Conceptual Offsetting Plan

Centerm Expansion Project

Vancouver Fraser Port Authority

Project reference: 60476505

November 2017
Quality information

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Prepared for: Vancouver Fraser Port Authority
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1. Introduction and Regulatory Context

The Centerm Container Terminal (Centerm) on the south shore of Burrard Inlet is one of three primary container terminals in the Vancouver area. DP World Vancouver (DPWV) operates Centerm on federal lands and waters that are leased from the Vancouver Fraser Port Authority (VFPA).

The Centerm Expansion Project (CEP) is a proposed series of improvements to Centerm, including works and activities in or near the marine environment (Figure 1). CEP would increase Centerm’s footprint by approximately 15 percent, and reconfigure Centerm to increase its maximum annual container-handling capacity by two-thirds, from 900,000 twenty-foot equivalent unit containers (TEUs) to 1.5 million TEUs. Expansion of Centerm includes both westward and eastward extensions of the existing footprint. The westward extension would accommodate expansion of the container yard and intermodal yard. The eastward extension would accommodate additional container storage, a new terminal gate, parking, and a new administrative building.

Construction of CEP, in particular the in-water works associated with the westward and eastward expansions (i.e., dredging, infilling and the removal of existing habitat features), will result in serious harm to fish that are part of a commercial, recreational, or Aboriginal (CRA) fishery or fish that support such a fishery. Accordingly, CEP will require an Authorization under section 35(2) of the Fisheries Act from Fisheries and Oceans Canada (DFO). The requirements of an application for authorization are specified in Fisheries Act regulation SOR/2013-191, Applications for Authorization under Paragraph 35(2) (b) of the Fisheries Act Regulations. One component of the application is to provide an offsetting plan to balance any residual (i.e., otherwise immitigable) serious harm to fish.

CEP is also subject to review and approval by VFPA under the Project and Environmental Review (PER) process before it can proceed. Under the Canada Marine Act, VFPA is responsible for the administration, management, and control of land and water within its jurisdiction. Section 67 of the Canadian Environmental Assessment Act, 2012 (S.C. 2012, c. 19, s. 52) (CEAA 2012) requires federal authorities to determine that projects will not likely cause significant adverse environmental effects. The PER application for CEP is currently undergoing review by the VFPA.

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1 “Serious harm to fish” is defined in Subsection 2(2) of the Fisheries Act as “the death of fish, or any permanent alteration to, or destruction of, fish habitat”. The prohibition against causing serious harm is provided in Section 35(1) “no person shall carry on any work, undertaking or activity that results in the serious harm to fish that are part of a commercial, recreational or Aboriginal fishery or fish that support such a fishery.”

2 The CEP site is located on federal land and waters under the jurisdiction of the VFPA and is subject to review and approval by VFPA under the Project and Environmental Review (PER) process before it can proceed. The PER application for the Project is currently undergoing review by the VFPA.
Figure 1

Legend
- Navigational Dredge Area
- On Terminal
- Centerm Expansion Project
- Proposed Dyke Fill Slope
2. Conceptual Offsetting Plan Purpose and Document Layout

In an email dated September 28th, 2017, VFPA PER requested information from the CEP team to provide a Conceptual Offsetting Plan (Plan) to assist VFPA PER with determining whether CEP is likely to result in significant adverse effects on the environment. The Plan, described herein, has been developed to demonstrate that there is a viable strategy to offset predicted adverse environmental effects (i.e., residual serious harm to CRA fish) caused by CEP.

This Plan has been structured to address the specific requirements as provided by PER (from email of September 28th, 2017). Table 1 summarizes concordance between the requested elements as stated by PER and the information presented in this document.

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<tr>
<th>Requirement Number</th>
<th>Conceptual Offsetting Plan Required Elements for Inclusion as Instructed by PER</th>
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<td>Quantification of potential residual adverse effects that require offsetting.</td>
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<td>2</td>
<td>Offsetting plan objectives/design criteria to offset project residual adverse effects.</td>
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<td>3</td>
<td>General description, location and conceptual design for the proposed offsetting.</td>
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<td>4</td>
<td>Description of how the proposed option will meet the offsetting objectives.</td>
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<td>If the preferred offsetting option is uncertain, alternative options could be included as contingencies. For example, other designs meeting the offsetting objectives or different locations for the preferred design could be included as possible alternatives.</td>
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This Plan draws on the following documents that have been prepared to support the CEP permitting process:

- Centerm Expansion Project Environmental Studies Report Volume 8 – Marine Resource (AECOM 2016)
- Centerm Expansion Project: Flushing Time Modelling Analysis – Centerm (Tetra Tech 2016)
- Centerm Expansion Project: Dispersal Modeling of Dredging-Derived Fugitive Sediments (Tetra Tech 2017)
- Centerm Expansion Project: Numerical Modeling of Silt Curtain Effectiveness in Reducing Dredging-Derived Fugitive Sediment (Tetra Tech 2017)
- Centerm Expansion Project: Dispersal Modelling of Infilling-Derived Fugitive Sediment (Tetra Tech 2017)
- Centerm Expansion Project: Draft Disposal at Sea Sampling and Analysis Plan Confirmatory Sampling of Material Suitable for Disposal at Sea (AECOM 2017)
- Centerm Expansion Project: Draft TSS/Turbidity Monitoring Plan (AECOM 2017)

As these reports have been previously submitted to PER, they have not been appended to this Plan.

2.1 Offsetting Objectives & Approach

The offsetting objectives for CEP are:

1. To counterbalance residual serious harm to fish and the loss of fisheries productivity resulting from CEP.
2. To reflect local fisheries-management objectives and to obtain support from local Aboriginal groups through the provision of a technically sound proposal for offsetting the residual serious harm to fish.

The offsetting approach for CEP is based on DFO’s *Fisheries Productivity Investment Policy: A Proponents’ Guide to Offsetting* (FPIP; DFO 2013a), which emphasizes that offsetting measures should “support and enhance the sustainability and ongoing productivity of fish that are part of or support a commercial, recreational or Aboriginal fishery.” This DFO policy identifies four “Guiding Principles” that are to be applied to the selection of offsetting measures:

- **Principle 1:** Offsetting measures must support fisheries management objectives or local restoration priorities.
- **Principle 2:** Benefits from offsetting measures must balance project impacts.
- **Principle 3:** Offsetting measures must provide additional benefits to the fishery.
- **Principle 4:** Offsetting measures must generate self-sustaining benefits over the long term.

The steps taken to achieve the offsetting objectives for CEP and align with DFO’s guiding principles include:

- Determine the residual serious harm to fish (Section 3).
- Establish criteria for selecting offsetting measures (Section 4), which include measures that are:
  - located within Burrard Inlet;
  - potentially support affected species;
  - consistent with DFO policy (DFO 2013a); and,
  - reflect local fisheries management objectives and habitat enhancement priorities.
- Determine the amount of offsetting required (Section 5), by estimating the:
  - productivity of the habitat adversely affected by CEP (predominantly deep subtidal mud) and of the proposed offsetting habitats—based on productivity estimates for similar habitat established through empirical and modelling studies, and review of scientific literature and technical reports; and
  - amount of habitat enhancement required to offset CEP residual serious harm to fish, based on the relative value of affected and offset habitat types, and taking into account time lag and the underlying habitat associated with offsetting measures.
- Determine priority habitat enhancement projects for local Aboriginal groups that could be appropriate for offsetting.
3. Summary of Residual Serious Harm to Fish

3.1 Overview

Serious harm to fish is defined in Subsection 2(2) of the *Fisheries Act* as “the death of fish, or any permanent alteration to, or destruction of, fish habitat”. The prohibition against causing serious harm is provided in Section 35(1): “no person shall carry on any work, undertaking or activity that results in the serious harm to fish that are part of a commercial, recreational or Aboriginal fishery or fish that support such a fishery.”

Not all levels of fish mortality or changes to fish habitat are expected to constitute serious harm to fish. Further clarification is provided in the DFO Fisheries Protection Policy Statement (DFO 2013b), which indicates that:

- Serious harm to fish from changes to habitat occurs only if permanent alteration to, or destruction of, fish habitat is of a spatial scale, duration or intensity that limits, diminishes, or prevents the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.
- Projects requiring authorization (i.e., to authorize residual serious harm to fish) are those likely to result in a localized effect on fish populations or fish habitat in the vicinity of the project.
- When considering whether a project is likely to cause serious harm to fish and requires an authorization, proponents should identify the potential project effects including:
  - their duration
  - their geographic scale
  - the availability and condition of nearby fish habitat
  - impacts on relevant fish
  - proposed avoidance and mitigation measures.

The determination of residual serious harm to fish as a result of CEP was based on assessment and abundance estimation of the CRA fishery species that could be subject to fish mortality, and quantification of potential permanent alteration to, or destruction of, CRA fishery species habitat, likely to result in a localized effect to fish populations, after consideration of:

- The likelihood, duration, geographic extent, and magnitude of the effect (including consideration of modelling results).
- Habitat dependency and availability.
- Avoidance and mitigation measures (including habitat replacement and reclamation).
3.2 Determination of Residual Serious Harm to Fish

Total CEP residual serious harm to fish expected to require offsetting is estimated to be a permanent loss of 100,300 m$^2$ of fish habitat, comprised of:

- approximately 99,900 m$^2$ of predominantly deep subtidal mud habitat lost through the dredging and infilling required for construction of the expansion areas; and,
- approximately 400 m$^2$ of lost habitat associated with previously installed shallow subtidal concrete/cobble tray habitat features at Berth 1 (Figure 1).

The 99,900 m$^2$ of existing deep, subtidal mudflat habitat is associated with notably low diversity and low abundance of marine life compared with the habitat associated with the existing rock dyke habitat on the west side of Centerm. This lack of marine life and biodiversity is considered to be due to the absence of large and diverse substrate materials, and the limited light penetration and resulting lack of flora. No notable macrobiotic communities were observed beyond the toe of the existing riprap slope into the deep subtidal mud, where abundance was categorized as sparse—with estimated average densities of less than 0.01 Dungeness crab adults per square metre, and less than 0.03 clams per square metre (Foreshore 2016).

The following CEP activities were considered not to contribute to residual serious harm to fish requiring offsetting:

- Removal of approximately 9,900 m$^2$ of existing rock dykes on the west side of Centerm—as this habitat will be replaced by a new and larger (approximately 19,900 m$^2$) perimeter rock dyke around the western expansion area (as well as new rock dykes around the eastern expansion area: approximately 21,700 m$^2$), effects are considered temporary (i.e., the time taken for recolonization of the new rock dyke by marine biota is expected to be relatively short [e.g., as quickly as within one year]).
- Dock demolition—potential effects to the marine environment will be managed through mitigation measures (e.g., by preventing the introduction of waste materials into the marine environment).
- Dredging of 23,500 m$^2$ outside of the permanent CEP footprint (i.e., overdredging) to facilitate construction of the new perimeter dykes—this area of sediment with elevated levels of polycyclic aromatic hydrocarbons (PAHs) and metals will be reclaimed using clean sand that will provide habitat of improved quality for similar biota at the same elevation, and is expected to recolonize within a short period (approximately 1 year).
- Navigational dredging of 3,300 m$^2$ to facilitate cruise ship docking—as this area is relatively small, the elevation change will be nominal, and it is expected to recolonize with similar biota within a short period (approximately 1 year).

In addition, the following potential effects resulting from CEP were not considered to contribute to residual serious harm to fish requiring offsetting:

- Change in CRAB Park flow dynamics as a result of the narrowing of the CRAB Park Embayment through the construction of the western expansion area, potentially affecting:
  - Temperature—moderate reduction in tidal flushing is predicted, potential effects on water temperature will be negligible (approximately 0.024°C) and well within natural background range$^3$ (J. Matthieu, pers. comm., September 2017).
  - Stormwater concentration—stormwater entering the embayment will continue to be serviced by the existing, and updated stormwater management system. The objectives of the stormwater management system are to prevent accidental release of pollutants, contain any erosion or spills, and reduce the use of potential pollutants to the extent possible. This system will operate with remotely controlled motorized valves that, in the event of an oil spill, will seal the system until the oil has been removed and the discharge quality of the storm system’s outfalls are acceptable. The system will also operate with installed oil-water sediment separators (OWSSs), which are structural devices intended to provide treatment of stormwater from industrial areas by capturing oil and grease and allowing suspended sediment to settle

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$^3$ The natural surface-water temperature in Burrard Inlet during August varies from 9.9°C to 12.3°C, a range of 2.4°C, while yearly variation can be from 5.0°C to 20.0°C, a range of 15°C.
out. The OWSSs will be designed to treat the frequently occurring water quality rainfall event (6-month, 24-hour storm).

- Sediment deposition outside the dredge and infill areas as a result of fugitive sediment escapement during the dredging program potentially resulting in alteration of habitat: Sediment dispersion and deposition was modelled to determine the effects of dredging and infilling on water quality and sediment deposition. The dispersion models predicted that, over the course of the dredging program, the maximum thickness of fugitive sediment deposited outside the dredge and infill areas would not exceed 1 cm (Tetra Tech 2017a). DFO considers deposition levels that may cause adverse effects to be 2 cm for eelgrass beds and 5 cm for other habitat types (R. Talbot, pers. comm., June 2017).

- Potential fish mortality during dredging and infilling:
  - Fugitive sediment release leading to a decrease in water quality: Modelling showed that by using silt curtains during dredging, CEP is expected to be in compliance with the CCME Water Quality Guidelines (WQGs) for Protection of Aquatic Life at, or within, 100 m from the boundary of the active dredge site (Tetra Tech 2017b; AECOM 2017a). The CCME WQGs allow for project-generated sediment to increase by an average of 5 mg/L of total suspended solids (TSS) over background. Other in-water works (e.g., infilling, construction of the rock dykes, placement of caissons and demolition activities) will release far less sediment than dredging and will have shorter durations. Therefore, with application of best management practices, sediment releases from these activities will also be in compliance with CCME WQGs. Accordingly, the potential for indirect mortality of fish as a result of CEP-derived fugitive sediment is considered low.

  - Direct mortality of fish: Efforts will be made to salvage CRA fishery species from the immediate work area to the extent practicable (i.e., crab and sea cucumber). In-water construction activities will employ slow start-up procedures, and work will be relatively continuous until completion. Therefore, it is expected that mobile CRA fishery species will leave, and be unlikely to re-enter, the work area once construction commences. Some CRA fishery species mortality within the CEP footprint is unavoidable, particularly in the case of sessile organisms such as clams, as there are no practicable salvage methods available. Some mortality of Dungeness crabs is also expected as the proposed crab salvage is unlikely to be 100% effective. The clams found in the CEP area are subject to harvest restrictions, too deep to harvest practically, and likely inhabit sediment with elevated levels of some potential contaminants (i.e., PAHs and metals) (AECOM 2017b). Furthermore, the predominantly deep subtidal mud habitat affected by the CEP represents approximately 3% of the total mud habitat present in the Inner Harbour (Foreshore 1996), and is therefore a highly available habitat in the vicinity of CEP. Based on the above points, no localized effect on the population of CRA fishery species is anticipated.
4. Offsetting Measure – Maplewood Marine Restoration Project

4.1 Overview

Consultation with the Tsleil-Waututh Nation identified enhancement of the Maplewood Flats area as a key priority for fisheries management in Burrard Inlet. Accordingly, it is proposed that the Maplewood Marine Restoration Project (Maplewood Project) be used to offset the 100,300 m$^2$ of low productivity habitat lost as a result of dredging, infilling, and other activities associated with CEP. The Maplewood Project reflects input from Aboriginal groups, achieves the offsetting objectives, and aligns with the approach outlined in Section 2.1.

The Maplewood Project is located in the district of North Vancouver, BC, approximately 6.8 km east of CEP and adjacent to the Maplewood Flats Conservation Area within the Maplewood Flats shoreline area. The existing site layout consists of a main, centre basin with a smaller basin in the northeast corner. The Maplewood Project will be located in the northeast basin, and in the southwest portion of Maplewood Flats. Maplewood Flats Conservation Area is located to the north of the main basin and northwest of the northeast basin, with the entirety of the Maplewood Project within the Maplewood Flats area (Figure 2).
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Legend

- Maplewood Marine Restoration Project Boundary
4.2 History of the Proposed Maplewood Project and Surrounding Area

The Maplewood Flats area has been used by Aboriginal groups since time immemorial, while industrial activities began in the early 1900s. During the 1900s the Maplewood Project area became increasingly industrialized by logging, land reclamation, and industry (PMV 1998). Aerial photographs suggest that the Maplewood Project area was dredged between 1940 and 1960 (Hemmera 2015b). From the 1940s until the 1980s, the Maplewood Project area supported gravel extraction and log-handling industries (PMV 1998). Upland areas were infilled between 1969 and 1979 to create an area to support a range of industrial uses.

The Maplewood Flats Conservation Area, to the north of the Maplewood Project, was established in 1991 under agreement from VFPA to Environment Canada (as Environment and Climate Change Canada was then known), and is currently operated by the Wild Bird Trust of British Columbia (PMV 1998).

4.3 Existing Ecological Conditions

As a result of its industrial past, the existing Maplewood Project site is a dredged, isolated, poorly flushed, deep subtidal basin that is low in both habitat value and biodiversity. Dungeness crabs, plumose anemones, and ochre sea stars are the dominant macrobiotic species (Hemmera 2015a). Fines are the predominate substrate, associated with wood waste (especially in the northeast basin).

There are some sparse areas of high-value habitat in close proximity to the northeast basin and proposed southwest channel, including:

- approximately 300 m² of eelgrass bed in the existing connector channel at the southeastern part of the main basin;
- approximately 10 m² of eelgrass bed in the north part of the main basin;
- approximately 7,000 m² of kelp bed at southern edge of the main basin (which is noted as being affected by siltation) (Hemmera 2015a);
- approximately 550 m² of low density (<1 individual/m²) bull kelp in the vicinity of the proposed southwest channel; and,
- marsh habitat and intertidal flats to the east of the Maplewood Project site.

4.4 Conceptual Offset Design

To offset CEP’s residual serious harm to fish, the Maplewood Project is proposed to enhance existing deep subtidal habitat in the northeast basin through the creation of new habitat types (Figure 3). The habitat types currently proposed as enhancement are:

- **Intertidal flats habitat** to support bivalve shellfish and other infauna, and **shallow subtidal eelgrass** habitat to provide nursery habitat for CRA fishery species (e.g., Dungeness crab and Pacific salmon). Intertidal flats and subtidal eelgrass habitat will be created by increasing the elevation of an existing subtidal area in the northeastern basin.

- **Rock reef habitat** in the northeastern basin at the toe of the eelgrass bed to support broad-bladed kelp and encrusting or colonial invertebrates, and to provide habitat and food for a variety of CRA fishery species (e.g., lingcod). It is anticipated that rock reef habitat will also be created within the proposed channel at the southwest corner of the Maplewood Project site (Figure 3). In addition to aforementioned benefits of rock reef habitat, and as described in Bohnssack et al., (1994) and Hueckle et al., (1989), there are known benefits of microhabitats that form between reef structures. In keeping with these findings, and proposed precedents within the Burrard Inlet, the recommended reef layout would not be one large structure but rather a series of smaller units with channels of soft substrate in between. Retaining this soft substrate enhances the habitat value further by creating foraging areas for species such as Dungeness crabs and flat fish. Introducing channels between the reef units is anticipated to improve tidal flushing, resulting in increased food and oxygen availability within the reef structures, and increase light penetration around developing kelp beds. Consequently, the area considered as newly created habitat is not simply the reefs but the surrounding channels as well. This so-called “edge”
habitat is reported to extend from approximately 3 m to 15 m around rock reefs (Bohnssack et al., 1994; Hueckle et al., 1989).

A conceptual offset design for the Maplewood Project is provided in Figure 4 (northeast basin) and Figure 5 (southwest channel).

It is anticipated that eelgrass habitat and rock reef-macroalgal habitat will increase the availability of refugia, primary productivity, and detrital production at the Maplewood Project site. These changes have the potential to benefit a variety of life stages of a range of marine fish that contribute to a CRA fishery, including rearing juvenile salmonids, juvenile Pacific Herring, rockfish, lingcod, Dungeness crab, and bivalves. The enhancements proposed will result in the creation of highly productive habitat in the vicinity of CEP, aligning with DFO’s offsetting goal of maintaining or improving CRA fishery productivity.

It is anticipated that the Maplewood Project site preparation and habitat enhancement work will be carried out in the following sequence:

1. Dredge a channel into the main basin at the southwestern area of the Maplewood Project site to facilitate construction access, and improve tidal flushing of the basin. Due to tidal range, direct access via the existing tidal channel at the southeast of the Maplewood Project site would impose considerable limits on the progress of the enhancement work, and increase the risk of equipment bottoming out on existing habitat.

2. Develop enhancement features in the northeast basin (approximately 45,000 m$^2$) by infilling, using a combination of southwest channel dredgeate, clean imported Fraser River sand, and riprap.

3. Introduce a rock layer (approximately 10,050 m$^2$) to the southwest channel to resist scour and provide additional habitat value in the form of rock reef (approximately 25,000 m$^2$ in the southwest channel when considering the addition of microhabitats and “edge” habitat).
Proposed Maplewood Marine Restoration Project
Offset Habitat Concept

November 2017
Project: 60476505

Legend
- Maplewood Marine Restoration Project Boundary
- Proposed Intertidal Flats
- Proposed Eelgrass Bed
- Proposed Rock Reef Area
- Southwest Channel
- Rock Reef Area

Basemapping from Microsoft Bing and AECOM 2017

Service Layer Credits: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, ©
Figure 4: Conceptual Design of the Proposed Maplewood Marine Restoration Project Northeast Basin
Figure 5: Conceptual Design of the Proposed Maplewood Marine Restoration Project Southwest Channel
4.5 Design Considerations and Supporting Studies

To support the design of the offsetting measures and provide a high degree of confidence in their effectiveness, a number of studies and investigations are planned, many of which are already underway. These studies, which will aid in the refinement and detailed engineering design of the offsetting plan, include:

- Surveys to gather information on bathymetry and topography of the Maplewood Project site, water level data, wind data, sea-level rise projections, sediment characteristics, and wave and ship wake conditions. This information will support coastal engineering studies to develop the detailed design.

- A modified Phase I Environmental Site Assessment (ESA) to identify areas of potential environmental concern and associated potential contaminants of concern, based on current or previous industrial operations on the uplands immediately adjacent to, and surrounding, the Maplewood Project site.

- Biophysical studies, including:
  - literature review and desktop data analysis to develop optimal environmental conditions criteria for the different offsetting habitat types;
  - diver-supported field surveys of the limited high-value habitat identified in the main basin during previous studies (i.e., eelgrass and kelp), to assess the extent, density, health, and abundance of marine life associated with those habitat areas/conditions, and determine any expansion, contraction, or additional development of such habitat;
  - diver-supported field surveys of the northeast basin and potential southwest channel footprints to determine the current conditions of the habitats expected to be directly affected by the Maplewood Project;
  - field assessment of the northeast basin shoreline to determine the potential for, and value of, shoreline naturalization;
  - assessment of potential watercourse drainage into the Maplewood Project, with a focus on potential salmonid usage or sensitive habitats; and,
  - desktop and field investigation of potential reference sites to support long-term effectiveness-monitoring of offset habitats.

- Engineering design work comprising 30%, 60%, 90%, and final habitat design stages. It is expected that a minimum 60% design level will be sufficient to enable DFO to commence review of the offsetting plan and Fisheries Act Authorization application, and that a 90% design level will be required by DFO for final approval. To achieve the 60% design level, a number of additional studies are anticipated:
  - Hydrodynamic/sediment transport modelling to determine how the work activities will affect hydrodynamic influences at the Maplewood Project site and how the dredging and placement of fill will effect sediment dispersal and deposition; and
  - Coastal engineering analyses of nearshore characteristics of the Maplewood Project site to establish water levels and wave conditions to support design of habitat features. Work will also include a sea-level rise evaluation, as this factor will inform design elevations and potential habitat-protection measures.

In addition to the ongoing and planned studies, the design development of the offsetting measure also continues to be informed by input and knowledge shared by Tsleil-Waututh Nation, Musqueam First Nation and Squamish Nation.
5. Meeting the Offsetting Objectives

5.1 Objective 1

To counterbalance residual serious harm to fish and the loss of fisheries productivity resulting from CEP

To determine the amount of offsetting required to counterbalance CEP’s residual harm to fish, a proposed relative productivity approach was established for assessing the relative value of habitats lost through CEP and gained from the proposed Maplewood Project within a habitat equivalency framework. DFO’s FPIP states that “Offsetting measures may be out-of-kind where offset measures target the limiting factors of productivity in a given area rather than replacing exactly what was lost. Out-of-kind offsetting measures may include the restoration or creation of habitat types that are different from the habitat type that was lost or chemical or biological manipulations” (DFO 2013a). According to Bradford et al. (2016), “in the context of offsets, ‘equivalency’ refers to the process to determine the amount and nature of offsets required to achieve a fair exchange between project impacts and gains…” The proposed relative productivity approach involves considering the following lines of evidence to determine relative productivity without emphasis on primary production:

- Estimates of total biomass minus primary producers for the different habitat types, measured as total mass of organisms per unit area (t/km²). The deep subtidal mud habitat affected by CEP is not associated with primary production. Therefore, primary producers were removed from total biomass estimates to enable a fair comparison with other sources of productivity and habitat value. Estimates of total biomass minus primary producers were as follows (relative habitat value based on total biomass estimates provided in parentheses with “1” being the lowest):
  - CEP habitat: 121 t/km² (1)
  - Eelgrass offset habitat: 417 t/km² (4)
  - Rock reef offset habitat: 362 t/km² (3)
  - Intertidal flats offset habitat: 1,112 t/km² (9)

- Relative habitat values proposed by others after considering various factors contributing to productivity.

- Qualitative consideration of the additional benefits provided by the proposed offset habitat types.

The relative habitat values based on estimates of total biomass minus primary producers were compared with the values proposed in other productivity studies to derive median relative habitat values for the deep subtidal mud habitat affected by CEP and the Maplewood Project’s proposed habitat types (Table 2). Additional productivity benefits provided by the Maplewood Project’s habitat types, that supported qualitative consideration of relative habitat value, are presented in Table 3.

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4 In the marine environment, primary production refers to the production of organic matter (e.g., body tissue), produced mainly by photosynthetic plants using sunlight as an energy source. It can be expressed as total biomass in a given area at a given time (e.g., tonnes of plant material in a square kilometre; t/km²) or as biomass produced in a given area over a period of time (e.g., mass of carbon produced in grams per square metre per year; g C m⁻² yr⁻¹). The euphotic zone, the upper section of the water column close enough to the water surface to receive sufficient light for photosynthesis to occur, extends to a depth of approximately 12 m in the Indian Arm of Burrard Inlet (Wallen 1971). The euphotic zone in the Inner Harbour is expected to extend to a similar depth or even less (due to the increased commercial and industrial activity, and turbidity inputs from freshwater discharge, associated with this area of Burrard Inlet compared to the Indian Arm). The predominantly deep subtidal mud affected by CEP is associated with limited or no flora and largely occurs outside of the expected euphotic zone.

5 Scientific literature range midpoint (ESSA 2014; Hemmera 2015b)

6 ESSA 2014

7 ESSA 2014

8 ESSA 2014

9 Scientific literature estimates of biomass (Short et al., 2000; Williams 2005)
Table 2 Proposed Relative Value of Habitat at CEP and Proposed for Maplewood Project

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CEP Deep Subtidal Mud Habitat</th>
<th>Maplewood Project: Intertidal Flats Habitat</th>
<th>Maplewood Project: Eelgrass Habitat</th>
<th>Maplewood Project: Rock Reef Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Biomass minus Primary Producers Relative Habitat Value (1 = lowest)</td>
<td>1</td>
<td>9</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Relative habitat values proposed by Williams and Associates Ltd. 2005</td>
<td>N/A</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Relative habitat values proposed by Short et al. 2000</td>
<td>N/A</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Median Relative Habitat Value</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Proposed Relative Habitat Value</td>
<td>1</td>
<td>3*</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes:
* Proposed relative habitat value for intertidal flats increased from 2 (median) to 3, in consideration of the high upper relative habitat value range (9).

Table 3 Additional Benefits of Maplewood Marine Restoration Project Habitats

<table>
<thead>
<tr>
<th>Offset Habitat Type</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| Intertidal Flats    | Provides important habitat for resident and migratory birds  
|                     | Regulates oxygen concentration  
|                     | Nutrient cycling  
|                     | Provides a food source through the creation of biofilm, especially for grazers, deposit feeders and filter feeders, and some birds (e.g., the western sandpiper, which is present in the Maplewood Flats area)  
|                     | Stabilizes fine sediments thereby optimizing productivity |
| Eelgrass Habitat    | Provides three-dimensional contiguous refuge, nursery, and forage habitat for invertebrates and fish  
|                     | Provides spawning medium for forage fish  
|                     | Provides food for resident and migratory birds  
|                     | Provides prey availability to aquatic and terrestrial species of animals through the year  
|                     | Coastal stabilization and erosion protection  
|                     | Sediment and contaminant filtration  
|                     | Carbon storage and oxygen production  
|                     | Nutrient cycling  
|                     | Detrital contribution to nearby habitats and food webs  
|                     | Optimizes ecological efficiency – energy loss associated with foraging or predator avoidance is relatively low |
| Rock Reef Habitat   | Provides three-dimensional contiguous refuge, nursery, and forage habitat for invertebrates and fish  
|                     | Provides spawning medium for forage and rock fish  
|                     | Coastal stabilization and erosion protection  
|                     | Carbon storage and oxygen production  
|                     | Nutrient cycling  
|                     | Detrital contribution to nearby habitats and food webs  
|                     | Optimizes ecological efficiency – energy loss associated with foraging or predator avoidance is relatively low |

Based on application of the proposed relative habitat values (Table 2), the area required to offset the habitat loss associated with CEP (predominantly deep subtidal mud) is expected to be in the range of approximately 25,000 m² to 35,000 m² (based on 100,300 m² of residual serious harm requiring offsetting, and applying an offset relative habitat value multiplier of between 3 and 4). The final area will be dependent on the configuration and composition of offset habitats, which will be influenced by the results of supporting studies, Aboriginal group and stakeholder input, and engineering design.
Given engineering and construction constraints, it is not feasible to enhance an area at the Maplewood Project to correspond with the exact CEP habitat offsetting requirements. Therefore, it is anticipated that the proposed Maplewood Project will result in an amount of habitat that is surplus to the CEP requirements. It is anticipated that surplus habitat could be deposited into VFPA’s habitat bank.

Consistent with *Fisheries Act* policy (DFO 2013a), other considerations need to be accounted for in determining offset requirements:

- **Time lag**—all reasonable efforts should be made to avoid time delays between the impacts and the functioning of offsetting measures. Where time delay is unavoidable, the resultant productivity loss may need to be accounted for.
- **Underlying habitat**—the enhancement options being considered are all expected to increase the value of fish habitat over and above the values currently provided in underlying areas. However, the value of existing habitat may need to be factored in.
- **Uncertainty**—provision may be required to account for uncertainty (e.g., that associated with the potential for the offsetting measures to achieve functionality at a slower rate than predicted, or fail altogether). Uncertainty can also be addressed through discussion of potential contingency measures (Section 5.3).

The influence of these aspects on offsetting habitat area requirements will be considered when more information is available on the type and composition of offset habitats, as well as the timelines associated with CEP and construction of the Maplewood Project. However, at this time, it is proposed that the following factors could address time lag and underlying habitat:

- **Primary productivity associated with the proposed offset habitats** (Table 4), which is absent from the CEP habitat being lost and has not been a focus of relative habitat value assessment up to this point.
- **Beneficial interplay among offset habitat types** (Table 4).
- **Improved tidal flushing** of the main dredge basin (i.e., the area not being directly enhanced) as a result of southwest channel creation.

### Table 4 Added Value from Maplewood Project Offset Habitat Primary Production and Interplay

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Primary Production (g C m(^{-2}) yr(^{-1}))</th>
<th>Examples of Beneficial Maplewood Project Habitat Interplay</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEP Habitat (Deep Subtidal Mud)</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Intertidal flats(^1)</td>
<td>220*</td>
<td>Supplies sediment and nutrients to adjacent eelgrass bed.</td>
</tr>
<tr>
<td>Eelgrass(^2)</td>
<td>550*</td>
<td>Provides detritus to intertidal flats food web and nursery habitat for fish and invertebrate species.</td>
</tr>
<tr>
<td>Rock reef(^3)</td>
<td>1,550*</td>
<td>Provides shelter and stability to eelgrass bed and contributes detritus to intertidal flats food web.</td>
</tr>
</tbody>
</table>

**Notes:**

* Scientific literature range midpoint


5.2 Objective 2

To reflect local fisheries-management objectives and to obtain support from local Aboriginal groups through the provision of a technically sound proposal for offsetting the residual serious harm to fish

The offsetting approach reflects local fisheries management objectives and habitat enhancement priorities by:

- Contributing to crab and sea cucumber habitat. This result aligns with the Integrated Fisheries Management Plans for harvesting crab by trap and sea cucumber by dive in the Pacific Region (DFO 2017a).
- Enhancement of rock fish habitat within Burrard Inlet though the creation of rock reef habitat. Rockfish Conservation Areas (RCAs) have been established throughout the BC coast (DFO 2017b). The objective of DFO’s rockfish conservation strategy is to limit further rockfish population declines.
- An Integrated Fisheries Management Plan also exists for salmon (Salmon Southern BC). While the location of the Project is not within the boundary of the integrated management plan, the proposed offsetting approach will contribute to the Integrated Fisheries Management Plan Management Issue #1 Lower Strait of Georgia (LGS) Chinook (DFO 2017c).

The offsetting approach has incorporated input from the Tsleil-Waututh Nation, specifically the Burrard Inlet Action Plan: A Tsleil-Waututh Perspective (the action plan) (Tsleil-Waututh Nation 2016) and input provided through consultation. The offsetting approach addresses a number of goals within the action plan, including:

- Goal B: Protect and enhance fish and wildlife habitat;
- Goal C: Protect and recover key species populations and food webs; and
- Goal D: Protect and restore supporting biophysical processes/ecological integrity.

The offsetting approach also contributes greatly to achieving Priority 5 of the action plan (Conserve Critical Nearshore Habitat Complexes – Pilot Project at Maplewood Flats).

Finally, the offsetting approach for CEP considered DFO’s Fisheries Protection Policy Statement. Specifically, the approach to offsetting contributes to DFO’s goal to “provide for the sustainability and ongoing productivity of commercial, recreational and Aboriginal fisheries” (DFO 2013b). The offsetting approach will:

- Increase the productivity of CRA fisheries, through creation of highly productive habitat(s) in an area that currently, with the exception of Dungeness crab habitat (Hemmera 2015a), offers minimal contribution to the productivity of CRA fisheries; and
- Provide long-term benefits to the CRA fisheries in the Maplewood Project area.

5.3 Confidence in the Maplewood Project and Contingencies

Two potential obstacles typically associated with offset habitat success are described below in the context of the Maplewood Project. The risk of these obstacles transpiring, along with proposed contingency measures in the unexpected event that they are encountered, is discussed.

Obstacle 1: Habitat type is considered unsuitable for the physical conditions at the Maplewood Project site

Risk Rating - Low: The final offset habitat composition will be based on data generated from a number of biophysical, oceanographic and engineering studies including:

- Bathymetric and topography studies
- A modified Phase I ESA
- A range of biophysical assessments
- Engineering design works encompassing hydrodynamic/sediment transport models
- Coastal engineering analysis
This information will underpin the selected habitat types and composition and, in combination with the factors provided above, leads to a high degree of confidence that the habitat types chosen will be suitable for the physical conditions at the Maplewood Project site.

**Contingency Measure:** Alter the composition and areas of the offset habitat types to focus on the habitats most suitable to the physical conditions at the Maplewood Project site, based on the results of supporting studies.

**Obstacle 2: Habitats proposed fail to meet the productivity and long-term monitoring objectives**

**Risk Rating - Low:** There is a high degree of confidence in the offset habitats proposed for the Maplewood Project and its capacity to offset residual serious harm to fish caused by CEP. This is based on a number of factors including:

- Precedents of other projects successfully adopting these offset habitat types;
- Habitat types are already supported in the Maplewood Project area;
- Habitat types would support CRA fishery species (including those affected by CEP);
- Short colonization rate of the habitats; and,
- Appropriate eelgrass donor sites and expert transplantation advice available.

**Contingency Measures:** In the event that proposed Maplewood Project habitats, or a portion thereof, fail to meet the long-term monitoring objectives. The following contingency steps would be taken:

- Identify why the Maplewood Project habitat is failing to meet the objectives;
- Investigate options to alter or enhance the existing Maplewood Project habitat through remedial efforts;
- Consider the construction or inclusion of additional offset habitat at the Maplewood Project site; and,
- Draw habitat credit from the existing VFPA habitat bank (upon DFO approval), or explore additional offsetting opportunities within Burrard Inlet (e.g., enhancement of eelgrass habitat identified by Tsleil-Waututh Nation, or the creation of subtidal rock reefs within the Inner Harbour [in VFPA property with no navigational constraints]).
6. References


Foreshore Technologies Inc. 2016. Biophysical Assessment: Biophysical Survey Results of Selected Areas, Port Metro Centerm Container Terminals, Vancouver, B.C. Report Number: 3787-R-04.1


