# REQUEST FOR MARINE MAMMAL PROTECTION ACT INCIDENTAL HARASSMENT AUTHORIZATION

**for the**
**Astoria Waterfront Bridge Replacement Project**
**Astoria, Oregon**

Original: October 2017
Revised: January 2018

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**LIST OF ABBREVIATIONS**

AASHTO.....American Association of State Highway and Transportation Officials
AERMA .....American Railway Engineering and Maintenance-of-Way Association
ADT.....Average Daily Traffic
BMPs.....Best Management Practices
CBD.....Convention on Biological Diversity
CFR.....Code of Federal Regulations
CIA.....Contributing Impervious Area
CWA .....Clean Water Act
dB.....Decibel
dBA.....A-Weighted Decibel
DPS .....Distinct Population Segment
EPA.....Environmental Protection Agency
ESA.....Endangered Species Act
FAHP.....Federal Aid Highway Program
FHWA .....Federal Highway Administration
HMT .....Highest Measured Tide
HUC .....Hydrologic Unit Code
IWW .....In-Water Work
IWWP .....In-Water Work Period
LCEP.....Lower Columbia Estuary Partnership
MHHW .....Mean Higher-High Water
MLW.....Mean Low Water
MLLW .....Mean Lower-Low Water
MMPA .....Marine Mammal Protection Act
msl.....Mean Sea Level
NOAA .....National Oceanic and Atmospheric Administration
NMFS.....National Marine Fisheries Service
OBEC.....OBEC Consulting Engineers
ODEQ.....Oregon Department of Environmental Quality
ODFW.....Oregon Department of Fish and Wildlife
ODOT.....Oregon Department of Transportation
PAH.....Polycyclic Aromatic Hydrocarbons
PCP .....Pollution Control Plan
PSO .....Protected Species Observer
PSU .....Portland State University
PTS.....Permanent Threshold Shifts
RM.....River Mile
RMS .....Root Mean Square
ROW .....Right-of-Way
SAR .....Stock Assessment Report
SBSTTA.....Subsidiary Body on Scientific, Technical and Technological Advice
SEL .....Cumulative sound exposure level over a 24-hour period
SPL .....Sound Pressure Level
SSV .....Sound Source Verification
TTS .....Temporary Threshold Shifts
UNEP .....United Nations Environment Programme
USACE.....US Army Corps of Engineers
USFWS.....US Fish and Wildlife Service
WSDOT .....Washington State Department of Transportation
ZOI.....Zone of Influence

# 1.0 DETAILED DESCRIPTION OF THE ACTIVITY

This section provides a detailed description of the specific class of activities that will occur during construction of the Astoria Waterfront Bridge Replacement Project, hereinafter referred to as the Project. The total Project proposes to replace six bridges that are located in consecutive blocks from 6th Street through 11th Street along the Astoria waterfront; however, this Request for Marine Mammal Protection Act Incidental Harassment Authorization (IHA) only covers work activities associated with the removal and replacement of the 7th, 9th, and 11th Street Bridges.

## 1.1 Overview

The portion of the Project addressed under this IHA will replace three bridges that connect city streets to waterfront piers supporting businesses and attractions. Project stakeholders include the business and property owners in the immediate vicinity, the Astoria Riverfront Trolley Association, ODOT, FHWA, the City Public Works Department, City residents, the City Council, and state and federal regulatory agencies.

The rail corridor is dominated by an existing timber trestle that runs east-west with 15-foot timber stringer spans. The rail trestle is currently in use as a single track structure with a width of approximately 18 feet throughout the corridor. Additional trestle structure exists to the north at some locations, as historically, the operating railway had spur lines to serve businesses along the Astoria Waterfront. As such, the trestle framing north of the in-service rail line varies by site. The rail trestle consists of timber decking over timber rail ties supported by stringers (one under each rail).

The existing bridges are structurally deficient, load posted bridges supported by decayed timber pile. The existing bridges are generally posted for a 3-ton load limit, which severely limits current uses and riverfront development. The proposed solution for the Project is to replace the existing bridges with modern concrete structures supported on steel piles built to current design standards. The bridges carry highway, rail, bicycle and pedestrian users. The street ROW limits extend north of the bridge sites and were established prior to construction of the rail line. The rail ROW is not continuous. It exists only between the streets ROW. This Project is currently limited to replacing the bridges within city street ROW. To avoid the need to demobilize and move equipment between the three bridge sites, the contractor is likely to remove all existing structures and reconstruct the trestles and roadway approaches at one street location before moving onto the next.

## 1.2 Superstructure Removal

Demolition of the existing bridge crossings will require the removal of the bridge decks and other aboveground components for the trestle crossings and roadway approaches. Most of the structure will be timber; however, there are concrete components at some of the crossings. Demolition of the superstructures will likely be accomplished using standard roadway and bridge construction equipment (Table 1-1). This will include an excavator, backhoe, jackhammer, and chain saw. In addition, a crane may be used to remove larger timber elements. The use of the excavator, crane, and concrete saw will account for the highest construction generated noise level during demolition of the superstructures. All removed materials will be hauled offsite to an approved upland location for disposal, and all equipment will be operated from the existing roadway, trestle, and upland areas away from the river.

**Table 1-1. Noise Levels for Bridge Demolition Equipment (Hanan & Associates, 2014)**

| Equipment | Peak Values (dB RMS) at 20 meters[1] |
|---|---|
| Backhoe | 78 |
| Chain Saw | 78 |
| Concrete Saw | 93 |
| Crane | 89 |
| Excavator | 91 |
| Generator Powered Jackhammer | 87 |
| Hand Tools | 85 |

California sea lions are known to haul-out near several of the crossings, and steller sea lions and harbor seals are likely to be transiting the area during the construction period. The airborne sound levels generated by the construction equipment could exceed the behavioral disruption thresholds, and there are very few structures situated between the river and the trestle crossings. *Based on the sound levels produced by the proposed equipment, existing site conditions, and the likely location of the pinnipeds within the area in relation to the associated construction activities, the City of Astoria is seeking an IHA for removal of the rail superstructures, because this work could result in acoustic and visual disturbance to pinnipeds.*

Construction activities related to the removal of the roadway approach superstructures will be situated away from the river. Structural noise reduction (FHWA, 2011) is the physical shielding of the construction equipment provided by existing buildings and the decking material of the pier structure. Buildings and other above grade structures will reduce noise by physically blocking the noise, and reflecting it away from the river. The pier structure will also block noise from reaching the river and bank areas by deflecting it upwards. The combined reduction could range from 5 to 12 dB or more, depending on the location of the equipment and the type and size of the structures between the river and the equipment. Steller sea lions and harbor seals are not known to utilize the banks within the Project area; however, California sea lions have been seen hauled out within the area on occasion.

Finally, noise levels from much of the construction equipment used for removal of the existing superstructures are no different than many of the existing noise sources in the area. For example, fuel trucks making deliveries to the gas station, delivery trucks accessing businesses in the dock area or other heavy vehicles using roadways in this area would also produce noise similar to those noted above in Table 1-1. *Based on the sound levels produced by the proposed equipment, existing site conditions, and the likely location of the pinnipeds within the area in relation to the associated construction activities, removal of the roadway approach superstructures are not expected to result in injury to or disrupt the behavior of nearby marine mammals.*

## 1.3 Foundation Removal

*The City of Astoria is seeking an IHA for construction work related to the demolition of the existing bridge substructures at the 7th, 9th and 11th Street crossings, because this work could result in acoustic and visual disturbance to pinnipeds.* Though all construction equipment will be operated from the existing roadway and upland areas, demolition activities will require the use of construction equipment that may generate sound levels that exceed the in-air thresholds

[1] Peak values have been rounded up from the original report.

currently prescribed by NOAA. Similarly, in-water construction would include the removal of previously installed piles using a vibratory hammer or via direct pull. Removal of wooden piling with a vibratory hammer will exceed the behavioral disruption threshold for non-pulse noise. Finally, work related to piling and footing removal could result in visual disturbance to pinnipeds. The following sections further describe the proposed demolition activities.

### 1.3.1 Timber Structure Removal

The existing bridge crossings are primarily founded on a timber substructure. All timber elements supporting the existing roadway approach and trestle crossing will be removed. The materials consist of round piles, columns, bottomplates, and lower braces and crossbracing. In addition, abandoned, cutoff timber piles that are located within close proximity to proposed piles will be removed. All removed timber elements will be hauled offsite to an approved upland location for disposal.

***Photographs of existing timber structure that will need to be removed during demolition activities***

An estimated 85 timber structural elements will be removed at each of the three bridge sites. The majority of the timber piling to be removed is located within the intertidal zone between the MHW elevation (7.73 feet above msl) and the MLLW elevation (0.43 feet above msl), with the exception of 29 piles at the 9th Street Bridge that are located below the MLLW elevation. Based on NOAA tide predictions for the 2018-2019 IWWP, negative tides are possible during this time; however, the negative tides will occur after 5pm when construction will likely have ceased. Due to the limited number of piles below the MLLW elevation, and the rate at which the tides change within this area, the following scenarios are likely:

- *7th Street Bridge* – Most of the piles to be removed are located between the MLW elevation (1.53 feet above msl) and 6 feet above msl at this bridge. Therefore, all piles are likely to be inundated by water levels greater than 2 feet deep at least 50 percent of the time.

- *9th Street Bridge* – All of the piles to be removed are located below the MLW elevation at this bridge. Therefore, all piles are likely to be inundated by water levels greater than 2 feet deep at least 75 percent of the time.
- *11th Street Bridge* – Most of the piles to be removed are located above the MLW elevation but below 5 feet above msl at this bridge. Therefore, all piles are likely to be inundated by water levels greater than 2 feet deep at least 50 percent of the time. The remaining landward piles are likely to be in the dry at least 75 percent of the time.

Old pilings are often in very poor condition near and above the ground surface, making attachment to the pilings for extraction very difficult. Old vertical piles and other obstructions encountered near the surface may need to be extracted or cut per FAHP guidance or other approved variance. If there is room to adjust the width across the cap of the new pilings, then the piles may be field-adjusted during construction to avoid the obstruction. Old wood pilings that are too deep to address from the ground surface may require auguring through the piles.

### 1.3.2 Concrete Structure Removal

Though the existing crossings are mostly comprised of timber substructures, there are several concrete footings that will need to be removed to facilitate construction of the new structures. Table 1-2 provides a summary of the concrete elements that will need to be removed. It is estimated that 18 concrete footings will need to be excavated; however, this estimate is preliminary.

**Table 1-2. Concrete Structure Removal Summary**

| Structure Type | 7th Street Bridge | 9th Street Bridge | 11th Street Bridge |
|---|---|---|---|
| Concrete Footings (16"x16") | 6 | 1 | 7 |
| Concrete Footings (4'x2') | 1 | -- | -- |
| Concrete Footings (12'x3') | -- | 1 | -- |
| Concrete Footings (10'x3') | -- | 1 | -- |
| Concrete Footings (9'x3') | -- | 1 | -- |
| **TOTAL** | **7** | **4** | **7** |

It is anticipated that the contractor will utilize an excavator, positioned on the existing roadway or adjacent gravel/asphalt parking areas, to reach down and remove the concrete footings. If the vertical or horizontal distance makes a footing unreachable, the contractor will likely drill an anchor into the concrete then attach the excavator bucket to the anchor with a chain and pull upwards to extract the concrete. All removed concrete will be hauled offsite to an approved upland location.

It is anticipated that the contractor will want to remove the concrete footings in the dry when they are visible and access is easier. At the 7th Street Bridge, all of the concrete structures to be removed are located above the MHHW elevation (8.43 feet above msl). As a result, removing these structures in the dry will not be an issue. At the 9th Street Bridge, the concrete structures are located lower in elevation, just above MLW. As a result, the contractor will be required to remove these structures during low tide when water levels are below the MLW elevation, or drill an anchor into the concrete blocks during low tide for removal with a chain and excavator as the tide comes in. For the 11th Street Bridge, all of the concrete structures are located at, or just below, the MHHW elevation. As a result, removing these structures in the dry will not be an issue.

***Photographs of existing concrete footings that will need to be removed during demolition activities***

### 1.3.3 Retaining Wall Removal

The existing retaining wall at the 9th Street crossing will need to be removed to facilitate construction of the new roadway approach. The wall is currently located below the HMT elevation (12.43 feet above msl) and will be exposed to surface flows during tides above the MHW elevation. The contractor will be required to remove the wall when flows are below this elevation to ensure that the wall is removed in the dry. The existing wall is concrete and will likely be cut into smaller pieces using a concrete saw. The contractor will then utilize an excavator with a bucket and thumb to remove the concrete pieces and the existing approach fill material. The excavator will be positioned on the existing roadway during demolition, and all concrete and fill material removed from the site will be hauled offsite with a dump truck to an approved upland location.

The loudest noise generating equipment during demolition of the 9th Street retaining wall will be a concrete saw, which will generate sound levels that exceed the in-air thresholds currently prescribed by NOAA. As previously indicated during the discussion of the proposed superstructure demolition, in-air noise from a concrete saw has been measured at 93 dB RMS

at 20 meters from the source. Though airborne sound levels reduce by 6 dB per doubling distance, the location of the retaining wall precludes the possibility of any additional attenuation by structural absorption. In addition, California sea lions have been known to haul-out and rest within close proximity to this bridge site

## 1.4 Temporary Shoring and Work Structures

*The City of Astoria is seeking an IHA for the construction of temporary shoring and work structures, because this work could result in acoustic and visual disturbance to pinnipeds.* Most of the proposed piles are within ±40 feet of the existing abutments, so the piles will be installed from a crane staged on the south side of the bridges. However, pilings at the 9th Street crossing are up to ±60 feet away from the south abutments. The size and length of the piling as well as the weight of the pile hammer and leads places additional demand on the supporting crane.

Selection of the appropriate equipment and design of a temporary work bridge is the responsibility of the contractor; however, for purposes of this IHA application, the following assumptions have been made for the 9th Street Bridge work platform: 1) temporary shoring will consist of two bents comprised of five 16-inch piles each, and 2) both bents will be located within two feet of the MLW elevation. Therefore, all piles are likely to be inundated by water levels greater than 2 feet deep at least 75 percent of the time during installation and extraction.

Construction of the work platform will be initiated following removal of the superstructure, as well as the retaining wall and approach fill. The contractor will be required to use an impact hammer to seat the pile tips into the bedrock and verify the required bearing resistances. All equipment will be operated from the existing roadway and upland areas. Due to the very soft soils, it is anticipated that the pile will advance predominantly under its own weight with a limited number of hammer strikes prior to reaching the bedrock surface (see Subsection 1.6.2 for further discussion on likely impact hammer equipment utilized for this project and Table 2-1 for estimated pile strikes per day). The contractor will likely construct the work platform with timber decking. All temporary piling for the work structure will be installed and removed during the ODFW prescribed IWWP, and will remain in place for only one construction season. The temporary piles will be removed via direct pull or vibratory hammer, similar to the removal of the existing timber piles.

## 1.5 Bridge Design

To provide full pedestrian and vehicle access to the businesses and attractions along this portion of the waterfront, the City will replace the old structures with new concrete bridges that have steel supports. The new bridge designs will feature more lighting, wider sidewalks, and decorative hand railings.

The foundation options considered to support the three replacement bridges included deep foundations consisting of driven piles and drilled shafts. Driven piles were selected since they are less costly and less difficult to construct than drilled shafts. We anticipate foundation loads will require driven piles extending to the mudstone, ±75 feet below the existing bridge decks.

The following sections provide an overview of the design of each of the three replacement bridges. A total of 74 24-inch steel piles will be installed to support the new trestle crossings and roadway approaches.

### 1.5.1 7th Street Bridge

The 7th Street Bridge will consist of a total of 21 plumb piles. Estimate pile depth is -76 feet below msl. The trestle crossing will consist of two end bents and one interior bent with the following pile configurations (total of 9 piles):

- Bent 7-T1: End bent comprised of 3 piles
- Bent 7-T2: Interior bent comprised of 3 piles
- Bent 7-T3: End bent comprised of 3 piles

The trolley bridge will be constructed using precast concrete tee beams. The roadway approach will consist of two bents, each constructed on 6 piles for a total of 12 piles, with a pre-cast prestressed slab bridge.

Proposed pile locations at the 7th Street Bridge are situated between the MLW elevation and the HMT elevation, with a majority of the new piles located below the MHHW elevation. As a result, all piles are likely to be inundated by water levels greater than 2 feet deep at least 50 percent of the time.

### 1.5.2 9th Street Bridge

The 9th Street Bridge will consist of a total of 25 plumb piles. Estimated pile depths range from -64 to -65 feet below msl. The trolley bridge will consist of two end bents and two interior bents with the following pile configurations (total of 13 piles):

- Bent 9-T1: End bent comprised of 2 piles
- Bent 9-T2: Interior bent comprised of 4 piles
- Bent 9-T3: Interior bent comprised of 4 piles
- Bent 9-T4 : End bent comprised of 3 piles

The trestle crossing will be constructed precast concrete tee beams. The roadway approach will consist of two bents, each constructed on 6 piles for a total of 12 piles, with a pre-cast prestressed slab bridge.

Most of the proposed pile locations at the 9th Street Bridge are located just above or below the MLW elevation, with the remaining 6 piles located at or above the MHHW elevation. It is anticipated that these six piles can be installed in the dry; however, the remaining piles are likely to be inundated by water levels greater than 2 feet deep at least 75 percent of the time.

### 1.5.3 11th Street Bridge

The 11th Street Bridge will consist of a total of 28 plumb piles. Estimated pile depth is -64 feet below msl. The trolley bridge will consist of two end bents and two interior bents with the following pile configurations (total of 16 piles):

- Bent 11-T1: End bent comprised of 4 piles
- Bent 11-T2: Interior bent comprised 4 piles
- Bent 11-T3: Interior bent comprised 4 piles
- Bent 11-T4: End bent comprised of 4 piles

The trestle crossing will be constructed using precast concrete tee-beams. The roadway approach will consist of two bents, each constructed on 6 piles for a total of 12 piles, with a pre-cast prestressed slab bridge.

Most of the proposed pile locations at the 11th Street Bridge are located above the MLW elevation but below 5 feet above msl at this bridge. Therefore, all piles are likely to be inundated by water levels greater than 2 feet deep at least 50 percent of the time. The remaining landward piles are likely to be in the dry at least 75 percent of the time.

## 1.6 Piling Installation

*The City of Astoria is seeking an IHA for pile installation activities, because this work could result in acoustic and visual disturbance to pinnipeds.* A total of 74 steel piles are proposed for this project, all 24-inches in diameter (see Table 1-3). The piles will be driven open-ended into very soft siltstone and mudstone to develop the required axial resistance. All equipment will be operated from the existing roadway and upland areas.

**Table 1-3. Pile Installation Summary**

| Pile Type | 7th Street Bridge | 9th Street Bridge | 11th Street Bridge |
|---|---|---|---|
| Plumb Piles | 21 | 25 | 28 |

Foundation construction for these bridges presents significant challenges. The bridge sites are located in a historic waterfront area with nearby buildings and private piers. Further complicating the construction are existing pilings, retaining walls and riprap. As a result, several driving methods and approaches for evaluating and reducing vibrations associated with pile driving were explored. The following sections discuss the methods chosen for the Project.

### 1.6.1 Predrilling and Site Preparation

During the preliminary geotechnical investigation, most of the borings encountered riprap. Further, the history of the area suggests that a wide variety of large debris and fill may be present. Attempting to drive the new piles through the fill and other obstructions may induce unacceptable vibration levels on adjacent structures. Therefore, it is estimated that all abutment pilings will be predrilled to an elevation of about ±3 feet below msl; however, the need to predrill will be determined onsite once the contractor has identified the exact pile locations. Equipment likely to be used includes a standard drill rig, auger driven with a Kelly bar.

The interior bent pilings are also likely to encounter riprap and obstructions near the ground surface. However, auger drills typically used in predrilling may be too heavy for the existing bridges. At the interior bents, it is expected that most of the riprap and obstructions will be near the surface and the obstructions may be moved or rearranged prior to pile driving to facilitate starting the piles.

### 1.6.2 Impact Hammer Pile Driving

The contractor will be required to use an impact hammer to seat the pile tips into the bedrock and verify the required bearing resistances. Due to the very soft soils, it is anticipated that the pile will advance predominantly under its own weight with a limited number of hammer strikes prior to reaching the bedrock surface. The FHWA Gates Equation was used to calculate a range of hammer energies required to drive the 24 inch pile sections to a nominal axial resistance of ±575 kips, with a final driving resistance from 2 to 10 blows per inch. The results indicate a hammer field energy range of 37 to 88-foot kips (37,000 to 88,000 pound-force) would be

required. However, ODOT recommends a minimum hammer field energy of 40-foot kips (40,000 pound-force) for piles driven to a nominal axial resistance between 500 and 600 kips. Because pile driving vibrations decrease with increasing hammer energy and decreasing duration of the pile driving, it will be recommended that the selected pile hammer have an energy level near the upper end of the calculated range.

### 1.7 Abutment Wingwalls

Wingwalls will need to be constructed at the 9th Street Bridge crossing to help contain the roadway approach fill. The wingwalls will be cast-in-place concrete retaining walls. The eastern retaining wall will be located above the HMT and the western one above the MHHW. As a result, the contractor will be able to complete the work in the dry; however, the contractor will install measures when necessary to isolate the work area. Construction of the wingwalls will require general construction equipment to be operated. Noise levels associated with possible equipment are noted below in Table 1-4, with the maximum sound level of 93 dB RMS at 20 meters from the source during the use of a concrete saw.

**Table 1-4 Noise Levels during Wingwall Construction (Hanan & Associates, 2014)**

| Equipment | Peak Values (dB RMS) at 20 meters[2] |
|---|---|
| Backhoe | 78 |
| Cement Pump | 73 |
| Concrete Saw | 93 |
| Crane | 89 |
| Excavator | 91 |
| Hammer | 82 |
| Hand Tools | 85 |

All equipment will be operated from the existing roadway and upland areas. The contractor will first excavate existing ground to the desired elevation using an excavator and dump truck positioned on the existing roadway. Then the contractor will frame the wall using pneumatic tools or hammer and nails. Once framed, concrete will be poured into the frame and allowed to cure. *Because California sea lions have been known to haul-out and rest throughout the project area, the City of Astoria is seeking an IHA for wingwall installation, because this work could result in acoustic and visual disturbance to pinnipeds.*

### 1.8 Rail Superstructure

Construction of the superstructure for the trestles will require the use of heavy construction equipment. The superstructures are comprised of precast, prestressed slabs with a 2 inch wearing surface. Possible construction equipment includes a crane, excavator, concrete saw, and concrete mixer, which will generate noise levels ranging from 78 dB RMS to 93 dB RMS at 20 meters from the source (Hanan & Associates, 2014).
California sea lions are known to haul-out near several of the crossings, and steller sea lions and harbor seals are likely to be transiting the area during the construction period. The airborne sound levels generated by the construction equipment could exceed the behavioral disruption thresholds, and there are very few structures situated between the river and the trestle crossings. *Based on the sound levels produced by the proposed equipment, existing site conditions, and the*

[2] Peak values have been rounded up from the original report.

*likely location of the pinnipeds within the area in relation to the associated construction activities, the City of Astoria is seeking an IHA for construction of the rail superstructures, because this work could result in acoustic and visual disturbance to pinnipeds.*

## 1.9 Roadway Improvements

Replacement of the three bridges will require roadway work in addition to bridge construction. Roadway improvements will consist of curb and sidewalk construction, asphalt paving, inlet construction and utility relocates. The roadway work will be completed using standard roadway construction equipment such as excavators and backhoes, dump trucks, pavers, and rollers. Other equipment that may be employed includes air compressors, jack hammers, concrete pumps and mixers, and pneumatic tools. The work will be conducted landward of the trolley crossings, and will not require IWW, and equipment will be operating away from the river. In-air noise produced by roadway construction equipment will range from 78 dB RMS to 93 dB RMS at 20 meters from the source (Hanan & Associates, 2014).

As previously noted, California sea lions are known to haul-out near several of the crossings, however, steller sea lions and harbor seals are not known to utilize the banks within the Project area. The airborne sound levels generated by the roadway construction equipment could exceed the 100 dB RMS behavioral disruption threshold for hauled-out California sea lions. However, airborne sound levels will be attenuated by structural and atmospheric absorption. As noted in Section 1.2, existing buildings and other above grade structures will reduce construction noise generated during roadway improvements by physically blocking the noise, and reflecting it away from the haul-out sites. The pier structure will also block noise from reaching the river and bank areas by deflecting it upwards. The combined reduction could range from 5 to 12 dB or more, depending on the location of the equipment and the type and size of the structures between the river and the equipment.

Finally, noise levels from much of the construction equipment used for removal of the existing superstructures are no different than many of the existing noise sources in the area. For example, fuel trucks making deliveries to the gas station, delivery trucks accessing businesses in the dock area or other heavy vehicles using roadways in this area would produce similar noise levels as the construction equipment. *Based on the sound levels produced by the proposed equipment, existing site conditions, and the likely location of the pinnipeds within the area in relation to the associated construction activities, construction of the roadway improvements are not expected to result in injury to or disrupt the behavior of nearby marine mammals.*

## 1.10 Stormwater Infrastructure

All stormwater within the Project site currently discharges to the Columbia River without treatment. The existing stormwater is currently being collected on 11th Street via grate inlets; however, stormwater runoff discharges directly to the Columbia River as overland flow at the 7th Street and 9th Street crossings. Pollutants of concern typically expected in roadway runoff are sediment, trash, oil and grease, PAH, and particulate and dissolved metals (such as copper and lead). Pollutants typically associated with rail operations include metals, solvents, and PAH's. Because the local streets and the Astoria Riverfront have very low ADT, pollutant loads and concentrations from vehicles are expected to be very low. Similarly, because trolley traffic is limited to part of the year, and it does not operate during steady rain events, pollutant loads and concentrations from the trolley are expected to be medium-low.

Coordination with NMFS and DEQ is currently underway to determine the best approach to treating the Project's stormwater runoff. The current proposal is to mitigate stormwater impacts offsite at a biofiltration swale or stormwater vault treatment system located at the City's maintenance yard at the intersection of Marine Drive and 30th Street. The inlets of the intersection will be re-routed from the existing combined sewer overflow, to the proposed treatment swale. The biofiltration swale or vault will discharge to the existing combined sewer overflow pipe located in 30th Street. The offsite stormwater treatment location CIA has a much higher CIA than the project area which is expected to offset the smaller overall treatment area.

*Because the Lower Columbia River is a large waterbody and the project will treat a CIA with a greater ADT than present within the project limits, the proposed stormwater treatment design is not expected to result in injury to or disrupt the behavior of nearby marine mammals.*

## 2.0 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

The following sections provide information related to the date(s) and duration of the activities identified in Section 1.0, as well as the specific geographical region where those activities will occur.

### 2.1 Dates and Duration of Construction and Demolition Activities

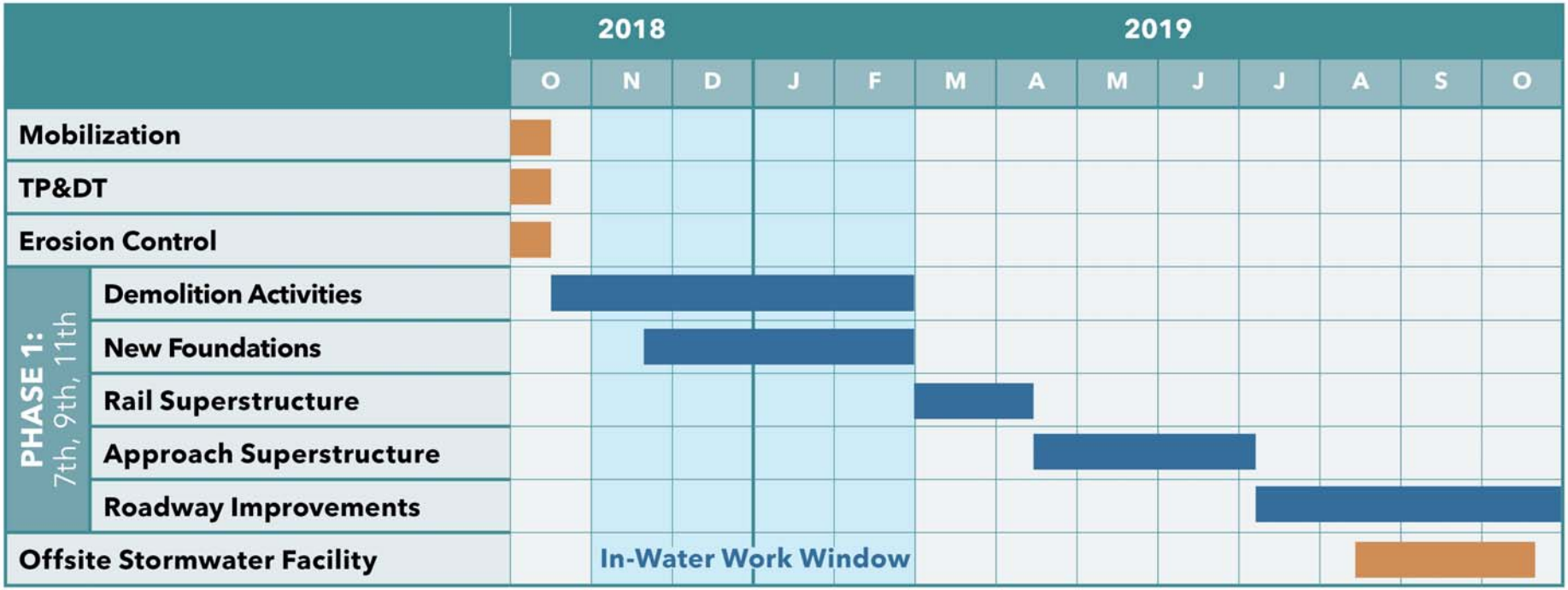
Project construction is anticipated to begin in October 2018. Space limitations at the waterfront make the bridge replacements challenging. Full bridge closures and detours will be necessary to complete the work safely and efficiently. In order to provide pedestrian access to the waterfront businesses and attractions during construction, the City will split the work into two phases:

- Phase 1 – will consist of demolition and construction activities related to the 7th, 9th, and 11th Street bridge crossings. Construction activities are estimated to occur from October 2018 to October 2019.
- Phase 2 – will consist of demolition and construction activities related to the 6th, 8th, and 10th Street bridge crossings. Construction activities are estimated to occur from October 2019 to October 2020.

This IHA request covers Phase 1 construction activities as indicated within Figure 1 on the following page. The construction activities that could potentially result in acoustic and visual disturbance to pinnipeds within the action area include rail superstructure and foundation removal activities, temporary work platform construction, piling installation, wingwall construction, and construction of the rail superstructures. Most of these activities will require work below the HMT elevation and will be conducted during the ODFW prescribed IWWP for the Lower Columbia River (November 1 through February 28). The only exception is the construction of the new rail superstructures, which will be completed landward of the HMT, but directly above the river banks where California sea lions may be temporarily hauled out.

Demolition activities will be initiated at the onset of the IWWP, and will include the removal of all timber and concrete foundations within the vicinity of the new crossing supports. It is anticipated that the contractor will be removing existing substructure elements concurrent with the construction of the new foundations. It is anticipated that these activities will occur over the entire IWWP, or 80 work days. Though the contractor is likely to complete this work simultaneously, estimates of foundation removal and pile installation duration are provided.

**Figure 1. Construction Activity Schedule**



The total IWWP includes 80 work days. Due to the winter season construction schedule for pile driving activities, installation is assumed to occur over an eight hour period. It is assumed that the contractor will drive the first 40 feet of piling for each pile location (each pile location consists of two 40-foot pile sections) over the first few days of pile driving, then splice on the additional 40 feet of piling at each location over the next few days. Once all of the piles are spliced, the contractor will resume pile driving activities to set each pile to the desired depth. It is estimated that the contractor can install four 40-foot piles a day at an estimated 250 strikes per pile. Based on the information provided in the table below, it is estimated that pile driving activities will account for just over half of those days.

**Table 2-1. Pile Driving Estimates per Day**

| Number of Permanent Piles | Number of Temporary Piles | 40' Piles Per Day | Number of Days | Number of Strikes Per Day |
|---|---|---|---|---|
| 74 | 10 | 4 | 42 | 1000 |

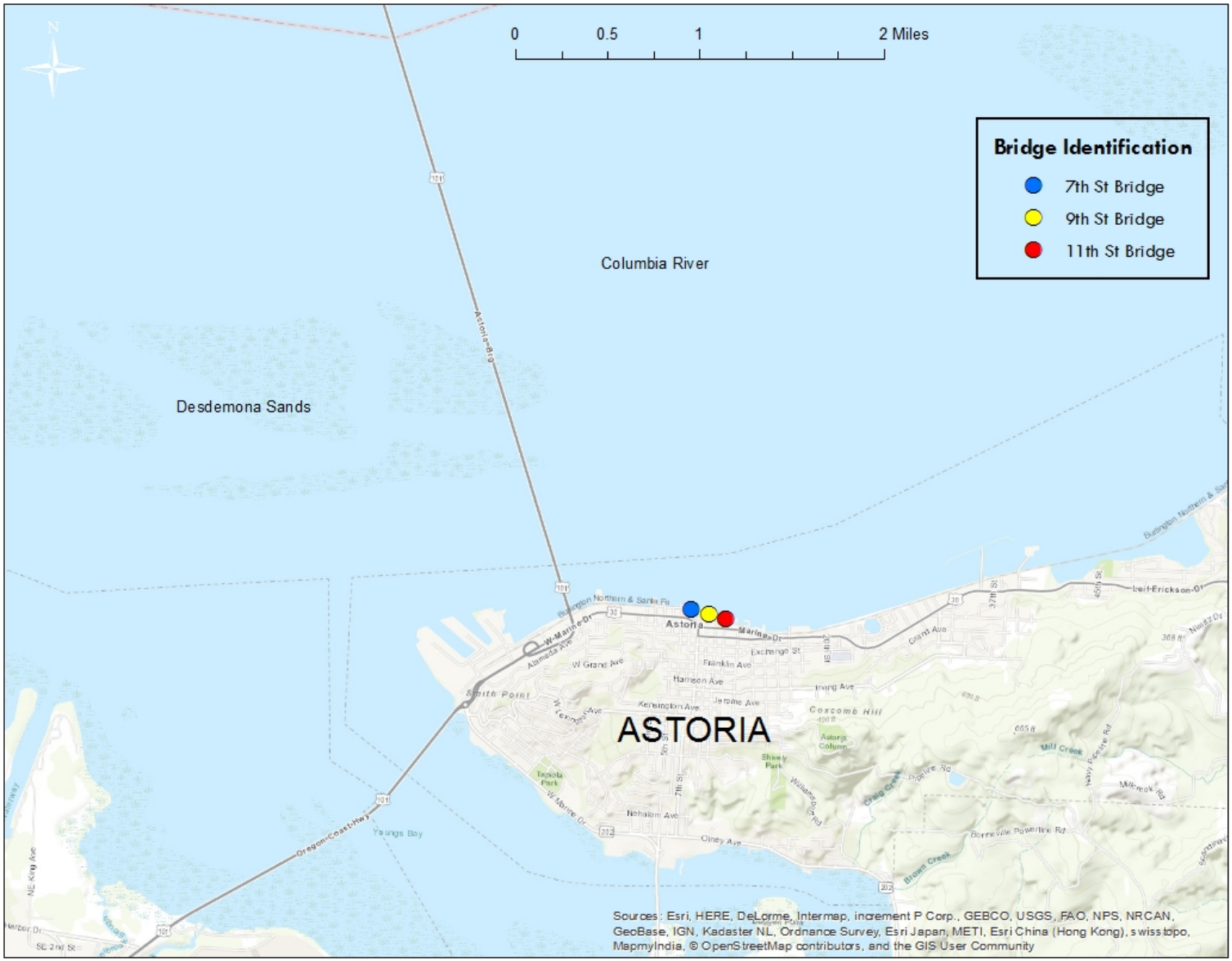
This would leave 38 work days for the removal of existing timber piling and concrete substructures. The contractor will attempt to extract the existing timber piles via direct pull or vibratory hammer. Vibratory removal of timber piles will take approximately 30 minutes per pile, and removal activities are anticipated to occur over an eight hour period during bridge demolition activities. A total of 255 timber piles are anticipated to be extracted. At an average of 10 piles removed per day (total vibratory removal over 26 days), that leaves 12 working days to cover the removal of all concrete footings and the 9th Street retaining wall.

Most of the remaining construction activities will be completed from March through October, with rail superstructure construction occurring from March 1 through April 11 (13 work days). All bridges will remain open during the summer months to allow for continued access along the waterfront for tourists, residents, and business owners throughout the busy summer months. Construction of the offsite stormwater facility will occur during the summer of 2019.

## 2.2 Geographical Setting

The Columbia River originates in the Rocky Mountains of British Columbia, flowing northwest at first, before turning south towards the border between Oregon and Washington, then west towards the Pacific Ocean (PSU, 2016). The Project is located in the Baker Bay-Columbia River subwatershed (170800060500) near the mouth of the Columbia River (at approximately RM 9) within the city of Astoria (Figure 2). This section of the Lower Columbia River represents the most saline portion of the river's estuarine environment. Tidal influence extends from the coast upriver 146 miles to Bonneville Dam (LCEP, 2016). Within the Project area, the Columbia River is wide (extends over 9 miles in width in the widest portion), and contains numerous islands, buoys, and sandbars that provide suitable haul-out locations for marine mammals.

**Figure 2. Project Location Map**



## 2.3 Region of Activity

In-water timber pile removal with a vibratory hammer will be the farthest reaching extent of aquatic impacts. In addition, pre-drilling and impact pile driving activities will also generate underwater sounds level that exceed the current NMFS thresholds. As a result, the Region of Activity has been defined by two distances in order to capture the extent of impacts during pile removal, drilling, and pile driving activities.

The Practical Spreading Loss Model was utilized to calculate the distance from the source within which noise is likely to exceed the in-water acoustic threshold for behavioral disruption for non-pulse noise and impulsive noise (see Section 5.2). This resulted in a Region of Activity that extends 1,600 meters from each pile during timber vibratory pile removal activities, and a Region of Activity that extends 398 meters from each pile during pre-drilling and impact pile driving activities. During construction, marine mammal behavior may be disturbed by underwater noise within these distances. Figure 3 depicts the combined Region of Activity for the three bridges sites during pile removal, pre-drilling, and pile driving activities.

### 2.3.1 Geographic Description

The upland portions of the Region of Activity have been highly altered by human activities, with substantial shoreline development and remnants of historical development throughout the Project area. This includes thousands of timber piles, overwater buildings, a railroad trestle, and vehicular bridges. There are no forested riparian areas or wetlands located within the Region of Activity. Riparian vegetation is almost entirely absent with the exception of a few small areas of blackberries and a couple trees/shrubs at several of the bridges.

The remainder of the Region of Activity is located within the Columbia River channel within the intertidal and subtidal zones. All in-water construction activities will occur within the intertidal zone where the substrate is primarily made up of historical rip rap and other rocks/cobbles. No construction activities are proposed within the soft bottom subtidal zone.

The USACE is charged with maintaining the navigation channel of the Columbia River to a depth of -25 feet from the Pacific Coast to Portland. Approximately 6 to 9 million cubic yards of dredged material is removed from the Columbia River annually to assist vessel traffic (USACE, 2015a). The Lower Columbia River is utilized by various types of vessels, including cargo ships, dredging vessels, fishing vessels, trawlers, pollution control vessels, and search and rescue vessels, among others.

**Figure 3. Region of Activity Map**

## 3.0 SPECIES AND NUMBER OF MARINE MAMMALS

Marine mammals that have been observed within the Region of Activity consist of the California sea lion, Pacific harbor seals, and steller sea lions. These species frequent the lower Columbia River and adjacent nearshore marine areas (NOAA, 2008).

### 3.1 California Sea Lions

The California sea lion (*Zalophus californianus*) is distributed along the North Pacific waters from central Mexico to southeast Alaska, with breeding areas restricted primarily to island areas off southern California (the Channel Islands), Baja California, and in the Gulf of California (Wright et al., 2010).

The U.S. stock of California sea lions was estimated to be 296,750 individuals in the 2015 SAR (Caretta et al., 2014). California sea lions are dark brown with broad foreflippers and a long, narrow snout and there are five genetically distinct geographic populations.

The population seen in Oregon is the Pacific Temperate stock, and they are migratory, commonly seen in Oregon from September through May (ODFW, 2015). Almost all California sea lions in the Pacific Northwest are sub-adult or adult males (NOAA, 2008). California sea lions feed in both the Columbia River and adjacent nearshore marine areas. Their population is lowest in Oregon in the summer months, from May-September, as they migrate south to the Channel Islands in California to breed.

California sea lions may be transiting through the Region of Activity during in-water construction activities, or may be temporarily hauled-out along the banks of the waterfront. The City of Astoria staff is currently monitoring the three bridges up to three times a week during low tide to further document California sea lion presence within the Project area.

### 3.2 Pacific Harbor Seals

The Pacific harbor seal (*Phoca vitulina richardii)* is the most widespread and abundant resident pinniped in Oregon. They are generally blue-gray with light and dark speckling; they lack external ear flaps and have short forelimbs. Harbor seals are generally non-migratory and occur on both the U.S east and west coasts. On the east coast, harbor seals are found from the Canadian Arctic to New York and occasionally in the Carolinas, while on the west coast they range from Alaska to Baja California, Mexico (ODFW, 2015).

The Oregon/Washington Coastal stock of Pacific harbor seals consists of about 24,732 animals as of 2014 (Caretta et al., 2014). They haul-out at low tide on sand bars in most bays and estuaries along the Oregon coast. They are also found on nearshore rocks and islands usually within 3 miles of the coast, and utilize rocks, reefs, beaches, and ice as haul-outs, while feeding in marine, estuarine, and occasionally fresh waters (NOAA, 2014b). In general, their local movements are associated with tides, weather, season, food availability, and reproduction, as they are non-migratory (NOAA, 2014b). Pacific harbor seals are present throughout the year at the mouth of the Columbia River and adjacent nearshore marine areas (NOAA, 2008).

The number of harbor seals expected to occur in the Region of Activity is low based on the observed haul-out sites, but they may be transiting the area.

### 3.3 Steller Sea Lions

The steller sea lion (*Eumetopias jubatus)* range extends along the Pacific Rim, from northern Japan to central California. They are light blonde to reddish brown in appearance and slightly darker on the chest and abdomen. For management purposes, Steller sea lions inhabiting US waters have been divided into two DPS: the Western US and the Eastern US. The population known to occur within the Lower Columbia River is the Eastern DPS.

Steller sea lions in Alaska are listed as Endangered under the ESA as their population has declined over 60-80 percent during the last 29 years (Allen and Angliss, 2015). The population of steller sea lions in Oregon is stable and slightly increasing. The Eastern DPS population of steller sea lions (including those living in Oregon) was ESA de-listed in 2013 following a population growth from 18,000 in 1979 to 70,000 in 2010 (an estimated annual growth of 4.18 percent) (NOAA, 2013b).

Steller sea lions are found on offshore rocks and islands along the Oregon coast. Most of these haul-out sites are part of the Oregon National Wildlife Refuge and are closed to the public. Oregon is home to the largest breeding site in U.S. waters south of Alaska, with breeding areas at Three Arch Rocks (Oceanside), Orford Reef (Port Orford), and Rogue Reef (Gold Beach) (ODFW, 2015). During the breeding season regulations exist to prohibit boaters from approaching within 500 feet of these rookeries (nursery rocks). Steller sea lions are also found year-around in smaller numbers at Sea Lion Caves and at Cape Arago State Park.

Steller sea lions are not known to use the Region of Activity for hauling-out, but they may be transiting through the Region of Activity during in-water construction activities.

### 3.4 Summary

California sea lions, Pacific harbor seals, and steller sea lions are the marine mammals that have the potential to be present within the Region of Activity during throughout the course of the project (Table 3-1). The California sea lion stock is the most abundant of the three, while the OR/WA coast stock of the Pacific harbor seal is the least abundant.

**Table 3-1. Stock Abundances of Marine Mammal Species within Region of Activity**

| Common Name | Scientific Name | Stock(s) Abundance Estimate[3] |
|---|---|---|
| California Sea Lions (U.S. Stock) | *Zalophus californianus* | 296,750 |
| Pacific Harbor Seals (Oregon/Washington Coast stock) | *Phoca vitulina richardii* | 24,732 |
| Steller Sea Lions (Eastern U.S. Stock) | *Eumetopias jubatus* | 41,638 |

[3] Sources: NOAA, 2014b; NOAA, 2015a; and NOAA, 2016g

## 4.0 AFFECTED SPECIES STATUS AND DISTRIBUTION

The Region of Activity is located within close proximity to known haul-out sites for two of the three species identified in Section 3. Within Figure 4, the nearest haul-out site and pupping area for the harbor seal is Desdemona Sands to the northwest (Sites 6 and 7) and Taylor Sands and Tongue Point Sands to the northeast (Sites 8, 26, and 27). The nearest haul-out site for the California sea lion is the East Mooring Basin to the east (Site 29). There are no known haul-out sites for the steller sea lion within close proximity to the Region of Activity.

**Figure 4. Haul-Out Sites near the Region of Activity**[4]


The following sections provide additional information on the species that may be affected during project construction activities.

### 4.1 California Sea Lions

California sea lions are members of the "eared seal" family, Otariidae, and they are among the most recognized of the pinniped species. Their breeding season lasts from May to August while most pups are born from May through July. Pups are weaned at 10 months old, reaching their sexual maturity at 4-5 years old, and they have a lifespan of 20 to 30 years. They feed on squid, anchovies, mackerel, rockfish, and sardines (NOAA, 2016e). Researchers believe that underwater, California sea lions have fairly acute underwater hearing, with a hearing range of 0.4–32 kHz (Reichmuth & Southall, 2011).

#### 4.1.1 Status

California sea lions are not listed under the ESA nor are they considered depleted or strategic under the MMPA. The approximate population growth rate for this species is 5.4 percent

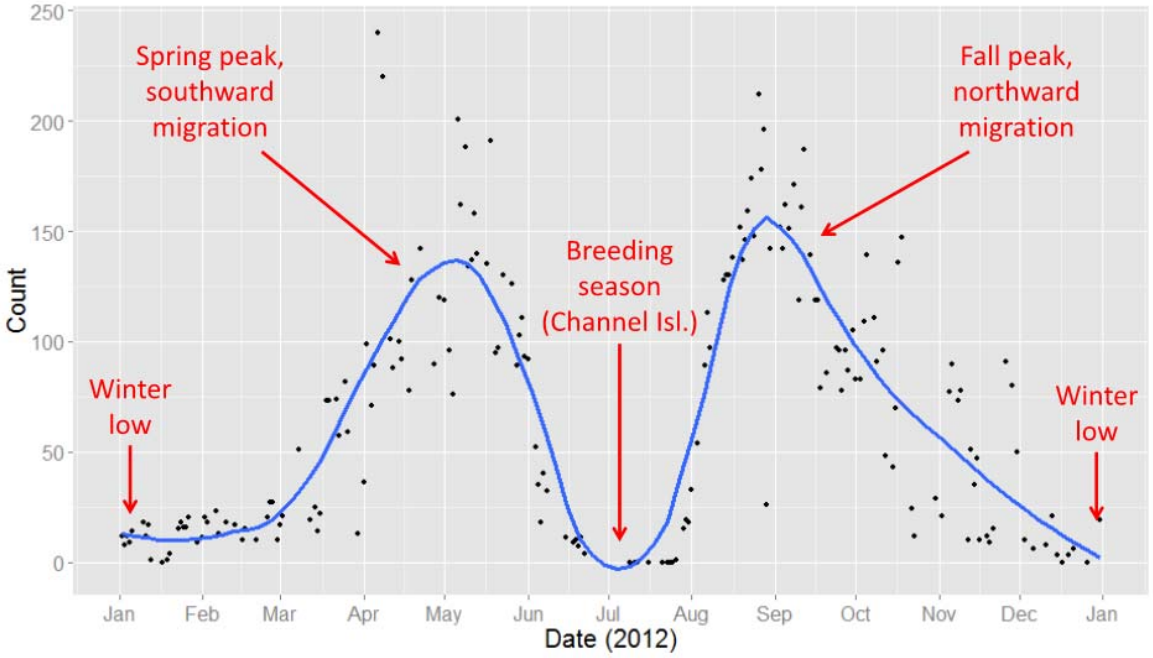
[4] Source: Jeffries et al., 2000

annually (Caretta et al., 2004). Threats to this species include incidental catch and entanglement in fishing gear, such as gillnets; biotoxins, as a result of harmful algal blooms; and gunshot wounds and other human-caused injuries, as California sea lions are sometimes viewed as a nuisance by commercial fishermen (NOAA, 2016e).

### 4.1.2 Distribution

California sea lions feed in both the Columbia River and adjacent nearshore marine areas. With the exception of a few females, all California sea lions in the Pacific Northwest are sub-adult or adult males (NOAA, 2008). Male California sea lions are commonly seen in Oregon from September through May (ODFW, 2015). California sea lions do not breed in Oregon though a few young animals may remain in Oregon during summer months while most return to California's Channel Islands to breed. Female California sea lions are a rare event in Oregon as most stay in California near the breeding rookeries. From September through May, California sea lions can be found in many bays, estuaries and on offshore sites along the coast, often hauled-out in the same locations as Steller sea lions. Some pass through Oregon to head north to feed during fall and winter months (see Figure 5).

**Figure 5. Seasonal Pattern of California Sea Lion Occurrence, East Mooring Basin, Astoria[5]**




California sea lions have been observed near several crossings within the Project site; however, this is not their main haul-out. Their main haul-out is the East Mooring Basin, which is located upstream, outside of the Region of Activity (Figure 4). Construction activities are proposed between September and March, which is during the peak usage of the lower river by California sea lions, with roughly 800 to 1,500 animals in the area during those months[6]. During a typical day in May, 800 California sea lions can be seen resting on haul-out sites (such as jetties) in the Columbia River estuary (NOAA, 2008). Recent years have shown an increase in the record

[5] Source: Brown, et al., 2015
[6] Information on species abundance within the lower Columbia River provided by the ODFW (S. Riemer, personal communication, May 16, 2016).

numbers of California sea lions at East Mooring Basin with a 2015 spring record of 2,340 individuals (up from 1,420 in 2014), though in past years, typical spring counts were closer to 100-300 individuals (Profita, 2015) (Figure 4-1). Changes in climate, food sources, and a growing population approaching 300,000 are all cited as possible reasons for these increases.

## 4.2 Pacific Harbor Seals

The Pacific harbor seals are part of the "true seal" family, Phocidae, and are widespread and abundant pinnipeds across their ranges. They are fast, agile swimmers, and as social animals, they form groups of several hundred individuals onshore. Harbor seals mate at sea generally in the warmer months, and pupping season within the Columbia River is from mid-April to July (NOAA, 2016d). Males reach sexual maturity at 5-6 years of age, females sexually mature at 2-5 years, and they have a lifespan of about 25-30 years, with a diet consisting mainly of fish, shellfish, and crustaceans. Researchers have found that the harbor seals range of best hearing (10 dB from the maximum sensitivity) was from 0.5 to 40 kHz (Kastelein et al. 2008).

### 4.2.1 Status

The Oregon/Washington stock of Pacific harbor seals is not listed under the ESA nor are they considered depleted or strategic under the MMPA. The most recent estimate for the population growth rate of the northern Oregon coast stock of harbor seals was approximately 10.1 percent annually (Caretta et al. 2014).

Threats to this species include (NOAA, 2016d):

- incidental capture in fishing gear, including
- gillnets, trawls, and purse seines
- weirs
- ship strikes
- oil spill exposure and chemical contaminants
- power plant entrainment
- harassment by humans while hauled out on land

### 4.2.2 Distribution

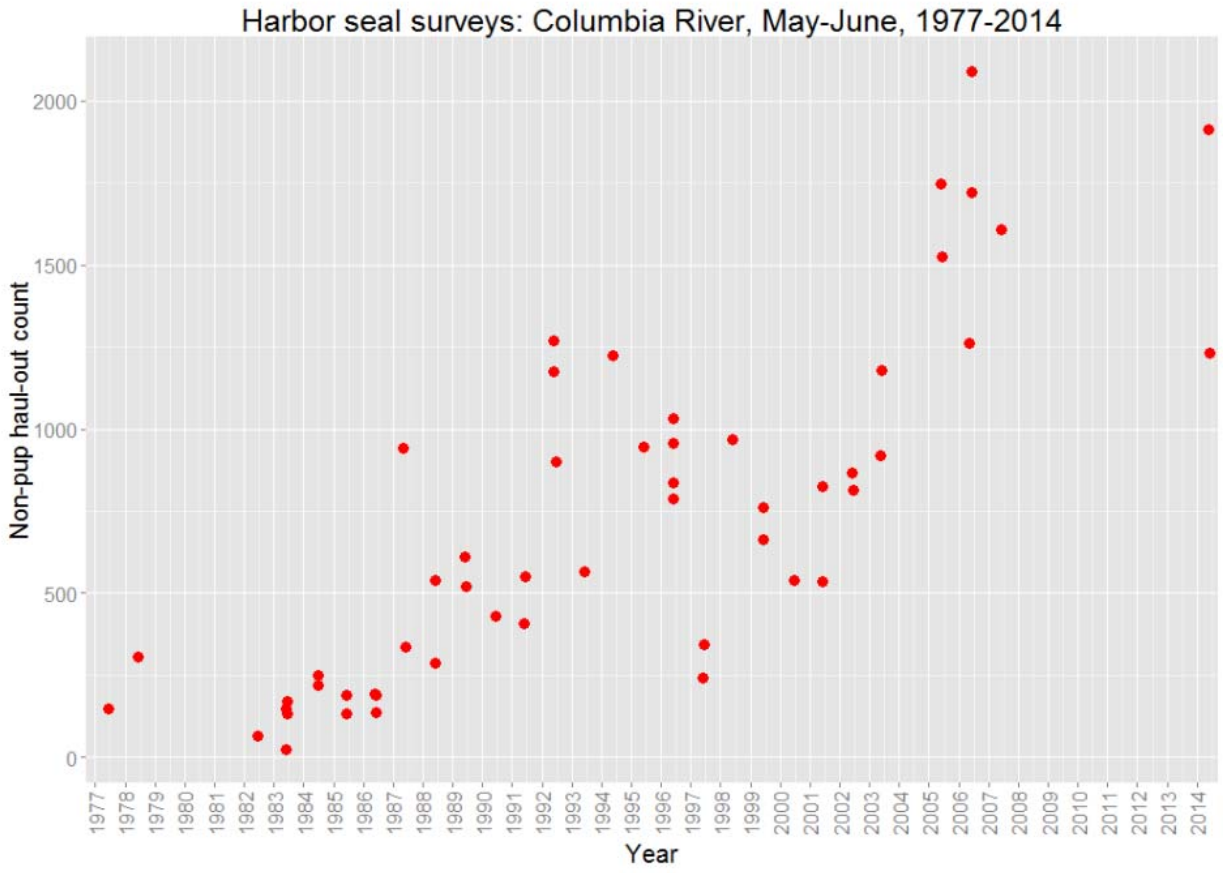
Harbor seals utilize specific shoreline locations on a regular basis as haul-outs including beaches, rocks, floats, and buoys. They must rest at haul-out locations to regulate body temperature, interact with one another, and sleep (NOAA, 2016d).

They're present throughout the year at the mouth of the Columbia and adjacent nearshore marine areas, and on a typical May day, approximately 3,000 Pacific harbor seals can be seen resting on haul-out sites in the Columbia River estuary (NOAA, 2008). Known haul-outs within the Columbia River include: South Jetty, Chinook/Baker Bay, Desdemona Sands, Taylor Sands, Tongue Point Sand, Grays Bay, Sandbourn Slough/Green Island, Snag Island, and South of Miller Sands (Figure 4).

The harbor seal is an infrequent visitor at the Astoria Mooring Basin, but they are known to be transiting through the Region of Activity. Mid-April to July is the pupping period for harbor seals, but their closest haul-out and pupping area is Desdemona Sands which is downstream of the Astoria-Megler Bridge, and outside the Region of Activity (Susan Riemer, personal

communication, May 16, 2016). Harbor seal surveys within the Columbia River from May through June show a general increase in population numbers over time (Figure 4-3). Due to their year-round occurrence in the Columbia River, harbor seals are likely to be found transiting the area during in-water construction.

**Figure 6. Harbor Seal Surveys: Columbia River, May-June, 1977-2014**




## 4.3 Steller Sea Lions

The steller sea lion, also known as the northern sea lion, is the largest member of the Otariid family. They have a lifespan of 20-30 years, and 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 (NOAA, 2016c). 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. Steller sea lions breed in Oregon during the months of June and July, and pregnancy lasts about 11.5 months. Males reach sexual maturity between 3 and 8 years of age and can live to be 20 years old, while females reproduce for the first time at 4 to 6 years and can live to be 30 (NOAA 2016b). Steller sea lions are known to have a hearing range with frequencies audible at 60 dB RMS re µ20 Pa of about 0.250–30 kHz, and a region of best hearing sensitivity from 5–14.1 kHz (Muslow & Reichmuth 2010).

#### 4.3.1 Status

Steller sea lions were listed as threatened range-wide under the ESA on November 26, 1990 (55 CFR 49204). In 2006, however, the Eastern DPS was removed from listing based on its annual rate of increase. The current minimum population estimate for the Eastern DPS is approximately 41,638 individuals (NOAA, 2016a). There are no substantial threats to the species, and the population continues to increase at approximately 3 percent per year (NMFS, 2011).

Threats to steller sea lions include (NOAA, 2016c):

- boat/ ship strikes
- contaminants/ pollutants
- habitat degradation
- illegal hunting/ shooting
- offshore oil and gas exploration
- interactions (direct and indirect) with fisheries

Critical habitat was designated for steller sea lions on August 27, 1993 (58 FR 45269), but is not present within the Region of Activity. Critical habitat is associated with breeding and haul-out sites in Alaska, California, and Oregon. Under the MMPA, all Steller sea lions are classified as strategic stocks and are not considered depleted (NOAA, 2016c).

#### 4.3.2 Distribution

For this species, haul-outs and rookeries usually consist of beaches, ledges, rocky reefs. Steller sea lions are present year-round at the mouth of the Columbia River, with the primary haul-out point on the top South Jetty (downstream, outside of the Region of Activity), and they are also at their peak in the lower river from September through March.[7] As mentioned, these areas are not critical habitat (which is defined as a 20 nautical mile buffer around specified major haul-outs and rookeries) (NOAA, 2008). The South Jetty haul-out is the only artificial structure Steller sea lions regularly use along the Oregon coast.

At South Jetty, typical single-day counts are approximately 100 individuals, while at Phoca Rock/Bonneville Dam, there are approximately 40 individuals in a single day. They feed in both the Columbia River and adjacent nearshore marine areas. Due to their year-round presence and peak of presence during the winter months, steller sea lions are likely to be transiting the area during in-water construction activities.

### 4.4 Summary

California sea lions, Pacific harbor seals, and steller sea lions are the marine mammals that have the potential to be present within the Region of Activity during throughout the course of the project (Table 4-1). None of these marine mammals are ESA-listed as threatened or endangered, but the MMPA status of steller sea lions is depleted. The marine mammals listed do not have major documented haul-out locations or breeding areas within the Region of Activity, but they are likely to be transiting the area during the construction period.[8] In addition,

[7] Information on species abundance within the lower Columbia River provided by the ODFW (S. Riemer, personal communication, May 16, 2016).
[8] Information on transiting presence likelihood provided by ODFW (S. Riemer, personal communication, May 16, 2016).

California sea lions have been observed hauled-out and resting near several crossings within the Project area. It is possible that all three species may be impacted by noise generated during in-water construction from November 1 to February 28 as well as construction activities in March and April for California sea lions. Other than exposure to underwater and airborne sounds, and visual disturbance, they are not anticipated to be impacted in any other way during the construction project.

**Table 4-1. Status and Frequency of Occurrence**

| Common Name | Scientific Name | ESA Status | MMPA Status | Frequency of Occurrence[9] |
|---|---|---|---|---|
| California Sea Lions (U.S. Stock) | *Zalophus californianus* | Not listed | Non-depleted | Likely |
| Pacific Harbor Seals (Oregon/Washington Coast stock) | *Phoca vitulina richardii* | Not listed | Non-depleted | Likely |
| Steller Sea Lions (Eastern U.S. Stock) | *Eumetopias jubatus* | Not listed | Depleted | Likely |

## 5.0 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

Under the 1994 Amendments to the MMPA, harassment is statutorily defined as any act of pursuit, torment, or annoyance which:

- has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or,
- has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B Harassment).

Under Section 101(a)(5)(D) of the MMPA, the City of Astoria requests an IHA for the take of small numbers of marine mammals, by Level B behavioral harassment only, incidental to the replacement of three crossings along the Astoria waterfront. The City of Astoria requests an IHA for incidental take of marine mammals during Phase 1 activities as described in this application for one (1) year commencing on October 1, 2018 (or the issuance date, whichever is later). The contractor will make every attempt to complete tasks under Phase 2 of the project during this time period; however, if unsuccessful, a second IHA application will need to be submitted for review.

The City of Astoria does not anticipate Level A injury for any of the species identified in Section 3 of this application as discussed in further detail in Section 5.3.

[9] Frequency defined here in[11] Information on winter pretty species abundance within the lower Columbia River provided by the ODFW (R. Bradley, personal communication, September 15, 2016).

## 5.1 Construction Noise Evaluations

### 5.1.1 In-Air Noise Thresholds

NMFS has been using generic sound exposure thresholds since 1997. Since then, NMFS has worked on developing new science-based thresholds to more accurately determine when an activity produces sound levels that might result in impacts to a marine mammal such that a take by harassment might occur (NOAA, 2005). The most current thresholds identified for in-air noise generated from anthropogenic sound sources are identified in the Interim Sound Threshold Guidance, which provides conservative thresholds of received SPLs (NOAA, 2016a).

**Table 5-1. Acoustic Thresholds for Airborne Noise**

| Level at Which Pinniped Haul-out Disturbance has been Documented* |
|---|
| 90 dB RMS (unweighted) for harbor seals<br>100 dB RMS (unweighted) for all other pinnipeds |
| * All decibels referenced to 20 micro Pascals (re: 20µPa). |

### 5.1.2 Underwater Disturbance Thresholds

To evaluate potential for behavioral disturbances for marine mammals, NOAA requires that the Practical Spreading Loss Model be used to estimate distances to marine mammal noise thresholds (NOAA 2016a). The current NOAA-directed disturbance thresholds are provided in Table 5-2 below.

**Table 5-2. NOAA Disturbance Thresholds for Marine Mammals**

| Vibratory Pile Driving Disturbance Threshold | Impact Pile Driving Disturbance Threshold |
|---|---|
| 120 dB RMS | 160 dB RMS |

### 5.1.3 Underwater PTS Thresholds

In July 2016, NMFS produced advanced acoustic threshold determination guidance for marine mammals to evaluate potential exposure to injurious levels of sound (NOAA 2016b). This guidance provides new methods to identify the received levels, or acoustic thresholds, at which individual marine mammals are predicted to experience changes in their hearing sensitivity (either temporary or permanent) for acute, incidental exposure to underwater anthropogenic sound sources. The thresholds resulting from application of the 2016 guidance rely upon weighting factors to evaluate the likelihood of an underwater sound source being detectable within the hearing frequencies of certain families of marine mammals.

The determination of the PTS onset isopleths in this document are based on the output of the alternative tool developed by NMFS (NMFS User Spreadsheet), looking at noise levels generated by impact and vibratory noise sources. The PTS isopleths or threshold areas identified for each noise source and marine mammal hearing group are described in the next section. Tables 5-3 and 5-4 below identify the new acoustic thresholds established in the 2016 guidance for each hearing group for onset of PTS.

**Table 5-3. Acoustic Thresholds for Non-Impulsive Sounds**

| Hearing Group | PTS Onset |
|---|---|
| Phocid Pinnipeds | 201 dB SEL |
| Otariid Pinnipeds | 219 dB SEL |

**Table 5-4. Acoustic Thresholds for Impulsive Sounds**

| Hearing Group | PTS Onset |
|---|---|
| Phocid Pinnipeds | 185 dB SEL |
| Otariid Pinnipeds | 203 dB SEL |

During construction, noise will be generated above and below the water by operation of construction equipment and related activities. Incidental take would be a temporary and localized disturbance from elevated sound levels and visual stimulus from construction equipment. A description of potential effects to pinnipeds from Project activities is provided below.

## 5.2 Methods of Incidental Taking

### 5.2.1 Disturbance during General Construction Activities

Level B behavioral disturbance may occur incidental to the use of construction equipment and its propagation of in-air noise during general construction that is proposed in the dry, above water, or inland within close proximity to the river banks. These construction activities are associated with the removal and construction of the rail superstructures, and the removal of the existing concrete foundations and the 9th Street retaining wall. Possible equipment includes an excavator, crane, dump truck, and chain saw. It is estimated that the sounds levels during these activities will range from 78 to 93 dB RMS at 20 meters from the sound source, with the loudest airborne noise produced by the use of a concrete saw (Hanan & Associates, 2014). These noise levels are based on acoustic data collected during the City of San Diego Lifeguard Station Demolition and Construction Monitoring project.

Current NMFS practice, regarding exposure of marine mammals to high-level in-air sounds, as a threshold for potential Level B harassment, is at or above 90 dB RMS for harbor seals and at or above 100 dB RMS for all other pinniped species (Table 5-1). The following formula was utilized to determine the distances at which in-air noise generated from heavy machinery would attenuate to the airborne noise thresholds:

$$D_1 = D_0 * 10^{((\text{initial SPL} - \text{airborne disturbance threshold})/\alpha)}$$

$D_1$ = distance from the pile at which noise attenuates to the threshold value

$D_0$ = distance from the pile at which the initial SPLs were measured

$\alpha$ = 20 for hard-site conditions

Using this formula, sounds levels would attenuate below the 90 dB RMS threshold for harbor seals at 28 meters, and below the 100 dB RMS threshold for all other pinnipeds at 9 meters.

Both Level B ZOIs are depicted in Figures 7 through 9 at the end of this section. Because harbor seals and steller sea lions are not known to utilize the banks along the waterfront, no disturbance to these species is anticipated within the 28 meter and 9 meter Level B ZOIs, respectively, during the removal and construction of the rail superstructures, or the removal of the existing concrete foundations and the 9th Street retaining wall.

Conversely, because California sea lions have been observed along the banks and on timber trestles near the 9th Street crossing, behavioral disturbance may occur during superstructure removal and construction activities. Airborne noise levels exceeding the threshold could alter the behavior of California sea lions by forcing them to alter their activities or interrupt them entirely, forcing them to swim away from the noise source. Their response may also include alert behavior, approaches to the water, and flushes into the water. California sea lions within the 9 meter Level B ZOI are often already exposed to elevated in-air sound levels due to daily activities along the waterfront.

### 5.2.2 Disturbance during Vibratory Pile Removal

Level B behavioral disturbance may occur incidental to the use of a vibratory hammer and its propagation of underwater noise during the removal of the existing timber substructures. An estimated 265 timber piles will need to be removed to facilitate construction of the new crossings. As previously discussed in Section 1, most of the structures are below the MHW elevation; the remaining timber elements are below the MHHW or the HMT elevation, with only a few piles being removed landward of the HMT elevation. It is anticipated that the contractor will need to utilize a vibratory hammer during extraction. Removal via vibratory hammer will result in the greatest amount of underwater noise during construction and will be the farthest reaching extent of aquatic impacts during pile removal activities.

WSDOT monitored underwater noise during the removal of three 12-inch timber dolphin piles at Port Townsend (Laughlin, 2011a). Average RMS values for vibratory removal of the wood piles were measured at 150 dB RMS at 16 meters from the source. The Practical Spreading Loss Model was utilized to calculate the Level B ZOI during vibratory removal.

$$D_1 = D_0 * 10^{((\text{initial SPL} - \text{airborne disturbance threshold})/\alpha)}$$

$D_1$ = distance from the pile at which noise attenuates to the threshold value

$D_0$ = distance from the pile at which the initial SPLs were measured

$\alpha = 15$

When the WSDOT study measurements are utilized in the Practical Spreading Loss Model, a 1,600 meter Level B ZOI is calculated for vibratory pile removal activities. In Figure 10 at the end of this section, the extent of the 1,600 meter ZOI can clearly be seen. The noise generated from vibratory pile removal extends north/northwest towards Desmedona Sands and east towards the East Mooring Basin; however, the Region of Activity excludes these known haul-out sites. The underwater sound levels will remain above the disturbance threshold for nearly 1 mile into the river channel, though, and this area is likely to be utilized by transiting seals and sea lions. Underwater noise levels exceeding the threshold could alter the behavior of transiting pinnipeds by forcing them to alter their activities or interrupt them entirely, forcing them to swim away from the noise source. Their response may also include alert behavior. Seals and sea lions within the 1,600 meter Level B ZOI, however, are often already exposed to elevated

underwater sounds levels from recreation boating activities, cargo ships, and other large marine vessels that are known to utilize the Lower Columbia River.

### 5.2.3 Disturbance during Impact Pile Driving

Level B behavioral disturbance may occur incidental to the use of an impact and its propagation of underwater noise during the installation of permanent and temporary substructures. The project proposes to install a total of 84 24-inch steel piles for all permanent and temporary foundations during Phase 1. Based on the most recent WSDOT data, the unmitigated sound pressure level associated with 24-inch steel piles during impact pile driving is 194 dB RMS (WSDOT, 2016). The contractor will be required to employ sound attenuation devices, such as bubble curtains, during impact pile driving activities in compliance with the conditions of the FAHP Programmatic Biological Opinion which will be utilized for ESA coverage for listed salmonids. Use of an attenuation device was assumed to decrease initial sound levels by 10 dB, resulting in an initial SPL of 184 dB RMS at 10 meters from the source.

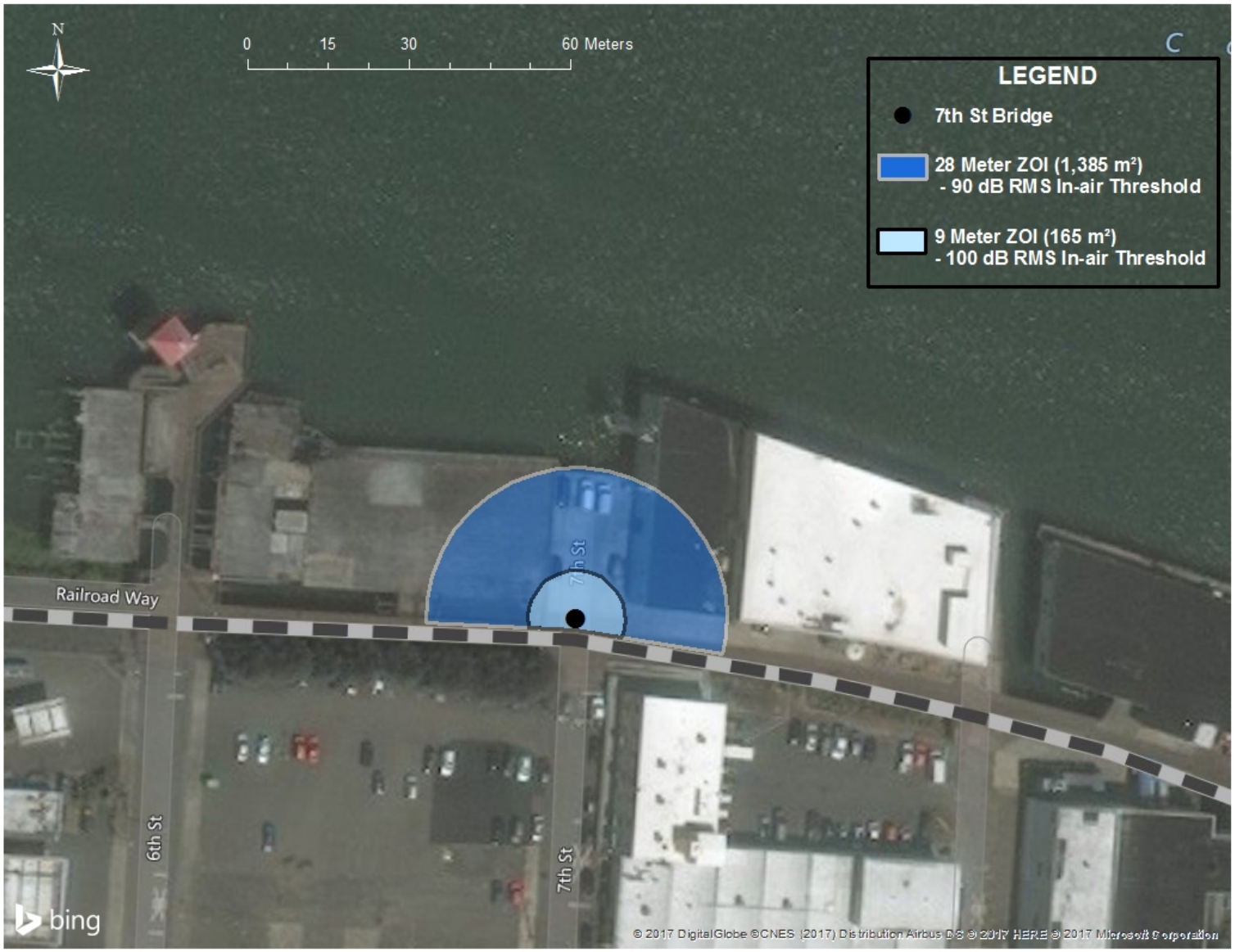
When these values are utilized in the Practical Spreading Loss Model, the distance to the behavioral disturbance threshold is calculated at a distance of 398 meters from the pile when a noise attenuation device is used as opposed to within 1,848 meters when a device is not used. In both cases, the use of a noise attenuation device will shrink the distance at which noise exceeds the thresholds by approximately 80 percent, resulting in a significantly smaller area of potential impact. The estimated ZOI for pile driving includes underwater noise levels associated with pre-drilling. Based on a recent report prepared by UNEP, typical noise levels range from 115-117 dB RMS for noise from fixed drilling platforms (UNEP, 2012). No additional ZOI will be determined for pre-drilling activities.

Within Figure 11 at the end of this section, the extent of the 398 Level B ZOI is depicted. The 398 meter ZOI includes the installation of both the temporary 16-inch steel piles and the permanent 24-inch steel piles. The noise generated from impact hammer pile installation will extend out into the river channel approximately 0.25 mile. These areas are likely to be utilized by transiting seals and sea lions, and could possibly be utilized by hauling California sea lions within the Project area. Underwater noise levels exceeding the threshold could alter the behavior of transiting pinnipeds by forcing them to alter their activities or interrupt them entirely to swim away from the noise source. Their response may include alert behavior, approaches to the water, and flushes into the water. The seals and sea lions within the area are often exposed to elevated underwater sounds levels from cargo ships and other large marine vessels that are known to utilize the Lower Columbia River.

### 5.2.4 Airborne Pile Removal and Installation Noise

Airborne noises could also affect pinnipeds during IWW requiring the use of a vibratory and/or impact hammer; however, in-air noise was not a factor in assessing take for in-water activities because the Level B ZOI for underwater noise extends farther. During IWW, temporary in-air disturbance would be limited to marine mammals swimming on the surface through the immediate Project area, or California sea lions flushed from their temporary haul-outs. At this distance, the marine mammals would have already been taken by the in-water noise levels; therefore, there is no need to distinguish between in-air and underwater noise impacts. For these reasons, in-air noise during the use of a vibratory and/or impact hammer is not considered further in this document.

**Figure 7. Airborne Noise ZOI Map – 7th Street Bridge**



**Fiaure 8. Airborne Noise ZOI Map – 9th Street Bridge**

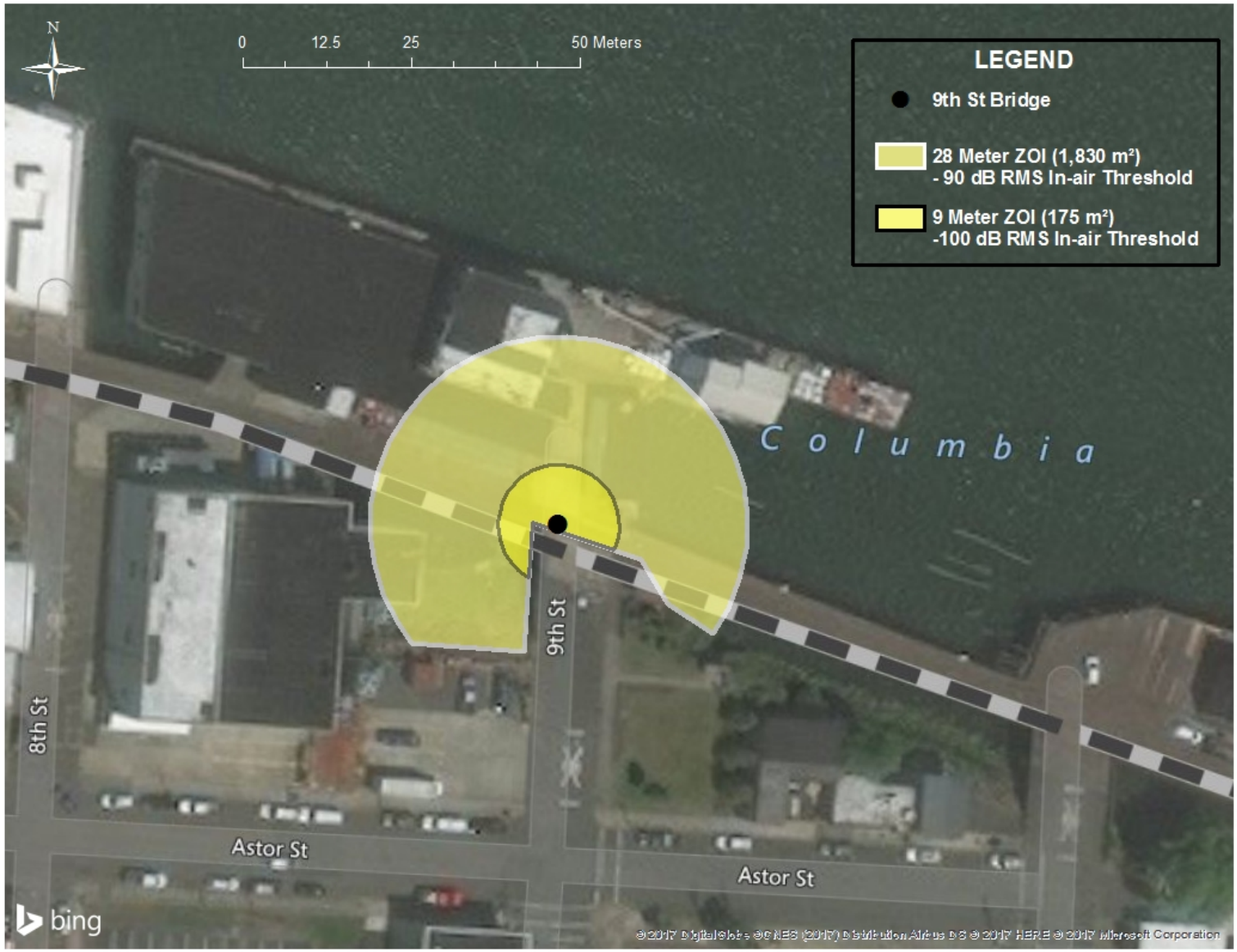


**Figure 9. Airborne Noise ZOI Map – 11th Street Bridge**

**Figure 10. 1,600 Meter Level B ZOI Map**

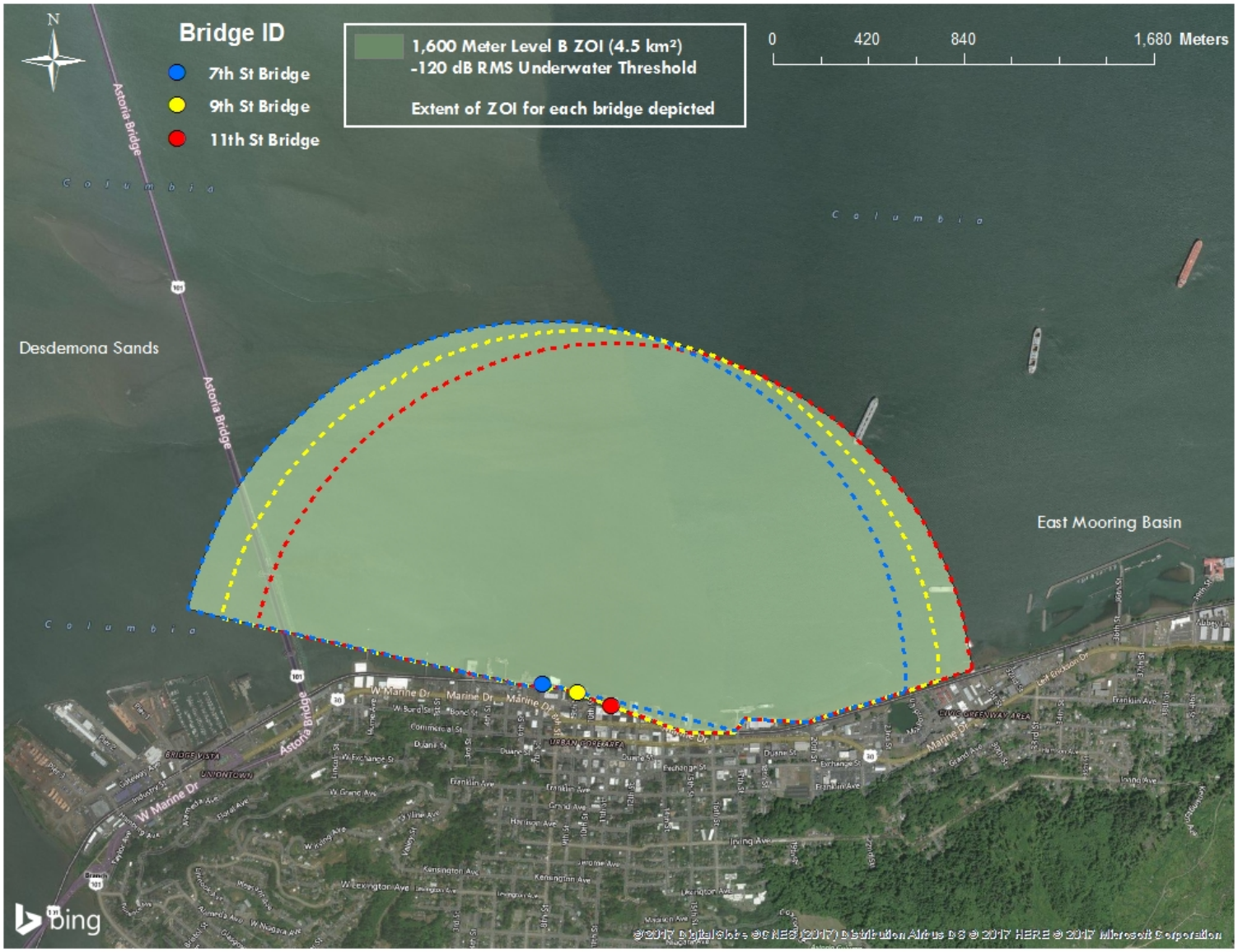
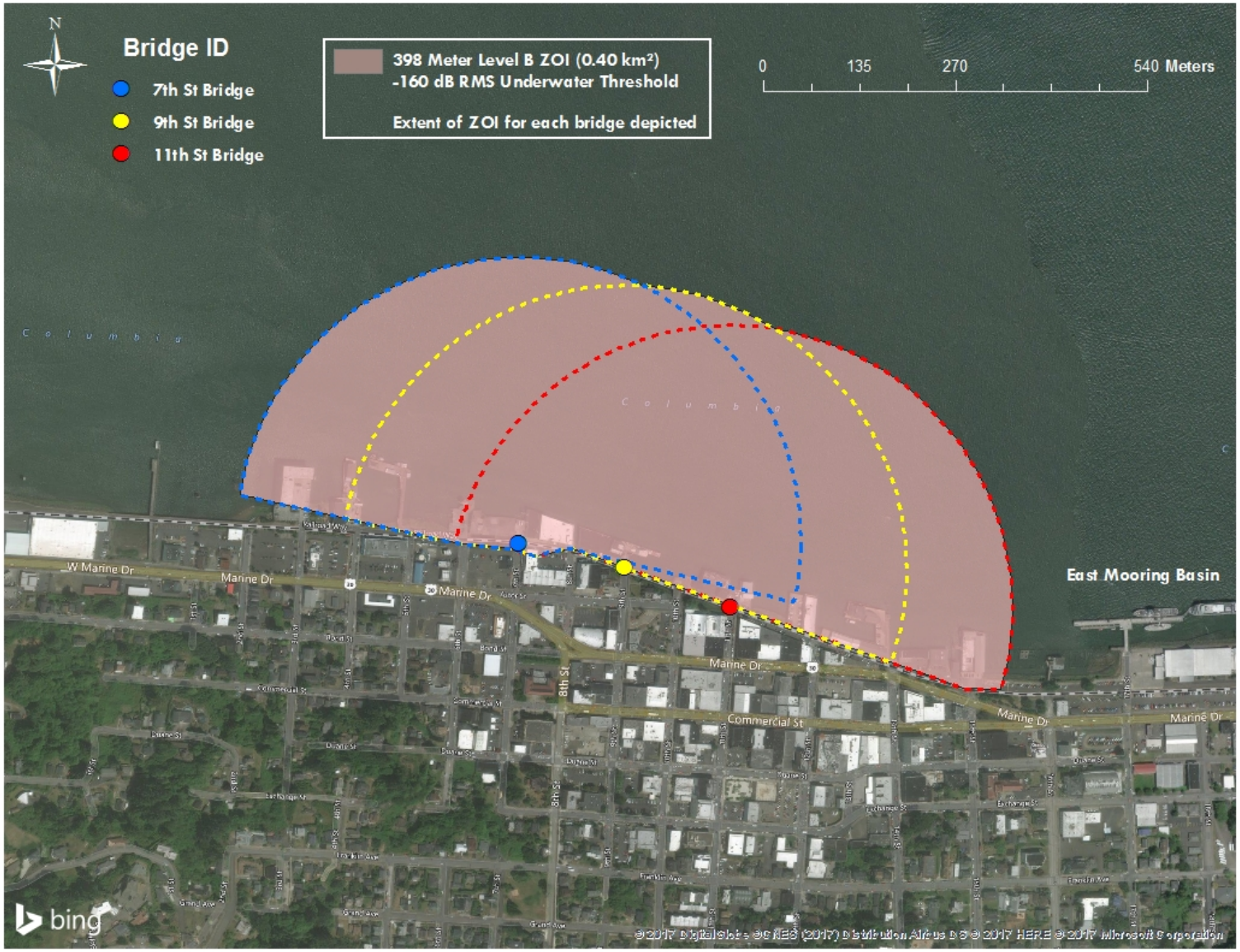


**Figure 11. 398 Meter Level B ZOI Map**



### 5.2.5 Visual Disturbance

Behavioral disturbance may potentially occur incidental to the visual presence of humans and demolition/construction activities; however, pinnipeds within the project site have likely adapted or become habituated to human presence along the Astoria waterfront.

## 5.3 PTS Isopleths

The distances from the pile removal or installation activity containing sound levels at or above the PTS levels (PTS isopleths) were identified for underwater noise generated by vibratory and impact pile removal and installation activities using the NMFS User Spreadsheet. The distance to PTS isopleth defines the area within which auditory damage to marine mammal hearing groups could possibly occur. Under most situations, PTS isopleths would be confined within a relatively small area near the actual work activities. For pile installation and removal activities, PTS isopleths are expected to begin immediately adjacent to the pile installation activity, and expand outward into the waters of the Columbia Estuary. The PTS isopleths are identified in Tables 5.6 and 5.7 below and the spreadsheet data provided in Figures 12 and 13.

**Table 5-5. PTS Threshold – Vibratory Hammer**

| Hearing Group | $SEL_{cum}$ Threshold | PTS Isopleth to Threshold (meters) |
|---|---|---|
| Phocid Pinnipeds | 201 | 2.7 |
| Otariid Pinnipeds | 219 | 0.1 |

**Table 5-6. PTS Threshold – Impact Hammer**

| Hearing Group | $SEL_{cum}$ Threshold | PTS Isopleth to Threshold (meters) |
|---|---|---|
| Phocid Pinnipeds | 201 | 53.4 |
| Otariid Pinnipeds | 219 | 3.9 |

Within Figure 14, the extent of the largest PTS isopleth (53.4 meter) is depicted. The remaining isopleths are not depicted due to mapping scale. It is clear from the aerial that existing conditions within 53.4 meters of the proposed pile driving activities consist primarily of overwater structure with substantial amounts of timber substructure. As a result, harbor seals and steller sea lions are not likely to transiting through this area.

Conversely, California sea lions have been observed along the banks and on timber trestles near several of the crossings. Though present within the Project area, this is not their main haul-out in the Lower Columbia River (East Mooring Basin), so overall numbers will be low. Further, pile driving activities will occur from November 1 through February 28 when California sea lion occurrence is at its winter low. Though they may be present within the vicinity of the pile driving activities, California sea lions are not likely to be within 0.1 meter during timber pile removal or within 3.9 meters during impact pile driving activities. During construction, the possibility of injury occurring is believed to be discountable due to the low numbers of sea lions observed on a daily basis within the PTS isopleth in combination with the proposed mitigation measures.

**Figure 12. PTS Isopleth Data for Vibratory Pile Removal**

**STEP 3: SOURCE-SPECIFIC INFORMATION**

| | |
|---|---|
| **Source Level (RMS SPL)** | 150 |
| **Activity Duration (hours) within 24-h period** | 8 |
| **Activity Duration (seconds)** | 28800 |
| **10 Log (duration)** | 44.59 |
| **Propagation (xLogR)** | 15 |
| **Distance of source level measurement (meters)⁺** | 16 |

⁺Unless otherwise specified, source levels are referenced 1 m from the source.

| Marine Mammal Hearing Group |
|---|
| **Low-frequency (LF) cetaceans**: baleen whales |
| **Mid-frequency (MF) cetaceans**: dolphins, toothed whales, beaked whales, bottlenose whales |
| **High-frequency (HF) cetaceans**: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis* |
| **Phocid pinnipeds (PW)**:true seals |
| **Otariid pinnipeds (OW)**:sea lions and fur seals |

**RESULTANT ISOPLETHS**

| Hearing Group | Low-Frequency Cetaceans | Mid-Frequency Cetaceans | High-Frequency Cetaceans | Phocid Pinnipeds | Otariid Pinnipeds |
|---|---|---|---|---|---|
| **$SEL_{cum}$ Threshold** | 199 | 198 | 173 | 201 | 219 |
| **PTS Isopleth to threshold (meters)** | **8.1** | **0.7** | **11.9** | **4.9** | **0.3** |

**Figure 13. PTS Isopleth Data for Impact Pile Driving**

## E.1-2: ALTERNATIVE METHOD (SINGLE STRIKE EQUIVALENT)

**Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = $SEL_{ss}$ + 10 Log (# strikes)** **198.0**

| | |
|---|---|
| **Source Level (Single Strike/shot SEL)** | 168 |
| **a) Number of strikes in 1 h OR b) Number of strikes per pile•** | 250 |
| **a) Activity Duration (h) within 24-h period OR b) Number of piles per day•** | 4 |
| **Propagation (xLogR)** | 15 |
| **Distance of single strike SEL measurement (meters)⁺** | 10 |

| Marine Mammal Hearing Group |
|---|
| **Low-frequency (LF) cetaceans**: baleen whales |
| **Mid-frequency (MF) cetaceans**: dolphins, toothed whales, beaked whales, bottlenose whales |
| **High-frequency (HF) cetaceans**: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis* |
| **Phocid pinnipeds (PW)**:true seals |
| **Otariid pinnipeds (OW)**:sea lions and fur seals |

• For cells B47 & B48 users should supply information for both cells as either a) OR b); Don't mix-n-match.

⁺Unless otherwise specified, source levels are referenced 1 m from the source.

**RESULTANT ISOPLETHS***

*Note: For impulsive sounds, action proponent must also consider isopleths peak sound pressure level (PK) thresholds (dual thresholds).

| Hearing Group | Low-Frequency Cetaceans | Mid-Frequency Cetaceans | High-Frequency Cetaceans | Phocid Pinnipeds | Otariid Pinnipeds |
|---|---|---|---|---|---|
| **$SEL_{cum}$ Threshold** | 183 | 185 | 155 | 185 | 203 |
| **PTS Isopleth to threshold (meters)** | **99.9** | **3.6** | **119.0** | **53.4** | **3.9** |

**Figure 14. PTS Isopleth Map**

## 6.0 NUMBER OF MARINE MAMMALS THAT MAY BE AFFECTED

This authorization is requesting incidental taking by Level B harassment for construction activities that require in-water work, as well as for the demolition and construction of the rail (trestle) superstructures due their proximity to the river. All remaining activities will be located away from the river and will not result in acoustic or visual disturbances, as discussed in Section 1. All in-water work will occur within the ODFW prescribed IWWP, and rail superstructures will be constructed during the following two month period. As a result, this analysis will focus on the take estimations for the months of November through April.

### 6.1 Level B ZOI Summary

During construction, underwater and in-air noise will be generated by operation of construction equipment and related activities. Incidental take would be a temporary and localized disturbance from elevated sound levels and visual stimulus from construction equipment. Specific construction activities with the potential for take are the removal and construction of rail superstructures (in-air noise), removal of the existing timber piling (underwater noise), the removal of existing concrete footings and a concrete retaining wall (in-air noise), and 24-inch steel pile installation (underwater noise). Table 6-1 below provides of summary of the harassment ZOIs that have been calculated for the Project using the Interim Sound Threshold Guidance as previously discussed in Section 5.0.

**Table 6-1. Level B ZOI Summary**

| Construction Activity | In-Air or Underwater Noise | Initial SPL* | Level B ZOI (meters) |
|---|---|---|---|
| Rail Superstructure Removal | In-Air | 93 dB RMS | 9 (sea lions); 28 (seals) |
| Retaining Wall and Concrete Removal | In-Air | 93 dB RMS | 9(sea lions); 28 (seals) |
| Timber Foundation Removal | Both | 150 dB RMS (underwater) | 1,600 |
| Pile Installation | Both | 168 dB RMS (underwater)** | 398 |
| Rail Superstructure Construction | In-Air | 93 dB RMS | 9 (sea lions); 28 (seals) |

* In-air noise decibels referenced to 20 micro Pascals; underwater noise decibels referenced to 1 micro Pascal
** Includes 10 dB reduction for the use of a sound attenuation device

Based on the information provided in Table 6-1, a Level B ZOI of 28 meters will be established and monitored during the demolition and construction of the existing trestle crossings. In addition, a Level B ZOI extending 1,600 and 398 meters from each bridge location will be established and monitored according to the schedule identified in Section 13 during pile removal activities and impact pile driving activities, respectively, from November 1 through February 28.

### 6.2 Exclusion Zone Summary

As discussed in Section 5.0, Level A injury is not anticipated during construction activities. Based on the data generated using the NMFS User Spreadsheet (Figures 12 through 14), the PTS isopleths for California and stellar sea lions would be 0.3 meter during pile removal activities and 3.9 meters during pile driving activities. For harbor seals, the PTS isopleths would be 4.9 meters during pile removal activities and 53.4 meters during impact pile driving activities. During all above-water

construction activities, a 10 meter Level A Exclusion Zone will be enforced to ensure that marine mammals are not injured by anthropogenic sound sources. Similarly, Harbor seals are not likely to be transiting through the 53.4 meter PTS isopleth during pile installation activities; however, the presence of harbor seals within this distance will be monitored and shutdown measures will be implemented if harbor seals enter the Level A Exclusion Zone during pile driving and pile removal activities. A Level A Exclusion Zone of 10 meters will be monitored during all in-water construction activities to ensure that sea lions are not injured.

### 6.3 Species Counts

Species counts were obtained from the most recent ODFW pinnipeds counts for 2000-2014 (USACE, 2015b). Because pile removal and installation activities and concrete foundation removal activities will occur from October through February, and rail superstructure activities will occur between March and April, an average of the following species counts will be utilized to generate exposure estimates and take for this IHA application.

**Table 6-2: Monthly Species Counts for Region of Activity**

| Month | Average # of California Sea Lions | Average # of Harbor Seals | Average # of Steller Sea Lions |
|---|---|---|---|
| **January** | 10 | 24 | 249 |
| **February** | 28 | 1 | 259 |
| **March** | 17 | 14 | 177 |
| **April** | 99 | 24 | 587 |
| **May** | 125 | 24 | 824 |
| **June** | 202 | 57 | 676 |
| **July** | 1 | 24 | 358 |
| **August** | 115 | 1 | 324 |
| **September** | 249 | 24 | 209 |
| **October** | 508 | 24 | 384 |
| **November** | 1,214 | 24 | 1,663 |
| **December** | 725 | 57 | 1,112 |
| * Species counts for months when surveys were not conducted based on the average counts for the months that were surveyed. | | | |

It is likely that all individuals transiting through the 1,600 meter and 398 meter Level B ZOIs during vibratory removal and impact pile driving activities, respectively, will be exposed to sound levels that exceed the underwater thresholds during vibratory removal and impact driving activities; however, only hauling and transiting California sea lions are likely to be exposed to sound levels that exceed the in-air noise thresholds during rail superstructure construction activities.

### 6.4 Estimated Harassment Exposures and Take

Although three species of pinniped occur in the vicinity of the Project, they do not occur in equal numbers. Harbor seals and steller sea lions are only known to occur out in the river channel and would only be harassed if they are transiting through the Zone of Influence (1,600 meters for vibratory pile removal, 398 m for impact pile driving). Harbor seals and steller sea lions would only be harassed during the in-water work period (November through February).

California sea lions are the most commonly seen in the area, and are known to haul out on the riverbanks and structures near the bridges. California sea lions may be harassed by underwater sound resulting from vibratory pile removal and impact pile driving (at the distances listed above) as

well as airborne sound resulting from roadway and railway demolition and construction. Using the highest sound source (concrete saw, 93 dB RMS re: 20 µPa at 20 meters), the isopleth to Level B harassment from airborne noise (100 dB re: 20 µPa) is 9 meters. The City of Astoria is proposing a 10 meter shutdown zone during all railway and roadway above-water construction to prevent injury from physical interaction with equipment. The City would therefore shut down equipment before sea lions would be acoustically harassed by the sound produced and no Level B acoustic harassment would occur. However, the City anticipates that California sea lions hauled out on the banks of the river may be visually disturbed by the presence of construction equipment and may flush from their haulout, resulting in Level B take. The City is requesting take of California sea lions during the above-water work period before and after the in-water work period as sea lions may be harassed due to human and equipment presence.

While harbor seals and steller sea lions would only be harassed during the in-water work period, California sea lions may be harassed over the duration of the Project (October through April). To determine the estimated pinniped exposure and take, average monthly counts for each species from the South Jetty haulout (USACE, 2015b) were multiplied by the duration (months) of their expected exposure as summarized in Table 6-3 below.

**Table 6-3: Estimated Pinniped Exposure and Take**

| | Average Count per Month | Visual Disturbance Months | In-water Months | Total Months of Impacts | Total Take |
|---|---|---|---|---|---|
| **California sea lion** | 372 | 3 | 4 | 7 | **2,604** |
| **Stellar sea lion** | 821 | 0 | 4 | 4 | **3,284** |
| **Harbor seal** | 27 | 0 | 4 | 4 | **108** |

*The take numbers requested greatly overestimates the number of stellar sea lion takes because California sea lions are more likely to be present in the ZOI than Stellar sea lions.

** 7 month period for California sea lions, and 4 month period for stellar sea lions and harbor seals

For California and stellar sea lions, sub-adult and adult males could be harassed during construction activities. For harbor seals, sub-adult and adult males and/or females could be harassed during construction activities. Abundance of sea lions and seals subject to harassment may decline over the work period, since animals may not forage or haulout in the location of the work area once they have been subjected to a few disturbance events.

## 7.0 ANTICIPATED IMPACT OF THE ACTIVITY

In-water construction activities resulting in an increase in underwater noise levels, specifically pile removal and installation, is the primary concern to pinnipeds using the Region of Activity, particularly within the identified Exclusion Zones. Additionally, seals and sea lions within the Region of Activity may be exposed to elevated SPL above airborne disturbance thresholds while surfacing within the designated ZOIs.

As indicated within Section 4.0, the current stock estimates for California sea lions, harbor seals, and steller sea lions are 296,750, 24,732, and 41,638 individuals respectively.[10] All three species

[11] Information on winter pretty species abundance within the lower Columbia River provided by the ODFW (R. Bradley, personal communication, September 15, 2016).

populations have seen continual growth between 3 and 10 percent annually. This application requests incidental taking by Level B acoustical harassment as noted on in Table 7-1 on the following page.

**Table 7-1: Species Stock Impact Summary**

| Month | Requested Take | Current Stock Estimates | Percent of Stock |
|---|---|---|---|
| **California sea lions** | 2,604 | 296,750 | 0.88% |
| **Harbor Seals** | 108 | 24,732 | 0.44% |
| **Steller Sea Lions** | 3,284 | 41,638 | 7.9% |

The anticipated in-water and airborne impacts are temporary disturbances that may alter behaviors and cause individuals to temporally disperse from the area. Temporary disturbance could also be caused by other construction activities, the presence of humans, etc. These disturbances could cause animals to avoid travel through the Region of Activity, but existing marine traffic, recreational boaters, and human presence along the waterfront already occur in the area. Thus, it is likely that seals and sea lions are habituated to these disturbances while transiting the Region of Activity.

Repetitive, short-term displacement is likely to cause repetitive, short-term disruptions in their normal behavioral patterns throughout the Region of Activity. Disruption from airborne or visual disturbance would be limited to working hours during the predicted construction seasons. The in-water acoustic threshold may be exceeded for up to 80 days during pile removal and installation activities. However as previously noted, the background acoustic levels around the waterfront are likely to be very high given the strong tides, high winds, and breaking surf conditions.

California sea lions that utilize the Project area to occasionally haul-out will likely spend less time in the immediate vicinity during construction activities. Further, all pinnipeds may refrain from transiting through or foraging within the Region of Activity during construction; however, there are alternative foraging and haul-out areas available to the affected individuals. There are no current threats to the species that are either part of the environmental baseline or proposed as a component of the Project that could have additional impacts on the species stocks. In addition, no reduction in prey resources is anticipated as a result of the Project. As a result, effects of the Project are not anticipated to appreciably reduce the species' ability to survive and recover.

## 8.0 ANTICIPATED IMPACT ON SUBSISTENCE USES

No impacts to the availability of California sea lions, Pacific harbor seals, or Steller sea lions to the Northwest treaty tribes will occur as a result of the Project.

## 9.0 ANTICIPATED IMPACTS ON HABITAT

Impacts to marine mammal habitat from the proposed construction actions are expected to be temporary and include increased human activity and noise levels, minimal impacts to water quality, and negligible changes in prey availability near the individual project sites. Beneficial effects on marine mammal habitat from the proposed construction actions include the removal of several hundred treated timber piles from within the Columbia River.

## 9.1 Effects of Project Activities on Marine Mammal Habitat

As described in Section 4, California sea lions, Pacific harbor seals, and steller sea lions are likely to be found transiting the Region of Activity during construction activities and throughout the length of the project. For these marine mammals, habitat is defined as the locality or environment that is essential for an animal's survival (feeding areas, resting areas, transit routes, socializing and breeding areas), and consists of in-water areas, haul-out sites or rookeries.

As a result of in-water construction activities, some degree of localized reduction in water quality would occur. This effect would occur during the installation and removal of piles from the substrate when bottom sediments are disturbed. Any effects to turbidity are expected to be short-term and minimal, and turbidity is expected to return to normal levels shortly following completion of the proposed actions. No direct effects to marine mammals are expected from turbidity impacts.

There are no designated critical habitats within this area of the Columbia River for the identified pinnipeds likely present within the Region of Activity. Further, the proposed project will not result in permanent impacts to habitats used by marine mammals. The proposed project will result in temporary changes in the acoustic environment; thus, the pinnipeds may experience a temporary loss of habitat because of temporarily elevated noise levels, and there may be minor visual disturbance due to the construction. The most likely impact to marine mammal habitat would be from impact hammer pile-driving effects on marine mammal prey at and near the Project Action Area and minor impacts to the immediate substrate during installation of piles.

## 9.2 Effects of Project Activities on Marine Mammal Prey

Besides physical locations, habitat also includes the available prey upon which these pinnipeds feed. Long-term effects of any prey displacements are not expected to affect the overall fitness of the pinnipeds present; effects will be minor and will terminate after cessation of the proposed construction actions. Specific project impacts to fish species will be covered under the FAHP, but below is a discussion of fish prey impacts as they relate to marine mammals transiting the Project Region of Activity.

The diets of California sea lions, Pacific harbor seals, and steller sea lions vary by season and location. Generally, harbor seals are opportunistic feeders who consume sole, flounder, sculpin, hake, cod, salmon, smelt, herring, octopus, and squid (NOAA, 2016d). California sea lions feed on squid, anchovies, mackerel, rockfish, and sardines (NOAA, 2016e). Steller sea lions diet consists of a wide variety of fish (e.g., capelin, cod, herring, mackerel, pollock, rockfish, salmon, sand lance, etc.), bivalves, cephalopods (e.g., squid and octopus) and gastropods (NOAA, 2016c). They all consume a variety of marine and estuarine prey, including squid, smelt, herring, flatfish, perch, pollock, hake, rockfish and salmon. Based on scat samples collected from several Pacific Northwest estuary and ocean sites (including the Columbia River estuary), salmon species generally make up 10-30 percent of these animals' diet (NOAA 2008). The in-water work period for this construction activity is from November 1 – February 28, and this would coincide with the presence of prey species including a variety of salmonids (coho or fall Chinook, possibly chum, steelhead, early spring Chinook salmon). This would include adults migrating upstream and juveniles rearing in or passing through the estuary. Green sturgeon, white sturgeon, and eulachon could be present in the vicinity, and potentially some marine species such as starry flounder or surfperch might be included.[11] In 2015, record numbers of pinnipeds were reported at the mouth of the Columbia (at

[11] Information on winter pretty species abundance within the lower Columbia River provided by the ODFW (R. Bradley, personal communication, September 15, 2016).

Desdemona Sands, South Jetty, and East Mooring Basin haul-out locations) driven north by starvation in California to the healthy smelt and salmon runs in the Columbia River. Smelt runs and adult spring chinook salmon are yearly continuous food sources for these species within this area (Stratton, 2015).

Fish populations in the Columbia River which serve as pinniped prey could be affected by noise from in-water pile driving. In general, fish perceive underwater sounds in the frequency range of 50 to 2,000 Hz, with peak sensitivities below 800 Hz (Popper and Hastings, 2009). Strong and/or intermittent sounds may elicit changes in fish behavior and local distribution and have the potential to harm fish. Research has shown that high underwater sound pressure levels, such as those occurring during pile-driving or removal activities, have the ability to alter behavior, cause hearing loss, and injure or kill individual fish by causing serious internal injury (Hastings and Popper, 2005). Pile-driving and removal activities have been shown to have the potential to cause traumatic fish injuries ranging from mild (recoverable injuries such as swim bladder deflation or hematomas), to moderate (e.g. intestinal hemorrhage), to mortal (leading to death, such as heart or liver hemorrhage), with effects varying based on the life stage and species of fish, the distance from the activity, etc. (Halvorsen et al., 2012). In general, the closer the animal is to the source the higher the likelihood of high energy and a resultant effect. Any of these effects could reduce fitness and lead indirectly to mortality, although it is difficult to assess is the disturbance of the natural behavior of pinniped prey fish species or the potential masking of the communication and orientation signals due to exposure to noise levels. It is not possible to say how long behavioral effects, if any, will continue following pile driving. However, the uncertainty regarding direct and indirect effects on prey species will be mitigated due to the seasonal presence of salmonids and other prey present in the area, and the mitigation measures already in place to reduce impacts to fish under FAHP. Further, it is anticipated that almost half of the pile driving activities will occur in the dry. If pile driving is required through the water column, appropriate sound attenuation devices will be installed.

### 9.3 Summary

Impacts to seal and sea lion habitat and prey species availability are expected to be minor and temporary. The area likely impacted by the construction is relatively small compared to the available habitat in this river, and there are no haul-outs or rookeries within the Project Region of Activity[12]. The most likely impact to fish and prey species from the construction actions will be temporary behavioral avoidance of the immediate area. Affected fish would represent only a small portion of food available to marine mammals in the area. Shortly following construction activities, a return to normal prey species behavior is anticipated, and any behavioral avoidance by fish of the disturbed area will still leave significantly large areas of fish and marine mammal foraging habitat in the Columbia River. Therefore, the impacts on pinniped habitat and prey availability during the proposed construction actions are expected to be negligible.

## 10.0 ANTICIPATED EFFECTS ON HABITAT IMPACTS ON MARINE MAMMALS

Descriptions of the proposed Project impacts on habitat were discussed in Section 9. The effects of the proposed project on marine mammal habitat are expected to be short-term and minor, as described in Section 9.1. The greatest impact on marine mammals associated with the proposed actions will be a temporary loss of habitat and displacement of prey species because of elevated noise levels. Displacement of marine mammals by noise will not be permanent and there will be no long-term effects to their habitat. The proposed Project is not expected to have any habitat-

[12] California sea lions have been observed hauling within the Project area, but this is not their main haul-out location.

related effects that could cause significant or long-term consequences for individual marine mammals or their populations, since pile driving and removal activities will be temporary, short-term, and intermittent.

## 11.0 MITIGATION MEASURES

The following mitigation measures will be employed by the contractor during all construction activities to avoid and minimize impacts to the Lower Columbia River, ESA-listed species and their designated critical habitat, and species protected under the MMPA to the maximum extent practicable.

### 11.1 General Construction Measures

All construction activities will be performed in accordance with the current ODOT Standard Specifications for Construction, the Contract Plans, and the Project Special Provisions. In addition, the following general construction measures will be adhered to.

- All work shall be performed according to the requirements and conditions of the regulatory permits issued by federal, state, and local governments. Seasonal restrictions, i.e., work windows, will be applied to the Project to avoid or minimize potential impacts to listed or proposed species based on agreement with, and the regulatory permits issued by DSL, and USACE in consultation with NMFS.
- OBEC will have an inspector onsite during construction. The role of the inspector is to ensure contract compliance. The inspector and the contractor will have a copy of the Contract Plans and Specifications on site and will be aware of all requirements. The inspector will also be trained in environmental provisions and compliance.
- All equipment to be used for construction activities shall be cleaned and inspected prior to arriving at the Project site, to ensure no potentially hazardous materials are exposed, no leaks are present, and the equipment is functioning properly.
- Mobile heavy equipment will be stored, fueled, and maintained in a vehicle staging area placed 150 feet or more from the river, or in an isolated hard zone such as a paved parking lot. It will be inspected daily for fluid leaks before leaving the vehicle staging area and steam-cleaned before operation on the barge or adjacent to the harbor.
- Generators, cranes, and any other stationary equipment operated within 150 feet of the river will be maintained and protected as necessary to prevent leaks and spills from entering the water.
- Erosion and sediment control BMPs will be installed prior to initiating any construction activities.
- All work below the HMT elevation will be completed during the ODFW prescribed IWWP of November 1 through February 28.
- The contractor will be responsible for the preparation of a PCP. The PCP will designate a professional on-call spill response team, and identify all contractor activities, hazardous substances used and wastes generated.
- The PCP will describe how hazardous substances and wastes will be stored, used, contained, monitored, disposed of and documented.
- The contractor will implement measures to deter marine mammal haul-outs within the Project area during construction activities. The potential deterrence methods will be listed

in the current November 2015 NOAA interim guidance13, or more recent guidance or formal guidelines and regulations.

## 11.2 Pile Removal and Installation BMPs

The following mitigation measures will be implemented to minimize disturbance during pile removal and installation activities (adopted from NOAA, 2016f).

- An air bubble system or other noise attenuation device shall be employed during impact installation unless the piles are driven in the dry or within less than 2 feet of water.
- The contractor will implement a soft-start procedure for impact pile driving activities. The objective of a soft-start is to provide a warning and/or give animals in close proximity to pile driving a chance to leave the area prior to an impact driver operating at full capacity thereby, exposing fewer animals to loud underwater and airborne sounds. A soft start procedure will be used at the beginning of each day that pile installation activities are conducted.
    - For impact driving, an initial set of three strikes would be made by the hammer at 40 percent energy, followed by a one minute wait period, then two subsequent three-strike sets at 40 percent energy, with one minute waiting periods, before initiating continuous driving.
- Monitoring of marine mammals shall take place starting 30 minutes before construction begins until 30 minutes after construction ends (see Section 13 for monitoring details).
- Before commencement of impact pile driving activities, ODOT will establish a 10 meter and a 53.4 meter Level A Exclusion Zone to prevent auditory injury to sea lions and harbor seals, respectively.
- Before commencement of vibratory pile removal activities, a 10 meter Level A Exclusion Zone will be established to prevent injury to marine mammals.
- Before commencement of above water construction activities, ODOT will establish a 10 meter Level A Exclusion Zone to prevent injury from physical interaction with construction equipment.
- Prior to initiating in-water pile driving, pile removal, and concrete removal activities, ODOT will establish the following Level B ZOIs for underwater noise.
    - The Level B ZOI for all pile removal activities will be established out to a distance of 1,600 meters from the pile.
    - The Level B ZOI for all pile driving activities will be established out to a distance of 398 meters from the pile.
    - If a marine mammal enters the Level B ZOI, but does not enter Level A Exclusion Zone, a "take" will be recorded and the work will be allowed to proceed without cessation. Marine mammal behavior will be monitored and documented.
- Prior to initiating demolition of the existing structures and construction of the new trestle crossings, ODOT will establish the following Level B ZOI for in-air noise.
    - The Level B ZOI during rail superstructure demolition and construction will be established out to a distance of 28 meters from the construction area.
    - If a marine mammal enters the Level B ZOI, but does not enter Level A Exclusion Zone, a "take" will be recorded and the work will be allowed to proceed without cessation. Marine mammal behavior will be monitored and documented.

- ODOT shall implement shutdown measures as follows:
    - If a marine mammal is sighted within or approaching the Level A Exclusion Zones, construction activities shall be suspended until the marine mammal is sighted moving away from the Exclusion Zone, or if a pinniped is not sighted for 15 minutes after the shutdown.
    - To prevent Level B takes when the take of a pinniped species is approaching the authorized take limits.
    - If marine mammals within the Level B ZOI appear to be injured by the work activity.
- If the exclusion and disturbance zones are obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire zones are visible.
    - The exclusion zone will include all areas where the underwater SPLs are anticipated to equal or exceed the Level A (injury) criteria, and will always be a minimum of 53.4 meters for harbor seals and 10 meters for sea lions.
    - The disturbance zone will include all areas where the underwater SPLs are anticipated to equal or exceed the Level B (harassment) criteria. This will include 1,600 meters during vibratory pile removal and pre-drilling activities, and 398 meters during impact pile driving activities.
    - If a marine mammal approaches or enters the Exclusion Zones, work will be halted and delayed until either the animal has voluntarily left, or 15 minutes have passed without re-detection of the animal.
- IWW will only commence once observers have declared the Exclusion Zones to be clear of marine mammals.
- A monitoring plan will be implemented as described in Section 13. This plan includes Exclusion Zones and specific procedures in the event a mammal is encountered.

## 12.0 ARCTIC PLAN OF COOPERATION

The proposed activity will take place in the Columbia River (RM 9), and no activities will take place in or near a traditional Arctic subsistence hunting area. Therefore, this element is not applicable to the Project.

## 13.0 MONITORING AND REPORTING

Impacts to marine mammals are likely to be temporary and negligible, and the mitigation measures described in Section 11 are meant to avoid and minimize impacts to the Lower Columbia River, ESA-listed species, and seal and sea lions to the maximum extent practicable. The following Monitoring and Reporting measures (adapted from NOAA, 2016f) will be implemented to further minimize disturbance to marine mammals, improve understanding of the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities, and increase the general knowledge about these marine mammals and the effectiveness of the mitigation measures.

### 13.1 Monitoring

1) Protected Species Observers: ODOT will employ qualified PSOs to monitor the extent of the Region of Activity for marine mammals. Qualifications for marine mammal observers include:

a) Visual acuity in both eyes (correction is permissible) sufficient for discerning moving targets at the water's surface with ability to estimate target size and distance. Use of binoculars is necessary to correctly identify the target.
b) Advanced education (at least some college level course work) in biological science, wildlife management, mammalogy or related fields (bachelor's degree or higher is preferred, but not required).
c) Experience or training in the field identification of marine mammals (cetaceans and pinnipeds).
d) Sufficient training, orientation or experience with the construction operation to provide for personal safety during observations.
e) Ability to communicate orally, by radio or in person, with project personnel to provide real time information on marine mammals observed in the area as necessary.
f) Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience).
g) Writing skills sufficient to prepare a report of observations that would include such information as the number and type of marine mammals observed; the behavior of marine mammals in the project area during construction, dates and times when observations were conducted; dates and times when in-water construction activities were conducted; and dates and times when marine mammals were present at or within the defined Region of Activity.

2) Monitoring Schedule: PSOs shall be present onsite during IWW construction activities as follows:
   a) During vibratory pile removal activities:
      i) Two NMFS qualified observers will be onsite the first day of removal at each bridge, one NMFS qualified observer will be onsite every third day thereafter.
      ii) One NMFS observer will be stationed at the best practicable land-based vantage point to observe the downstream portion of the disturbance zone, and the other positioned at the best practicable land-based vantage point to monitor the upstream portion of the disturbance zone.
      iii) The OBEC onsite inspector will be trained in species identification and monitoring protocol, and will be onsite during all pile removal activities to ensure that no species enter the 10 meter Exclusion Zone.
   b) During pile driving activities:
      i) Two NMFS qualified observers will be onsite the first two days of pile driving at each bridge, and every third day thereafter.
      ii) One NMFS observer will be stationed at the best practicable land-based vantage point to observe the downstream portion of the disturbance and 53.4 meter Exclusion zone, and the other positioned at the best practicable land-based vantage point to monitor the upstream portion of the disturbance and exclusion zones.
      iii) The OBEC onsite inspector will be trained in species identification and monitoring protocol, and will be onsite during all pile driving activities to ensure that no species enter the 10 meter Exclusion Zone.
   c) During substructure demolition activities (not including pile removal) and superstructure demolition and construction activities:
      i) One NMFS qualified observer will be onsite once a week to monitor the 28 meter ZOI.
      ii) The OBEC onsite inspector will be trained in species identification and monitoring protocol, and will be onsite during all construction activities to ensure that no species enter the 10 meter Exclusion Zone during superstructure demolition and construction activities.

3) Monitoring Protocols: PSOs shall monitor marine mammal presence within the Level A Exclusion Zone and Level B ZOIs per the following protocols:
   a) A range finder or hand-held global positioning system device will be used by PSOs to ensure that the defined Exclusion Zones are fully monitored and the Level B ZOIs monitored to the best extent practicable.
   b) A 30-minute pre-construction marine mammal monitoring period will be required before the first pile driving or pile removal of the day. A 30-minute post-construction marine mammal monitoring period will be required after the last pile driving or pile removal of the day. If the contractor's personnel take a break between subsequent pile driving or pile removal for more than 30 minutes, then additional pre-construction marine mammal monitoring will be required before the next start-up of pile driving or pile removal.
   c) If marine mammals are observed, the following information will be documented:
      i) Species of observed marine mammals;
      ii) Number of observed marine mammal individuals;
      iii) Life stages of marine mammals observed;
      iv) Behavioral habits, including feeding, of observed marine mammals, in both presence and absence of activities;
      v) Location within the Region of Activity; and
      vi) Animals' reaction (if any) to pile-driving activities or other construction-related stressors including:
         (1) Impacts to the long-term fitness of the individual animal, if any
         (2) Long-term impacts to the population, species, or stock (e.g. through effects on annual rates of recruitment or survival), if any
      vii) Overall effectiveness of mitigation measures
   d) During vibratory pile removal and impact driving, qualified PSOs will monitor the Level B ZOIs from the best practicable land-based vantage point to observe the downstream and upstream portions of the disturbance zone according to the above schedule.
   e) PSOs shall use binoculars to monitor the Region of Activity.

### 13.2 Reporting

   a) ODOT shall provide NMFS with a draft monitoring report within 90 days of the conclusion of the construction work. This report shall detail the monitoring protocol, summarize the data recorded during monitoring, and estimate the number of marine mammals that may have been harassed.
   b) If comments are received from the NMFS West Coast Regional Administrator or NMFS Office of Protected Resources on the draft report, a final report shall be submitted to NMFS within 30 days thereafter. If no comments are received from NMFS, the draft report will be considered to be the final report.
   c) In the unanticipated event that the construction activities clearly cause the take of a marine mammal in a manner prohibited by the NMFS authorization, such as an injury, serious injury or mortality (e.g., gear interaction), ODOT shall immediately cease all operations and immediately report the incident to the Supervisor of Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinators. The report must include the following information:
      i) Time, date, and location (latitude/longitude) of the incident;
      ii) Description of the incident;
      iii) Status of all sound source use in the 24 hours preceding the incident;

iv) Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, visibility, and water depth);
v) Description of marine mammal observations in the 24 hours preceding the incident;
vi) Species identification or description of the animal(s) involved, including life stage; the fate of the animal(s); and
vii) Photographs or video footage of the animal (if equipment is available). Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with ODOT to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Activities may not be resumed until notified by NMFS via letter, email, or telephone.

d) In the event that ODOT discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), ODOT will immediately report the incident to the Supervisor of the Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinators. The report must include the same information identified above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with ODOT to determine whether modifications in the activities are appropriate.

e) In the event that ODOT discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), ODOT shall report the incident to the Supervisor of the Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinators, within 24 hours of the discovery. ODOT shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. ODOT can continue its operations under such a case.

## 14.0 SUGGESTED MEANS OF COORDINATION

In-water noise generated by Project construction actions such as piling removal and installation is the primary issue of concern relative to the marine mammals potentially within the Project Region of Activity: California sea lions, Pacific harbor seals, and steller sea lions. Pinniped monitoring will be conducted to collect information on presence of marine mammals within the Level A Exclusion Zones and Level B ZOIs for this project. The monitoring report, which will include a discussion of any behavioral changes in harbor seals and sea lions resulting from the proposed IWW, will be submitted to NMFS, and therefore, the monitoring report will be available to public review in the future. As such, the Applicant and other Project proponents who might undertake similar projects in the future will be able to use the results of this Project's monitoring report to inform future project designs and plan projects that minimize the take of marine mammals associated with pile driving and removal activities. The monitoring data will inform NMFS and future permit applicants about the behavior and adaptability of pinnipeds for future projects of a similar nature.

## 15.0 REFERENCES

Allen, B.M., and R.P. Angliss. 2015. Alaska marine mammal stock assessments, 2014. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-301, 304p. doi:10.7289/V5N0RTS.

Behrens and Associates, 2006. Gas Well Drilling Noise Impact and Mitigation Study. April 2006. Accessed September 16, 2016 at http://pstrust.org/docs/GasWellDrillingNoiseImpactandMitigationStudy.pdf.

Brown, R, S. Jefferies, D. Hatch., and B. Wright. 2015. *Field Report: 2015 Pinniped Research and Management Activities at Bonneville Dam*. October 30, 2015.

Brown, Robin F., Bryan Wright E., Susan Riemer D., and Jeffrey Laake. "Trends In Abundance And Current Status Of Harbor Seals In Oregon: 1977–2003." *Marine Mammal Sci Marine Mammal Science* 21.4 (2005): 657-70.

Caltrans, 2015. Incidental Harrassment Authorization Application: Murray Street Bridge (#36C-0108) Seismic Retrofit Project, January 2015. Accessed September 16, 2016 at http://www.nmfs.noaa.gov/pr/permits/incidental/construction/caltransmurraybridge_2015iha_appl.pdf.

Carretta, J.V., E.M. Oleson, D.W. Weller, A.R. Lang, K.A. Forney, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.L. Brownell Jr. 2015. U.S. Pacific Marine Mammal Stock Assessments: 2014. U.S. Department of Commerce, NOAA Technical Memorandum, NOAA-TMNMFS-SWFSC-549. 414 p.

*Discovery of Sound in the Sea*. The University of Rhode Island, 2016. Web. April 18, 2016. http://www.dosits.org/.

FHWA, 2011. FHWA Highway Noise Barrier Design Handbook. Available online at http://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/design/.

Halvorsen, M. B., B. Casper M., F. Matthews, T. Carlson J., and A. Popper N. 2012. "Effects of Exposure to Pile-driving Sounds on the Lake Sturgeon, Nile Tilapia and Hogchoker." *Proceedings of the Royal Society B: Biological Sciences* 279.1748. 4705-714.

Hanan & Associates, 2014. *Final Incidental Harassment Authorization Monitoring Report*. Issued June 28, 2013 – June 27, 2014 to the City of San Diego for La Jolla California Children's Pool Construction and Harbor Seal Monitoring. 35 Pages.

Hastings, Mardi C., and Arthur Popper. 2005. Effects of Sounds on Fish. Tech. N.p.: California Department of Transportation. Accessed online September 15, 2016 at: http://149.136.20.66/hq/research/researchreports/2002-2006/2005/effects_of_sounds_on_fish.pdf

Huey, Richard D, 2015. Request for an Incidental Harassment Authorization Under the Marine Mammal Protection Act: Coupeville Timber Towers Preservation Project. Washington State Ferries. May 8, 2015.

Jeffries, S.J., P.J. Gearin, H.R. Huber, D.L. Saul, and D.A. Pruett. 2000. Atlas of Seal and Sea Lion Haulout Sites in Washington. Washington Department of Fish and Wildlife, Wildlife Science Division, 600 Capitol Way North, Olympia WA. pp. 150.

Kastelein, R.A., P.J. Wensveen, L. Hoek, W.C.Verboom, J.M. Terhune, R. Hille Ris Lambers. 2008. Underwater hearing sensitivity of harbour seals for tonal signals and noise bands.

Wageningen. Retrieved on September 14, 2016 at: http://www.noordzeewind.nl/wp-content/uploads/2012/02/OWEZ_R_254_T1_20080530.pdf

KE KAI OLA, 2016. The Marine Mammal Center Website, accessed June 16, 2016, at http://www.marinemammalcenter.org/education/marine-mammal-information/.

Mulsow, J., and C. Reichmuth. "Psychophysical and Electrophysiological Aerial Audiograms of a Steller Sea Lion (Eumetopias Jubatus)." *The Journal of the Acoustical Society of America J. Acoust. Soc. Am.* 127.4 (2010): 2692. Retrieved September 14, 2016 at http://pinnipedlab.ucsc.edu/publications/pub_135_2010.pdf.

Laughlin, 2011a. Port Townsend Dolphin Timber Pile Removal – Vibratory Pile Monitoring Technical Memorandum. WSDOT, Office of Air Quality and Noise, Seattle, WA, January 3, 2011. Accessed at http://www.wsdot.wa.gov/nr/rdonlyres/062b9d1e-0908-47ec-bece-6e9a0bbbc53b/0/porttownsendtimberpileremoval.pdf on September 15, 2016.

Laughlin, 2011b. Underwater Sound Levels Associated with Driving 72-inch Steel Piles at the SR 529 Ebey Slough Bridge Project Replacement. WSDOT, Office of Air Quality and Noise, Seattle, WA, March 2011

LCEP, 2016. Quick Facts: What is an estuary? Retrieved on September 14, 2016 at http://www.estuarypartnership.org/learn/quick-facts.

NOAA, 2016a. Interim Sound Threshold Guidance. http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html. Accessed April 25, 2016.

NOAA, 2016b. *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*. NOAA Technical Memorandum NMFS-OFR-55, 178 p.

NOAA, 2016c. Stellar Sea Lion (*Eumetopias jubatus*) website, accessed June 16, 2016 at http://www.fisheries.noaa.gov/pr/species/mammals/sealions/steller-sea-lion.html.

NOAA, 2016d Harbor Seal (*Phoca vitulina*) website, accessed September 14, 2016 at http://www.fisheries.noaa.gov/pr/species/mammals/seals/harbor-seal.html

NOAA, 2016e. California Sea Lion (*Zalophus californianus*) website, accessed September 14 at http://www.fisheries.noaa.gov/pr/species/mammals/sealions/steller-sea-lion.html.

NOAA, 2016f. Issued IHA for the Coupeville Timber Towers Preservation Project, Whidbey Island, WA. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, March 22, 2016. Access online September 16, 2016 at http://www.nmfs.noaa.gov/pr/permits/incidental/construction/wsdot_coupeville_2016iha_iha.pdf.

NOAA, 2016g. NOAA Technical Memorandum NMFS. U.S. Pacific Marine Mammal Stock Assessments, Stellar Sea Lion (*Eumetopias jubatus):* Eastern U.S. Stock. Revised 12/30/2016.

NOAA, 2015a. NOAA Technical Memorandum NMFS. U.S. Pacific Marine Mammal Stock Assessments, California Sea Lion (*Zalophus californianus*): U.S. Stock. Revised 6/30/2015.

NOAA, 2015b. *Potential Deterrence Methods for Pacific Harbor Seals, California Sea Lions, & Eastern U.S. Stock Steller Sea Lions*. NOAA Fisheries, West Coast Region. Updated November 2015.

NOAA, 2014a. "Protected Resources Glossary." *NOAA Fisheries*. 7 May 2014. Accessed online Sept 13, 2016 at http://www.nmfs.noaa.gov/pr/glossary.htm#h.

NOAA, 2014b. NOAA Technical Memorandum NMFS. U.S. Pacific Marine Mammal Stock Assessments, Harbor Seal (*Phoca vitulina richardii)*: Oregon/Washington Coast Stock. Revised 7/15/2014

NOAA, 2011. Endangered Species Act Section 7 Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Conservation Recommendations for the Columbia River Crossing (Federal #: HPP S001(250), Lower Columbia-Clatshanie Rivers (4th field HUC 1708003), Lower Colubmia River (4th field HUC 17080006), Lower Willamette River (4th field HUC 17090012), Oregon and Washington. NMFS, Northwest Region. NMFS No. 2010/03196. January 19, 2011.

NOAA, 2013a. Department of Commerce, National Oceanic and Atmosspheric Administration. Takes of Marine Mammals Incidental to Specifid Activities; Demolition and Constructon Activities of the Children's Pool Lifeguard Station at La Jolla, California. Federal Register, Vol. 78, No. 86, May 3, 2013.

NOAA, 2013b. "The Eastern Population of Steller Sea Lions, Now Recovered, Is Off the Threatened Species List." *NOAA Fisheries*. Accessed online September 13, 2016 at http://www.nmfs.noaa.gov/stories/2013/10/10_23_13eastern_steller_sea_lion_delisting.html

NOAA, 2008. Seal & Sea Lion Facts of the Columbia River & Adjacent Nearshore Marine Areas. March 2008. Accessed online December 29, 2015 at http://web.pdx.edu/~zelickr/biology253/lecture-notes/notes/Dr.Cook.Lecture/CR-Pinniped-FS.pdf

NOAA, 2005. Department of Commerce, National Oceanic and Atmospheric Administration. Endangered Fish and Wildlife; Notice of Intent to Prepare an Environmental Impact Statement. Federal Register, Vol. 70, No. 7, Tuesday, January 11, 2005.

ODFW, 2015. Marine Resources Website: Marine Mammal Species. Accessed December 29, 2015 online at www.dfw.state.or.us/MRP/mammals.species.asp.

Parametrix, 2010. Request for Marine Mammal Protection Act Letter of Authorization for the Columbia River Crossing. November 2010.

Popper, A.n., and M.c. Hastings. "The Effects of Anthropogenic Sources of Sound on Fishes." *Journal of Fish Biology* 75.3 (2009): 455-89.

Profita, 2015. Hungry Sea Lions Pile Into The Columbia River. EarthFix. March 26, 2015. Accessed online December 29, 2015 at http://www.opb.org/news/article/hungry-sea-lions-pile-into-the-columbia-river/.

PSU, 2016. The Columbia River Basin, Study Area Background. Accessed September 14, 2016 at http://www.pdx.edu/columbia-basin/the-columbia-river-basin.

Reichmuth, Colleen, and Brandon Southall L. "Underwater Hearing in California Sea Lions (Zalophus Californianus): Expansion and Interpretation of Existing Data." *Marine Mammal Science* 28.2 (2011): 358-63. Accessed September 14, 2016 at: http://onlinelibrary.wiley.com/doi/10.1111/j.1748-7692.2011.00473.x/abstract

Stratton, E. "Once-starving Seals, Sea Lions Swarm Columbia River for Smelt, Salmon Runs." OregonLive. *The Oregonian*, 25 Mar. 2015. Accessed September 15, 2016 at: http://www.oregonlive.com/pacific-northwest-news/index.ssf/2015/03/hungry_in_california_pinnipeds.html

UNEP, 2012. Scientific Synthesis on the Impacts of Underwater Noise on Marine and Coastal Biodiversity and Habitats. UNEP/CBD/SBSTTA, Montreal, 10 April – May 2012. Accessed September 16, 2016 at https://www.cbd.int/doc/meetings/sbstta/sbstta-16/information/sbstta-16-inf-12-en.doc.

USACE, 2015a. Regional Sediment Management Program Portland District (NWP): Lower Columbia River – Regional Management Strategy, Oregon. USACE Engineer Research and Development Center, January 2015.

USACE, 2015b. Request for Incidental Harrasment Authorization and a Letter of Authorization Under the Marine Mammal Protection Act for Rehabilitation of the Jetty System at the Mouth of the Columbia River: North Jetty, South Jetty, and Jetty A. USACE Portland District. Revised June 2015.

Wiles, G. J. 2015. Washington State Periodic Status Review for the Steller Sea Lion. Washington Department of Fish and Wildlife, Olympia, Washington. 38 pp.

Wright, Bryan E., Mathew Tennis J., and Robin Brown F. "Movements of Male California Sea Lions Captured in the Columbia River." Northwest Science 84.1 (2010): 60-72. Accessed online September 12, 2016 at https://www.researchgate.net/profile/Bryan_Wright2/publication/228658288_Movements_of_Male_California_Sea_Lions_Captured_in_the_Columbia_River/links/5464dcb60cf25b85d17d2083.pdf.

WSDOT, 2016. Pile Diameter and Noise Levels. Accessed September 14, 2016 at http://www.wsdot.wa.gov/NR/rdonlyres/AF4933DD-46D6-4B8A-8644-487D45B19F6E/0/ImpactPileNoise7_12.pdf.

WSDOT, 2017. Advanced Training Manual. Biological Assessment Preparation for Transportation Projects. February, 2015. Accessed online at http://www.wsdot.wa.gov/Environment/Biology/BA/BAguidance.htm#manual.

WSDOT, 2011. Port Townsend Dolphin Timber Pile Removal – Vibratory Pile Monitoring Technical Memorandum. January 3, 2011. Accessed online at http://www.wsdot.wa.gov/NR/rdonlyres/062B9D1E-0908-47EC-BECE-6E9A0BBBC53B/0/PortTownsendTimberPileRemoval.pdf.

# APPENDIX A