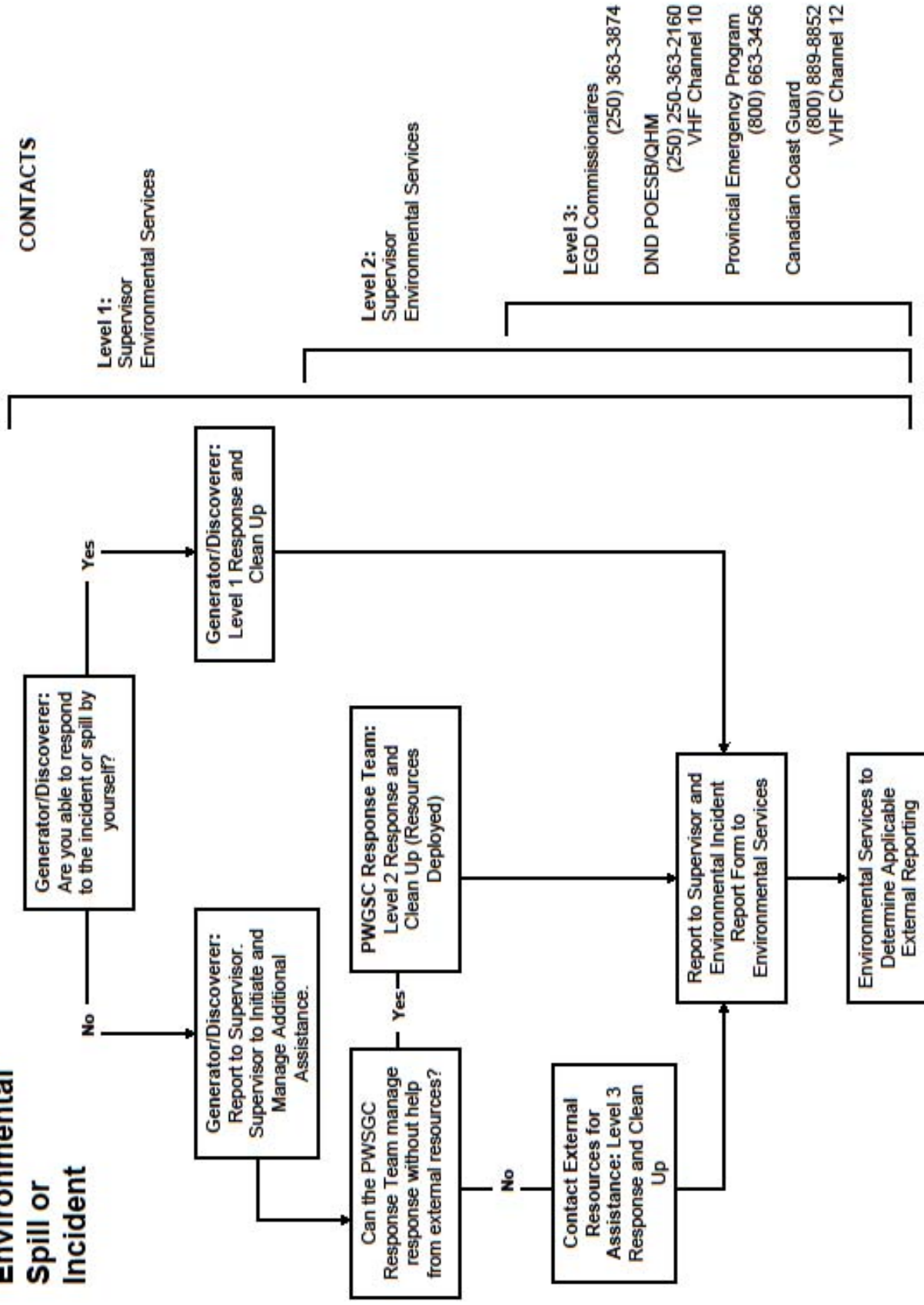
When oil is spilled on water, the slick itself can be affected by a number of weathering processes including oxidation, evaporation, spreading, emulsification, dissolution, biodegradation, and sedimentation. Weathering is a series of chemical and physical changes that cause spilled oil to break down and become heavier than water. Winds, waves, and currents may result in natural dispersion, breaking a slick into droplets which are then distributed throughout the water.

Appendix III

Environmental Spill or Incident Flow Chart

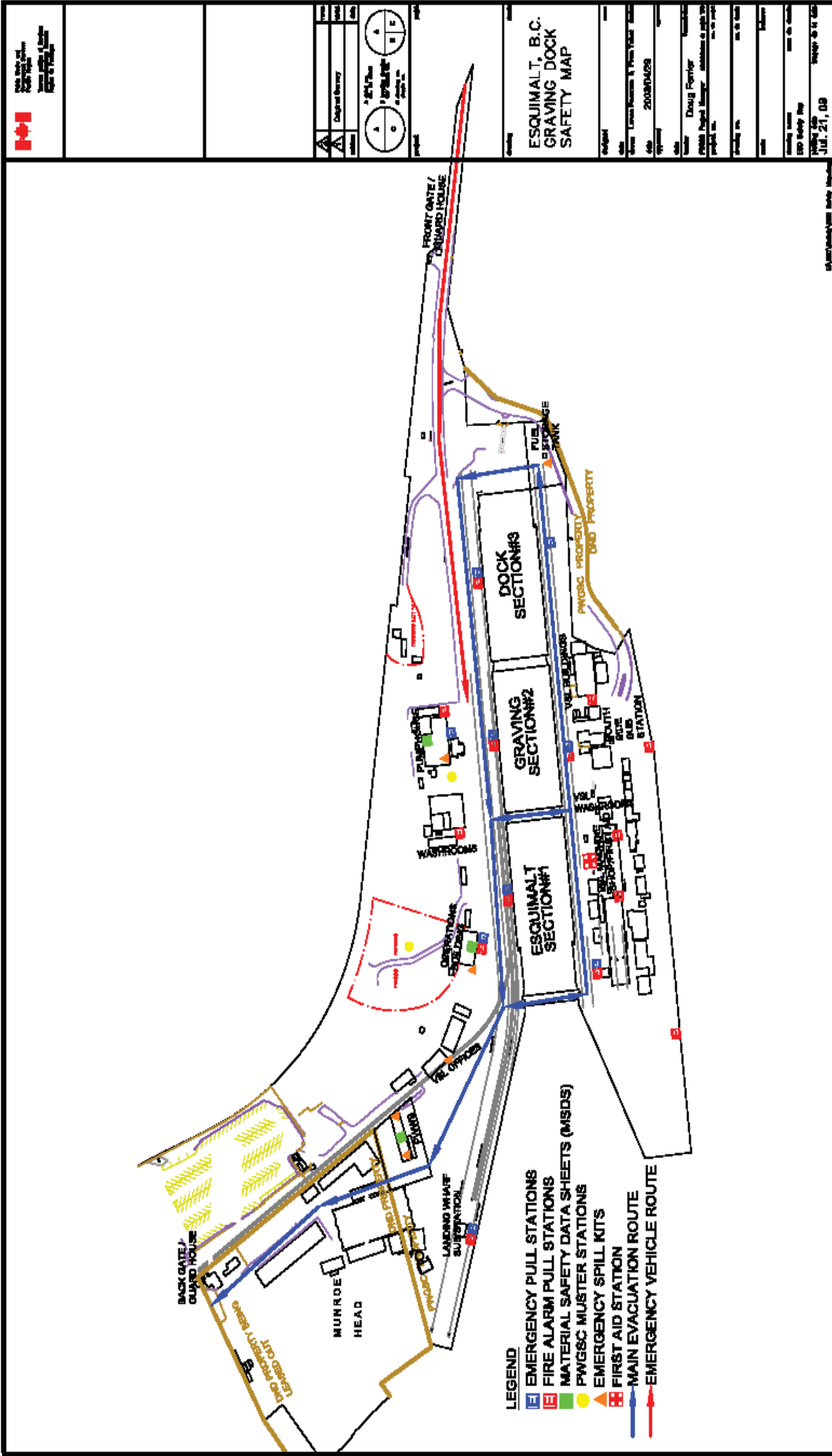
Environmental Spill or Incident

CONTACTS



Appendix IV

Site and Location Map



ESQUIMALT, B.C.
CRAVING DOCK
SAFETY MAP

ESQUIMALT, B.C.
CRAVING DOCK
SAFETY MAP

ESQUIMALT, B.C.
CRAVING DOCK
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ESQUIMALT, B.C.
CRAVING DOCK
SAFETY MAP

Appendix 9

Fuelling and Oil Transfer Policy

Esquimalt Graving Dock Fuelling and Oil Transfer Policy
(PWGSC, 2007)

Esquimalt Graving Dock Oil Transfer Checklist
(PWGSC, no date)

Esquimalt Graving Dock Fueling and Oil Transfer Policy

From time to time, bulk transfer of oil and fuel to or from vessels takes place at the Esquimalt Graving Dock (EGD) facility. Oil spills pose a significant risk to the environment, economy, and infrastructure at the EGD.

Scope: This policy applies to all vessel fueling operations involving trucks and barges, as well as bulk oil transfers of greater than 10 tonnes (10,000 litres) per day involving vessels berthed at the EGD. It applies to fueling of vessels in the drydock, but not bulk oil transfers involving dry-docked ships.

Oil, as described in the *Canada Shipping Act*, is considered petroleum in any form, including crude oil, fuel oil, sludge, oil refuse and refined products.

Requirements: The following must be adhered to when transferring bulk fuel/oil to or from vessels at the EGD:

1. Transfer operations must comply with the requirements outlined in the *Canada Shipping Act, Oil Pollution Prevention Regulations Part IV – Transfer Operations*.
2. An **Oil Transfer Checklist** must be completed and signed by both the representatives from the transfer vehicle (tank, truck or barge) and the vessel. This checklist must be received and signed by an EGD Representative prior to fuel/oil transfer.
3. For berthed vessels, a containment boom must be securely in place so that the areas of operations involved in the oil transfer process are completely surrounded. The containment boom must be structurally sound and have a minimum stand off of 5 feet from the sides of the vessel (this standoff may be adjusted to meet short term needs as long as potential spills from the dock, transfer hoses, decks and vents can be contained). *Users may deploy their own containment boom, have boom provided by a third party, or rent the Esquimalt Graving Dock boom.*
4. For transfers involving vessels in the Graving Dock, there must be a Pumphouse Operator present to shut down the auxiliary drydock pumps if a spill occurs. If no operator is on site, the drains and trenches on the dock floor should be covered, blocked or otherwise isolated from the tunnels leading to the auxiliary pumps.

Fuel transfer will not be allowed to commence without the permission of an Esquimalt Graving Dock Supervisor and completion of the **Oil Transfer Checklist**. The **Oil Transfer Checklist** can be obtained from the Front Gate Commissionaires or Pumphouse Operator. It must be filled out and submitted to the Pumphouse Operator or Front Gate Commissionaires prior to transfer.

Further details on safe transfer procedures can be found in the **Tank Truck to Marine Vessel-Oil Transfer Manual** (http://www.pacific.ccg-gcc.gc.ca/er/oiltransfer/index_e.htm).

Example Scenarios

Fuelling a Vessel at a Jetty

1. Agent/User arranges fuel for vessel.
2. Agent/User notifies Esquimalt Graving Dock Supervisor of fuelling plan.
3. A containment boom is secured around the vessel.
4. Fuel truck arrives at Front Gate.
5. Front Gate Commissionaire provides Oil Transfer Checklist. Commissionaire notifies the Pumphouse Operator of the operation, and to expect a submitted checklist.
6. Truck meets with the responsible vessel representative.
7. The checklist is filled out and signed by both parties.
8. Checklist is taken to the Pumphouse, signed as received by Pumphouse Operator, and filed. Copy is provided to the vessel or truck representative if requested.
9. Transfer takes place.
10. Truck leaves property.
11. Containment boom is retrieved.



Containment boom around vessel during fueling operations

Transfer of Lube Oil (> 10,000 litres) from a Berthed Vessel.

1. Shipyard prepares to transfer 10,000 litres of lube oil from a vessel to dockside tanks/totes.
2. Shipyard notifies Esquimalt Graving Dock Supervisor of transfer.
3. A containment boom is secured around the vessel.
4. The responsible personnel on the vessel and the shore fill out the Oil Transfer Checklist (this may be the same company if they are responsible for both ends of transfer).
5. Checklist is taken to the Pumphouse, signed as received by Pumphouse Operator, and filed. Copy is provided to the vessel or truck representative if requested.
6. Transfer takes place.
7. Containment boom is retrieved.

ESQUIMALT GRAVING DOCK OIL TRANSFER CHECKLIST

OIL TRANSFER LOCATION (circle): South Jetty North Landing Wharf Graving Dock (Section 1 2 3)
TANK/TRUCK/BARGE COMPANY NAME: _____
VESSEL NAME: _____

RESPONSE PERSONNEL INFORMATION:

Vessel (Name, Phone): _____
Tank, Truck or Barge (Name, phone): _____

INSTRUCTIONS FOR COMPLETION: No vessel berthed at the Esquimalt Graving Dock is to begin loading or discharging oil until this form is completed in its entirety, and submitted to the Pumphouse Operator. For dry-docked vessels, this checklist needs to be completed for fuelling operations only. Transfer must not proceed unless affirmative answers are provided for each applicable checklist question. If the Pumphouse Operator is not on Duty, please provide the completed form to the Front Gate Commissionaires.

QUESTIONS	VESSEL		TANK, TRUCK or BARGE	
	Yes	No	Yes	No
Is there a written spill procedure plan?				
Is there immediately available cleanup and containment material?				
Are sufficient/qualified personnel available to deal with an emergency?				
Is there an effective deck watch and adequate supervision ashore?				
Have procedures for <i>oil</i> transfer handling been agreed to?				
Is there an agreed upon communication system?				
Agree on units of volume measure (gallons, litres)				
Have emergency shutdown procedures been agreed to?				
Are transfer hoses in good condition, tested and properly rigged?				
Are scuppers plugged and drip tray positioned?				
Are unused connections blanked?				
Are safety/smoking requirements being observed?				
Berthed Vessels				
Is the vessel securely moored? (Vessel at a Jetty)				
Is there a sufficient containment boom in place to contain a spill or release? (Vessel at a Jetty)				

DATE/TIME	PRODUCT	QUANTITIY TO BE LOADED	DESCRIPTION OF RECEIVING TANK	CAPACITY OF RECEIVING TANK	RATE	PUMPING PRESSURE (psi)

DECLARATION

We have checked all the items on this checklist and have satisfied ourselves that the entries we have made are correct to the best of our knowledge.

VESSEL REPRESENTATIVE

NAME: _____
SIGNATURE: _____
DATE: _____

TANK, TRUCK, BARGE REPRESENTATIVE

NAME: _____
SIGNATURE: _____
DATE: _____

EGD REPRESENTATIVE SIGNATURE: _____ DATE: _____

In case of emergency contact the Commissionaires immediately
(250) 363-3784