Anson Road Dock Facility
Aquatic Effects Assessment / Environmental Impact Assessment

Contract No: 2019-478

Mayne Island, BC

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FINAL

Prepared for: **Capital Regional District**
Integrated Water Services
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1 Introduction

The Capital Regional District's (CRD) Integrated Water Services is proposing the construction of a new public dock facility (the Project) that will make use of the upland property off Anson Road (located between 686 and 694 Horton Bay Road) and the CRD waterlot lease area in Horton Bay on Mayne Island (Figure 1). The new Anson Road public dock facility will replace the existing Horton Bay public dock facility, which is located approximately 400 m away. The CRD acquired the Horton Bay public dock facility from Fisheries and Oceans Canada's Small Craft Harbours as part of their divestiture program. A requirement of this specific divestiture was the replacement of the Horton Bay public dock facility with a new public dock facility at Anson Road.

CRD contracted Archipelago Marine Research Ltd. (Archipelago) to undertake an Aquatic Effects Assessment (AEA) (Sections 3 to 8) of the marine portion of the project and an Environmental Impact Assessment (EIA) of the upland portion of the project, which includes terrestrial and freshwater resources (Sections 9 to 14). Archipelago subcontracted Dillon Consulting (Dillon) to undertake the EIA of the upland portion of the project due to their terrestrial and freshwater expertise. The results of both assessments are summarized in this report, which will be submitted as supporting documentation for the Fisheries and Oceans Canada's Project Review application.

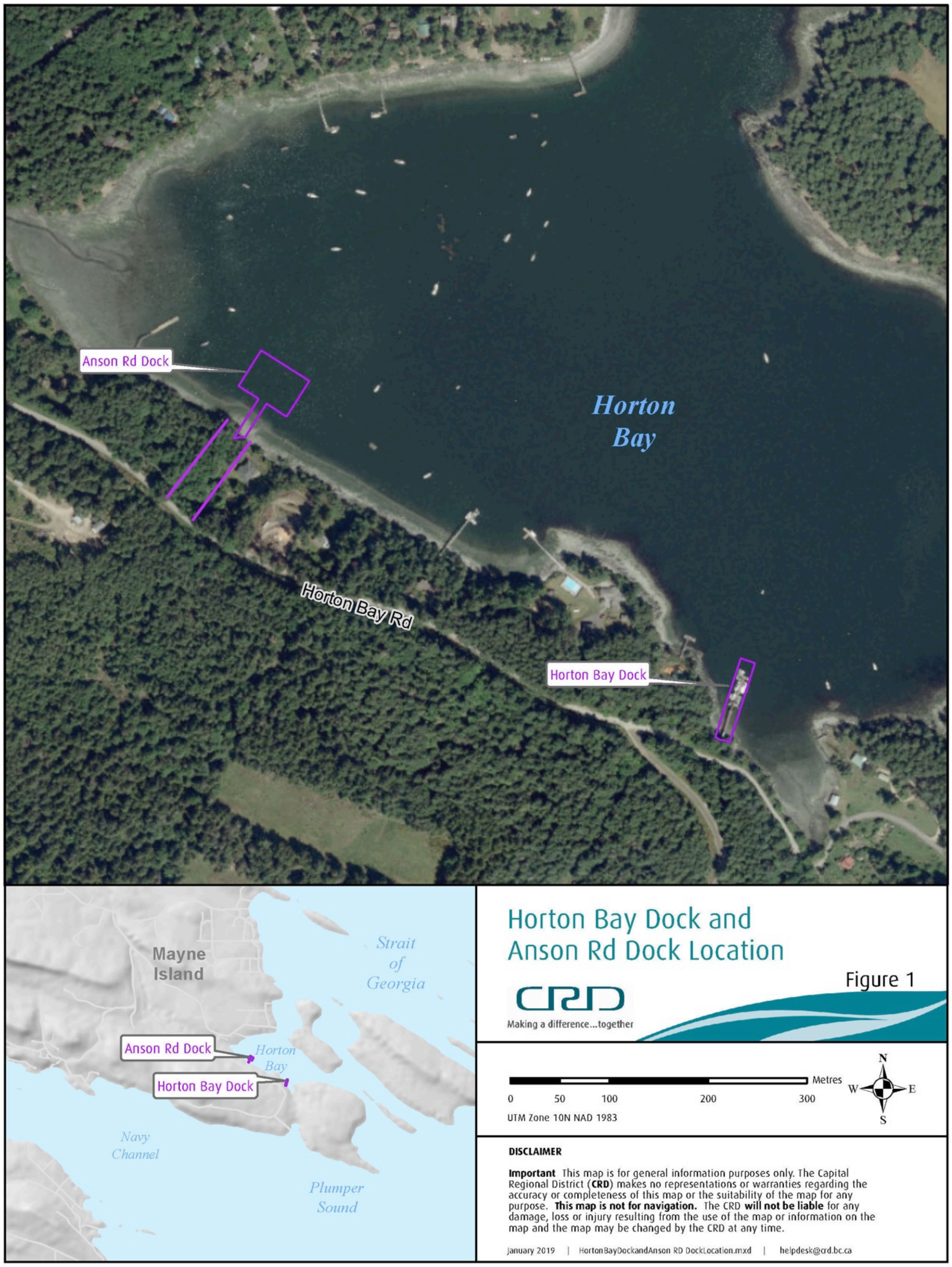

Figure 1. Location for the proposed new Anson Road public dock facility on Mayne Island (upland boundaries are approximate).

2 Project Description

Based on the preliminary design drawings (Appendix A), the upland portion of the new Anson Road public dock facility will consist of an upper and lower gravel parking lot; the lower gravel parking lot will have pit toilets. The construction of the parking lots will require vegetation clearing, rerouting of drainage ditches, and cut and fill activities to achieve a flat grade; both parking lots will include retaining walls. The existing road right away that extends from the natural boundary to Horton Bay Road will be utilized as part of the public dock facility. The upland construction component will likely be undertaken before the marine construction component and is anticipated to take five weeks. Heavy equipment that will be used during construction includes dump trucks, excavators, backhoes, and diesel plate compactors. Construction materials, such as gravel fill, will most likely be brought in overland to the Project site.

The preliminary design drawings for the marine portion of the new Anson Road public dock facility include a dock approach (27.43 m X 3.20 m), gangway/ramp (10.72 m X ~1.92 m), main float (46.61 m X 3.20 m) and six float fingers (18.29 m X 2.74 m each) (total area of approximately 558 m^2). The CRD has indicated that the new public dock facility will provide a minimum total moorage length of 91 m, although the planned total moorage length is 219 m, which will be afforded by the six float fingers shown in the preliminary design drawings (Appendix A); the planned capacity would support 30 boats, 5.5 m to 8.2 m long (18 to 27 feet). Depending on final design requirements, up to 40 steel, likely 12-inch diameter, piles will be required and installed using vibratory and/or impact pile driving methods. Three concrete abutments, less than one cubic meter each, will be required. Float construction will either be timber or concrete decking although light penetrating grating will be considered. The marine construction component will likely be undertaken after the upland construction component and is anticipated to take four weeks. It will be scheduled within the 2019/2020 winter least risk timing window or 2020 summer least risk timing window, as it is not anticipated that the 2019 summer least risk timing window will be possible due to Project timelines. Heavy equipment that will be used during construction includes up to two barges (including crane barge for pile driving) with three tending vessels. Construction materials will most likely be delivered to the Project site by barge.

Marine Aquatic Effects Assessment

3 Marine Desktop Review and Survey Methods

The Aquatic Effects Assessment (AEA) of the marine Project component was based on a desktop review and intertidal foot and subtidal dive survey data collected at the Anson Road Project site.

3.1 Desktop Review

A review of existing publically available information was conducted for the Project location and broader Mayne Island area. Information was assembled to characterize known marine habitat features, marine species known to use the area, and possible migratory, refuge or spawning concentration areas.

In addition, marine species at risk or of potential conservation concern possibly occurring within the Project location or vicinity were considered. The Committee on Endangered Species in Canada (COSEWIC) identifies species of potential conservation concern in Canada and assesses them as Data Deficient, Not at Risk, Special Concern, Threatened, Endangered, Extirpated or Extinct. The species may then be considered for listing under the *Species at Risk Act* (SARA) as Extirpated, Endangered, Threatened or Special Concern. Species are listed in a provincial ranking system, typically with input based on COSEWIC's assessment, by the BC Conservation Data Centre (CDC) as Yellow (Secure, Not-at-Risk), Blue (Special Concern, at risk of becoming Threatened) or Red (Threatened or Endangered, at risk of becoming Extinct or Extirpated). For the aquatic effects assessment, marine species of conservation concern include species listed as Endangered, Threatened, or Special Concern under SARA or recommended for listing under COSEWIC, as well as species listed as Red or Blue by the CDC.

Data sources accessed and/or information collected and reviewed for relevance to this assessment included but are not limited to the following:

- Islands Trust MapIT (online resource mapping tool) (Islands Trust 2019)
- BC ShoreZone Imagery for the Gulf Islands (CORI 2004)
- NuSEDS-New Salmon Escapement Database System (Fisheries and Oceans Canada 2019a)
- Herring spawning areas of British Columbia (Hay and Carter 2013)
- Habitat Wizard (Government of British Columbia 2019)
- Rockfish Conservation Areas (Fisheries and Oceans Canada 2019b)
- Important Bird Areas, including Great blue heron colony areas (Bird Studies Canada 2015; Community Mapping Network 2019)
- Species at Risk Public Registry (2019)
- BC Conservation Data Centre– BC Species and Ecosystem Explorer (MOE 2018)

3.2 Surveys

Intertidal foot and subtidal dive surveys were conducted to generally describe the biophysical features within and adjacent to the upland and marine project-related footprints and to identify any valued or sensitive[1] habitat areas that may be impacted by the Project footprint, construction and/or operation of the proposed new dock facility at Anson Road. The marine surveys were conducted with consideration for project effects related to fish and fish habitat, marine birds and marine mammals as protected in Canada (*Fisheries Act*, *Species at Risk Act* (SARA), *Migratory Bird Convention Act*, *Marine Mammal Regulations*).

[1] Valued/sensitive habitat areas are habitats that are sensitive to perturbation and/or that are valuable for feeding, rearing or nursery grounds for fish and invertebrates.

3.2.1 Intertidal Foot Survey

An intertidal foot survey was conducted during the low tide window of April 10, 2019, which ranged between 1.18 m and 1.0 m during the time of the survey[2]. The surveyed area included one intertidal transect (Transect 3 as shown in Figure 2) within the proposed dock approach and gangway/ramp footprint, and approximately 25 m of shoreline on either side of the transect, encompassing the entirety of the intertidal zone adjacent to the upland portion of the project. The intertidal transect was 20.94 m long (slope distance) and was surveyed between +5.52 m and +0.71 m[3] above chart datum (CD) (Figure 2). General biophysical features of intertidal areas potentially affected by the marine and upland project components were also characterized, including valued/sensitive habitat areas and listed species.

The intertidal survey methodology followed Fisheries and Oceans Canada's *Marine Foreshore Environmental Assessment Procedures* (MFEAP). The intertidal survey transect was positioned perpendicular to the shoreline (Figure 2), and upper and lower transect positions were recorded using a handheld Garmin GPS. Measurements of slope distance and vertical elevation were made at changes in biota and/or substrate along each transect. Vertical elevations were measured using a survey level and rod and are reported relative to CD[4].

Qualitative observations of key biota zones such as barnacle, rockweed (*Fucus* sp.), red/green algae, and bladed kelps, as well as substrate, were recorded for each habitat zone 25 m on either side of the transect. Vegetation was recorded as percent cover and identified to species or species group (e.g. as summarized above). Fauna was recorded as either percent cover (for sessile invertebrates) or as an estimate of relative abundance (i.e., present (P), common (C) and abundant (A)) for mobile invertebrates and identified to species or lowest possible taxonomic level. If species listed as rare or at risk (e.g. native oyster (*Ostrea conchaphila*) were observed, they were also recorded. Substrate was classed as bedrock, boulder, cobble, pebble, sand, and silt/mud/clay consistent with Wentworth grain size classification and recorded by percent cover range.

Supplemental information was also collected from within the intertidal zone during the biophysical dive survey to address the data gap between 0 m and +1.0 m, which was not accessible during the intertidal survey due to the available low tide at the time of the survey.

[2] Based on the tidal height prediction for the Samuel Island South Tide Station using tidal prediction software (Tides and Currents Pro).
[3] The final two metres of the transect were surveyed in very shallow water.
[4] Elevations were calculated relative to chart datum (CD) based on the tidal height prediction (Samuel Island South Tide Station) at the time of each transect using tidal prediction software (Tides and Currents Pro). Positive (+) elevations are above CD while negative (–) elevations are below CD.

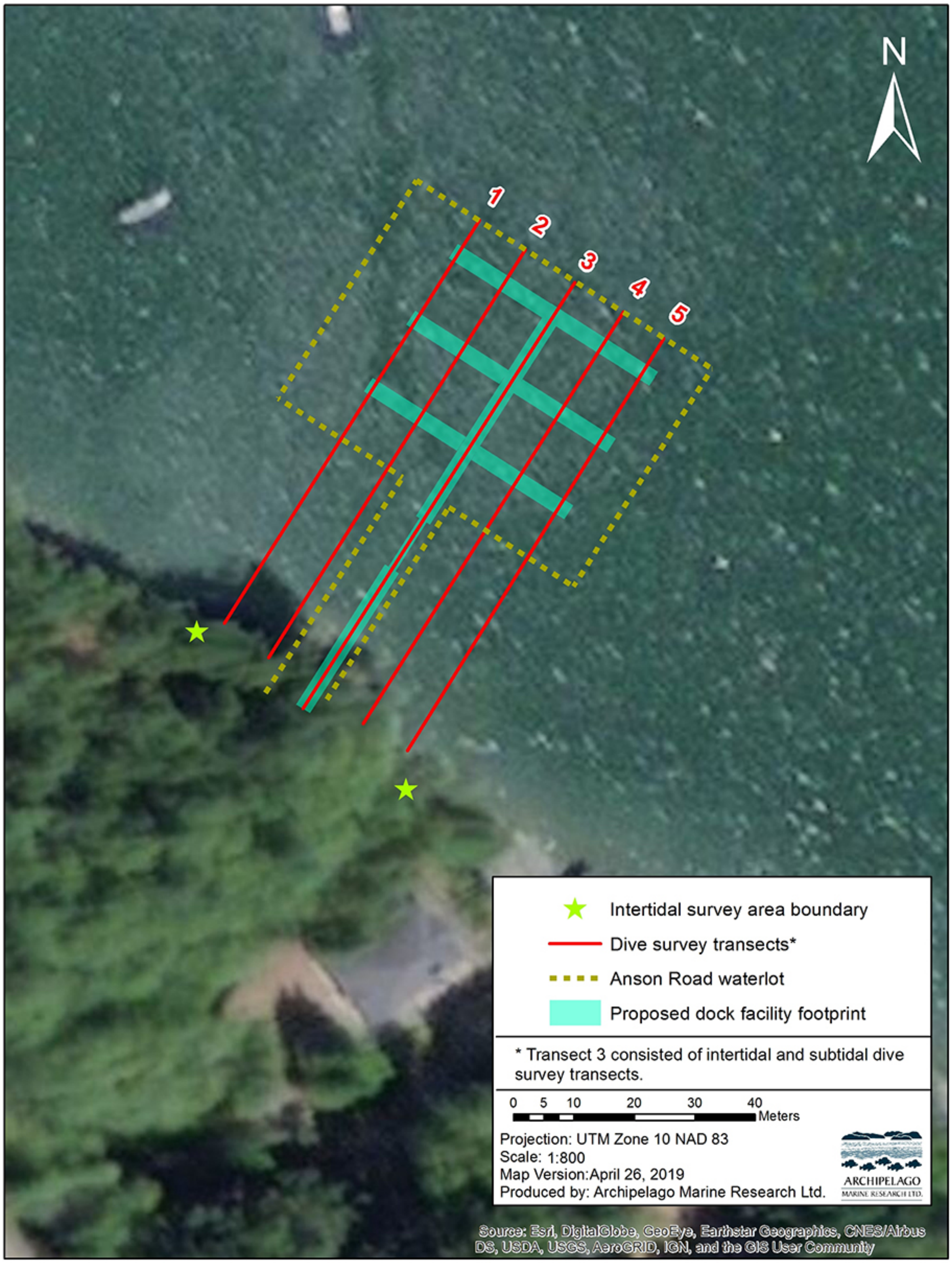

Figure 2. Intertidal and subtidal dive survey area and transects. Intertidal zone was surveyed between the two green stars and along Transect 3 to the waterline at the time of the survey.

3.2.2 Subtidal Dive Survey

A daytime biophysical dive survey was conducted on April 9, 2019 during a falling tide (1.85 m to 1.18 m[2]). Five transects (T1-T5) extending perpendicular to shore were surveyed within the proposed footprint of the dock approach, gangway/ramp and floats (Figure 2). The coordinates for the transect end points, which were identified during the pre-survey planning stage, were navigated to by the dive survey vessel during the placement of the physical transects from aboard the vessel. Transect 3 was positioned within the proposed dock approach and gangway/ramp alignment while the remaining four transects were aligned to intersect with the six proposed floats.

All five transects extended into the intertidal zone to survey the area that was not accessible during the intertidal survey, as previously identified in Section 3.2.1. Transects 1, 2 and 4 extended above the elevation of the lower end of the intertidal transect (i.e. above +0.71 m CD) while Transects 3 and 5 extended to +0.62 m and +0.68 m CD, as the tide was too low for the divers to survey to the end of the transect (i.e. the end of the transect extended above the low tide line in the intertidal zone). The difference in elevations between the lower end of the intertidal transect and the upper ends of Transects 3 and 5 is 9 cm and 3 cm, respectively. This is well within the range of accuracy of the diver's depth gauge, which reads to the nearest 10 cm (water depths are subsequently converted to elevation relative to chart datum). Therefore the elevations between the lower end of the intertidal transect and the upper ends of Transects 3 and 5 may be closer to each other than reported. Furthermore, divers were able to surface and confirm that the biophysical conditions of the lower intertidal zone above the low tide line were similar to the conditions surveyed directly below the low tide line. Table 1 summarizes details for each of the five transects.

Table 1. Summary of subtidal dive survey transect details.

Transect #	Survey Time Period	Length (m)	Elevation Range (m, CD)
1	11:38 to 12:03	80	-4.95 to +1.03
2	12:06 to 12:27	79	-4.88 to +1.33
3	12:29 to 12:47	59	-4.98 to +0.62
4	12:52 to 13:09	61	-5.15 to +0.82
5	13:11 to 13:25	78	-5.35 to +0.68

The biophysical dive survey generally followed Fisheries and Oceans Canada's *Marine Foreshore Environmental Assessment Procedures* (MFEAP). Horizontal transect distance, depth and time were recorded every 10 m of horizontal distance and where changes in biota and/or substrate occurred along each transect. Water depths were measured with a diver's depth gauge and subsequently converted to elevations relative to CD for reporting[4]. One diver recorded observations of substrate, vegetation and fauna while the other diver recorded video with an underwater video camera (Go Pro Hero 5). Substrate was classed as bedrock, boulder, cobble, pebble, sand, and silt/mud/clay consistent with Wentworth grain size classification and recorded by percent cover range. Dominant vegetation was reported as percent cover and identified to species or morphological group (e.g. red foliose algae). Dominant fauna was reported as an estimate of relative abundance (i.e. present (P), common (C) and abundant (A)) and identified to species or the lowest possible taxonomic level. If species listed as invasive, rare or at risk (e.g. native oyster, Northern abalone (*Haliotis kamtschatkana*)) were observed they were also recorded.

4 Marine Survey Results

4.1 Intertidal Foot Survey

The intertidal zone within the survey area is characterized by a near vertical eroding bank (0.8 m – 3.39 m high) at the high water mark, and a moderately sloping beach comprised of sand and clay with a veneer of angular cobble, pebble and boulder.

Riparian vegetation within the splash zone was limited due to the steeply eroding bank along the high tide mark. Vegetation that was present consisted of Western red cedar (*Thuja plicata*) and Douglas fir (*Pseudotsuga menziesii*), often with roots exposed due to erosion, as well as honey suckle vine (*Capriofoliaceae sp.*), red alder (*Alnus rubra*), sword fern (*Polystichum munitum*), oceanspray (*Holodiscus discolor*), and grasses.

The upper intertidal zone (> 2.13 m CD) of Transect 1 consisted of a clay matrix with a veneer of angular sand (0 –10%), pebble (50–60%), cobble (20–40%), and boulder (5–10%). Rockweed (*Fucus distichus)* and Turkish towel (*Mastocarpus sp.*) were present in trace amounts (<5% cover). The mid-intertidal zone (1.02 – 2.13 m CD) consisted of a sand matrix with a veneer of angular pebble (75%), cobble (20%), and boulder (5%). Rockweed and filamentous green algae, foliose green algae, and foliose brown algae were present in trace amounts (<5% cover for each). Substrate in the lower intertidal zone (0.71 – 1.02 m) consisted of silt (80%), sand (10%), pebble (5%), and cobble (5%). Foliose green algae (*Ulva* sp.), foliose brown algae and brown bladed sugar kelp (*Saccharina latissima)* were present in trace amounts (<5% cover). The most abundant invertebrate species observed throughout the upper and mid-intertidal zones (+ 1.0 – 3.58 m) were barnacles (*Balanus glandula* (5–25%) cover), limpets (*Tectura persona),* periwinkles (*Littorina sp.)* and shore crabs (*Hemigrapsus sp.*). Pacific oysters (*Crassostrea gigas*), barnacles (*Balanus crenatus)*, and sea stars (*Pisaster sp.*) were also present in the lower intertidal zone. The presence of other infaunal organisms was evident from the common to abundant infaunal holes and infaunal mounds.

As indicated in Section 3, all five subtidal dive survey transects extended into the intertidal zone to survey the area that was not accessible during the intertidal survey. The dive survey identified that the lower intertidal zone consisted either of sand with pebble and shell hash/fragments (Transects 1 and 2), sand (50%) intermixed with cobble, pebble and shell hash/fragments (50%) (Transects 3 and 5), or sand and pebble (75%) with cobble (20%) and boulder (5%) (Transect 4). Diatoms, a brown algae, were present as a surface film on the substrate with trace (<5%) to moderate (25-50%) cover. Drift (unattached) green foliose algae and drift brown bladed sugar kelp were also observed with trace (<5%) to moderate (25-50%) cover. Algal species attached to coarse substrate (pebble and cobble) included young bull kelp

(*Nereocystis luetkeana*, trace (<5%) cover), false kelp (*Petalonia fascia*, trace (<5%) cover), sugar kelp (trace (<5%) to low (5-25%) cover), and green foliose algae (moderate (25-50%) cover). The most abundant invertebrate species observed in the lower intertidal zone included barnacles, brittle stars, ochre sea star (*Pisaster ochraceus*), and unidentified infaunal tubeworms. The presence of other infaunal organisms was evident from the common to abundant infaunal holes and infaunal mounds, some of which contained horse clams (*Tresus* spp.) and cockles (*Clinocardium* spp.), which were identified by their siphons. Other species present included Pacific oysters, hermit crabs (*Pagurus* spp.), mottled sea star (*Evasterias troschelii*), and bubble shell (Family Bullidae).

Representative photographs from the intertidal foot survey are presented in Photo Plate 1 while the Transect 3 profile and tabulated data are presented in Appendix B.

Photo Plate 1. Photographic documentation of intertidal foot survey.

Photo 1. Steep eroding bank at the high tide line of the intertidal transect (Transect 3, Figure 2). Higher high-water swash is at the base of the bank.

Photo 2. View east from head of transect, showing overhanging Douglas fir eroded roots and current staircase for shore access from Anson Road.

Photo 3. Transect across the beach along the proposed dock alignment, looking north.

Photo 4. Characteristic substrate in the upper intertidal zone consisting of angular cobble/ pebble with embedded wood debris.

Photo 5. Sea stars (*Pisaster ochraceus*) in the lower intertidal zone.

Photo 6. View across mid-transect, looking northwest to head of Horton Bay. Note scattered boulder with sparse cover of barnacle and foliose green algae.

4.2 Subtidal Dive Survey

The biophysical conditions were similar across all five subtidal dive transects. The surface substrate throughout most of the subtidal survey area consisted of sand often with shell hash or shell fragments. Transects 1 and 2 were characterized by this substrate over their entire lengths with the exception of Transect 2 which had a small bedrock outcropping present approximately 23 m from the nearshore end of the transect. Pebble and cobble representing 50% to 75% of the surface substrate was intermixed with sand around the middle of Transect 3; the surface substrate transitioned to predominantly sand (>75%) with pebble (<25%) in the upper subtidal zone near zero chart datum. Similarly, on Transect 4 surface substrate consisting of sand (50% to 75%) and pebble (25% to 50%) was present from the middle of the transect to the upper subtidal zone. Sand representing 50% to 75% of the surface substrate was intermixed with pebble and cobble (25% to 50%) around the middle of Transect 5; the surface substrate transitioned to sand (100%) in the upper subtidal zone near zero chart datum.

The most widespread algae observed throughout the subtidal survey area were diatoms, a brown algae that was present as a surface film on the substrate with a trace (<5%) to high (>75%) cover. Drift green foliose algae (*Ulva* sp.) and drift sugar kelp were also observed across all five transects with trace (<5%) to low (5-25%) cover. Algal species attached to the pebble and/or cobble substrate present on Transects 3, 4 and/or 5 included young bull kelp (trace (<5%) cover), acid kelp (*Desmerestia* sp., trace (<5%) to low (5-25%) cover), brown filamentous algae (trace (<5%) cover) and red branching and filamentous algae (trace (<5%) cover). Eelgrass (*Zostera marina*) was present along and to either side of all five transects and extended beyond the survey area to the west and east. The eelgrass cover ranged between trace (<5%) and moderate (25-50%) cover and was present between -3.55 m and -0.77 m CD. Eelgrass blades were approximately 0.5 m to 1.0 m long. Table 2 provides a summary of eelgrass details for each transect.

Table 2. Summary of eelgrass presence measured along each subtidal dive transect.

Transect #	Length Along Transect (m)	Elevation Range (m, CD)
1	20	-3.15 to -1.17
2	22.5	-3.28 to -0.78
3	11	-2.98 to -0.88
4	12	-2.77 to -0.77
5	14	-3.55 to -0.85

The most abundant and widespread invertebrate species observed throughout the subtidal survey area included unidentified infaunal tubeworms, shrimp (*Crangon* spp.), and brittle stars. The presence of other infaunal organisms was evident from the common to abundant infaunal holes and infaunal mounds, some of which contained horse clams, cockles and macoma clams

(*Macoma* spp.), which were identified by their siphons. Other potentially occurring bivalve species that were identified from shell fragments included littleneck/Manila (*Protothaca staminea* or *Venerupis philippinarum*) and butter clam (*Saxidomus gigantea*), as well as previously observed cockle and macoma[5]. Other species present or common included mottled sea stars, leather sea star (*Dermasterias imbricata*), ochre sea star, Heath's dorid nudibranch (*Geitodris heathi*), yellow margin dorid nudibranch (*Cadlina luteomarginata*), frosted dirona nudibranch (*Dirona albolineata*), unidentified olive snail, hermit crabs, kelp crab (*Pugettia* sp.), graceful crabs (*Metacarcinus gracilis*), red rock crab (*Cancer productus*), unidentified juvenile crab, and short plumose anemone (*Metridium senile*). In addition, one solitary orange sea pen (*Ptilosarcus gurneyi*) was observed on Transect 3, an indicator of current. Hooded nudibranchs (*Melibe leonina*) were commonly observed on the eelgrass blades.

Fish species observed included an unidentified juvenile flatfish and a saddleback gunnel (*Pholis ornata*).

Representative photographs from the subtidal dive survey are presented in Photo Plate 2 while tabulated data are presented in Appendix C.

[5] A 6.66 hectare area was identified by Fisheries and Oceans Canada at the head of Horton Bay near the small estuary/tidal flat in 1997 as supporting populations of Manila, littleneck and butter clams (Fisheries Management Area 18, Sub-Area 5, beach ID#450) (Harbo et. al 1997). Harbo et. al noted that only a portion of the identified beach area supports clam populations. Its current harvest status is closed (iMAPBC 2019). iMAPBC (2019) shows this closed clam bed area extending throughout Horton Bay to the north and to the east through Robson Channel.

Photo Plate 2. Photographic documentation of subtidal dive survey.

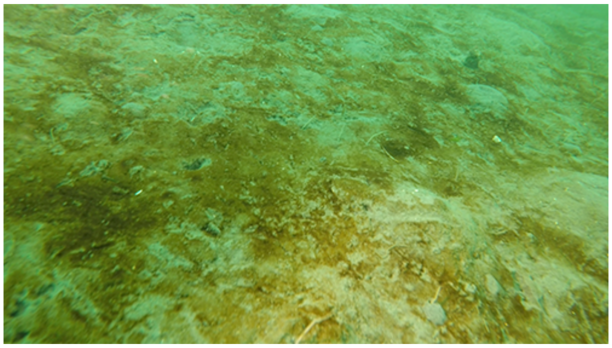

Photo 1. Soft bottom with diatom cover and infaunal holes on T1, common across all transects.

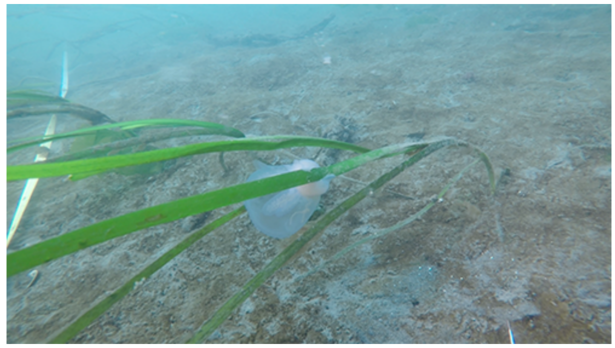

Photo 2. Trace (<5%) to low (5-25%) eelgrass (*Zostera marina*) cover on T1 with hooded nudibranch (*Melibe leonina*) and evidence of current.

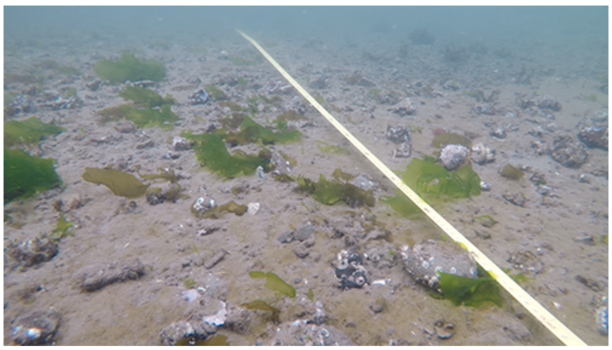

Photo 3. Pebble and cobble with foliose green algae (*Ulva* sp.) on T1 at approximately 7 to 9 m from nearshore end of transect.

Photo 4. Soft bottom with diatom cover and infaunal mounds with trace (<5%) eelgrass in background on T2.

Photo 5. Soft bottom with infaunal holes and drift foliose green algae and brown bladed kelp on T2.

Photo 6. Nearshore edge of trace (<5%) to low (5-25%) eelgrass cover on T2 with bedrock outcrop.

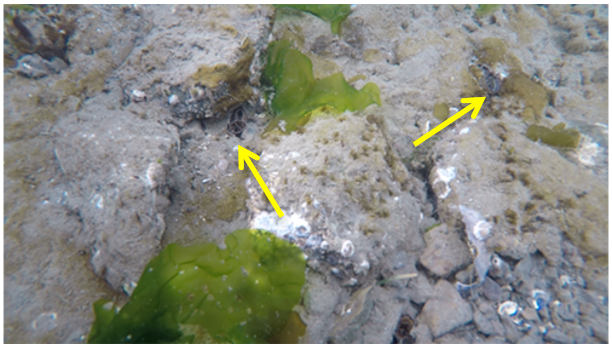

Photo 7. Pebble and cobble at nearshore end of T2 with foliose green algae and horse clams (*Tresus* spp.).

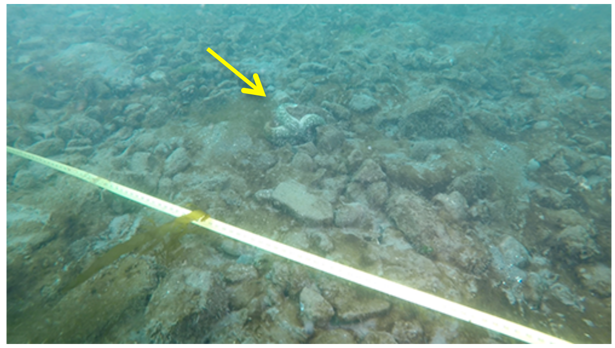

Photo 8. Pebble and cobble at approximately 46 m from nearshore end of T3 with mottled seastar (*Evasterias troschelii*).

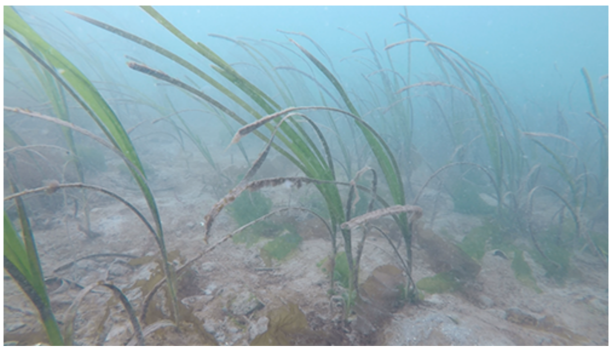

Photo 9. Moderate (25-50%) eelgrass cover on T3.

Photo 10. Individual sea pen (*Ptilosarcus gurneyi*) on T3, an indicator of current.

Photo 11. Pebble and cobble with individual bull kelp stipe (*Nereocystis luetkeana*) on T4.

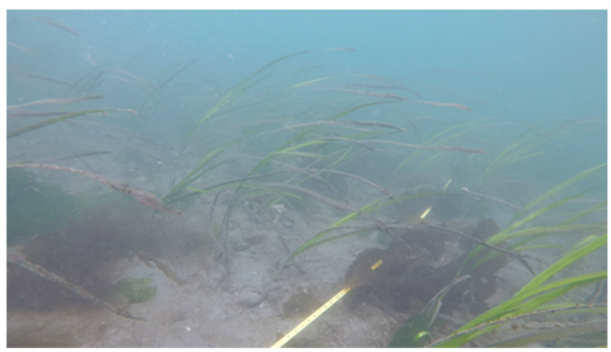

Photo 12. Moderate (25-50%) eelgrass cover on T4.

Photo 13. Pebble and cobble with infaunal mound at approximately 70 m from nearshore end of T5.

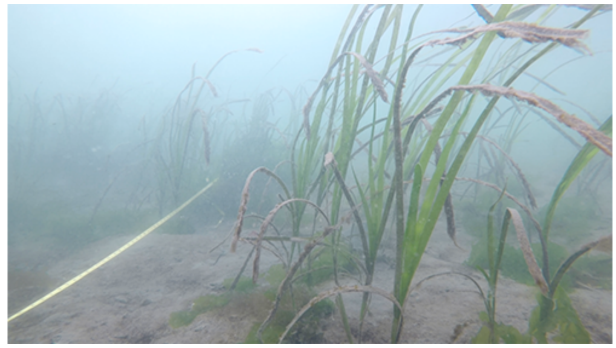

Photo 14. Moderate (25-50%) eelgrass cover on T5.

5 Marine Setting and Biophysical Characterization

The marine component of the Project resides within the Strait of Georgia marine ecosection, one of twelve marine ecosections in British Columbia that are based on the British Columbia Marine Ecological Classification and are defined by physical, oceanographic and biological features (MSRM 2002). The Strait of Georgia marine ecosection is characterized as "a broad shallow basin surrounded by coastal lowlands", "protected coastal waters with significant freshwater input, high turbidity and seasonally stratified; very warm in the summer", and "a nursery area for salmon, herring; abundant shellfish habitat; neritic plankton community".

Protected marine areas are located north of the Project site that are part of the Gulf Islands National Park Reserve system: waters around Campbell Point on Mayne Island, Georgeson Island (east of Campbell Point), and islands/islets north of Samuel Island that include Anniversary Island, Belle Chain Islets and Little Samuel Island (Parks Canada 2019). The closest Important Bird Area (IBA) is Active Pass (BC015) located between the northwest end of Mayne Island and southeast end of Galiano Island (Figure 3). It is designated as an IBA due to global and continentally significant populations of Pacific loon (*Gavia pacifica*), Brandt's cormorants (*Phalacrocorax penicillatus*) and Bonaparte's gulls (*Chroicocephalus philadelphia*) (Bird Studies Canada 2015). The closest documented Pacific great blue heron (*Ardea Herodias fannini*) colony is at Winter Cove at the northwest corner of Saturna Island (GBHE-101-028) (British Columbia Great Blue Herons Atlas 2019). The colony's first documented active year was in 1999 and the last documented active year was in 2010 (British Columbia Great Blue Herons Atlas 2019). The closest rockfish conservation areas (RCAs) are the Belle Chain Islets (north of Samuel Island), Mayne Island North (north end of Mayne Island extending to Galiano Island at east entrance to Active Pass), and Navy Channel (between south end of Mayne Island and north end of North Pender Island) (Figure 3) (Fisheries and Oceans Canada 2019b; Islands Trust 2019). The Islands Trust Conservancy included the entire Horton Bay shoreline in their Mayne Island sensitive ecosystem mapping project for the importance of the intertidal ecosystem, which "links marine and terrestrial environments" (Islands Trust Conservancy 2019). The mapping project "focused on mudflats and beaches", which "provide wildlife with food, nursery areas (fish and marine invertebrates), feeding grounds (migrating birds), travel corridors (species using both marine and terrestrial areas), and protection from weather and predators" (Islands Trust Conservancy 2019).

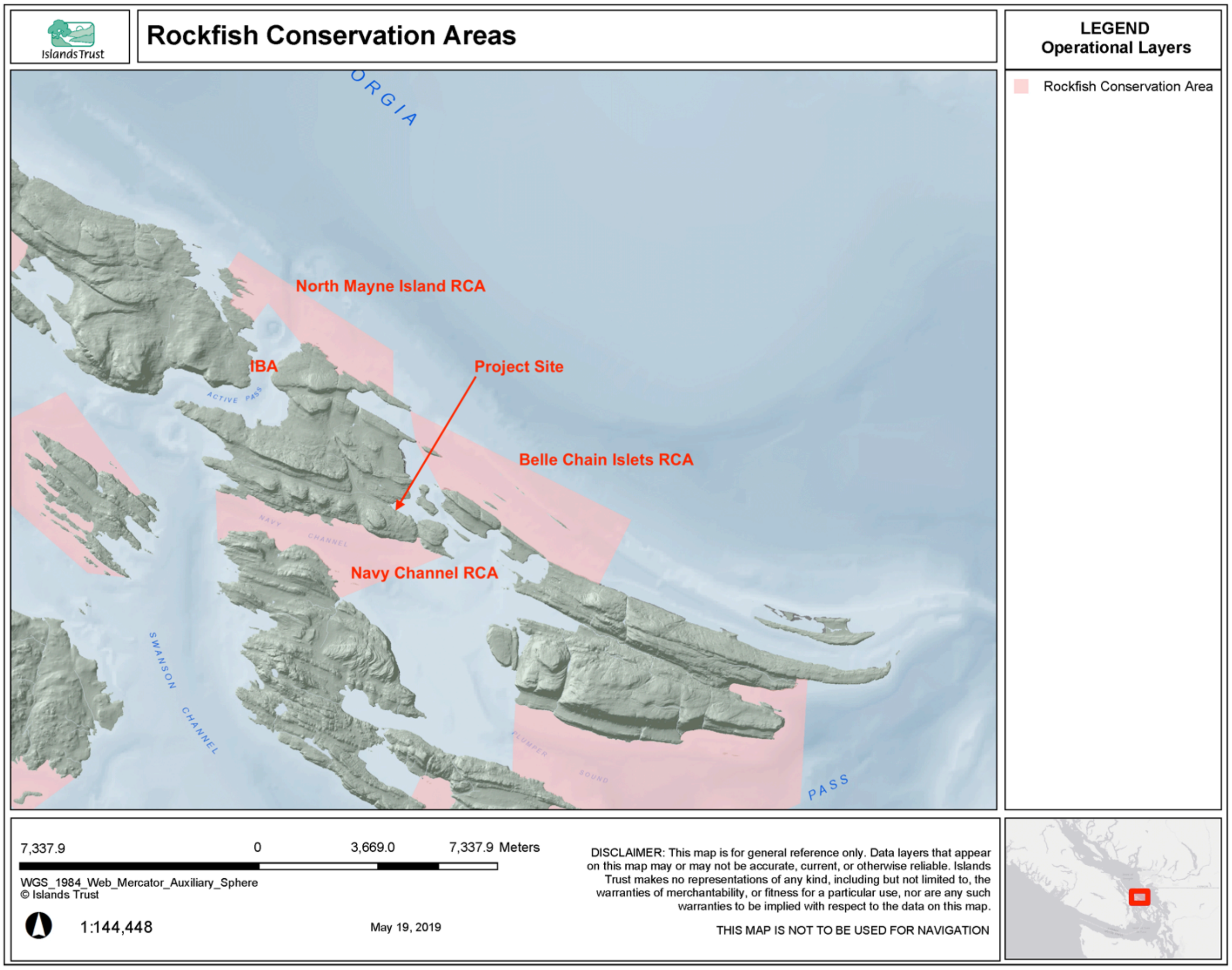

Figure 3. Rockfish Conservation Areas (RCA) in vicinity of the Project site and general location of closest Important Bird Area (IBA) in Active Pass (Islands Trust 2019).

Based on the intertidal foot and subtidal dive surveys, the intertidal area between the proposed dock footprint and upland project components is characterized by a moderately sloping beach comprised of sand and clay with a veneer of angular cobble, pebble and boulders supporting an infaunal community and a relatively low to moderate diversity and abundance of epifaunal invertebrates (i.e. gastropods, sea stars) and algal species. Of significance is the steep eroding bank at the location of the proposed dock approach, and along the high-water mark adjacent to the upland portion of the Project, which may require erosion protection measures. Several mature conifers within this area and nearby have much eroded root systems across the coastal riparian vegetation and down the bank into the upper intertidal zone.

The subtidal area within the proposed dock footprint and surrounding area is characterized predominantly by soft bottom habitat with an infaunal community (i.e. tubeworms, bivalves, brittle stars) and a relatively low to moderate diversity and abundance of epifaunal invertebrates, fish and algal species. Of significance is the eelgrass bed, a valued/sensitive habitat feature that overlaps with portions of the proposed dock footprint (Figure 4) and which was observed during the subtidal dive survey to extend beyond the footprint to the west and to the east. The Islands Trust's online resource mapping tool (MapIT) identifies the presence of patchy and continuous eelgrass that extends along the shoreline from the unnamed point to the east of the Project site, through the proposed dock footprint, and to Aitken Point located to the north of the Project site (Islands Trust 2019) (Figure 5). This mapped eelgrass is based on an eelgrass inventory completed by the Mayne Island Conservancy between 2008 and 2012, which only shows the extent of the eelgrass (i.e. line feature) and not the delineated area of the eelgrass (i.e. polygon feature). However, the Mayne Island Conservancy directly provided[6] their eelgrass survey data that was collected in 2009, 2012 and 2015 and that delineates the area of the eelgrass bed (Figure 6 and Figure 7).

[6] Provided by e-mail by Rob Underhill of the Mayne Island Conservancy on June 3, 2019.

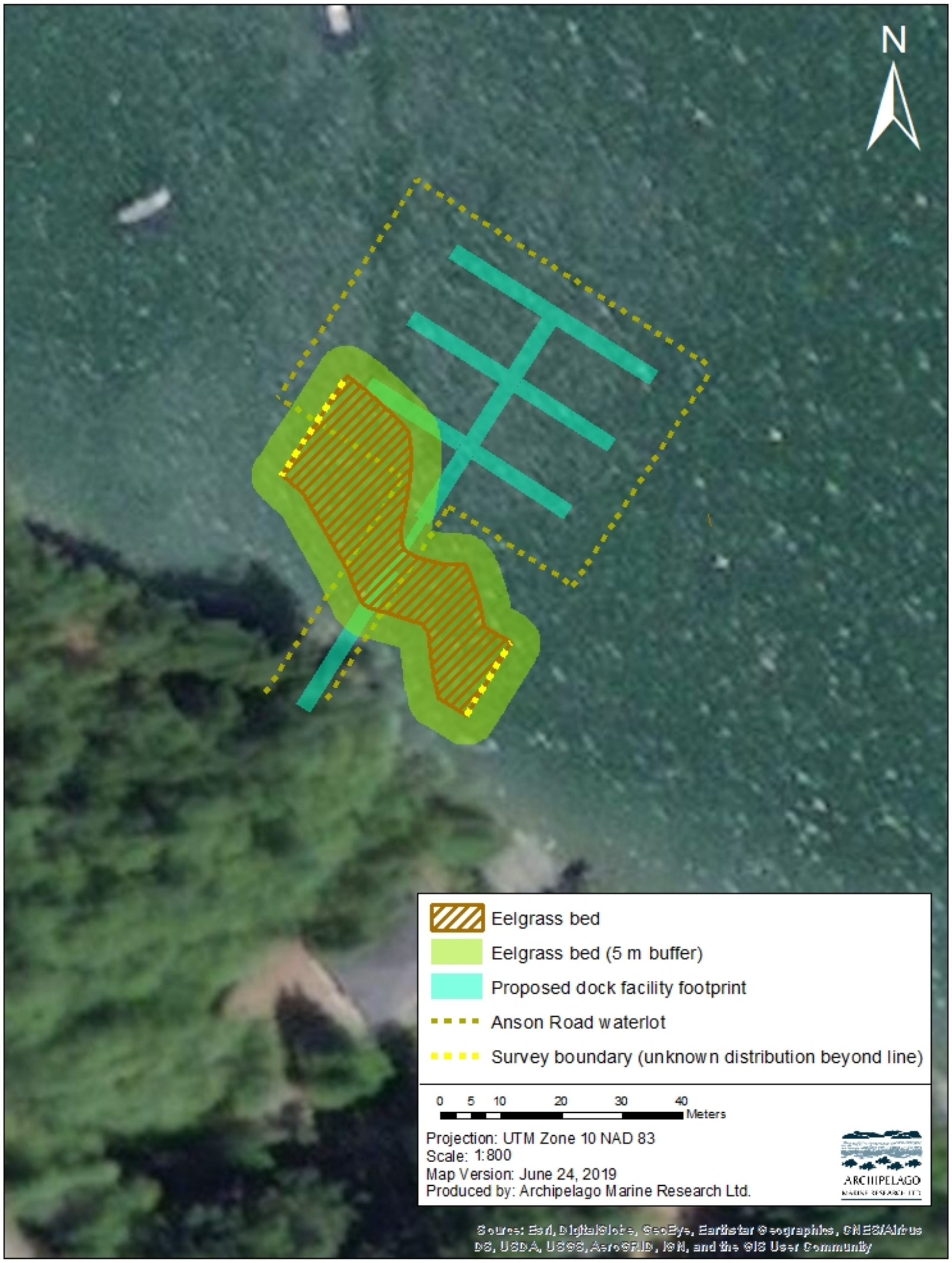

Figure 4. Area of eelgrass observed during the subtidal dive survey with (1,561 m^2) and without (747 m^2) a 5 m buffer. As a conservative measure, a five-meter buffer was applied to the perimeter of the eelgrass to account for positional accuracy of the survey methodology.

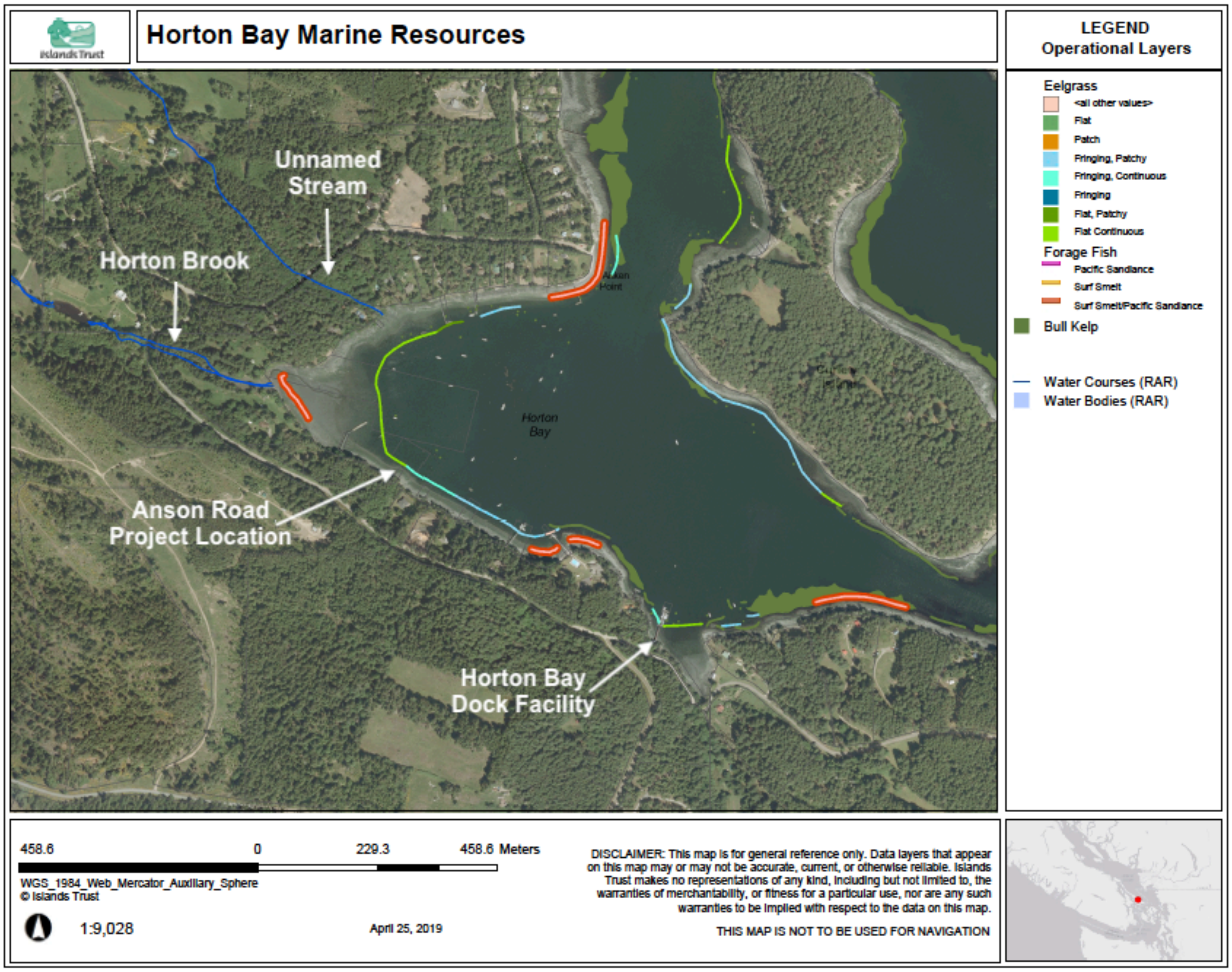

Figure 5. Mapped eelgrass in Horton Bay also showing freshwater streams, bull kelp and Pacific sand lance and surf smelt spawning areas (Islands Trust 2019).

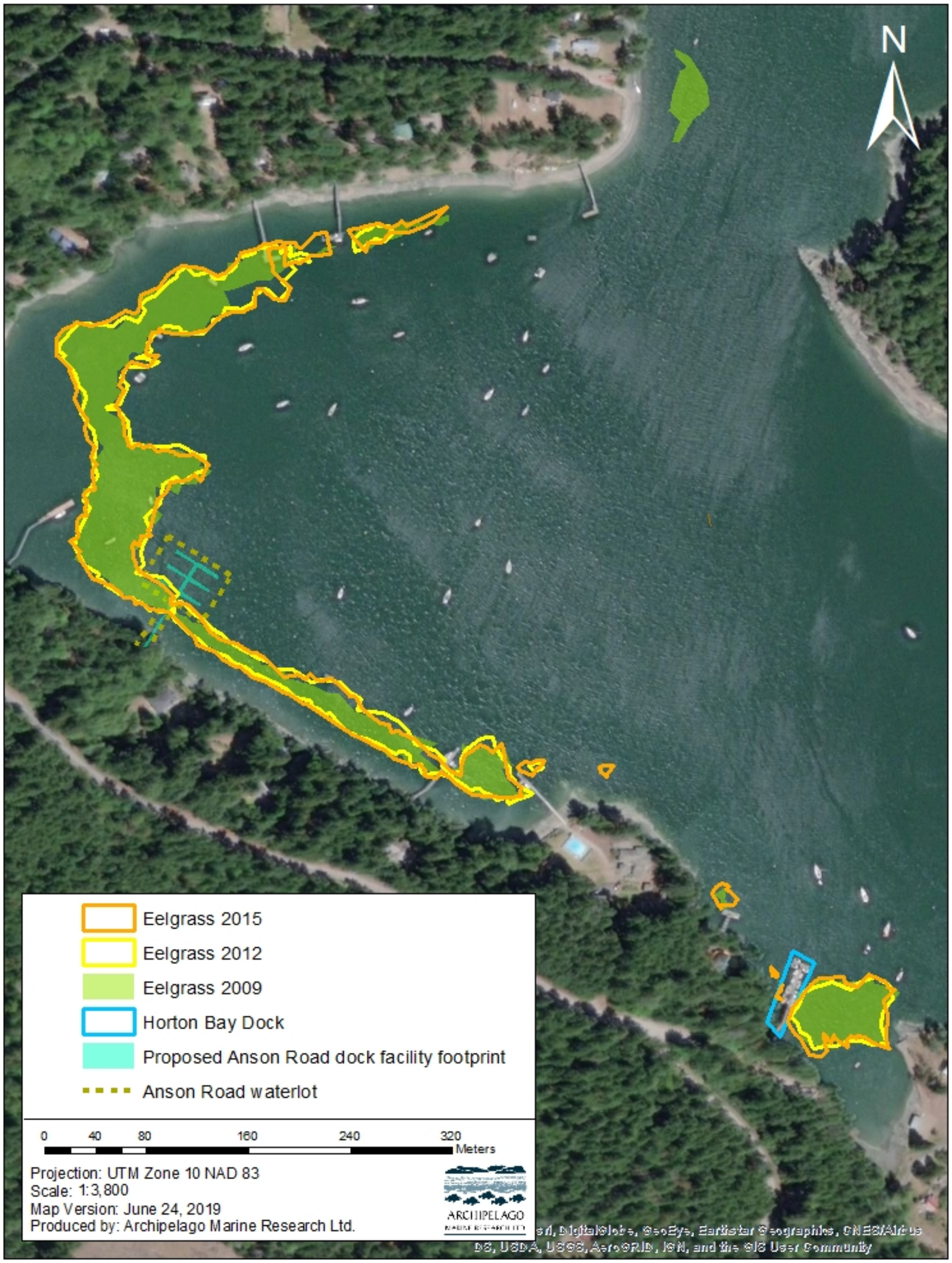

Figure 6. Mayne Island Conservancy 2009, 2012 and 2015 delineated eelgrass areas in Horton Bay relative to the Project site and footprint.

Figure 7. Mayne Island Conservancy 2009, 2012 and 2015 delineated eelgrass areas relative to the Project site, footprint and 2019 subtidal dive survey data (without the 5 m buffer).

Eelgrass beds provide habitat structure that supports both ecologically and economically important finfish (e.g. salmonids, herring) and shellfish (e.g. crab and shrimp) populations. They contribute nutrients and invertebrate prey items to the nearshore areas upon which many fish and shellfish species depend. These nearshore habitats also tend to have high biological productivity and species abundance and diversity. They provide spawning, nursery, and/or rearing habitat for a variety of species including Dungeness crab (*Metacarcinus magister*), red rock crab, graceful crab, perch, juvenile rockfish (*Sebastes* sp.) and salmon (*Oncorhynchus* sp.), as well as provide substrate for spawning herring.

Overall eelgrass beds provide a variety of ecological services that assist in the maintenance of healthy estuarine and nearshore marine habitats and are considered essential (Duarte et al. 2008) or valued habitat. Eelgrass is considered sensitive habitat, as it is negatively affected by stressors such as, but not limited to, physical disturbance through anchoring, fishing practices, dredging, filling, and shoreline hardening; shading from in-water structures; and increased nutrient inputs leading to decreased light availability (Kemp et al. 1983; Moore et al. 1997) and increased algal abundance (den Hartog 1994; Short and Burdick 1996; Bowen and Valiela 2001).

Bull kelp beds, like eelgrass beds, are considered valuable and important habitat, as they provide three-dimensional habitat structure that benthic and pelagic fish and invertebrate species utilize for shelter/refuge and rearing/nursery needs. The kelp beds also provide nutrients and prey items. Although only a couple instances of bull kelp were observed during the subtidal dive survey, bull kelp has been previously mapped in small patches at the head of Horton Bay and as more extensive kelp beds along the shoreline to the east and to the north of the Project site (Islands Trust 2019; data collected by the Mayne Island Conservancy) (Figure 5). Due to the timing of the 2019 survey in early April, bull kelp that was observed was still small and did not form a canopy at the surface therefore unless observed during the dive survey, it was not apparent at the surface. However, as the Project site is characterized predominantly by soft bottom substrate, the abundance and extent of bull kelp within the Project site is likely low.

Juvenile salmonids may be present in estuarine and nearshore habitats, such as eelgrass, between early spring and late summer, during which time they utilize these habitats for feeding and rearing before migrating to the open ocean. The nearest streams to the Project site are Horton Brook and an unnamed stream (Figure 5; (Reimer 2007; CRD 2019). Both streams drain into Horton Bay approximately 300 m from the Project site. Horton Brook was restocked for several years with coho salmon (*Oncorhynchus kisutch*) and is also known to support chum salmon (*O. keta*) and cutthroat trout (*O. clarkii*) (Reimer 2007; iMAPBC 2019). The unnamed stream located further north is ephemeral, and may not support fish or provide fish habitat (Reimer 2007). Other online databases reviewed did not contain information regarding fish presence for this unnamed stream (iMAPBC 2019, Fisheries and Oceans Canada 2019a).

Herring are generally present in estuarine and nearshore habitats, such as eelgrass, between February and May while they spawn. Fisheries and Oceans Canada's long-term cumulative spawn records for Pacific herring (*Clupea harengus pallasi*) do not show spawn records directly in Horton Bay. However, spawn records in Campbell Bay, Mayne Island between 1947 and 1974 are present (Hay et al. 2013, subarea 1 in Figure 8). Based on Fisheries and Oceans Canada's analysis of cumulative herring spawn, these were classified as 'minor' to 'low' spawn and ranked within the bottom 25% and 50% of ranked shoreline kilometer segments, respectively (Hay et al. 2013). A 'minor' to 'low' classified spawn was also identified by surface observation at Samuel Cove Island from 1973 to 1975 (Hay et al. 2013; subarea 2 in Figure 8). The Mayne Island Conservancy reported herring spawn in Horton Bay in 2013 and on April 8, 2014 (Michael Dunn, Mayne Island Conservancy, personal communication, March 28, 2019).

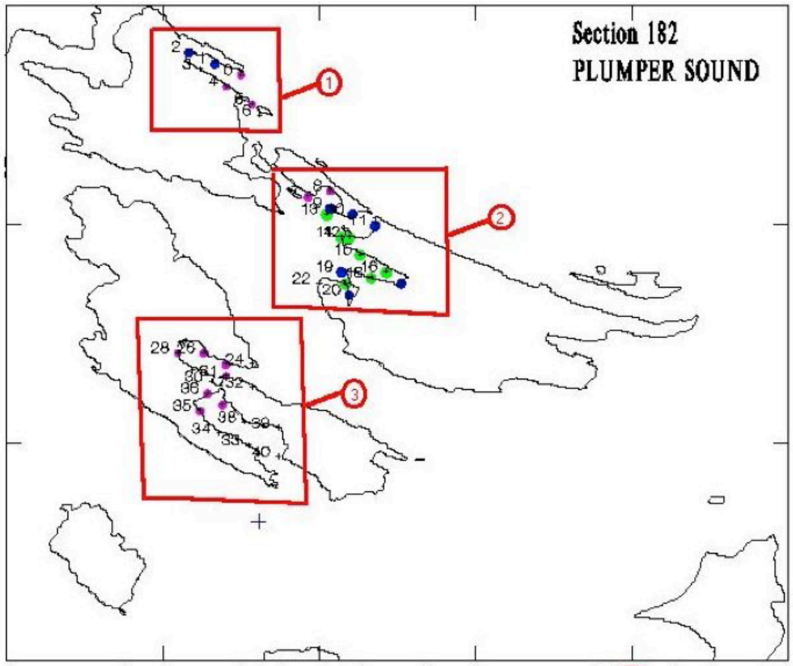

Figure 8. Cumulative herring spawn for Section 182 Plumper Sound from 1947 to 1982 around the Project site. Accessed March 26, 2019 from: http://www.pac.dfo-mpo.gc.ca/science/species-especes/pelagic-pelagique/herring-hareng/herspawn/182fig-eng.html Red dots are classified as vital spawning areas, brown - major, yellow - high, green - medium, blue - low, and purple - minor.

Surf smelt (*Hypomesus pretiosus*) and Pacific sand lance (*Ammodytes hexapterus*) may be present year-round but in particular may be found in the upper intertidal zone during spawning events (summer and winter for surf smelt and between November and February for Pacific sand lance) (de Graaf 2013; de Graaf 2017; Fisheries and Oceans Canada 2012; Thuringer 2004). An estuary/tidal flat is present north west of the Project site where Horton Brook drains. This area provides spawning habitat for the forage fish species surf smelt and Pacific sand lance (Islands Trust 2019; data collected by the Mayne Island Conservancy). Pacific sand lance eggs were observed during a January 2010 survey in Horton Bay (Rob Underhill, Mayne Island Conservancy, e-mail communication, May 23, 2019).

Based on the salmon, herring spawn and forage fish data reviewed and nearshore habitats identified in the vicinity of the Project site, salmon, herring and surf smelt and Pacific sand lance can reasonably be expected to occur along the Horton Bay shoreline at certain times of the year as previously described. Species of conservation concern that potentially make transit through the Project site are listed in Section 5.1 below, along with other potentially occurring transitory non-listed species.

Potential effects to marine habitat and resident and transient species from the location, design and construction/installation of project components are presented in greater detail in Section 6. Recommended mitigation measures and Best Management Practices (BMPs) to offset potential effects are presented in Section 7 followed by a residual effects assessment and summary in Section 8.

5.1 Transitory Non-Listed and Listed Marine Species

In addition to juvenile salmon, herring, surf smelt and Pacific sand lance that were previously discussed, other transitory, non-listed marine species that could possibly occur in the vicinity of the Project site throughout or at certain times of the year include Dall's porpoise (*Phocoenoides dalli*), harbour seals (*Phoca vitulina richardsi*), California sea lions (*Zalophus californianus*), river otters (*Lontra canadensis*), and marine birds such as diving birds (e.g. loons, grebes, cormorants), alcids (e.g. murres, auklets, guillemots, murrelets), gulls, waterfowl (e.g. geese, wigeon, teal, scoters, harlequin duck (*Histrionicus histrionicus*), bufflehead, goldeneye, merganser), shorebirds, and raptors.

The listed marine species native oyster and Northern abalone or evidence of their presence (i.e. empty shells) were not observed during the subtidal dive survey. Other listed marine species that were not observed during the survey and are considered transitory that may occur in the vicinity of the Project site include:

- Southern resident killer whale (*Orcinus orca*) (SARA listed as Endangered)
- Transient killer whale (*O. orca*) (SARA listed as Threatened)
- Grey whale (*Eschrichtius robustus*) (SARA listed as Special Concern for the Eastern North Pacific population; the Pacific coast feeding group population is designated as Endangered by COSEWIC)
- Humpback whale (*Megaptera novaeangliae*) (SARA listed as Special Concern)
- Harbour porpoise (*Phocoena phocoena vomerina*) (SARA listed as Special Concern)
- Steller sea lion (*Eumetopias jubatus*) (SARA listed as Special Concern)
- Great blue heron (*Ardea herodias fannini*) (SARA listed as Special Concern; BC listed as Special Concern (Blue))
- Brandt's cormorant (*Phalacrocorax penicillatus*) (BC listed as Endangered or Threatened (Red))
- Double-crested cormorant (*P. auritus*) (BC listed as Special Concern (Blue))
- Common murre (*Uria aalge*) (BC listed as Endangered or Threatened (Red))
- Marbled murrelet (*Brachyramphus marmoratus*) (SARA listed as Threatened; BC listed as Special Concern (Blue))

The leatherback turtle (*Dermochelys coriacea*) is also a federally listed marine species (SARA listed as Endangered) that has been observed off the coast of BC; however, sightings are considered rare (Species at Risk Public Registry 2019).

6 Marine - Potential Project-Related Effects

Potential effects from the proposed Project include: 1) shading of habitat from the dock approach, gangway/ramp, main float and six float fingers, and moored boats 2) direct physical disturbance to habitat from barge spud and pile placement, and 3) underwater noise from pile driving. Design considerations and other potential effects from construction-related activities (e.g. accidental spills, working over eelgrass) and operation (e.g. pollutants from motors and bilges) not addressed in this section will be addressed (avoided) through the implementation of the recommended mitigation measures and BMPs, as outlined in Section 7. The following sub-sections describe the three primary project related potential effects.

6.1 Shading

The estimated area of the dock footprint directly overlapping with habitat was interpolated from the preliminary Project design and the intertidal and subtidal survey data. The estimated area of the footprint of moored boats is based on the known length of the float fingers (18.29 m), the known number of float sides (12) that will have moored boats and the anticipated average beam (boat's widest point) (2.6 m) of the moored boats[7]. The average beam was used to calculate the footprint of the moored boats because the minimum or maximum beam will not apply to all moored boats, as there will be a diversity of boat sizes moored at the Anson Road public dock facility. Furthermore, the average beam helps to offset the fact that the beam (width) does not apply to the entire boat length (i.e. the boat tapers towards the bow). Note that the estimated footprint of the moored boats was also calculated using the anticipated average length (6.9 m) of the moored boats (instead of float finger length), anticipated number of boats (30) (instead of number of float sides), and the anticipated average beam (2.6 m) of the moored boats. As the resultant area value for this second calculation (517 m^2) was less than that resulting from the first calculation (i.e. float finger length, number of float finger sides and average beam) (571 m^2), it was decided to use the more conservative calculation (571 m^2). In addition, this more conservative calculation includes more known variables than the second calculation. The estimated area of the footprint of moored boats directly overlapping with habitat was interpolated from the preliminary Project design and the intertidal and subtidal survey data.

Table 3 provides a summary of the dimensions and footprint areas for each of the dock components and for the moored boats.

[7] The beam (a boat's widest point) range for the range of boat lengths (5.5 m to 8.2 m) identified for the Anson Road public dock facility are anticipated to be between 2.4 m and 2.7 m, average boat beam 2.6 m. Lifetimer Boats' specifications (www.lifetimerboats.com) for their pleasure craft series, crew workboat series, runabouts, hardtops and offshore series were referenced as a guideline for identifying boat beams, as their range of boat styles are likely to be similar to what will be moored at the public dock facility.

Table 3. Summary of estimated dimensions and footprint areas for dock components and moored boats.

	Dimensions (m)	Area (m^2)
Dock Approach	27.43 X 3.20	87.8
Gangway/Ramp	10.72 X ~1.92	20.6
Main Float	46.61 X 3.20	149.1
Six Float Fingers	18.29 X 2.74 each	50.11 X 6 = 300.7
	TOTAL Dock Components	**558**
Moored Boats	18.29 (float finger length), 12 float finger sides, 2.6 (average beam)	18.29 X 12 X 2.6 = 570.6
	TOTAL Moored Boats	**571**
	OVERALL TOTAL	**1,129**

With respect to shading effects from the overlapping footprints of the dock components and moored boats, the portion of the habitat that is eelgrass is the subject of the effects assessment due to its value and sensitivity to shading. All other habitat areas overlapping with the footprints of the dock components and moored boats were devoid of vegetation or had less than 5 % vegetation cover that was primarily drift algae and therefore are not considered in the effects assessment with respect to shading.

Shading is one of the primary (anthropogenic) disturbances to *Zostera marina* (eelgrass) resulting in areal reduction (Burdick and Short 1999; Gayaldo et al. 2001; Mumford 2007; Thom et al. 2008). Eelgrass beds beneath and directly adjacent to docks (and associated floats and boats) were shown to be impacted as indicated by depressed shoot density and canopy structure and that severe impacts can lead to eelgrass bed fragmentation (Burdick and Short 1999). Floating docks result in greater severity of impacts with high likelihood for complete elimination of eelgrass shoots beneath the docks and therefore should not be placed over eelgrass and alternatively should be placed in water deeper than the lower depth limit for eelgrass (Burdick and Short 1999; Fisheries and Oceans Canada 1995). In addition, shaded eelgrass beds may be (further) fragmented by boating activities (i.e. prop dredging effects/prop wash) leading to bed destabilization (Burdick and Short 1999; Thom et al. 2008).

Table 4 provides a summary of the estimated area of eelgrass overlapping with the dock footprint. Table 5 provides a summary of the estimated area of eelgrass overlapping with the footprint of the moored boats. Area estimates are provided with and without the five meter buffer that was applied to the perimeter of the eelgrass to account for positional accuracy of the survey methodology.

Table 4. Summary of estimated area of eelgrass overlapping with the dock footprint.

Dock Component	Eelgrass Area (m^2)	% of Total Dock Footprint (558 m^2)	% of Total Eelgrass Area (747 m^2 without 5 m buffer; 1,561 m^2 with 5 m buffer)
Without 5 m Buffer around Eelgrass Perimeter			
Dock Approach	20.3	3.6%	2.7%
Gangway/Ramp	5.4	1%	0.7%
Main Float	0	-	-
Six Float Fingers	<1	0.2%	0.1%
TOTAL	**26.7 (27)**	**4.8%**	**3.5%**
With 5 m Buffer around Eelgrass Perimeter			
Dock Approach*	34.2	6.1%	2.2%
Gangway/Ramp*	13.5	2.4%	0.9%
Main Float**	12.6	2.2%	0.8%
Six Float Fingers**	37	6.6%	2.4%
TOTAL	**97.3 (97)**	**17.3%**	**6.3%**
***Elevated dock components**	**47.7 (48)**	**8.5%**	**3.1%**
****Floating dock components**	**49.6 (49)**	**8.8%**	**3.2%**

Table 5. Summary of estimated area of eelgrass overlapping with the footprint of moored boats.

	Eelgrass Area (m^2)	% of Total Footprint of the Moored Boats ($571\ m^2$)	% of Total Eelgrass Area ($747\ m^2$ without 5 m buffer; $1,561\ m^2$ with 5 m buffer)
Without 5 m Buffer around Eelgrass Perimeter			
Moored Boats	20	3.5%	2.7%
With 5 m Buffer around Eelgrass Perimeter			
Moored Boats	62	10.9%	4.0%

The total area of the surveyed eelgrass bed (without five meter buffer) that overlaps with the dock footprint is estimated at 27 m^2 (less than 5% of the dock footprint and 3.5% of the total eelgrass area surveyed without the five meter applied buffer) and is characterized as trace (<5%) to moderate (25-50%) cover[8]. It is mainly the elevated dock approach and gangway/ramp that overlap with the surveyed eelgrass; only the first float finger on the west side of the main float overlaps with eelgrass and represents less than 1% of the dock footprint; the main float does not overlap with the surveyed eelgrass bed (without five meter buffer). The total area of the surveyed eelgrass bed (without five meter buffer) that overlaps with the footprint of the moored boats is estimated at 20 m^2 (3.5% of the footprint of the moored boats and 2.7% of the total eelgrass area surveyed without the five meter applied buffer) and is characterized as trace (<5%) to low (5-25%) cover[9].

However, to account for positional accuracy of the survey methodology it is best to use the more conservative total area that was calculated with the five meter buffer applied to the perimeter of the eelgrass (Figure 4). The total area of the surveyed eelgrass bed with the applied five meter buffer that overlaps with the dock footprint is estimated at 97 m^2 (17.3% of the dock footprint and 6.3% of the total eelgrass area surveyed with the applied five meter buffer) and is used for the assessment of potential effects. The estimated 97 m^2 consists of 48 m^2 of elevated dock components (dock approach and for the most part the gangway/ramp) and 49 m^2 of floating dock components (main float and float fingers). The total area of the surveyed eelgrass bed with the applied five meter buffer that overlaps with the footprint of the moored boats is estimated at 62 m^2 (10.9% of the footprint of the moored boats and 4.0% of the total eelgrass area surveyed with the five meter applied buffer).

The total area of eelgrass potentially affected by shading from the dock footprint (i.e. 97 m^2) and moored boats (i.e. 62 m^2) (overall total 159 m^2) could be minimized and/or the shading

[8] The total area of habitat without eelgrass that overlaps with the dock footprint is estimated at 531 m^2 without the 5 m eelgrass buffer applied, and 461 m^2 with the 5 m eelgrass buffer applied.
[9] The total area of habitat without eelgrass that overlaps with the footprint of the moored boats is estimated at 551 m^2 without the 5 m eelgrass buffer applied, and 509 m^2 with the 5 m eelgrass buffer applied.

effects could be minimized when taking into the account the following Project design, orientation, materials and operational considerations:

- The dock approach, gangway/ramp and main float are more or less in a north-south alignment, which results in shading directly under the dock for a few hours around (solar) noon, as opposed to the entire day with a west-east orientation (Burdick and Short 1999; Fisheries and Oceans Canada 1995);
- The elevation of the dock approach and for the most part the gangway/ramp (48 m^2), provides a greater distance for sunlight to diffuse and refract around the dock resulting in fewer associated impacts from shading compared to the floating dock structures (49 m^2) and moored boats (62 m^2). However, the extent of shading effects is dependent on the dock height and tidal range (Burdick and Short 1999), which can reach at least 4 m in the region of the Project. Although the dock approach is well elevated above the eelgrass and the gangway/ramp is relatively elevated above the eelgrass compared to the main float and float fingers, they could consist of, in part, light permeable surface materials that allow greater than 50% light penetration (see next bullet);
- The main float and the float fingers (in particular the two inshore fingers) should consist of light permeable surface materials that allows greater than 50% light penetration given they are not elevated above the water surface, and the float fingers are in a more or less west-to-east alignment, which results in shading directly under the dock for most of the entire day. Light permeable deck grating up to 50% of the total dock float area was not adequate by itself to ensure *no-net-loss* of eelgrass (consistently or predictably) according to one study (Fresh et al. 2001). The study suggested that light permeable deck grating greater than 50% of the total float area in combination with a north-south orientation of floats and/or implementing seasonal removal of floats may avoid impacting eelgrass density. The Green Shores™ for Homes' guideline for light penetration is using grating on all overwater structure surfaces that results in a total open area of at least 30%, which can be achieved by using grating with 60% open area on at least 50% of the overwater structure (Green Shores for Homes 2015). Light permeable deck grating not only improves submarine lighting conditions beneath the dock floats, but also light conditions adjacent to the floats by minimizing shadows cast by the floats (Fresh et al. 2001). Light permeable deck grating should be installed so that the long axis runs north-to-south (Blanton et al. 2002). In addition, thinner, wider-spaced grating will allow more light to penetrate under the structure (Blanton et al. 2002); and
- Operationally, restrict the inshore finger float on the west side that overlaps with eelgrass for use by the smallest boats (i.e. dinghies) to minimize shading effects as well as potential effects from prop scour.

The repositioning/orientation of the Project footprint was also considered; however, it is currently constrained by the existing water lot lease area as well as eelgrass located to the west and east of the Project along much of the Horton Bay shoreline. Therefore minor shifts in the position of the Project footprint will not mitigate shading effects, with the exception of extending the length of the main float so that the six finger floats and associated moored boats are well beyond the seaward edge of the eelgrass bed; this would require a modification to the existing waterlot lease area, although the CRD has indicated that this is not possible (Lani O'Dwyer, CRD Project Technologist, e-mail communication, May 22, 2019).

The mitigation measures and BMPs in Section 7 (Design Considerations) outline measures to minimize the effects from shading, including the ones identified above. Refer to Section 8 for an assessment of residual effects from shading from the dock footprint and footprint of the moored boats.

6.2 Direct Physical Disturbance

6.2.1 Barge Spud Placement

Direct physical disturbance of habitat will occur from the placement of barge spuds during pile driving activities and any other Project activity requiring the barge to be positioned at the Project site.

The potentially affected habitat is characterized predominantly as soft bottom habitat with an infaunal community (i.e. tubeworms, bivalves, brittle stars) and a relatively low to moderate diversity and abundance of epifaunal invertebrates, fish and algal (predominantly drift algae) species. Of significance, however, is the eelgrass habitat that is located within and directly adjacent to the proposed dock footprint (Figure 4) and which also extends to the west and to the east of the Project location.

The mitigation measures and BMPs outlined in Section 7 (Construction Tending Vessel and Barge Operations) include measures to prevent or minimize the effects from barge spud placement such as minimizing the movement/positioning of the barge, providing the contractor with ideal locations for spudding and establishing eelgrass exclusion zones where possible. The mitigation measures and BMPs outlined in this section also address potential effects to the seabed/eelgrass from the operation of construction-tending vessels (e.g. prop scour).

Refer to Section 8 for an assessment of residual effects from barge spud placement.

6.2.2 Pile Placement

Direct physical disturbance of habitat will occur from the placement of up to 40 steel piles, likely 12-inch diameter, that are currently estimated for the public dock facility. As identified in the previous section, the potentially affected habitat is characterized predominantly as soft bottom habitat with an infaunal community and a relatively low to moderate diversity and abundance of epifaunal species, although eelgrass habitat is also present within and directly adjacent to the proposed dock footprint. As detailed Project designs are unavailable at this time, the exact locations of the piles are unknown. Therefore it is unknown whether direct physical disturbance to the eelgrass habitat will occur from the placement of piles. A calculation of the total area of eelgrass affected will need to be completed once the number of piles overlapping with eelgrass is known.

The mitigation measures and BMPs outlined in Section 7 (Design Considerations) include measures to minimize the effects from pile placement such as minimizing the Project footprint and number of piles required, locating piles in areas without eelgrass, and considering the use of an alternative dock/float anchoring system such as the system that incorporates specialized Seaflex® dock/float mooring "lines" and Nautiscaphe® helical anchors (http://www.seaflex.net).

Refer to Section 8 for an assessment of residual effects from pile placement.

6.3 Pile Driving Noise

Noise generated during pile driving activities may potentially result in physical injury to fish and potentially prevent fish from reaching breeding and spawning grounds. In addition, it may potentially result in physical injury or disturbance to marine mammals. The magnitude of the effects depends on the pile material and type of hammer being used.

The scheduling of construction inside the least risk timing windows (i.e. marine/estuarine timing windows) for the Project site will minimize interactions on herring and salmon. The use of a vibratory hammer will result in reduced sound levels relative to impact pile driving. If impact pile driving is to be utilized and/or if pile driving occurs outside the least risk timing windows, bubble curtains and/or other fish exclusion measures will be required as per the pile driving Best Management Practices (BC Marine and Pile Driving Contractors Association 2003) and the mitigation measures and BMPs listed in Section 7 (Pile Driving), which also include measures to protect marine mammals during pile driving activities.

One option is to minimize the number of piles required along the main float and float fingers by using an alternative dock/float anchoring system identified in the previous section.

Refer to Section 8 for an assessment of residual effects from pile driving noise.

7 Marine - Recommended Mitigation Measures and Best Management Practices

This section outlines the mitigation measures and Best Management Practices (BMPs) recommended for implementation during construction and operation of the proposed Project, as well as design considerations, to minimize or prevent potential residual effects to the marine environment resulting from the Project. Refer to Section 13 of the Upland EIA for additional mitigation measures and BMPs identified for the upland portion of the Project that also relate to protecting the marine environment.

One of the proposed recommendations is environmental monitoring of the site, particularly during any work in environmentally sensitive areas (i.e. eelgrass) or when higher risk activities are being conducted (i.e. impact pile driving). Regarding the frequency of environmental monitoring, it is anticipated that the Environmental Monitor would have a significant presence on-site during Project initiation, the establishment of environmental controls, and during key activities taking place in areas where sensitive environmental features/functions may be affected. Initially, frequent monitoring is anticipated in order to assess the efficacy of environmental controls. The requirement for monitoring visits to the Project site will subsequently be reduced as construction proceeds.

Design Considerations (excerpted from Fisheries and Oceans Canada 2001 and 2018; Green Shores for Homes 2015)

- Design dock facility and plan activities and works in the waterbody such that loss or disturbance to aquatic habitat is minimized and sensitive spawning habitats are avoided, and impacts to SARA-listed aquatic species, their residences or critical habitat are avoided;
- Design and construct approaches to the waterbody such that they are perpendicular to the waterbody to minimize loss or disturbance to coastal riparian vegetation;
- Minimize the footprint to only what is required to serve the purpose;
- Use the minimum number and size/diameter of pilings required to achieve safety and stability to minimize disturbance to the seabed, in particular eelgrass habitat;
- Locate piles in areas without eelgrass wherever possible;
- Consider using an alternative dock/float anchoring system such as the system that incorporates specialized Seaflex® dock/float mooring “lines” and Nautiscaphe® helical anchors. The Seaflex® mooring system does not result in erosion/scour impacts to the seabed from dragging or a swing radius as traditional chain-based anchoring systems do. The Nautiscaphe® helical anchors have a minimal seabed footprint compared to traditional concrete block anchors;
- Dock approach should be at least 2 to 2.3 m above the higher high water mark;
- Dock approach and gangway/ramp should be less than 1 to 1.5 m wide;
- Floats should be limited to 3 m wide and 8 m long;

- Finger floats should not rest on the seabed at any time. The minimum clearance below the floats at the lowest low tide should be 1.5 m to prevent propeller wash from disturbing the seabed;
- Use grating or space boards on all overwater structure surfaces (namely gangway/ramp, main float and float fingers) that allow greater than 50% light penetration or use grating on all overwater structure surfaces that results in a total open area of at least 30%, which can be achieved by using grating with 60% open area on at least 50% of the overwater structure;
- Avoid overwater lighting, or minimize and use diffuse lighting that is not directed downward to the water or upward to the sky to avoid/minimize effects on marine life (e.g. fish) and wildlife; and
- Operationally, restrict the inshore finger float on the west side that overlaps with eelgrass for use by the smallest boats (i.e. dinghies) to minimize shading effects as well as potential effects from prop scour.

General

- Prepare a Project-specific Environmental Management Plan (EMP) that outlines the mitigation measures and BMPs and how they will be implemented. Provide EMP to all contractor employees for review and acknowledgment of understanding;
- Ensure the proponent, Environmental Monitor(s) and contractors on-site are familiar with mitigation measures and BMPs and ensure appropriate equipment and personnel are in place to execute the mitigation measures and BMPs as required;
- Contractors must be able to properly install any protection measures and understand mitigation measures and BMPs used on the Project. If measures are not properly installed, they will not provide the necessary environmental protection;
- Appropriate supplies (e.g. bubble curtain during pile driving activities; silt curtain) required to execute BMPs (e.g. underwater noise control measures; turbidity control measures potentially required during pile cleaning and water pumping, and pile drilling if method applied) should be readily available on-site in sufficient quantities for the local conditions;
- Prepare to change existing mitigation measures and BMPs should they fail or be deemed inadequate by the Environmental Monitor or a regulatory agency;
- Minimize the area disturbed by construction activities spatially and temporally;
- Minimize foot traffic and heavy equipment operation, if required, within the exposed intertidal zone spatially and temporally;
- Minimize duration of in-water work;
- Conduct work in intertidal zone at low tide to further reduce the risk to fish and fish habitat and/or isolate work from tidal waters;

- Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage or result in the stranding or death of fish;
- Ensure appropriate protocols are applied, and applicable permits for relocating fish are obtained and to capture any fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters;
- Ensure that building material used in the marine environment has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish; and
- Schedule project works to coincide with the least risk timing windows (i.e. marine/estuarine timing windows) for the Project site to reduce the risk of harm to fish and fish habitat. Timing windows for Area 18 Cowichan are between December 1 – February 15 (winter window) and July 1 – October 1 (summer window): (http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/bc-s-eng.html#area-18).

Coastal Riparian and Shoreline

- Minimize clearing of coastal riparian vegetation and avoid disturbance of soils where the dock approach is attached to land, as vegetation removal and soil disturbance can increase erosion and sedimentation of the intertidal zone and adjacent subtidal areas. This is of particular importance given the degree of existing upland/shoreline erosion at the Project site. Typically a minimum vegetated buffer of 15 m to 30 m set back from the higher high water mark is recommended, with wider buffers sometimes required in more remote and undeveloped crown foreshore areas (Stewardship Centre of BC date unknown). Stabilization of the existing eroding shoreline through re-vegetation or as specified by a coastal shoreline erosion specialist should be undertaken;
- Do not remove coastal riparian vegetation if the riparian area is identified as part of critical habitat of an aquatic listed species at risk;
- Immediately stabilize shoreline disturbed by any activity associated with the Project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site; and
- Minimize the removal of natural woody debris, rocks, sand or other materials from the shoreline below the ordinary high water mark. If material is removed, set it aside and return it to the original location once construction activities are completed.

Machinery and Equipment

It is anticipated that heavy equipment and machinery (e.g. pile driving equipment) will be necessary for on-site Project construction activities in the marine environment including barges and tending vessels. Mitigation measures to reduce the impact of machinery and equipment on site are as follows:

- Ensure that machinery and equipment arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds;
- Inspect, keep clean and maintain all equipment, heavy machinery, and vessels in good working condition to prevent leaks of potentially deleterious products (e.g. hydraulic fluid, diesel, gasoline and other petroleum products) or transmission of noxious fumes;
- Maintain all equipment to limit noise generation and fit with functioning exhaust and muffler systems. Ensure all equipment complies with local emissions standards. Minimize idling of vessels and equipment. Turn off equipment and machinery when not in use. As much as possible, coordinate construction activities with daylight periods and regional noise bylaws;
- Ensure all machinery working in or around water has marine grade fluids and oils;
- For machinery working in or around water, utilize biodegradable hydraulic fluid where its use is compatible with the manufacturer's specifications of construction equipment required to achieve project-specific construction objectives;
- Ensure an emergency spill response/containment kit will be readily accessible on each piece of equipment, barge and tending vessel;
- Operate equipment at optimum rated loads and turn off when not in use;
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water. Ideally, refuel equipment on land and at least 30 metres from any waterbody where possible. Ensure appropriate spill prevention and containment measures are in place at all times during refueling or use of petroleum or other harmful chemicals on site;
- Minimize light pollution by pointing lights downward and placing task lighting as close to the work area as possible; and
- Use of heavy equipment below the high water mark should be avoided wherever possible (i.e. operate machinery on land above the high water mark or from a floating barge). If necessary, the work must occur only under approved conditions and when the intertidal zone is not wetted by the tide. Minimize back and forth movements (tracking) within the exposed intertidal zone.

Construction Tending Vessel and Barge Operations

- Conduct works during suitable tides to prevent grounding by barges on the seabed;
- Ensure construction vessels are not operating in shallow water causing direct, physical disturbance to seabed/habitat (i.e. eelgrass bed) from prop scour, which can also lead to sediment resuspension/turbidity and sedimentation of habitat, algae and sessile organisms;
- Minimize movements/repositioning of barge(s) and subsequent spudding to minimize direct, physical disturbance to seabed;

- Create surface marked exclusion zone to avoid effects to eelgrass bed (i.e. avoid positioning of barge(s) over eelgrass beds to prevent spudding in the bed and shading of the habitat; may require on-site confirmation of eelgrass bed boundaries);
- Minimize vessel traffic over the eelgrass bed; and
- Avoid purposefully approaching marine mammals. Vessels must maintain a minimum distance of 100 m from marine mammals with the exception of all populations of killer whales (*Orcinus orca*) where a minimum 200 m approach distance is required and a minimum 400 m approach distance is required between June 1 and October 31 in southern resident killer whale critical habitat (echo sounders should be shut off and engines turned to idle when killer whales are within 400 m)[10].

Turbidity and Upland Erosion and Sediment Control

Although turbidity is anticipated to be negligible during in-water construction activities, there is still the potential for it to occur as a result of pile cleaning and water pumping, and pile drilling if this method is employed. In addition, construction activities in the upland portion of the Project may result in increased erosion at the site and the potential for sediment release into the surrounding (marine) environment. The following mitigation measures have been developed to minimize the effects of construction activities on the marine environment, most of which have been excerpted from Section 13 of the EIA as they relate to upland construction activities that can directly or indirectly effect the marine environment (See Section 13 for more details on upland erosion and sediment control):

- Monitor water quality for turbidity and implement silt curtains around in-water works (i.e. pile cleaning and water pumping, pile drilling) if turbidity levels exceed the BC Approved Water Quality Guidelines (i.e. 8 NTU over background);
- Ensure erosion and sediment control equipment and devices are readily available and in sufficient quantity on site. Ensure construction team members are trained in the appropriate installation and use of ESC equipment. ESC measures will be reviewed and approved by a Qualified Environmental Professional (QEP) prior to work beginning;
- Prepare to install ESC equipment and measures quickly to minimize sediment entering the marine environment. The overall goal is to isolate the work area and prevent any potential sediment-laden runoff from entering the marine environment (i.e. from upland clearing and cut/fill/grading activities, disturbance to the steep eroding bank along the high water mark);
- Install a floating curtain in the receiving marine environment to isolate potential effects of sediment runoff from the construction site, if terrestrial ESC measures are inadequate for containing sediment runoff from the site;

[10] https://www.dfo-mpo.gc.ca/species-especes/mammals-mammiferes/watching-observation/index-eng.html

- Minimize exposed soil and sediment on site through phasing of construction activities, retaining as much vegetation as possible, or covering exposed areas with an appropriate temporary material (e.g. plastic sheeting or filter cloth);
- Stabilize disturbed areas at the end of construction through the effective use of soil cover (e.g. vegetation, straw mulch, erosion control blankets);
- Schedule project activities for dry or fair weather whenever possible to minimize erosion and sediment concerns. Additional ESC measures may need to be erected during or in anticipation of heavy precipitation. Avoid Project works during times of extreme precipitation;
- Re-vegetate all areas that are not part of the final footprint of construction to prevent potential surface erosion and siltation of aquatic habitat;
- Protect exposed soil on any steep grade at the end of construction from surface erosion by hydroseeding with a heavy mulch, tackifier, and seed mix or by installing erosion control blankets;
- Inspect ESC structures at least weekly and after each storm event of 25 mm+ of rain within a 24-hour period. Complete repairs as required;
- Avoid entering a wetted area with machinery unless appropriate approvals have been obtained to do so. Isolate the site to minimize the potential generation of sediment;
- Avoid site grading activities during periods of inclement weather; and
- Retain sediment-laden water exceeding discharge limits until concentrations reach an acceptable level.

Pile Driving

The 2003 BMPs for pile driving (BC Marine and Pile Driving Contractors Association 2003) indicate that steel piles less than 18-inch in diameter will not result in shock waves in excess of 30 kPa (equivalent to approximately 209.54 dB peak sound pressure level (SPL)[11]) and that hydrophone and visual monitoring and protective measures to reduce shock waves are not expected to be required regardless of pile driving method (i.e. vibratory and impact). Although the steel piles for the Project are 12-inch diameter, Fisheries and Oceans Canada may still require that initial acoustic monitoring be conducted to verify sound pressure levels during impact pile driving activities. This may also extend to initial vibratory pile driving activities. The CRD should confirm with Fisheries and Oceans Canada the monitoring requirements, including the monitoring thresholds (see below), based on the Project area, pile size and pile driving equipment being used.

[11] The peak sound pressure level (SPL) threshold more recently referenced by Fisheries and Oceans Canada for monitoring fish injury/mortality sound levels is 206 dB re: 1μPa as well as a cumulative sound exposure level (cSEL) of 187 dB re $\mu Pa^2 s$.

The following mitigation measures and BMPs are typically required by Fisheries and Oceans Canada for impact pile driving to minimize impacts to fish and marine mammals:

- Implement acoustic monitoring that adheres to the following sound pressure level thresholds and exclusion zones, which are based on requirements formally written by Fisheries and Oceans Canada for other projects involving impact pile driving:

  <u>Fish:</u>

  - Injury/mortality sound levels not to exceed a peak sound pressure level (peak SPL) of 206 dB re: 1μPa and a cumulative sound exposure level (cSEL) of 187 dB re $\mu Pa^2 s$ for fish at a practical and implementable fish exclusion zone (e.g. 10 m from sound source);
  - Stop impact pile driving and notify Fisheries and Oceans Canada immediately if sound levels exceed 206 dB re: 1μPa at the fish exclusion zone boundary and/or if dead or distressed fish are observed within or in close proximity to the Project site. Work will not proceed until additional mitigation measures are implemented that reduce the sound levels below the threshold (e.g. deployment of bubble curtain over full length of wetted pile[12], amend exclusion zone distance, extend hammer 'ramp up'/'soft start'[13]) and/or preclude the further distress or death of fish;
  - Suspend activities if aggregations of Pacific herring or salmon are observed within or in close proximity to the Project site during respective sensitive periods (more likely in fall and winter for returning adult salmon, spring for out-migrating juvenile salmon, and February to June for spawning Pacific herring, i.e. if working outside the least risk timing windows). Assess potential for activities to disturb or interfere with the fish and decide on appropriate management actions; and
  - Temporarily suspend activities if Pacific herring spawn is observed within or in close proximity to the Project site. Implement appropriate management actions or further suspend activities until the eggs have hatched and detached from equipment and/or materials (e.g. piles) and larvae have dispersed into the water column.

  <u>Marine Mammals:</u>

  - Define marine mammal exclusion zone using a disturbance threshold of 160 dB re: 1μPa (RMS for repetitive activities) and confirmed by acoustic monitoring and recording of activities;
  - Stop impact pile driving if sound levels exceed 160 dB re: 1μPa at the marine mammal exclusion zone boundary. Work will not proceed until additional

[12] Use of a bubble curtain may be required at all times during impact pile driving and for certain during impact pile driving that is allowed to be conducted outside the least risk timing windows.
[13] Hammer 'ramp up'/ 'soft start' should be conducted at all times not just when an exceedance is identified.

mitigation measures are implemented that reduce the sound levels below the threshold (e.g. deployment of bubble curtain over full length of wetted pile, amend exclusion zone distance, extend hammer 'ramp up'/'soft start');

- Complete pile driving that results in sound levels above 160 dB re: 1μPa (inside the marine mammal exclusion zone) during daylight hours;
- Ensure that identified marine mammal exclusion zone is clear of marine mammals prior to commencing or during impact pile driving; and
- Delay or stop impact pile driving if a marine mammal is in or enters the exclusion zone before or during impact pile driving operations. Impact pile driving must not start until the marine mammal has left the exclusion zone or when a minimum of 30 minutes has elapsed since the last sighting of the marine mammal.

Appropriate acoustic monitoring equipment needs to be identified based on the defined Project monitoring requirements (i.e. capability of live readings). In addition to the above, other best management practices for pile driving outlined by the BC Marine and Pile Driving Contractors Association (2003) should be followed where applicable.

Concrete Works and Grouting

The following BMPs are recommended to prevent and minimize the potential for impacts on the receiving environment from concrete works and grouting:

- Use pre-cast structures where possible;
- Prevent uncured or wet concrete from contact with precipitation or marine waters (minimum of 72 hours curing);
- Carefully pour and distribute concrete to minimize spillage;
- Complete concrete works in isolation of flowing water or marine waters (i.e. complete in the dry during low tides);
- Employ proper housekeeping and appropriate work site isolation techniques to minimize the potential for spills;
- Ensure appropriate spill cleanup materials are readily available, easily accessible, and in sufficient quantity on site; and
- If applicable, contain all wastewater, such as displacement water from piles during concrete tremie placement works, until water quality monitoring confirms applicable water quality criteria are met.

Storage of Petroleum Products

Petroleum products (i.e. fuels, oils, hydraulic fluids and lubricants) will be used during construction. Effective mitigation will be required to ensure that these materials are stored and managed appropriately and are not accidentally discharged to the marine environment. The following BMPs will mitigate the effect of petroleum product use on site:

- Store all petroleum products used on-site in a designated location that poses no risk of marine water contamination. Secure the designated storage area and clearly label and manage it in accordance with local safety regulations;
- Use impervious containment structures able to contain 110% of the maximum capacity of storage vessels on the site;
- Handle petroleum products in such a manner as to minimize leakage and spillage and ensure containment and recovery in the event of a spill. Remove petroleum products no longer required from the site;
- Appropriately label containers and designate them to be used for the temporary storage of used petroleum products. Do not use these containers for disposal of garbage or construction debris; and
- Inspect the site on a regular basis to ensure that all waste petroleum products and waste materials (e.g. oil cans, grease tubes, oily rags) are collected and properly disposed of at a location approved by regulatory authorities.

Spill Prevention and Readiness

Project construction will involve the operation of vessels, equipment and machinery using petroleum products (i.e. fuels, oils, hydraulic fluids, lubricants) and other substances that may be deleterious if released into the marine environment. There is, therefore, the potential for environmental damage to occur from accidental spills of petroleum or other products to the marine environment with the resulting potential for contamination of the marine waters and habitat. To minimize the likelihood and potential environmental impact of a spill event, BMPs to be implemented during construction include:

- Establish a Project-specific Emergency and Spill Response Plan prior to commencement of site preparation and/or construction activities to ensure compliance with Project-specific environmental protection measures and commitments;
- Response plan is to be implemented immediately in the event of a spill of a deleterious substance;
- Maintain appropriate supplies for spill response and containment on all construction equipment onsite. Maintain a spill kit in an accessible central location;
- Identify all materials of a deleterious nature that could be spilled;
- Ensure all Contractor personnel are trained in proper spill containment and remediation procedures;
- Monitor all on-site storage areas throughout the construction period for signs of spillage or leakage of stored product;

- Inspect and monitor equipment, storage, refueling/maintenance and construction areas regularly; and
- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, poured concrete or other chemicals do not enter the watercourse.

Solid Waste Management

Solid wastes generated during the Project will be removed from the site for recycling, where possible, or disposal. The following BMPs will minimize the effects of solid waste on the receiving environment:

- Recover all pile cut offs, waste or any miscellaneous unused materials for either disposal in a designated facility or placed in storage. Under no circumstances will materials be deliberately thrown into the marine environment;
- Collect all recyclable or compostable materials separately from general waste according to regional bylaw requirements. Remove garbage from site on a regular basis;
- Adhere to all applicable legislation with respect to the handling, transportation, and/or disposal of all materials related to the Project. Regulations include, but are not limited to, the *BC Hazardous Water Regulations*, *Spill Reporting Regulations*, *Workers Compensation Board Regulations*, *Transportation of Dangerous Goods Regulations*, etc.;
- Provide portable sanitary facilities on-site for workers' use throughout the duration of the construction period. Service the facilities regularly with a qualified Contractor;
- Provide properly labeled separate container(s) for potentially hazardous waste such as oily rags and hydrocarbon absorbent pads. Handle and transport absorbent materials or soils contaminated with oil (greater than 3% by weight) or any quantity of gasoline as Hazardous Waste. Excavate and haul off any contaminated soils to an authorized treatment/disposal area in accordance with the *BC Hazardous Waste Regulations*; and
- Remove all construction-related materials from site upon Project completion.

Operation

- The placement of educational signage regarding the presence and ecological importance of the eelgrass habitat, as well as the importance to protect it, will help mitigate potential effects occurring from regular dock use, such as the deposition of anthropogenic debris and boat operation over the eelgrass habitat; and
- Adoption of responsible boating principles such as those outlined in Georgia Strait Alliance's Green Boating Program will encourage environmental stewardship with regards to fuelling, sewage, bilge waste, boat maintenance, waste disposal, eco-friendly materials, and wildlife interactions and sensitive areas (https://georgiastrait.org/wp-content/uploads/2019/04/19.GGB-web.pdf).

8 Marine - Residual Effects Assessment and Summary

Table 6 provides a summary of the criteria used to characterize the residual effects, post mitigation, for the marine portion of the proposed public dock facility. These criteria are identified by Fisheries and Oceans Canada as a requirement of the AEA.

Table 6. Criteria for the characterization of residual effects for the marine portion of the proposed public dock facility at Anson Road.

Criteria	Definitions		
Magnitude Intensity or severity of the effect	*Low* - a measurable change from existing baseline conditions but is below environmental and/or regulatory thresholds.	*Moderate* - a measurable change from existing baseline conditions that is below but approaching environmental and/or regulatory thresholds.	*High* - a measurable change from existing baseline conditions that is above environmental and/or regulatory thresholds.
Geographic Extent Spatial range of the effect	*Site-Specific* - effects are contained within the Project footprint.	*Local* – effects are contained within the local study area (i.e. Horton Bay and water bodies along east side of Mayne Island).	*Regional* – effects are contained within the regional study area (i.e. Gulf Islands area).
Duration Temporal period for which the effect will persist	*Short Term* - residual effect restricted to project construction and/or decommissioning phase and is predicted to return to existing baseline conditions within two years with no lasting effect.	*Long Term* - residual effect continues for more than two years after the project construction and/or decommissioning phase, before returning to existing baseline conditions.	*Permanent* - residual effect is unlikely to return to existing baseline conditions.
Probability Likelihood of the effect occurring	*Low* - the predicted residual effect is not likely to occur.	*Moderate* - the predicted residual effect has a reasonable likelihood to occur.	*High* - the predicted residual effect is likely to occur or certain.

Table 7 provides a summary of the potential project-related effects, the recommended mitigation measures and BMPs to minimize or offset the effects, and the magnitude, geographic extent, duration, and likelihood of residual effects after the implementation of the mitigation measures and BMPs.

Table 7. Summary of potential Project-related effects, recommended mitigation measures and BMPs, and resultant residual effects associated with the marine portion of the proposed public dock facility at Anson Road.

	Shading	Direct Physical Disturbance	Noise
Potential Project-Related Effects	Shading of estimated 159 m^2 trace to moderate cover of eelgrass (97 m^2 from dock footprint; 62 m^2 from footprint of the moored boats).	1) Habitat disturbance from barge spud placement. 2) Habitat disturbance from pile placement.	Noise from impact pile driving may injure and/or disturb fish and marine mammals.
Mitigation	Light permeable surfaces for gangway/ramp, main float and finger float with consideration also given to dock approach.	1) Minimize repositioning of barges to minimize spud placement; 2) Where possible, identify areas where eelgrass is absent or minimal for spud placement; 3) Establish eelgrass exclusion zone if possible. 1) Reduce number of required piles if possible; 2) Consider use of alternative specialized dock/float mooring "lines" instead of piles for the main float and float fingers; 3) Where possible, identify areas where eelgrass is absent or minimal for pile placement.	1) Pile driving scheduled within the least risk timing windows; 2) Use of a vibratory hammer instead of an impact hammer, or the use of an impact hammer with implementation of bubble curtains and/or other fish exclusion measures; 3) Acoustic monitoring (at least during initial impact pile driving activities) to verify sound pressure levels and to ensure thresholds are not exceeded; and 4) Monitoring for fish and marine mammals within the work area during pile driving operations.
Potential Residual Effect? (Y/N)	Y	Y	Y
Magnitude	Low to Moderate	Low (areas without eelgrass) Moderate to High (if eelgrass directly impacted by barge spud or pile placement)	Low

	Shading	Direct Physical Disturbance	Noise
Geographic Extent	Site-Specific	Site-Specific	Local
Duration	Long Term	Short Term (spud placement) Long Term (pile placement)	Short Term (~4 weeks)
Probability	Moderate to High	Moderate	Low

8.1 Shading

Although general effects on eelgrass from shading is known from available literature, the specific shading effects that might occur from the proposed public dock facility and moored boats are unknown as certain variables are unknown such as deck grating and light permeability specifications and exact dimensions of moored boats. In addition, there will be variability in the shading effects as some of the eelgrass habitat potentially affected overlaps with elevated structures (dock approach, gangway/ramp) (48 m^2) while the remaining overlaps with floating structures (main float, float fingers) (49 m^2) and moored boats (62 m^2). However, the residual effects from shading are anticipated to be low to moderate in magnitude, limited spatially and long term if the majority of the design and operational considerations outlined in Section 7 can be implemented.

8.2 Direct Physical Disturbance

8.2.1 Barge Spud Placement

With the implementation of relevant mitigation measures and BMPs outlined in Section 7 (Construction Tending Vessel and Barge Operations), the residual effects from the deployment of barge spuds in areas without eelgrass are anticipated to be low in magnitude, limited spatially, and short term; affected infaunal and epifaunal communities are expected to recover to a pre-construction state relatively quickly.

In areas with eelgrass, avoidance or an exclusion zone may not always be possible (i.e. the pile driving crane barge will likely need to access areas adjacent to the length of the dock approach where eelgrass is present on both sides of the proposed alignment). Discussions with the contractor will be required to identify options for avoiding as much of the eelgrass, if not all of the eelgrass, during the deployment of barge spuds. If eelgrass cannot be avoided, the residual effects from barge spud placement are anticipated to be limited spatially, short term, but moderate to high in magnitude depending on the extent of eelgrass affected and whether it results in rhizome exposure (i.e. around edge of depression created by the spud), plant damage or plant loss.

8.2.2 Pile Placement

With the implementation of relevant mitigation measures and BMPs, the residual effects from pile placement in areas without eelgrass are anticipated to be low in magnitude, limited spatially, and long term.

Outside of identifying areas devoid of eelgrass (within and outside the eelgrass bed) where piles can be located, minimizing the number of piles required, and/or using an alternative dock/float anchoring system such as the Seaflex® dock/float mooring "lines" and Nautiscaphe® helical anchors there are few available measures to fully mitigate the effect from pile placement on eelgrass. The repositioning/orientation of the Project footprint is constrained by the existing water lot lease area as well as eelgrass located to the west and east of the Project. If eelgrass cannot be avoided, the residual effects from pile placement are anticipated to be limited spatially, long term, but moderate to high in magnitude depending on the extent of eelgrass affected and whether it results in rhizome exposure or plant damage at the edge of the piles or plant loss.

8.3 Pile Driving Noise

With respect to noise effects from pile driving, given that the anticipated construction time is short (approximately four weeks), and the potential noise effects from pile driving can for the most part be mitigated, it is anticipated that residual effects to fish and marine mammals will be low in magnitude, limited to a local area, and short term provided the mitigation measures and BMPs outlined in Section 7 (Pile Driving) are implemented.

8.4 Conclusion

As the specific shading effects on eelgrass that might occur from the footprints of the dock and moored boats are unknown and the potential direct physical disturbance or impact to eelgrass from barge spud and pile placement is unknown, it is possible that a pre- and post construction monitoring program will be required as a first step. The monitoring program would serve to identify and characterize negative effects that occur on the eelgrass bed from shading and barge spud and pile placement and would be conducted at a frequency specified by Fisheries and Oceans Canada[14]. Baseline data (e.g. area, percent cover, density, length area index (LAI) measurements) would be collected prior to dock facility construction, and thereafter collected annually at the same time of year as the baseline to eliminate seasonal variation.

If offsetting measures are required instead of or as a result of the monitoring program, there is the option to conduct eelgrass transplants within the Horton Bay dock facility footprint after it is decommissioned, as there is an existing, well-established eelgrass bed located to the east of the dock facility that likely would expand naturally into the area of the dock facility footprint along with some transplant enhancement measures. The offsetting habitat would require monitoring typically over a five year period where monitoring is conducted in Year 1, 2, 3 and 5.

[14] Due to the carbohydrate storage capacity of eelgrass rhizomes, effects from shading may not be obvious for several months therefore it is important to monitor for at least one full growing season (Shafer 1999). Based on similar projects, Fisheries and Oceans Canada may require the monitoring to take place over a three to five year period where monitoring is conducted in Year 1, 2, 3 and/or 5.

Upland Environmental Impact Assessment

9 Upland Desktop Review and Survey Methods

The Environmental Impact Assessment (EIA) of the upland Project component (terrestrial and freshwater) included a combination of desktop review of existing publically available information and field data collection at the Project site. The desktop review consisted of background review and information gathering on the Project site and broader Mayne Island area. Information was gathered to document species known to use the area, possible migratory concentration areas in the area and possible species at risk or of conservation concern that may use the area.

The Committee on Endangered Species in Canada (COSEWIC) identifies species of potential conservation concern in Canada and assesses them as Data Deficient, Not at Risk, Special Concern, Threatened, Endangered, Extirpated or Extinct. The species may then be considered for listing under SARA as Extirpated, Endangered, Threatened or Special Concern. Species are listed in a provincial ranking system, typically with input based on COSEWIC's assessment, by the BC Conservation Data Centre (CDC) as Yellow (Secure, Not-at-Risk), Blue (Special Concern, at risk of becoming Threatened) or Red (Threatened or Endangered, at risk of becoming Extinct or Extirpated). For the upland assessment, terrestrial and freshwater species of conservation concern include species listed as Endangered, Threatened, or Special Concern under SARA or recommended for listing under COSEWIC, as well as species listed as Red or Blue by the CDC.

Information collected and reviewed for relevance to the upland assessment included the following:

- Provincial IMapBC data and CDC data;
- Important habitat features known to occur in the area (e.g. Important Bird Areas (IBAs), wetlands);
- Species of conservation concern known to occur in the area;
- Biogeoclimatic data;
- Potentially sensitive environmental features, significant wildlife habitat and water bodies; and
- Available local species lists and other sources of species information (where relevant).

Information collected through the desktop review was supplemented with information collected at the Project site. On April 10, 2019, a Dillon biologist travelled to Mayne Island and completed a survey of the upland environment of the Project site. The site review was conducted with consideration for project effects related to fish and fish habitat, migratory birds, occupied bird nests, and wildlife as protected in BC (*Fish Protection Act*, *Riparian Areas Protection Act*, *Wildlife Act*) and Canada (*Fisheries Act*, *Migratory Bird Convention Act*, SARA). During the assessment, wildlife observations, potential bird nesting locations, descriptions of existing watercourses and descriptions of existing environmental features were recorded. Field methods followed standard protocols adapted from *Field Manual for Describing Terrestrial Ecosystems* (MOE 1998).

10 Upland Survey Results

The weather during the upland survey was mild (8°C), with gentle breeze15, 80 - 100% cloud and intermittent rain. The rain throughout the day resulted in accumulated runoff (5% of culvert capacity) in all ditches that were observed at the Project site.

The Project site is bounded by the properties of 686 Horton Bay Road to the west and 694 Horton Bay Road to the east. There is a dirt driveway that intersects the Project site. The property slopes from approximately 25 m above sea level along Horton Bay Road to approximately 2 m above sea level at the boundary with the intertidal zone. The canopy covers the majority of the Project site, with the understory less developed and partially cleared by a large gravel driveway intersecting the property. The canopy at the property is dominated by Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*) western hemlock (*Tsuga heterophylla*), red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and western red cedar (*Thuja plicata*). Shrub and understory species include Oregon grape (*Berberis* spp.), sword fern (*Polystichum munitum*), red-flowering currant (*Ribes sanguineum*), salal (*Gaultheria shallon*), huckleberry (*Vaccinium* spp.), oceanspray (*Holodiscus discolor*), stinging nettle (*Urtica dioica*), salmonberry (*Rubus spectabilis*) and Indian plum (*Oemleria cerasiformis*). There was an occurrence of a large English holly (*Ilex aquifolium*) within the property, and one adjacent to the Project site (Figure 9). A number of small Scotch broom (*Cytisus scoparius*) plants were observed along Horton Bay Road (Figure 9).

During the upland survey, numerous passerine species were observed at the site including song sparrow (*Melospiza melodia*), common raven (*Corvus corax*), brown creeper (*Certhia americana*), red-breasted nuthatch (*Sitta canadensis*), Oregon junco (*Junco hyemalis*), American robin (*Turdus migratorius*), chestnut-back chickadee (*Poecile rufescens*), Pacific wren (*Troglodytes pacificus*), ruby-crowned kinglet (*Regulus calendula*), Anna's hummingbird (*Calypte anna*), and golden-crowned kinglet (*Regulus satrapa*). Other avian species observed included Northern flicker (*Colaptes auratus*), hairy woodpecker (*Leuconotopicus villosus*), bald eagle (*Haliaeetus leucocephalus*), turkey vulture (*Cathartes aura*), bufflehead (*Bucephala albeola*) and gulls (*Larus* spp.). Many of the passerine species were observed calling, singing and feeding on the Project site. No nest of any bird species were observed. In particular, no eagle, osprey, heron or falcon nests, which are protected at all times, per *The Wildlife Act*, were observed within or immediately adjacent to the Project site. Two trees with evidence of extensive wildlife use by woodpeckers or other species ("wildlife trees") were observed during the upland survey (Figure 9).

[15] Government of Canada. 2017. Beaufort wind scale table. Accessed April 29, 2019 at: https://www.canada.ca/en/environment-climate-change/services/general-marine-weather-information/understanding-forecasts/beaufort-wind-scale-table.html

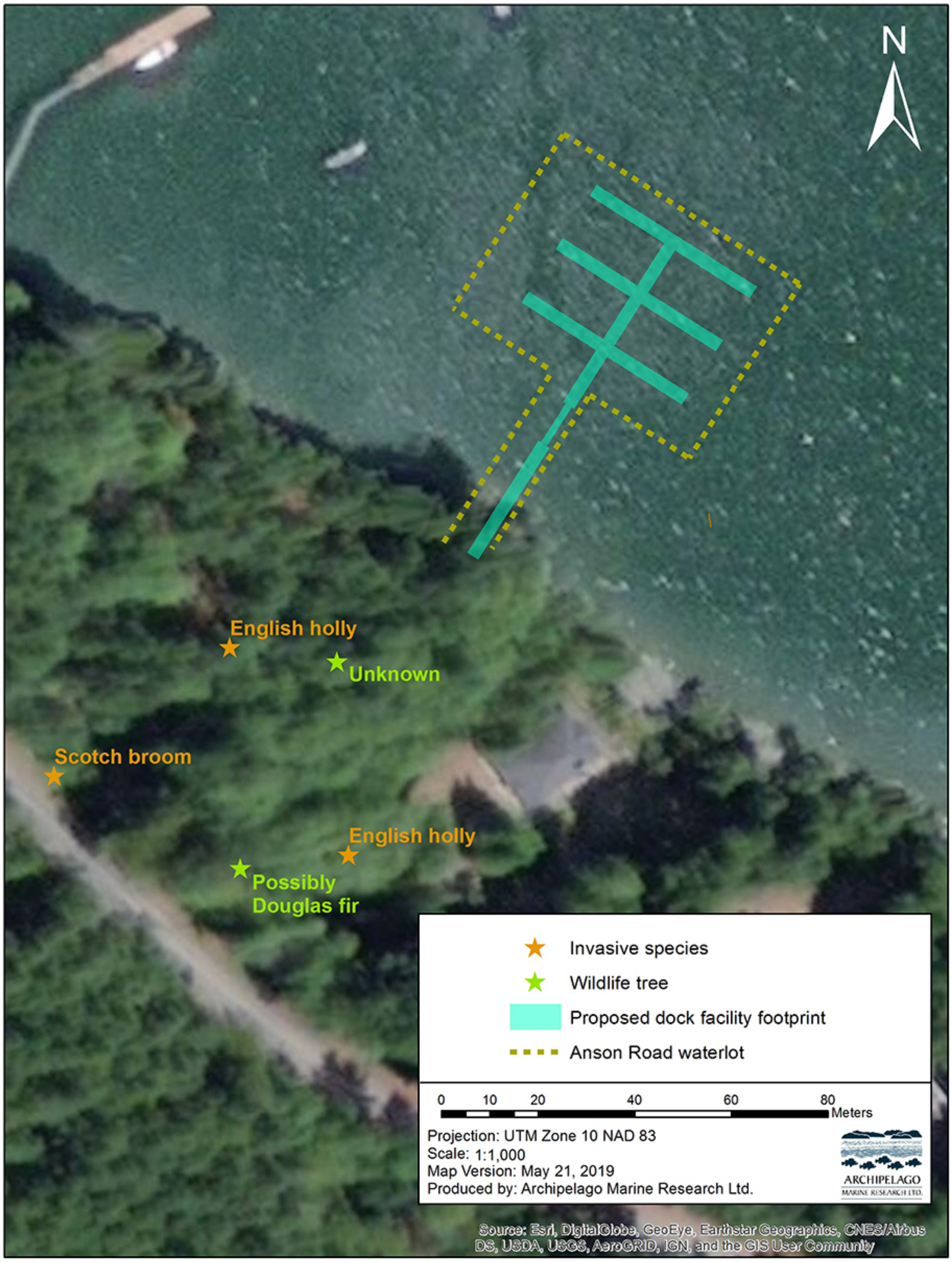

Figure 9. Invasive species and wildlife tree observations during the upland survey at the Anson Road Project site.

There are six culverts that empty within the Project site. Information and approximate locations of the culverts are listed below in Table 8

Table 8. Culverts assessed during the upland survey at the Anson Road Project site.

Culvert	Location[16]	Type and condition	Habitat Features
Northwest culvert	At the northwestern end of the driveway that intersects the Anson Road property. At the boundary of the property and 686 Horton Bay Road.	15" (38 cm) Corrugated Steel Pipe (CSP).	Drains slope and ditch along driveway. Substrate is angular rock, cobble to gravel sized (50%) and organics (50%). Downstream full of debris. Maximum bankfull width 2 m. Trickle flow.
North culvert	Approximately 10 m east of the northwest culvert. Runs under the driveway that intersects the Anson Road property.	5" (13 cm) plastic culvert.	Steady low flow. Drains ditch line. Maximum bankfull width 0.5 m. Organic substrate (100%).
East culvert	At the eastern boundary of the Anson Road property adjacent to the curved portion of the driveway bisecting the property.	15" (38 cm) CSP. Culvert partially collapsed and partially filled with material.	Trickle flow. Maximum bankfull 0.7 m. Substrate at culvert gravel (50%) and organics (50%). Downstream substrate bedrock (90%) and organics (10%).
South culvert	Runs under driveway leading to 694 Horton Bay, at eastern end.	12" (30 cm) CSP. Partially (50%) filled with material.	Collects water from slope and ditchline. Upstream end not visible. Substrate is gravel (15%), cobble (30%), boulder (5%), and organics (50%). Maximum bankfull width 3 m.
West culvert	Runs under southern branch near "Y" in driveway – southern branch leads to 694 Horton Bay Road.	15" (38 cm) CSP. Culvert exit (downstream) hidden under plants/debris. Partially (20%) filled with material.	Collects water from ditchline. Maximum bankfull width 0.5 m. Substrate organics (100%).

[16] Culverts are indicated on the engineering drawing "Site Plan Of: Anson Road, Mayne Island, Cowichan District" by Wey Mayenburg Land Surveying Inc. dated January 25th, 2019.

Culvert	Location[16]	Type and condition	Habitat Features
Top-of-bank culvert	Culvert runs under Horton Bay Road and empties at top-of-bank of Anson Road property (southern corner).	9” (23 cm) concrete culvert.	Drains water from road ditchline and upland slopes. Maximum bankfull width 0.5 m. Eroded channel downslope. Substrate organics (100%).

The Northwest and North culverts drain down into the intertidal zone. Access to the culverts is >2 m above the high tide level. The drainage slope is steep and eroded, providing no fish access, and contributing only food and nutrients to downslope fish and fish habitat. As the ditches had low to trickle flow along a steep grade, they are unlikely to provide any resident fish habitat. Flow is likely ephemeral.

Representative photographs from the upland survey are presented in Photo Plate 3.

Photo Plate 3. Photographic documentation of upland survey.

Photo 1. Douglas-fir and red alder lining the dirt driveway at the Anson Road property, looking southeast at the entrance to the property.

Photo 2. Forest characteristic of the Anson Road property. Project construction necessitates removal of an area of this patch of trees and vegetation.

Photo 3. Mature trees in the forest habitat at the Anson Road property, looking north.

Photo 4. Forest at the Anson Road property, looking southeast.

Photo 5. Mature red alder dominates the lower elevations of the site.

Photo 6. Forest leading down to intertidal zone with existing dirt road/trail, looking north toward where proposed dock will be installed. Project construction necessitates the removal of an area of these trees and vegetation.

Photo 7. Tree with evidence of extensive wildlife use present at the Project site.

Photo 8. Evidence of wildlife use of tree at the Project site.

Photo 9. Section of dirt driveway where culvert that runs underneath may be re-aligned or relocated.

Photo 10. Ditch running along dirt driveway, leading to Northwest culvert.

Photo 11. Habitat upstream of Northwest culvert. Property boundary at right-hand side of photo.

Photo 12. Entrance to Northwest culvert.

Photo 13. Habitat downstream of Northwest culvert.

Photo 14. Upstream end of North culvert and surrounding habitat.

Photo 15. Outlet of East culvert.

Photo 16. Habitat upstream of East culvert.

Photo 17. Habitat downstream of West culvert.

Photo 18. Inlet to West culvert.

Photo 19. Habitat looking upslope and upstream from West culvert.

Photo 20. Outlet of South culvert. Culvert 50% blocked with debris.

Photo 21. Concrete culvert at top-of-bank that runs under Horton Bay Road.

Photo 22. Habitat downstream of top-of-bank culvert.

Photo 23. Habitat upstream of top-of-bank culvert, looking across Horton Bay Road.

11 Upland Setting and Biophysical Characterization

Mayne Island falls within the biogeoclimatic zone of Coastal Douglas-fir moist maritime subzone (CDFmm) (MFLNRORD 2018). The forest on the Project site is second growth, of young seral to maturing seral stage. This region is restricted to low elevations of southeast Vancouver Island, the Gulf Islands south of Cortes Island, and a narrow strip along the Sunshine Coast. The zone extends from sea level to a maximum of 150 m above sea level (Green & Klinka 1994). Climate of the CDFmm region is mild, in the rain shadow of the Olympic Mountains resulting in warm dry summers and wild, wet winters. Mean annual precipitation ranges from 636 – 1263 mm with a mean annual temperature of 8.8 – 10.5°C (Green & Klinka 1994). The soils of the Project area are very shallow (<50 cm to bedrock) shaly loam colluvial, residual, and glacial drift materials over shale or siltstone bedrock at slopes of 10 – 45% (Kenney et al. 1988).

The terrestrial habitat at the Project site is mostly of a moderately disturbed and discontinuous nature. It provides habitat for transitory passerine and wildlife species. The vegetation likely provides nesting and feeding habitat for a variety of passerine species; breeding bird behaviour was observed during the terrestrial survey. The vegetation provides shade, food and nutrients, and water quality protection to downslope fish habitat. Although the ditches at the Project site are unlikely to contain fish, they are considered fish habitat (*Fish Protection Act*, 1997). It should be noted that development at the Project site requires maintaining a 2-m setback from the top-of-bank of all onsite ditches per the requirements of the Provincial *Riparian Areas Regulation*.

According to the BC Conservation Data Centre (CDC 2019), known occurrences of the sensitive ecosystems grand fir/dull Oregon-grape (*Abies grandis* / *Berberis nervosa*) and Douglas-fir/dull Oregon-grape occur immediately adjacent to the Project site. Both ecosystems are listed as Endangered or Threatened in BC (Red). The CDC was contacted about a masked occurrence in the area, and the information has been integrated into the report in a manner to not disclose the specific location of sensitive species. Species of conservation concern that potentially make transit through the Project site are listed in Section 11.1 below, along with other potentially occurring transitory non-listed species.

Potential effects to upland habitat and resident and transient species from the location, design, construction and installation of project components (i.e. gravel parking lots, retaining wall, and terrestrial components of dock installation/construction) are presented in greater detail in Section 12. Recommended mitigation measures and best management practices (BMPs) are presented in Section 13 followed by an effects summary in Section 14.

11.1 Transitory Non-Listed and Listed Upland Species

Although not observed during the upland survey, a variety of other terrestrial species inhabit Mayne Island and may occur within the Project site (Mayne Island Conservancy 2019). These include native black-tailed deer (*Odocoileus hemionus*), non-native fallow deer (*Dama dama*), bats, herptofauna (e.g. frogs, lizards, snakes), small and medium mammals (e.g. river otter (*Lontra canadensis*), raccoon (*Procyon lotor*), rodents) and a wide variety of birds such as passerines and raptors (e.g. osprey, hawks, owls). Cougars (*Puma concolor*), wolves (*Canis lupus*) or bears (*Ursus* spp.) are not known to be present on Mayne Island.

No listed species, or evidence of listed species, were observed during the upland survey. Listed terrestrial species (MOE 2018) that are known to occur on Mayne Island, considered transitory, and that may occur in the vicinity of the Project site include:

- Little brown myotis (*Myotis lucifugus*) (SARA listed as Endangered)
- Olive-sided flycatcher (*Contopus cooperi*) (SARA listed as Threatened; BC listed as Special Concern (Blue))
- Barn swallow (*Hirundo rustica*) (SARA listed as Threatened; BC listed as Special Concern (Blue))
- Western screech owl (*Megascops kennicottii kennicottii*) (SARA listed as Threatened; BC listed as Special Concern (Blue))
- Peregrine falcon (*Falco peregrinus*) (SARA listed as Special Concern)
    - Subspecies a*natum* (SARA listed as Special Concern; BC listed as Endangered or Threatened (Red))
    - Subspecies *pealei* (SARA listed as Threatened; BC listed as Special Concern (Blue))
- Propertius Duskywing (*Erynnis propertius*) (BC listed as Endangered or Threatened (Red))
- Purple martin (*Pyrola aphylla*) (BC listed as Special Concern (Blue))
- Northern Red-legged frog (*Rana aurora*) (BC listed as Special Concern (Blue))
- Townsend's big-eared bat (*Corynorhinus townsendii*) (BC listed as Special Concern (Blue))
- Keen's myotis[17] (*Myotis keenii*) (BC listed as Special Concern (Blue))

[17] Recent population genetics reveal Keen's myotis and Long-eared myotis (*Myotis evotis*) to be a single species. When the new rankings are released in spring 2019, only Long-eared myotis rankings will be maintained (CDC 2019).

12 Upland - Potential Project-Related Effects

Potential effects from the proposed Project include: 1) effects due to vegetation removal at the Project site, 2) changes to surface water quality and quantity, and 3) disturbance due to noise and air quality. Potential effects from the deposit of deleterious substances and waste materials will be addressed (avoided) through the implementation of mitigation measures and BMPs as outlined in Section 13. The following sections describe the three primary project related potential effects.

12.1 Vegetation Removal and Grubbing

The total area of vegetation expected to be cleared[18] is a minimum of 650 m^2 for the lower parking lot and 280 m^2 for the upper parking lot, for a total minimum of 930 m^2 as outlined in Table 9 (refer to preliminary Project design drawings in Appendix A). This vegetation consists of mixed forest, shrub and herbaceous species.

Removal of this vegetation will result in loss of habitat to birds and wildlife inhabiting or transiting through this area. Removal of vegetation can also result in changes to surface water (Section 12.2 below). Removal of blocks of vegetation can result in windthrow to remaining trees subsequently exposed to prevailing winds. Effects on birds and wildlife can be minimized by following associated BMPs as outlined in Section 13.

Table 9. Anticipated area of vegetation removal at the Anson Road Project site.

Feature	Area (m^2)
Lower Parking Lot	650 m^2
Upper Parking Lot	280 m^2
Total Area	**930 m^2**

12.2 Changes to Surface Water

Slope grading, infilling of material, relocating or realigning culverts and changes to surface material (e.g. parking structures) will result in changes to surface water runoff at the site. Changes to surface water quality or quantity can result in effects to fish and fish habitat through transport of sediment downstream or changes in water flow or temperature. These effects can result in physiological stress on fish, reducing reproductive output, negatively affecting fish health or resulting in fish mortality in the downslope marine environment; however, given the size of the site and expected activities at the project site, effects on the downslope are expected to be minimal.

[18] Estimated from Draft Anson Road Dock Facility Engineering drawings dated March 21, 2019. Construction footprint may change during detailed drawing design changes or additional clearing required during construction.

The magnitude of the change in water quality depends on the materials used, the area covered, and the depth and extent of slope re-grading activities. Avoid hardening of watercourse channels where possible as this can increase flow rate. Impermeable surfaces can result in sheet flow and increased erosion and channelization at the edges of the surface, therefore permeable or semi-permeable surfaces should be included where possible. Retain vegetation and riparian buffers where possible to reduce erosion potential and increase watercourse shading. The implementation of BMPs and mitigation measures outlined in Section 13 will reduce the impact of changes to surface water.

12.3 Disturbance

Construction activities cause noise, changes to air quality and other physical disturbance, which can have negative effects on terrestrial wildlife. Construction activities are expected to be of a localized nature and occur over a short time span (estimated 5 weeks). While the effects of noise or air quality on the upland environment are likely to be minimal, mitigation measures are provided in Section 13.

13 Upland - Recommended Mitigation Measures and Best Management Practices

This section outlines the mitigation measures and BMPs recommended to be applied during construction of the proposed Project. One of the proposed recommendations is environmental monitoring of the site, particularly during any work in environmentally sensitive areas. Regarding the frequency of environmental monitoring, it is anticipated that the Environmental Monitor would have a significant presence on-site during Project initiation, the establishment of environmental controls, and during key activities taking place in areas where sensitive environmental features/functions may be affected. Initially, frequent monitoring is anticipated in order to assess the efficacy of environmental controls. The requirement for visits to the Project site will subsequently be reduced as construction proceeds.

Design Considerations

- Design upland features and plan activities and works such that loss or disturbance to terrestrial habitat and wildlife species is minimized;
- Minimize the footprint to only what is required to serve the purpose; and
- Design and construct approaches to the waterbody such that they are perpendicular to the waterbody to minimize loss or disturbance to coastal riparian vegetation.

General Practices

- Prepare a Project-specific Environmental Management Plan (EMP) that outlines the mitigation measures and BMPs and how they will be implemented. Provide EMP to all contractor employees for review and acknowledgment of understanding;

- Ensure the proponent, Environmental Monitor(s) and contractors on-site are familiar with associated BMPs and ensure appropriate equipment and personnel are in place to execute the BMPs as required;
- Contractors must be able to properly install any protection measures and understand BMPs used on the Project. If measures are not properly installed, they will not provide the necessary environmental protection;
- Appropriate supplies (e.g. rock, gravel, grass seed, silt fencing, staking, polyethylene sheeting) required to execute BMPs (e.g. erosion and sediment control (ESC) measures) should be readily available on-site in sufficient quantities for the local conditions;
- Schedule Project activities for dry or fair weather whenever possible to minimize the environmental impact of Project works. Avoid project works during times of extreme precipitation; and
- Prepare to change existing mitigation measures and BMPs should they fail or be deemed inadequate by the Environmental Monitor or a regulatory agency.

Site Access, Mobilization and Laydown Areas

It is anticipated that access to the site for construction and hauling will be primarily via the existing dirt driveway and road. These BMPs will minimize the environmental effects associated with access, mobilization and laydown:

- Plan mobilization to minimize the number of trips to and from the Project site;
- Establish a laydown area for equipment and materials on a flat, stable area, and away from watercourses as possible;
- Avoid stockpiling of rock, sediment or fill material or ensure it is covered and other appropriate BMPs are applied to mitigate offsite runoff; and
- Manage track out of vehicles from site (i.e. wheel wash station or cleaning of road ways) to reduce dispersion of sediment and material offsite.

Machinery and Equipment

Machinery and heavy equipment that will be used during construction in the upland portion of the Project includes, but is not limited to, dump trucks, excavators, backhoes, and diesel plate compactors. Mitigation measures to reduce the impact of machinery and equipment on site are as follows:

- Ensure that machinery and equipment arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds;
- Properly maintain all equipment and ensure it is in good working order to prevent leaks or transmission of noxious fumes;
- Maintain all equipment to limit noise generation and fit with functioning exhaust and muffler systems;

- Ensure all machinery working in or around water has marine grade fluids and oils;
- For machinery working in or around water, utilize biodegradable hydraulic fluid where its use is compatible with the manufacturer's specifications of construction equipment required to achieve project-specific construction objectives;
- Ensure a spill containment kit will be readily accessible on each piece of equipment and at a central location within the site;
- Operate equipment at optimum rated loads and turn off when not in use;
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water. Refuel equipment on land and at least 30 metres from any waterbody where possible. Ensure appropriate spill prevention and containment measures are in place at all times during refueling or use of petroleum or other harmful chemicals on site; and
- Minimize light pollution by pointing lights downward and placing task lighting as close to the work area as possible.

Vegetation Management

Vegetation removal at the Project site will be required. The following mitigation measures have been developed for vegetation management:

- Limit removal of vegetation to only what is required to construct the proposed infrastructure;
- Do not remove vegetation, including coastal riparian vegetation, if it is identified as part of critical habitat of listed species at risk;
- Retain a minimum 2-m buffer around all watercourses that provide fish habitat;
- Where appropriate, protect areas of vegetation not within the construction footprint with snow fence, silt fence or some other visible barrier;
- If a rare or sensitive plant or vegetation community is discovered on site, notify the Environmental Monitor and appropriate regulatory authorities;
- Prohibit removing vegetation during bird nesting season (March 1 to August 15) or do so only with approval by the Environmental Monitor or other Qualified Environmental Professional (QEP) after completion of a nesting bird survey. Clearing must be conducted within 72 hours of completion of the survey;
- Remove invasive species detected at the site and dispose of them in a manner appropriate to prevent further spread or invasion of the species;
- Prohibit burning and burying of vegetation and/or woody materials on-site;
- Maintain equipment in a clean and weed-free condition; and
- Specific to coastal riparian vegetation:

- Minimize clearing of coastal riparian vegetation and avoid disturbance of shoreline soils, as vegetation removal and soil disturbance can increase erosion and sedimentation of the intertidal zone and adjacent subtidal areas. This is of particular importance given the degree of existing upland/shoreline erosion at the Project site. Typically a minimum vegetated buffer of 15 m to 30 m set back from the higher high water mark is recommended, with wider buffers sometimes required in more remote and undeveloped crown foreshore areas (Stewardship Centre of BC date unknown).

Wildlife Species Management

Habitat in and around the Project site provides nesting opportunities for numerous bird species and habitat for numerous terrestrial wildlife species. The following mitigation measures have been developed for wildlife species management, in accordance with the *Wildlife Act*:

- The nesting "window" for most bird species extends from March 1 to August 15 at the Project site. As such, clearing of vegetation during this window is restricted unless a "nest sweep" is completed by a QEP following standard procedures to ensure that no active nests occur in the area identified for clearing. Nests of certain species (e.g. bald eagle, heron, osprey) are protected whether active or not. If a nest is observed, liaise with the Environmental Monitor and construction contractor to identify and maintain a species-specific buffer around the nest until all young have fledged;
- Do not feed, harass or otherwise interact with wildlife species at the Project site. Organic and food waste will be managed to avoid attracting wildlife to the site; and
- If a rare species or species of conservation concern is detected on site, notify the Environmental Monitor and appropriate regulatory authorities. Halt work in proximity to the species. Develop a management plan prior to re-initiating work.

Water Management

Surface water management will be required – particularly during months of precipitation. All surface water leaving the Project site will be required to meet or exceed federal water quality standards. The primary source of potential water quality degradation is related to erosion and sedimentation; however, other sources of deleterious substances include equipment, machinery, and construction materials. General mitigation measures to assist in preserving water supply and quality are provided below:

- Isolate any in-water/instream works from flowing water by temporarily diverting, enclosing or pumping water around the site as required;
- Monitor ESC controls, such as a floating silt curtain, sand bags and silt fence, for effectiveness and maintain as necessary; and
- Initiate spill response if fuels, oil or coolants are observed to be present. Dispose of the contaminant material in an appropriate manner at an approved facility.

Hydraulic Connections

The Project may require repair, realignment or extension of existing culverts. The following mitigation measures will be applied in constructed ditches and culverts:

- As much as possible, perform work during periods of dry or low precipitation weather;
- Isolate the upstream work area using sandbags, road plates or other appropriate material;
- Dewater the isolated section of ditch/channel and pump water onto the adjacent vegetation. Discharge flow to a hard surface for energy dissipation;
- Maintain isolation of the work area as long as construction activities are anticipated;
- To re-establish flow into the new/repaired culvert and/or channel section, remove the upstream isolation barrier slowly to prevent a rush of water that may cause erosion and generate sediment. Allow this water to fill the culvert/channel where it will be held by the lower isolating barrier to promote the settlement of sediment; and
- Remove the lower isolating barrier slowly once the upstream water is clear.

Erosion and Sediment Control

It is anticipated that construction activities may result in increased erosion at the site and the potential for sediment release into the surrounding environment, potentially affecting fish or fish habitat. The following mitigation measures have been developed to minimize the effects of construction on the marine environment:

- Develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation of the waterbody during all phases of the project. Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear;
- Develop a response plan that is to be implemented immediately in the event of a sediment release;
- Ensure erosion and sediment control equipment and devices are readily available and in sufficient quantity on site. Ensure construction team members are trained in the appropriate installation and use of ESC equipment. ESC measures will be reviewed and approved by a QEP prior to work beginning;
- Install ESC equipment and measures before starting work to prevent sediment from entering receiving waterbodies;
- Implement measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system;

- Implement measures for containing and stabilizing waste material (e.g., construction waste and materials, uprooted or cut vegetation, accumulated debris) above the high water mark of nearby waterbodies to prevent re-entry;
- Install a floating curtain in the receiving marine environment to isolate potential effects of sediment runoff from the construction site, if terrestrial ESC measures are inadequate for containing sediment runoff from the site;
- Minimize exposed soil and sediment on site through phasing of construction activities, retaining as much vegetation as possible, or covering exposed areas with an appropriate temporary material (e.g. plastic sheeting or filter cloth);
- Schedule project activities for dry or fair weather whenever possible to minimize erosion and sediment concerns. Additional ESC measures may need to be erected during or in anticipation of heavy precipitation. Avoid Project works during times of extreme precipitation;
- Stabilize disturbed areas at the end of construction through the effective use of soil cover (e.g. vegetation, straw mulch, erosion control blankets);
- Immediately stabilize shoreline disturbed by any activity associated with the Project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site (stabilization of the existing eroding shoreline through re-vegetation or as specified by a coastal shoreline erosion specialist is likely required regardless of future disturbance from Project-related activities);
- Re-vegetate all areas that are not part of the final footprint of construction to prevent potential surface erosion and siltation of aquatic habitat;
- Protect exposed soil on any steep grade at the end of construction from surface erosion by hydroseeding with a heavy mulch, tackifier, and seed mix or by installing erosion control blankets;
- Inspect ESC structures at least weekly and after each storm event of 25 mm+ of rain within a 24-hour period. Complete repairs as required;
- Avoid entering a wetted area with machinery unless appropriate approvals have been obtained to do so. Isolate the site to minimize the potential generation of sediment;
- Avoid site grading activities during periods of inclement weather;
- Retain sediment-laden water exceeding discharge limits until concentrations reach an acceptable level; and
- Remove non-biodegradable erosion and sediment control materials once site is stabilized.

Soil Management

Only small areas of soil will be managed during the proposed Project construction. It is not anticipated for there to be any contaminated soils on site, or stockpiling of soils or fill on site.

Concrete Works and Grouting

If concrete or grouting works are deemed necessary, works will employ the following BMPs to prevent and minimize the potential for impacts on the receiving environment:

- Prevent uncured or wet concrete from contact with precipitation or a waterbody on-site (minimum of 72 hours curing);
- Carefully pour and distribute concrete to minimize spillage;
- Complete concrete works in isolation of flowing water or other waterbodies (i.e. when working near or below the high water mark);
- Employ proper housekeeping and appropriate work site isolation techniques to minimize the potential for spills; and
- Ensure appropriate spill cleanup materials are readily available, easily accessible, and in sufficient quantity on site.

Air Quality Management

Construction activities can cause adverse impacts to local air quality. The following mitigation measures will address concerns regarding the potential degradation of local air quality during construction:

- No on-site burning of cleared vegetation or other construction-related materials will be permitted;
- Ensure all mechanical equipment that is required on-site is in good working order and complies with local emissions standards;
- Minimize idling of vehicles and equipment;
- Cover loads of dusty material; and
- Minimize dust-generating activities as much as possible during windy periods to limit airborne dust emissions. Ensure water or some other environmentally acceptable dust suppressant and appropriate application equipment is available to be used as needed. Chemical dust suppressants will not be used.

Construction Noise Management

Short-term noise generation will result from construction equipment and associated activities during Project construction. The following general measures will minimize the potential for construction-related noise effects:

- Maintain all equipment to limit noise generation and fit with functioning exhaust and muffler systems;
- Turn off equipment and machinery when not in use; and
- As much as possible, coordinate construction activities with daylight periods and regional noise bylaws.

Conduct noise monitoring during any particularly noisy activities to ensure the predicted impacts are not exceeded, particularly during any marine aquatic pile driving.

Storage of Petroleum Products

Petroleum products (i.e. fuels, hydraulic fluids and lubricants) will be used during construction. Effective mitigation will be required to ensure that these materials are stored and managed appropriately and are not accidentally discharged to the environment. The following BMPs will mitigate the effect of petroleum product use on site:

- Store all petroleum products used on-site in a designated location that poses no risk of soil or surface water contamination. Secure the designated storage area and clearly label and manage it in accordance with local safety regulations;
- Use impervious containment structures able to contain 110% of the maximum capacity of storage vessels around the site;
- Handle petroleum products in such a manner as to minimize leakage and spillage and ensure containment and recovery in the event of a spill. Remove petroleum products no longer required from the site;
- Appropriately label containers and designate them to be used for the temporary storage of used petroleum products. Do not use these containers for disposal of garbage or construction debris; and
- Inspect the site on a regular basis to ensure that all waste petroleum products and waste materials (e.g. oil cans, grease tubes, oily rags) are collected and properly disposed of at a location approved by regulatory authorities.

Spill Prevention and Readiness

Project construction will involve the operation of vehicles, equipment and machinery using petroleum products (i.e. fuels, hydraulic fluids, lubricants) and other substances that may be deleterious if released into the surrounding environment. There is, therefore, the potential for environmental damage to occur from accidental spills of petroleum or other products to the surrounding environment with the resulting potential for soil or waterbody contamination. To minimize the likelihood and potential environmental impact of a spill event, BMPs to be implemented during construction include:

- Establish a Project-specific Emergency and Spill Response Plan prior to commencement of site preparation and/or construction activities to ensure compliance with Project-specific environmental protection measures and commitments;
- Response plan is to be implemented immediately in the event of a spill of a deleterious substance;
- Maintain appropriate supplies for spill response and containment on all construction equipment onsite. Maintain a spill kit in an accessible central location;
- Identify all materials of a deleterious nature that could be spilled;

- Ensure all Contractor personnel are trained in proper spill containment and remediation procedures;
- Monitor all on-site storage areas throughout the construction period for signs of spillage or leakage of stored product;
- Inspect and monitor equipment, storage, refueling/maintenance and construction areas regularly; and
- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, poured concrete or other chemicals do not enter the watercourse.

Solid Waste Management

Solid wastes generated during the Project will be removed from the site for recycling, where possible, or disposal. The following BMPs will minimize the effects of solid waste on the receiving environment:

- Remove garbage from site on a regular basis;
- Collect all recyclable or compostable materials separately from general waste according to regional bylaw requirements;
- Adhere to all applicable legislation with respect to the handling, transportation, and/or disposal of all materials related to the Project. Regulations include, but are not limited to, the *BC Hazardous Water Regulations*, *Spill Reporting Regulations*, *Workers Compensation Board Regulations*, *Transportation of Dangerous Goods Regulations*, etc.;
- Provide portable sanitary facilities on-site for workers' use throughout the duration of the construction period. Service the facilities regularly with a qualified Contractor;
- Provide properly labeled separate container(s) for potentially hazardous waste such as oily rags and hydrocarbon absorbent pads. Handle and transport absorbent materials or soils contaminated with oil (greater than 3% by weight) or any quantity of gasoline as Hazardous Waste. Excavate and haul off any contaminated soils to an authorized treatment/disposal area in accordance with the *BC Hazardous Waste Regulations*; and
- Remove all construction materials from site upon project completion.

14 Upland - Residual Effects Assessment and Summary

Table 10 provides a summary of the criteria used to characterize the residual effects, post mitigation, for the upland portion of the proposed public dock facility.

Table 10. Criteria for the characterization of residual effects for the upland portion of the proposed public dock facility at Anson Road.

Criteria	Definitions		
Magnitude Intensity or severity of the effect	*Low* - a measurable change from existing baseline conditions but is below environmental and/or regulatory thresholds.	*Moderate* - a measurable change from existing baseline conditions that is below but approaching environmental and/or regulatory thresholds.	*High* - a measurable change from existing baseline conditions that is above environmental and/or regulatory thresholds.
Geographic Extent Spatial range of the effect	*Site-Specific* - effects are contained within the Project footprint.	*Local* – effects are contained within the local study area.	*Regional* – effects are contained within the regional study area (i.e. Gulf Islands area).
Duration Temporal period for which the effect will persist	*Short Term* - residual effect restricted to project construction and/or decommissioning phase and is predicted to return to existing baseline conditions within two years with no lasting effect.	*Long Term* - residual effect continues for more than two years after the project construction and/or decommissioning phase, before returning to existing baseline conditions.	*Permanent* - residual effect is unlikely to return to existing baseline conditions.
Probability Likelihood of the effect occurring	*Low* - the predicted residual effect is not likely to occur.	*Moderate* - the predicted residual effect has a reasonable likelihood to occur.	*High* - the predicted residual effect is likely to occur or certain.

Table 11 provides a summary of the potential project-related effects, the recommended mitigation measures and BMPs to minimize or offset the effects, and the magnitude, geographic extent, duration, and likelihood of residual effects after the implementation of the mitigation measures and BMPs.

Table 11. Summary of potential Project-related effects, recommended mitigation measures and BMPs, and resultant residual effects associated with the upland portion of the proposed public dock facility at Anson Road.

	Vegetation Removal	Changes to Surface Water	Disturbance
Potential Project-Related Effects	Loss of vegetation (930 m^2); changes to surface water.	Changes in sedimentation; flow volume or temperature may result in physiological stress to fish in the marine environment resulting in negative effects on fish health, loss of reproduction potential or fish mortality.	Noise or changes in air quality may cause physiological stress or disturbance to terrestrial species resulting in negative effects on health or reproduction potential.
Mitigation	Avoid bird nesting window; retain vegetation where possible; retain riparian buffer around local watercourses.	Avoid hardening of watercourses; prevent sediment transport downstream through BMPs; reduce area of impermeable surface where possible.	Reduce noise where possible; work during daylight hours; avoid idling of equipment where possible.
Potential Residual Effect? (Y/N)	Y	Y	Y
Magnitude	Low	Low	Low
Geographic Extent	Site-specific	Local	Local
Duration	Permanent	Short-term	Short-term (~five weeks)
Probability of Residual Effect	High	Moderate	Moderate

Even with the permanent removal of a small area (930 m^2) of vegetation and realignment of the existing ditches, overall the residual effects are likely small. The anticipated construction time is short (approximately five weeks), the potential effects from construction are limited, and can for the most part be mitigated through the BMPs outlined in Section 13. After the realignment of the ditches is complete, they are likely to return to a similar state of contribution to fish habitat, provided the BMPs in Section 13 are followed. It is anticipated that the residual effects to the identified terrestrial habitat and adjacent fish habitat will be minimal and will avoid significant or long-term residual effects to terrestrial species and adjacent fish habitat.

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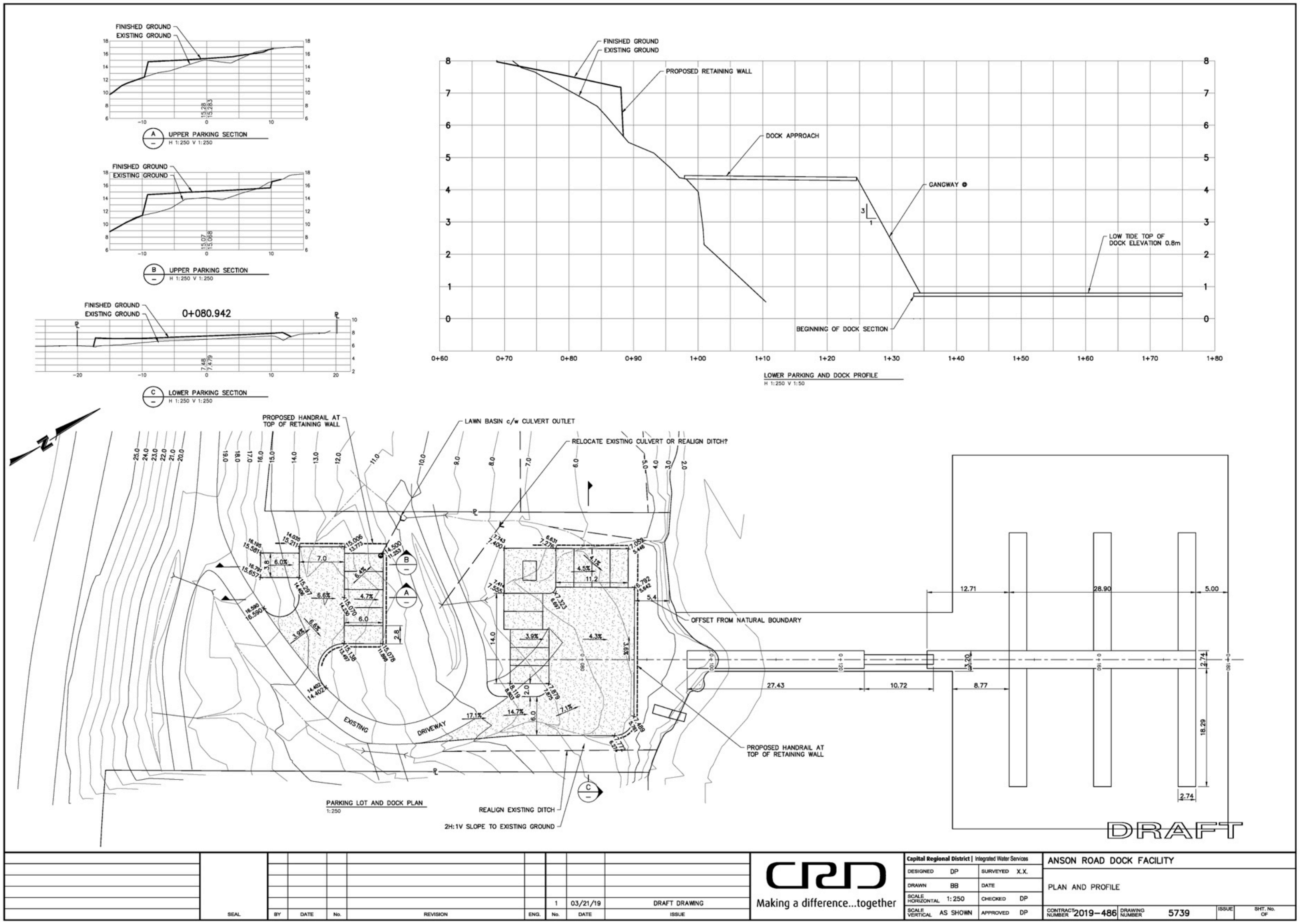
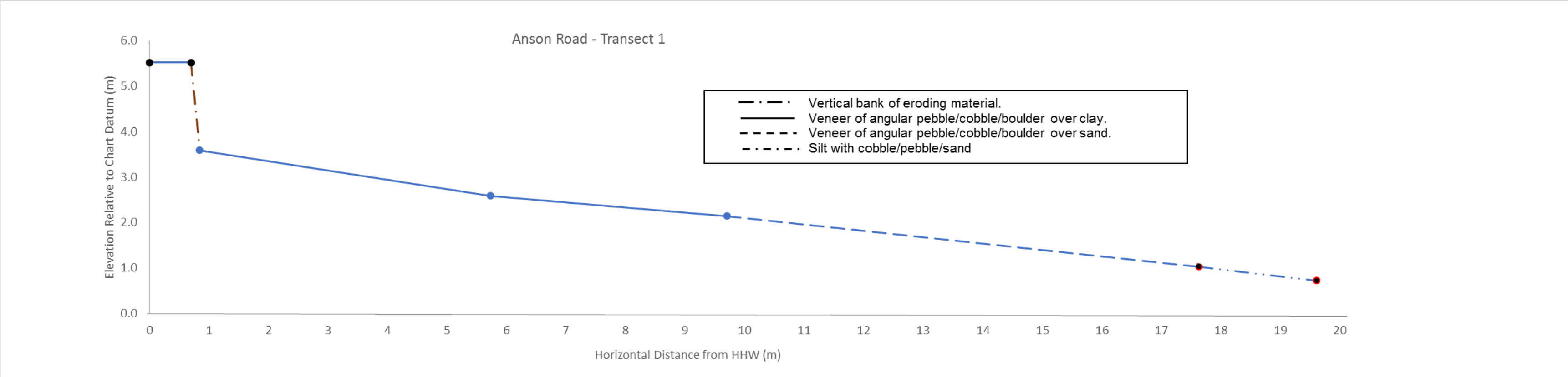
Appendix A: Preliminary Project Design


UPPER PARKING SECTION
LOWER PARKING SECTION
LOWER PARKING AND DOCK PROFILE
PROPOSED RETAINING WALL
DOCK APPROACH
GANGWAY
LOW TIDE TOP OF DOCK ELEVATION 0.8m
BEGINNING OF DOCK SECTION
PARKING LOT AND DOCK PLAN
PROPOSED HANDRAIL AT TOP OF RETAINING WALL
LAWN BASIN c/w CULVERT OUTLET
RELOCATE EXISTING CULVERT OR REALIGN DITCH?
OFFSET FROM NATURAL BOUNDARY
REALIGN EXISTING DITCH
2H:1V SLOPE TO EXISTING GROUND
EXISTING DRIVEWAY
DRAFT
CRD
Making a difference...together
Capital Regional District | Integrated Water Services
ANSON ROAD DOCK FACILITY
PLAN AND PROFILE
03/21/19
DRAFT DRAWING
2019-486
5739

Appendix B: Intertidal Foot Survey Data



Biophysical profile of Transect 1

Intertidal Transect Data for Transect 1 (surveyed from high to low intertidal zone)

Transect 1		
Bioband	**Type**	**Data**
Splashzone	Elevation	3.58 to 5.52 m
	Slope Distance	0.0 to 1.9 m
	Substrate	Vertical bank of eroding unconsolidated materials
	Vegetation	Douglas fir (*Pseudotsuga menzesii*) roots, small western redcedar (*Thuja plicata*), honeysuckle vine (*Lonicera ciliosa*)
	Invertebrates	None
Barnacle/ Rockweed	Elevation	2.58 to 3.58 m
	Slope Distance	1.9 to 6.9 m
	Substrate	veneer of angular cobble/pebble over clay Boulder 5 %, cobble 40%, pebble 50%
	Vegetation	Rockweed (*Fucus distichus*) <5 %, Turkish towel (*Mastocarpus*) <5%
	Invertebrates	periwinkle snail *(Littorina sp.*) C; limpet (*Tectura persona)* C; acorn barnacle (*B. glandula)* 5-25%
	Comments	bivalve shells (*Macoma* and *Mya*)
Barnacle/ Rockweed	Elevation	2.13 to 2.58 m
	Slope Distance	6.9 to 10.9 m
	Substrate	Boulder 10%, cobble 20%, pebble 60%, sand 10%, veneer over clay
	Vegetation	Rockweed (*Fucus distichus*) *<5 %,* Turkish towel (*Mastocarpus*) *<5%*
	Invertebrates	Acorn barnacle (*Balanus glandula*) 5-25%
		Periwinkle snails (*Littorina* sp.) C; shore crab (*Hemigrapsus sp.*) C
Barnacle/ Rockweed	Elevation	1.02 to 2.13
	Slope Distance	10.9 to 18.9 m
	Substrate	Boulder 5%, cobble 20%, pebble 75%, over matrix of coarse sand
	Vegetation	Rockweed (*Fucus distichus*) <5 %
		Filamentous green algae < 5%, Foliose green algae <5%,
		Foliose brown algae <5%
	Invertebrates	Acorn barnacle (*Balanus glandula*) 5-25%
		Small limpets C, shore crab (*Hemigrapsis* sp.) C
	Comments	Abundant tiny barnacle spat
Barnacle/ Green algae	Elevation	0.71 to 1.02
	Slope Distance	18.9 to 20.9 m
	Substrate	Cobble 5%, pebble 5%, sand 10%, silt 80%
	Vegetation	Foliose green algae <5%, Foliose brown algae (?*Petalonia*?) <5%, small bladed kelp (*Saccharina* sp.) <5%
	Invertebrates	Japanese oyster (*Crassostrea gigas*) F, ochre seastar (*Pisaster ochraceous*) F, smooth acorn barnacle (*B. crenatus*) C, shield limpets (*Tectura scutum*) with epiphytic green algae strings
	Comments	Diatoms and silt-covered holes and mounds from infauna. Abundant tiny barnacle spat. This last section of the transect was completed in shallow water.

Elevations: relative to chart datum (e.g. -5 = 5 m below chart datum; +5 = 5 m above chart datum)
Sediment sizes: Boulder > 25 cm, Cobble 6 to 25 cm, Pebble 0.2 to 6 cm, Sand 0.2 cm to 2 mm, mud/silt < 2 mm
Vegetation: percent cover estimated for dominant species
Invertebrates: A = Abundant, C = Common, P = Present

Appendix C: Subtidal Dive Survey Data

Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 1/1**
Recorder: Gina Lemieux **Time IN: 1138** **Time OUT: 1203**
Transect #: 1 **Transect Length: 80m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
85	-4.95	1138	7	100	DI	5-25	Tubeworms, IH/IM	A	Juv. Flatfish	P
					Dr. GF	<5	Crangon shrimp	C		
					Dr. LA	<5	Brittle stars	P		
75	-4.55	1142	7	100	DI	5-25	Tubeworms, IH/IM	A	Saddleback gunnel	P
					Dr. GF	5-25	Brittle stars	A		
							Crangon shrimp	C		
65	-4.25	1145	7	100	DI	50-75	Tubeworms, IH/IM	A/C	-	-
					Dr. GF	<5	Brittle stars	A/C		
					Dr. LA	<5	Graceful crab	P		
55	-3.85	1147	7, 8	100	DI	>75	Tubeworms, IH/IM	A/C	-	-
							Brittle stars	A/C		
45	-3.15	1149	7, 8	100	DI	>75	Tubeworms, IH/IM	A/C	-	-
					EG	<5	Brittle stars	A/C		
							Heath's nudibranch	P		
							Hooded nudibranch	P		
35	-2.07	1154	7, 8	100	DI	>75	Tubeworms, IH/IM	A/C	-	-
					EG	5-25	Brittle stars	A/C		
							Hooded nudibranch	C		
25	-1.17	1157	7, 8	100	DI	>75	Tubeworms, IH/IM	A/C	-	-
					EG	5-25	Brittle stars	A/C		
15	0.03	1159	6, 7, 8	100	DI	25-50	Tubeworms, IH/IM	A/C	-	-
					Dr. GF	<5	Brittle stars	A/C		
					Dr. LA	<5				
5	1.03	1203	7, 6, 5	100	Dr. GF	5-25	Barnacles	A	-	-
Too shallow to continue					DI	<5	Oysters	P		
End of transect in exposed intertidal zone										
Shell debris: cockles, butter clam, littleneck										
Eelgrass ~0.5 to 1 m long; observed on each side of transect										

(A=Abundant C=Common P=Present) Substrate/algae percent cover: <5% 5-25% 25-50% 50-75% >75%
1=Bedrock smooth 2=Bedrock crevice 3=Boulder 4=Cobble 5=Pebble 6=Pea Pebble 7=Sand 8=Shell 9=Mud
DI=Diatoms; Dr. GF=Drift green foliose algae; Dr. LA=Drift Laminaria; NT=Nereocystis
G=Green R=Red B=Brown F=Foliose H=Filamentous B=Branching
EN=Encrusting coralline red algae; EG=Eelgrass
IH=Infaunal holes; IM=Infaunal mounds

Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 1/2**

Recorder: Gina Lemieux **Time IN: 1206** **Time OUT: 1227**

Transect #: 2 **Transect Length: 79m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
84	-4.88	1227	7	100	DI	50-75	Tubeworms, IH/IM Brittle stars	C C	-	-
75	-4.68	1225	7	100	DI	50-75	Tubeworms, IH/IM Brittle stars	C C	-	-
65	-4.38	1223	7	100	DI Dr. GF Dr. LA	50-75 <5 <5	Tubeworms, IH/IM Brittle stars Juv. Crab	C C P	-	-
55	-3.98	1221	7	100	DI	50-75	Tubeworms, IH/IM Brittle stars	C C	-	-
45	-3.38	1219	7	100	DI	50-75	Tubeworms, IH/IM Brittle stars Graceful crab (2)	C C P	-	-
43.5	-3.28	1219	7	100	EG	<5	-	-	-	-
35	-2.28	1217	7	100	DI EG	>75 5-25	IH/IM	C	-	-
25	-1.28	1215	7	100	DI EG	25-50 5-25	IH/IM	C	-	-
23.4	-1.18	1214	2	100	-	-	-	-	-	-
21	-0.78	1213	7	100	DI EG	5-25 5-25	IH/IM Horse clam	A/C C	-	-

Surveyed onshore to offshore, but transcribed offshore to onshore therefore time stamps decrease
Eelgrass ~0.5 to 1 m long; observed on each side of transect

(A=Abundant C=Common P=Present) Substrate/algae percent cover: <5% 5-25% 25-50% 50-75% >75%
1=Bedrock smooth 2=Bedrock crevice 3=Boulder 4=Cobble 5=Pebble 6=Pea Pebble 7=Sand 8=Shell 9=Mud
DI=Diatoms; Dr. GF=Drift green foliose algae; Dr. LA=Drift Laminaria; NT=Nereocystis
G=Green R=Red B=Brown F=Foliose H=Filamentous B=Branching
EN=Encrusting coralline red algae; EG=Eelgrass
IH=Infaunal holes; IM=Infaunal mounds

Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 2/2**
Recorder: Gina Lemieux **Time IN: 1206** **Time OUT: 1227**
Transect #: 2 **Transect Length: 79m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
15	0.02	1211	7	100	DI Dr. GF Dr. LA	5-25 <5 <5	IH/IM	A/C	-	-
11	0.52	1208	7	100	DI Dr. GF Dr. LA	50 <5 <5	IH/IM Horse clam/cockle Hermit crab	A C P	-	-
5	1.33	1206	7, 5, 6	100	GF False kelp	<5 <5	Barnacles Oysters	A/C P	-	-
Too shallow to continue End of transect in exposed intertidal zone										

(A=Abundant C=Common P=Present) Substrate/algae percent cover: <5% 5-25% 25-50% 50-75% >75%
1=Bedrock smooth 2=Bedrock crevice 3=Boulder 4=Cobble 5=Pebble 6=Pea Pebble 7=Sand 8=Shell 9=Mud
DI=Diatoms; Dr. GF=Drift green foliose algae; Dr. LA=Drift Laminaria; NT=Nereocystis
G=Green R=Red B=Brown F=Foliose H=Filamentous B=Branching
EN=Encrusting coralline red algae; EG=Eelgrass
IH=Infaunal holes; IM=Infaunal mounds

Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 1/1**
Recorder: Gina Lemieux **Time IN: 1229** **Time OUT: 1247**
Transect #: 3 **Transect Length: 59m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
69	-4.98	1229	7	100	DI	50	Tubeworms, IH/IM	C	-	-
					Dr. GF	<5	Brittle stars	C		
					Dr. LA	<5				
60	-4.88	1231	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
							Brittle stars	C		
							Sea pen	P		
							Mottled seastar	P		
50	-4.68	1234	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
							Brittle stars	C		
							Hermit crab	P		
47	-4.48	1236	4, 5	75	DI	50-75	Tubeworms, IH/IM	C	-	-
			7	25	DE	<5	Brittle stars	C		
							Graceful crab	P		
							Mottled seastar	P		
40	-4.18	1238	4, 5	75	DI	>75	Tubeworms, IH/IM	C	-	-
			7	25	Dr. GF	<5	Brittle stars	C		
					RB/RH	<5	Graceful crab	P		
							Mottled seastar	P		
31	-2.98	1241	4, 5	50	DI	>75	Leather seastar	P	-	-
			7	50	EG	<5, 5-25, 25-50	Cadlina nudibranch	P		
20	-0.88	1244	7	>75	DI	50-75	IH/IM	P	-	-
			5	<25	EG	5-25/ 25-50	Barnacles	P		
10	0.62	1247	7	50	DI	50	Barnacles	A	-	-
Too shallow to continue			4, 5, 8	50	Dr. GF	25-50				
End of transect in exposed intertidal zone					Dr. LA	<5				
Shell debris: cockles, bentnose macoma										
Eelgrass ~0.5 to 1 m long; observed on each side of transect										

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1=Bedrock smooth 2=Bedrock crevice 3=Boulder 4=Cobble 5=Pebble 6=Pea Pebble 7=Sand 8=Shell 9=Mud
DI=Diatoms; Dr. GF=Drift green foliose algae; Dr. LA=Drift Laminaria; NT=Nereocystis; DE=Desmerestia
G=Green R=Red B=Brown F=Foliose H=Filamentous B=Branching
EN=Encrusting coralline red algae; EG=Eelgrass
IH=Infaunal holes; IM=Infaunal mounds

Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 1/1**
Recorder: Gina Lemieux **Time IN: 1309** **Time OUT: 1252**
Transect #: 4 **Transect Length: 61m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
71	-5.15	1309	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
							Brittle stars	C		
60	-5.07	1307	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
					Dr. GF	<5	Brittle stars	C		
47	-4.87	1304	7	95	DI	5-25	Tubeworms, IH/IM	P	-	-
			5	5	DE	<5	Brittle stars	P		
					NT	<5				
40	-4.37	1302	7	50	DI	50-75	IH/IM	P	-	-
			5	50	Dr. GF	5-25	Heath's nudibranch	P		
					Dr. LA	5-25	Dirona nudibranch	C		
					DE	5-25	Mottled seastar	P		
							Ochre seastar	P		
31	-2.77	1259	7	75	DI	>75	IH/IM	P	-	-
			5	25	EG	<5/25-50	Hooded nudibranch	C		
					DE	5-25	Kelp crab	P		
					BH	<5	Mottled seastar	P		
					Dr. GF	5-25				
19	-0.77	1256	7	75	DI	5-25	IH/IM	C	-	-
			5	25	EG	25-50	Mottled seastar	P		
							Olive snail	P		
10	0.82	1252	5, 7	75	DI	5-25	Tubeworms, IH/IM	C	-	-
			4	20	GF	25-50	Horse clam, cockle	C		
Too shallow to continue			3	5	LA	<5	Ochre seastar	C		
End of transect in exposed intertidal zone										

Surveyed onshore to offshore, but transcribed offshore to onshore therefore time stamps decrease
Eelgrass ~0.5 to 1 m long; observed on each side of transect

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Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 1/2**
Recorder: Gina Lemieux **Time IN: 1311** **Time OUT: 1325**
Transect #: 5 **Transect Length: 78m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
78	-5.35	1311	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
							Brittle stars	C		
							Crangon shrimp	P		
74	-5.25	1312	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
							Brittle stars	C		
							Crangon shrimp	P		
							Horse clam	C		
64	-5.15	1313	7	100	DI	50-75	Tubeworms, IH/IM	C	-	-
							Brittle stars	C		
							Crangon shrimp	C		
							Plumose anemone	P		
54	-4.95	1315	7	75	DI	25-50	Tubeworms, IH/IM	C	-	-
			4, 5	25	DE	<5	Brittle stars	C		
					Dr. GF	<5				
34	-4.25	1317	7, 8	50	DI	50-75	Tubeworms, IH/IM	C	-	-
			4, 5	50	Dr. GF	<5	Brittle stars	C		
					BH	<5	Heath's nudibranch	P		
					DE	<5				
24	-3.55	1319	7, 8	50	EG	<5	IM	P	-	-
			4, 5	50	DE	<5	Red rock crab	P		
					Dr. GF/LA	<5	Graceful crab	P		
					NT	<5				

Eelgrass ~0.5 to 1 m long; observed on each side of transect
Shell debris: cockles, butter clam, littleneck

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Site Name: Anson Road, Mayne Island **Date: April 9, 2019** **Page 2/2**
Recorder: Gina Lemieux **Time IN: 1311** **Time OUT: 1325**
Transect #: 5 **Transect Length: 78m** **Sampling Frequency: 10m**

Dist. (m)	Depth (m) (CD)	Time	Substrate/%		Algae/%		Inverts		Fish	
10	-0.85	1322	7	100	DI	25-50	Tubeworms, IH/IM	P	-	-
					EG	5-25/ 25-50	Brittle stars	P		
					Dr. LA	<5				
					BH	<5				
0	0.68	1325	7	50	Dr. GF	5-25	Tubeworms, IH/IM	C	-	-
Too shallow to contin[u]			4, 5	50	LA	5-25	Brittle stars	C		
End of transect in exposed intertidal zone					NT	<5	Mottled seastar	P		
							Bubble shell	P		

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