



**REPORT**

# Environmental Management Plan

Esquimalt Harbour Remediation Project (EHRP) - Phase 2C and 2D - Y Jetty and Lang Cove (YJLC)

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## Notice to Readers

This report was prepared for Canada in accordance with the terms and conditions outlined in the Public Works and Government Services Canada (PWGSC) Contaminated Sites Marine Sediment Task Authorization No. EZ897-172925/002/VAN dated 21 November 2017. The scope of work for this report (Task 3: Update the YJLC Environmental Management Plan (EMP) and Water Quality Monitoring Plan (WQMP)) was outlined in Golder's "Workplan and Cost Estimate for Environmental, Heritage and Engagement Support for the Esquimalt Harbour Remediation Project, Esquimalt Harbour, BC", dated 25 May 2018. Task Authorizations (TA) for the above work plans were provided by Public Services and Procurement Canada (PSPC) on 4 June 2018 under TA 700412027.

The inferences concerning the Site conditions contained in this report are based on information obtained during the assessment conducted by Golder personnel, and are based solely on the condition of the property at the time of the Site reconnaissance, supplemented by historical and interview information obtained by Golder, as described in this report.

This report was prepared, based in part, on information obtained from historic information sources. In evaluating the subject Site, Golder has relied in good faith on information provided. We accept no responsibility for any deficiency or inaccuracy contained in this report as a result of our reliance on the aforementioned information.

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 practicing under similar conditions in the jurisdiction.

With respect to regulatory compliance issues, regulatory statutes are subject to interpretation. These interpretations may change over time, these should be reviewed.

If new information is discovered during future work, the conclusions of this report should be re-evaluated and the report amended, as required, prior to any reliance upon the information presented herein.

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### APPENDIX A

Water Quality Monitoring Plan (WQMP)

### APPENDIX B

Example Reporting Templates

## List of Acronyms and Abbreviations

BGID	Below-grate inlet device
BMP	Best management practice
CCME	Canadian Council of Ministers of the Environment
CD	Chart datum
CEAA	Canadian Environmental Assessment Act
CFB	Canadian Forces Base
COPC	contaminants of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRD	Capital Regional District
CSA	<i>Canada Shipping Act</i>
CSR	Contaminated Sites Regulation
DCC	Defence Construction Canada
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DR	Departmental Representative
DU	Dredge Unit
EED	Environmental Effects Determination
EIR	Environmental incident report
EM	Environmental monitor
EMBC	Emergency Management British Columbia
EMA	<i>Environmental Management Act</i>
EMP	Environmental management plan
EPP	Environmental protection plan
FSEMS	Formation Safety Environment Management System
H <sub>2</sub> S	Hydrogen sulphide
HEPH	heavy extractable petroleum hydrocarbons
INAC	Indian and Northern Affairs Canada
LEPH	light extractable petroleum hydrocarbons
MOE	British Columbia Ministry of Environment and Climate Change Strategy
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PEL	Probable effects level
PSPC	Public Services and Procurement Canada
QHM	Queens Harbour Master
QP	Qualified Professional
SARA	<i>Species at Risk Act</i>
SDS	Safety data sheet
SQG	Sediment quality guideline
TSS	Total suspended solids
UXO	Unexploded ordnance
WHMIS	Workplace Hazardous Materials Information System
WQMP	Water Quality Monitoring Plan
YJLC	Y Jetty and Lang Cove

## List of Units

kg	kilograms
km	kilometres
km <sup>2</sup>	square kilometres
L	litres
lb	pound

## 1.0 INTRODUCTION

### 1.1 Overview

This Environmental Management Plan (EMP) has been prepared for the Y Jetty and Lang Cove (YJLC) sub-project (the Project) of the Esquimalt Harbour Remediation Project (EHRP) and is based on potential environmental effects and mitigation measures identified in the *Canadian Environmental Assessment Act 2012* (CEAA 2012) Section 67 Environmental Effects Determination (EED) for the EHRP as well as other relevant environmental legislation and bylaws.

The contents of this EMP are organized as follows:

- **Section 1.0: Introduction** – Provides overview of the Project and the purpose and organization of the EMP.
- **Section 2.0: Environmental Setting** – Provides summary of the physical, biological and social/cultural setting of the Project area.
- **Section 3.0: Roles and Responsibilities** – Describes roles, responsibilities, and reporting relationships of the Department of National Defence (DND), Public Services and Procurement Canada (PSPC), the Environmental Monitor (EM), and the Contractor(s) for implementing environmental management and mitigation measures.
- **Section 4.0: Regulatory Setting** – Outlines environmental legislation, authorizations, permits, approvals, and best management practices (BMPs) applicable to the work.
- **Section 5.0: Environmental Requirements** – Summarizes measures that will be undertaken for protection of environmental resources, components to be included in the contractor's environmental protection plan, and environmental site inspection and monitoring activities that will be undertaken to assess and document that environmental management goals set for the Project are being met.
- **Section 6.0: Environmental Incidents** – Defines environmental incidents and outlines reporting and notification protocol to DND, PSPC and relevant regulatory agencies.
- **Appendix A – Water Quality Monitoring Plan (WQMP)** – The WQMP outlines the scope of water quality monitoring that will be undertaken during project activities and identifies appropriate monitoring parameters, performance objectives, and a decision framework to guide appropriate response to where changes in water quality are observed.
- **Appendix B – Example Reporting Templates** – Examples of reporting templates are provided as guidance for expected contents.

This EMP is intended to be read in conjunction with applicable environmental approvals, authorizations, and permits for the Project as well as contract requirements.

## 1.2 Project Description

DND has implemented a remediation program in Esquimalt Harbour as part of a long-term strategy to address sediments that have been contaminated by historical industrial activities. The remediation and risk management of sediment contamination will be undertaken at two remediation areas in Esquimalt Harbour. For the purposes of this report, only the remediation and risk management activities (the “Project”) within the YJLC remediation area (the “Project Area”) are considered (Figure 1).

As a result of historical activities in Esquimalt Harbour, sediment contamination exceeding the Canadian Council of Ministers of the Environment (CCME) probable effects level (PEL) sediment quality guidelines (SQGs) are present within the Project Area. The primary contaminants of potential concern (COPCs) resulting from historical activities in the harbour include arsenic, copper, lead, zinc, mercury, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and dioxins and furans. Sources of historical contamination in the general vicinity of YJLC include (Anchor QEA 2016):

- private dry dock and ship building activities as part of the former Yarrows Shipyard including the construction of frigates and ferries
- berthing of naval vessels at Y Jetty during DND operations
- infilling of Lang Cove as a result of expanding naval operations
- disposal of dredged material in Lang Cove from other parts of Esquimalt Harbour

The remediation and risk management of sediment contamination for this Project consists of the following components:

- mobilization and demobilization
- contractor vessel moorage and anchorage
- structure demolition/removal, relocation and reinstatement
- dredging, excavating and debris removal
- stabilization of material
- dewatering of dredged material
- placement of material
- in-water transportation
- offloading, stockpiling, processing
- upland transportation
- disposal

Specific details for Project components outlined in Table 1 are based on Anchor QEA’s 14 June 2018 specifications and drawings (Anchor QEA 2018a, b).



**Table 1: Description of Project Components and Activities.**

Project Component	Y Jetty and Lang Cove
Mobilization and demobilization	<ul style="list-style-type: none"> <li>■ Set up temporary facilities at the Y Jetty Access Area. An upland area adjacent to Y Jetty will be made available for the Contractor's use. The Y Jetty Access Area may not be used for stockpiling of dredge material or debris unless accepted by the Departmental Representative (DR).</li> <li>■ Staging of contractor materials from off site to complete the work either on barges within the Project Area or at an off-site location accepted by the DR.</li> <li>■ Set up of contractor processing facility, off-site offload facility and off-site stockpile area (location to be determined by contractor).</li> <li>■ Mobilization and demobilization of equipment.</li> <li>■ Cleaning of work site, off-site staging areas and offload facility at completion of work.</li> </ul>
Contractor vessel mooring and anchoring	<ul style="list-style-type: none"> <li>■ The contractor will not be allowed to moor construction equipment at the Y Jetty berths.</li> <li>■ The contractor may be allowed to drive temporary timber or steel piling to support mooring of the contractor's floating equipment at a location agreed to by the DR. When using steel piles the contractor will be responsible for all mitigation activities as well as obtaining all relevant and appropriate permits.</li> <li>■ Anchoring of equipment may also be allowed (i.e., processing barge near F-Jetty)</li> </ul>
Structure demolition/removal, relocation and reinstatement	<ul style="list-style-type: none"> <li>■ <b>Y Jetty Fender System:</b> To facilitate dredging in areas adjacent to and under Y Jetty, the existing Y Jetty fender system will be removed, cleaned, stored and reinstated in original location. Fender system includes timber fender piles and timber chocks. Salvaged timber fender piles will be reused except where the DR accepts that they are unsuitable for re-use. After timber piles are extracted, sediment and other objects that are attached to the surface of the piles will be cleaned off.</li> <li>■ <b>Former Marine Railway:</b> the former marine railway which is almost completely buried in the seabed will be removed. This work includes structure dismantling, pile extraction and off-site disposal of steel rail tracks, rail track support system, timber piled foundation, timber framing, bolting material and miscellaneous timber and steel components. A silt curtain will be used around the perimeter of the demolition work for the underwater portion of the former marine railway.</li> <li>■ For the <b>Y Jetty fender system</b> and <b>former marine railway</b>, vibratory piling hammer (with timber pile clamp) will be used to extract existing timber piles from the seabed except where an equivalent alternative method has been accepted by the DR.</li> <li>■ There will be no structure demolition/removal, relocation and reinstatement at Lang Cove.</li> </ul>
Dredging and debris removal	<ul style="list-style-type: none"> <li>■ Sediment and debris will be removed from the seabed to a specific dredge cut thickness or elevation.</li> <li>■ The dredge area, including side slopes, is estimated to be 31,200 m<sup>2</sup>. The dredge volume, including contingency re-dredging, is estimated to be 51,400 m<sup>3</sup>.</li> <li>■ Debris includes identified debris and dredge debris (e.g. timber piles, pile stubs, logs, wire, cable, concrete, trash). Dredge debris includes timber piles or pile stubs that are not part of identified structures to be demolished or relocated and reinstated.</li> <li>■ Dredging of contaminated sediments will be conducted using mechanical equipment. The bucket types and size is the contractor's choice provided that water quality requirements of the EMP and permit conditions are met.</li> <li>■ Contractor is not required to remove the till or bedrock material. The intent of remedial dredging is to remove contaminated sediment and not to remove till or bedrock material, which is not contaminated sediment.</li> <li>■ Identified debris will be removed by methods determined by the contractor.</li> <li>■ Suspected unexploded ordnance (UXO) of an unknown quantity may be encountered during dredging operations.</li> <li>■ The dredge sediment, including any incidental dredge debris, will be placed on a sealed (watertight) barge.</li> <li>■ One contingency re-dredging pass may be required if testing indicates contaminated sediment remains that exceeds criteria for the Project.</li> </ul>
Stabilization of Sediment	<ul style="list-style-type: none"> <li>■ Marine sediments to be removed from the Leachable Metals Area in Dredge Unit 9 north of Y Jetty have the potential for lead leachate concentrations to exceed the hazardous waste Leachate Quality Standard.</li> <li>■ Material removed from the Leachable Metals Area must be stabilized within Esquimalt Harbour and subsequently disposed of as IL+ waste material after the results of post-stabilization TCLP analysis (that must be collected and analyzed by the Contractor and accepted by the DR) indicate that the material no longer exceeds the hazardous waste Leachate Quality Standard for lead per the BC HWR regulations, Schedule 4 (Table 1 – Leachate Quality Standards).</li> <li>■ No stabilization is required for sediment in Lang Cove.</li> </ul>

Project Component	Y Jetty and Lang Cove
Excavation	<ul style="list-style-type: none"> <li>■ Land-based excavation of Dredge Units 29 and 30 to remove shoreline riprap is allowed.</li> <li>■ Salvaged riprap that is free of sediment and reusable, must be stockpiled on site,</li> <li>■ No excavation will occur in Lang Cove.</li> </ul>
Dewatering of dredge material	<ul style="list-style-type: none"> <li>■ Dredge sediment dewatering is not a requirement of the Project but can be implemented if desired by the contractor.</li> <li>■ Dredged material may be either passively dewatered on the dredge barge or collected for treatment prior to discharge, depending on the area, following the decision framework outlined in the WQMP (Appendix A) and the required mitigation measures outlined in Section 5.2.2.</li> <li>■ Results from recent dredging projects in Esquimalt Harbour suggest that some sediments may contain dissolved concentrations of metals, PAHs and PCBs that have the potential for acute toxicity to marine life under the evaluated conditions. Site-specific evaluation of each of the proposed dredge units for the Project was undertaken as part of a barge dewatering assessment to develop appropriate mitigation measures. The results of the assessment were incorporated into site-specific mitigation measures including the development of the WQMP (Appendix A) with a decision framework for managing dredging and dewatering.</li> <li>■ Passive dewatering consists of drainage of dredge effluent water through filter media (such as filter fabric) back into the Work Zone.</li> </ul>
Placement of material	<ul style="list-style-type: none"> <li>■ Following dredging and contingency re-dredging, a combination of different types of backfill material and engineered cap materials will be placed.</li> <li>■ Material will be placed in the water from a barge. Riprap maybe placed from the shore.</li> </ul>
In-water transportation	<ul style="list-style-type: none"> <li>■ In-water transportation from the dredging location to the processing facility and the contractor off-site offload facility will occur in a sealed watertight barge with sidewalls. Route to be determined by contractor.</li> </ul>
Offloading, stockpiling and processing	<ul style="list-style-type: none"> <li>■ The Contractor must provide a contractor off-site offload facility to be used to transfer materials between the contractor's floating equipment and land.</li> <li>■ The dredged sediment and debris will be offloaded at the off-site offload facility and may be loaded directly onto trucks or rail cars or may be placed into a constructed stockpile storage area.</li> <li>■ Stockpiling of existing site armour for re-use and of clean material for engineered capping material placement may be permitted adjacent to the Y jetty steep shoreline DUs (DUs 29 and 30) upon acceptance by the DR.</li> <li>■ The Contractor must provide a Processing Facility to segregate out all suspected UXO greater than 6 mm.</li> <li>■ Processing of sediment and debris to remove suspected UXO may occur before or after offloading. The contractor may perform processing on a floating platform in Esquimalt Harbour or at a processing facility at an upland site after offloading from the barge. The upland processing facility must be located within the area of responsibility for DND's Explosive Ordnance Disposal Team based at the Pacific Fleet Diving Unit.</li> </ul>
Upland transportation	<ul style="list-style-type: none"> <li>■ Sediment and debris from the sediment stockpile will be transported by barge, truck or rail to the permitted disposal facility.</li> <li>■ The contractor will be responsible for the safe transport of all waste (e.g., contaminated sediment, effluent, and debris) in accordance with all applicable regulations and guidelines.</li> <li>■ Dredged material will be transported in accordance with applicable municipal, provincial or federal regulations and legislation, including applicable United States legislation if transported there for disposal.</li> </ul>
Disposal	<ul style="list-style-type: none"> <li>■ The disposal facility will be chosen by the contractor and may be located in Canada or the United States. The disposal facility must hold a valid permit from a facility regulator for the handling, processing, treatment, or disposal of contaminated material, and be accepted by the DR. The facility regulator may be a provincial or territorial ministry, Indigenous and Northern Affairs Canada, a relevant First Nation Council, or a relevant state or federal authority in the United States, as defined in the Project specifications. No recycling of dredge material or debris is allowed. Any discharges of dewatering effluent at the receiving facility will be in accordance with the permit requirements of that facility.</li> <li>■ No material designated for the removal from the Project Area has been identified as Hazardous Waste Quality Materials under the British Columbia Hazardous Waste Regulation (BC HWR), with the potential exception for the Leachable Metals Area material. If hazardous waste is encountered during construction, it will be disposed of at a facility authorized to treat, destroy, and dispose of Class 9 Solid Waste, as defined by the Hazardous Waste Regulations (BC Reg. 63/88, including amendments up to BC Reg. 179/2016, (2016)) if disposal in BC is contemplated. Disposal outside BC will be carried out under the applicable laws and regulations at the receiving site.</li> </ul>

## 1.3 Objectives

The overall objective of the EMP is to provide a framework for the management of potential environmental effects during the Project through the implementation of protection measures. Specifically, the EMP identifies:

- roles, responsibilities, and communication structure of DND, PSPC, and the Contractor(s) during the Project
- federal and provincial environmental legislation and municipal bylaws that apply to the Project
- measureable environmental protection requirements, including environmental mitigation measures and monitoring that are to be undertaken during the Project
- environmental incident reporting protocols in the event an environmental incident occurs during implementation of the Project

The EMP addresses Project effects identified in the EED report (Golder 2018), as well as those identified through subsequent engineering design, and allows for a process of continuous improvement and adaptive management if additional effects are identified as the Project progresses.

In the event of a discrepancy between the EMP and the provisions of any legislation, regulations, or municipal bylaws, the more stringent provisions resulting in the higher protection of the environment, the lower discharge of contaminants, and the higher degree of environmental protection and safety will prevail.

## 2.0 ENVIRONMENTAL SETTING

This section provides a summary of the environmental resources in and adjacent to the Project Area. A more detailed description is provided in the EED report (Golder 2018).

### 2.1 Physical Environment

Esquimalt Harbour is a sheltered marine body of water that is 3.4 km<sup>2</sup> in area with 20 km of shoreline. Over the past 160 years, various industries have operated in the harbour. Past and present industrial activities and log storage have physically impacted large portions of the harbour, resulting in sediment contamination and accumulation of wood debris on the seafloor.

Intertidal and subtidal habitats within the YJLC Project area contained a mix of soft sediment, mixed substrate and boulder/bedrock/riprap. The upper and lower intertidal area was primarily boulder, bedrock and riprap along the shoreline. The nearshore subtidal portion of the proposed dredge boundary consisted of mostly boulder substrate with several patches of mixed cobble, gravel and sand substrate. Further offshore, the substrate was predominantly sand and silt with a few patches of cobble/gravel/sand substrate. A large amount of shell, wood and anthropogenic debris (e.g., metals, plastics, ceramics) was observed in nearshore areas, primarily in the areas adjacent to existing jetties and float structures (Balanced 2012; Golder 2016a). Wood debris includes 1,500 to 2,500 timber piles that may be encountered during dredging (Anchor QEA 2018a).

### 2.2 Biological Environment

Several key biological resources have been documented in Esquimalt Harbour including kelp, eelgrass, Dungeness crab (*Metacarcinus magister*) habitat, salmon spawning streams, Pacific herring (*Clupea pallasii*) spawning habitat, as well as bird foraging and nesting habitat (CRD 2017). Various provincial and federal listed species have also been observed in Esquimalt Harbour including Northern abalone (*Haliotis kamtschatkana*), Olympia oyster (*Ostrea lurida*), coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), canary rockfish (*Sebastes pinniger*), quillback rockfish (*Sebastes maliger*), harbour porpoise (*Phocoena vomerina*), killer whale (*Orcinus orca*), Steller sea lion (*Eumetopias jubatus*), and various listed bird species (Golder 2018).

No evidence of eelgrass (*Zostera marina*) was found within the Project Area during habitat surveys in February 2015 and February 2016 (Golder 2015a; Golder 2016a). A small area of tidal salt marsh exists in southern Lang Cove in an area called Black Beach consisting of low density common orache (*Atriplex patula*) and a small patch of salt grass (*Distichlis spicata*) (Golder 2016a).

No canopy-forming kelps (e.g., bull kelp [*Nereocystis luetkeana*]) were observed in the Project area; however, understory kelp (*Laminaria* sp. and *Costaria costata*) was observed. In winter 2016, patchy understory kelp (*Laminaria* sp.) was also observed in the south areas of Y Jetty, specifically in areas where boulder/bedrock habitat was the dominant substrate type and in northeast and northwest areas of Lang Cove within soft sediment and mixed substrate habitat (Golder 2016a). As part of a survey of the adjacent Constance Cove Remediation Project in summer 2016, understory kelp (mainly sugar wrack kelp [*Saccharina latissima*]) on boulder/cobble with > 75% cover was observed at the west side of the Y Jetty area (Golder 2018). DFO has indicated that unavoidable serious harm to fish will occur in areas with understory kelp and that an authorization under paragraph 35(2)(b) of the *Fisheries Act* is required (pers. comm. Mike Bodman, DND, 3 March 2018). An application for an authorization has been submitted to DFO.

Potential northern abalone habitat was identified within Y Jetty; however, targeted dive surveys conducted in the area found no abalone (Golder 2016a). No suitable abalone habitat was identified in Lang Cove; therefore, they are not expected to be present within this area (Balanced 2012; Golder 2016a). No evidence of Olympia oyster was observed during habitat surveys in 2000, 2012 or 2016 (Archipelago 2004; Balanced 2012; Golder 2016b). Several species of clams were documented in the eastern area of Lang Cove in January 2015 (Golder 2015a) including horse clam (*Tresus* sp.), piddock clam (*Zirfaea pilsbryi*) and Nuttall's cockle (*Clinocardium nuttallii*).

Pacific herring spawning was recorded in and adjacent to the area by DFO in 1993 (DFO 2016). Pacific herring and were recently documented adjacent to the Project Area during marine habitat surveys conducted by Archipelago in August 2016 (Archipelago 2016). Juvenile salmonids were observed near Y Jetty in April 2018 (pers. comm. Mike Waters, DND). Lingcod were observed in the YJLC area by Balanced in 2012 (Balanced 2012). There is potential for rockfish, flatfish and North Pacific spiny dogfish to occur based on habitat requirements.

There is potential for smaller marine mammals to occur in the area and larger marine mammals to occur further out in the harbour. Birds that may nest within and adjacent to the Project Area include ospreys (*Pandion haliaetus*), bald eagles and barn swallows (*Hirundo rustica*). Osprey and eagle nests are not known to occur within or adjacent to the Project Area. Barn swallows, a COSEWIC threatened species and a migratory bird under the *Migratory Birds Convention Act*, may nest under Y Jetty structures.

## 2.3 Social and Cultural Environment

Esquimalt Harbour is administered by DND and is governed by the *Canada Marine Act*, the Natural and Man Made Harbour Navigation and Use Regulations (pursuant to the *Canada Marine Act*), and Esquimalt Harbour – Practices and Procedures (DND 2016). The harbour is open to the public within the limitations set out in an Order in Council regarding Controlled Access Zones that provide for security zones around warships berthed or moving in the harbour. Vessels entering or departing Esquimalt Harbour must contact Queens Harbour Master (QHM) Operations on marine VHF channel 10 or by telephone at (250) 363-2160. QHM has inspection requirements for vessels mooring at the project sites and vessels must go through a security screening.

Four types of vessels enter and exit Esquimalt Harbour, including naval ships accessing DND Jetties, commercial traffic accessing the Esquimalt Graving dock, pleasure craft of all sizes, and recreational and commercial crab harvesting vessels (Golder 2018).

Crab harvesting is only allowed outside of the controlled access zones and water lease areas. Fishing is not permitted in the harbour (QHM pers. comm. 2016). Anchoring is prohibited anywhere in the harbour except in the northern most part of the Inner Harbour. Ships at anchor must register with QHM Operations and cannot remain at anchor for longer than two weeks.

Esquimalt Harbour is surrounded by three Municipalities, the City of Colwood (Colwood), the Town of View Royal (View Royal), and the Township of Esquimalt (Esquimalt). The Project Areas are located adjacent to Esquimalt.

Esquimalt Nation and Songhees Nation have Indian Reserves (IRs) on Esquimalt Harbour and are thus considered local to the EHRP area. The following groups and organizations also have Aboriginal interests in the EHRP area:

- Te'mexw Treaty Association, representing the Malahat Nation, Scia'new (Beecher Bay) First Nation, Snaw-naw-as (Nanoose) First Nation, Songhees Nation, and the T'Sou-ke (Sooke) Nation
- Hul'qumi'num Treaty Group, representing the Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, Penelakut Tribe, and Stz'uminus (Chemainus) First Nation
- Saanich Nations (Malahat First Nation, Pauquachin First Nation, Tsartlip First Nation, Tsawout First Nation and Tseycum First Nation)
- Métis Nation British Columbia
- Métis Nation of Greater Victoria

Under the Douglas Treaty, the Esquimalt and Songhees Nations have fishing and hunting rights which are practiced in Esquimalt Harbour (INAC 2016a, b). In meetings with DND, these First Nations have indicated that they have ongoing subsistence and cultural uses in the harbour. Both the Esquimalt and Songhees Nations assert Aboriginal rights and interests within the harbour area.

Both First Nations are concerned with the treatment of archaeological resources in the region, including ancestral remains which are found in many of the registered archaeological sites located on the Esquimalt Harbour.

There are no recorded precontact archaeological sites located within the Project Area; however, the precontact archaeological site DcRu-6 is located immediately north of Lang Cove (Golder 2015b). In addition, the archaeological overview assessment determined that there were locations with potential to contain undocumented precontact archaeological sites and heritage wrecks within portions of the YJLC Project area, including along formerly exposed surfaces of seabed which have been inundated by post-glacial sea-level change (Golder 2018). An archaeological impact assessment conducted by Golder in Lang Cove resulted in the identification of the heritage wreck site DcRu-1259 (Golder 2016b). This site includes several historical features, including a patent slip cradle and two heritage wrecks. One of the heritage wrecks has been identified as the pioneer coastal steamer, the *S.S. Barbara Boscowitz*; the second shipwreck, Lang Cove Wreck II, has not been identified by name.

### 3.0 ROLES AND RESPONSIBILITIES

This section describes the roles and responsibilities of DND, PSPC, and the Contractor for implementing, inspecting, and reporting on the effectiveness of the environmental mitigation measures. The team organization and communication structure is illustrated in Figure 2.

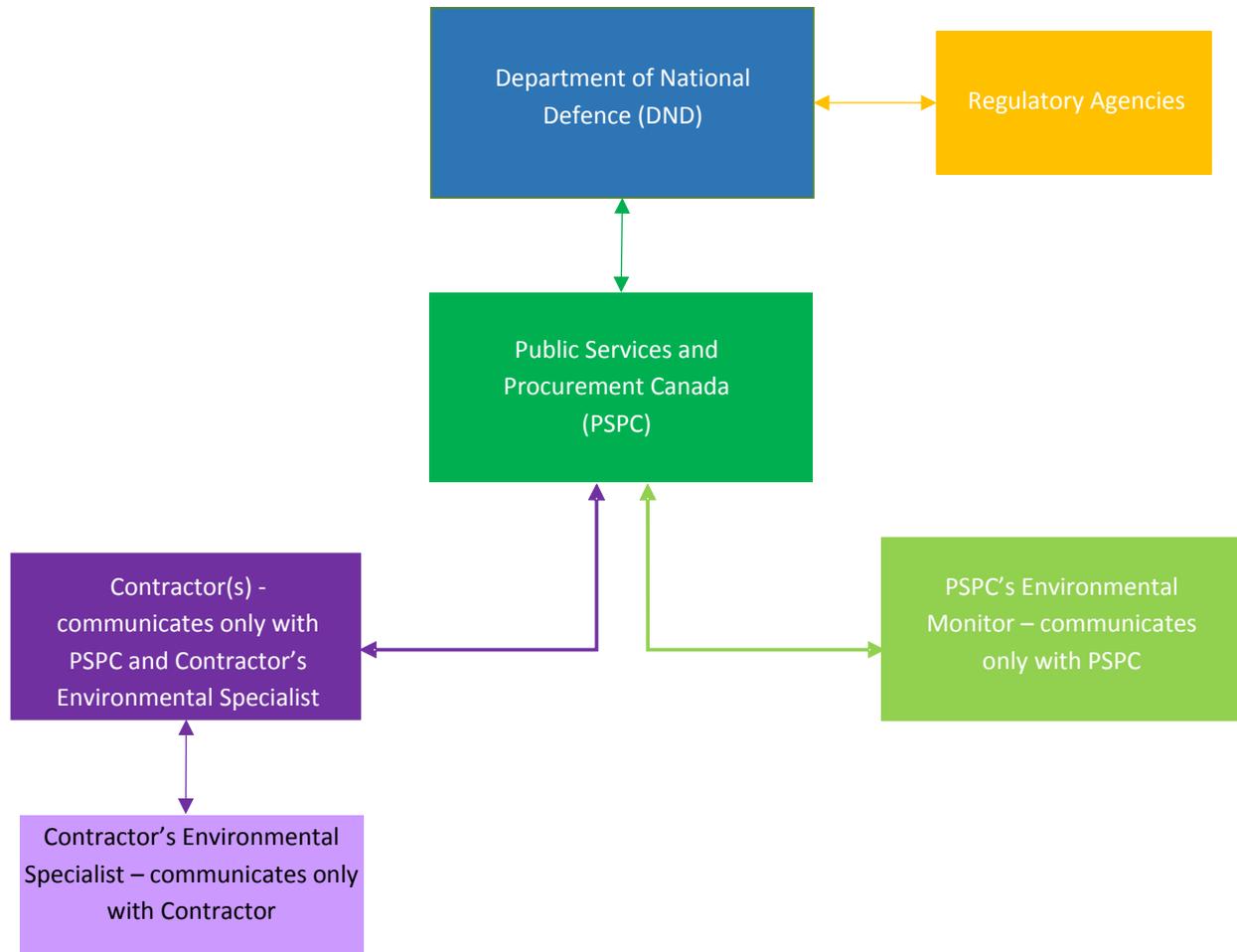


Figure 2: Project Environmental Team Organizational and Communication Structure

### 3.1 Department of National Defence (DND)

DND is the proponent of the Project and is the overall authority. DND is responsible for the overall compliance with federal and provincial legislation. All communications with DND are to go through PSPC. All communications with outside regulatory agencies are to go through DND, except as required by relevant laws and regulations (e.g., in the event of reporting a spill in which case the Contractor may contact Environmental Management BC directly), as described in Section 5.2.9.

### 3.2 Public Services and Procurement Canada (PSPC)

PSPC is DND's representative for the Project or the Departmental Representative (DR), and is responsible for day to day compliance with environmental mitigation measures, permits, approvals, and authorizations. The Contractor(s) and EM will communicate with PSPC about environmental aspects of the Project. All communications to DND will go through PSPC.

PSPC may retain an environmental monitor (EM) to confirm that environmental management measures and controls are implemented in accordance with regulatory approvals, authorizations and permits, environmental components of the contract requirements, including this EMP, and the EPP prepared by the Contractor.

Environmental monitoring will be conducted by or under the supervision of a Qualified Professional (QP). For the purposes of this EMP, a QP is defined as a person who is registered and/or licensed in the relevant jurisdiction with his or her appropriate professional association and/or licensing authority, acts under that professional association's and/or licensing authority's code of ethics, and is subject to disciplinary action by that professional association and/or licensing authority, and through suitable education, experience, accreditation, and knowledge can be reasonably relied on to provide advice within his or her area of expertise.

### 3.3 Contractor(s)

The Contractor(s) will be responsible for the actions of its agents, employees, and subcontractors, and thus will undertake all reasonable actions to have environmental protection measures in place and working effectively throughout the Project Area. The contractor(s) will:

- Adhere to requirements set out in regulatory authorizations, approvals and permits, and contract requirements, including this EMP.
- Undertake effective communication with work crews and subcontractors such that environmental responsibilities and requirements are understood prior to the commencement of work, and are implemented during the work. This will include disseminating information from orientation and other meetings to personnel not in attendance at those meetings.
- Retain an Environmental Specialist with appropriate skills to prepare the EPP(s) and evaluate performance against the requirements outlined in regulatory approvals, authorizations, and permits, as well as environmental protection goals provided in this EMP and the contract requirements. The environmental specialist will also conduct environmental monitoring to verify and document that the objectives of environmental legislation, terms and conditions of regulatory permits and approvals, and environmental contract requirements, including this EMP, are being met. Environmental monitoring tasks will include participating in meetings, conducting work site inspections, and reporting. The Contractor's Environmental Specialist will also be a QP (as defined in Section 3.2).

- Use equipment and implement work procedures and controls to prevent and/or reduce work-related disturbance to environmental, social, heritage, archaeological, and cultural resources.
- Take preventative and corrective measures in response to non-conformance with regulatory permits and approvals, the contract requirements including this EMP.
- Immediately respond to environmental incidents (defined in Section 6.0).

### 3.4 Meetings

Environmental requirements of the Project are to be reviewed by the Contractor(s) and their crews in the pre-construction and daily tailgate meetings. Environmental updates will also be provided during weekly progress meetings with the DR.

#### Pre-Construction Meeting(s)

A pre-construction meeting will be held between DND, PSPC, PSPC's EM(s) (if applicable), the Contractor(s), and the Contractor's Environmental Specialist(s) which will include, at a minimum, the following:

- a review of environmental requirements of the contract
- transfer of further relevant information or precautions that PSPC and/or DND is aware of, and which pertain to the contract
- consequences of non-compliance with environmental law, authorizations, approvals, and permits
- a review of the communication protocol between DND, PSPC, PSPC's EM(s) (if applicable), the Contractor(s), and the Contractor's Environmental Specialist(s) for communication of environmental issues, incidents and emergencies
- reporting of environmental incidents and emergencies (see Section 6.0)

#### Tailgate Meetings

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

#### Weekly Progress Meetings

Environmental issues which arise during the course of the work will be communicated and addressed, as necessary, during weekly progress meetings between the Contractor and PSPC.

## 3.5 Environmental Reporting

### Spill and Environmental Incident Reporting

Refer to Section 5.2.9 for spill reporting procedures, and Section 6.0 for environmental incident reporting.

### Weekly Environmental Monitoring Reporting

Environmental inspection and monitoring reports will be prepared by the PSPC EM(s) and submitted weekly. Example report templates are provided in Appendix B. Reports may be submitted, as required, to regulatory agencies, First Nations, and public stakeholders, during the course of the Project. Monitoring reports will include, at a minimum, the following information:

- a description of construction activities undertaken during the reporting period
- a description of site inspections and monitoring activities undertaken
- results of testing (e.g., water quality data)
- a description of environmental issues and corresponding mitigation measures implemented, and communication steps taken
- tracking of emerging and outstanding environmental issues
- photos documenting construction activities, environmental issues, and corresponding mitigation measures
- reporting on environmental incidents (e.g., spills) and corrective action taken

### Environmental Monitoring Completion Reporting

The PSPC EM(s) will prepare an environmental completion report following completion of the Project. The report will include 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, and mitigation measures.

## 4.0 REGULATORY SETTING

Table 2 provides a summary of federal and provincial environmental legislation and municipal bylaws, as well as authorizations, permits and approvals issued for the Project (current to August 2017). This legislation provides the framework for the procedures described in Section 5.0 of this EMP. This section is not necessarily exhaustive or all inclusive; it is the Contractor's responsibility to understand the regulatory context governing their activities and to act accordingly. Should clarification of any environmental issue be required, the Contractor should consult the original regulation or legislative document.

If additional authorizations, permits or approvals are required, the Contractor(s) will be provided with copies received by DND from regulatory agencies and will be responsible for complying with the terms and conditions specified within these documents as well as the provisions of the statutes under which the approvals have been issued. DND and the Contractor(s) will be required to keep copies of all Project approvals, authorizations, and permits on the Project site available for inspection as needed.

**Table 2: Relevant Environmental Legislation.**

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
<b>Federal</b>			
<i>Canadian Environmental Assessment Act, 2012</i>	Section 67 specifies that Federal Authorities must not make a decision about a proposed "project" on federal lands unless the proposed "project" is determined to be unlikely to cause significant adverse environmental effects, or the Governor in Council decides that those effects are justified. Section 5 provides protections against adverse project effects to 'any structure, site or thing that is of historical, archaeological, paleontological or architectural significance'.	The proposed Project meets the definition of a "project" under the <i>Act</i> , and an Environmental Effects report has been prepared.	No formal approval required. The EED indicates that the Project is unlikely to cause significant adverse environmental effects with mitigation measures that have been recommended.
<i>Fisheries Act</i>	Section 35 prohibits causing serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery unless authorized under the <i>Act</i> .	Project involved work in water which has the potential to cause serious harm to fish.	A Request for Review was submitted by DND to DFO in 2017. DFO's review indicated that unavoidable serious harm to fish will occur in areas with understory kelp. An application for Paragraph 35(2)(b) <i>Fisheries Act</i> Authorization has been submitted to DFO, and DND is awaiting approval.

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
	Section 36 prohibits the deposit of a deleterious substance in water frequented by fish.	Dredging and other project activities could cause a release of deleterious substances.	Water quality performance objectives have been developed in the WQMP to help meet the intent of this section. Contractor also to prepare and implement a Spill Prevention and Response Plan, Water Quality Protection Plan, Stormwater Pollution Prevention Plan, and a Sediment and Erosion Control Plan
	Section 38 specifies a duty to notify and take corrective measures when serious harm to fish occurs and when spills of deleterious substances occur.	Project involves work in and around water that contains fish and fish habitat.	DFO must be notified if serious harm or spill of deleterious substance occurs.
Deposit out of the Normal Course of Events Notification Regulations under the <i>Fisheries Act</i>	The regulations identify the “prescribed person” for notifications under Section 38 of the <i>Fisheries Act</i>	The BC Provincial Emergency Program, now called Emergency Management BC (EMBC), is the 24-hr emergency telephone service for notification	Spill reporting requirements are to be considered in the development of a spill response plan.
Marine Mammal Regulations under the <i>Fisheries Act</i>	Section 7 prohibits the disturbance of marine mammals except when fishing for marine mammals under the authority of these Regulations.	Marine mammals may occur in and adjacent to the Project area.	Mitigation measures will be implemented to avoid disturbing marine mammals.
<i>Species at Risk Act</i> (S.C. 2002, c. 29)	SARA contains prohibitions that make it an offence to: <ul style="list-style-type: none"> <li>▪ kill, harm, harass, capture, or take an individual of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated;</li> <li>▪ possess, collect, buy, sell or trade an individual of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated;</li> <li>▪ damage or destroy the residence (e.g., nest or den) of one or more individuals of a species listed in Schedule 1 of SARA as endangered, threatened or extirpated, if a recovery strategy has recommended the reintroduction of that extirpated species.</li> </ul>	Several marine mammal species at risk have some potential to occur in the in-water project areas including harbour porpoise, killer whales, and Steller sea lions.	Mitigation measures will be followed to avoid contravening the act.

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
<i>Migratory Birds Convention Act</i>	Section 5.1/ 5.2 prohibits the deposit of a substance that is harmful to migratory birds.	Migratory birds may occur in the Project area, and deposition of a substance such as fuel may harm migratory birds.	Mitigation measures will be implemented to avoid depositing harmful substances.
Migratory Birds Regulations (pursuant to the MBCA)	Section 6 – Prohibits the disturbance, destruction or removal of a nest or related shelter, or egg of a migratory bird, or possession of a live migratory bird, or a carcass, nest or egg of a migratory bird.	Barn swallows may nest under structures to be removed in the Project Area.	General prohibition – no authorization issued.
<i>Navigation Protection Act</i>	Regulates and protects navigable waters in Canada including Esquimalt Harbour. No work will be built or placed in, on, over, under, through or across any navigable water unless approved or exempted under this act.	Project works meet the assessment criteria for the Minor Works Order and are classified as “designated works” under the Act.	A Notice to the Minister is not required under the Act for works classified as “designated works” as long as all legal requirements are met.
<i>Canada Marine Act</i>	The Act establishes the means of management of ports and harbour facilities such as through the establishment of ports and harbour authorities. The Queen’s Harbour Master is the designated Authority for Esquimalt Harbour. Esquimalt Harbour Practices and Procedures are made pursuant to the Act. Procedures include marine spill response and reporting.	The Project will be undertaken in Esquimalt Harbour.	Esquimalt Harbour Practices and Procedures shall be followed by all harbour users associated with the Project
<i>Canada Shipping Act</i>	The Act promotes safety in marine transportation and recreational boating; protects the marine environment from damage due to navigation and shipping activities; prohibits the discharge of pollutants and contains reporting requirements; and prescribes regulations for vessels on or in any Canadian waterway through the “Collision Regulations”.	Project involves work in a waterway.	All vessels used by the Contractor will comply with the relevant orders and regulations of the CSA including pollution prevention and reporting.

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
<i>Transportation of Dangerous Goods Act</i>	Regulates the transport of dangerous goods in Canada, whether by rail, road, air, or water, and establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with prescribed safety marks. The Act also establishes requirements regarding emergency response assistance plans.	Dangerous goods may be transported during this Project.	Hazardous materials associated with the Project will be transported in accordance with this Act.
<b>Provincial</b>			
<i>Environmental Management Act</i>	Prohibition against the introduction of waste into the environment in such a manner or quantity as to cause pollution, unless the introduction of that waste is conducted in accordance with a permit, approval, order, or regulation. The Act also prohibits causing pollution which is defined in the Act as "...the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment."	Dredging is not a prescribed activity per the Waste Discharge Regulation; an effluent permit is not required for the dredging or dewatering activities. This general prohibition is addressed by the water quality protection measures developed for the Project as outlined in the WQMP. Processing facilities for this Project would be considered "contaminated sites contaminant management activities" per Schedule 1 of the regulation and therefore would require an authorization if the activity includes discharges of waste to the environment (e.g., effluent).	General prohibition – no permit or approval for dredging. A permit or authorization may be required for the discharge of waste (effluent) from processing facilities.
Hazardous Waste Regulation (pursuant to EMA)	Hazardous wastes are wastes that could harm human health or the environment if not properly handled and disposed of. The Hazardous Waste Regulation includes the identification, handling, transport, disposal and treatment of hazardous wastes.	Hazardous wastes may be generated during this Project.	General provisions – no authorization issued.

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
Contaminated Sites Regulation (pursuant to EMA)	<p>The CSR provides a process for identifying and tracking the movement and deposition of soils from contaminated sites. Previously (prior to November 2017), the CSR Schedule 7 was applicable to the assessment of soils/sediments being relocated or disposed on provincial land. The Stage 10 amendments allow use of the soil standards as applicable to the receiving site, in determining when a Contaminated Soil Relocation Agreement might be required to relocate soil to a receiving site. The CSR is also relevant to the characterization, transportation and disposal of the dredged materials to provincial lands.</p>	<p>The Stage 10 amendments have eliminated the Schedule 7 unique soil standards to trigger contaminated soil relocation agreements and replaced that schedule by reference to a new Schedule 3.1 soil standards applicable to the receiving site.</p>	<p>Any treatment of hydrocarbon contaminated soils/sediments through bioremediation will be required to follow the Protocol 15 pursuant to section 64 of the EMA</p>
Spill Reporting Regulation (pursuant to EMA)	<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. The regulation also identifies to whom spills are to be reported.</p>	<p>Listed substances might be used during the Project. The BC Provincial Emergency Program, now called Emergency Management BC (EMBC), is the 24-hr emergency telephone service for notification.</p>	<p>The requirements of the Regulation are to be considered in the development of a spill response plan. Spill reporting requirements are to be considered in the development of a spill response plan.</p>
<i>Wildlife Act</i>	<p><u>Section 34</u> – A person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys:</p> <ul style="list-style-type: none"> <li>(a) a bird or its egg</li> <li>(b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl</li> <li>(c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg</li> </ul>	<p>Loud noises from equipment may be considered ‘molestation’ if this causes the birds to abandon active nests. Barn swallows may nest under structures to be removed in the Project Area.</p>	<p>General prohibition – no authorization issued.</p>

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
<i>Heritage Conservation Act</i>	Archaeological sites that predate AD 1846 are automatically protected. Heritage wrecks, consisting of the remains of vessels or aircraft after two or more years have passed since they sank, crashed, or were abandoned, are also protected under the Act.	There are archaeological sites and wrecks in the vicinity of the Project area.	Measures will be implemented to help avoid or otherwise mitigate archaeological sites and wrecks.
<i>Transportation of Dangerous Goods Act</i>	Regulates the transport of all dangerous goods in British Columbia on provincial highways and ferry routes. The Act establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with prescribed safety marks.	There may be dangerous goods that need to be transported for this Project.	General provisions – no authorization issued. Any hazardous materials associated with the Project will require be transported with a manifest.
<b>Municipal</b>			
Town of View Royal Bylaw No. 523 (2003)	Outlines noise disturbance in the Town.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
City of Colwood Noise Bylaw, No. 1594 (2016)	Outlines noise disturbance during certain hours and days of the week.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.
City of Colwood Traffic and Highway Regulation Bylaw, No. 1134 (2010)	Designates truck routes for heavy trucks (over 8,600 kg).	If over-land transportation is undertaken, specific truck routes may need to be used.	A Traffic Management Plan will be prepared by the contractor if over-land transport is undertaken.
Township of Esquimalt Maintenance of Property and Nuisance Regulation Bylaw No. 2826 (2014)	Regulates the maintenance of property, unsightly property, and nuisance, including noise.	Noise from Project activities may cause disturbance.	Mitigation measures will be implemented to help avoid noise disturbance.

Act, Regulation or Bylaw	Description	Applicability to the Project	Approval/Permit OR Requirements Met
Township of Esquimalt Bylaw No. 2607 (2005) and amendments.	The Bylaw identifies roads that are not acceptable for trucks over 10,000 kg within Esquimalt.	If over-land transportation is undertaken, specific truck routes may need to be used.	A Traffic Management Plan will be prepared by the contractor if over-land transport is undertaken.
Capital Regional District (CRD) Bylaw No. 2922 (Consolidated) (2016)	Regulate the discharge of waste into sewers connected to a sewage discharge facility operated by the Capital Regional District”	Potential for Contractor to want to discharge waste into sewers.	In the event that the Contractor wishes to discharge waste such as dewatering effluent, into the CRD sewer system, the Contractor will apply for permits / authorizations for such a discharge.

#### 4.1 Applicable Best Management Practices and Guidelines

The following is a list of applicable best management practices and guidelines that apply to the Project.

**Table 3: Applicable Best Management Practices and Guidelines.**

Best Management Practice / Guidelines	Applicability to the Project
Fisheries and Oceans Canada’s (DFO’s) Measures to Avoid Causing Harm to Fish and Fish Habitat: <a href="http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html">http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html</a>	Provides advice that will help to avoid causing serious harm to fish and fish habitat.
BC Guidelines for Industry Emergency Response Plans: <a href="http://www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/planning-prevention-response/industry-emergency-response-plans">http://www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/planning-prevention-response/industry-emergency-response-plans</a>	Provides information for preparing a plan to respond to emergencies.
DND Formation Safety Environmental Management System (FSEMS) Directives and Shipyard BMPs	Directives for emergency reporting, solid waste management, hazardous materials management, spill response, storage tanks, and effluent management.
DFO’s guidelines Be Whale Wise – Marine Wildlife Laws & Guidelines for Boaters, Paddlers and Viewers (2016): <a href="http://www.bewhalewise.org/wp-content/uploads/2016/04/BeWhaleWise_Brochure_2016">http://www.bewhalewise.org/wp-content/uploads/2016/04/BeWhaleWise_Brochure_2016</a>	Guidelines for boating around marine mammals.

## 5.0 ENVIRONMENTAL REQUIREMENTS

This section is an overview of environmental requirements of the Project and is intended to be read in conjunction with environmental legislation, authorizations, permits, and approvals issued for the Project, best management practices and guidance documents (Section 4.0), and the contract requirements for the Project, which includes this EMP. The environmental requirements are based on potential Project effects identified in the EED Report and other relevant environmental legislation and bylaws (Golder 2018).

### 5.1 Environmental Protection Plan (EPP)

Prior to the commencement of the Project, the Contractor will prepare an Environmental Protection Plan (EPP) that demonstrates how they will satisfy the requirements set out in this EMP. The Contractor will retain a QP to prepare the EPP. The EPP will include the following information:

- organization chart and names of persons responsible for EPP implementation and compliance
- training requirements
- site and activity-specific measures that will be implemented, equipment that will be used, and maintenance that will be undertaken
- contingency procedures in the event that environmental protection goals are not being met
- drawings, for example, showing work and storage areas

The EPP will include, at a minimum, procedures for the following:

- Dust and emissions control
- Water quality protection
- Spill prevention and response
- Silt curtain control
- Sediment and erosion control
- Non-hazardous waste storage and disposal
- Hazardous materials storage and disposal
- Monitoring for presence of herring, marine mammals and barn swallow nests as well as triggers for modifying work
- Archaeological chance find management

The EPP will be part of submissions by the contractor and will be reviewed by DND/PSPC and must be accepted prior to construction to make sure it meets the intent of the EMP. The contractor will address any deficiencies in the EPP.

## 5.2 Protection Measures

### 5.2.1 Air Quality

#### References

- The Township of Esquimalt Maintenance of Property and Nuisance Regulation Bylaw, 2014, No. 2826.
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- Contract technical specifications

#### Mitigation Measures and Monitoring

Air Quality Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
Dust and Emissions Control Plan will include specific measures that will be undertaken to meet prohibitions outlined within relevant municipal bylaws and exposure limits outlined within the Occupational Health and Safety Regulation.	Contractor	Before work commences
<b>Mitigation Measures</b>		
Implement dust control measures (such as the use of water as a dust suppressant) as outlined in the design specifications.	Contractor	On-going during work
Vessels and equipment will be well maintained and in good working order.	Contractor	On-going during work
Efforts will be made to minimize exhaust emissions. The contractor will be encouraged to use clean alternative fuels for vessels and equipment. Idling of vessels and equipment will be minimized.	Contractor	On-going during work
<b>Monitoring</b>		
No monitoring is required.	N/A	N/A

### 5.2.2 Water Quality

#### References

- *Fisheries Act*
- *Canada Shipping Act* and associated regulations
- *Environmental Management Act*
- Capital Regional District (CRD) Bylaw No. 2922 (Consolidated)
- DFO "Guidelines to Protect Fish and Fish Habitat from Treated Wood Used in Aquatic Environments in the Pacific Region" (Hutton and Samis 2000)
- Water Quality Monitoring Plan (WQMP; Appendix A)
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- Contract technical specifications
- Formation Safety and Environment Management System Directives for spill response, storage tanks, and effluent management

## Mitigation Measures and Monitoring

Water Quality Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
Water Quality Protection Plan which will include specific measures that will be undertaken and equipment used to meet the water quality objectives outlined in the WQMP for dredging and dewatering.	Contractor	Before work commences
Spill Prevention and Response Plan which will include specific measures that will be undertaken to prevent and respond to spills.	Contractor	Before work commences
Silt Curtain Control Plan to describe how the silt curtain will be installed and maintained.	Contractor	Before work commences
Sediment and Erosion Control Plan which will include specific measures that will be undertaken and equipment to be used to prevent sediment transport and erosion of stockpiles during periods of rain and/or wind.	Contractor	Before work commences
<b>Mitigation Measures</b>		
<b>Structure Demolition/Removal, Relocation and Reinstatement</b>		
Use silt curtain(s) during all demolition activities at the Former Marine Railway.	Contractor	On-going during work
<p>During removal and storage of creosote pilings, best management practices (Hutton and Samis 2000) will be followed, for example:</p> <ul style="list-style-type: none"> <li>▪ For pile removal, a reasonable attempt should be made to remove the entire pile.</li> <li>▪ Piles will be removed in a manner that minimizes disturbance of seafloor habitats and to avoid bringing creosote-contaminated sediments to the surface. If the pile breaks off below the biologically-active zone in the sediment, it may not be advisable to dredge the remainder of the pile out, depending on the sensitivity of the habitat at the site.</li> <li>▪ Extracted timber piles and other timber components must be inspected to look for the presence of "Timberfume" chloropicrin fumigant vials. Piles and other timber components containing the vials must be decommissioned and disposed offsite in accordance with applicable provincial and federal legislation and as per the disposal methods indicated in the safety data sheets (SDS), and must not be re-used in the work. Precautions must be taken to ensure that the contents of the vials are not inadvertently released to the marine environment.</li> <li>▪ When cutting creosote timbers near or over water, ensure that all cuttings are contained and collected from the water, and ensure that any sheen or residue resulting from cutting creosote timbers is contained and cleaned up</li> <li>▪ If timber piles are cleaned over water, cleaning shall be conducted within the dredge area prior to dredging such that material (e.g., attached biological growth and sediment) is ultimately removed during dredging.</li> <li>▪ If timber piles are cleaned on a barge or at the contractor off-site offload facility, sediment and other attached objects that are cleaned off shall be</li> </ul>	Contractor	On-going during work

Water Quality Protection Measures	Responsibility	Timing
<p>disposed of at an appropriate disposal facility</p> <ul style="list-style-type: none"> <li>■ Booms or other measures will be implemented to contain floating debris from pile removal and cleaning.</li> <li>■ Treated piles should be stored in an area away from the water and surface runoff contacting treated piles should be directed away from the water.</li> <li>■ Where feasible, alternatives to treated wood products such as treated timber pilings should be used during pilings and structure reinstatement (for pilings and structures being replaced).</li> <li>■ Field treatment of re-used timber pile components exposed by cutting, trimming or other activities, when necessary, will be conducted in such a manner as to prevent the release of preservative (e.g., copper naphthenate or creosote) into the marine environment.</li> <li>■ Used/decommissioned piles will be disposed of on land at a waste management facility that has been accepted by the DR and meets the requirements for a disposal facility described in the Project specifications.</li> <li>■ Use allocated storage areas per the contract technical specifications.</li> <li>■ Removed creosote treated piles will be inspected for excessive creosote. If excessive creosote is observed, new treated piles treated with creosote following best management practices in Hutton and Samis (2000) will be used instead.</li> </ul>		
<b>Dredging</b>		
<p>The perimeter of the dredge area will be confirmed against the specification drawings throughout dredging such that dredging only occurs within the planned dredge area.</p>	Contractor	On-going during work
<p>A silt curtain will be used to help contain re-suspended sediments and contribute to attainment of the water quality performance objectives outlined in the WQMP. The silt curtain will be of a suitable type for the conditions (i.e., tidal waters).</p>	Contractor	On-going during work
<p>As outlined in the WQMP</p>	Contractor	On-going during work
<p>Dredging will be undertaken in a manner to minimize disruption, disturbance and re suspension of seabed sediments (i.e., no multiple bites with the clamshell bucket and no underwater stockpiling as per the design specifications).</p>	Contractor	On-going during work
<p>The dredge material barge will be loaded in such a way to prevent loss of sediment over the side rails or as a result of barge listing.</p>	Contractor	On-going during work
<b>Excavating</b>		
<p>All shoreline excavation activities below the higher high water large tide (3.39 m CD) must be performed within a silt curtain.</p>	Contractor	On-going during work
<p>All contaminated sediment removed during excavation will be placed on a water tight barge with the exception of existing site armour for re-use from DUs 29 and 30 and clean material for engineered capping material placement adjacent to the Y jetty steep shoreline, subject to acceptance by the DR.</p>	Contractor	As necessary

Water Quality Protection Measures	Responsibility	Timing
Any sediment on the removed riprap must be cleaned off, contained, and disposed of appropriately.	Contractor	As necessary
<b><i>Discharge of Dredge Effluent Water Directly from a Barge</i></b>		
Dredge effluent water that is collected and transported via barge out of the Project Area must not be returned to the Project Area for discharging.	Contractor	On-going during work
Passive dewatering of dredge material from the barge is not permitted outside of the Project Area.	Contractor	On-going during work
Passive dewatering of dredge material from the barge is allowed within the Project Area in Water Quality Management Area (WQMA) B provided the dewatering effluent meets the performance objectives in the WQMP.	Contractor	On-going during work
<b>As outlined in the WQMP, passive dewatering from the barge is not permitted within WQMA-A (Dredge Units 9, 25, 26, 27, 28, 29, 31, 32, 34, 37 and 38 in Anchor QEA 2018b) as delineated within the WQMP.</b>	Contractor	On-going during work
Passive dewatering from the barge is permitted in WQMA-B (i.e. the remainder of the YJLC dredge units) provided that TSS is controlled (i.e., 75 mg/L TSS maximum).	Contractor	On-going during work
The compliance point for passive dewatering (i.e. the point where a TSS of 75 mg/L must be met) is the point of discharge (POD) from the barge, or the edge of the silt curtain if the barge is dewatered into the silt curtain.	Contractor	On-going during work
If the dewatering discharge is found to contain a TSS concentration >75 mg/L in WQMA-B, management actions (e.g., cease loading of dredged material on the barge and/or cease dewatering discharge) must be implemented and confirmatory monitoring conducted as per the WQMP.	Contractor	On-going during work
Passive dewatering of dredge material from the barge is not permitted during transport to the off-site offload facility.	Contractor	On-going during work
To facilitate dewatering from the barge, the Contractor may elect to mix additives with the sediments to bind available water. Additives, if used, will require proper storage, handling and containment. In the event that additives are used to facilitate dewatering of the dredged material, the decant water must be tested prior to discharge to verify that the added constituents will not be harmful to the receiving environment. Any leachate generated will need to be contained, treated and appropriately disposed of.	Contractor	As necessary
<b><i>Discharge of Dredge Effluent from a Treatment System (Floating or Land Based)</i></b>		
Dredge effluent from WQMA-A is considered unsuitable for direct discharge to the marine environment without treatment or other management methods prior to disposal. The dredge effluent from WQMA-A must be treated so that the effluent has a TSS level of 40 mg/L or less at the point of discharge (POD) from the treatment system.	Contractor	On-going during work
Discharge within a silt curtain is not an acceptable means of treatment.	Contractor	On-going during work

Water Quality Protection Measures	Responsibility	Timing
Prior to initial commencement of discharge of treated barge dewatering effluent from WQMA-A, the effluent must be tested for toxicity (96-hr LC <sub>50</sub> test using a salt-water acclimated salmonid) to confirm that the effluent is non-acutely lethal, unless the Contractor's QP determines that toxicity testing is not necessary.	Contractor	On-going during work
If the effluent is found to contain a TSS concentration >40 mg/L (or 20 NTU per the TSS-turbidity relationship in the WQMP), management actions (e.g., cease discharge from the system) must be implemented and monitoring undertaken as outlined in the WQMP.	Contractor	On-going during work
<b>Discharge of Dredge Effluent via Sanitary Sewer System</b>		
If the contractor chooses to dispose of dredge effluent via a sanitary sewer system, the contractor must comply with applicable local sewer use bylaws/regulations.	Contractor	As necessary
<b>Material Placement</b>		
<p>Chemical testing of backfill material is required to assess the acid rock drainage (ARD) and metal leaching (ML) potential of the materials as this can negatively affect water quality. The following laboratory tests will be performed by an independent, certified testing laboratory, hired by the Contractor:</p> <ul style="list-style-type: none"> <li>■ ARD Potential: Acid Base Accounting (ABA) testing</li> <li>■ ML Potential: Multi-Element Analysis (ICP-MS)</li> <li>■ Shake Flask Extraction (SFE) testing</li> </ul> <p>Results of laboratory testing of metal leaching will be compared, as a screening benchmark, with provincial and federal ambient water quality guidelines for the protection of aquatic life (a Qualified Professional will determine which guidelines are applicable). Based on the results of the screening, the Contractor will submit a letter from a qualified professional regarding suitability of the backfill material for use in the Project area. One sample for every one thousand (1,000) m<sup>3</sup> (with an absolute minimum of one sample) of imported backfill material imported will be collected and analyzed per the above tests. The frequency of testing may be increased or decreased by the DR if considered appropriate based on the results of testing or visual assessment of imported material. A minimum of one sample will be collected and analyzed for each backfill type if regardless of the volume. The laboratory utilized by the Contractor must have the appropriate certification in accordance with ISO/IEC Standard 17025. The Contractor will submit documentation showing that the proposed laboratory is certified for the specific parameters of concern and proposed analytical methods.</p>	Contractor. Results will be review and approved by the DR prior to use	Before material placement
The Contractor will employ placement means and methods that will avoid re-suspending sea bed sediment during placement activities, and prevent excessive mixing of the placed materials with the sea bed sediment.	Contractor	On-going during work

Water Quality Protection Measures	Responsibility	Timing
During placement of in-fill substrate material in both WQMAs, a silt curtain is not required, provided that performance objectives for TSS and turbidity are met. Additional measures as outlined in the WQMP will be required if objectives are not met.	Contractor	As necessary
The Contractor will not place substrate by rapid dumping of a barge load.	Contractor	On-going during work
<b><i>In-water Transportation</i></b>		
In-water transport of dredge material and debris will be performed using a barge/vessel with sidewalls of sufficient height to fully contain the dredge material, water, and debris.	Contractor	On-going during work
Watertight barges will be used when dredged material is being transported from the site.	Contractor	On-going during work
The contractor will be required to provide certification of seaworthiness from an independent Marine Surveyor for each haul barge that will be used for the Project. In the event that a barge is damaged during Project activities and requires repair, a new certification of seaworthiness will be required. In addition, material transportation by barge will require the contractor to obtain authorization from the Queen's Harbour Master pursuant to the <i>Canada Marine Act</i> and from DND.	Contractor	On-going during work
<b><i>On-land Offloading, Stockpiling and Processing</i></b>		
No sediment, debris, or water transfer can begin at the off-site offloading facility until the spill prevention measures are reviewed by the DR and determined to be in place.	Contractor	On-going during work
The Contractor will offload in-water transportation barges in a manner that prevents spillage of waste or effluent to the water. A spill apron (or equivalent spill prevention measure) will be used during all offloading activities.	Contractor	On-going during work
Any spillage on the spill apron will be removed as soon as practicable and properly disposed. Any such spillage outside of the offloading facility and stockpile storage area will be promptly cleaned up.	Contractor	On-going during work
Spillage of sediment or debris during offloading will be promptly cleaned up. If uncontrolled spillage occurs, all offloading operations will cease until the spillage is contained and cleaned up.	Contractor	On-going during work
<p>Additional mitigation measures that apply to control water quality include:</p> <ul style="list-style-type: none"> <li>▪ Construction of stockpile areas at the offload facility (no stockpiling will be permitted at the DND work site) using berms or other barrier devices to prevent uncontrolled spreading of debris and/or contaminated sediment.</li> <li>▪ Covering stockpiles to prevent erosion during periods of rain and/or wind.</li> <li>▪ The contractor will construct, operate, and maintain the off-site offloading and stockpile area such that all effluent drainage water, stormwater, or other form of discharges from stockpiled sediment and debris are collected for treatment and proper disposal.</li> <li>▪ No direct discharge of untreated effluent from the off-site offloading and stockpile area to the receiving waters will be allowed</li> <li>▪ Stockpiles will be managed to prevent uncontrolled runoff of water that has</li> </ul>	Contractor	On-going during work

Water Quality Protection Measures	Responsibility	Timing
<p>been in contact with the dredged material and to protect them from the weather.</p> <ul style="list-style-type: none"> <li>▪ Catch basins beneath stockpiles will be sealed and all water will be collected and stored on-site for treatment and/or off-site disposal. Other catch basins within the upland staging area but not directly beneath stockpiles will be protected with a below-grate inlet device (BGID) to collect sediment and debris from stormwater prior to discharge. The BGID will be inspected and maintained on a regular basis, with records available.</li> <li>▪ The contractor will be required to maintain a clean stockpile storage area and provide a wheel/truck wash to prevent vehicles from tracking contaminated soil or sediment off-site.</li> <li>▪ Equipment will be fuelled in a designated area that separates fuelling operations and protects the environment from accidental spills during fuelling.</li> <li>▪ Effluent from the off-site offloading and stockpile area will be collected, treated, and discharged to federal, provincial, and local laws and regulations. Discharge of water from off-site offloading and stockpile area may need a permit or temporary authorization from the regulatory agency applicable to the offloading/stockpile area. The Contractor will retain a Qualified Professional to obtain the applicable authorizations.</li> <li>▪ If the contractor chooses to make arrangements to dispose of water via the nearby sanitary sewer system, this acceptance must be obtained prior to bid, and the contractor will be responsible for acquiring the permit for discharge. At a minimum, it must be demonstrated that this water meets Project discharge water quality requirements and/or local municipal sewer discharge limits. Meeting discharge requirements may require treatment prior to discharge.</li> <li>▪ All water discharged to any surface water originating from the off-site offloading and stockpile area will meet Canadian Council of Ministers of the Environment (CCME) or BC Ministry of the Environment water quality guidelines (WQGs), or the more stringent of the two. Where these WQGs cannot be met or a WQG is not available, the Contractor will propose an alternative effluent limit. If the off-Site offload facility is located in the U.S., water discharged will meet relevant laws and regulations in the U.S. regarding discharge to surface waters. The Contractor will provide analytical test results to the DR prior to discharge and will account for time for the DR to review and accept the discharge as part of the completion of the work.</li> </ul>		
<p>The Contractor may elect to conduct additional testing of the dredged material to evaluate disposal options. In the event that additional testing is necessary, material will be stockpiled only in areas where stockpiling is already permitted (e.g., on the dredge barge, at the off-site offload facility or at the disposal facility).</p>	Contractor	On-going during work
<b>Monitoring</b>		
<p>Water quality shall be monitored as per the WQMP</p>	Contractor's Environmental Specialist. PSPC's EM may do spot checks	On-going during work

Water Quality Protection Measures	Responsibility	Timing
Inspection of offloading and stockpiling area prior to or during material transportation from the site may be conducted. Environmental records pertaining to the management of the sites will be made available by the Contractor, if requested.	PSPC's EM	On-going during work

### 5.2.3 Marine Vegetation, Invertebrates, and Fish and Fish Habitat

#### References

- *Fisheries Act*
- DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)

#### Mitigation Measures and Monitoring

Marine Vegetation, Invertebrates, and Fish and Fish Habitat Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
The EPP will include Contractor monitoring requirements for fish and triggers for modifying work.	Contractor	Before work commences
<b>Mitigation Measures</b>		
<b>All Work Activities</b>		
Verify that vessels are free of marine species attached to the hull or inside the vessel before entering Esquimalt Harbour to help avoid the spread of marine invasive species.	Contractor	Before work commences and on-going during work
<b>Timing Windows</b>		
In-water work including sediment dredging, structure removal and reinstatement, and backfill and material placement will occur inside and outside the least-risk work window with the application of appropriate mitigation measures, with the exception of impact pile driving of steel piles should it occur.  Impact pile driving of steel piles will not take place between 1 April and 31 May due to potential effects from underwater noise on fisheries resources in Esquimalt Harbour. The 1 April to 31 May time period is particularly sensitive due to the potential for herring spawning and out-migration of juvenile salmon in Esquimalt Harbour.  Vibratory pile driving and impact pile driving of timber piles can still occur outside the window.	Contractor	Impact pile driving of steel piles will not take place between 1 April and 31 May

Marine Vegetation, Invertebrates, and Fish and Fish Habitat Protection Measures	Responsibility	Timing
<b><i>Dredging and Backfilling</i></b>		
Prior to dredging, the perimeter of the dredge area, including any previously identified “no dredge/backfill zones” and “no anchoring zones” in areas with bedrock outcrops and kelp, will be delineated using GPS chart plotting software so that work occurs within the confines of the Work Sites.	Contractor	Before work commences
The barge will not come to rest on the seafloor (no grounding) in areas where subsequent disturbance through dredging will not occur. Barge grounding will be only be permitted in nearshore areas where dredging will occur, provided water quality is managed according to the requirements outlined in Section 5.2.2 and Appendix A.	Contractor	On-going during work
Prevent excessive dredging, the removal of material outside of the dredge prism or below the payable over-dredge allowance, to avoid potentially adversely affecting slope and/or structural stability.	Contractor	On-going during work
<b><i>Vibratory Pile Driving</i></b>		
<p>Vibratory methods will be used for pile removal and reinstatement where possible. If vibratory methods are not used, an alternative similar method will be submitted to the Departmental Representative for review.</p> <p>Vibratory pile driving may take place year round with the following mitigation measures for fish:</p> <ul style="list-style-type: none"> <li>▪ Sound levels must not exceed 206 dB re 1 uPa SPLpeak at 10 m from the piling.</li> <li>▪ Monitoring via underwater noise recordings will be conducted by PSPC’s EM, and must be conducted at the start of pile driving within 10 m of the pile being driven to verify that underwater noise does not exceed 206 dB re 1 uPa SPLpeak.</li> <li>▪ If noise levels exceed this threshold, or fish mortality is observed, pile driving activities are to cease immediately. DFO must be notified about fish mortality as required under subsection 38(4) of the <i>Fisheries Act</i>.</li> <li>▪ The work will only resume after additional measures (e.g., bubble curtain, timing) have been discussed with DFO and have been implemented to reduce noise levels below the threshold or after sensitive life history stages of fish have moved from the area.</li> </ul>	Contractor	As necessary
<b><i>Impact Pile Driving</i></b>		
<ul style="list-style-type: none"> <li>▪ During impact pile driving, the following monitoring and mitigation shall be undertaken for fish: <ul style="list-style-type: none"> <li>▪ Upon commencement of pile driving, or recommencement after a delay of 30 minutes or more, pile installation shall ramp-up by starting with less frequent impact strikes of lower force. This ramp-up period is designed to provide fish time to leave the area prior to generation of peak pressure and noise levels.</li> <li>▪ Sound levels must not exceed 206 dB re 1 uPa SPLpeak at 10 m from the piling.</li> </ul> </li> </ul>	Contractor	As necessary

Marine Vegetation, Invertebrates, and Fish and Fish Habitat Protection Measures	Responsibility	Timing
<ul style="list-style-type: none"> <li>▪ Monitoring via underwater noise recordings will be undertaken by PSPC's EM and will be conducted continuously and within 10 m of the pile being driven to verify that underwater noise does not exceed 206 dB re 1 uPa SPLpeak.</li> <li>▪ If noise levels exceed this threshold, or fish mortality is observed, pile driving activities are to cease immediately. DFO must be notified about fish mortality as required under subsection 38(4) of the <i>Fisheries Act</i>.</li> <li>▪ The work will only resume after additional measures (e.g. bubble curtain, timing) have been discussed with DFO and have been implemented to reduce noise levels below the threshold or after sensitive life history stages of fish have moved from the area.</li> </ul>		
<b>Intertidal Excavation/Material Placement</b>		
<p>For intertidal excavation / material placement, work should be planned and conducted in a manner so that fish cannot become stranded. The following mitigation measures should be implemented:</p> <ul style="list-style-type: none"> <li>▪ The excavation / material placement area and depth will be delineated before works begin to avoid over-excavation or excess material placement, and to avoid impacting adjacent areas.</li> <li>▪ Material will be placed in dredged/excavated areas</li> <li>▪ Depth and slope of the intertidal will be similar to existing conditions</li> </ul>	Contractor	As necessary
<p>Placement of suitable substrate (i.e. angular rock) in a portion of the dredged areas to mitigate for removal of substrate with attached understory kelp. This area is adjacent a bedrock outcrop with relatively high kelp coverage which will not be disturbed by dredging. The plants on the bedrock are expected to function as a "seedbank" that can support recolonization of the placed coarse substrates.</p>	Contractor	As necessary
<b>Monitoring</b>		
<b>General</b>		
<p>Visual observations from the surface of the water for herring spawning and herring eggs will be undertaken within the in-water work areas. If herring spawning is observed within in-water work areas, PSPC will be informed and work with potential to affect herring egg masses or emergent larvae will be stopped for 10 to 14 working days. If herring eggs are found on equipment, PSPC will be informed and work will be stopped and will not resume until after eggs have hatched.</p>	Contractor's Environmental Specialist. PSPC's EM may do spot checks	During in-water works after February 15
<p>Monitoring for signs of dead fish will be undertaken. If dead/injured fish are observed, work will be suspended and DFO will be notified.</p>	Contractor's Environmental Specialist. PSPC's EM may do spot checks	During in-water works
<p>For work within a silt curtain, if large schools of fish are observed in the enclosed silt curtain, in-water work should be temporarily suspended, and the silt curtain opened to allow fish to escape.</p>	Contractor's Environmental Specialist. PSPC's EM may do spot checks	During in-water works

Marine Vegetation, Invertebrates, and Fish and Fish Habitat Protection Measures	Responsibility	Timing
<b><i>Vibratory Pile Driving</i></b>		
<ul style="list-style-type: none"> <li>■ During impact pile driving, the following monitoring shall be undertaken for fish.               <ul style="list-style-type: none"> <li>■ Monitoring via underwater noise recordings will be conducted by PSPC's EM, and must be conducted <b>at the start</b> of pile driving within 10 m of the pile being driven to verify that underwater noise does not exceed 206 dB re 1 uPa SPL<sub>peak</sub>.</li> <li>■ If noise levels exceed this threshold, or fish mortality is observed, the EM will inform the DR who will inform the contractor to cease pile driving activities immediately.</li> </ul> </li> </ul>	PSPC's EM	During vibratory pile driving
<b><i>Impact Pile Driving</i></b>		
<ul style="list-style-type: none"> <li>■ During impact pile driving, the following monitoring shall be undertaken for fish:               <ul style="list-style-type: none"> <li>■ Monitoring via underwater noise recordings will be undertaken by PSPC's EM and will be conducted <b>continuously</b> and within 10 m of the pile being driven to verify that underwater noise does not exceed 206 dB re 1 uPa SPL<sub>peak</sub>.</li> <li>■ If noise levels exceed this threshold, or fish mortality is observed, the EM will inform the DR who will inform the contractor to cease pile driving activities immediately.</li> </ul> </li> </ul>	PSPC's EM	During impact pile driving

**Notes:** 1. 206 dB SPL<sub>peak</sub> re 1 (µPa) is the most conservative injury threshold for fish and the threshold which represents best available science (Stadler and Woodbury 2009; FHWG 2008).

## 5.2.4 Marine Mammals

### References

- Marine Mammal Regulations
- *Species at Risk Act*
- DFO's guidelines Be Whale Wise – Marine Wildlife Guidelines for Boaters, Paddlers, and Viewers (DFO 2013)
- The National Oceanic and Atmospheric Administration's Interim Sound Threshold Guidance for Marine Mammals (NOAA 2016).
- The California Department of Transportation's Technical Guidance for the Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (Caltrans 2015)
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- DND FSEMS Natural Resource Management directive E5

## Mitigation Measures and Monitoring

Marine Mammal Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
The EPP will include Contractor monitoring requirements for marine mammals and triggers for modifying work.	Contractor	Before work commences
<b>Mitigation Measures</b>		
Concurrent multiple underwater noise generating activities will be minimized where practicable (e.g., avoiding multiple pile driving activities at the same time). Where multiple underwater noise generating activities are planned they will be sequenced where possible to minimize cumulative underwater noise effects.	Contractor	On-going during work
Pile driving will, when practical and feasible, be undertaken with vibratory methods rather than impact methods to minimize underwater sound pressure levels.	Contractor	On-going during work
Timber piles will be used, when practical and feasible, rather than steel piles to minimize underwater sound pressure levels.	DR	On-going during work
<p>The following mitigation measures may be employed if underwater noise monitoring determines that injury thresholds of marine mammals are exceeded:</p> <ul style="list-style-type: none"> <li>▪ Measures to reduce sound transmission (e.g., bubble curtains, isolation casing, coffer dams, cushion blocks).</li> <li>▪ Measures to reduce sound generated by the pile (e.g., design specifications, pile-driving equipment used).</li> </ul>	Contractor	As necessary
<p>Vessels will follow standard boat operation when in proximity to marine mammals:</p> <ul style="list-style-type: none"> <li>▪ Under no circumstances, other than in the case of an emergency, will vessels approach within 300 m of any whale engaged in feeding activities. For all other marine mammal encounters, vessels will avoid approaching within 100 m of a marine mammal in the water or a seal/sea lion haul out.</li> <li>▪ As safe navigation allows, reduce speed to less than 7 knots when within 300 m of the nearest whale. Avoid abrupt course changes.</li> <li>▪ Do not drive through groups of porpoises or dolphins to encourage bow or stern riding. Should dolphins or porpoises choose to ride the bow wave of the vessel, the vessel operator will avoid sudden course changes, hold course and speed, or reduce speed gradually.</li> <li>▪ Be cautious when motoring near seal and sea lion haul-outs, especially during breeding and pupping seasons (generally May to September). Reduce speed when approaching or driving by a haul-out, minimize wake, wash and noise, and then slowly pass without stopping.</li> <li>▪ Pay attention and move away, slowly and cautiously, at the first sign of disturbance or agitation.</li> <li>▪ Do not disturb, move, feed or touch any marine wildlife, including seal pups.</li> </ul>	Contractor	On-going during work

Marine Mammal Protection Measures	Responsibility	Timing
<ul style="list-style-type: none"> <li>▪ Emergency collisions with marine mammals, or a sighting of an entangled or injured marine mammal, are to be immediately reported to Coast Guard (VHF Channel 16) or Whale Emergency Network (1-800-465-4336)</li> </ul>		
Monitoring		
<p>Underwater noise monitoring will be conducted by PSPC's EM during the initial phases of pile driving (including vibratory pile driving) to confirm underwater noise levels do not exceed injury thresholds for marine mammals.</p>	PSPC's EM	As necessary
<p>Should impact pile driving of steel piles be required for pile installation, the following mitigation measures will be implemented by PSPC's EM who will also be a certified Marine Mammal Observer (MMO) with relevant marine mammal monitoring experience:</p> <ul style="list-style-type: none"> <li>▪ A marine mammal safety perimeter of 100 m for marine mammals will be established during impact pile driving.</li> <li>▪ This marine mammal safety perimeter is based on an injury threshold of 180 dB re 1µPa (RMS). If the threshold is exceeded at 100 m, the marine mammal safety perimeter will be widened to a new outer limit where underwater noise recordings demonstrate that the threshold is not exceeded.</li> <li>▪ Activities will cease if a marine mammal is observed within the marine mammal safety perimeter, and will only resume once the marine mammal has left the marine mammal safety perimeter or has not been re-sighted for 10 minutes.</li> <li>▪ Impact pile driving may only be carried out during daylight hours to enable effective visual monitoring of marine mammal exclusion zones.</li> </ul>	PSPC's EM	As necessary
<p>Visual observations of work within a silt curtain will be made to verify that marine mammals do not become entrapped. If a marine mammal is observed in the enclosed area, PSPC will be informed, and in-water work will be suspended and the enclosed area opened to allow the mammal to leave.</p>	Contractor's Environmental Specialist. PSPC's EM may do spot checks	On-going during work

## 5.2.5 Birds

### References

- *Migratory Birds Convention Act*
- *Wildlife Act*
- Draft Environmental Effects Determination: Esquimalt Harbour Remediation Project (Golder 2018)
- DND FSEMS Natural Resource Management directive E5

## Mitigation Measures and Monitoring

Bird Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
The EPP will include Contractor monitoring requirements for birds and triggers for modifying work.	Contractor	Before work commences
<b>Mitigation Measures</b>		
Structures with nests should be removed outside of the breeding season for barn swallows. The breeding season for passerines including barn swallows is 1 March to 31 August according to Develop with Care 2014 (MOE 2014).	Contractor	Outside of 1 March to 31 August breeding season
<b>Monitoring</b>		
Outside of the 1 March to 31 August breeding season, prior to removal of structures, surveys for old barn swallow nests should be undertaken. If old nests are found on structures to be removed, FSE, Environment Canada and the Ministry of Environment should be consulted first before removal.	Contractor's Environmental Specialist. PSPC's EM may do spot checks	Outside the 1 March to 31 August breeding season
Inside of the 1 March to 31 August breeding season, prior to removal of structures, non-intrusive surveys should be conducted by a qualified environmental professional to determine the presence of active nests immediately before structures are to be removed. If barn swallow nests containing eggs or young are located, removal of the structures will be halted until nesting is completed.	Contractor's Environmental Specialist. PSPC's EM may do spot checks	Inside the 1 March to 31 August breeding season

## 5.2.6 Navigation

### References

- Esquimalt Harbour – Practices and Procedures (Royal Canadian Navy 2017)
- *Canada Shipping Act* and its associated regulations
- Contract technical specifications
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- Review of Risk Mitigation Strategies for Collisions/Allisions of Work Vessels Operating in Esquimalt Harbour during Remediation Projects (Ironclad Marine Surveys and Consulting Ltd. 2017)

## Mitigation Measures and Monitoring

Navigation Protection Measures	Responsibility	Timing
<b>Navigation Control Plan</b>		
The Contractor must submit a Navigation Control Plan describing means and methods by which vessel movements and harbour control procedures and practices will be completed and monitored.	Contractor	Before work commences
<b>Mitigation Measures</b>		
The work will be conducted in accordance with the Esquimalt Harbour Practices and Procedures (Royal Canadian Navy 2017).	Contractor	On-going during work
Material transported by barge into, within, and out of Esquimalt Harbour requires the Contractor to coordinate directly with Queen's Harbour Master (QHM) pursuant to the <i>Canada Marine Act</i> . The DR requires 72-hour notification of all material transported by barge into or out of Esquimalt Harbour. Material barge transport movements within Esquimalt Harbour require a 24-hour notification to the QHM.	Contractor	As necessary
Work will be phased to minimize disruptions to other vessel traffic.	Contractor	On-going during work
Additional emergency docking and navigation management procedures outlined in the Navigation Control Plan will be followed.	Contractor	On-going during work
<b>Monitoring</b>		
No monitoring required	N/A	N/A

### 5.2.7 In-Air Noise, Light and Odour

#### References

- City of Colwood Noise Bylaw No. 1594
- The Township of Esquimalt Property, Unsightly Properties and Nuisance Bylaw No. 2826
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- Contract technical specifications

### Mitigation Measures and Monitoring

In-Air Noise, Light and Odour Protection Measures	Responsibility	Timing
<b>Mitigation Measures</b>		
The Contractor must comply with local ordinances regarding noise control while conducting activities at the Work Site	Contractor	On-going during work
The Contractor is to meet the intent of Township of Esquimalt, Colwood, and View Royal Noise By-laws at the Work Site boundary or modify work activities. Noise restrictions apply within the hours of 7:00 p.m. to 7:00 a.m. between Monday and Saturday and at all times on Sundays and statutory holidays. The Contractor must undertake noisier work activities during daytime hours and modify activities based on noise monitoring and resident feedback.	Contractor	On-going during work
Construction equipment must be operated with exhaust systems in good repair to minimize noise	Contractor	On-going during work
Make sure that noise control devices (i.e., mufflers and silencers) on construction equipment are properly maintained	Contractor	On-going during work
The Contractor must implement use of lighting shrouds for work to be completed during night-time hours to minimize lighting disruptions to local residents.	Contractor	On-going during work
<b>Monitoring</b>		
An ambient noise monitoring program will be implemented to provide a baseline for assessing the effects of Project-related noise. In-air noise monitoring will also be conducted during each new Project activity. Additional in-air noise monitoring may be conducted on an as needed basis if complaints are received, to verify that specified bylaw noise levels are met. Complaints received about noise will be reviewed to evaluate the need to implement additional noise monitoring or modifications to activities.	DND/PSPC	On-going during work
Complaints received about odour will be reviewed to evaluate the need to implement odour monitoring or modifications to activities. H <sub>2</sub> S monitoring will be undertaken on an as needed basis if complaints are received.	DND/PSPC	As necessary

## 5.2.8 Archaeology

### References

- Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under the *Canadian Environmental Assessment Act, 2012* (March 2015) (Canadian Environmental Assessment Agency 2015)
- *Heritage Conservation Act*
- B.C. Archaeological Impact Assessment Guidelines. (Archaeology Branch, Ministry of Forests, Lands, Natural Resource Operations and Rural Development 1989).
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- Archaeological Overview Assessment of Six Proposed Remedial Dredging Areas in Esquimalt Harbour, CFB Esquimalt, Esquimalt, BC (Golder 2015b)
- Archaeological Impact Assessment of Remedial Dredging Areas at Lang Cove and F & G Jetty in Esquimalt Harbour, Esquimalt, BC (Golder 2016b)

### Mitigation Measures and Monitoring

Archaeology Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
The EPP will include Archaeological Chance Find Management procedures	Contractor	Before work commences
<b>Mitigation Measures</b>		
Maintaining all floating equipment and vessels outside of the Exclusion Zone in Lang Cove, as indicated on the design drawings, to protect sensitive historically, archaeologically, architecturally, or paleontologically significant structures, sites, or things located within the Exclusion Zone. There must be no dredging, material placement, spudding, or anchoring in the Exclusion Zone.	Contractor	On-going during work
Archaeological Chance Find Management Guidelines are to be followed during bulk handling of dredge material (e.g. dredging, offloading).	Contractor	As necessary
<b>Monitoring</b>		
Monitoring of machine sorting of dredgeate during material processing activities for unexploded ordnance (UXO) will include provisions for the collection of observed historically, archaeologically, or paleontologically significant artifacts, features, and faunal materials, as well as human remains.	Contractor's Archaeological Monitor. PSPC's Archaeologist will conduct periodic monitoring and respond to chance find call-outs.	On-going during work

## 5.2.9 Spill Prevention and Emergency Response

### References

- *Fisheries Act*
- *Migratory Birds Convention Act*
- *Canada Shipping Act*
- *Environmental Management Act and Spill Reporting Regulation*
- Esquimalt Harbour Practices and Procedures
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- FSEMS Emergency Reporting Directive SE1
- Contract technical specifications

### Mitigation Measures and Monitoring

Spill Prevention and Emergency Response Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
<p>Spill Prevention and Emergency Response Plan which will include specific measures that will be undertaken and equipment used to prevent spills and to respond to emergencies.</p> <p>At a minimum, the plan will include:</p> <ul style="list-style-type: none"> <li>■ a general measure of the probability and severity of an adverse effect to health, property, or the environment, on the basis of fuel, oil, and other hazardous materials consumed, handled, and stored</li> <li>■ spill/release notification and alerting procedures</li> <li>■ spill incident report forms</li> <li>■ containment, recovery, and clean-up procedures</li> <li>■ on-site spill/release clean-up materials, equipment, and locations</li> <li>■ names and telephone numbers of persons and organizations that may be contacted in the event of a potential environmental incident, including PSPC/ DND and representatives, the Contractor’s Environmental Specialist(s), Contractor(s) representative and local emergency response organizations</li> </ul> <p>The Plan will be available for inspection by PSPC and regulatory agency personnel and will be posted at conspicuous locations in the work site and in relevant machinery.</p>	Contractor	Before work commences
<b>Mitigation Measures</b>		
<p>To reduce the risk of fluid spills reaching the aquatic environment and to protect worker safety, the Contractor will follow, at a minimum, the following mitigation measures:</p> <ul style="list-style-type: none"> <li>■ Vessels and machinery will arrive on-site in a clean/good condition and maintained free of fluid leaks.</li> <li>■ All work will be conducted in a manner that does not result in the deposit of a toxic or deleterious substance into waters frequented by fish.</li> </ul>	Contractor	On-going during work

Spill Prevention and Emergency Response Protection Measures	Responsibility	Timing
<ul style="list-style-type: none"> <li>■ All field personnel will be made aware of the location of Emergency Spill Response equipment and the procedures necessary to contain spills of any fluid.</li> <li>■ The washing, refueling and servicing of machinery, and the storage of fuel and other materials for the machinery will occur away from the water to prevent any deleterious substance from entering the water.</li> <li>■ Secondary containment trays will also be used for any products that have potential to leak or spill, such as gasoline, diesel fuel, oil, paints and solvents</li> <li>■ Excess lubrication and grease will be wiped off of equipment where practical. Oily rags and used spill cleanup materials will be appropriately disposed of in sealed storage containers.</li> <li>■ Appropriate spill control equipment will be kept on-site at all times during the work. The spill kit will be checked prior to commencement of work to verify that it contains (at a minimum) all of the recommended spill kit contents as listed in Table 4. Operating personnel are to be familiar with the contents and use of spill response equipment and the location and operation of emergency 'shut-offs'.</li> <li>■ Materials contaminated by a Project-related release of deleterious substances will be recovered and placed into containment for subsequent off-site disposal at an appropriate facility.</li> </ul>		
<b>Monitoring</b>		
<p>The work area will be inspected for effectiveness of control measures put into place by the Contractor(s).</p>	<p>Contractor's Environmental Specialist. PSPC's EM may do spot checks</p>	<p>On-going during work</p>
<b>Reporting</b>		
<p>For spills to the marine environment, the Contractor will immediately notify the DR upon detection of the spill. As per the Esquimalt Harbour Practices and Procedures, the <i>Fisheries Act</i>, the <i>Canada Shipping Act</i> and the <i>BC Environmental Management Act</i>, the Contractor will also notify Emergency Management BC (1-800-663-3456), the Harbour Authority (250-363-2160), and the Canadian Coast Guard (1-800-889-8852).</p> <p>For spills to land, refer to the <i>BC Environmental Management Act</i> Spill Reporting Regulations to determine if the spill is reportable to Emergency Management BC. If the spill to land is of a reportable size, the Contractor will report the spill to the DR and Emergency Management BC (1-800-663-3456). A written report is to be provided to the DR and applicable government agencies within 24 hours of any spill to the marine environment, or a reportable spill to land.</p>	<p>Contractor</p>	<p>On-going during work</p>

**Table 4: Recommended Minimum Spill Kit Contents**

Item	Quantity
Oil spill boom	1
360L polyethylene overpack drum	1
Oil Sorbent socks (3"x 4')	5
Oil Sorbent Pillows (12" x 13")	5
Oil Sorbent Sheets (16.5" x 20" x 3/8")	50
Oil Sorbent Roll (16.5" x 115' x 3/8")	1
Universal (non-hydrocarbon) Sorbent socks (3" x 4')	5
Universal (non-hydrocarbon) Sorbent sheets (16.5" x 20" x 3/8")	25
Sphag-sorb or other hand-cast sorbent material (bag)	1
Drain Cover (36"x36"x1/16")	1
Caution Tape (3"x500')	1
1 lb. Plugging Compound	1
Nitrile Gloves	2
Safety Glasses	2
Tyvek Coveralls	2
Instruction booklet	1
Printed Disposal Bags	10

## 5.2.10 Non-Hazardous Waste Management

### References

- BC Industrial Non-hazardous Waste Landfills Code of Practice
- Formation Safety and Environment Management System Directives
- Contract technical specifications
- *Canada Marine Act*
- *Canada Shipping Act*
- *Transportation of Dangerous Goods Act*
- *BC Transportation of Dangerous Goods Act*
- *Navigation Protection Act*

- *Fisheries Act*
- *Environmental Management Act*
- Contaminated Sites Regulation (pursuant to EMA)
- Environmental Effects Determination Report: Esquimalt Harbour Remediation Project (Golder 2018)
- Contract technical specifications

**Mitigation Measures and Monitoring**

Non-Hazardous Waste Management Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
Specific measures to be undertaken and equipment to be used to manage non-hazardous waste will be described. The measures will address, at a minimum: <ul style="list-style-type: none"> <li>■ a list of approved locations that will accept recyclable and non-recyclable solid non-hazardous construction wastes to be generated during the Work</li> <li>■ the types and quantities of materials to be recycled, as well as those requiring disposal, names of construction waste material haulers, and approved disposal facilities that meet the requirements of the BC <i>Environmental Management Act</i>.</li> </ul>	Contractor	Prior to work commencing
Specific measures that will be undertaken and equipment used to manage the off-site transport, handling and disposal of dredged material will be described in the EPP.	Contractor	Before work commences
<b>Mitigation Measures</b>		
Refuse and debris related to the Work will be collected and disposed of at approved disposal facilities in compliance with laws and requirements of all authorities having jurisdiction.	Contractor	On-going during work
Surficial debris, such as metal, cable and tires, encountered during excavation will be removed and recycled or disposed of at an appropriate disposal site.	Contractor	
The Contractor will not dump, burn, bury, or allow others under its control to dump, burn, or bury construction wastes and refuse associated with the Work. Should refuse or construction wastes related to the Work be dumped, the Contractor will immediately act to clean up and remove the waste material to an approved location.	Contractor	
The Contractor's work area will have a recycling and waste management program in place. Among other things, clearly labelled garbage bins with lids and recycling containers must be made available for food waste and recyclable office waste. The Contractor will arrange for the placement of garbage receptacles and recycling containers at key locations within the Project area such as in the vicinity of the laydown area. Garbage bins kept outside will have lids sufficient to keep wildlife from accessing the waste inside.	Contractor	

Non-Hazardous Waste Management Protection Measures	Responsibility	Timing
The Contractor will establish regular clean up and disposal programs so as to prevent the unnecessary accumulation of excessive construction waste and refuse.	Contractor	
Transport of debris and dredge material will be managed such that debris, dredged material, and water are contained during transportation.	Contractor	
Dredged material will be transported in accordance with applicable municipal, provincial or federal regulations and legislation, including applicable United States legislation if transported there for disposal.	Contractor	
The Contractor will provide waste manifests for shipment/disposal of dredged materials.	Contractor	
If temporary storage of material is proposed prior to final transportation and disposal, the Contractor will use appropriately permitted sites. The contractor will provide adequate containment of dredge material and debris prior to final shipping of this material.	Contractor	
The Contractor will dispose of the dredged material at a permitted disposal facility and will provide certification from the landfill operator that they can accept the dredged sediment with its contaminant and salinity concentrations.	Contractor	
Monitoring		
The work area will be inspected for effectiveness of control measures put into place by the Contractor(s).	Contractor's Environmental Specialist. PSPC's EM may do spot checks	As necessary

### 5.2.11 Hazardous Materials Handling and Storage

#### References

- BC Fire Code
- National Fire Code of Canada
- *Transportation of Dangerous Goods Act*
- *BC Transportation of Dangerous Goods Act*
- Workplace Hazardous Materials Information System (WHMIS)
- Occupational Health & Safety Regulation, BC Regulation 296/97
- *Environmental Management Act*
- Hazardous Waste Regulation (pursuant to EMA)
- BC Field Guide to Fuel Handling Transportation & Storage
- Formation Safety and Environment Management System Directive
- Contract technical specifications

## Mitigation Measures and Monitoring

Hazardous Materials Handling and Storage Protection Measures	Responsibility	Timing
<b>Environmental Protection Plan Components</b>		
<p>Specific measures that will be undertaken and equipment that will be used to manage hazardous materials will be described, including:</p> <ul style="list-style-type: none"> <li>▪ The proposed location and types of facilities where hazardous materials will be stored and handled, and where construction equipment will be refuelled.</li> <li>▪ Details of containment facilities for fuels, oils, antifreeze, and other liquid forms of hazardous materials such that spills can be contained and collected before contaminants enter soils or reach any watercourse or storm water system.</li> </ul> <p>This information may be included in the Health and Safety Plan prepared by the Contractor for the Project.</p>	Contractor	Prior to work commencing
<b>Mitigation Measures</b>		
Hazardous materials will be disposed of in accordance with law and the requirements of all authorities having jurisdiction.	Contractor	On-going during work
Should the on-site storage of hazardous materials such as gasoline or oils be required, secondary containment capable of holding at least 110% of all hazardous materials stored within will be in place.	Contractor	
Above ground storage tank areas will be bermed, lined, and have in place appropriate drainage systems for removing accumulated rainwater.	Contractor	
Current Safety Data Sheets (SDS) <sup>(a)</sup> and an inventory will be maintained for all controlled substances used, stored, and handled on-site associated with Project activities.	Contractor	
An area will be designated, as required, for the transfer or temporary storage of hazardous materials and wastes. The area will be clearly labelled and controlled in accordance with WHMIS and other statutes.	Contractor	
Where construction activities involve the handling, storage, and removal of hazardous waste, the Contractor(s) will maintain the following records: <ul style="list-style-type: none"> <li>▪ inventories of types and quantities of hazardous waste generated, stored, or removed</li> <li>▪ manifests identifying hazardous waste haulers and disposal destinations</li> <li>▪ disposal certification documents</li> </ul>	Contractor	
Personnel will be trained in the handling and transportation of dangerous goods and controlled substances.	Contractor	
<b>Monitoring</b>		
The work area will be inspected for effectiveness of control measures implemented by the Contractor(s).	Contractor's Environmental Specialist. PSPC's EM may do spot checks	As necessary

Notes:

(a) Formerly called "material safety data sheets" or MSDS.

### 5.3 Environmental Site Inspections

Environmental site inspection tasks are outlined in Table 5. These inspections will be separate from inspections carried out by the Contractor as part of their implementation and quality control for the EPP. Environmental site inspections should be undertaken at the beginning of the work and throughout the program thereafter dependent on the activities and equipment on-site. The frequency of inspections may be increased based on direction from PSPC or based on co-ordination with PSPC/DND regarding the results of the inspections.

The Contractor is responsible for mechanical inspections by qualified personnel, for maintaining health and safety equipment and procedures for their work, and for maintaining equipment logs (maintenance and inspection) which can be produced upon request to verify that mechanical inspections are being conducted.

**Table 5: Environmental Site Inspection Tasks.**

Environmental Component	Description
Air Quality	<ul style="list-style-type: none"> <li>■ Visually observe activities for conformance with the Dust and Emissions Control Plan.</li> </ul>
Water Quality - Spill Prevention and Response	<ul style="list-style-type: none"> <li>■ Confirm that the Contractor spill prevention and emergency response plan is posted on-site, readily available to personnel, and discussed at daily pre-job briefings.</li> <li>■ Confirm with the Contractor that operating personnel are familiar with the locations, contents and use of spill response equipment.</li> <li>■ Confirm with the Contractor that operating personnel are familiar with the location and operation of emergency 'shut-offs', and the notification procedures to be followed in the event of an emergency or environmental incident.</li> <li>■ Verify that spill response equipment is available on-site and confirm with the Contractor that trained personnel are available to deploy the spill response equipment.</li> <li>■ Verify that Safety Data Sheets (SDS) are available on-site.</li> <li>■ Confirm with the Contractor that operating personnel are familiar with the locations and use of the SDS.</li> <li>■ Visually inspect equipment for hydraulic fluid, fuel and other leaks.</li> <li>■ Equipment logs (maintenance and inspection) may occasionally be checked to verify that maintenance/inspection of equipment is being conducted in accordance with DND directives.</li> <li>■ Confirm with the Contractor that the spill prevention and emergency response measures have the capability to effectively manage spills resulting from their activities and operations.</li> <li>■ Visual observation of fueling events and confirm that they conform to Spill Prevention and Response Plan.</li> </ul>
Water Quality - Stormwater Pollution Prevention	<ul style="list-style-type: none"> <li>■ Visually inspect stormwater protection measures to confirm they conform to the Stormwater Pollution Prevention Plan and that they are functioning to prevent pollution from entering surface waters.</li> </ul>

Environmental Component	Description
Water Quality - Silt Curtain	<ul style="list-style-type: none"> <li>■ Visibly inspect silt curtain daily from above water for damage, shift in location, anchorage to shore (if applicable), and conformance with the Silt Curtain Control Plan.</li> </ul>
Water Quality - Sediment and Erosion Control	<ul style="list-style-type: none"> <li>■ Visually inspect sediment and erosion control measures to confirm they conform to the Sediment and Erosion Control Plan and that they are functioning as intended.</li> </ul>
Noise, Light and Odour	<ul style="list-style-type: none"> <li>■ Inspect work areas and work activities for conformance with the Noise, Light and Odour Plan. Conduct in-air noise monitoring in the event complaints are received.</li> </ul>
Non-hazardous Waste Storage and Disposal	<ul style="list-style-type: none"> <li>■ Inspect work areas and work activities for conformance with the Non-hazardous Waste Storage and Disposal Plan.</li> </ul>
Hazardous Materials Storage and Disposal	<ul style="list-style-type: none"> <li>■ Inspect hazardous materials storage for compliance with Hazardous Materials Storage and Disposal Plan.</li> </ul>

## 6.0 ENVIRONMENTAL INCIDENTS

An environmental incident is an event that has caused, or has the potential to cause, one or more of the following:

- damage to aquatic or terrestrial habitat
- adverse/harmful effects to fish, wildlife or other environmental resources
- adverse publicity associated with impacts on the environment
- violation of statutes or regulatory authorizations
- environmental damage

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

- Spill to the marine environment or a spill of reportable size under the BC *Environmental Management Act* Spill Reporting Regulation.
- Deposit of a deleterious substance
- serious harm to fish without prior authorization
- injury to marine mammals or birds

All environmental incidents are to be reported to DND immediately via the DR. Refer to Section 5.2.9 for additional spill reporting requirements to be undertaken by the Contractor.

An Environmental Incident Report (EIR) is to be prepared and submitted by the Contractor(s) to provide a timely and accurate internal written notification of environmental incidents to DND. The deadline for submission of the EIR is within 24 hours following an incident. The EIR will include the following information:

- who reported, and responded, to the incident
- a description of the incident (e.g., date, time, cause, personnel present, type of material spilled, environment affected)
- actions taken to mitigate the incident
- preventative measures implemented following the incident
- photo documentation
- Spill Report Number issued by Emergency Management BC if applicable

The written EIR is not intended to take the place of verbal notification of an incident requiring immediate action or further notification of regulatory agencies (e.g., a spill that affects neighbouring properties or requires assistance in the supply or deployment of containment equipment).

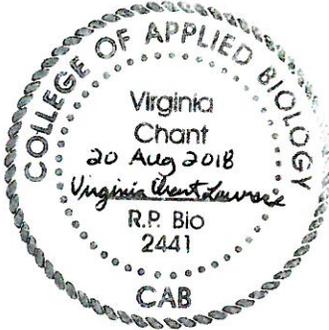
As well as internal reporting to PSPC and DND and external reporting to authorities listed in Section 5.2.9, it may be necessary in some situations to report an environmental incident to local municipal environmental representatives (Township of Esquimalt, City of Colwood) and owners of neighbouring properties (e.g., DND, QHM). DND will provide these notifications.

In the event that the incident is considered an emergency, and the DR is not available, or where a delay in notification could result in environmental damage or risk to human health, PSPC's EM will provide these notifications. Notification of corrective measures and closure of the incident may also be reported, as per direction from DND.

## 7.0 CLOSURE

We trust that this Environmental Management Plan provides sufficient information for your present needs. If you have any questions, please do not hesitate to contact the undersigned.

### GOLDER ASSOCIATES LTD.



Virginia Lawrence, BSc, RPBio  
*Biologist*



Barbara Wernick, MSc, RPBio  
*Principal, Senior Environmental Scientist*

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## 8.0 REFERENCES

### 8.1 Acts, Regulations and Policies

- *BC Wildlife Act*
- *BC Contaminated Sites Regulation*
- *BC Environmental Management Act*
- *BC Hazardous Waste Regulation (pursuant to EMA)*
- *BC Contaminated Sites Regulation (pursuant to EMA)*
- *BC Spill Reporting Regulation (pursuant to EMA)*
- *BC Heritage Conservation Act*
- *BC Transportation of Dangerous Goods Act*
- *Canada Marine Act*
- *Canada Shipping Act, 2001*
- *Canadian Environmental Assessment Act, 2012*
- *Canadian Environmental Protection Act, 1999*
- *Fisheries Act*
- *Migratory Birds Convention Act, 1994*
- *Navigation Protection Act*
- *Species at Risk Act*
- *Transportation of Dangerous Goods Act, 1992*
- *Town of View Royal Bylaw No. 523, 2003*
- *The City of Colwood Noise Bylaw No. 1594, 2016*
- *The Township of Esquimalt Maintenance of Property and Nuisance Regulation Bylaw No. 2826, 2014*
- *City of Colwood Traffic and Highway Regulation Bylaw No. 1134, 2010*
- *Township of Esquimalt Streets and Traffic Regulation Bylaw No. 2607, 2005*
- *Capital Regional District (CRD) Bylaw No. 2922 (Consolidated), 2016*

## 8.2 Other References

- Anchor QEA (Anchor QEA, LLC). 2016. Draft Y Jetty and Lang Cove Remedial Action Plan/Risk Management Plan Esquimalt Harbour Remediation Project. August 2016. 150553-11.05
- Anchor QEA. 2018a. EHRP Phase 2C and 2D – Y Jetty and Lang Cove – Draft 100% Design. June 2018. L-23\_2018Jun14\_EHRP\_DRAFT\_Specs\_Y Jetty-Lang Cove 100percent Design\_AQ\_KCB.pdf
- Anchor QEA. 2018b. EHRP Phase 2C and 2D – Y Jetty and Lang Cove – Draft 100% Design. June 2018. L-23\_2018Jun14\_EHRP\_DRAFT\_Drawings\_Y Jetty-Lang Cove 100percent Design\_AQ\_KCB.pdf
- Archipelago (Archipelago Marine Research Ltd.). 2004. Subtidal Survey of Physical and Biological Features of Esquimalt Harbour Report and Map Folio. Revised and Updated February 2004.
- Archipelago Marine Research Ltd. 2016. Biophysical Characterization of Seabed Habitat and Phase II Abalone Survey. Small Boat Float Project. Constance Cove. Esquimalt Harbour. August 2016.
- Balanced. 2012. Qualitative Presence/Absence Survey for Marine Species, Esquimalt Harbour Remediation Project, Lang Cove Remediation Area. 19 November 2012
- Caltrans (California Department of Transportation). 2015. Technical Guidance for the Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. California Department of Transportation: Division of Environmental Analysis. Available at: [http://www.dot.ca.gov/hq/env/bio/files/bio\\_tech\\_guidance\\_hydroacoustic\\_effects\\_110215.pdf](http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf). Accessed 13 June 2016.
- Canadian Environmental Assessment Agency. 2015. Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under the Canadian Environmental Assessment Act, 2012 (March 2015). Available at <https://www.ceaa-acee.gc.ca/default.asp?lang=en&n=536A4CFE-1>. Accessed 3 December, 2016.
- CRD (Capital Regional District). 2017. Esquimalt Harbour – Interesting Facts. Available at: <https://www.crd.bc.ca/education/our-environment/harbours/Esquimalt-harbour/interesting-facts>. Accessed on: 6 August 2017.
- DFO (Fisheries and Oceans Canada). 2013. Be Whale Wise – Marine Wildlife Guidelines for Boaters, Paddlers, and Viewers. Available at: <http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especies/mammals-mammiferes/view-observer-eng.html>. Accessed 17 June 2016.
- DFO. 2014. British Columbia Marine/Estuarine Timing Windows for the Protection of Fish and Fish Habitat – South Coast and Lower Fraser Areas. Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/bc-s-eng.html#area-19>. Accessed 17 June 2016.
- DFO. 2016. Section 193, Victoria Herring Spawn Records. Available at: <http://www.pac.dfo-mpo.gc.ca/science/species-especies/pelagic-pelagique/herring-hareng/herspawn/193fig-eng.html>.
- FHWG (Fisheries Hydroacoustic Working Group). 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities. 12 June 2008 edition. Available at: [http://www.dot.ca.gov/hq/env/bio/files/fhwgcriteria\\_agree.pdf](http://www.dot.ca.gov/hq/env/bio/files/fhwgcriteria_agree.pdf). Accessed 24 June 2016.

- Golder (Golder Associates Ltd.). 2015a. Marine Biophysical Assessment: Lang Cove, Esquimalt Harbour, Esquimalt, BC. 31 March 2015.
- Golder. 2015b. Archaeological Overview Assessment of Six Proposed Remedial Dredging Areas in Esquimalt Harbour, CFB Esquimalt, Esquimalt, BC. Final report prepared for DCC, 31 March 2015.
- Golder. 2016a. Draft Marine Habitat Assessment: Esquimalt Harbour Remediation Program. 21 March 2016.
- Golder. 2016b. Archaeological Impact Assessment of Remedial Dredging Areas at Lang Cove and F & G Jetty in Esquimalt Harbour, Esquimalt, BC (Non-Permit Report) . Final Report prepared for PSPC and PSPC, 31 March 2016.
- Golder. 2018. Environmental Effects Determination: Esquimalt Harbour Remediation Project. In preparation.
- Hutton, K.E. and S.C. Samis. 2000. Guidelines to protect fish and fish habitat from treated wood used in aquatic environments in the Pacific Region. Can. Tech. Rep. Fish. Aquat. Sci. 2314: vi + 34 p.
- INAC (Indigenous Affairs and Northern Development Canada). 2016a. Registered Population: Songhees First Nation. Available at: [http://pse5-esd5.aadnc-aandc.gc.ca/fnp/Main/Search/FNRegPopulation.aspx?BAND\\_NUMBER=656&lang=eng](http://pse5-esd5.aadnc-aandc.gc.ca/fnp/Main/Search/FNRegPopulation.aspx?BAND_NUMBER=656&lang=eng). Accessed March 2016.
- INAC. 2016b. Registered Population: Esquimalt First Nation. Available at: [http://pse5-esd5.aadnc-aandc.gc.ca/fnp/Main/Search/FNRegPopulation.aspx?BAND\\_NUMBER=644&lang=eng](http://pse5-esd5.aadnc-aandc.gc.ca/fnp/Main/Search/FNRegPopulation.aspx?BAND_NUMBER=644&lang=eng). Accessed March 2016.
- MOE (Ministry of Environment). 2014. Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia. Available at: <http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare/#Main>.
- NOAA (National Oceanic and Atmospheric Administration). 2016. *Marine Mammals: Interim Sound Threshold Guidance* (webpage). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. [http://www.westcoast.fisheries.noaa.gov/protected\\_species/marine\\_mammals/threshold\\_guidance.html](http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html) (Accessed June 2016).
- Royal Canadian Navy. 2017. Esquimalt Harbour - Practices and Procedures - September 2016. Available at: <http://www.navy-marine.forces.gc.ca/en/about/structure-marpac-poesb-practices-procedures.page>. Accessed on: 15 February 2017.
- Stadler, J.H. and D.P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. National Marine Fisheries Service. Available at: [http://golderportal/Technical/GroupGlobalMarineServicesNetwork/Documents/Reference/Pile%20Driving%20%20Overpressure/Stadler\\_and\\_Woodbury\\_2009.pdf](http://golderportal/Technical/GroupGlobalMarineServicesNetwork/Documents/Reference/Pile%20Driving%20%20Overpressure/Stadler_and_Woodbury_2009.pdf). Accessed 13 June 2016.
- SLR. 2016. Detailed Quantitative Ecological Risk Assessment to Support Environmental Risk Management, Esquimalt Harbour, BC. Draft #2. May 2016 SLR Project No.: 205.03774.00001.

**APPENDIX A**

**Water Quality Monitoring Plan  
(WQMP)**



**REPORT**

# Water Quality Monitoring Plan

Esquimalt Harbour Remediation Project (EHRP) - Phase 2C and 2D - Y Jetty and Lang Cove (YJLC)

Submitted to:

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18101029-003-R-Rev0

20 August 2018

# Distribution List

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# Executive Summary

## Project Description

The Department of National Defence (DND) is proposing to remediate contaminated sediment in the areas of Y Jetty and Lang Cove (YJLC) as part of the Esquimalt Harbour Remediation Project (EHRP) (referred to hereafter as ‘the Project’). The proposed remediation involves the removal of sediments that have contaminant concentrations exceeding the Canadian Council of Ministers of the Environment (CCME) probable effects level (PEL) sediment quality guidelines (SQGs).

Golder Associates Ltd. (Golder) was retained by Public Services and Procurement Canada (PSPC) on behalf of DND to develop a Water Quality Monitoring Plan (WQMP) that will be implemented during the Project to verify water quality predictions for Project activities, including the dredging itself, as well as discharge of barge dewatering effluent, and that will provide a feedback mechanism for implementing management actions. The WQMP, which is part of the Environmental Management Plan (EMP), outlines the scope of monitoring that will be undertaken during project activities and identify appropriate parameters and assessment criteria.

## Why Monitor Water Quality?

Water quality monitoring is a necessary part of the Project for the following reasons:

- To verify that the remedial project is not resulting in environmental impacts (i.e., harmful changes) during its implementation
- To verify that the environmental controls on the dredging project are adequate to protect the environment
- To provide environmental management data that will identify, through pre-established triggers, when additional controls on, or cessation of, Project-related activities (e.g., dredging, intertidal excavation) is necessary
- To provide data that will enable regulatory reporting and confirmation of regulatory targets
- To form part of PSPC’s due diligence efforts for this project. PSPC is DND’s representative for the Project, and is responsible for day to day compliance with environmental mitigation measures, permits, approvals, and authorizations.

## What are the Monitoring Plan Elements?

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

- Induced suspension of solids / turbidity (e.g., during dredging, dewatering of dredged material, in-water transport of dredged material and debris, placement of substrate in-fill)
- Release of contaminants from:
  - Re-suspension of contaminated sediments during dredging to a lesser extent during piling removal, cleaning, and installation

- Dewatering of the dredged sediment on the barge
- In-water transportation of dredged material, offloading and stockpiling of dredged material through stormwater system, or upland equipment decontamination through stormwater system
- Release of creosote from pilings during removal and storage (before disposal) as well as re-installation of existing timber piles if in suitable condition
- Fuel or hydraulic spills from equipment

Physical controls will be used to minimize the induced suspension of solids and potential release of contaminants associated with sediments and monitoring will be undertaken in part to verify that these controls are functioning as intended.

The monitoring plan is based on a combination of “real-time” collection of *in situ* measurements for day-to-day management of Project activities, as well as collection of water samples for laboratory analyses for verification purposes. The monitoring program is also designed to provide information to distinguish induced turbidity related to Project activities from that generated by normal vessel activities in Esquimalt Harbour.

- ***In situ* turbidity measurements** – turbidity can be monitored manually on a “real-time” basis without costs for laboratory analysis (i.e., *in situ* with a field meter), which allows for more measurements to be collected at a greater frequency and across a greater spatial scale. This provides the monitoring program with flexibility to meet the conditions of the project at a given time. A turbidity-total suspended solids (TSS) relationship has been developed, which allows for turbidity to be a surrogate for TSS, and by extension, contaminants of concern associated with the TSS. The turbidity-TSS relationship will be verified and re-calibrated as necessary based on the results of paired turbidity and TSS results.
- **Collection of water samples for laboratory analysis** – these samples will be collected, but on a less frequent basis to verify that the environmental controls are functioning as intended and that environmental impacts are not being caused

## Notice to Readers

This report was prepared for Canada in accordance with the terms and conditions outlined in the Public Works and Government Services Canada (PWGSC) Contaminated Sites Marine Sediment Task Authorization No. EZ897-172925/002/VAN dated 21 November 2017. The scope of work for this report (Task 3: Update the YJLC Environmental Management Plan (EMP) and Water Quality Monitoring Plan (WQMP)) was outlined in Golder's "Workplan and Cost Estimate for Environmental, Heritage and Engagement Support for the Esquimalt Harbour Remediation Project, Esquimalt Harbour, BC", dated 25 May 2018. Task Authorizations (TA) for the above work plans were provided by Public Services and Procurement Canada (PSPC) on 4 June 2018 under TA 700412027.

The inferences concerning the Site conditions contained in this report are based on information obtained during the assessment conducted by Golder personnel, and are based solely on the condition of the property at the time of the Site reconnaissance, supplemented by historical and interview information obtained by Golder, as described in this report.

This report was prepared, based in part, on information obtained from historic information sources. In evaluating the subject Site, Golder has relied in good faith on information provided. We accept no responsibility for any deficiency or inaccuracy contained in this report as a result of our reliance on the aforementioned information.

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 practicing under similar conditions in the jurisdiction.

With respect to regulatory compliance issues, regulatory statutes are subject to interpretation. These interpretations may change over time, these should be reviewed.

If new information is discovered during future work, the conclusions of this report should be re-evaluated and the report amended, as required, prior to any reliance upon the information presented herein.

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## 1.0 INTRODUCTION

### 1.1 Background

The Department of National Defence (DND) is proposing to remediate contaminated sediment in the areas of Y Jetty and Lang Cove (YJLC) as part of the Esquimalt Harbour Remediation Project (EHRP) (referred to hereafter as 'the Project') (Figure 1). The proposed remediation involves the removal of sediments that have contaminant concentrations exceeding the Canadian Council of Ministers of the Environment (CCME) probable effects level (PEL) sediment quality guidelines (SQGs; CCME 1999a) as outlined in the basis of design report for the Project (Anchor QEA 2017).

Golder Associates Ltd. (Golder) was retained by Public Services and Procurement Canada (PSPC) on behalf of DND to develop a Water Quality Monitoring Plan (WQMP) that will be implemented during the Project to verify water quality predictions for Project activities, including the dredging itself, as well as discharge of barge dewatering effluent and placement of material, and that will provide a feedback mechanism for implementing management actions. The WQMP, which is part of the Environmental Management Plan (EMP), outlines the scope of monitoring that will be undertaken during Project activities and identify appropriate parameters and assessment criteria.

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## 1.2 Objectives

The objectives of the WQMP are to address the following:

- Outline the scope of water quality monitoring that will be undertaken during Project activities including location and frequency of monitoring
- Identify appropriate parameters and assessment criteria
- Present decision criteria and high-level management actions
- Present data compilation and quality assurance/quality control (QA/QC) measures

## 1.3 Report Structure

The WQMP includes the following components:

- A description of baseline water quality conditions in Esquimalt Harbour, including an evaluation of implications for the Project (Section 2.0)
- Parameters to be monitored (Section 3.1) and limits that will trigger management actions (Section 3.2)
- Methodology for *in-situ* water quality monitoring for real-time assessment and automated turbidity monitoring (Section 3.3)
- Validation of total suspended solids (TSS) levels and plume direction (Section 3.4)
- Monitoring data management procedures (Section 3.5.3)
- Monitoring data quality assurance/quality control (QA/QC) procedures that will be undertaken to verify the reliability of collected data (Section 3.5)
- Reporting (Section 4.0)

**This WQMP is intended to be read in conjunction with the Environmental Management Plan (EMP), environmental approvals, authorizations and contract requirements for the Project.**

A summary of federal and provincial pollution prevention legislation is provided in the EMP for the Project. The intent of this WQMP is to provide direction to DND, Consultants, and the Contractor that is consistent with the provisions for environmental protection contained in that legislation. Should further clarification of any environmental issue be required, the appropriate regulation or legislative document should be consulted, or advice sought from DND.

## 2.0 PROJECT AREA AND LOCATION

Esquimalt Harbour is a sheltered body of water that covers a total area of 3.4 km<sup>2</sup> and occupies approximately 20 km of shoreline. The harbour entrance, Royal Roads passage, connects to the Strait of Juan de Fuca. The main body of Esquimalt Harbour has an average depth of 10 m below chart datum (CD) in open-water areas, and is deepest near the mouth of the harbour and shallowest towards Price Bay at the northern extent of the harbour. The mouth of Millstream Creek, at the northwest end of Esquimalt Harbour, is a productive estuary and mud flats, with tidal influence present for several hundred metres upstream of the shoreline of the harbour.

Surface water in Esquimalt harbour exchanges with waters of the Strait of Juan de Fuca through the harbour entrance, Royal Roads passage, which is approximately 750 m across. The relatively wide entrance of the harbour allows the tidal regime of the harbour to match surrounding areas outside the harbour.

Based on Canadian Tide and Current Tables, Esquimalt Harbour's mean tide is 1.8 m (relative to chart datum) with a reported large tide of 3.1 m. The mean tide Higher High Water (HHW) is 2.5 m, and the large tide HHW is 3.4 m. The mean Lower Low Water (LLW) is 0.7 m, and the large tide LLW is 0.1 m (DFO 2010).

An investigation of currents and tidal effects in the harbour was conducted in 2010 (Golder 2011). A vessel mounted acoustic doppler current profiler (ADCP) was towed along five survey lines to determine current speeds and direction over an entire tidal cycle. Exchange of water through the mouth of the harbour during peak flood and ebb tidal periods resulted in depth-averaged current speeds in excess of 1 m/s near the mouth of the harbour. For most of the harbour, including the Project Area, the measured currents were shown to be typically weak and variable in direction (Golder 2011).

The Project is located at YJLC on the east shore of Esquimalt Harbour at Canadian Forces Base (CFB) Esquimalt in Constance Cove (Figure 1).

## 2.1 Water Quality in Esquimalt Harbour

### 2.1.1 Surface Water Quality

Existing surface water quality is relevant to the Project water quality monitoring because:

- It provides a characterization of pre-project water quality conditions; and
- It provides a basis of "background" conditions against which monitoring data can be compared, such that interpretation (by a Qualified Professional [QP])<sup>1</sup> of water quality monitoring results is better supported.

A brief overview of contaminants data is provided here, with additional detail on background turbidity data provided because this parameter will be a substantial component of the water quality monitoring program during remedial dredging. In the event that further interpretation is needed, the QP should refer to the original reports referenced below. Overall, the available data indicate the importance of collecting contemporary and project-

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<sup>1</sup> A QP is defined as a person who is registered and/or licensed in the relevant jurisdiction with his or her appropriate professional association and/or licensing authority, acts under that professional association's and/or licensing authority's code of ethics, and is subject to disciplinary action by that professional association and/or licensing authority, and through suitable education, experience, accreditation, and knowledge can be reasonably relied on to provide advice within his or her area of expertise. This definition was adapted from the Municipal Wastewater Regulation (pursuant to the BC *Environmental Management Act*).

specific data for managing the dredging at YJLC because intermittent events unrelated to dredging can affect what is relatively good water quality in Esquimalt Harbour (Anchor QEA 2016).

Water quality data for Esquimalt Harbour are available from surface water samples collected during multiple separate investigations between 2005 and 2017. Metals were generally found to be below or at federal (CCME 1999a) and provincial (MOE 2010) water quality guidelines (WQGs), with slightly higher concentrations occurring near the mouth of the Esquimalt Graving Dock than in Esquimalt Harbour to the west (SLR 2008, 2014; SEACOR 2005, Golder 2006a,b). Polycyclic aromatic hydrocarbons (PAHs) were also below WQGs except in some samples collected near Outfall D adjacent to Munroe Head on the east side of Esquimalt Harbour in 2005. This dataset is limited and these conditions should not be assumed to represent background concentration at the time the Project is implemented.

Turbidity monitoring was undertaken in Esquimalt Harbour between 18 October and 15 December 2010 prior to remedial dredging at the Esquimalt Graving Dock (Golder 2011). Turbidity values ranged between 0 and 165 nephelometric turbidity units (NTU) south of D Jetty and up to 817 NTU at stations on the east side of Esquimalt Harbour. The 99th percentile of all NTU values observed in the field was 6.4 NTU (n = 59,000). The short-duration peaks in turbidity observed during the program may have been due to sediment re-suspension caused by operational activities including boat/tug activity, propeller wash, or by natural re-suspension of sediments caused by wind-waves and tidal currents. Turbidity monitoring was also undertaken between January 4 and April 28, 2017 during remedial dredging and backfilling at D Jetty and F/G Jetty (Golder 2017). Ambient turbidity measured during the program was generally low (<2 NTU), while turbidity at 100 m from the dredging or backfilling activities ranged between 0 and 107.5 NTU.

Manual monitoring of turbidity, water temperature, pH, and dissolved oxygen was undertaken at each of the automated turbidity monitoring stations at the Esquimalt Graving Dock (Golder 2011), and at far-field reference locations adjacent to Plumper Bay during the remedial dredging program at D Jetty and F/G Jetty (Golder 2017). During both monitoring programs, these parameters were relatively consistent among sampling stations and across water depths, indicating that the harbour was relatively well mixed (Table 1). These data may not be representative of conditions during colder or warmer weather when stratification may occur. Potential stratification of the water column will need to be taken into consideration during monitoring for potential turbidity plume generation and distribution.

**Table 1: Vertical Profile Data from Esquimalt Harbour (Collected Manually) for Turbidity, Temperature, Dissolved Oxygen, and pH**

Parameter	Depth	Ambient Water Quality Measurements (Mean Values)					
		EGD <sup>1</sup>		Munroe Head <sup>1</sup>		Plumper Bay <sup>2</sup>	
		Easting 5365323	Northing 0467871	Easting 5364985	Northing 0468117	Easting <sup>3</sup> 5365421	Northing 0467933
Turbidity (NTU)	Shallow (0-4 m)	0.76		0.53		0.65	
	Mid-water (4-8 m)	0.57		0.63		0.53	
	Deep (8 m+)	0.59		-		0.51	
	<i>All depths</i>	0.64		0.55		0.56	
Temp. (°C)	Shallow (0-4 m)	7.78		8.51		8.12	
	Mid-water (4-8 m)	7.70		8.00		8.03	
	Deep (8 m+)	7.51		-		7.94	
	<i>All depths</i>	7.69		8.42		8.03	

Parameter	Depth	Ambient Water Quality Measurements (Mean Values)					
		EGD <sup>1</sup>		Munroe Head <sup>1</sup>		Plumper Bay <sup>2</sup>	
		Easting 5365323	Northing 0467871	Easting 5364985	Northing 0468117	Easting <sup>3</sup> 5365421	Northing 0467933
Dissolved Oxygen (mg/L)	Shallow (0-4 m)	7.53		7.27		9.22	
	Mid-water (4-8 m)	7.31		7.25		9.34	
	Deep (8 m+)	7.37		-		9.32	
	<i>All depths</i>	7.40		7.27		9.29	
pH	Shallow (0-4 m)	7.93		8.07		7.97	
	Mid-water (4-8 m)	8.03		8.15		7.95	
	Deep (8 m+)	8.07		-		7.94	
	<i>All depths</i>	8.00		8.08		7.95	

**Notes:**

CFSA – Canadian Forces Sailing Association; NTU – nephelometric turbidity units; ‘-’ – measurement not made because the sampling station was shallower than 8 m.

<sup>1</sup> – Data collected in October/November 2010 (Golder 2011)

<sup>2</sup> – Data collected between January and April 2017 (Golder 2017)

<sup>3</sup> – Location is approximate center of reference locations used to calculate mean values

## 2.1.2 Turbidity Implications for the WQMP

On average, turbidity in Esquimalt Harbour is low, with mean values typically being less than 5 NTU<sup>2</sup> at most stations and median turbidity being <1 NTU. However, the data available from the turbidity loggers demonstrates that Esquimalt Harbour turbidity can, at times be “patchy.” Additionally, large turbidity events (e.g., two orders of magnitude increases) can occur as short-duration (i.e., hours long) transient events, for example from activities such as ship passage and propeller wash. Thus a turbidity value that represents an increase over background and thus the operational characterization of background (i.e., during Project activities) will be an important information item because it will aid in deciding if turbidity measurements are of concern or if turbidity measurements are simply normal, transient events associated with operations in the harbour.

Two WQMP considerations are raised by these observations:

- A greater number of reference stations and/or samples than recommended here could be necessary. That determination should be made under operational conditions and with the benefit of visual observations made and turbidity data collected during operations. Because the turbidity monitoring costs are not unit costs (equipment rental plus staff time), this should not appreciably impact on the monitoring implementation costs.
- An appropriate response to a single high turbidity value that is outside the range of data depicted in Table 1 is to resample and to identify the reasons for that increase prior to implementing more stringent operational controls. Because of the characteristics of background turbidity data (short duration, relatively high magnitude transient events), there is a risk of incorrect presumptive decisions that could affect project cost and schedule.

<sup>2</sup> For reference, a turbidity reading of 5 NTU is the upper limit for drinking water turbidity. Prior to Metro Vancouver implementing filtration, this was the approximate cloudiness of Vancouver tap water on a “bad day”.

### 3.0 WATER QUALITY MONITORING

This section describes the following components of the water quality monitoring program that will facilitate verification that environmental controls on the dredging project are adequate, and provide environmental management data that will be used to identify when additional controls on, or cessation of Project activities is necessary:

- Monitoring parameters
- Decision criteria and management actions
- Manual (“real-time”) water quality monitoring

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

- Induced suspension of solids / turbidity (e.g., during structure removal, dredging, dewatering of dredged material, discharge of effluent from a treatment system (if applicable), in-water transport of dredged material and debris, placement of substrate in-fill)
- Release of contaminants from:
  - Re-suspension of contaminated sediments during dredging and to a lesser extent during piling removal, cleaning, and installation
  - Dewatering of the dredged sediment on the barge
  - Discharge of effluent from a treatment system (barge- or land-based), should one be used on site during dredging
  - In-water transportation of dredged material, offloading and stockpiling of dredged material through stormwater system, or upland equipment decontamination through stormwater system
- Release of creosote from pilings during removal and storage (before disposal) as well as re-installation of timber piles if suitable for re-installation
- Fuel and hydraulic spills from equipment

The suspension of sediment into the water column can have physical effects on fish and other organisms and cause behavioural changes. The effects of excessive suspended particulate matter have been well documented in several review papers and include: gill abrasion, decreased ability to capture food or avoid predation, and changes in behaviour (i.e., Bilotta and Brazier 2008; CCME 1999b; Birtwell 1999; Caux et al. 1997; Newcombe and Jensen 1996; Newcombe and MacDonald 1991; EIFAC 1964).

Where sediments have associated contaminants, the suspension of sediments can result in the dispersion to adjacent, uncontaminated areas and release of contaminants into the water column where they can cause toxicity to aquatic organisms. The effects associated with contaminants is discussed further in Golder 2017.

Anchor QEA (2011) used DREDGE<sup>3</sup> to model 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 dredge cycle time for dredging at the EGD Waterlot. The modelling did not include the presence of a silt curtain. As expected, the model predicted that the highest TSS concentration would occur in the immediate vicinity of the dredge bucket for all scenarios (11 to 307 mg/L within 1 m of the

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<sup>3</sup> A United States Army Corp of Engineers model (Hayes and Je 2000).

dredge bucket), with TSS decreasing rapidly within 25 m of the dredge bucket (1 to 60 mg/L). However, depending on the scenario, the associated metals and/or PAH concentrations were predicted to exceed ambient federal (CCME 1999a) and provincial WQG (MOE 2010) up to 150 m from the dredge bucket. Thus, the modelling confirmed that a silt curtain will need to be used to help control and minimize the potential dispersion of fines-associated contaminants. The need for this mitigation is also applicable to YJLC because the sediment to be dredged is similar.

The water discharging to the marine environment during barge dewatering activities has been assessed by Golder by estimating the potential release of sediment-associated substances on the dewatering barge to identify 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. The assessment also identified controls that may need to be implemented to manage concentrations of TSS in the discharge water. The detailed assessment, including the modelling theory and assumptions, is provided in Golder (2018). The results of the barge dewatering assessment were also used to select appropriate TSS levels to manage dredging activities.

The WQMP provides a more structured monitoring program for induced turbidity/TSS (and by extension) release of contaminants, as this is the primary component of the project with potential for affecting water quality.

### 3.1 Monitoring Parameters

The WQMP includes measurement of various parameters that will provide information to manage potential effects from the Project. Background information on these parameters is provided below.

#### 3.1.1 Total Suspended Solids

TSS encompasses both inorganic solids such as clay, silt, and sand, and organic solids such as algae and detritus and is a gravimetric measurement of the dry weight of suspended particulate material (solids) per unit volume of water. The measurement of TSS requires the collection of a sample and submission of that sample to the laboratory. Analysis is done by filtering the sample onto a glass fibre filter and drying the sample at a specified temperature. Data for this analysis are typically available on a 24-h turnaround.

The Project Area has been divided into two Water Quality Management Areas (WQMAs; Figure 2) for which different TSS levels have been established for management of barge dewatering, dredging and placement of substrate in-fill, related to the physical effects of particulates as well as associated contaminants:

- WQMA-A: As described in Golder (2018), barge dewatering effluent from dredging of sediment in dredge units (DUs) 9, 25, 26, 27, 28, 29, 31, 32, 34, 37 and 38 has the potential to cause effects in the receiving environment due to the presence of copper, zinc and several PAHs parameters. No direct dewatering without additional mitigation (e.g., treatment) will occur when these DU's are dredged. Based on the findings of the barge dewatering assessment, a TSS concentration of 40 mg/L for induced suspension of solids will be applied at the point of discharge from a treatment system (barge- or land-based), should one be used on site during dredging. A TSS concentration of 40 mg/L for induced suspension of solids will also be used to manage day-to-day dredging.
- WQMA-B: Potential effects from contaminants associated with the sediment were not predicted. Therefore, passive dewatering will be permitted and the TSS limit for induced suspension of solids will be 75 mg/L (adopted from DFO and MELP [1992]) to manage the potential for physical effects from suspended solids. A TSS concentration of 75 mg/L for induced suspension of solids will also be used to manage day-to-day dredging and placement of substrate.



### 3.1.2 Turbidity

Turbidity is a measure of the optical properties (e.g., scattering of light) of particulates suspended in water. Turbidity is often used for the day-to-day management of dredging activities as the results are available in real-time. Turbidity is measured using an instrument that measures the passage of light through the sample as well as the scattered light that is reflected from the sediment particles and reports values in units such as nephelometric turbidity units (NTU). Turbidity can be measured on-site, in real and near-real time.

Anchor QEA (2018) developed a TSS-turbidity relationship from data collected recently during the Plumper Bay Ash Head Remediation Project in Esquimalt Harbour north of the Esquimalt Graving Dock, and PSPC provided that relationship to Golder for use in this WQMP. Based on the relationship, a TSS of 75 mg/L is related to a turbidity of 90 NTU and a TSS of 40 mg/L is related to a turbidity of 30 NTU.

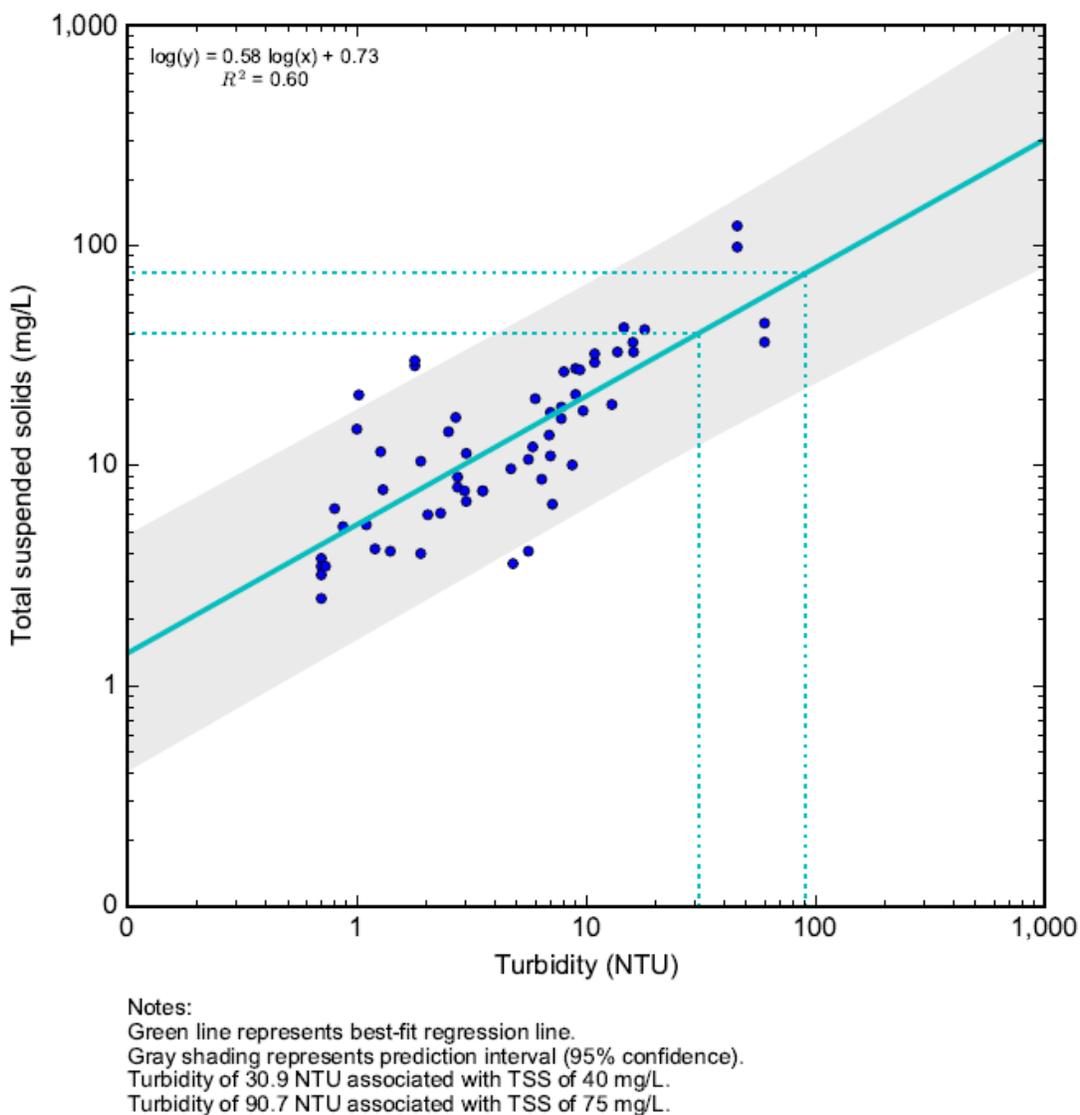


Figure 3: Total suspended solids – turbidity relationship and proposed decision criteria for management actions during dredging and barge dewatering activities (graph from Anchor QEA 2018)

The optical properties of suspended particulates may be different between sites; therefore, the TSS-turbidity relationship will need to be verified and re-calibrated as necessary based on measurements collected during dredging at Y Jetty Lang Cove. It is recommended that this re-calibration be undertaken during the first month of dredging in the project area. Additional bench-scale testing of clean backfill material to be placed within the project area is also recommended to confirm whether the TSS-turbidity relationship developed for dredging needs to be revised for placement of clean material.

### 3.1.3 Dissolved Oxygen

Dissolved oxygen provides a measure of the amount of oxygen available for aquatic organisms. The oxygen content in the atmosphere is 21%, which equates to approximately 210,000 parts per million. However, the amount of oxygen dissolved in water is temperature and salinity-dependent but on the order of 10 parts per million or less. The ability of aquatic organisms to obtain oxygen from water is therefore susceptible to reductions in dissolved oxygen. In Esquimalt Harbour, dissolved oxygen concentrations of 7.03 to 9.29 mg/L were measured during Fall 2010 and Winter 2017. Concentrations were variable between locations and were lower deeper in the water column than at the surface (Table 1).

Dredging of marine sediments can result in the re-suspension of sediments that may be in an anoxic state, which can reduce the dissolved oxygen concentration in the water column to potentially harmful levels. The content of dissolved oxygen in water can also be affected by natural processes such as photosynthesis by algal blooms. Lower dissolved oxygen measurements were observed during remediation dredging of the EGD Waterlot; however, the cause was not identified.

Dissolved oxygen will be measured *in situ* during manual water quality monitoring and results will be available in near real-time. The information will be used by the QP to evaluate potential for environmental impacts, for example to interpret whether effects are project-related or the result of natural processes.

### 3.1.4 pH

The pH measures how acid or alkaline a substance is with a pH of 7 being neutral (neither acid nor alkaline). Normal seawater pH values are slightly alkaline (in Fall 2010 and Winter 2017, pH values of 7.86 to 8.17 were measured in Esquimalt Harbour (Table 1) and seawater chemistry has the ability to resist minor changes but can be overcome when such changes are substantial. pH can be influenced by natural processes such as photosynthesis during algal blooms, which can result in elevated pH (i.e., >9 pH units), whereas open-water dredging is not likely to change pH values to an extent that is, on its own, harmful. pH changes can affect the toxicity of other substances and it is therefore a necessary parameter to monitor so that interpretation of certain results by a QP is possible.

pH will be measured *in situ* during manual water quality monitoring.

### 3.1.5 Polycyclic Aromatic Hydrocarbons (PAH)

PAH substances are present in hydrocarbon products, vessel exhaust, and creosote used to treat timber used in marine construction. Water samples will be collected as indicated in Section 3.2 for submission to an analytical laboratory for analysis of a suite of PAHs. PAH analysis requires a minimum 24-h turnaround time, making its utility to the WQMP retrospective rather than operational. The modelling predicts that PAHs would not occur at concentrations that could cause harm in the receiving environment. The purpose of collecting PAH data will be to confirm the results of the predictive modelling.

### 3.1.6 Metals

The environmental effects determination indicated that the metals of potential concern include: copper, lead and zinc. Water samples will be collected as indicated in Section 3.2 for submission to an analytical laboratory for analysis of total and dissolved metals. Metals analysis requires a minimum 24-h turnaround time, making its utility to the WQMP retrospective rather than operational. The purpose of collecting metals data will be to confirm whether or not TSS limits selected based on predictive modelling of metals concentrations are protective.

## 3.2 Decision Criteria and Management Actions

There are presently no 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”<sup>4</sup>. 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, the end of pipe is the edge of the silt curtain for the dredging (Figure 4) and at the point of discharge (POD) for the dewatering barge (Figure 5) and the treatment system, should one be used (Figure 6). In order to evaluate the controls, the Project must meet pre-specified criteria at the edge of the silt curtain for dredging and the POD for the dewatering barge and treatment system which are referred to as compliance points. 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 operational compliance point may need to be re-evaluated.*

To verify that these controls are sufficient to protect the surrounding environmental values, additional assessment will be carried out approximately 100 m away (assessment point) where water quality should meet ambient WQGs or a pre-specified change from background condition.

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<sup>4</sup> 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.

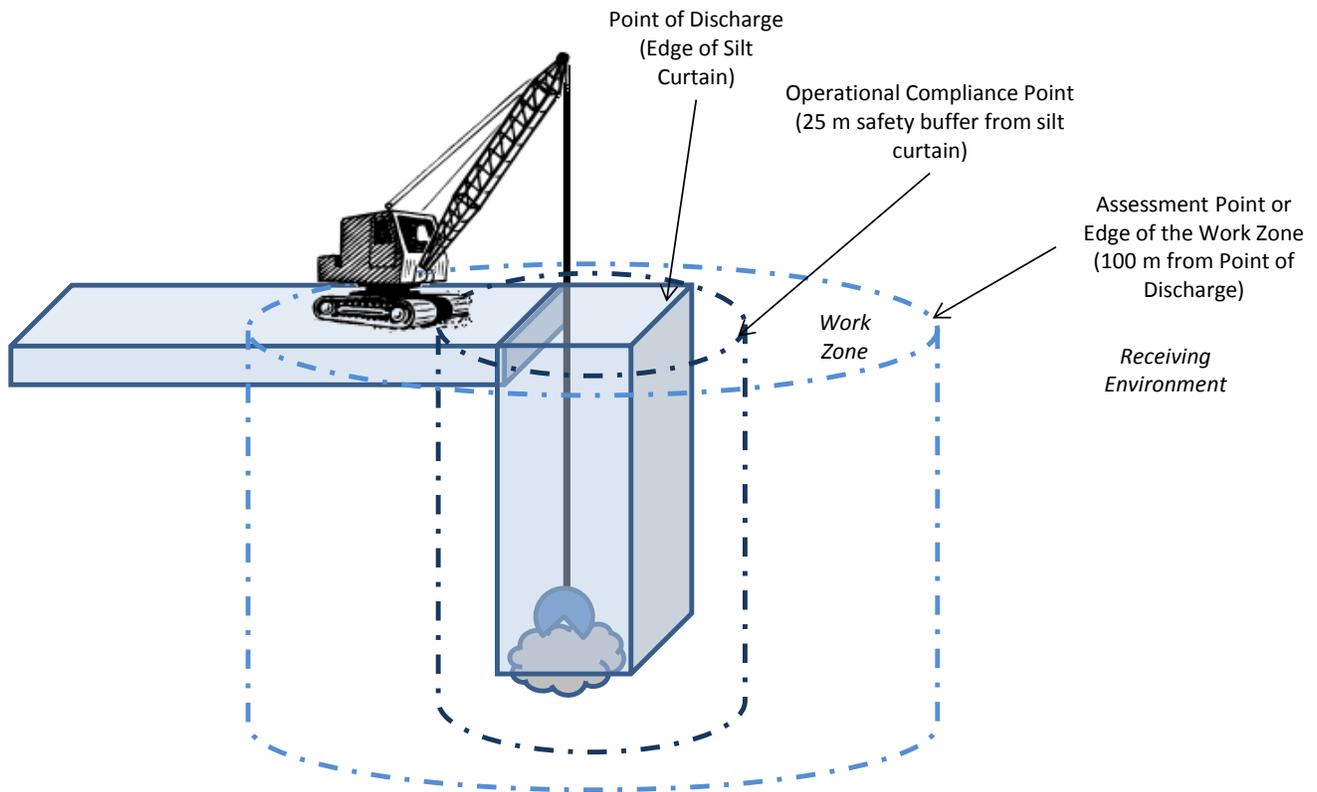


Figure 4: Schematic diagram showing the point of discharge, operational compliance point, and assessment point for a conceptual remedial dredging configuration.

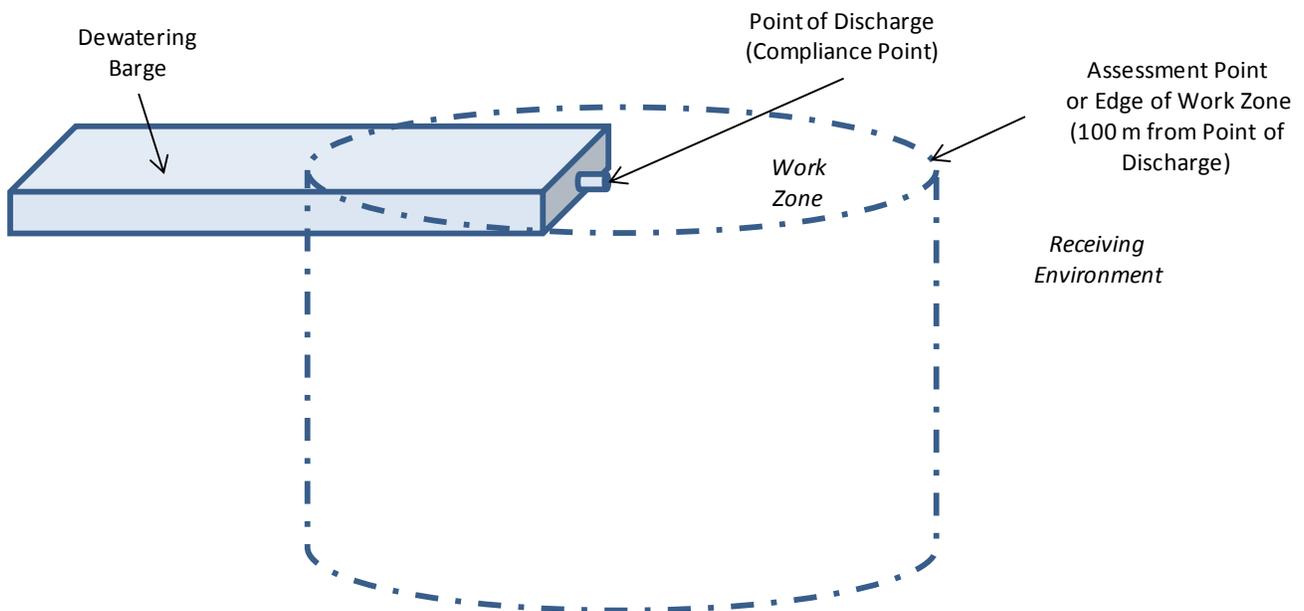
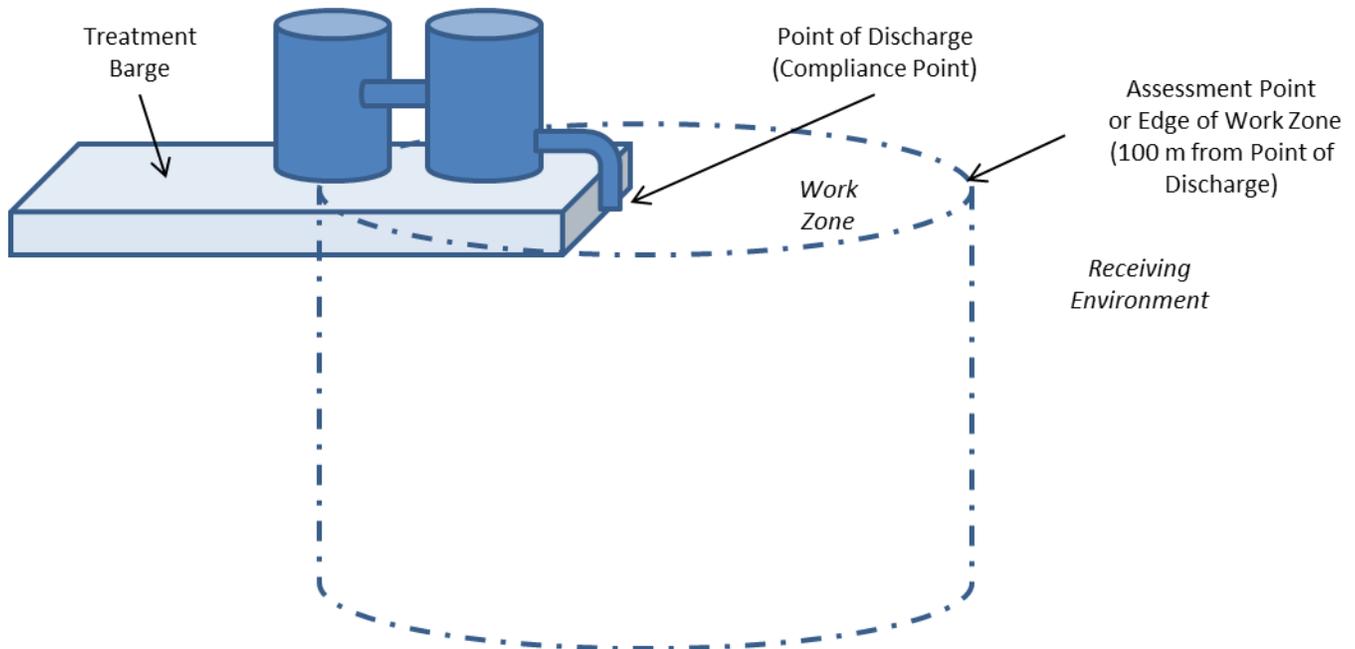


Figure 5: Schematic diagram showing the point of discharge (compliance point) and the assessment point for a conceptual dewatering barge configuration.



**Figure 6: Schematic diagram showing the point of discharge (compliance point) and the assessment point for a conceptual barge-based treatment system layout. The same concepts apply to a land-based treatment system.**

For the purposes of the 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 2 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 the assessment point as represented by the outer boundary of the work zone. Parameter limits for TSS for the POD are provided for two portions of the Project Area (shown in Figures 2 and 3):

- **WQMA-A** – This management area has been identified in the barge dewatering assessment to have sufficiently high metals and/or PAH concentrations such that direct barge dewatering is not suitable without treatment. No direct dewatering without additional mitigation (e.g., treatment) will occur when this area is dredged. A TSS concentration of 40 mg/L will be applied at the point of discharge from a treatment system (barge- or land-based), should one be used on site during dredging. A TSS concentration of 40 mg/L will also be used to manage day-to-day dredging.
- **WQMA-B** – 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 90 NTU as described in Section 3.1.2). A TSS concentration of 75 mg/L will also be used to manage day-to-day dredging. The management consideration for, WQMA-B is related to the control of particulates.

For both WQMAs, a TSS concentration of 75 mg/L will be used to manage day-to-day back-filling activities.

Water quality parameters listed in Tables 2 to 4 are based on previously accepted<sup>5</sup> limits for remedial dredging projects as well as the assessment of barge dewatering effluent quality (Golder 2018). It is proposed that the day-to-day dredging activities be managed on the basis of real-time turbidity measurements (Figure 7). *In situ* measurements will also include dissolved oxygen, temperature, and pH, 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.

**Table 2: General Water Quality Requirements for the Project**

Parameter	Point of Discharge (Compliance Point) <sup>1</sup>			Receiving Environment at Edge of Work Zone (Assessment Point) <sup>2</sup>
Total Suspended Solids	<i>Open-water Dredging</i>	WQMA-A: 40 mg/L (over background) <sup>3</sup>	WQMA-B: 75 mg/L (over background) <sup>4</sup>	<10 mg/L over background at any given time (<24 h duration) when background is <100 mg/L;
	<i>Direct Barge Dewatering</i>	WQMA-A: No discharge without treatment <sup>5</sup>	WQMA-B: 75 mg/L <sup>4</sup>	
	<i>Treatment System<sup>5</sup></i>	WQMA-A: 40 mg/L	WQMA-B not applicable	<10% of background when background is >100 mg/L
Turbidity <sup>6</sup>	Turbidity values as compliance limits for the discharge are not commonly specified for effluents. For the purposes of day-to-day management of dredging activities, turbidity value based on the TSS/turbidity relationship derived (Section 3.1; Figure 3) and are applied as over background values. The TSS/turbidity relationship will be verified and re-calibrated as necessary based on real-time data collected during the Project. For direct barge dewatering and treatment system discharges, the turbidity value is intended to be applied as an absolute maximum.			< 5 NTU over background <sup>6,7</sup> when background is <50 NTU;  < 10% of background when background is > 50 NTU
Dissolved Oxygen	5 mg/L <sup>8</sup>			8 mg/L
pH	6.5 to 9.0 <sup>9</sup>			7.0-8.7 <sup>10</sup>
Metals – various	See Table 3			See Table 3
PAHs – various	See Table 4			See Table 4
Toxicity <sup>11</sup>	<i>Treatment System</i>	WQMA-A: 96h LC <sub>50</sub> ≥ 100% for treated effluent	n/a	n/a

**Notes:**

- <sup>1</sup> 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.
  - <sup>2</sup> 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).
  - <sup>3</sup> Based on barge dewatering assessment (Golder 2018).
  - <sup>4</sup> 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.
  - <sup>5</sup> "Treatment" and "treatment system" refers to an additional means of reduction of suspended solids (e.g., settling tanks) and verification that the treated water will not be acutely lethal prior to discharge.
  - <sup>6</sup> Background is defined as the NTU value measured in the receiving environment up current from the activity.
  - <sup>7</sup> The baseline monitoring program indicated that background turbidity in Esquimalt Harbour is relatively low (mean = 3.8 NTU). However, intermittent increases to 400 NTU have been observed in related to vessel operations at the EGD and storm events. Therefore, turbidity will be evaluated for the Project as induced turbidity above background measured at the time of sampling.
  - <sup>8</sup> Based on British Columbia MOE ambient water quality guidelines for instantaneous minimum dissolved oxygen (BC MOE 2016).
  - <sup>9</sup> The range of pH specified for protection of marine waters is 7.0 – 8.7 to protect mollusk embryo development, based on BC MOE ambient water quality guidelines for pH (BC MOE 1991). However, for the purposes of managing pH during construction projects, DFO has typically specified the same range as for freshwater (6.5 to 9.0), recognizing that these pH differences are small, short-term in nature, are not harmful, and with marine water buffering, the pH water quality guidelines will be met very quickly. Transient pH excursions to less than 7 or greater than 8.7 units are common natural occurrences in coastal environment.
  - <sup>10</sup> Based on MOE ambient water quality guidelines for pH (MOE 1991).
  - <sup>11</sup> 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 (Figure 2).

<sup>5</sup> By federal regulators for remedial dredging projects in Vancouver and Esquimalt Harbour.

**Table 3: Proposed Discharge Criteria for Metals**

Parameter (as total)	Monitoring Criteria (µg/L) <sup>1</sup>	
	Point of Discharge <sup>2</sup>	Receiving Environment at Edge of Work Zone <sup>3</sup>
Arsenic	125	12.5
Copper	30	3
Lead	140	14
Zinc	100	10

**Notes:**

<sup>1</sup> The selection of this subset of metals is discussed in Golder (2018).

<sup>2</sup> 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 (Figure 2). The values are based on 10 x ambient WQG for short-term exposures (i.e., "maximum" WQGs), with the exception of lead for which the value equals the ambient WQG for short-term exposure.

<sup>3</sup> Receiving environment taken to be the edge of the work zone (i.e., 100 m from the POD). Values are based on ambient WQG for short-term exposure with the exception of lead which is based on the POD value with a 10-fold safety factor applied (CCME 2016; CCME 1999c; Singleton 1987; Nagpal 1987, 1999).

**Table 4: Proposed Discharge Criteria for Polycyclic Aromatic Hydrocarbons**

Parameter	Monitoring Criteria (µg/L) <sup>1</sup>	
	Point of Discharge <sup>2</sup>	Receiving Environment at Edge of Work Zone <sup>3</sup>
Acenaphthene	510	51
Anthracene	5.0	0.5
Benzo(a)anthracene	1.8	0.18
Benzo(a)pyrene	5.6	0.56
Chrysene	8.6	0.86
Fluoranthene	20	2
Fluorene	82	8.2
2-Methylnaphthalene	58	5.8
Naphthalene	100	10
Phenanthrene	40	4.0
Pyrene	12.8	1.28

**Notes:**

<sup>1</sup> The selection of this subset of PAHs is discussed in Golder (2018).

<sup>2</sup> 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 (Figure 2). The values are based on a combination of literature review and quantitative structure-activity (QSAR) relationship evaluations as described in Golder (2018).

<sup>3</sup> 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 7 and for WQMA-B is illustrated in Figure 8. The decision framework is based on real-time measurements of turbidity. Other factors may also be considered in a decision by PSPC to implement management actions, for example, interaction with other projects occurring at the same time or the extent of visually obvious turbidity.

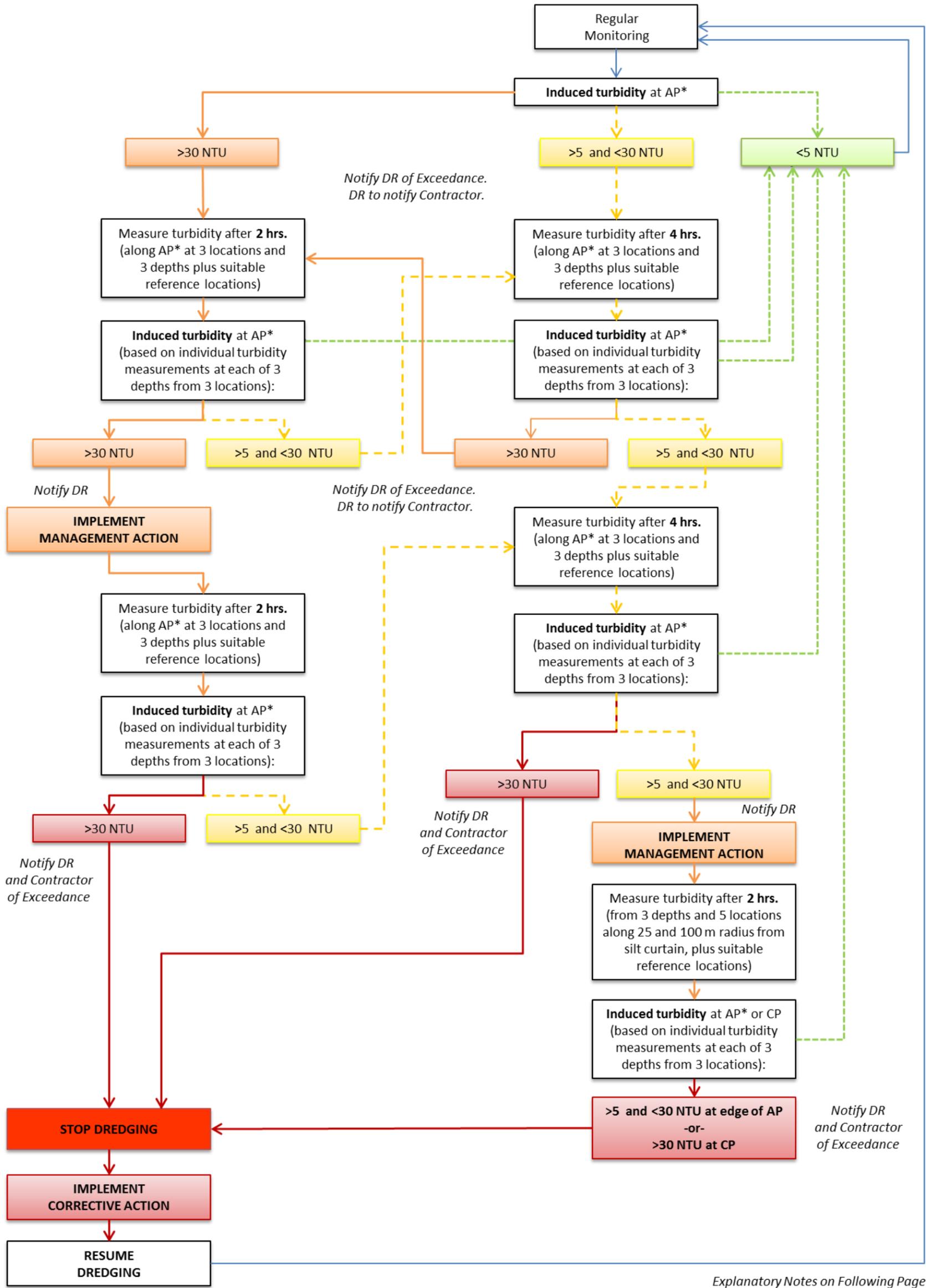
The steps in the decision framework are as follows (turbidity values for WQMA-A are used in this example; for dredging in WQMA-B, the applicable turbidity values should replace the ones below):

- 1) Regular monitoring (Section 3.3) is undertaken to evaluate potential for induced turbidity (i.e., the change in turbidity greater than background) at the edge of the work zone (i.e., the assessment point) during dredging (Figure 4).
- 2) If turbidity is observed to be less than the ambient WQG (i.e., <5 NTU above background), regular monitoring of turbidity continues, with no application of management actions. In the event that turbidity is greater than the ambient WQG, the level of exceedance determines whether:
  - a) Confirmatory sampling will be conducted after 4 hours when induced turbidity is between 5 and 30 NTU above background (for dredging in WQMA-A) and after 2 hours when induced turbidity is >30 NTU (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 >30 NTU above background 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 and when 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 <30 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 Professional to evaluate the potential for environmental effects (which is determined in part by a combination of duration and magnitude). The QP will need to take into account background conditions, visual observations, and level of accuracy of field instrumentation when assessing which course of action should be taken.
  - b) Dredging will be stopped if induced turbidity is >30 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 <30 NTU for WQMA-A) or is >30 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.

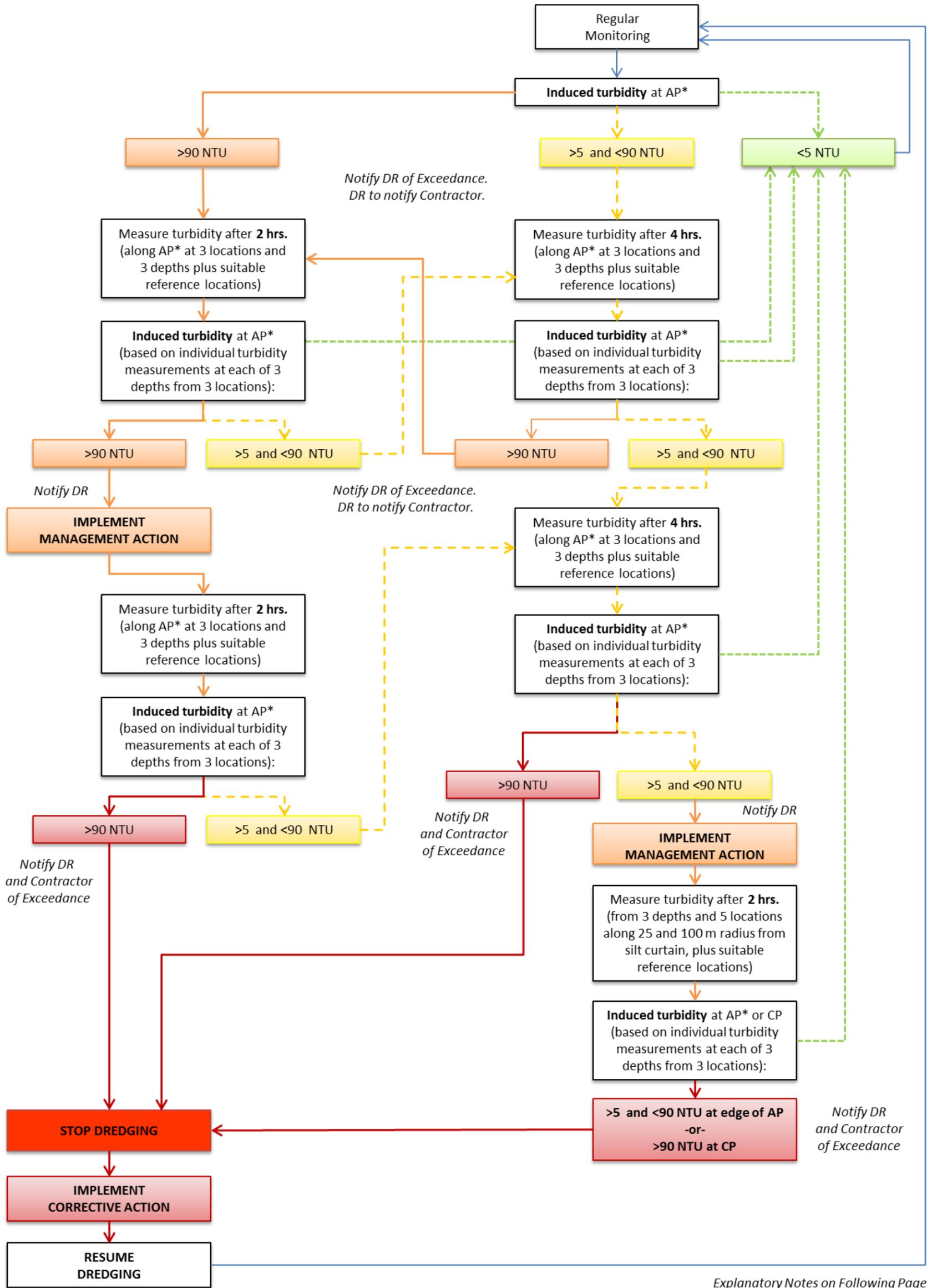
The same process will be followed for dredging in WQMA-B (Figure 8); however, a different turbidity trigger value will be used (i.e., 90 NTU rather than 30 NTU).

**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.**



Explanatory Notes on Following Page

Figure 7: Decision Framework for Implementing Management Actions During Open-water Dredging of Water Quality Management Area A Based on Real-time Monitoring of Turbidity.



Explanatory Notes on Following Page

Figure 8: Decision Framework for Implementing Management Actions During Open-water Dredging of Water Quality Management Area B Based on Real-time Monitoring of Turbidity.

**Notes for Figure 7 and 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 background. The value used for triggering management actions is dependent on the WQMA in which the work is being conducted. The WQMAs are illustrated in Figure 2. For dredging in WQMA-A, the turbidity limit is 30 NTU, and for dredging in WQMA-B, the turbidity limit is 90 NTU.

The 2 and 4 hour intervals set for confirmatory sampling and implementation of management actions were assessed against the “severity of ill effects” (SEV) concept underlying the ambient water quality guidelines for TSS (Newcombe and Jensen 1996). SEV relates the potential for biological effect to fish to both duration and magnitude of TSS concentration. The potential for toxicity from exposure of biota to contaminants of potential concern associated with intermittent, short-duration elevations in TSS was also considered.

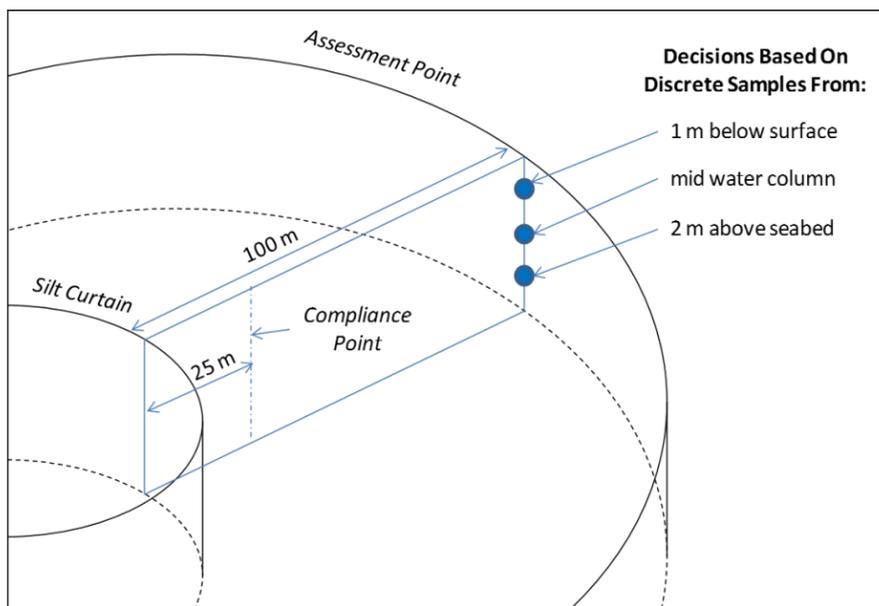
Turbidity values triggering confirmatory sampling and/or implementation of management actions may change as the TSS-turbidity relationship is verified and recalibrated based on data collected during dredging.

A Qualified 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).
- DR – PSPC Departmental Representative
- m – metres.
- min. – minutes.
- NTU – nephelometric turbidity units.
- PAH – polycyclic aromatic hydrocarbon.
- TSS – total suspended solids.



**Figure 9: Conceptual layout of location of turbidity measurements in the water column.**

### 3.2.2 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 down current from the barge outlet (Figure 5). Both points will be monitored regularly, and if the dewatering discharge is found to contain a TSS concentration  $>75$  mg/L in WQMA-B (or 90 NTU when measured as turbidity), management actions (e.g., cease loading of dredged material on the barge and/or cease dewatering discharge) will be implemented and confirmatory monitoring conducted on the water in the barge 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.

### 3.2.3 Decision Framework for Treatment System Discharges

For **discharge from a treatment system**, if used on site, the compliance point is the point of discharge from the system, whether land- or barge-based, and the assessment point is 100 m down current from the outlet (Figure 6). Both points will be monitored regularly, and if the effluent is found to contain a TSS concentration  $>40$  mg/L (or 30 NTU per the TSS-turbidity relationship illustrated in Section 3.1.2), management actions (e.g., cease discharge from the system) will be implemented and confirmatory monitoring conducted on the water in the treatment system and at the assessment point to evaluate the potential for environmental impacts. Prior to initial commencement of discharge of treated barge dewatering effluent from WQMA-A, the effluent must be tested for toxicity (96-hr  $LC_{50}$  test using a salt-water acclimated salmonid) to confirm that the effluent is non-acutely lethal, unless the Contractor's Qualified Professional determines that toxicity testing is not necessary.

If the effluent from the treatment system meets the discharge limits, the effluent may be discharged outside of the Project Area in Esquimalt Harbour, within the limitations of other factors that DND may want to apply.

### 3.2.4 Decision Framework for Placement of Material

During **placement of in-fill substrate material** in both WQMAs, a silt curtain is not required, provided that performance objectives for TSS and turbidity are met. 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-B outlined in Section 3.2.1 generally be followed.

## 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 5; 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 7]). Water samples will also be collected for chemical analysis; samples for analysis of TSS will be collected as noted in Table 5, whereas metals and PAH analysis

(for both total and dissolved<sup>6</sup> 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. The number of samples for analysis of TSS will be relatively high initially to facilitate validation of the TSS-turbidity relationship (see also Section 3.4). 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 and Figure 11 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 and placement of substrate in-fill).

### ■ Compliance Samples

- **Dredging location, 25 m from the edge of the silt curtain<sup>7</sup>** – this will consist of measurements collected down-current from the dredging in the water column outside the silt curtain as safety permits (Figure 10). Turbidity measurements will be collected from multiple depths:
  - At the surface of the water column: 1 m below the surface.
  - At the bottom of the water column 2 m above the sea bed (the grab sampler should be fitted with a weighted lead to help prevent the sampler itself from hitting the seabed and causing re-suspension of solids that may become entrained in the sample).
  - Mid-water column. This can be approximately half-way between the surface and bottom of the water column when it is not stratified, or just below the density barrier (i.e., thermocline or halocline) when/if stratification is occurring.

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<sup>6</sup> 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).

<sup>7</sup> 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.

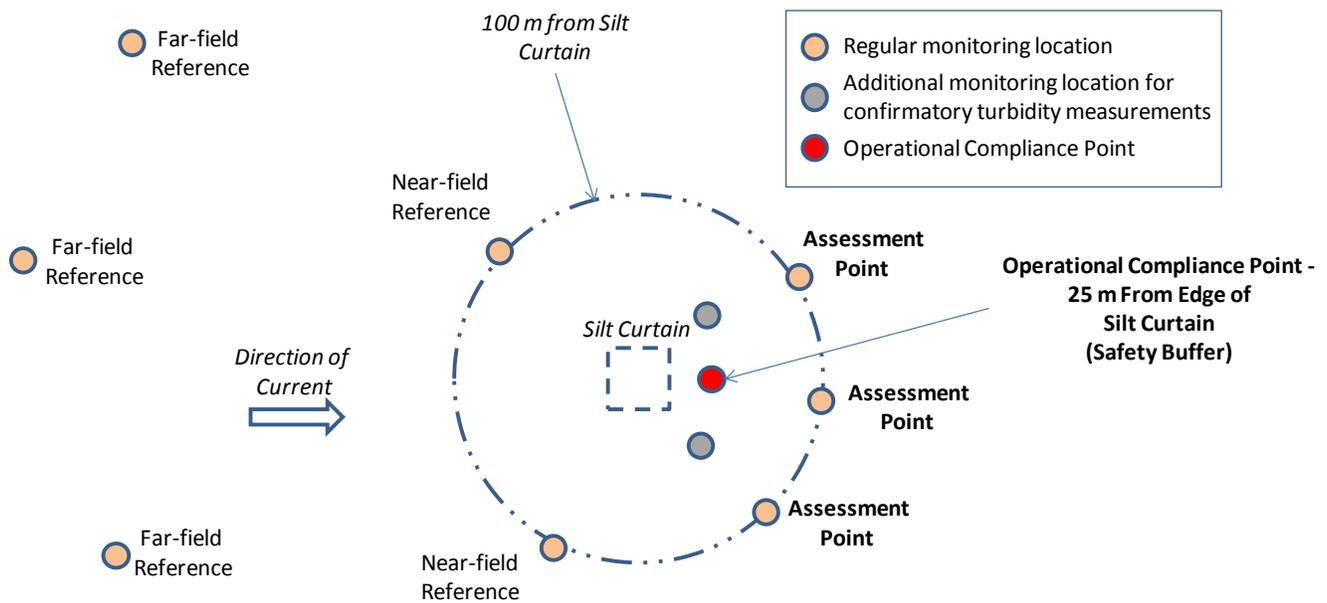


Figure 10: Conceptual layout of monitoring locations for dredging activities.

- **Barge Discharge location, dewatering material** – this will be a single grab sample of the dewatering discharge as it leaves the dewatering barge (or other facility depending on the dredging plan) (Figure 11).

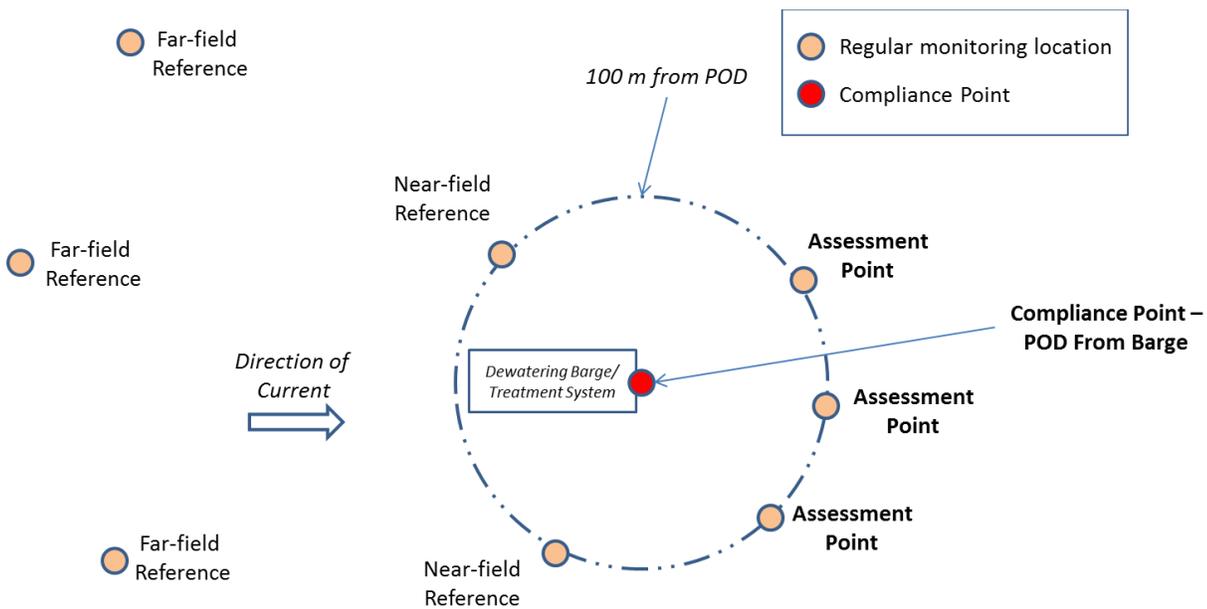


Figure 11: Conceptual layout of monitoring locations for barge dewatering and treatment system.

- **Assessment Samples** – samples will be collected at a distance of 100 m down-current from the point at which the operator no longer exercises control over the discharge material (e.g., from the edge of the 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.
- **Reference samples** – samples will be collected outside of the project area influence to obtain reference (or background) turbidity measurements. During periods of time when the potential for non-Project related activities (e.g., vessels berthing at nearby jetties) to influence background turbidity, a higher number of reference stations will be sampled, including near-field (two stations) and far-field (three stations) locations. When the potential for non-Project related activities is low, fewer reference samples may be collected. Turbidity will be measured at three depths, in the same manner as the compliance samples. When the potential for confounding activities is relatively low, the QP may take turbidity measurements at fewer reference locations.

**Table 5: Summary of Sampling Locations and Numbers Per Sampling Round for Laboratory Analysis**

Type of Sample	Number of Locations <sup>5</sup>	Number of Depth Intervals	Estimated Number of Samples for Analysis of TSS <sup>3</sup>	Frequency of Laboratory Samples <sup>1,2</sup>		
				Week 1	Weeks 2 and 3	Weeks 4 and following
<b>Compliance Point (Discharge Locations)</b>				Once daily (rush analysis)	Once, every three days (standard TAT)	Once, one day per week (standard TAT)
25 m <sup>4</sup> from Edge of Silt Curtain	1	3	3			
Barge Dewatering Discharge	1	1	1			
<b>Assessment Point</b>						
100 m from Discharge Point	3	3	9			
<b>References</b>						
Near-field	2	3	6			
Far-field	3	3	9			

**Notes:**

- <sup>1</sup> This schedule assumes that effective environmental management measures are in place and water quality decision criteria are being met. **In the event that requirements for discharge quality are not being met, the frequency of monitoring may be increased.** Metals will be analysed in approximately 50% of the samples collected, at least initially, to be determined at the time of sampling.
- <sup>2</sup> Field duplicates will be collected at a rate of approximately 10% for quality control purposes and equipment blanks will be collected once per week (Section 3.5).
- <sup>3</sup> The number of samples collected for analysis of TSS and metals may be reduced over time if the monitoring indicates that the environmental management measures are demonstrated to be effective. Field and laboratory measurements of turbidity will be collected concurrently with TSS analyses for the purposes of verifying the TSS-turbidity relationship.
- <sup>4</sup> This is a safety buffer.
- <sup>5</sup> The actual number of locations from which samples are collected for laboratory analysis will be determined by the QP and number of reference samples collected will be dependent on the need to evaluate the potential for non-Project related activities (e.g., vessels berthing at EGD) to influence background turbidity.

TAT – turnaround time.

The collection of samples for laboratory analysis at smaller distances from the discharge point (e.g., 25, 50, or 75 m) could be an agency requirement in situations where there may be habitat sensitivities within the 100 m radius (e.g., abalone habitat). This is unlikely to be the case if consideration to equipment placement is incorporated into the plan. There can also be advantages to collecting samples between the discharge point and the assessment point where other contaminant sources are possible because it provides a stronger basis to interpret monitoring data at the edge of the work zone. At the present time, it is proposed that sampling in these locations only be conducted as part of “real-time” turbidity monitoring as outlined in the decision framework for implementing management actions (Figure 7).

Real-time monitoring will also be conducted during **debris removal and placement of substrate in-fill**, but will consist only of turbidity measurements (and TSS as necessary). Debris removal is not expected to substantially disturb seabed sediments. Placed material is expected to be similar to adjacent sediment or coarser material (e.g., pebble or cobble). Turbidity measurements will be taken 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 suitable reference points at multiple depths as described above.

### 3.3.2 Monitoring Frequency

A higher frequency of monitoring will occur at the beginning of each type of work (e.g., debris removal, open-water dredging, and placement of material) and each WQMA. For in situ monitoring, turbidity measurements would be taken daily for the first two to three weeks. Monitoring frequency may be progressively reduced after the first three weeks (e.g., twice during the fourth week and once a week thereafter) if water quality decision criteria are met during this interval. **If an exceedance is observed during any stage of the dredging program, the frequency of monitoring may be increased.** The management of day-to-day Project activities will rely on *in situ* monitoring of turbidity, which may be carried out more frequently, as necessary, than collection of samples for laboratory analysis, the primary purpose of which is the verification of predictions of contaminant release and the TSS/turbidity relationship. There are no laboratory costs associated with *in situ* turbidity monitoring, which allows for greater flexibility in frequency and spatial coverage for day-to-day monitoring. Water samples for laboratory analysis will be collected during open-water dredging at the frequency summarized in Table 5.

### 3.4 Validation of TSS/Turbidity Relationship

The TSS/turbidity relationship upon which the decision framework for management actions during open-water dredging was based on recently obtained data from the Colwood Jetties Remediation Project (Section 3.1.2). Although this assessment was based on data from Esquimalt Harbour, in reality, the relationship between turbidity and TSS may be different due to factors such as the behaviour of sediment plumes and differences in and heterogeneity of the optical properties of the material in the natural water column. For example certain blasting abrasives have reflective surfaces and those surfaces will produce different turbidity measurements as they will scatter light differently than particles of native geological material. The same may be true of clean, imported fill material which may produce different turbidity measurements than dredged sediments. Thus, a review of data collected throughout the dredging program will be undertaken and additional sampling will be conducted as necessary to validate the TSS/turbidity relationship. This is an appropriate step because turbidity is used as a real-time proxy for TSS, on which certain decision criteria are based. Additional bench-scale testing of clean backfill material to be placed within the project area is also recommended to confirm whether the TSS-turbidity relationship developed for dredging needs to be revised for placement of clean material.

Throughout the dredging program, paired laboratory TSS and field turbidity measurements will be collected during the manual monitoring program (Section 3.3). Commencing at the end of the first month, the data collected will be compared to the bench-scale relationship initially derived (Section 3.1). The data collected can then be reviewed periodically to confirm that an appropriate turbidity value is being used for day-to-day management of the dredging. The turbidity values used in the decision framework (Section 3.2) may need to be adjusted from time to time if the results obtained during the Work differ significantly from the relationship presented in Section 3.1.2.

## 3.5 Quality Assurance/Quality Control (QA/QC)

### 3.5.1 Field

#### 3.5.1.1 General

The following general guidelines will apply to field sampling activities:

- Sampling equipment will be decontaminated between sampling stations where applicable (i.e., when sampling for analysis of contaminants).
- Samples will be:
  - Collected in containers and preserved as necessary with supplies provided by the analytical laboratory.
  - Collected in such way as to minimize the introduction of foreign material to the sample and the loss of material of interest from the sample prior to analysis.
  - Stored in coolers with ice packs<sup>8</sup> during collection and shipping.
- Sufficient volume will be collected, where possible, such that required analytical detection limits can be met and quality control samples can be analyzed.
- Field meters will be calibrated according to manufacturers' instructions and calibrations will be verified with applicable commercially-formulated calibration standard solutions. Calibration records will be kept and submitted with data reports.
- Chain-of-custody documentation will be maintained to document holding times and storage conditions and sample continuity.
- Field duplicate samples will be collected where applicable, and the relative percent difference (RPD) calculated to provide a measure of method precision:

$$RPD = \left( \frac{\text{sample} - \text{duplicate}}{(\text{sample} + \text{duplicate})/2} \right) \times 100$$

In accordance with the BC Field Sampling Manual (BC MOE 2013), an RPD value of  $\pm 20\%$  for values  $\geq 5$  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.

<sup>8</sup> Ice packs or ice in sealed bags. Loose ice is not recommended due to the potential for sampling containers to shift and break when the ice melts (BC MOE 2013).

### 3.5.1.2 Water Sampling for Laboratory Analysis

Duplicate water samples will be collected for laboratory analysis at a rate of 10% (i.e., for every 10 samples collected, one sample will be collected as a duplicate) and analyzed for the same set of parameters as the original sample.

Equipment blanks will be collected once per week and analyzed for metals.

### 3.5.2 Laboratory

Samples for chemical analyses will be submitted to CALA-accredited laboratories.<sup>9</sup> Laboratory QA/QC will include analysis of laboratory duplicates, method blanks, and certified reference materials (CRMs) as appropriate (i.e., depending on the parameter).

Prior to entry into the data management system (Section 3.5.3), laboratory data will be reviewed to verify that they are reliable. For example, this review may include checking the following:

- Sample control numbers of the chain of custody sheets and laboratory reports match.
- Confirmation that hold times have been met.
- Results are provided for samples submitted and analyses requested.
- Method blanks are below method detection limits.
- Results of QC samples (e.g., duplicate samples, matrix spikes, CRMs) are within an acceptable range.

### 3.5.3 Data Management

Protocols for managing data quality will include the following:

- For field collection of water quality measurements, templates standardizing data collection requirements will be developed and used by the Environmental Monitor to promote consistency of data collection. Information to document includes:
  - Field personnel
  - Weather conditions and other site observations relevant to interpretation of monitoring data
  - Station ID
  - Unique ID for laboratory samples with linkage to site identifiers as appropriate
  - Depth of sample
  - Sample type (e.g., “normal”, field duplicate, equipment blank)
  - Unit of measurement
  - Equipment used
  - Where there are missing values (e.g., data were not collected), explanatory notes will be recorded

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<sup>9</sup> CALA = Canadian Association of Laboratory Accreditation.

- Data (laboratory chemistry and field measurements) will be entered into a data management system agreed to between PSPC and the Environmental Monitor following confirmation that laboratory and field data quality objectives (DQOs) were met (Section 3.5.2). Data that do not meeting the DQOs for the project will be flagged.
- A number of different platforms are available for data management. The specific platform for data management will be selected by the Environmental Monitor in conjunction with PSPC.
- Data entry (either manual or transfer of electronic data) will be cross-checked by a second person at a rate of approximately 10% of entries. The rate of verification will be increased proportionately to errors found, if any.

Archives of original hard and electronic copies, as appropriate, of data files will be maintained for future reference, including original laboratory reports, electronic data files (e.g., telemetry files from automated data loggers), field notes and QA/QC documentation.

## 4.0 REPORTING

### 4.1 General

Results of regular real-time monitoring will be documented in daily reports provided to PSPC who will forward reports to other applicable parties on the frequency outlined in the EMP (weekly reporting and monitoring completion reports following completion of each project phase). Laboratory data will be reported in the next applicable monitoring report following receipt of the Certificate of Analysis from the analytical laboratory.

Interim summary reports will be prepared following completion of dredge within each dredging zone and a final report will be prepared at the conclusion of the open-water dredging. The reports will summarize water quality measurements, corrective measures taken and lessons learned for application to subsequent dredging sessions (as applicable).

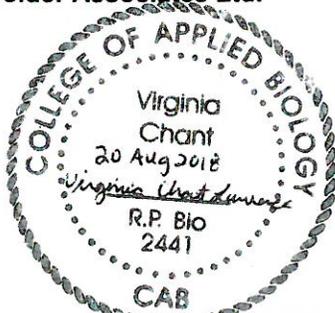
### 4.2 Exceedances

The Environmental Monitor undertaking the monitoring outlined in this WQMP will document exceedances in daily reports and report exceedances and other compliance events to PSPC (who will provide reports to other parties as applicable) as soon as possible commensurate with the severity of the event.

## 5.0 CLOSURE

We trust that this Water Quality Monitoring Plan provides sufficient information for your present needs. If you have any questions, please do not hesitate to contact the undersigned.

### Golder Associates Ltd.



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VL/BGW/lih

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## 6.0 REFERENCES

- Anchor QEA (Anchor QEA L.L.C.). 2018. Environmental closeout report: Plumper Bay and Ashe Head Remediation Project. Prepared for Public Works and Government Services Canada. Project Number: 170553-11.01.
- Anchor QEA. 2017. Y Jetty and Lang Cove 90% Design – Basis of Design Report Esquimalt Harbour Remediation Project. July 2017. 150553-11.12.
- Anchor QEA. 2016. Draft Harbour-Wide Recontamination Evaluation Esquimalt Harbour Remediation Project. Draft Report prepared for Public Works and Government Services Canada. 31 March 2016.
- Anchor QEA. 2011. Dredging water quality evaluation, Esquimalt Graving Dock Waterlot Remediation Project. Memorandum prepared for Public Works and Government Services Canada. 25 February 2011.
- BC MOE (British Columbia Ministry of Environment). 2016. British Columbia approved water quality guidelines: aquatic life, wildlife & agriculture. Summary Report. Available at: [http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/waterqualityguidesobjs/approved-wat-qual-guides/final\\_approved\\_wqg\\_summary\\_march\\_2016.pdf](http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/waterqualityguidesobjs/approved-wat-qual-guides/final_approved_wqg_summary_march_2016.pdf)
- BC MOE. 2013. 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.
- BC MOE. 1997. Ambient water quality criteria for dissolved oxygen: overview report. Available at: [http://www.env.gov.bc.ca/wat/wq/BCguidelines/do/do\\_over.html](http://www.env.gov.bc.ca/wat/wq/BCguidelines/do/do_over.html).
- BC MOE. 1991. Ambient water quality criteria for pH: technical appendix. Available at: <http://www.env.gov.bc.ca/wat/wq/BCguidelines/phtech.pdf>.
- Bilotta GS, Brazier RE. 2008. Understanding the influence of suspended solids on water quality and aquatic biota. *Wat. Res.* 42: 2849-2861.
- Birtwell I. 1999. The effects of sediment on fish and their habitat. Canadian Stock Assessment Secretariat Research Document 99/139. Fisheries and Oceans Canada, Science Branch, Marine Environment and Habitat Sciences Division. West Vancouver BC. 33 p.
- Caux P-Y, Moore D., MacDonald D. 1997. Ambient water quality guidelines (criteria) for turbidity, suspended and benthic sediments. Technical Appendix. Prepared for BC Ministry of Environment of Lands and Parks.
- CCME (Canadian Council of Ministers of the Environment). 1999a. Canadian environmental quality guidelines (for sediment and water). Updated to 2007. <http://st-ts.ccme.ca>
- CCME. 1999b (updated 2002). Canadian water quality guidelines for the protection of aquatic life: total particulate matter. Canadian Council of Ministers of the Environment, Winnipeg.
- CCME. 1999c (updated 2001). Canadian water quality guidelines for the protection of aquatic life: arsenic. Canadian Council of Ministers of the Environment, Winnipeg.

- DFO and MELP (Department of Fisheries and Oceans and Ministry of Environment, Lands and Parks). 1992. Land development guidelines for the protection of aquatic habitat. Available at: <http://www.dfo-mpo.gc.ca/Library/165353.pdf>.
- DFO. 2010. Canadian Tide and Current Tables: Volume 5. Canadian Hydrographic Service, Ottawa, ON.
- EIFAC (European Inland Fisheries Advisory Commission). 1964. Water quality criteria for European freshwater fish. Report on finely divided solids and inland fisheries. European Inland Fisheries Advisory Commission. Food and Agriculture Organization of the United Nations. Rome. EIFAC/1. 21p.
- Golder (Golder Associates Ltd.). 2018. Preliminary modeling of predicted quality of discharge water during barge dewatering for the Esquimalt Harbour remediation project - Y Jetty and Lang Cove. In progress.
- Golder. 2017. Environmental Monitoring Closure Report – Colwood Jetties Remediation Project (Draft). Submitted to PSPC. Reference No. 1664698-029-R-RevA.
- Golder. 2011. Baseline Turbidity and Current Monitoring in Esquimalt Harbour – Preliminary Data Report. February, 2011.
- Golder. 2006a. Interim Data Report Supplemental Field Investigation. Esquimalt Graving Dock Waterlot. Prepared for PSPC.
- Golder. 2006b. Detailed Quantitative Ecological and Human Health Risk Assessment and Updated Risk Management Plan, PSPC Graving Dock Waterlot. August 2006.
- Hayes DF, Je C-H. 2000. DREDGE Module user's guide (draft). Department of Civil and Environmental Engineering, University of Utah. 27 pp.
- Nagpal NK. 1987. Water quality criteria for lead: technical appendix. Ministry of Environment and Parks.
- Nagpal NK. 1999. Ambient water quality guidelines for zinc - overview. Ministry of Environment and Parks.
- Newcombe C, MacDonald D. 1991. Effects of suspended sediments on aquatic ecosystems. N. Amer. J. Fish. Manage. 11: 72-82.
- Newcombe C, Jensen J. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. N. Amer. J. Fish. Manage. 16: 693-727.
- Singleton HJ. 1987. Water quality criteria for copper: technical appendix. Ministry of Environment and Parks.
- SLR (SLR Consulting Ltd.). 2014. Phase 1B Environmental monitoring completion report, Esquimalt Graving Dock Waterlot Sediment Remediation Project. July, 2014
- SLR. 2008. Esquimalt Harbour Sediment Management Esquimalt, BC. 2007/2008 Supplemental Site Investigation

**APPENDIX B**

# Example Reporting Templates



# Technical Memorandum

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DATE PROJECT No.  
TO  
CC  
FROM EMAIL  
RE: ENVIRONMENTAL MONITORING WEEKLY SUMMARY

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## 1.0 INTRODUCTION

## 2.0 CONSTRUCTION ACTIVITIES

## 3.0 ENVIRONMENTAL MONITORING ACTIVITIES

### 3.1 Environmental Site Inspections and Observations

### 3.2 Water Quality Monitoring

Table 1: Summary of In Situ Water Quality Measurements.

Parameter	Performance Objective (PO)	Surface Range	Mid-Depth Range	Bottom Range	Comments
Compliance Points					

### 3.3 In-Air Noise Monitoring

### 3.4 Underwater Noise Monitoring

### 3.5 Marine Mammal Monitoring

### 3.6 Fish Monitoring

### 3.7 Archaeology Chance Find

## 4.0 EMERGING ISSUES

Table 2: Emerging Issues.

Date Noted	Environmental Issue	Recommendation/Action	Comments	Completed

## 5.0 CLOSURE



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