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<td>LAA</td>
<td>Likely to Adversely Affect</td>
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<td>L_{eq}</td>
<td>Energy-average sound level over specified time interval</td>
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<td>L_{max}</td>
<td>Maximum sound level occurring over specified time interval</td>
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<tr>
<td>OHWM</td>
<td>ordinary high water mark</td>
</tr>
<tr>
<td>PCB</td>
<td>polychlorinated biphenyl</td>
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<tr>
<td>PCE</td>
<td>Primary Constituent Element</td>
</tr>
<tr>
<td>PNNL</td>
<td>Pacific Northwest National Laboratory</td>
</tr>
<tr>
<td>Port</td>
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<tr>
<td>ppm</td>
<td>parts per million</td>
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<td>PSL</td>
<td>Practical Spreading Loss</td>
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<td>RM</td>
<td>River Mile</td>
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1 PROJECT OVERVIEW

This document presents the Biological Evaluation (BE) for the Port of Vancouver, USA (Port) Terminal 5 Bulk Potash Handling Facility. BHP Billiton Canada Inc. or an affiliate of the BHP Billiton Group (BHP Billiton) is proposing to lease part of Terminal 5 located at the Port for the purpose of establishing a bulk handling export facility to allow shipping of approximately 8 million tonnes per annum (Mtpa) of potash to global markets. The facility will accept potash shipped by rail from potash mines located in Saskatchewan, Canada. On-site infrastructure is proposed to enable the unloading of rail cars into on-site storage, and the conveyance of potash to vessels at a new berth to be constructed on the Columbia River adjacent to the facility. The on-site infrastructure will include a dedicated rail track for BHP Billiton, the construction and installation of materials handling equipment, storage structures, utilities, and internal access roads on the site (and other related ancillary infrastructure).

The term potash is a colloquial term that refers to potassium chloride (KCl) or muriate of potash (MOP). Potash has valuable properties as a fertilizer, including increasing plant resistance to cold, droughts, pesticides, and diseases. Potash also activates key enzymes involved in photosynthesis. As a result, there is wide demand for the product in emerging markets such as China, India, and Southeast Asia where economic growth is driving increased agricultural production. Potash is a non-flammable, non-combustible substance requiring a dry location for storage and garners an “insignificant” rating for fire and reactivity according to the National Fire Protection Association (NFPA). Potash is non-toxic to aquatic organisms as defined by the U.S. Environmental Protection Agency (USEPA).

The proposed facility is designed to accommodate the arrival of bulk quantities of potash via freight rail, unload the rail cars into on-site storage, and convey potash to vessels at a berth structure on the Columbia River. From these shipping vessels, potash will be carried to various international destination ports. In order to accomplish the receipt, storage, and transfer of potash, the proposed project will involve three primary infrastructure components: rail infrastructure, material storage and handling, and a berth with ship loaders (i.e., marine structures). The focus of this BE is on the construction activities where in-water work will occur because these activities have the potential to impact Endangered Species Act (ESA)-listed aquatic species and critical habitats.
This report was prepared for the Port and BHP Billiton Canada Inc. for the development of the Terminal 5 Bulk Potash Handling Facility (proposed project) to be constructed and operated by BHP Billiton Canada Inc. or an affiliate of the BHP Billiton Group. This BE was prepared for compliance with Section 7 of the ESA, as required for the U.S. Army Corps of Engineers (Corps) permit application.

The key project effects that could impact the listed species and that will occur during construction of the ship loader facility are noise, water quality, and direct habitat effects. Conservation measures and Best Management Practices (BMPs) will be employed to minimize these effects. Expected effects from the stormwater outfall replacement work include short-term water quality impacts related to the construction activities, which will be minimized through implementation of BMPs. No long-term water quality impacts are expected because the water moving through the outfall and into the river will be monitored for compliance with the Port’s existing National Pollutant Discharge Elimination System (NPDES) permit. The species addressed in this BE and the effects determination for each are listed in Table 1. The effects determinations provided in Table 1 are consistent with the Final ESA Section 7 Consultation Handbook (USFWS and NMFS 1998).

Table 1

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<th>Species</th>
<th>Status</th>
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Port of Vancouver USA Terminal 5 Bulk Potash Handling Facility
Biological Evaluation

February 2011
100215-01.01
### Species Status

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<td><strong>Steller sea lion (Eumetopias jubatus), eastern DPS</strong></td>
<td>Threatened</td>
<td>NMFS</td>
<td>LAA</td>
<td>Designated, not in action area</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Notes:
1. NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service
2. LAA = Likely to Adversely Affect; NLAA = Not Likely to Adversely Affect; NAM = No Adverse Modification
3. ESU = Evolutionarily Significant Unit
4. DPS = Distinct Population Segment

Terrestrial species listed by the U.S. Fish and Wildlife Service (USFWS) for Clark County are not addressed in this BE based on the lack of suitable habitat on the site and in surrounding areas, which are developed and industrial in nature. These species include golden paintbrush (Castilleja levisecta), water howellia (Howellia aquatilis), Bradshaw’s desert parsley (Lomatium bradshawii), northern spotted owl (Strix occidentalis), and Nelson’s checkermallow (Sidalcea nelsoniana). There are no listed terrestrial species that could be potentially impacted by the proposed project.
2 PROJECT DESCRIPTION

This section provides information on the project location and setting, a description of the project elements, and additional considerations important to the project.

2.1 Project Location and Setting

The proposed project is located waterward of the upland Terminal 5 property at 5701 NW Lower River Road in Vancouver, Washington. The proposed project site is located approximately 3 miles (4.8 kilometers [km]) northwest of downtown Vancouver, Washington, and is composed of submerged, tidal, nearshore, and upland lands (Figure 1). It is located along a 2,300-foot-long (701-meter [m]-long) section of shoreline owned by the Port on the north bank of the Columbia River across from Hayden Island centered approximately at River Mile (RM) 103.3. The project area is bounded by the Columbia River to the south, NW Lower River Road to the north, NW Gateway Avenue to the east, and Tidewater Road to the west. The project area is located in the Vancouver Lake lowlands.

This reach of the Columbia River, known as the Friendly Reach, is approximately 3,000 feet (914 m) wide and is surrounded by industrial areas. The majority of the marine portion of the project is located on submerged and tidal lands. The submerged and tidal lands are owned by the State of Washington and managed by the Port through a Port Management Agreement, with the Washington State Department of Natural Resources (DNR).

A portion of the project will occur within designated shorelines of the state of Washington, as regulated by local governments under the Shoreline Management Act. All of the shoreline is within the jurisdiction of the City of Vancouver. The City of Vancouver Shoreline Master Plan designation for this area is Urban High-Intensity, and the area is zoned as Heavy Industrial land use.
Figure 1
Vicinity Map
Biological Evaluation
Port of Vancouver USA Terminal 5 Bulk Potash Handling Facility
2.2 Proposed Action

The proposed action consists of both upland and marine components. The marine components will be the focus of this BE; however, the upland components are briefly discussed here to give a complete overview of the proposed action.

On-site infrastructure will consist of three primary components: rail infrastructure, material storage and handling, and a berth with ship loaders (Figure 2). The rail infrastructure will consist of a single loop track designed to accommodate a single potash unit train of up to 170 railcars carrying approximately 19,290 tons (17,500 tonnes) of potash.

After entering the loop track, covered potash railcars will be emptied into a deep pit housed in a steel railcar storage building designed to ensure potash handling occurs indoors and is protected from weather. The potash will then be transferred from the bottom of the dumper pit via a conveyor to a storage building located immediately to the north. In certain instances when a cargo vessel is at the berth, potash may be transferred directly from the dumper pit following unloading from rail cars to a surge bin and onto the cargo vessel. In these instances, the facility is designed to allow the potash to bypass the storage building. In all cases, due to the soluble nature of potash, all materials handling will occur within protective structures designed to protect the potash from weather.

The berth will contain a dual-quadrant ship loader system to receive and service the cargo vessels, with the ability to accommodate vessels with carrying capacities ranging from 20,000 deadweight tonnage (DWT) vessels up to 60,000 DWT “Panamax Class” vessels that can measure up to 790 feet long by 115 feet wide (240 m by 35 m). The berth will comprise two ship loader quadrant beams and pivot supports, complete with access roadway, a central maintenance trestle between the quadrant beams, berthing dolphins, mooring dolphins, and interconnecting catwalks (Figures 2 through 6).

The berth layout provides sufficient clearance from existing dock structures at the Port and the requisite space for vessel maneuvering during berthing and departure. A new berth is proposed for construction, with the existing dock remaining in place for securing mooring lines as well as providing dock space for other vessels. The position of the berth face is
shown on Figures 2 and 3 and is governed by navigational requirements for vessel movement in the Columbia River.

Overall, the proposed marine structures will increase over-water coverage by 21,626 square feet (sf) (2,009 square meters \([m^2]\)) and will increase the number of piles in the aquatic environment by approximately 100 (Table 2). However, a majority of the over-water coverage (18,132 sf, or 1,685 m²) and piles (approximately 94) will be placed in the deep water zone (measured as greater than 20 feet \((6 \text{ m})\) of water depth from the ordinary high water mark \([\text{OHWM}])\), which is 15.2 feet Columbia River Datum \([\text{CRD}]\)). A small amount of over-water coverage (2,964 sf, or 275 m²) and number of piles (5) will be placed in the shallow water zone (measured as 20 feet \((6 \text{ m})\) or less of water depth from the OHWM \([15.2 \text{ feet CRD}]\)), but in an area completely armored with riprap substrate. The habitat types including deep water and shallow water with riprap substrate are found frequently in the lower Columbia River system and provide limited habitat function for juvenile salmonids. These zones do not provide habitat features (such as overhanging vegetation, sand and gravel substrate, low flow velocity) preferred by juvenile salmon. Thus, an increase in over-water coverage in areas of the deep water zone and shallow water zone with riprap substrate would be expected to have minimal impact on juvenile salmonid habitat.

A very small amount of over-water coverage consisting of 530 sf \((49 \text{ m}^2)\) will occur over the portion of the shallow water zone that is not armored with riprap (Table 2). This area is the most important habitat zone for juvenile salmonids because it provides valuable habitat functions and is not found frequently in the lower Columbia River system.
### Table 2

Summary of New Over-water Structure and Piles Resulting from the Proposed Action

<table>
<thead>
<tr>
<th>Shoreline Location Description</th>
<th>Area of Over-water Coverage (sf)</th>
<th>Area of Over-water Coverage (m²)</th>
<th># Piles (36- to 40-inch diameter)</th>
<th>Area of Pile Footprint (sf)</th>
<th>Area of Pile Footprint (m²)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shallow Water Below Corps OHWM (20 feet or less) with Riprap Substrate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Trestle</td>
<td>1,585</td>
<td>147</td>
<td>2</td>
<td>14</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>West Trestle</td>
<td>1,347</td>
<td>125</td>
<td>2</td>
<td>14</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>East Pivot</td>
<td>32</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>2,964</td>
<td>275</td>
<td>5</td>
<td>35</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Shallow Water Below Corps OHWM (20 feet or less) with Silt/Sand Substrate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Trestles</td>
<td>530</td>
<td>49</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>530</td>
<td>49</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Deep Water (20 feet below Corps OHWM and Deeper)</strong></td>
<td>1,959</td>
<td>182</td>
<td>6</td>
<td>42</td>
<td>4</td>
<td></td>
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<tr>
<td>Quadrant Beam</td>
<td>8,423</td>
<td>782</td>
<td>36</td>
<td>255</td>
<td>24</td>
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<tr>
<td>Center Roadway</td>
<td>1,643</td>
<td>153</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Center Dolphin</td>
<td>1,033</td>
<td>96</td>
<td>6</td>
<td>42</td>
<td>4</td>
<td></td>
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<tr>
<td>Berthing Dolphins (4)</td>
<td>1,724</td>
<td>160</td>
<td>24</td>
<td>170</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Center/Berthing Dolphin</td>
<td>356</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Connection (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mooring Dolphins (2)</td>
<td>538</td>
<td>50</td>
<td>8</td>
<td>57</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Walkway Bridges</td>
<td>2,456</td>
<td>228</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>grated</td>
</tr>
<tr>
<td>Contingency (14 piles)</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>71</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>18,132</td>
<td>1,685</td>
<td>94</td>
<td>615</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td><strong>Total In-water Piles</strong></td>
<td>18,132</td>
<td>1,685</td>
<td>99</td>
<td>615</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td><strong>Upland</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trestle</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Pivot Supports</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Contingency Piles</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Total Upland Piles</strong></td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Total All Piles</strong></td>
<td>21,626</td>
<td>2,009</td>
<td>116</td>
<td>672</td>
<td>62</td>
<td></td>
</tr>
</tbody>
</table>

Note: All measurements and pile numbers are approximate.

More detailed information related to the proposed marine structures is provided in the following sections.
Figure 2
Site Plan
Biological Evaluation
Port of Vancouver USA Terminal 5 Bulk Potash Handling Facility

SOURCE: Drawing prepared from PDF provided by WorleyParsons/Westmar '08709 02-101', dated 12/10/2010.
NOTES:

1. DATUM DATA DERIVED FROM INFORMATION PROVIDED BY
   POC: DRAWING NO. T3187 AND T3192 ENGINEERING SERVICES
   COASTAL ENGINEERING, LTD. DATED
   JANUARY 25, 2004

2. ALL ELEVATIONS REFERENCED TO COLUMBIA RIVER DATUM (CRO)
   UNLESS NOTED OTHERWISE.

3. EXISTING COASTAL INFRUSTRY AND SUBJECT TO BE REMOVED.
   FILES SHALL BE CUT-OUT AT WELDLINE.

Figure 4

Dual Quadrant Shiploader Marine Structure Elevations

Biological Evaluation

Port of Vancouver USA Terminal 5 Bulk Potash Handling Facility

NOTES:
1. ELEVATIONS SHOWN ARE TO COLUMBIA RIVER DATUM (ORD) UNLESS NOTED OTHERWISE.

Figure 6
Action Area
Biological Evaluation
Port of Vancouver USA Terminal 5 Bulk Potash Handling Facility
2.2.1 **Ship Loading System**

The ship loading system will be designed to accommodate vessels capable of navigating the Columbia River shipping channel, ranging in size from 20,000 DWT to 60,000 DWT. Potash from the storage building or directly from the railcar dumper will be transported on a fully enclosed belt conveyor system to a surge bin located upland of the berth. All conveyors have been designed as fully enclosed, in order to prevent the ingress of moisture and foreign objects and to minimize fugitive dust emissions. The function of the surge bin is to provide sufficient time for changes in the ship loading rate (e.g., when the ship loader operation is temporarily suspended during ship hatch changes). The surge bin will be located upland of the berth to allow maintenance accessibility.

2.2.2 **Dual Quadrant Ship Loaders**

The berth will contain a dual-quadrant ship loader system. The berth structures for the dual-quadrant ship loading system will consist of two ship loader quadrant beams and pivot supports, complete with access roadway, a central maintenance access platform between the two quadrant beams, four berthing dolphins, four mooring dolphins, and interconnecting catwalks. Ship loaders will be designed to minimize the length of belt exposed to the environment and will be equipped with soft loading, cascade-style chutes to minimize dust generation. The ship loader pivot supports will be sized to accommodate the ship loader feed conveyor transfer and the electrical substation for the wharf facilities.

The deck structure will be constructed of reinforced concrete pile caps, precast box beams, and composite concrete topping. Reinforced concrete up-stands will support the pivot loads for the quadrant loaders. The quadrant beams will consist of short-length concrete box beams with extended flanges for walkways on both sides of the crane rail. The berthing dolphins are piled structures with concrete pile caps, and will be equipped with fender systems and mooring bollards for ship mooring lines. The mooring dolphins are also piled structures with concrete pile caps, and will be placed beyond the berthing dolphins to accommodate bow and stern mooring lines.

The ship loader feed conveyors will be self-supporting spans, using steel trusses, and will be supported on piled bents and cast-in-place reinforced concrete pile caps.
2.2.2.1 **Quadrant Beams and Pivot Supports**

The dual quadrant ship loaders will be supported by pivot pile caps at the shoreline and by pile-supported quadrant beams at the berth. The upstream (eastern) pivot pile cap will be located at the OHWM, and the downstream (western) pivot pile cap will be located upland approximately 30 feet (9 m) landward of the OHWM. Each pivot pile cap will be cast-in-place concrete and will be topped by a concrete pivot bearing upstand that supports the end of the ship loader.

Two pile-supported quadrant beams will support the crane rail, allowing the ship loader truck assemblies to travel along an arc to load the multiple holds on the vessels (Figure 4). Each of the quadrant beams will consist of cast-in-place concrete pile caps. Nine pre-cast concrete box girders will rest on the pile cap to support the crane rail and provide a maintenance walkway.

2.2.2.2 **Mooring and Berthing Dolphins and Platform**

For vessel mooring, four breasting dolphins, and one center platform (for mooring and vessel access) will be constructed. Each of the breasting dolphins and the center platform will include two cone rubber fenders and steel fender panels attached one above the other to a precast concrete panel (Figures 4 and 5). This positioning will allow the berth to operate at a variety of river levels. Each breasting dolphin will consist of five 36- to 40-inch (914- to 1,016-mm) diameter steel batter piles and one 36-inch (914-mm) diameter steel plumb pile supporting a cast-in-place concrete pile cap.

The center platform will be connected to the inner two breasting dolphins by an 8-foot (2.4-m) wide walkway constructed of precast concrete box beams. The two outer and two inner breasting dolphins will be connected by a 6-foot 6¾-inch (2-m) steel grated walkway approximately 70 feet (21.3 m) in length. The center platform will consist of six 36- to 40-inch (914- to 1,016-mm) diameter steel plumb piles supporting a cast-in-place concrete pile cap.
Two mooring dolphins will be constructed upstream of the ship loader to provide anchoring points for bow or stern lines. Each mooring dolphin will consist of four 36- to 40-inch (914- to 1,016-mm) diameter steel batter piles supporting a cast-in-place concrete pile cap. Access to the mooring dolphins will be provided from the ship loader quadrant beams by 6-foot-6¾-inch (2-m) wide steel grated walkways. Downstream anchor points will be provided by newly installed mooring points on the existing dock. Up to four additional anchoring piles consisting of 36- to 40-inch (914- to 1,016-mm) steel pipe piles will be installed to transfer the mooring loads to the shoreline.

2.2.2.3 Access Trestles

To provide vehicle and equipment access to the center platform and the ship loaders, two access trestles will be provided that converge at a central support dolphin with a single trestle extending to the center platform to provide access to the vessel (Figure 3). The two trestle legs are necessary to provide maintenance access to the ship loaders. When maintenance is necessary, the ship loaders will be moved to the most inward position parallel to the access trestle legs. Service vehicles and cranes will be located on the trestle to service the equipment. The maintenance roadway will accommodate a 44-ton (40-metric-tonne) mobile crane.

The trestle will be 24 feet (7.3 m) wide and constructed of pre-cast concrete box beams supported on steel pipe piles with steel bull rail. Each initial leg will be supported on land by a pile-supported abutment located above the OHWM. Each trestle leg will be supported by two 36- to 40-inch (914- to 1,016-mm) diameter steel pipe piles. The central trestle will be supported by the central support dolphin and the center berthing dolphin. The steel piles will be open-ended and may be filled with concrete to meet structural load requirements.

2.2.3 Marine Structures Access

Access to the marine structures will be provided by a newly constructed paved access road from the proposed Gateway Avenue overpass or if the overpass is not constructed, from the Harborside Drive. There is a Port-maintained shoreline access road near the top of bank of the Columbia River (along the southern perimeter of the site) that will provide access to ship loading facilities and the surge bin.
2.2.4 Stormwater Outfall

Due to the need for increased capacity for the entire redeveloped Terminal 5 the project will include the installation of a larger stormwater outfall. The existing stormwater outfall will be relocated and upsized to a 48-inch to 60-inch (1,220 to 1,524 mm) diameter pipe to address the anticipated increased flow rate from the entire redeveloped Terminal 5 property. The new outfall will replace the existing outfall but will be located further downstream. The existing outfall will be decommissioned and removed once the new outfall is operational. The new outfall will be located where the riprap starts and will exit the bank below the OHWM. The quality of the water exiting the outfall to the river will be monitored for compliance with the Port’s NPDES permit. The proposed pipe will be constructed of reinforced concrete, corrugated steel, or similar product.

The stormwater outfall will likely be supported in one of two ways. One option will be to support the outfall on underwater precast concrete saddles, which will be spaced to support the weight of the pipe at joint locations. Minor work may be required on the river bottom to allow for the saddles to be placed on a flat grade. The end of the outfall will be equipped with an elastomeric check valve. It is anticipated that small areas of the riverbank will be disturbed to allow for outfall pipe construction.

The second option is to install the outfall on a pile and beam support system. With this system, a pair of H-Piles would be driven at each joint in the run of an unburied (supported) stormwater pipe. The piling would be driven to adequate depth to achieve fixity and a steel beam would be bolted across the two piles. The stormwater pipe would bear on these beams and would be held in place with a saddle and/or strap that is structurally connected to the beam. This technique requires little earthwork or disturbance to the river bottom, but it does entail driving piling in the river. These piles can be embedded using vibratory equipment without proofing the installation with an impact hammer. Areas disturbed by the outfall construction will be restored by either replacing the riprap or planting/seeding the exposed earth. Appurtenant structures, such as manholes, will be required to provide permanent access to the new stormwater outfall.
2.2.5 Marine Structure Mitigation

To mitigate for the unavoidable project effects discussed in Section 6.0, namely temporarily elevated underwater noise levels during pile installation and removal, temporary water quality impairment during in-water and over-water construction, permanent direct habitat impacts associated with the pile installation, stormwater outfall construction, and over-water shading in functional nearshore habitat, a variety of measures will be taken to offset the effects on aquatic resources or provide an ecological uplift to result in habitat conditions that are better than or equal to what is being impacted. This mitigation includes removal of existing structures from the Columbia River and the planting of native vegetation on a portion of Buckmire Slough in the Vancouver Lake lowlands.

To offset the placement of additional piles for the marine structures, the project will remove an existing dolphin and catwalk from the project area and additional piles at Terminal 2 (approximately at RM 105). Approximately two treated timber piles will be removed for each pile placed (approximately 177 piles from Terminal 2 and 31 piles from Terminal 5). The existing dolphin consists of 13 plumb and 14 batter (1H:IV) treated 16-inch (406-mm) diameter timber piles affecting approximately 40 sf (3.7-m²) of river bed and shading approximately 200 sf (19 m²). The dolphin is located approximately 30 feet (9 m) below the OHWM. The existing catwalk is supported by treated timber piles and is approximately 560 sf (52 m²) of over-water coverage. All piles will be removed with a barge-mounted vibratory hammer. If piles break during removal, they will be cut or pushed into the sediment consistent with agency-approved BMPs.

To compensate for the loss of primary productivity attributable to 530 sf (49 m²) of over-water shading over functional nearshore habitat, and to provide ecological lift of riparian function within the watershed, 2,650 sf (246 m²) of native riparian plantings will be established at Buckmire Slough, near Lake River. The existing vegetation, consisting of teasel (Dipsacus sylvestris), reed canarygrass (Phalaris arundinacea), and Himalayan blackberry (Rubus armeniacus), lacks structural diversity and the capacity to provide shade. The Buckmire Slough riparian planting will include initial removal of invasive species to allow the planting of native trees and shrubs and the installation of black cottonwood (Populus balsamifera), Pacific willow (Salix lasiandra), Oregon ash (Fraxinus latifolia), Columbia willow (Salix fluviatilis), and red osier dogwood (Cornus sericea). Tree species will
be planted at 10 feet (3 m) on center and shrubs will be planted at 5 feet (1.5 m) on center spacing.

2.3 Construction Methods

The in-water and over-water construction methods for the various components of the marine structures (i.e., ship loaders and support structures, mooring and berthing dolphins and platform, and access trestles) include pile removal and installation as well as work over water to install the marine structures. These activities are described in the following sections.

2.3.1 Pile Removal and Installation

Pile removal and pile installation activities will occur in water and upland. Piles will be removed by using vibratory extraction or by directly pulling them with a crane mounted on a barge. If a pile is unable to be completely removed using the vibratory or pulling methods, the pile will be cut or pushed into the sediment consistent with agency-approved BMPs using a pneumatic underwater chainsaw.

Pile driving will be performed using a vibratory hammer to the greatest extent possible because this form of hammer has less noise impacts than an impact hammer. Piles will be driven to refusal (the point at which the pile will no longer advance with the vibratory hammer) with the vibratory hammer, and then installed to final tip elevations with an impact hammer. It is estimated that pile installation activities will result in approximately 600 to 3,000 strikes per day with an impact hammer.

Piles are expected to be installed using a combination of the following two methods:

- Vibratory installation
- Impact installation

The project requires installation of a total of approximately 100 open-ended in-water piles (85 planned and 14 contingency) and approximately 21 open-ended upland piles (17 planned and 4 contingency), all of which are 36 to 40-inches (914 to 1,016-mm) in diameter. The size of the piles is based on design considerations. Critical design considerations, including soil
liquefaction and associated lateral spreading, were evaluated for pile structural stability. Due to the potential for seismically-induced lateral spreading, a very high pile structural capacity is required. To achieve the required structural capacity, a 36- to 40-inch (914- to 1,016-mm) diameter steel pile is necessary. If it is necessary to fill piles with concrete, the removal of material from inside of the piles will follow standard BMPs described in Section 2.5.2.3 to minimize environmental impact.

All piles will be installed using a vibratory hammer to the extent practicable. The final driving will be performed using an impact hammer. Impact hammer installation may be accomplished using either a small impact hammer with a range of 60 to 80 maximum blows per foot (DELMAG D46-32, or similar) or a large impact hammer with a range of 20 to 30 maximum blows per foot (DELMAG D80, or similar).

Two barges located within 250 feet (76 m) of each other will be working on pile installation at the same time. Each barge will operate both a vibratory hammer and an impact hammer and it is expected that one pile from each barge will be completely installed before moving on to the next pile. As such, there is a potential that two impact hammers could be installing piles at the same time. It is estimated that for approximately 80 percent of the installation, the vibratory and impact hammers will be working concurrently, and that for approximately 20 percent of the installation, two impact hammers could be installing piles at the same time. Pile installation using an impact hammer as described above is expected to result in approximately 600 to 3,000 total strikes per day. No pile driving will occur between the hours of 8 pm and 7 am per the City of Vancouver’s noise ordinance.

It is also expected that the in-water piles will be installed by a crane located on a derrick barge with piles and materials stored on a work barge. A tug boat is also anticipated for this work. Shoreline piles are expected to be installed from shore by land-based equipment.

Temporary piles are expected to be used to support pile installation guides to enable correct positioning and alignment of the permanent piles and formwork for the concrete superstructure. Three or four piles are anticipated to be installed during construction in up to 23 different locations to total approximately 95 temporary piles. These temporary piles
will be 18- to 24-inch (457- to 610-mm) diameter open-ended steel pipe and will be driven
solely with a vibratory pile driver.

2.3.1.1 Vibratory Installation

The vibratory hammer method is a common technique used in steel pile installation where
the type of sediment allows this method to be used. This process begins by placing a choker
around the pile and lifting it into vertical position with the crane. The pile will then be
lowered into position and set in place at the mudline. The pile will be held steady while the
vibratory hammer installs the pile to the required tip elevation. It is expected that the
vibratory hammer will be used to install all of the permanent structural piles to the extent
practicable, as well as to fully install all 95 temporary piles.

2.3.1.2 Impact Installation

In order for load-bearing structures to meet design criteria and ensure proper functioning of
the structure, piles often must be “proofed” by striking them with an impact hammer. In
areas where the vibratory hammer is not sufficient to install the piles and for “proofing,” an
impact hammer will be used.

An impact hammer is a large steel device that works with a hydraulic or diesel piston.
Impact hammers have guides (called a lead) that hold the hammer in alignment with the pile
while the heavy piston moves up and down, striking the top of the pile, and driving it into
the substrate from the downward force of the hammer on the top of the pile. It is expected
that the impact hammer will be used when it has been determined that vibratory installation
methods are no longer practicable.

Where the impact hammer is used, work will be conducted using a bubble curtain or other
similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks).
Sound attenuation options are discussed in more detail in Section 3.1.1.1.1.

2.3.1.3 Concrete-filled Piles

As mentioned previously, it may be necessary to fill the steel piles with concrete in order to
achieve the appropriate structural capacity. Any necessary removal of material or water
from the open-ended pile will occur after the piles are installed, consistent with associated BMPs in Section 2.4.2.3.

Once piles are cleared of material, concrete filling is expected to be accomplished by using the tremie method, which consists of placing wet concrete mixture in the pile through the use of a pipe. The process and associated BMPs are designed such that no uncured concrete will come into contact with the water.

2.3.2 **Demolition and Installation of the Marine Structure Components**

Demolition of existing dock components, including an existing dolphin and catwalk, is expected to occur using a barge-mounted crane. The existing timber piles will be unbolted and extracted with a vibratory hammer.

Installation of the marine structure components will occur over the water and will consist of cast-in-place and pre-cast elements, and marine structure outfitting. Pre-cast elements will be constructed off-site and delivered by barge to the work site where they will be placed by a barge-mounted crane. Cast-in-place elements will utilize concrete-proof wooden forms that will be attached to piles with friction collars or other appropriate false work. Concrete will be delivered by barge or trucks and pumped into the forms.

Placement of all required mechanical equipment, steel walkways, ship loaders, electrical utilities, and surface features on the dock structures will also be accomplished using a barge-mounted crane.

2.3.3 **Construction Sequencing**

It is expected that the construction of the marine facility will occur over a 2-year period. The exact sequencing of the construction activities will be determined during subsequent design phases; however, the proposed construction is generally expected to occur as follows (Table 3).
**Table 3**  
**Construction Sequencing**

<table>
<thead>
<tr>
<th>Description of Proposed Construction</th>
<th>Timing of Proposed Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition of existing dolphin and catwalk</td>
<td>Expected to occur during the approved in-water work window</td>
</tr>
<tr>
<td>Installation of piles</td>
<td>Expected to occur during two approved in-water work windows</td>
</tr>
<tr>
<td>Filling piles with concrete</td>
<td>Expected to occur year round provided that appropriate BMPs are implemented (see Section 2.4) and water quality standards are met</td>
</tr>
<tr>
<td>Construct cast-in-place pile caps and other elements</td>
<td>Expected to occur year round provided that appropriate BMPs are implemented (see Section 2.4) and water quality standards are met; the temporary pile installation will occur within an approved work window</td>
</tr>
<tr>
<td>Placement of precast concrete dock elements</td>
<td>Expected to occur year round</td>
</tr>
<tr>
<td>Marine structure outfitting (placement of all required mechanical equipment, steel walkways, fenders, ship loaders, electrical utilities, and surface dock features)</td>
<td>Expected to occur year round</td>
</tr>
<tr>
<td>Removal of in-water piles for mitigation</td>
<td>Expected to occur during two approved in-water work windows</td>
</tr>
</tbody>
</table>

### 2.4 Impact Avoidance and Minimization Measures

Impact avoidance and minimization measures are proposed action design elements that avoid and minimize the potential for adverse environmental effects, including BMPs and conservation measures. General impact avoidance and minimization measures include the following.

#### 2.4.1 Minimization Measures

- The face of the berth has been located beyond the shallow water zone (i.e., between the OHWM and 20 ft [6.1 m] below the OHWM) to avoid and minimize impacts to shallow water habitat.
- Grating has been used on platform surfaces where practicable to allow light to penetrate through the surfaces.
- The ship loader structures will have sufficient clearance between the surface and the water surface at the OHWM elevation to allow for light penetration under the berth.
surfaces.

- The potash will be transferred to the vessels at the berth via fully enclosed conveyors in order to avoid potash spill-over from the conveyors. The surge bin will store the potash temporarily during pauses in ship loading so that the product does not back up and overload the conveyors.

- Timing restrictions are used to avoid in-water work when listed species are most likely to be present. The current Washington Department of Fish and Wildlife (WDFW)-recommended work window for this area is November 1 to February 28 annually. It is expected that in-water work for this project will occur over two work windows.

- Project construction will be completed in compliance with Washington State Water Quality Standards (Washington Administrative Code [WAC] 173-201A), including:
  - No petroleum products, fresh cement, lime, concrete, chemicals, or other toxic or deleterious materials will be allowed to enter surface waters.
  - There will be no discharge of oil, fuels, or chemicals to surface waters, or onto land where there is a potential for re-entry into surface waters.
  - Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc. will be checked regularly for leaks, and materials will be maintained and stored properly to prevent spills.
  - A spill prevention, control, and countermeasures (SPCC) plan will be prepared for use during construction and operation of the project. A copy of the plan with any updates will be maintained at the work site.

- The SPCC plan will outline BMPs, responsive actions in the event of a spill or release, and notification and reporting procedures. The SPCC plan will also outline management elements such as personnel responsibilities, project site security, site inspections, and training.

- The SPCC plan will outline measures to be taken to prevent the release or spread of hazardous materials, either found on-site and encountered during construction, but not identified in contract documents, or any hazardous material that is stored, used, or generated on the construction site during construction activities. These items include, but are not limited to, gasoline, oils, and chemicals.

- Applicable spill response equipment and material designated in the SPCC plan will be
stored at the job site during construction.

2.4.2  Best Management Practices

2.4.2.1  General BMPs

Typical construction BMPs for working in, over, and near water include:

- Checking equipment for leaks and other problems that could result in discharge of petroleum-based products or other material into the Columbia River.
- Corrective actions, including those listed below, will be taken in the event of any discharge of oil, fuel, or chemicals into the water:
  - In the event of a spill, containment and cleanup efforts will begin immediately and be completed in an expeditious manner in accordance with all local, state, and federal regulations; these efforts will take precedence over normal work. Cleanup will include proper disposal of any spilled material and used cleanup material.
  - The cause of the spill will be assessed and appropriate action will be taken to prevent further incidents or environmental damage.
  - Spills will be reported to the Washington State Department of Ecology (Ecology) Southwest Regional Spill Response Office at 360-407-6300.
- Work barges will not be allowed to ground out on the river bottom.
- Excess or waste materials will not be disposed of or abandoned waterward of the OHWM or allowed to enter waters of the state. Waste materials will be disposed of in an appropriate landfill.
- Demolition and construction materials will not be stored where wave action or upland runoff can cause materials to enter surface waters.
- Oil-absorbent materials will be stored on site during construction in the event of a spill or if any oil product is observed in the water.

2.4.2.2  Pile Removal BMPs

- While creosote-treated piles are being removed, a containment boom will surround the work area to contain and collect any floating debris and sheen. Also, any debris will be retrieved and disposed of properly. The piles will be dislodged with a vibratory hammer, when possible, and will not be intentionally broken by twisting or
bending.

- The piles will be removed in a single, slow, and continuous motion so as to minimize sediment disturbance and turbidity in the water column.

- If a pile breaks above or below the mudline, it will be cut or pushed in the sediment consistent with agency-approved BMPs.

- Removed piles, stubs, and associated sediments (if any) will be contained on a barge. If piles are placed directly on the barge and not in a container, the storage area will consist of a row of hay or straw bales, filter fabric, or similar material placed around the perimeter of the storage area.

- All creosote-treated material, pile stubs, and associated sediments (if any) will be disposed of in a landfill approved to accept those types of materials.

2.4.2.3 Pile Installation BMPs

- The vibratory hammer method will be used to drive steel piles, to the extent possible, to minimize noise levels.

- A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks, etc.) will be employed during impact pile driving.

- A marine mammal monitoring plan will be implemented during pile driving activities to reduce the risk of potential impacts to marine mammals.

- If material needs to be excavated from inside piles to facilitate infill of concrete for structural purposes, appropriate methods will be put in place to minimize the contact of any excavated material with the marine environment. Excavated material will be stockpiled and disposed of in an appropriate upland location.

2.4.2.4 Over-water Concrete BMPs

- Wet concrete will not be allowed to come in contact with surface waters.

- Forms for any concrete structure will be constructed to prevent leaching of wet concrete.

- Curing concrete will not be watered.

- If piles need to be filled with concrete, concrete will be installed using the tremie method (a method of construction commonly used for projects spanning water).
2.4.2.5  Stormwater Outfall Support Structure Construction BMPs

During construction of the stormwater outfall support structures, the following BMPs will be employed:

- The vibratory hammer method will be used to drive steel piles, to the extent possible, to minimize noise levels.
- Silt curtains may be employed if there is significant disturbance to the river bottom.
- Excavated material will be stockpiled and disposed of in an appropriate upland location.
- In-water construction may occur during the WDFW-approved in-water work, or during low water, when work can occur above the usual seasonal low water level.
- Temporary jute netting or cut straw, wattles, and/or silt fencing may be placed in disturbed areas of the shoreline.
- Work will be performed from the land side where possible.

2.4.3  Conservation Measures

Conservation measures are measures taken to directly contribute to the recovery of a listed species, including:

- Native shoreline vegetation that is disturbed during construction will be restored after construction is completed to the extent practicable.
- To mitigate for impacts to the benthic environment from pile placement and upgrades to a stormwater outfall, the project will remove an existing dolphin and catwalk at Terminal 5 and will remove additional treated timber piles at Terminal 2, for a total of approximately 208 piles to be removed.
- To mitigate for impacts from over-water shading in the nearshore environment, the project will install native trees and shrubs on 2,650 sf (246 m²) of riparian habitat at Buckmire Slough.
3  ACTION AREA

The action area is defined as the area to be affected directly or indirectly by the federal action. In this case, the federal action is the issuance of the USACE permit (50 CFR §402.02). The action area considers the effects of interrelated and interdependent activities and includes the geographic extent of the effects resulting from the proposed action. USFWS interprets the action area to include the extent of effects of the project on the environment. Information provided in the following sections for each direct, indirect, interrelated and interdependent effect is used to determine the limits of the effects of the proposed action (e.g., potential area of impact related to in-water noise from pile driving). The action area boundary is thus set as the limits of the effects of the proposed action. National Marine Fisheries Service (NMFS) interprets the action area as the area where effects to listed species are expected to occur (WSDOT 2010a).

3.1  Potential Direct Project Effects

Direct effects include immediate impacts resulting from the proposed action. Potential direct effects of the proposed action include noise, water quality, and direct habitat effects in the project area. Each of these potential direct effects is discussed in the following sections.

3.1.1  Noise

3.1.1.1  In-Water Noise

In-water pile installation activities. As described in Section 2.3.1, vibratory pile installation methods will be used to the extent practicable on all piles. An impact hammer will be used to complete any installation not achieved by the vibratory hammer as well as to “proof” the piles. Impact hammer installation may be accomplished using either a small impact hammer with a range of 60-80 maximum blows per foot (DELMAG D46-32, or similar) or a large impact hammer with a range of 20-30 maximum blows per foot (DELMAG D80, or similar). A bubble curtain, or other similar noise attenuation method (such as a noise attenuation pile cap, or cushion block) will be employed during impact pile driving to minimize the potential noise impacts.
The project requires installation of a total of approximately 100 open-ended piles (85 planned and 14 contingency), between 36 and 40 inches (914 to 1,016-mm) in diameter. Two barges located within 250 feet (76 m) of each other will be working on pile installation at the same time. Each barge will operate both a vibratory hammer and an impact hammer, and it is expected that one pile from each barge will be completely installed before moving on. As such, there is a potential that two impact hammers could be installing piles at the same time. It is estimated that for 80 percent of the installation, the vibratory and impact hammers will be working concurrently, and that for 20 percent of the installation, two impact hammers could be installing piles at the same time. Pile installation using an impact hammer as described above is expected to result in approximately 600 to 3,000 total strikes per day. Pile installation is expected to occur over two in-water work periods.

To protect ESA-listed species, the Services (NMFS and USFWS) developed injury and disturbance criteria for Steller sea lions and salmonids, which are shown in Tables 4 and 5. These criteria are used to determine thresholds below which no injury or disturbance can be expected. The measurement $\text{dB}_\text{PEAK}$ refers to the maximum level reached by a sound impulse, while $\text{dB}_\text{RMS}$ refers to the average sound pressure level experienced during a series of sound impulses. The measurement $\text{dB}_\text{SEL}$ refers to cumulative sound exposure levels.

### Table 4
**Steller Sea Lion (Eumetopias jubatus) Sound Injury and Disturbance Threshold**

<table>
<thead>
<tr>
<th></th>
<th>Pulse</th>
<th>Non-Pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury</td>
<td>190 $\text{dB}_\text{RMS}$</td>
<td>--</td>
</tr>
<tr>
<td>Disturbance</td>
<td>160 $\text{dB}_\text{RMS}$</td>
<td>120 $\text{dB}_\text{RMS}$</td>
</tr>
</tbody>
</table>

### Table 5
**Salmonid (Oncorhynchus spp.) Sound Injury and Disturbance Threshold**

<table>
<thead>
<tr>
<th></th>
<th>Pulse</th>
<th>Non-Pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Strike Injury</td>
<td>206 $\text{dB}_\text{PEAK}$</td>
<td>--</td>
</tr>
<tr>
<td>Cumulative Sound Injury</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>&lt; 2 grams</td>
<td>183 $\text{dB}_\text{SEL}$</td>
<td>--</td>
</tr>
<tr>
<td>≥ 2 grams</td>
<td>187 $\text{dB}_\text{SEL}$</td>
<td>--</td>
</tr>
<tr>
<td>Disturbance</td>
<td>150 $\text{dB}_\text{RMS}$</td>
<td>150 $\text{dB}_\text{RMS}$</td>
</tr>
</tbody>
</table>
For underwater sound, the area of potential impact for listed species will be defined as the distance required for noise to attenuate to ambient/background levels. The Practical Spreading Loss (PSL) model, currently accepted by the Services, is used to estimate the attenuation distance to ambient levels. This model requires sound level inputs (dBS and dBRS) as well as the ambient background noise level. In-water noise will be created by impact pile driving and vibratory pile driving. Impact pile driving produces the highest noise levels, and in addition, produces a rapid rise in sound pressure that is associated with noise injury. Vibratory pile driving produces noise levels that are less than those generated during impact pile driving (WSDOT 2010a) under similar conditions. There is a lack of information related to the size of the impact hammer and the resulting sound levels for 36 to 40 inch (914- to 1,016-mm) pile installations. As such, for this analysis, the noise levels recorded for a project in Alameda, California, that installed 40-inch (1,016-mm) steel pipe piles using a DELMAG D80 impact hammer are used (CalTrans 2009).

Table 6

<table>
<thead>
<tr>
<th>Pile Diameter</th>
<th>Sound Level ¹ (Single Strike)</th>
<th>Sound Level ² (Vibratory Installation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 to 40 inches (914 to 1,016 mm) – Unattenuated</td>
<td>208 dBPEAK 195 dBRS 180 dBSEL</td>
<td>174 dBRS</td>
</tr>
</tbody>
</table>

Sources: 1 - CalTrans 2009
2 - WSDOT 2010b

Sound attenuation devices, such as air bubble curtains and sound attenuation pile caps (cushion blocks), have been effective at attenuating sound in riverine environments with sandy or silty bottoms resulting from installation of steel pipe piles with an impact hammer. Tests by Washington State Ferries (WSF) showed that in a deep sandy marine environment, an unconfined air bubble curtain achieved attenuation levels of between 3 to 11 dB (Anacortes) and 17 to 23 dB (Mukilteo), and that a confined air bubble curtain achieved attenuation levels of between 12 to 14 dB (Eagle Harbor) and 12 to 23 dB (Mukilteo). WSDOT (2010) found that bubble curtain effectiveness depends on the type of bubble
curtain used, the design of the system, and the specific conditions of the substrate in the construction area. Unconfined bubble curtains with additional rings attenuated sound better than those with fewer rings under similar conditions (WSDOT 2010a). The proposed project involves the installation of both batter piles and plumb piles. There are expected difficulties in using bubble curtains for the installation of batter piles.

Sound attenuation pile caps, or cushion blocks, are blocks of material placed on top of a pile during impact pile driving to minimize the noise generated while driving the pile. Materials typically used for cushion blocks include wood, nylon, and micarta blocks. Studies conducted by WSDOT indicate the following reductions in sound pressure levels (CalTrans 2009):

- Wood: 11 to 26 dB
- Micarta: 7 to 8 dB
- Nylon: 4 to 5 dB

Geotechnical testing has found that the riverbed in the proposed action area is composed primarily of silts and sand (URS 2010), which is optimal for sound attenuation in riverine environments (WSF 2009). However, to be conservative in calculating risk to listed species, unattenuated sound levels will be used in the noise analysis for pile driving (Table 6).

The worst-case value of 208 dBAEAK, the average value of 195dBRSMS, and the average value of 180dBEL will be used for the noise analysis for impact pile driving. The average value of 174 dBRSMS will be used for the noise analysis for vibratory pile installation. This value came from a WSDOT monitoring project of vibratory installation of a 36-inch (914-mm) steel pipe pile at Port Townsend (WSDOT 2010b). No reference underwater sound levels suitable for ESA consultation are available for this area, so 120 dBRSMS (the lowest potential impact threshold for listed species) has been used as a surrogate reference (WSDOT 2010a). To complete the noise analysis, the following assumptions were made:

- Noise will attenuate at a rate of 4.5 dB per doubling distance, and this attenuation rate increases to 10 dB per doubling distance beyond 0.6 mile (1 km) (WSDOT 2010a).
- Sound will not propagate beyond an intervening land mass.
Using the PSL model, the largest noise impact zone is expected to result from vibratory installation of 36- to 40-inch (914- to 1,016-mm) steel pipe piles, and it is expected to take up to 7 miles (11 km) at most for underwater sound to attenuate to the 120 dB\textsubscript{RMS} surrogate background level, since sound will not propagate beyond an intervening land mass. Because of the project area’s location on a river bend and across the river from Hayden Island, noise transmission will be stopped by land masses long before it has the opportunity to attenuate to background levels (Figure 6).

3.1.1.1.2 Upland Pile Installation

Upland pile installation has the potential to impact listed species through the re-radiation of sound energy from the ground to the water within the action area. Generally, ground-radiated noise is dominated by low frequencies, which cannot propagate efficiently through bottom substrates or shallow water. In most instances, the geotechnical conditions below the mudline are not completely known, and the potential for direct transmittance of energy through the bottom substrates complicates the prediction of sound propagation to any point in the water (CalTrans 2009). The action area is primarily composed of sand and gravel substrates, which may facilitate propagation of higher sound levels. However, obstructions (such as barges, other piles, and other structures [e.g., existing docks]) and channel characteristics (such as the narrowness of the channel and the slope of side of the channel) can modify how sound propagates in water (CalTrans 2009). The slope of the channel in the action area is fairly steep; therefore, it is expected that sound will attenuate more rapidly than with a gradual slope.

Noise levels generated through upland pile installation are unlikely to cause disturbance to listed species in excess of noise levels generated during in-water pile installation. Approximately seven upland piles will be installed within 15 feet (4.5 m) of the OHWM, and would be the most likely to cause noise in the aquatic environment. It is not known how far subsurface noise may propagate when moving into the aquatic environment, yet it is expected to be less than potential noise generated for in-water pile installation (CalTrans 2009). Therefore, for the remainder of this document, potential effects to listed species due to noise generated from upland pile installation will be covered by the more conservative analysis of in-water pile installation.
3.1.1.2  **In-Air Noise**

In-air noise is evaluated here to be inclusive of all the potential impacts that could affect the terrestrial and aquatic environments associated with the proposed action, despite the fact that there are no terrestrial ESA-listed species near the project area and no Steller sea lion haul out areas in the project area. Pile driving activities tend to be louder and more disruptive than typical construction activities, and sound levels (hourly $L_{eq}$ – energy-average sound level) of pile driving activities (either impact hammer or vibratory) are estimated to be approximately 94 dBA at 50 feet (15 m) with possible maximum levels ($L_{max}$ – Maximum sound level) up to 110 dBA (assuming impact-driven steel piles). These estimates were developed from the FHWA Roadway Construction Noise Model (RCNM), version 1.1, 2008.

The PSL model was used to estimate the attenuation distance to ambient levels. Using noise estimates from WSDOT (2010) and assuming the upper range of values for an urban industrial area, the ambient noise level within the action area would be approximately 65 dBA. Assuming hard-site conditions (because of water and paved surfaces in the area), pile-driving noise is expected to attenuate to background levels over a distance of about 10,000 feet, or 1.89 miles (3.0 km). In reality, this distance is likely to be less because of topography, tree cover, built structures, and other factors.

3.1.2  **Water Quality**

Temporary turbidity will result from in-water pile removal and, to a lesser degree, from pile installation associated with the construction of the ship loading facility and potentially the replacement stormwater outfall. Turbidity from pile removal is not expected to exceed state water quality standards as defined by WAC 173 201A 200(1)(e)(i). Turbidity will be minimized with BMPs, which are listed in Section 2.4.

Temporary turbidity is also possible from potential soil erosion associated with the upland work adjacent to the water. BMPs will be employed during construction to manage potential soil erosion consistent with a stormwater pollution prevention plan (SWPPP) prepared for the NPDES Construction Stormwater General Permit, WAC Chapter 463-76, and to comply with the erosion prevention and sediment control plan requirements of VMC 14.24.070.
These BMPs may include silt fencing along the shoreline embankment. Erosion control BMPs may also include stabilized construction entrances, biofiltration bags at existing stormwater inlets, and periodic watering during dry weather to reduce wind erosion.

Potential impacts to water quality from cast-in-place concrete are possible and will be minimized as follows:

- Wet concrete will be managed in a manner to ensure that it does not come in contact with surface waters.
- Forms for any concrete structure will be constructed to prevent leaching of wet concrete, and will remain in place until concrete is cured.
- Additionally, curing concrete will not be watered.

A SPCC plan will be used for the construction and operation of the project. The SPCC plan will outline BMPs, responsive actions in the event of a spill or release, and notification and reporting procedures. It is not expected that waste materials would enter ground or surface waters during operation of the bulk potash handling facility (after construction). The potash will be transferred to the vessels at the berth via fully enclosed conveyors. Therefore, potash cannot spill over from the conveyors. It is also not expected that potash or any waste material will enter the stormwater system because of the containment measures (i.e., fully enclosed conveyors and dry baghouse-style dust collectors) that are included in the project design.

In the long term, water quality is expected to be maintained within the project area as a result of implementing construction BMPs and minimization measures. In addition, the water exiting the updated outfall is not expected to impact long-term water quality as the water quality will be monitored for compliance with the Port's NPDES permit.

3.1.3 Habitat Impacts

3.1.3.1 Over-water Coverage

There will be a small amount (530 sf, or 0.01 acre [49 m²]) of shallow water habitat with silt/sand substrate that will be shaded by the proposed structure. The new structure will be placed at a height above the water that allows for light to penetrate underneath it and was
designed to minimize the width of the structure. The remaining over-water coverage will occur within the deep water zone and the shallow water zone with riprap substrate. These habitat areas provide few functions and are plentiful in the system. To compensate for the loss of productivity attributable to 530 sf (49 m²) of over-water shading over functional nearshore habitat, and to provide ecological lift of riparian function within the watershed, 2,650 sf (246 m²) of native riparian plantings will be established at Buckmire Slough, near Lake River. The existing vegetation, consisting of teasel (*Dipsacus fullonum*), reed canarygrass (*Phalaris arundinacea*), and Himalayan blackberry (*Rubus armeniacus*), lacks structural diversity and the capacity to provide shade. The Buckmire Slough riparian planting will include initial removal of invasive species to allow planting of native trees and shrubs, and the installation of black cottonwood (*Populus trichocarpa*), Pacific willow (*Salix lucida*), Oregon ash (*Fraxinus latifolia*), Columbia willow (*Salix fluviatilis*), and red-osier dogwood (*Cornus sericea*). Tree species will be planted at 10 feet (3 m) on center and shrubs will be planted at 5 feet (1.5 m) on center spacing.

### 3.1.3.2 Substrate Disturbance

Pile installation and removal will result in some disturbance of the river substrate as the piles are either installed or removed. This disturbance is expected to be localized and short term. Substrate disturbance impacts to aquatic species will be minimized and mitigated with the implementation of appropriate BMPs, as discussed in Section 2.4. In addition, the substrate that each individual installed pile covers will be permanently impacted by the proposed action.

To offset the placement of additional piles for the marine structures and the resulting substrate disturbance, the project will remove approximately 208 piles (177 piles from Terminal 2 and 31 piles from Terminal 5 associated with an existing dolphin).

### 3.2 Potential Indirect Project Effects

Indirect effects are those that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur (50 CFR §402.02). A potential indirect project effect includes an increase in vessel traffic in the Columbia River. However, the
potential for a significant increase in vessel traffic over historical levels as a result of the proposed action is not expected, as discussed below.

It is expected that the proposed project, at full buildout will receive approximately 145 ship calls per year or 290 ship transits (one-way trips). It is estimated that approximately 1,500 deep draft vessels currently use the Columbia River navigational channel per year, or approximately 2,980 deep draft transits per year, as one transit is equal to a one-way vessel trip. Due to the economic decline in recent years, this number of deep draft transits has decreased from historical levels. Therefore, the proposed addition of the deep draft vessels that would result from the proposed project is consistent with the historic levels of cargo vessels in the Columbia River; thus, it is not expected to result in congestion of the Columbia River navigational channel.

3.3 Potential Effects of Interrelated/Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification (50 CFR §402.02). Interdependent actions have no independent utility apart from the proposed action (50 CFR §402.02) and depend on the project actions for justification. There are no known potential interrelated/interdependent actions associated with the proposed project.

3.4 Potential Cumulative Effects

Cumulative effects are effects of future state, tribal, local, or private actions that are reasonably certain to occur within the proposed action area (50 CFR §402.02). From an ESA perspective, the analysis of cumulative effects considers future non-Federal actions (i.e. non-federal projects that do not require federal permits) that may affect habitats and listed species in the action area. No such actions have been identified. Any future project involving in-water work will require a Federal permit and appropriate ESA review. Future federal actions that are unrelated to this proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.
3.5 Action Area Boundary

The boundary of the action area is defined by the potential geographic reach of all potential direct, indirect, and interrelated and interdependent activities that could impact listed species. For this project, in-water noise associated with pile driving is the mechanism with the greatest impact distance, and thus, constitutes the boundary of the action area. The action area is considered the area within the radius required for impact noise to attenuate to background levels. Using the PSL model, it will take up to 7 miles (11 km) (Figure 6) at most for underwater sound coming from pile installation activities of a 36- to 40-inch (914- to 1,016-mm) steel pipe pile to attenuate to background levels (120 dB_{RMS}) because underwater sound transmission is halted by intervening barriers, such as the banks of the Columbia River, bottom topography, and underwater structures. In-air sound has the potential to travel up to a radius of 10,000 feet (1.89 miles; 3.0 km) from the construction area, although topography, built structures, and vegetation are likely to reduce this range. The extent of the action area is shown in Figure 6 and includes most of the mainstem Columbia River between the Multnomah County River Patrol Park (upstream, approximately RM 108) and Belle Vue Point County Park (downstream, approximately RM 101). The action area continues landward from the location of proposed action for 10,000 feet (1.89 miles; 3.0 km). This region delimits the maximum area where in-water and terrestrial noise may be elevated above background levels during pile driving activities.
4 STATUS OF SPECIES AND CRITICAL HABITAT

This section summarizes the status of listed species expected to be in the action area and designated critical habitat and provides species and critical habitat information and presence within the action area. The listed species within the action area are:

- Chinook salmon (*Oncorhynchus tshawytscha*) (five Evolutionarily Significant Units [ESUs])
  - Lower Columbia River ESU
  - Upper Columbia River spring-run ESU
  - Snake River fall-run ESU
  - Snake River spring/summer-run ESU
  - Upper Willamette River ESU
- Coho salmon (*Oncorhynchus kisutch*) (Lower Columbia River ESU)
- Chum salmon (*Oncorhynchus keta*) (Columbia River ESU)
- Sockeye salmon (*Oncorhynchus nerka*) (Snake River ESU)
- Steelhead trout (*Oncorhynchus mykiss*) (five Distinct Population Segments [DPSs])
  - Lower Columbia River DPS
  - Upper Columbia River DPS
  - Snake River Basin DPS
  - Middle Columbia River DPS
  - Upper Willamette River DPS
- Bull trout (*Salvelinus confluentus*) (Columbia River DPS)
- Green sturgeon (*Acipenser medirostris*) (southern DPS)
- Eulachon (*Thaelicthys pacificus*)
- Steller sea lion (*Eumetopias jubatus*)

Within the action area, designated critical habitat exists for all listed salmon, steelhead, and bull trout populations except for Lower Columbia River coho. Within the action area, critical habitat has been proposed for eulachon.

Tables 7, 8, and 9 review the timing of juvenile and adult salmonid migrations in the Columbia River and will be referred to throughout this section. The timing shown in the
Tables reflect potential presence in the project area and does not provide an indication of relative abundance or probability of fish presence throughout the time period (i.e., peak migration periods). This information was developed through discussions with Steve West of WDFW, Tabitha Reeder (BergerABAM), and Dan Gunderson (BergerABAM) and based on WDFW’s information on run timing developed out of research conducted for the Columbia River Crossing project (WDFW 2008b).

### Table 7
**Timing of Juvenile Salmonid Downstream Migration within Action Area**

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= WDFW Lower Columbia River in-water work window

= Potential presence of outmigrating juvenile salmonids

Source: WDFW 2008b
### Table 8
Timing of Adult Salmonid Migration within Action Area

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= WDFW Lower Columbia River in-water work window

= Potential presence of migrating adult salmonids

Source: WDFW 2008b
Table 9
Timing of Potential Non-Salmonid Species Occurrence within Action Area

<table>
<thead>
<tr>
<th>Species and ESU/DPS</th>
<th>Jan</th>
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<tr>
<td>Pacific Eulachon (smelt) – Southern DPS</td>
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<td>Steller sea lion – Eastern DPS</td>
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<td>North American Green Sturgeon – Southern DPS</td>
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Source: WDFW 2008b

4.1 Chinook Salmon (*Oncorhynchus tshawytscha*)

This project is located in the mainstem of the Lower Columbia River (RM 103.3); therefore, all five ESUs of threatened or endangered Columbia/Willamette Basin Chinook salmon (*Oncorhynchus tshawytscha*) may be present in the action area at some time during the year. The five ESUs with potential to be present in the action area are the Snake River fall ESU (Threatened), Snake River spring/summer ESU (Threatened), Upper Columbia River spring ESU (Endangered), Lower Columbia River ESU (Threatened), and Upper Willamette River ESU (Threatened).

4.1.1 Chinook Salmon (*Oncorhynchus tshawytscha*) Information and Presence in the Action Area

Adult Chinook salmon could be migrating through the action area between February and November (Table 8). Adults generally migrate in the deeper waters in the main channel of the river. Juvenile Chinook salmon, particularly subyearling migrants, are generally oriented closer to shore in water less than 2 m (6.6 feet) deep, and where currents do not exceed 1 foot per second (NMFS 2005a). Juvenile subyearling Chinook may reside and rear in the Lower Columbia River estuary prior to entering the ocean, but are not expected to remain in high energy, deep water areas upstream. In the mainstem river, they are most likely to be found just a few feet from shore, beneath piers or other protective structures where water velocity is lower (NMFS 2005a).
All of the Chinook populations found in the action area are defined geographically as well as by run timing, with the exception of the Lower Columbia River ESU, which is defined solely by geography. The three runs exhibited are spring, summer, and fall run Chinook, indicating the time of return to fresh water (Healey 1991). This BE focuses on the Lower Columbia River Chinook salmon ESU, as this is the ESU that is expected to be rearing as well as migrating through the action area. The other ESUs are expected to move quickly through the action area as they migrate through the Columbia River.

Populations of Chinook salmon within the Lower Columbia River exhibit wide variation in outmigration timing due to variation in spawning timing (fall and spring runs) and water temperatures. The majority of juveniles migrate downstream as subyearlings following emergence. Juvenile outmigration of Chinook through the action area could occur from March through October (Table 7). Chinook in the Lower Columbia River spawn off the mainstem river in off-channel habitat or in tributary streams. Generally, they rear in these shallower waters, but they may move into the river shoreline areas as subyearlings and continue rearing until they migrate as yearlings (Myers et al. 1998).

The action area is used as a migration corridor for Chinook salmon. Shoreline and shallow water habitat are limited due to extensive riprap along the Columbia River in the action area. The upper slope of the banks within the action area is primarily composed of planted grass, rabbit’s foot (Trifolium arvense), spotted knapweed (Centaurea stoebe), white sweet clover (Melilotus alba), and mullein (Verbascum thapsus). Other species observed include Himalayan blackberry (Rubus armeniacus), golden rod (Solidago sp.), horse tail (Equisetum sp.), and vetch (Vicia sp.), and percent cover varies along the action area. The bathymetry in the vicinity of the existing dock slopes gently toward the navigation channel. The substrate along the shoreline is a mix of silts and sands.

Rearing in these areas would be primarily limited to feeding during downstream migration. Adult fish returning to the Columbia River are no longer feeding by the time they reach the action area. Mainstem spawning in the Columbia River does not occur for more than 200 miles upstream. Thus, the action area is used strictly as a migration corridor for adult and juvenile fish.
4.1.2  **Chinook Salmon (Oncorhynchus tshawytscha) Critical Habitat

Information and Presence in the Action Area

The action area falls within designated critical habitat for Upper Columbia River spring run ESU, the Lower Columbia River ESU, the Upper Willamette River ESU, and the Snake River fall run and spring/summer run ESUs. The action area is designated as a rearing/migration corridor for all five ESUs. Based on information available in the WDFW StreamNet database (http://www.streamnet.org), this area of the Columbia River is primarily used as a migration corridor by these listed species.

Designated critical habitat within fresh water is the entire lateral extent of designated reaches with the upper elevation boundary defined by OHWM (NOAA 2005b). Therefore, the entire action area waterward of the OHWM elevation (15.2 feet CRD) is within critical habitat.

4.2  **Lower Columbia River Coho Salmon (Oncorhynchus kisutch)**

This project is located in the mainstem of the Lower Columbia River (RM 103.3); therefore, the Lower Columbia River ESU (Threatened) of coho salmon (O. kisutch) may be present in the action area at some time during the year.

4.2.1  **Lower Columbia River Coho Salmon (Oncorhynchus kisutch)

Information and Presence in the Action Area

The Lower Columbia River coho ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, along with a number of hatchery stocks.

In the Columbia River there are early (Type S) and late (Types N) types of run timing (Myers et al. 2006). Type S fish typically return to the Columbia River from August to October and spawn in October and November. Type N fish return to the Columbia River from October to November/December and spawn in November through January, with some spawning into
mid-February (Myers et al. 2006) (Table 8). Yearling juveniles could migrate through the action area from mid-February through mid-September (Table 7).

The action area provides both rearing and migration function for Lower Columbia River coho salmon, based on information from the WDFW StreamNet database. For adults, the action area is used primarily as a migration corridor, whereas juveniles also use the mainstem for rearing during some parts of the year (Myers et al. 2006). Based on general life history traits, it is more likely that these fish overwinter outside of the mainstem Columbia River.

4.2.2 Lower Columbia River Coho Salmon (Oncorhynchus kisutch) Critical Habitat Information and Presence in the Action Area

Critical habitat has not been designated for Lower Columbia River coho salmon.

4.3 Columbia River Chum Salmon (Oncorhynchus keta)

The Columbia River chum (O. keta) ESU (Threatened) includes all naturally spawned fish in the Columbia River, its tributaries in Washington and Oregon, and a few hatchery programs (NOAA 2005a).

4.3.1 Columbia River Chum Salmon (Oncorhynchus keta) Information and Presence in the Action Area

Adult chum return to the Columbia River and could be migrating through the action area from October through November (Table 8). The life histories of chum salmon are characterized by juveniles showing very little freshwater rearing and typically beginning their downstream migration to estuarine and marine areas quickly after emergence (Salo 1991). Chum may spend 4 to 5 years in marine waters before returning to spawn. Juveniles could be migrating through the action area between mid-February and mid-June (Table 7).

Chum salmon spawn in shallow water in the main channel of the Columbia River upstream of the project site, between RMs 113 and 114, near RM 123, between RMs 136 and 139, and near Ives Island at RM 143 (NMFS 2005b). As such, the action area is used as both a migration corridor and rearing area for juvenile and adult chum.
4.3.2  **Columbia River Chum Salmon (Oncorhynchus keta) Critical Habitat Information and Presence in the Action Area**

The action area falls within designated critical habitat for the Columbia River ESU of chum salmon. Based on information from the StreamNet database, this area of the Columbia River is primarily used as a migration corridor by this listed species. Despite this information, the area may also be used for rearing, as there are some spawning locations within the project vicinity, but outside of the action area.

Designated critical habitat within fresh water is the entire lateral extent of designated reaches with the upper elevation boundary defined by OHWM (NOAA 2005b). Therefore, the entire action area waterward of the OHWM elevation (15.2 feet CRD) is within critical habitat for Columbia River chum salmon.

4.4  **Snake River Sockeye Salmon (Oncorhynchus nerka)**

The Snake River sockeye (O. nerka) ESU (Endangered) includes all anadromous and residual populations originating from the Snake River Basin in Idaho, as well as one artificially propagated population (NOAA 2005a). This ESU does not include populations from the Upper Columbia River.

4.4.1  **Snake River Sockeye Salmon (Oncorhynchus nerka) Information and Presence in the Action Area**

Spawning for the Snake River ESU of sockeye salmon occurs only in the far upper reaches of the Snake River Basin. Sockeye salmon typically spawn in the late summer and fall (Burgner 1991). The Upper Snake River is rearing grounds for juveniles for a number of years before they outmigrate to sea as relatively large smolts in late spring and early summer.

The action area is used solely as a migration corridor for the Snake River ESU of sockeye salmon. Adults could be migrating through the action area between June and July (Table 8) while juveniles could be migrating through between April and June (Table 7).
4.4.2 *Snake River Sockeye Salmon (Oncorhynchus nerka) Critical Habitat Information and Presence in the Action Area*

The action area falls within designated critical habitat for the Snake River ESU of Sockeye Salmon. Based on information available in the WDFW StreamNet database, this area of the Columbia River is primarily used as a migration corridor by this listed species.

Designated critical habitat within fresh water is the entire lateral extent of designated reaches with the upper elevation boundary defined by OHWM (NOAA 2005b). Therefore, the entire action area waterward of the OHWM elevation (15.2 feet CRD) is within critical habitat for Columbia River sockeye salmon.

4.5 *Steelhead Trout (Oncorhynchus mykiss)*

All five DPSs of threatened or endangered steelhead trout (*O. mykiss*) may be present in the action area at some time during the year. The five DPSs with the potential to occur in the action area are the Snake River Basin DPS (Threatened), Upper Columbia River DPS (Endangered), Middle Columbia River DPS (Threatened), Lower Columbia river DPS (Threatened), and Upper Willamette River DPS (Threatened).

4.5.1 *Steelhead Trout (Oncorhynchus mykiss) Information and Presence in the Action Area*

Most steelhead are anadromous and have similar life histories to stream-type salmon, with a multi-year fresh water period, followed by an ocean migration and residency, and a return to freshwater to spawn. There are two life histories of steelhead in the Columbia River basin: summer run fish and winter run fish. Summer run fish enter fresh water as immature adults between May and October. Winter run fish enter fresh water as mature adults between November and April. Snake River DPS adults could be migrating through the action area between June through October. The Lower Columbia River DPS could be migrating through the action area from mid-November through October. Upper Willamette River DPS, Middle Columbia River DPS, and Upper Columbia River DPS could be migrating through the action area from May through October (Table 8). Overall, this means that adult fish could be present in the action area throughout the year (Good et al. 2005).
Juvenile steelhead may spend up to 7 years in fresh water before migrating to estuarine areas as smolts and then into the ocean to feed and mature. They can then remain at sea for up to 3 years before returning to fresh water to spawn. Lower Columbia River DPS juveniles could be in the action area from February to November. The Snake River DPS, Middle Columbia River DPS, Upper Columbia River DPS, and Upper Willamette DPS could be migrating through the action area from March through June (Table 7). Overall, juvenile steelhead could be migrating through the action area between February and November (Table 7).

Conditions within the mainstem Columbia River within the action area are not suitable for steelhead spawning or rearing. The action area is used primarily as a migration corridor for steelhead trout, based on information available in the WDFW StreamNet database. Outmigrating juveniles are not shoreline dependent.

4.5.2 Steelhead Trout (Oncorhynchus mykiss) Critical Habitat Information and Presence in the Action Area

The action area falls within designated critical habitat for the Snake River DPS, the Upper Columbia River DPS, the Middle Columbia River DPS, the Lower Columbia River DPS, and the Upper Willamette River DPS. Based on information available in the StreamNet database, this area of the Columbia River is primarily used as a migration corridor by these listed species.

Designated critical habitat within fresh water is the entire lateral extent of designated reaches with the upper elevation boundary defined by OHWM (NOAA 2005b). Therefore, the entire action area waterward of the OHWM elevation (15.2 feet CRD) is proposed critical habitat for the five DPSs.

4.6 Columbia River Bull Trout (Salvelinus confluentus)

The Columbia River bull trout (Salvelinus confluentus) DPS (Threatened) occurs throughout the entire Columbia River Basin within the United States and its tributaries, with the exception of fish found in the Jarbridge River, Nevada (USFWS 1998). Bull trout populations occur below the Bonneville Dam in two drainages: the Lewis River and the Willamette River.
Individual bull trout are occasionally present in the mainstem Columbia River, but any extensive use has not been documented.

### 4.6.1 Columbia River Bull Trout (Salvelinus confluentus) Information and Presence in the Action Area

Bull trout prefer the upper reaches of cold, clear running streams with clean gravel and cobble substrate for spawning. Bull trout are not known to spawn within the action area but are occasionally observed in the mainstem Columbia River (Corps 2004). Juvenile and adult bull trout could be present in the action area at any time, but the probability of occurrence in the action area is very low and individuals are more likely to be larger in size than juvenile salmon. Because bull trout spawning areas are not found near the action area as spawning occurs primarily in third and fourth order streams, bull trout individuals migrating through the action area would primarily be adults and older juveniles. Bull trout in the area would have migrated over long distances before reaching the project area. Adult bull trout, similar to adult salmon, are expected to pass through the project area quickly during upstream mitigation.

Bull trout may be migratory or resident types, and adult bull trout may be found in the action area between April and September (Table 8). Juvenile bull trout may be found year round in the action area (Table 7). Despite this timing information, the likelihood of bull trout occurrence in the action area is very low. Bull trout typically emerge from spawning gravel in April or May and are opportunistic feeders. Small bull trout eat terrestrial and aquatic insects but shift to preying on other fish as they grow larger. Adult bull trout prey on whitefish, sculpins, and other trout as they grow larger.

### 4.6.2 Columbia River Bull Trout (Salvelinus confluentus) Critical Habitat Information and Presence in the Action Area

The action area falls within designated critical habitat for the Columbia River bull trout (USFWS 2010). This area of the Columbia River is considered critical habitat for bull trout based on its importance as forage, migration, and overwintering habitat (USFWS 2010).
The entire action area waterward of the OHWM elevation (15.2 feet CRD) is within critical habitat for bull trout (USFWS 2010).

### 4.7 Eulachon (*Thaleichthys pacificus*)

Eulachon (*Thaleichthys pacificus*, threatened) are small ocean-going fish that occur in offshore marine waters and return to tidal portions of rivers to spawn in late winter and early spring (WDFW 2001). Eulachon are important prey species for other fishes, mammals, and birds. Spring river flows are critical for successful eulachon spawning, and changes in the timing of flows can create declines in eulachon populations (NOAA 2009).

Eulachon are present in the mainstem Columbia River up to approximately the Bonneville Dam. The southern DPS of eulachon was designated as threatened under the ESA on March 18, 2010 (NOAA 2010).

#### 4.7.1 Eulachon (*Thaleichthys pacificus*) Information and Presence in the Action Area

Adult eulachon are found in the mainstem Columbia River between December and May, with peak spawning occurring in February or March (WDFW 2001). Eulachon may be present in the action area in December (Table 9). The Washougal River, which empties into the Columbia River from Washington at approximately RM 122, above the northeastern corner of Lady Island, is known to support smelt (WDFW 2008a). The Sandy River, also upstream at about RM 122 and located in Oregon, supports a smelt run as well (Corps 2003b).

It is possible that spawning occurs within the action area, and active upstream migration by adults occurs in the action area. Eulachon do not feed in fresh water (WDFW 2001).

#### 4.7.2 Eulachon (*Thaleichthys pacificus*) Critical Habitat Information and Presence in the Action Area

Critical habitat was proposed for eulachon on January 5, 2011 (NOAA 2011). This area of the Columbia River is proposed critical habitat for eulachon based on its importance as migration and spawning habitat (NOAA 2011).
The entire action area waterward of the OHWM elevation (15.2 feet CRD) is within proposed critical habitat for eulachon (NOAA 2011).

4.8 **Green Sturgeon (Acipenser medirostris)**


Green sturgeon are long-lived, slow-growing fish and the most marine-oriented of the sturgeon species. Mature males range from 4.5 to 6.5 feet (1.4 to 2 m) in "fork length" and do not mature until they are at least 15 years old, while mature females range from 5 to 7 feet (1.6 to 2.2 m) in fork length and do not mature until they are at least 17 years old. Maximum ages of adult green sturgeon are likely to range from 60 to 70 years. This species is found along the west coast of Mexico, the United States, and Canada.

Green sturgeon utilize both freshwater and saltwater habitat. Green sturgeon spawn in deep pools or "holes" in large, turbulent, freshwater river mainstems (Moyle et al. 1992). Specific spawning habitat preferences are unclear, but eggs likely are broadcast over large cobble substrates, but range from clean sand to bedrock substrates as well (Moyle et al. 1995). It is likely that cold, clean water is important for proper embryonic development.

Adults live in oceanic waters, bays, and estuaries when not spawning. Green sturgeon are known to forage in estuaries and bays ranging from San Francisco Bay to British Columbia.

4.8.1 **Green Sturgeon (Acipenser medirostris) Information and Presence in the Action Area**

Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. During early life-history stages, they reside in fresh water, with adults returning to fresh water to spawn when they are more than 15 years of age and more than 4 feet (1.3 m) in size. Spawning is believed to occur every 2 to 5 years (Moyle 2002). Adults typically are found within the Lower Columbia River from June through August (Table 9).
Green sturgeon once ranged at least 225 km (140 miles) up the Columbia River before the construction of large dams (Wydoski and Whitney 1979 in NMFS 2008; ODFW 1991 in NMFS 2008); however, now they are rarely found above Puget Island (approximately RM 39; King and Norman 1991 in NMFS 2008.). Green sturgeon are primarily bottom feeders, highly adapted for preying on benthic animals, which they detect with a row of extremely sensitive barbells on the underside of their snouts. The mouth is ventrally located and sturgeon move along the bottom sucking up mud and debris, sifting out the organisms on which they feed. Green sturgeon protrude their extraordinarily long and flexible “lips” to suck up their food (Moyle et al. 1995 in NMFS 2008). Subadult and adult green sturgeon in freshwater rivers most likely feed on benthic prey species similar to those fed on in bays and estuaries, including shrimp, clams, and benthic fish (Moyle et al. 1995 in NMFS 2008; Erickson et al. 2002 in NMFS 2008; Moser and Lindley 2007 in NMFS 2008; Dumbauld et al. 2008 in NMFS 2008).

Because green sturgeon do not spawn in the Columbia River or its tributaries, larval and juvenile life stages of this species do not occur in the Columbia River. Sub-adult and adult green sturgeon are found in the lower river during the summer (McCabe and Tracy 1994; WDFW 2008b). Based on the information that green sturgeon are now rarely found above Puget Island (approximate RM 39; King and Norman 1991 in NMFS 2008), it is unlikely that green sturgeon would be found as far upriver as the action area, which begins at RM 101. Green sturgeon are unlikely to be present in the action area in significant numbers at any time.

4.8.2 Green Sturgeon (Acipenser medirostris) Critical Habitat Information and Presence in the Action Area

In October 2009, NMFS designated critical habitat for the Southern DPS of green sturgeon. Critical habitat is not designated for areas of the Lower Columbia River outside of the Columbia River estuary.

4.9 Steller Sea Lion (Eumetopias jubatus)

The Steller sea lion (Eumetopias jubatus) was listed under the ESA as threatened throughout its range on December 4, 1990. This listing included animals from Alaska, California,
Oregon, and Washington in the U.S., as well as Canada, Japan, and Russia. On June 4, 1997, the population west of 144° W longitude was listed as an endangered DPS (the Western DPS) under the ESA; the population east of 144° W remained listed as threatened as the Eastern DPS.

The Steller sea lion, also known as the northern sea lion, is the largest member of the Otariid (eared seal) family. Steller sea lions "forage" in both near shore and pelagic waters. They are capable of traveling long distances in a season and can dive to approximately 1300 feet (400 m) in depth. They also use terrestrial habitat as haul out sites for periods of rest, molting, and as rookeries for mating and pupping during the breeding season. At sea, they are seen alone or in small groups, but may gather in large "rafts" at the surface near rookeries and haul outs. This species is capable of powerful vocalizations that are accompanied by a vertical head bobbing motion by males. Steller sea lions are opportunistic predators, foraging and feeding primarily at night on a wide variety of fishes (e.g., capelin, cod, herring, mackerel, pollock, rockfish, salmon, sand lance, etc.), bivalves, cephalopods (e.g., squid and octopus) and gastropods. Their diet may vary seasonally depending on the abundance and distribution of prey. They may disperse and range far distances to find prey, but are not known to migrate.

**4.9.1 Steller Sea Lion (Eumetopias jubatus) Information and Presence in the Action Area**

The epicenter of Steller sea lion abundance in Washington State is along the coastline from Cape Flattery to the Columbia River (NOAA 2009), but there are no breeding rookeries in Washington. The Washington population peaks at approximately 1,000 individuals in the fall and winter months, and the most recent stock assessment (NOAA 2009) cites 516 individuals as the most recent population count for the state of Washington (Allen and Angliss 2008).

The nearest documented haul out for Steller sea lion is the south jetty at the mouth of the Columbia River (Jeffries et al. 2000). Individuals are known to travel upstream of the Columbia River as far as the Bonneville Dam. USACE has observed low numbers of Steller sea lion presence from January through May in the Columbia River during the salmonid fish
passage season as far upstream as the Bonneville Dam (Stansell et al. 2009). Steller sea lions are expected to be moving through the action area between January and February (Table 9).

### 4.9.2 Steller Sea Lion (Eumetopias jubatus) Critical Habitat Information and Presence in the Action Area

In 2003, NMFS designated critical habitat for the Oregon and California rookeries of the Steller sea lion. Critical habitat is not designated for the Columbia River.
ENVIRONMENTAL BASELINE IN ACTION AREA

The environmental baseline in the action area is described based on physical, chemical, and biological indicators.

5.1 Physical Indicators

5.1.1 Shoreline Armoring, Substrate and Slope

The bed of the Columbia River in this area is composed of up to 15 percent fine silts and coarse sand overlying bedrock. In the project area, the slopes are armored with riprap (Figure 7) between 0 and +20 feet National Geodetic Vertical Datum (NGVD) and are generally steeper than 5:1, followed by a gently sloped expanse and then the bank drops off sharply. There is an existing dock along the shoreline just downstream of the proposed project area.

Figure 7
Slopes Armored with Riprap in Project Area
5.1.2  Flows, Currents, and Salt/Freshwater Mixing

Saline influence extends up the Columbia River for about 33 miles (53 km). The project area is about 70 miles beyond the upriver extent of saltwater intrusion.

The Columbia River is a high-energy flow environment, pushing its sandy bed toward the ocean in a series of sand waves. The tidal fluctuation is approximately 2.5 feet (0.76 m) at Vancouver, Washington, and tidal influence is evident up to RM 140 (Corps 1999). Because of the steep and moderate bank slopes and the presence of flood control dikes, this river reach is largely disconnected from its floodplain (Vigil Agrimis and Herrera 2004). Flows from the upper river are dominated by snowmelt, causing low winter flows and spring freshets. However, dams and reservoirs upstream of the project area help to maintain more consistent flows downstream of the dams, and flow is regulated for navigation, recreation, and irrigation, and to ensure an adequate year-round water supply for hydroelectric power generation (Corps 1999).

Dams upstream of the project action area limit downstream sediment transport. The river valley is underlain by a thick layer of sandy alluvium, which furnishes sand for bedload transport. Suspended sediment concentrations averaged approximately 130 parts per million (ppm) in 1959, 1960, and 1980 to 1986 (Corps 1999).

5.1.3  Acoustic Disturbance

Existing noise in the action area is primarily related to vessel traffic and approved industrial operations on the Columbia River.

5.2  Chemical Indicators

5.2.1  Water Quality

The 303(d) list for Washington showed the Columbia River as exceeding water quality standards for total dissolved gas and temperature (during the summer months) in the action area (Ecology 2000). However, this listing was dropped in the 2004 list (Ecology 2004). An area about 5 miles (8 km) upstream of the project site remains on the 303(d) list for temperature. No other water quality parameter exceeding state water quality standards is noted in the action area.
5.2.2  **Sediment Quality**

The sediment adjacent to the project site was remediated in 2009 as part of the Alcoa Sediment Remediation project under the oversight of Ecology and the provisions of the Washington State Sediment Management Standards and Model Toxics Control Act. Polychlorinated biphenyl (PCB) exceedances of project-specific cleanup standards were addressed during the remediation through dredging. The sediment adjacent to the project site achieved a clean closure designation from Ecology as a result of a successful remediation (Ecology 2010).

Material removed from the Federal Navigation Channel within the action area is generally clean sand containing very little organic matter. Sediment quality in this area was previously evaluated under the Dredged Material Evaluation Framework (Corps 1999). In this regional compilation of dredged material quality, the Federal Navigation Channel between RMs 99 and 106 was designated as having “exclusionary” status. This ranking signifies that clean, coarse-grained channel sands with low organic carbon content have a high likelihood of being uncontaminated based on the Corps’ dredged material testing data.

5.3  **Biological Indicators**

5.3.1  **Habitat Access and Refugia**

There are no barriers to fish access in this river reach. Habitat complexity is generally lacking and refugia from swift currents are absent.

5.3.2  **Prey Species**

Overall, benthic and epibenthic diversity are low within this section of the Columbia River (NMFS 2005a). There is some evidence from the Willamette River that juvenile Chinook and coho diets may be more tied to pelagic food webs than to epibenthic prey items (ODFW 2005). These fish have adapted to the scarcity of benthic prey.

Freshwater clams are abundant in the action area. Freshwater clams are a common prey item for Columbia River sturgeon (Corps 2003a, Exhibit K-1).
5.3.3 **Shoreline Vegetation**

High quality native vegetation along the project shoreline and bank is sparse (Figure 8). The upper slope of the re-graded bank (above +20 feet NGVD) of the project area is primarily composed of planted grasses, rabbit’s foot (*Trifolium arvense*), spotted knapweed (*Centaurea stoebe*), white sweet clover (*Melilotus alba*), and mullein (*Verbascum thapsus*). The upland area is also dominated by scrub/shrub vegetation. Other plant species observed in the upper re-graded slope include Himalayan blackberry (*Rubus armeniacus*), goldenrod (*Solidago* sp.), horsetail (*Equisetum arvense*), and vetch (*Vicia* sp.).

![Figure 8](image_url)

**Figure 8**

**Riparian Vegetation in the Project Area**

The upper portion of the existing dock bank is a gradual slope that extends 30 to 70 feet (9 to 21 m) channel-ward from the fence line. A steep, armored bank is then the transition between the upper slope and the water’s edge. Bank armoring consists of brick and concrete debris.
Vegetation in the upper slope of the existing dock bank is similar to the upper re-graded bank slope except that significant patches of Scot’s broom (*Cytisus scoparius*) and tansy (*Tanacetum vulgare*) are present. The armored bank below is approximately 50 percent covered by vegetation. Vegetation is primarily false indigo (*Baptisia australis*) and Himalayan blackberry (*Rubus armeniacus*) with some patches of Columbia River willow.

### 5.3.4 Aquatic Vegetation

There is no documented aquatic vegetation in the area (Vigil Agrimis and Herrera 2004). Additionally, no aquatic vegetation was observed during field investigations in the immediate project area.
6 SPECIES EFFECTS ANALYSIS

Potential direct and indirect effects of the proposed action include noise, water quality, and direct habitat effects associated with construction of the marine structures. The effects are evaluated below for listed species in the following sections. Species not known to occur in the action area were excluded from this analysis.

6.1 Direct and Indirect Effects to Listed Pacific Salmon (Oncorhynchus spp.)

This section includes information related to the potential impacts of the proposed action on listed salmon.

6.1.1 Noise (In-water)

Impact driving of steel piles can produce sound pressure waves that can injure and kill fish (multiple sources cited in NMFS 2005a). The injuries caused by such pressure waves are known as barotraumas and include hemorrhage and rupture of internal organs, including the swimbladder and kidneys in fish, and damage to the auditory system. Death can be instantaneous, or occur within minutes of exposure or several days later. Another mechanism of injury and death is “rectified diffusion,” which is the formation and growth of bubbles in tissue, causing inflammation and cellular damage (Vlahakis and Hubmayr 2000 in NMFS 2005a), and blockage or rupture of capillaries, arteries, and veins (Crum and Malo 1996 in NMFS 2005a). In addition, vibratory installation methods cause disturbance level impacts to salmonids.

Overall, based on the noise analysis summarized in this section and subsections, there is a potential for instantaneous and cumulative injury as well as disturbance to salmon from impact pile driving associated with the proposed action. To minimize potential impacts of the proposed action, pile driving will be conducted within the in-water work window approved for the protection of salmon. It is therefore unlikely that listed salmon would be present in appreciable numbers at any given time, and any that were present would likely be large sub-adults or adult fish as opposed to outmigrating juveniles.

As described in Section 2.3.1, vibratory pile installation methods will be used to the extent practicable on all piles. The final driving and “proofing” will be performed using an impact
hammer. Impact hammer installation may be accomplished using either a small impact hammer with a range of 60-80 maximum blows per foot (DELMAG D46-32, or similar) or a large impact hammer with a range of 20-30 maximum blows per foot (DELMAG D80, or similar). In addition, a bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving.

As described in the analysis of the action area in Section 3, effect type and threshold Sound Pressure Levels (SPLs) are based on the most current guidelines from the Services as summarized in the current Washington State Department of Transportation Biological Assessment Author Manual (WSDOT 2010a). The extent of temporarily elevated underwater noise from impact pile driving is calculated using the PSL model as described in Section 3.1.1.1.

For this analysis of potential cumulative pile driving impacts, the range of number of strikes per day that is expected during pile installation activities was estimated. The NMFS Stationary Fish Model assumes that only the number of strikes in a single day is counted towards the cumulative impact. The model does not take into consideration the timing of the total number of strikes achieved in a day. For pile driving activities, the vibratory hammer will be used to install piles to the extent practicable. The final driving and proofing will be performed using either a small or large impact hammer as described in Section 2.3.1. Two barges located within 250 feet (76 m) of each other will be working on pile installation concurrently. Each barge will operate both a vibratory hammer and an impact hammer, and it is expected that one pile from each barge will be completely installed before moving on to the next pile. As such, there is the potential for the two impact hammers to be installing piles at the same time. It is estimated that for approximately 80 percent of the installation, the vibratory and impact hammers will be working concurrently, and that for approximately 20 percent of the installation, two impact hammers could be installing piles at the same time. Pile installation using an impact hammer as described above is expected to result in approximately 600 to 3,000 total strikes per day. Because the NMFS Stationary Fish Model does not consider the timing of the total number of strikes (i.e., amount of time between strikes) achieved in a day and the pile drivers would be less than 250 feet (76 m) apart, both pile driving scenarios described above were analyzed using the same input parameters, thus resulting in the same sized impact zones.
The PSL and NOAA Stationary Fish models were run based on the assumptions below to determine the extent of potential impacts associated with elevated sound pressure levels (SPLs) during impact driving. Salmonid injury threshold assumptions are listed in Table 5. To summarize:

- SPLs resulting from impact driving 40-inch (1,016-mm) diameter unattenuated steel piles are 208 dB\text{PEAK}, 195 dB\text{RMS}, and 180 dB\text{SEL}, measured at 10 m from the source. SPLs for impact installation of a 40-inch (1,016-mm) diameter steel pile are expected to also be inclusive of impacts for a 36-inch (914-mm) diameter pile.
- SPLs specific to vibratory pile driving are 174 dB\text{RMS} measured at 10 m from the source (WSDOT 2010b).
- A range between 600 and 3,000 total strikes per day is expected during pile installation.
- A daily rest period between pile driving activities during which no pile driving will occur is assumed. No pile driving will occur between 8:00 pm and 7:00 am per the City of Vancouver’s noise ordinance.
- Underwater sound transmission will not propagate beyond an intervening barrier, such as land masses, bottom topography, and underwater structures.

### 6.1.1.1 Single-strike Injury

The single-strike peak decibel level generated is expected to be 208 dB\text{PEAK}, measured at 10 m from the pile. Therefore, underwater noise generated during impact pile driving would be expected to exceed the single-strike injury threshold for salmonids within approximately 46 feet (14 m) of the pile. Thus, there is potential for instantaneous injury to salmonids from impact driving in the immediate 46-foot (14-m) vicinity of the pile.

Noise from the vibratory installation of piles has not been found to cause barotraumas to fish (like physical injury documented by impact pile driving) because the vibratory pile extractor noise does not have the rapid-rise peak pressure that is characteristic of impact pile driving (WSDOT 2010a). As such, a single-strike injury threshold has not been developed for the effects of vibratory pile installation on salmonids.
6.1.1.2  **Cumulative Injury**

For the proposed estimate of 600 to 3,000 impact hammer strikes per day, the cumulative extent of potentially injurious sound for sub-adult and adult salmonids (those greater than or equal to 2 grams) would range between:

- 1,470 and 3,280 feet (450 and 1000 m) from the installation point depending on the size of the impact hammer used (large versus small)

It is unlikely that salmonids less than 2 grams in size (juveniles) would be present in the project site during the proposed work window, and it is also unlikely that large sub-adults and adults would be present in appreciable numbers.

Noise from the vibratory installation of piles has not been found to cause barotrauma to fish (like physical injury documented by impact pile driving) because the vibratory pile extractor noise does not have the rapid-rise peak pressure that is characteristic of impact pile driving (WSDOT 2010a). As such, a cumulative sound injury threshold has not been developed for the effects of vibratory pile installation on salmonids.

6.1.1.3  **Disturbance**

Potentially disturbing sound from impact driving of 36- to 40-inch (914- to 1,016-mm) diameter piles (195 dBRMS) could extend up to a 6.2-mile (10-km) radius. However, because underwater sound transmission propagates in straight lines, and does not propagate beyond intervening barriers such as land masses, bottom topography, and underwater structures, this extent could be reduced in some directions. For example, because Hayden Island is located directly to the south, the majority of underwater sound transmission will not propagate beyond that point (Figure 6). Potentially disturbing sound from vibratory installation of 36- to 40-inch (914- to 1,016-mm) diameter piles (174 dBRMS) could extend up to 0.24 mile (0.4 km).

6.1.1.4  **Noise Impact Summary**

Table 10 shows a summary of the noise impact thresholds for salmonids and the radial distance to the threshold level for vibratory driving and impact driving including a range of
600 to 3,000 impact pile strikes per day (worst case scenario). The pile driving work associated with this proposed action will be conducted between the hours of 7:00 am and 8:00 pm and during the recommended work window, which will reduce daily disturbance to salmonids in the Columbia River. This reduces the likelihood of salmonids being present in the action area and within the potential impact areas. Due to project timing, there is a low likelihood that juvenile salmonids less than 2 grams in size will be present during pile installation. In addition, the juvenile fish are expected to be more shoreline oriented and a majority of the piles will be installed in the deep water zone. To further minimize potential impacts, a bubble curtain or another similar sound attenuation method (e.g., noise attenuation pile caps, or cushion blocks) will be used when using an impact hammer.

As shown in Table 10, underwater noise generated during impact pile driving would be expected to exceed the single-strike injury threshold for salmonids within approximately 46 feet (14 m) of the pile. Similarly, for salmonids greater than 2 grams in size, the model predicts potential injury to a maximum radial distance of 3,280 feet (1,000 m) and potential disturbance to a maximum radial distance of 6.2 miles (10 km) for the impact hammer installation. For vibratory installation, the model predicts potential disturbance effects to a maximum of 0.24 miles (0.40 km).

These noise impact radial distances are expected to be worst-case scenario and are a conservative estimate of risk for the following reasons:

- Because SPL values used for calculating noise effects to listed species have been taken from studies where the subsurface conditions are denser than those expected in the project area, which therefore conduct noise more readily, these calculations are a conservative estimate of risk.
- Additionally, the NOAA Stationary Fish Model overestimates likely noise exposure for individual fish because it assumes exposure through an entire day. Fish are most likely to be moving through the action area as opposed to standing still. It is anticipated that NMFS will use its less conservative Moving Fish Model to estimate injury exposure during the consultation process.


### Table 10

**Noise Impact Threshold Summary and Radial Distance to Threshold for Salmonids based on Installation of In-Water Piles**

<table>
<thead>
<tr>
<th>Pile Driving Type</th>
<th>Radial Distance of Single Strike Injury (threshold=206 dB_{PEAK}) (meters)</th>
<th>Radial Distance of Cumulative Sound Injury (threshold=187 dB$_{SEL}$; &gt;2 grams) (meters)</th>
<th>Radial Distance of Disturbance Level (threshold=150 dB$_{RMS}$) (kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact Hammer</td>
<td>14 (46 feet)</td>
<td>1,000 (3,281 feet) $^1$</td>
<td>10 (6.2 miles)</td>
</tr>
<tr>
<td>Vibratory Hammer</td>
<td>N/A</td>
<td>N/A</td>
<td>0.40 (0.24 miles)</td>
</tr>
</tbody>
</table>

Notes:

1 Radial distance of cumulative sound injury ranges between 1,470 and 3,280 feet (450 and 1,000 m), depending on the size of the impact hammer used. This range is based on the number of strikes ranging from 600 to 3,000 per day for use of the impact hammer.

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### 6.1.2 Water Quality

#### 6.1.2.1 Turbidity

Turbidity occurs when suspended organic and inorganic particles in the water column scatter light waves and reduce the light available to underwater environments.

Pile removal and installation may temporarily increase turbidity resulting from suspended sediments. Any increases would be temporary, localized, and minimal. All project construction will be in compliance with Washington State water quality standards under WAC 173 201A 200(1)(e)(i). Based on flow data for the Columbia River, temporary exceedances for turbidity would be allowed up to 300 feet (91 m) downstream from areas of pile removal and installation.

The potential effects of increased temporary turbidity on salmonids have been investigated in a number of dredging studies, which result in higher turbidity levels than pile installation or removal activities (Servizi and Martens 1987 and 1992; Emmet et al. 1988; Simenstad 1988; Redding et al. 1987; Berg and Northcote 1985; Noggle 1978; Mortensen et al. 1976). There are several mechanisms by which suspended sediment can affect juvenile salmonids, including direct mortality, gill tissue damage, physiological stress, behavioral changes, and effects from reduced dissolved oxygen levels. Turbidity levels that might result in harm are
generally associated with activities such as dredging in fine sediments. Project activities proposed for pile removal and installation would not result in turbidity levels that would elicit harm for fish. Standard BMPs for pile removal and installation would be in place during construction and would reduce the potential for temporary turbidity increases. No harm or direct mortality is expected to occur as a result of localized increased turbidity.

As proposed, all sediment disturbing activities will take place during the approved in-water work window. Overall, effects of increased turbidity on salmonids are expected to be insignificant due to scale of impact, and also discountable due to work timing.

### 6.1.2.2 Other Potential Water Quality Impairments

During any in-water construction activities there is a risk of localized and temporary water quality impairments from the unintentional release of machinery fluids. All necessary actions will be taken to avoid such a discharge, and in the event of a spill, containment and cleanup would take precedence over continued work. Any potential for construction material or debris to enter the water will be managed by strictly adhering to above-water and in-water BMPs.

Above-water work, such as concrete filling of piles (if required), marine structure outfitting, and placement of precast concrete dock elements, may occur outside the approved in-water work period. While some potential exists for impairments to water quality from these activities, any risk would be greatly minimized by the implementation of standard BMPs.

Overall, long-term water quality is expected to be maintained within the project area as a result of implementing construction BMPs and minimization measures. In addition, the water exiting the updated outfall is not expected to impact long-term water quality as the water quality will be monitored for compliance with the Port’s NPDES permit.

### 6.1.3 Habitat Impacts

#### 6.1.3.1 Over-water Coverage

The effects of over-water structures on outmigrating juvenile salmonids are not well understood. Some literature suggests that over-water structures have the potential to affect
juvenile salmonids through habitat changes, increased predation, and disruption of migration patterns (Nightengale and Simenstad 2001). These issues have been studied to varying degrees but have not yielded conclusive results. Sections 6.1.3.1.1 through 6.1.3.1.3 discuss the potential effects of over-water cover, including migration disruption, the potential for increased predation, and primary and epibenthic productivity.

6.1.3.1.1 Migration Disruption

Juvenile salmonids are reliant on shallow water nearshore habitats for food and refuge. Recent studies suggest that the movement of juvenile salmonids is affected by sharp shadows and dark/light interfaces cast by over-water structures (Nightengale and Simenstad 2001; NOAA Fisheries 2004; Southard et al. 2006). Studies have shown that juvenile salmonids may follow the edge of a shadow along piers, rather than pass under the pier. A recent study conducted by Pacific Northwest National Laboratory (PNNL) at 10 Washington State Ferries terminals found it to be probable that over-water structures are temporary impediments to juvenile salmonid movement during specific times of day (depending on light level, sun angle, and cloud cover) or under specific environmental conditions (depending on current magnitude and direction, and tidal stage). The study also found that “juvenile chum remained on the light side of a dark/light shadow line when the decrease in light level was approximately 85 percent over a shore horizontal distance (e.g., 16.4 feet [5 m])” (Southard et al. 2006). However, another study conducted by PNNL at the existing Mukilteo Ferry Terminal found that “salmon fry moved freely under the relatively narrow, shaded portion of the Mukilteo Ferry Terminal where mean light levels in water were reduced by over 97 percent” (Williams et al. 2003). The observers concluded that “during the day, fry moved freely under the relatively narrow (33 feet [10 m] wide), shaded portion of the ferry terminal and did not appear to be inhibited by the differences in light levels detected here…the terminal structure did not appear to act as barriers to fry movement at this location” (Williams et al. 2003).

The proposed ship loader structure is not expected to negatively impact juvenile salmon migration, as the amount of over-water shading in the nearshore environment has been minimized through project design. In addition, the majority of existing substrate along the shoreline consists of riprap, which has minimal habitat value for salmonids. The face of the
marine structure will be placed outside of the shallow water zone, which is defined as the area between the OHWM and 20 feet (6 m) below the OHWM. The height of the marine structures is also at a level above the water that allows light underneath the structure. Therefore, construction of the proposed marine facility is not expected to cause any significant additional disruptions to salmonid migrations beyond existing conditions in the action area.

6.1.3.1.2 Potential for Increased Predation

Studies have suggested that migrating salmonids may not pass under an over-water structure and may be forced to move farther offshore where they may become more susceptible to predation from birds, mammals, and fish. However, no conclusive evidence has been found to suggest that marine over-water structures contribute to increased predation on juvenile salmonids. According to Simenstad et al. (1999), “despite considerable speculation about the effects of over-water structures increasing predation on juvenile salmonids, evidence supporting this contention scientifically is uncertain at best.”

In addition, the placement of piles associated with the over-water coverage may also provide habitat for salmonid predators, such as northern pikeminnow, largemouth bass, smallmouth bass, black crappie, white crappie, and walleye. If there is not sufficient light penetration, a light/dark interface is created that may prevent outmigrating smolts from seeing predators before it is too late to avoid them.

The proposed marine facility is not expected to cause an increase in predation on juvenile salmon, as the number of piles has been minimized in the shallow water zone, and there will be only a small gain in the number of piles in the deep water zone of the action area. The piles to be removed at the Port’s Terminal 2 are expected to replace any lost function associated with the proposed action as these piles will be removed from the shallow water zone, while most of the installed piles will be in the deep water zone. The shallow water zone provides more functions for salmonids than the deep water zone. In addition, the amount of over-water coverage has also been minimized, especially in the shallow water zone, as discussed in Section 3.1.3.1. The face of the berth and pier structures will be placed outside of the shallow water zone, which is defined as the area between the OHWM and 20
feet (6 m) below the OHWM. As a result, a majority of the piles will be installed in the deep water zone rather than in the shallow water zone. Thus, construction of the proposed marine facility is not expected to significantly increase the predation potential for juvenile salmonids in the action area.

6.1.3.1.3 Primary and Epibenthic Productivity

Shading from over-water structures may limit light penetration to the bottom of the river and restrict vegetation growth and primary and epibenthic productivity.

For this project, the face of the marine facility will rest over deep water, which is close to the limit of the photic zone where light reaches the bottom during low water conditions. As a result, shading effects are limited to the rest of the structure shoreward of the berthing area. Furthermore, the facility will be placed at a level above the water that will allow light penetration, which will minimize the potential impact to primary and epibenthic productivity. In addition, there is existing riprap covering a large portion of the shoreline area, which already limits the primary and epibenthic productivity level within the project area. As a result, construction of the proposed marine facility is not expected to further decrease the primary and epibenthic productivity within the action area.

6.1.3.2 Substrate Disturbance

Pile installation and removal will result in some disturbance of the river substrate as the piles are either installed or removed. This disturbance is expected to be localized and short term. Substrate disturbance impacts to aquatic species will be minimized and mitigated with the implementation of appropriate BMPs, as discussed in Section 2.4. In addition, the substrate that each individual pile covers will be permanently impacted by the proposed action. To offset the placement of additional piles for the marine structures and the resulting long-term impact to the substrate, the project will remove an existing dolphin and catwalk from the project area and additional piles at Terminal 2 (approximately at RM 105). Two treated timber piles will be removed for each pile placed (approximately 177 piles from Terminal 2 and 31 piles from Terminal 5). The existing dolphin consists of 13 plumb and 14 batter (1H:IV) treated 16-inch (406-mm) diameter timber piles, affecting approximately 40 sf (3.7 m²) of river bed and shading approximately 200 sf (19 m²). The dolphin is located
approximately 20 feet (6 m) below the OHWM. The existing catwalk is supported by four treated timber piles and is approximately 560 sf (52 m²) of over-water coverage.

6.2 Direct and Indirect Effects on Bull Trout

As with salmonids, potential direct and indirect project effects on bull trout include in-water noise, water quality, and direct habitat effects. Noise is the only potential effect discussed in more detail below as there is minimal risk of impacts associated with water quality and direct habitat effects beyond what is described in Sections 6.1.2 through 6.1.4 for salmonids.

6.2.1 Noise

The noise models described in Section 6.1.1 (fish greater than 2 grams for the NMFS Stationary Fish Model) can be applied to bull trout. As with salmonids, the model predicts potential effects out to a maximum distance of 3,280 feet (1,000 m) (cumulative injury) and 6.2 miles (10 km) (disturbance) for the impact hammer installation and 0.24 mile (0.40 km) (disturbance) for vibratory installation. It is extremely unlikely that bull trout in any appreciable numbers would be found within the action area during pile driving activities, and the risk of exposure of any one individual is considered discountable. A “discountable” effect is one which is extremely unlikely to occur (USFWS and NMFS 1998).

6.3 Direct and Indirect Effects on Eulachon

Eulachon could experience similar direct effect mechanisms from in-water construction as those described for salmonids: impacts from noise, water quality, and direct habitat effects. Eulachon lack a swim bladder, so are not similarly vulnerable to swim bladder rupture from rapid changes in over-pressure or under-pressure as salmonids are. It is likely that eulachon are less affected by underwater sound pressure levels created by impact and vibratory pile installation. A common interpretation is that the appropriate injury threshold for eulachon should be higher than those for salmonids, but noise disturbance thresholds specifically for eulachon have not yet been determined. Thus, salmonid injury thresholds will be used.

As with salmonids, there is minimal risk of impacts associated with water quality and habitat impacts, and adverse effects are not expected.
6.3.1 Noise

As described above, the threshold of injury may be higher for eulachon than for salmonids due to eulachon’s lack of a swim bladder, yet the noise models described in Section 6.1.1 (fish greater than 2 grams for the NMFS Stationary Fish Model) can be conservatively applied to eulachon. As with salmonids, the model predicts potential effects to a maximum distance of 3,280 feet (1,000 m) (injury) and 6.2 miles (10 km) (disturbance) for impact hammer installation and 0.24 mile (0.40 km) (disturbance) for vibratory installation.

6.4 Direct and Indirect Effects on Green Sturgeon

Reduction in spawning habitat due to impassable barriers is the main factor leading to decline of green sturgeon (NOAA 2006). As described in Section 4.8, green sturgeon do not spawn and are extremely unlikely to forage in the Lower Columbia River. For this reason, the project would not adversely affect green sturgeon spawning and foraging habitat.

Green sturgeon could experience similar direct effect mechanisms from in-water construction as those described for salmonids: noise, water quality, and direct habitat effects. The impacts described for salmonids in Sections 6.1.2 through 6.1.4 are expected to have less of an impact on green sturgeon because salmon are a more sensitive species.

In addition, the noise models described in Section 6.1.1 (fish greater than 2 grams for the NMFS Stationary Fish Model) can be applied to green sturgeon. As with salmonids, the model predicts potential effects to a maximum distance of 3,280 feet (1,000 m) (injury) and 6.2 miles (10 km) (disturbance) for impact installation and 0.24 mile (0.40 km) (disturbance) for vibratory installation. However, green sturgeon presence in the Columbia River is primarily focused on summer groupings in the estuary more than 40 miles (64 km) downstream from the action area. It is extremely unlikely that green sturgeon in any appreciable numbers would be found outside of this area, and the risk of exposure of any one individual is considered discountable (i.e., extremely unlikely to occur). Additionally, because these fish do not spawn and are unlikely to feed in the system, it is unlikely that behavioral effects would result in significant impacts to individual fish.
6.5 Direct and Indirect Effects on Steller Sea Lion

Steller sea lions are present in the Columbia River further downstream in the estuary, and are not known to regularly or seasonally haul out, forage, or otherwise spend time in the action area. However, small numbers have been noted in the vicinity of the Bonneville Dam, so they could have traveled through the action area. It is expected that few Steller sea lions would be present anywhere in the Lower Columbia River during the proposed in-water work window. Stellar sea lion could be traveling through the action area between January and February, and although they are unlikely to be present in substantial numbers at any time, they could be present during in-water work.

There is little potential for Steller sea lions to be affected by localized, minimal, and temporary water quality impairments at any given time. Effects would be further reduced by adherence to BMPs described in this document. Noise poses the largest potential threat to Steller sea lions.

6.5.1 Noise

6.5.1.1 Underwater Noise

During impact and vibratory pile installation, underwater noise and SPLs may exceed established injury and disturbance thresholds for Steller sea lions. Section 6.1.1 describes the pile installation specifics and the assumptions used in the PSL model to describe attenuation of underwater sound.

To protect Steller sea lions, the Services (NMFS and USFWS) developed injury and disturbance criteria, which are summarized in Table 4. The PSL model was run based on the assumptions described in Section 6.1.1 to determine the extent of potential impacts associated with elevated SPLs during impact driving and vibratory installation. Table 11 provides a summary of the noise impact threshold and distances to each threshold.
Table 11
Noise Impact Threshold Summary and Radial Distance of Threshold for Steller Sea Lion based on Installation of In-water Piles

<table>
<thead>
<tr>
<th>Pile Driving Type</th>
<th>Radial Distance of Injury Level (threshold=190 dB&lt;sub&gt;RMS&lt;/sub&gt;) (meters)</th>
<th>Radial Distance of Disturbance Level (threshold=160 dB&lt;sub&gt;RMS&lt;/sub&gt;) (kilometers)</th>
<th>Radial Distance of Disturbance Level (threshold=120 dB&lt;sub&gt;RMS&lt;/sub&gt;) (kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>21 (70 feet)</td>
<td>2 (1.3 miles)</td>
<td>N/A</td>
</tr>
<tr>
<td>Vibratory</td>
<td>N/A</td>
<td>N/A</td>
<td>11 (7 miles)</td>
</tr>
</tbody>
</table>

Using the PSL model, underwater noise during impact driving may exceed the established injury threshold for pulsed sound (impact hammer) (190 dB<sub>RMS</sub>) within 70 feet (21 m) of the pile installation area. Underwater noise during impact driving may exceed the established disturbance threshold for pulsed sound (160 dB<sub>RMS</sub>) within 1.3 miles (2 km) of the proposed location for pile installation.

The noise disturbance threshold exceedance area for vibratory installation of 36- to 40-inch (914- to 1,016-mm) steel piles is a maximum of 7 miles (11 km), as noise transmission is halted between intervening barriers such as the banks of the Columbia River, bottom topography, and underwater structures.

Because there is a chance that Steller sea lions may be present in the action area, monitoring of the modeled injury threshold exceedance areas during pile installation will be implemented according to the monitoring plan provided as Appendix B to this document. The distance to the injury threshold for pinnipeds (190 dB<sub>RMS</sub>) would be monitored during pile driving according to the protocol identified in the marine mammal monitoring plan (see Appendix B). The area within the 190 dB isopleth would be maintained as an injury protection zone, in which impact pile driving would be immediately shut down if any Steller sea lion were to enter. This would effectively eliminate the possibility of any marine mammals being exposed to injury level harassment.

The distances to the disturbance thresholds for impact driving (the 160 dB<sub>RMS</sub> isopleth) and vibratory driving (120 dB<sub>RMS</sub> isopleth) would also be monitored according to the monitoring plan (Appendix B). Marine mammal presence within these zones, if any, would be
monitored; however, pile driving activity would not cease should marine mammals be present. Any marine mammal documented within the 160 dB isopleth during impact driving, or the 120 dB isopleth during vibratory driving, would be potentially exposed to underwater noise levels that would be defined as disturbance.

6.5.1.2 *In-Air Noise*

During impact and vibratory pile installation, in-air noise and SPLs may exceed established thresholds for Steller sea lions. Section 6.1.1 describes the range of pile installation scenarios and the assumptions used in the PSL model to describe attenuation of in-air sound.

To protect Steller sea lions, the Services developed disturbance criteria for in-air SPLs (RMS), which are summarized in Table 12. The PSL model was run based on the assumptions described in Section 3.1.2 to determine the extent of potential impacts to Steller sea lions from associated elevated in-air SPLs during impact driving and vibratory installation.

**Table 12**

*Steller Sea Lion Airborne Noise Threshold Level and Comparison to Potential Impact from Proposed Work*

<table>
<thead>
<tr>
<th>Functional Hearing Group</th>
<th>In-air Sound Pressure Level (RMS)</th>
<th>In-air Threshold Exceedance Area for Proposed Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinnipeds</td>
<td>Disturbance: 100 dB RMS (un-weighted) for sea lions</td>
<td>11.8 feet (3.6 m)</td>
</tr>
</tbody>
</table>

In-air noise is evaluated here to be inclusive of the potential impacts that could affect Stellar sea lions associated with the proposed action, despite the fact that there are no documented haul outs near the action area. The nearest documented Stellar sea lion haul out is the South jetty at the mouth of the Columbia River (Jeffries et al. 2000). Individuals have been known to travel up stream as far as the Bonneville Dam, and the nearest observed haul out is at Phoca Rock (RM 162), more than 50 miles (80 km) upstream from the action area. Thus, it is highly unlikely that Stellar sea lions would haul out in the action area.

The in-air noise disturbance threshold exceedance area for use of an impact pile driver is 11.8 feet (3.6 m) from the pile driver. As discussed in more detail in Section 3.1.2, pile-driving
noise is expected to attenuate to background levels over a distance of about 10,000 feet (1.89 miles) or 3 km. In reality, this distance is likely to be less because of topography, tree cover, built structures, and other factors.

The area of effect for in-air disturbance is within the action area for in-water disturbance. Thus, it is assumed that any potential take would be from aquatic disturbance and not in-air disturbance based on the lack of documented Stellar sea lion haul outs within the action area. Because there is a chance, albeit unlikely, that Steller sea lions may be present on land in the action area, monitoring of the modeled disturbance threshold exceedance areas during pile installation will be implemented according to the monitoring plan provided as Appendix B to this document.

### 6.6 Effects on Salmonid Critical Habitat

The action area includes critical habitat for all Chinook salmon ESUs, chum salmon, sockeye salmon, and all DPSs of steelhead. NOAA defines the same six Primary Constituent Elements (PCEs) of critical habitat for all of these species (NOAA 2005a). Because the PCE definitions are the same, the critical habitat analysis will be completed together. Only the PCEs specific to non-spawning freshwater areas apply within the action area.

#### 6.6.1 PCE No. 2: Freshwater Rearing Sites

PCE No. 2 is defined by NOAA (2005a) as “Freshwater rearing sites with water quality and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.” Analysis of project effects on PCE No. 2 is presented in the following sections.

#### 6.6.1.1 Water Quantity and Floodplain Connectivity

The proposed action has no elements that would affect subsurface water quantity or floodplain connectivity and thus, would have no effect on these PCE features.
6.6.1.2 Water Quality

Water quality during construction is addressed in Section 6.1.3. While there is potential for short-term, localized increases in turbidity during pile removal and installation, expected increases in turbidity would be well within the Washington State water quality standards for temporary construction exceedances. The risk of unintentional discharges of machinery fluids would be managed through adherence to standard BMPs. Potential construction effects on water quality would be localized and temporary, and would not adversely affect this PCE feature.

6.6.1.3 Forage Supporting Juvenile Development

Temporary construction-related activities within the action area may result in a temporary reduction in salmonid prey in the immediate vicinity of construction activities, but this would not significantly affect salmonid forage potential within the action area. Project-related noise has the potential to increase prey avoidance in the action area, but in-water work will occur during the time of year when salmonids are relatively unlikely to be in the action area. In addition, primary productivity is not expected to be impacted by the proposed action as described in Section 6.1. Overall, the project would not adversely affect forage opportunities within the action area.

6.6.1.4 Natural Cover

Natural cover as defined in PCE No. 2 is “shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks” (NOAA 2005a). No natural cover as defined exists within the project area. As such, the project would have no effect on the natural cover element of PCE No. 2.

6.6.2 PCE No. 3: Freshwater Migration Corridors

PCE No. 3 is defined by NOAA (2005a) as “Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.” Analysis of project effects on PCE No. 3 within the action area is presented in the following sections.
6.6.2.1 **Obstructions**

The construction of the proposed marine facility will increase the amount of over-water coverage. This increase is not expected to be significant in the deep water zone to the point of reducing the function of the habitat for migration as there are ample deep water areas for adults to migrate through in the action area. The shallow water areas, which are important migration routes for juveniles, are expected to be maintained through removal of piles and over-water structures. As such, no increased migration obstructions are anticipated. Overall, the project would not adversely affect the function of the action area as a migration corridor.

6.6.2.2 **Water Quality, Water Quantity**

The analyses for these components are described in Section 6.1.3. The project will not permanently adversely affect these elements of PCE No. 3 within the action area.

6.7 **Effects on Bull Trout Critical Habitat**

USFWS designated critical habitat for bull trout on September 30, 2010. Under the critical habitat rule, the action area is within the Coastal Recovery Unit’s Unit 3, Lower Columbia River Basins Critical Habitat Unit (CHU). Although bull trout have rarely been documented in the mainstem Lower Columbia, the critical habitat designation includes this area based on its potential importance as forage, migration, and overwintering habitat, along with its role in providing connectivity among systems within the Lower Columbia basin. Nine PCEs have been designated for bull trout critical habitat, but only the seven PCEs applicable to the action area will be included for consideration here.

6.7.1 **PCE No. 1: Water Connectivity**

PCE No. 1 is defined as “Springs, seeps, groundwater sources, and subsurface water connectivity (hyporeheic flows) to contribute to water quality and quantity and provide thermal refugia” (USFWS 2010). The project has no elements that would affect subsurface water sources or connectivity, and would have no effect on PCE No. 1.


### 6.7.2 PCE No. 2: Migratory Habitats

PCE No. 2 is defined as “Migratory habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including, but not limited to permanent, partial, intermittent, or seasonal barriers” (USFWS 2010).

Noise levels, as described in Section 6.2, could exceed disturbance thresholds for bull trout within the action area. Because noise transmission stops at land masses, the Oregon side of Hayden Island would not be affected, and thus, the entire migratory corridor would not be affected at any time. Additionally, in-water work will occur between the hours of 7:00 am and 8:00 pm and during the recommended work window for salmonids, which reduces the likelihood of individual fish being disturbed by in-water noise. Furthermore, bull trout have rarely been documented in the Lower Columbia River and are not expected to be present in substantial numbers at any given time.

The construction of the proposed marine structure will increase the amount of over-water coverage. This increase is not expected to be significant in the deep water zone to the point of reducing the function of the habitat for migration, as there are ample deep water areas for adults to migrate through in the action area. The shallow water areas, which are important migration routes for juveniles, are expected to be maintained through removal of piles and over-water structures. As such, no increased migration obstructions are anticipated. Overall, the project would not adversely affect the function of the action area as a migration corridor.

### 6.7.3 PCE No. 3: Abundant Food Base

PCE No. 3 is defined as “an abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish” (USFWS 2010). Fish prey organisms may experience noise levels at which behavioral effects could occur during pile installation, but it is highly unlikely that bull trout will be present in the action area during that time. In addition, primary productivity is not expected to be impacted by the proposed action as described in Section 6.1. Therefore, it is unlikely that bull trout foraging within the action
area will be disrupted, and the proposed action is not expected to adversely modify PCE No. 3. In the long term, there will be no effect on PCE No. 3.

6.7.4 **PCE No. 4: Complex Shoreline**

PCE No. 4 is defined as “complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure” (USFWS 2010). The existing shoreline substrate consists of riprap extending from 0 to +20 feet NGVD. The proposed marine facility will cover a small amount of shoreline area, most of which is covered with riprap and does not contain any complex shoreline structures. This project has no elements that would affect shoreline complexity and, thus, would have no effect on PCE No. 4.

6.7.5 **PCE No. 7: Water Flow**

PCE No. 7 is defined as “a natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, they minimize departures from a natural hydrograph” (USFWS 2010). This project has no elements that would affect the natural hydrograph and would have no effect on PCE No. 7.

6.7.6 **PCE No. 8: Water Quality and Quantity**

PCE No. 8 is defined as “sufficient water quality and quantity such that normal reproduction, growth, and survival are not limited” (USFWS 2010). There is the potential for short-term increases in turbidity during pile removal and installation, but these effects will be minimal, temporary, and localized. Potential effects of construction-related turbidity or water quality would not adversely modify PCE No. 8. Additionally, there are no project elements that would impact water quantity.

6.7.7 **PCE No. 9: Predatory Species**

PCE No. 9 is defined as “few or no nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass; inbreeding (e.g. brook trout); or competitive (e.g., brown trout) species present” (USFWS 2010). There is no net increase in the number of piles installed in
the action area that could potentially provide habitat for bull trout predators. As such, this project has no elements that would increase the presence of nonnative species within the action area and would have no effect on PCE No. 9.

6.8 Effects on Proposed Eulachon Critical Habitat

NMFS proposed critical habitat for eulachon on January 5, 2011. Under the proposed critical habitat rule, the action area is within the Lower Columbia River area proposed for critical habitat designation. The Lower Columbia River and its tributaries support the largest known spawning run of eulachon, and provides spawning and incubation sites, as well as a large migratory corridor to spawning areas in the tributaries.

Three physical or biological features essential for conservation have been proposed for eulachon critical habitat, and are included for consideration here.

6.8.1 Freshwater Spawning and Incubation Sites

This feature includes “freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation” (NOAA 2011).

The project has no elements that would affect subsurface water sources, flow, and temperature and would have no effect on freshwater spawning and incubation. There is the potential for short-term increases in turbidity during pile removal and installation, but these effects will be minimal, temporary, and localized. Potential effects of construction-related turbidity or water quality would not adversely modify freshwater spawning and incubation sites. Additionally, there are no project elements that would impact water quantity.

6.8.2 Freshwater and Estuarine Migration Corridors

This feature relates to “freshwater and estuarine migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted” (NOAA 2011).
Noise levels, as described in Section 6.2, could exceed levels that may potentially disturb eulachon within the action area. Because noise transmission stops at land masses, the Oregon side of Hayden Island would not be affected, and thus, the entire migratory corridor would not be affected at any time. Additionally, in-water work will occur between the hours of 7:00 am and 8:00 pm and during the recommended work window for eulachon, which reduces the likelihood of individual fish being disturbed by in-water noise.

The construction of the proposed marine structure will increase the amount of over-water coverage. This increase is not expected to be significant to the point of reducing the function of the habitat for migration, as there are ample deep water areas for adults to migrate through in the action area. As such, no increased migration obstructions are anticipated. Overall, the project would not adversely affect the function of the action area as a migration corridor.

Additionally, primary productivity is not expected to be impacted by the proposed action as described in Section 6.1. Therefore, it is unlikely that eulachon larval feeding within the action area will be impacted.

6.8.3 Nearshore and Offshore Marine Foraging Habitat

This feature concerns “nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival” (NOAA 2011). The proposed project will not impact any nearshore or offshore marine foraging habitat.
7 SPECIES EFFECTS DETERMINATION

7.1 Regulatory Basis for ESA Effect Determinations

The effect determination is the conclusion of the analysis of potential direct or indirect effects of the proposed activity together with the potential effects of other activities that are interrelated or interdependent with the proposed action on listed or proposed species (at the individual level) and/or designated or proposed critical habitat. A formal biological opinion from the Services will make a determination of jeopardy/no jeopardy to the species at the population level and/or adverse modification/no adverse modification of designated critical habitat, and recommendations on reasonable and prudent alternatives, as appropriate. Regulatory guidance from the Final Section 7 Consultation Handbook (USFWS and NMFS 1998) was used to make the effects determination for the proposed activity as described below.

For listed species and designated critical habitat, the range of conclusions that could result from the effects analysis for the effect determination includes the following:

- **No effect**—the appropriate conclusion when the action agency determines its proposed action and any interrelated or interdependent actions will have no direct or indirect effect on listed species or destroy/adversely modify designated critical habitat.

- **May affect, is not likely to adversely affect**—the appropriate conclusion when effects of the proposed action on listed species or critical habitat are expected to be beneficial, insignificant, or discountable. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur.

- **May affect, is likely to adversely affect**—the appropriate conclusion if any adverse effect to listed species or critical habitat may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or completely beneficial (see definitions of “is not likely to adversely affect”). If the overall effect of the proposed action is beneficial to listed
species or critical habitat, but may also cause some adverse effect on individuals of the listed species or critical habitat segments, then the determination should be “likely to adversely affect.”

7.2 Listed Pacific Salmon (*Oncorhynchus* spp.)

The timing of downstream juvenile and adult salmon migration in the Lower Columbia River is summarized in Tables 7, 8, and 9 in Section 4. This information is relied on to determine species potential presence in the action area during the in-water work window when construction activities would be occurring with the highest potential to impact listed species (i.e., pile installation) and the resulting effect determination.

7.2.1 Chinook Salmon (*Oncorhynchus tshawytscha*)

The proposed pile installation activities could impact Chinook salmon if present in the action area during construction. While large numbers of Chinook salmon are not expected during the work window, their presence cannot be ruled out. Therefore, based on the analysis presented in Section 6.1, and the species presence in the action area information presented in Section 4.1.1, it is concluded that the project may affect, and is likely to adversely affect, Snake River spring/summer-run Chinook salmon, Upper Columbia River spring-run Chinook salmon, Lower Columbia River Chinook salmon, and Upper Willamette River Chinook salmon and that the project may affect, but is not likely to adversely affect, Snake River fall-run Chinook salmon. Justifications for these determinations are provided below.

The project may affect, and is likely to adversely affect, Snake River spring/summer-run Chinook salmon, Upper Columbia River spring-run Chinook salmon, Lower Columbia River Chinook salmon, and Upper Willamette River Chinook salmon because:

- Although in-water work will occur during the in-water work window when listed fish are expected to be present in very low numbers, it is possible that individual listed fish from the Chinook ESUs listed above could be present in the action area. Thus, in-water work will occur with the risk that fish that are present could experience effects that are not discountable or insignificant.
- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities.
bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.

The project may affect, but is not likely to adversely affect, Snake River fall-run Chinook salmon because:

- In-water work will occur during the in-water work window when the listed fish in this ESU are not expected to be present. Thus, in-water work will occur without the risk that fish could experience effects that are not discountable or insignificant.

**7.2.2 Coho Salmon (O. kisutch)**

The proposed pile installation activities could impact coho salmon if present in the action area during construction. Though the action area serves as habitat for a portion of all the salmonid ESUs addressed in this BE, its significance as habitat is greater for Lower Columbia River coho than for other Columbia and Snake River species because the Lower Columbia River coho rear in the Columbia River for a greater length of time (NMFS 2005a). Juvenile coho outmigration peaks in May. Adult coho may be migrating upstream August through February and while work is in progress.

While large numbers of subyearling Lower Columbia River coho salmon are not expected during the work window, their presence cannot be ruled out. Therefore, based on information provided in Section 6.1 and the species presence in the action area information presented in Section 4.2.1, it is concluded that the project *may affect, and is likely to adversely affect, coho salmon*.

The project may affect, and is likely to adversely affect, coho salmon because:

- Although in-water work will occur during the in-water work window when listed fish are expected to be present in very low numbers, it is possible that individual listed fish from the ESU listed above could be present in the action area. Thus, in-water work will occur with the risk that fish that are present could experience effects
that are not discountable or insignificant.

- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities. A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.

### 7.2.3 Chum Salmon (O. keta)

The proposed pile installation activities could impact chum salmon if present in the action area during construction. Adult chum are expected to migrate rapidly through the area, and juveniles are expected to be in the action area during February of the permitted work window. Based on the analysis provided in Section 6.1 and the species presence in the action area information presented in Section 4.3.1, it is concluded that the project may affect, and is likely to adversely affect, chum salmon.

The project may affect, and is likely to adversely affect, chum salmon because:

- Although in-water work will occur during the in-water work window when listed fish are expected to be present in very low numbers, it is possible that individual listed fish from the ESU listed above could be present in the action area. Thus, in-water work will occur with the risk that fish that are present could experience effects that are not discountable or insignificant.
- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities. A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.
7.2.4 **Sockeye Salmon (O. nerka)**

The proposed pile installation activities could impact sockeye salmon if present in the action area during construction. Sockeye salmon are expected to migrate rapidly through the area, and juveniles are not expected to be in the action area during the permitted work window. Based on the analysis provided in Section 6.1 and the species presence in the action area information presented in Section 4.4.1, it is concluded that the project *may affect, but is not likely to adversely affect, sockeye salmon.*

The project may affect, and is likely to adversely affect, sockeye salmon because:

- Although in-water work will occur during the in-water work window when listed fish are expected to be present in very low numbers, it is possible that individual listed fish from the ESU listed above could be present in the action area. Thus, in-water work will occur with the risk that fish that are present could experience effects that are not discountable or insignificant.

- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities. A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.

7.2.5 **Steelhead Trout (O. mykiss)**

The proposed pile installation activities could impact steelhead if present in the action area during construction. Adult steelhead may be found in the action area year-round, but the peak of upstream migration (to upstream spawning and rearing areas) generally occurs between mid-January and mid-March, and again between the beginning of May and middle of September (Ellis 1999).

Based on the analysis presented in Section 6.1 and the species presence in the action area information presented in Section 4.5.1, it is concluded that, although unlikely, steelhead presence in the action area cannot be ruled out, and thus, the project *may affect, and is likely*
to adversely affect, the Lower Columbia River DPSs of steelhead trout, and may affect, but is not likely to adversely affect, the Snake River DPS of steelhead trout, the Upper and Middle Columbia River DPSs of steelhead trout, and the Upper Willamette River DPS of steelhead trout.

The project may affect, and is likely to adversely affect, the Lower Columbia River DPS of steelhead trout because:

- Although in-water work will occur during the in-water work window when listed fish are expected to be present in very low numbers, it is possible that individual listed fish from the DPS listed above could be present in the action area. Thus, in-water work will occur with the risk that fish that are present could experience effects that are not discountable or insignificant.
- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities. A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.

The project may affect, but is not likely to adversely affect, the Snake River DPS of steelhead trout, the Upper and Middle Columbia River DPSs of steelhead trout, and the Upper Willamette River DPS of steelhead trout because:

- In-water work will occur during the in-water work window when listed fish from the DPSs above are not expected to be present. Thus, in-water work will occur without the risk that fish could experience effects that are not discountable or insignificant.

### 7.3 Bull Trout (Salvelinus confluentus)

The proposed pile installation activities could impact bull trout if present in the action area during construction. Bull trout are not known to spawn within the action area and are rarely known to be present in the action area. Based on the analysis provided in Section 6.2, it is concluded that the project may affect, but is not likely to adversely affect, bull trout.
Species Effects Determination

The project may affect, but is not likely to adversely affect, bull trout because:

- In-water work will occur during the in-water work window when listed fish are not expected to be present. Despite the timing information provided in Tables 7 and 8, the likelihood of bull trout occurrence in the action area during the work window is very low. Thus, in-water work will occur without the risk that fish could experience effects that are not discountable or insignificant.

7.4 Eulachon (*Thaelichthys pacificus*)

The proposed pile installation activities could impact eulachon if present in the action area during construction. Eulachon are not known to spawn within the action area and are not found in large numbers in the action area. However, eulachon could be present in the action area in December. Based on the analysis provided in Section 6.3 and the species presence in the action area information presented in Section 4.7.1, it is concluded that the project *may affect, and is likely to adversely affect, eulachon*.

The project may affect, and is likely to adversely affect, eulachon because:

- Although in-water work will occur during the in-water work window when listed fish are expected to be present in very low numbers, it is possible that individual listed fish from the species listed above could be present in the action area. Thus, in-water work will occur with the risk that fish that are present could experience effects that are not discountable or insignificant.
- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities. A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.
7.5  Green Sturgeon (*Acipenser medirostris*)

Potential direct effects on green sturgeon related to noise from project activities are expected to be insignificant due to timing of the work window and diminished presence of green sturgeon in the action area during construction-related activities. If green sturgeon were present in the action area, foraging would be highly unlikely and they would not be breeding. Impacts from turbidity and other construction-related water quality effects are expected to be insignificant. Impacts associated with this project will be minimized through the use of BMPs and project design and construction considerations. Based on the analyses in this document, this project *may affect, but is not likely to adversely affect, green sturgeon in the southern DPS*.

The project may affect, but is not likely to adversely affect, green sturgeon in the southern DPS because:

- In-water work will occur during the in-water work window when the listed fish in this DPS are not expected to be present. Thus, in-water work will occur without the risk that fish could experience effects that are not discountable or insignificant.

7.6  Steller Sea Lion (*Eumetopias jubatus*)

As discussed previously, Steller sea lions are unlikely to be present in the action area in substantial numbers at any given time. Risk of exposure to underwater and in-air noise levels that may be above the threshold for injury, disturbance, and behavioral effects is possible over an extended period of time during the recommended in-water work window. Monitoring for the presence of Steller sea lions will be conducted to ensure that individuals are not exposed to noise levels that lead to injury, but there is still the potential for Steller sea lions to be subjected to disturbance level noise if present in the action area during pile driving activities. Although impacts associated with this project will be minimized through the use of regulatory mechanisms, minimization measures, and project design and construction considerations described in this document, it is still possible that a Steller sea lion within the action area could be disturbed. Based on this analysis, this project *may affect, and is likely to adversely affect, Steller sea lions in the eastern DPS.*
The project may affect, and is likely to adversely affect, Steller sea lions in the eastern DPS because:

- Although in-water work will occur during the in-water work window when Steller sea lions are expected to be present in very low numbers, it is possible that individual listed sea lions from the species listed above could be present in the action area. Thus, in-water work will occur with the risk that Steller sea lions that are present could experience effects that are not discountable or insignificant.
- Impacts from increased noise levels above established injury and disturbance thresholds within the action area may occur during pile installation activities. A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks) will be employed during impact pile driving to minimize the impact, but it is not certain that the noise levels can be reduced below both the injury and disturbance thresholds. Thus, impacts from increased noise levels are not discountable or insignificant.

7.7 **Salmon and Steelhead Critical Habitat**

Project effects for the two applicable PCEs of salmon and steelhead critical habitat were considered in Section 6.6. Construction noise and other construction-related effects on elements of critical habitat are expected to be insignificant. In addition, long-term impacts of the new facility are not expected to impact salmonid critical habitat after considering the mitigation measures. Therefore, the proposed action *may affect, but is not likely to adversely affect, critical habitat for salmon and steelhead.*

7.8 **Bull Trout Critical Habitat**

Project effects for the seven applicable PCEs of bull trout critical habitat were considered in Section 6.7. Construction noise and other construction-related effects on elements of critical habitat are expected to be insignificant. In addition, long-term impacts of the new facility are not expected to impact bull trout critical habitat after considering the mitigation measures. Further, bull trout have rarely been documented in the Lower Columbia River. Therefore, the proposed action *may affect, but is not likely to adversely affect, critical habitat for bull trout.*
7.9 Proposed Eulachon Critical Habitat

Project effects for the three applicable proposed physical or biological features essential for conservation of eulachon critical habitat were considered in Section 6.8. Construction noise and other construction-related effects on elements of proposed critical habitat are expected to be insignificant in the long-term and will not impact the ability of the action area to function as critical habitat.

Therefore, it is determined that there will be no adverse modification to proposed critical habitat, and if critical habitat is designated before this consultation is complete, the project may affect, but is not likely to adversely affect critical habitat for eulachon.
8 REFERENCES


Corps. See U.S. Army Corps of Engineers.


Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake, 1995. Fish Species of Special Concern in California. Second edition. Final report to CA Department of Fish and Game, contract 2128IF.


NMFS, 2009. Endangered Species Act Section 7 Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Conservation Recommendations for The City of The Dalles Commercial Dock Facility, Columbia River (HUC 1707010504), Wasco County, Oregon (Corps No.: NWP-2007-524).


Salmon Movement along Puget Sound Shorelines. Prepared for WSDOT, Olympia, WA.


WDFW, 2008b. Personal communication with Steve West (WDFW), Tabitha Reeder (BergerABAM), and Dan Gunderson (BergerABAM). Spring 2008.


APPENDIX A

ESSENTIAL FISH HABITAT ASSESSMENT
INTRODUCTION

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and the 1996 Sustainable Fisheries Act (SFA), an Essential Fish Habitat (EFH) evaluation of impacts is necessary for activities that may adversely affect EFH.

EFH is defined by the MSFMCA in 50 Code of Federal Regulation (CFR 600.905-930) as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” and has been designated for groundfish, coastal pelagic, and Pacific salmon composites. The action area for the proposed action includes habitats that have been designated as EFH for various life-history stages of Chinook and Coho salmon (Pacific salmon EFH composite). There are no coastal pelagic or ground fish species or habitat within the action area.

Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (as identified by the Pacific Fisheries Management Council [PFMC]), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Salmonid EFH is discussed in detail in Appendix A of Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999).

The objective of this EFH Assessment (Appendix A to the Biological Evaluation [BE]) is to describe potential adverse effects to designated EFH for federally managed fisheries species within the action area. It also describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the Project. EFH and life history stages for species that may occur in the action area are listed in Table A-1.
Appendix A – Essential Fish Habitat Assessment

Table A-1
MSFCMA-managed Species and Life-history Stages
with Designated EFH that May Occur in the Project Vicinity

<table>
<thead>
<tr>
<th>Species</th>
<th>Adult</th>
<th>Spawning/Mating</th>
<th>Juvenile</th>
<th>Larvae</th>
<th>Eggs/Parturition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook salmon</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coho salmon</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DESCRIPTION OF THE PROPOSED ACTION AND CONSTRUCTION METHODS

A detailed description of the proposed action and associated construction methods is presented in Section 2 of the BE.

POTENTIAL ADVERSE EFFECTS OF PROPOSED ACTION

Adverse Effects on Essential Fish Habitat for Salmonids

Potential adverse effects on salmonid EFH related to the proposed project include construction-related noise, water quality, and habitat impacts.

Noise

In-water noise is expected to result from piling installation activities and from general construction activities and could negatively impact Pacific salmon (as discussed in Section 6.1 of the BE). Table A-2 shows a summary of the noise impact thresholds for salmonids and the distance to the threshold level for impact installation ranging between 600 and 3,000 strikes per day. To minimize potential water column noise impacts, the pile driving work associated with this proposed action will be conducted within the recommended work window to avoid disturbance to salmonids in the Columbia River. This reduces the likelihood of salmonids being present in the action area and within the potential impact areas. Due to project timing, there is an extremely low likelihood that juvenile salmonids less than 2 grams in size will be present during pile installation. In addition, the juvenile fish are expected to be more shoreline oriented, and a majority of the piles will be installed in the deep water zone.
**Water Quality**

Pile removal and installation will temporarily disturb sediments and increase turbidity levels within the project area. The elevated turbidity levels are expected to be of limited duration and localized to the pile removal/installation area.

During any in-water construction activities, there is a risk of localized and temporary water quality impairments from the unintentional release of machinery fluids. All necessary actions will be taken to avoid such a discharge and, in the event of a spill, containment and cleanup would take precedence over continued work. Any potential for construction material or debris to enter the water will be managed by strictly adhering to above-water and in-water best management practices (BMPs). Above-water work, such as concrete filling of piles, marine structure outfitting, and placement of precast concrete dock elements may occur outside the approved in-water work period.

While some potential exists for impairments to water quality from these activities, any risk would be greatly minimized by the implementation of standard BMPs. Overall, potential water quality impairments from the construction activities are not expected to adversely affect any salmonids.

**Habitat Impacts**

As shown in Table 2 of the BE, there will be a small amount (530 sf, or 0.01 acre [49 m²]) of shallow water habitat with silt/sand substrate that will be covered by the proposed structure. The new structure will be placed at a level above the water that allows for light to penetrate underneath it and was designed to minimize the width of the structure. The remaining over-water coverage will occur within the deep water zone and the shallow water zone with riprap substrate. These habitat areas provide few functions and are plentiful in the system. To compensate for the loss of productivity attributable to 530 sf (49 m²) of over-water shading over functional nearshore habitat, and to provide ecological lift of riparian function within the watershed, 2,650 sf (246 m²) of native riparian plantings will be established at Buckmire Slough, near Lake River. The existing vegetation, consisting of teasel (*Dipsacus sylvestris*), reed canarygrass (*Phalaris arundinacea*), and Himalayan blackberry (*Rubus armeniacus*), lacks structural diversity and the capacity to provide shade. The Buckmire Slough riparian planting will include initial removal of invasive species to allow planting...
Appendix A – Essential Fish Habitat Assessment

native trees and shrubs, and the installation of black cottonwood (*Populus balsamifera*), Pacific willow (*Salix lasiandra*), Oregon ash (*Fraxinus latifolia*), Columbia willow (*Salix fluiatiilis*), and red-osier dogwood (*Cornus sericea*). Tree species will be planted at 10 feet (3 m) on center and shrubs will be planted at 5 feet (1.5 m) on center spacing.

Pile installation and removal will result in some disturbance of the river substrate as the piles are either installed or removed. This disturbance is expected to be localized and short term. Substrate disturbance impacts to aquatic species will be minimized and mitigated with the implementation of appropriate BMPs, as discussed in Section 2.4 of the BE. In addition, the substrate that each individual pile covers will be permanently impacted by the proposed action. To offset the placement of additional piles for the marine structures and the resulting long-term impact to the substrate, the project will remove an existing dolphin and catwalk from the project area and additional piles at Terminal 2 (approximately at river mile 105). Approximately two treated timber piles will be removed for each pile placed (approximately 177 piles from Terminal 2 and 31 piles from Terminal 5). The existing dolphin consists of 13 plumb and 14 batter (1H:IV) treated 16-inch (406-mm) diameter timber piles, affecting approximately 40 sf (3.7 m²) of river bed and shading approximately 200 sf (19 m²). The dolphin is located approximately 20 feet (6 m) below the Ordinary High Water Mark (OHWM). The existing catwalk is supported by four treated timber piles and is approximately 560 sf (52 m²) of over-water coverage.

### Table A-2
Noise Impact Threshold Summary and Radial Distance of Threshold for Salmonids based on Installation of In-Water Piles

<table>
<thead>
<tr>
<th>Pile Driving Type</th>
<th>Radial Distance of Single Strike Injury (threshold=206 dB&lt;sub&gt;PEAK&lt;/sub&gt;) (meters)</th>
<th>Radial Distance of Cumulative Sound Injury (threshold=187 dB&lt;sub&gt;SEL&lt;/sub&gt;; &gt;2 grams) (meters)</th>
<th>Radial Distance of Disturbance Level (threshold=150 dB&lt;sub&gt;RMS&lt;/sub&gt;) (kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact Hammer</td>
<td>14 (46 feet)</td>
<td>1,000 (3,281 feet)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>10 (6.2 miles)</td>
</tr>
<tr>
<td>Vibratory Hammer</td>
<td>N/A</td>
<td>N/A</td>
<td>0.40 (0.24 miles)</td>
</tr>
</tbody>
</table>

Notes:

1. Radial distance of cumulative sound injury ranges between 1,470 and 3,280 feet (450 and 1,000 m), depending on the size of the impact hammer used. This range is based on the number of strikes ranging from 600 to 3,000 per day for use of the impact hammer.
**Adverse Effects on Essential Fish Habitat for Ground Fishes**

Ground fishes are not present in the action area; therefore, this project will have no effect on EFH for ground fishes.

**Adverse Effects on Essential Fish Habitat for Coastal Pelagic Species**

Coastal pelagic species are not present in the action area; therefore, this project will have no effect on EFH for coastal pelagic species.

**ESSENTIAL FISH HABITAT CONSERVATION MEASURES**

Impact avoidance and minimization measures are proposed action design elements that avoid and minimize the potential for adverse environmental effects, including BMPs and conservation measures. General impact avoidance and minimization measures include the following.

**Minimization Measures**

- The face of the berth has been located beyond the shallow water zone (i.e., between the OHWM and 20 feet [6.1 m] below the OHWM) to avoid and minimize impacts to shallow water habitat.
- Grating has been used on platform surfaces where practicable to allow light to penetrate through it.
- The ship loader structures will have sufficient clearance between the surface and the water surface at the OHWM elevation to allow for light penetration under the berth surfaces.
- The potash will be transferred to the vessels at the berth via fully enclosed conveyors in order to avoid potash spill over from the conveyors. The surge bin will store the potash temporarily during pauses in ship loading so that the product does not back up and overload the conveyors.
- Timing restrictions are used to avoid in-water work when listed species are most likely to be present. The current Washington Department of Fish and Wildlife (WDFW)-recommended work window for this area is November 1 through February
28 annually. It is expected that in-water work for this project will occur over two work windows.

- Project construction will be completed in compliance with Washington State Water Quality Standards (Washington Administrative Code [WAC] 173-201A), including:
  - No petroleum products, fresh cement, lime, concrete, chemicals, or other toxic or deleterious materials will be allowed to enter surface waters.
  - There will be no discharge of oil, fuels, or chemicals to surface waters, or onto land where there is a potential for re-entry into surface waters.
  - Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc., will be checked regularly for leaks, and materials will be maintained and stored properly to prevent spills.
  - A spill prevention, control, and countermeasures (SPCC) plan will be prepared for use during construction and operation of the project. A copy of the plan with any updates will be maintained at the work site.

- The SPCC plan will outline BMPs, responsive actions in the event of a spill or release, and notification and reporting procedures. The SPCC plan will also outline management elements such as personnel responsibilities, project site security, site inspections, and training.

- The SPCC plan will outline measures to be taken to prevent the release or spread of hazardous materials, either found on-site and encountered during construction, but not identified in contract documents, or any hazardous material that is stored, used, or generated on the construction site during construction activities. These items include, but are not limited to, gasoline, oils, and chemicals.

- Applicable spill response equipment and material designated in the SPCC plan will be stored at the job site during construction.

**Best Management Practices**

**General BMPs**

Typical construction BMPs for working in, over, and near water include:

- Checking equipment for leaks and other problems that could result in discharge of petroleum-based products or other material into the Columbia River.
- Corrective actions, including those listed below, will be taken in the event of any
discharge of oil, fuel, or chemicals into the water:

- In the event of a spill, containment and cleanup efforts will begin immediately and be completed in an expeditious manner in accordance with all local, state, and federal regulations, and taking precedence over normal work. Cleanup will include proper disposal of any spilled material and used cleanup material.
- The cause of the spill will be assessed and appropriate action will be taken to prevent further incidents or environmental damage.
- Spills will be reported to the Washington State Department of Ecology Southwest Regional Spill Response Office at 360-407-6300.

- Work barges will not be allowed to ground out on the river bottom.
- Excess or waste materials will not be disposed of or abandoned waterward of the OHWM or allowed to enter waters of the state. Waste materials will be disposed of in an appropriate landfill.
- Demolition and construction materials will not be stored where wave action or upland runoff can cause materials to enter surface waters.
- Oil-absorbent materials will be stored on site during construction in the event of a spill or if any oil product is observed in the water.

**Pile Removal BMPs**

- While creosote-treated piles are being removed, a containment boom will surround the work area to contain and collect any floating debris and sheen. Also, any debris will be retrieved and disposed of properly. The piles will be dislodged with a vibratory hammer, when possible, and will not be intentionally broken by twisting or bending.
- The piles will be removed in a single, slow, and continuous motion so as to minimize sediment disturbance and turbidity in the water column.
- If a pile breaks above or below the mudline, it will be cut or pushed in the sediment consistent with agency-approved BMPs.
- Removed piles, stubs, and associated sediments (if any) will be contained on a barge. If piles are placed directly on the barge and not in a container, the storage area will consist of a row of hay or straw bales, filter fabric, or similar material placed around the perimeter of the storage area.
• All creosote-treated material, pile stubs, and associated sediments (if any) will be disposed of in a landfill approved to accept those types of materials.

Pile Installation BMPs

• The vibratory hammer method will be used to drive steel piles, to the extent possible, to minimize noise levels.
• A bubble curtain or other similar noise attenuation method (such as sound attenuation pile caps, or cushion blocks, etc.) will be employed during impact pile driving.
• A marine mammal monitoring plan will be implemented during pile driving activities to reduce the risk of potential impacts to marine mammals.
• If material needs to be excavated from inside piles to facilitate infill of concrete for structural purposes, appropriate methods will be put in place to minimize the contact of any excavated material with the marine environment. Excavated material will be stockpiled and disposed of in an appropriate upland location.

Over-water Concrete BMPs

• Wet concrete will not be allowed to come in contact with surface waters.
• Forms for any concrete structure will be constructed to prevent leaching of wet concrete.
• Curing concrete will not be watered.
• If piles need to be filled with concrete, concrete will be installed using the tremie method (a method of construction commonly used for projects spanning water).

Stormwater Outfall Support Structure Construction BMPs

During construction of the stormwater outfall support structures, the following BMPs will be employed:

• The vibratory hammer method will be used to drive steel piles, to the extent possible, to minimize noise levels.
• Silt curtains may be employed if there is significant disturbance to the river bottom.
• Excavated material will be stockpiled and disposed of in an appropriate upland location.
• In-water construction may occur during the WDFW-approved in-water work, or during low water, when work can occur above the usual seasonal low water level.
• Temporary jute netting or cut straw, wattles, and/or silt fencing may be placed in disturbed areas of the shoreline.
• Work will be performed from the land side where possible.

Conservation Measures

Conservation measures are measures taken to directly contribute to the recovery of a listed species, including:

• Native shoreline vegetation that is disturbed during construction will be restored after construction is completed to the extent practicable.
• To mitigate for impacts to the benthic environment from pile placement and upgrades to a stormwater outfall, the project will remove an existing dolphin and catwalk at Terminal 5 and will remove additional treated timber piles at Terminal 2, for a total of approximately 208 piles to be removed.
• To mitigate for impacts from over-water shading in the nearshore environment, the project will install native trees and shrubs on 2,650 sf (246 m²) of riparian habitat at Buckmire Slough.

CONCLUSION AND EFFECT DETERMINATION

The assessment of potential impact from the proposed action to Pacific salmon EFH is based on information in Appendix A to Amendment 14 of the Pacific Coast Salmon Plan (PFMC).

In-water work for this proposed action is limited to pile removal (approximately 208 piles) and installation (up to approximately 100 36-inch or 40-inch steel piles) necessary for dock improvements. Potential impact mechanisms of these actions to salmonid species EFH and minimization measures that avoid and minimize impacts are discussed above. Additional discussion of the proposed action effects is presented in Sections 3 and 6 of the BE for this proposed action.

Based on the potential impacts and proposed impact minimization measures described in this appendix, it is expected that implementation of the proposed action will not adversely affect
EFH for Pacific salmon. Short term effects are expected to be minimal, localized, and temporary, and project timing and BMPs will be used to avoid and minimize those effects.

APPENDIX A REFERENCES


