U.S. Coast Guard Station Siuslaw River Project

Request for Marine Mammal Protection Act Incidental Harassment Authorization

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LIST OF ACRONYMS

AUD INJ	Auditory Injury
BMPs	Best Management Practices
CFR	Code of Federal Regulations
dB	Decibels
dBA	A-Weighted decibels
DPS	Distinct Population Segment
ESA	Endangered Species Act
FR	Federal Register
ft	Feet
GRLWEAP	GRL Engineers Inc. Wave Equation Analysis of Pile Driving
H	Horizontal
HAZMAT	Hazardous Materials
HF	High frequency
Hz	Hertz
IHA	Incidental Harassment Authorization
IWWW	In-water work window
ISO	International Organization for Standardization
kHz	Kilohertz
L_E	Sound Exposure Level
$L_{E, 24h}$	Cumulative sound exposure over a 24-hour period
LF	Low frequency
LID	Low Impact Development
L_{max}	Maximum Sound Pressure Level
L_{pk}	Peak Sound Pressure Level
M	Meter
MHHW	Mean Higher High Water
MLB	Motor Lifeboat
MMPA	Marine Mammal Protection Act
μPa	Micropascal
M/SI	Mortality/Serious Injury
NIHL	Noise-induced hearing loss
N_{min}	Minimum Population Estimate
NOAA	National Oceanic and Atmospheric Administration

NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries Service
OA	Otariids in Air
ODFW	Oregon Department of Fish and Wildlife
OW	Otariids in Water
PA	Phocid in Air
PBR	Potential Biological Removal
PGIS	Pollution Generating Impervious Surface
PPE	Personal protective equipment
PSO	Protected Species Observer
PTS	Permanent Threshold Shift
PW	Phocid Pinniped underwater
RM	River Mile
RMS	Root mean square
SAR	Stock Assessment Report
SEL	Sound Exposure Level
SEL_{cum}	Accumulated Sound Energy
SF	Square Foot
SPCC	Spill Prevention, Containment, and Countermeasure
SPL	Sound Pressure Level
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sediment Control
TTS	Temporary Threshold Shift
USCG	United States Coast Guard
V	Vertical
VHF	Very High Frequency
ZOI	Zone of Influence

1.0 INTRODUCTION & DESCRIPTION OF ACTIVITIES

1.1 INTRODUCTION

Pursuant to the Marine Mammal Protection Act (MMPA) Section 101(a)(5)(D), this document constitutes a request for an Incidental Harassment Authorization (IHA) for the take of marine mammals incidental to a U.S. Coast Guard (USCG) project to correct shoreline erosion and replace the covered mooring and appurtenant structures at USCG Station Siuslaw River (Station) in Florence, Oregon. This application includes the potential effects of the project's proposed activities on marine mammals and their habitat in the region, as well as mitigation measures and monitoring protocols to minimize those effects. This IHA is submitted to ensure the project does not result in takes that exceed the numbers and levels of those requested.

The project is divided into two phases of construction activities. For take authorization purposes, activities that may result in the take of marine mammals discussed in this application are part of phase 2 which is expected to occur in year 2. This IHA is intended to cover in-water and over-water demolition and pile driving activities that may result in takes of marine mammals for one year beginning on November 1, 2025 and which are anticipated to continue through October 31, 2026.

1.2 DESCRIPTION OF ACTIVITIES

Both onshore (upland) and overwater or in-water activities will occur during this project. Project activities include site preparation, demolition, shoreline stabilization measures, pile removal and installation, and overwater construction. The USCG proposes to install an interlocking steel pile wall along the length of the Station property waterfront with the top of the wall above the mean higher high water (MHHW). elevation to correct shoreline erosion while minimizing project impacts below the MHHW elevation. The proposed infrastructure, including a covered mooring (boathouse), bridge, and debris boom, will be constructed in the same location as the existing infrastructure but the covered mooring will have a slightly larger footprint and will be engineered to resist weathering and future riverbed scour.

The project footprint, or the limits of direct construction-related ground disturbance, will include onshore (upland) areas, and areas of in-water or overwater work. Areas of disturbance within the project area are depicted in Figure 1-1. Onshore disturbance, or disturbance above the MHHW elevation, will include upper slope stabilization measures including a new sheet pile wall and a retaining wall, site preparation, demolition, excavation and fill in uplands for stormwater infrastructure improvements, stockpile areas, and fencing to accommodate slope stabilization measures. In-water or overwater disturbance areas, or disturbance below the MHHW elevation, will include removal of up to 71 existing timber and steel H-piles, the boathouse superstructure and pier access bridge, and fixed debris screen supports; and installation of up to 79 replacement steel piles for replacement of the boathouse, access pier bridge, and fixed debris screen.

In addition to construction activities associated with the shoreline correction and boathouse replacement, the federal action includes temporary use of mooring and parking facilities found at the downtown waterfront of Florence. Use of these facilities would not require modification of navigation or mooring facilities and will not result in additional in-water disturbance other than minor noise in keeping

with existing waterfront activities from daily ingress or egress of USCG motor lifeboats (MLBs). Due to the low impact of this component of the proposed action, it is not discussed further in this document.

Phasing

Construction for all project aspects is anticipated to occur in two phases over an approximate two-year duration (2025-2027), depending on environmental and regulatory requirements, final plans and specifications, and options awarded to the construction contractor. Activities occurring during each phase are described in Section 2.1. This IHA addresses activities in year 2, for Phase 2.

Figure 1-1. Project Site Map

1.2.1 Onshore Infrastructure Improvements and Sitework

The existing, upland storm drain system consists of storm drain pipes and structures, and a below-surface horizontal drain array that collects at a triangular soil nail wall catchment area. The collected stormwater and groundwater are combined to discharge near the top of the slope through a controlled outfall protected with rip rap.

Stormwater improvements will include minor modifications including some Low Impact Development (LID) storm system features that will reduce erosion and sedimentation loss at the project site. No additional impervious surface area will be added as part of the project. The concept is to adjust the existing storm drainage system and convey the stormwater to a single outfall and discharge beyond the new sheet pile wall onto an energy dissipater. Existing drainage structures will be retrofitted with manufactured treatments such as filter inserts for water quality treatment and LID best management practices (BMPs) will be incorporated where feasible to meet the City of Florence stormwater design standards. BMPs included in final designs may include but would not be limited to bioswales with engineered soils/gravel and a subsurface drain to emphasize filtration, storage, and evaporation and transpiration before runoff is conveyed to the outfall. The project will likely result in a slight, net decrease in existing impervious surfaces. The project will include the following onshore stormwater infrastructure improvements:

- Addition of drainage swales with gravel trench drains to redirect runoff from the embankment and to slow down the surface flow and collect groundwater flow. The stormwater in the swale will discharge into the triangular soil nail wall catchment area prior to outfalling through a controlled outlet structure.
- Addition of a trench drain to collect stormwater runoff currently flowing down the pier access driveway and over the embankment. The trench drain will redirect the runoff into a drainage structure which will release runoff at a controlled rate and prevent stormwater discharge onto the steep slope.
- Retrofit or replacement of existing catch basins with water quality filtration unit(s) to treat runoff from impervious surfaces considered to be a significant source of pollutants in stormwater runoff, or pollution generating impervious surfaces (PGIS), before being conveyed and discharged from an outfall at the riprap layer. Filtration units specifically designed to capture specific pollutants such as zinc, copper, and sediments will be installed.
- Reconstruction of drainage outlet structure including water quality filtration inserts.
- A grassy swale underlain by a gravel trench will be installed along the top of the steep slope to collect lawn area surface sheet flows and shallow subsurface flows and convey them to the outfall onsite.
- A surface-mounted storm outfall pipe anchored to the embankment slope will replace the existing outfall. The new outfall will discharge beyond the new sheet pile wall to an energy dissipater to prevent embankment erosion at the upper elevation.
- Minor asphalt pavement repairs in the parking lot where the embankment failure occurred.
- Shoreline stabilization including pile walls, a retaining wall and embankment reestablishment with native vegetation as described in the following section.

1.2.1.1 Shoreline Stabilization (Phase I)

Shoreline stabilization will be accomplished through construction of an upland, steel interlocking pile wall, with the above-grade portion of the wall above the 50-year calculated extreme tide level (Figure 1-2). The top of the wall will be approximately 3.5 meters (m) (12 feet; ft) above MHHW. It will run

approximately 111 m (400 ft) along the top of bank from approximately the north property line to the south property line, with approximately 9 m (30 ft) returns inland and upslope at either end. The wall will implement a long-term solution by adding a rigid structure of steel sheet or pipe piles, with grouted soil tie-back anchors located near the top of the wall, that would retain upper and lower slope sands and mitigate negative scour effects on the soils landward of the wall. A drainage element (e.g., weep hole) through the wall at the elevation where the paleosol layer contacts the upper dune sands will facilitate a free-draining retention system (e.g., a nonwoven geotextile or an open-graded aggregate filter) to relieve groundwater flow and prevent loss of dune sand material.

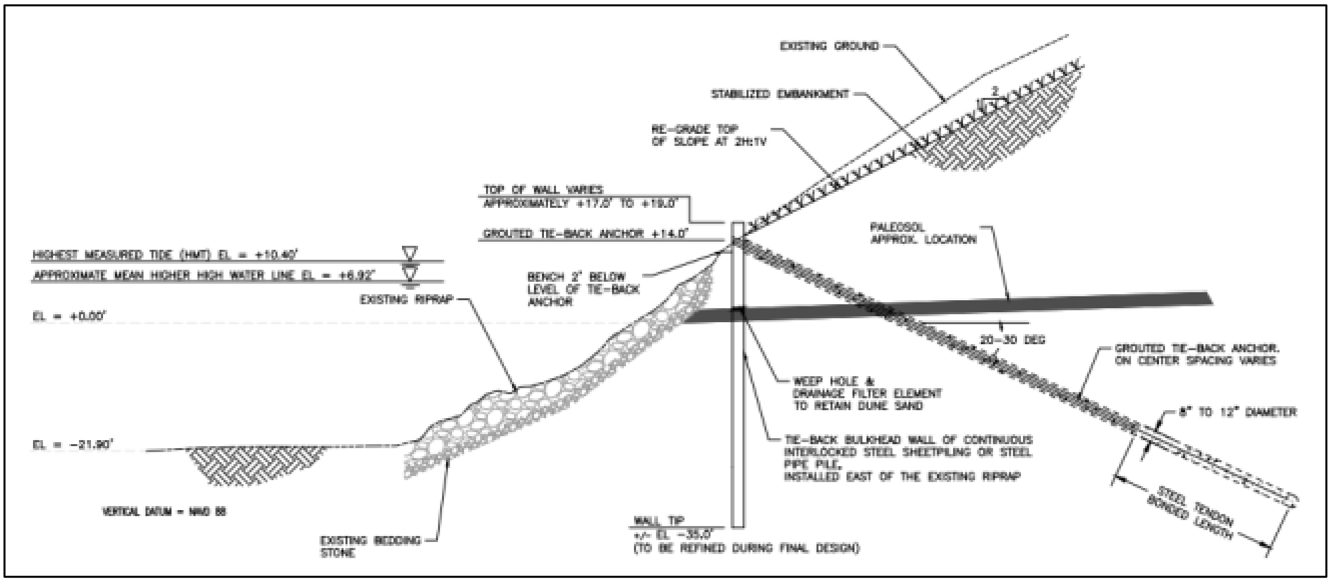

Figure 1-2. Preliminary design of a typical section for the tubular steel interlocking pile wall

Sheet or pipe pile installation would be a combination of auger predrilling and/or hydraulic press-in installation, as opposed to driven or vibratory installation approaches, which were determined to be less desirable as primary methods of installation, considering the hardness of the Lower Dune Sand layer and the potential for negative impacts to the marginally unstable slope. The wall is planned to be installed above MHHW, just upslope of the existing riprap installed in 2016, which will be disturbed as little as possible. It should be noted that scour forces in the river at this location are significant and have changed the depth of the riverbed to a great extent in this location over the last sixty years. It is entirely possible that future scour will remove more bank material and remove or relocate the riprap and leave a more significant wall height exposed on the river side. The wall will be structurally designed for this potential future retained height.

Upslope of the proposed pile wall, protection against seepage-induced erosion and washout of lower sands will be provided to prevent undermining and erosion of the silt layer. The sand slope above the wall will be graded to maximum slope of two horizontal to one vertical (2H:1V) and stabilized and protected through application of a geocell cellular confinement geotextile, nonwoven geotextile filtration system with granular stone embankment material, biotic soil media planted with native vegetation or a combination thereof. Several surface swales with gravel trench drains will be added to divert surface runoff from sheet-flowing down the embankment and channeling them to the existing underground storm drain system. The existing outfall at the downstream end of the stormwater system will be extended with a pipe that will be placed at-grade with cutoff concrete collars and outfall beyond the new wall.

A second, smaller wall is proposed near the crest of the slope at the edge of the existing parking lot in the southwest corner of the property. This wall will be a cantilevered design, with the pile embedment taking into consideration the regraded slope of 2H:1V.

1.2.2 Overwater and In-Water Infrastructure Demolition and Replacement (Phase II)

The Station's existing covered mooring (boathouse), bridge, and debris boom will be demolished, and all piles will be removed. Piles supporting the boathouse to be removed include the original timber vertical piles and timber batter piles installed in 1969, and steel H-piles installed in 2008. Demolition debris and materials will be transported to a permitted landfill and/or recycling facility. In total, approximately 71 piles will be removed by vibratory hammer. A conservative estimate for vibratory extraction is 15 minutes per pile. If any timber piles break during removal, the remaining portion of the broken piles will be cut 0.6 m (two ft) below the mud line. Removed piles will be disposed of in an upland location.

As shown in the project drawings (Appendix A),the following new facilities will be constructed: a 4,730 square foot (SF), two-bay covered mooring, including an interior floating dock for two 14 m (47 ft) MLBs, a mezzanine and deck space for engineering shop, storage, personal protection equipment (PPE) and hazardous materials (HAZMAT); a 1,220 SF pedestrian bridge, including a small marine diesel fueling platform; a 520 SF exterior floating dock; and a vertical debris screen. Total overwater structures will cover approximately 6,500 SF. It is estimated that up to 79 replacement steel piles will be necessary to reconstruct the boathouse, floating docks, bridge, and debris screen. The new piles will be 16-inch to 20-inch steel pipe piles filled with concrete, and/or 14-inch steel H-Piles which will be installed by vibratory driving and driven to the final tip elevation by impact strikes after the initial vibratory set. The exact sizes and quantities of pipe piles used will be determined through the remaining design iterations. In the event a small number of smaller diameter piles are used, these are still covered by this IHA as detailed in the analyses provided in Chapter 5. The USCG may opt for a smaller set of piles than the ones evaluated in detail in this IHA and in the Acoustic Modelling Report (Appendix B). The Level A and Level B Zones of Influence (ZOIs) in this IHA are inclusive of these smaller piles, should they be used.

The new pier access and debris screen will be constructed in approximately the same footprint as the existing structures to minimize riverbed soil disturbance and shadowing from overwater structures. The new covered mooring footprint will be approximately 1,800 SF larger than the existing structure. The southeast corner will be placed in the same location, but the west end of the structure will extend 8.3 m (30 ft) further out into the Siuslaw River to accommodate the two 47 ft MLBs. The existing covered mooring width is insufficient for mooring the two 47 ft MLBs. This will result in additional shadowing compared to existing conditions.

To mitigate for the additional pilings (approximately eight), and expansion of the covered mooring (approximately 1,800 SF), the Applicant is proposing to purchase 2,000 SF of estuarine credits from the Wilbur Island Mitigation Bank and is currently coordinating with the Oregon Department of State lands on the credit approval and purchase. Estuarine wetlands have historically been degraded and lost in the Siuslaw watershed.

1.2.3 Equipment and Methods

During Phase I, it is anticipated that the installation of the upland pile wall would be from a barge or similar floating work platform which would also serve as the primary staging area. Typical equipment for this work would include a drill or hydraulic rig (or both), an appropriately sized crawler crane or tracked hydraulic excavator (or both) for mounting and operation of the drill or hydraulic rigs operated from a spud barge, and a support and materials barge. A small support boat and barge tug would be required periodically for positioning equipment or materials. To facilitate construction of the pile wall a bench will be needed on the upper slope (above MHHW) for access or another similar means to construct the wall and install the tie-backs. The upper slope will be fully restored including invasive removal and native revegetation with a contractor-required establishment and maintenance period.

During Phase II, upland site and stormwater infrastructure work will require a staging area designated within the Station’s property for heavy equipment and materials. A temporary stockpile area or areas will also be designated. Temporary erosion and sediment control BMPs, including outlet protection, inlet protection, biofilter bags, stabilized construction entrances, sediment fencing, and straw wattles as appropriate for site conditions will be installed prior to ground disturbance. Typical equipment for this work would include one or more appropriately sized tracked hydraulic excavators, wheel loader, track loader, on-road dump truck(s), water pumps, pavement sawing equipment, compacting equipment, paving machinery, and common landscaping equipment. Excavated materials will either be stockpiled for reuse or removed from the site to a permitted landfill as per the final plans and specifications. Disturbed natural area grades and vegetation will be restored upon completion of stormwater infrastructure upgrades and sitework.

Piling removal is expected to be accomplished with a vibratory pile driver/extractor mounted to a crawler crane operated from an appropriately sized spud barge. Removed piles will be staged on a second demolition debris barge for transportation. All pier pilings and timbers to be demolished are either steel, or wood creosote or salt treated. The contractor will be required to ensure that these timbers are handled and disposed of in accordance with applicable local, state, and federal regulations. The contractor will also be required to perform all required sampling and analysis and provide any required shipping and disposal paperwork. In addition, if any unidentified or unexpected hazardous materials are discovered during demolition work, the contractor will be required to immediately notify the USCG prior to commencing any further cleanup of the discovered materials.

Construction of the overwater and in-water infrastructure would be accomplished from a barge, or multiple barges, using similar equipment as described above for installation of the pile wall. It is assumed that up to three piles will be driven each 8-hour workday. The actual driving time for each pile could be as much as approximately one hour but is anticipated to be less. Thus, an estimated 28 total days of pile driving (not all consecutive) and 20 days of non-consecutive pile removal will occur over the duration of the project. Smaller work vessels and platforms will be utilized to construct the covered mooring superstructure.

Exact equipment requirements and construction means and methods for both phases will be determined through ongoing studies, surveys, and the design-build contractor’s design process using the final engineering designs, specifications, and estimates.

Table 1-1. Summary of Piles and Estimated Installation Requirements

Pile Diameter x thickness (inches)[1]	Supporting/Guiding	Total Number	Driver/Hammer	Estimated Strikes/Pile[2]	Estimated Minutes/Pile[2]	Estimated Blows/Minute[2]
20 x 0.625	Covered Mooring (Boathouse); Floating Docks; Bridge	49	D46	975	24	40
16 x 0.5	Boathouse; Debris Screen	30	D46	975	24	40

[1] All pile thicknesses provided are estimates as the selected design-build contractor will complete the actual design.
[2] Based on the GRL Engineers, Inc. Wave Equation Analysis of Pile Driving (GRLWEAP) model. The GRLWEAP model was used to calculate the estimated strikes, estimated minutes, and estimated blows. The GRLWEAP model was not used for sound source level or acoustic propagation modeling (see Appendix B for further details on acoustic modeling)
[3] Piles would be driven at a mudline elevation above 3.2 m (+10.5) feet NAVD88

2.0 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

2.1 DATES AND DURATIONS OF ACTIVITIES

The project is anticipated to occur over an approximate two-year period, depending on environmental and regulatory requirements, final plans and specifications, and options awarded to the design-bid-build contractor. It is also noteworthy that interlocking pipe piles are a specialized product with limited market sources which could in turn affect the schedule. The USCG would complete work to occur below the MHHW elevation during the Oregon Department of Fish and Wildlife (ODFW)-preferred in-water work window (IWWW) from November 1, 2025 to February 15, 2026. Over-water construction actions, or those action which will be performed waterward of MHHW but above the elevation of MHHW, may be performed outside of the IWWW subject to contractor means and methods complying with permitting and MMPA consultation conditions.

Phase I: Based on preliminary project acquisition planning, Phase I construction is expected to commence in early 2025 and take less than one year to complete. Initial steps include the mobilization of materials and equipment to construct the steel interlocking pile wall and initiate shoreline stabilization. There will be no in-water work during this phase.

Phase II: Mobilization, materials and equipment staging, and the demolition and construction of the over-water and in-water infrastructure would occur in Phase II. The in-water work is projected to occur in the ODFW-designated IWWW from November 1, 2025 through February 15, 2026, followed by remaining overwater work to construct the covered mooring superstructure later in the second phase during more favorable weather conditions.

While the project is divided into two phases of construction activities, for take authorization purposes activities that may result in the take of marine mammals discussed in this application are part of phase 2 only which is expected to occur in year 2. This IHA is intended to cover in-water and overwater demolition and pile driving activities that may result in takes of marine mammals for a duration of one year beginning on November 1, 2025 and which are anticipated to continue through October 31, 2026.

2.2 GEOGRAPHIC REGION

The Station is located on the river right (east) bank of the Siuslaw River at river mile (RM) 1.5, approximately 5 kilometers (3 miles) north-northwest of the downtown waterfront of the City of Florence in Lane County, Oregon (Figure 2-1). Vegetated dunes in the Oregon Dunes National Recreation Area, protected by a series of four rock groin structures, is located on the opposite bank of the Siuslaw River from the Station. This application considers the effects of noise disturbance that may occur in the project vicinity during both in-air and in-water construction activities at the USCG Station Siuslaw River property, and a temporary mooring area proposed for use during construction. The project vicinity is shown in Figure 2-1.

Figure 2-1. Project Vicinity

Table 2-1. Project Location Attributes

Attribute	Description
Township, Range, Section	T18S, R12W, S15
Latitude, Longitude (decimal degrees)	44.002417, -124.122336
Nearest City	Florence, OR
County	Lane
12-digit Hydrologic Unit Code	Bernhardt Creek-Siuslaw River – 171002060804
Siuslaw River Mile	1.5

3.0 SPECIES AND NUMBERS OF MARINE MAMMALS

All marine mammals are protected by the MMPA and some by the Endangered Species Act (ESA). Marine mammals that have the highest potential to occur near the project area include the California sea lion (*Zalophus californianus*), Steller sea lion (*Eumetopias jubatus*), Pacific harbor seal (*Phoca vitulina*), and harbor porpoise (*Phocoena phocoena*) (ODFW 2024a). These species frequent the Oregon coast and adjacent nearshore marine areas (Carretta et al. 2023). A summary of each species' abundance (minimum population estimate; N_{MIN}), special status listings potential biological removal (PBR), annual mortality and serious injury (Annual M/SI) totals, and year of last stock assessment report (SAR) update is provided in Table 3-1.

Table 3-1. Summary of Marine Mammals Observed in the Project Vicinity

Common name	Stock	ESA/MMPA Status	Stock Abundance (N_{MIN})	PBR	Annual M/SI	SAR Last Revised
California sea lion[/a]	United States	Not listed / Protected	233,515	14,011	≥321	2019
Steller sea lion[/b]	Eastern U.S.	Not listed / Protected	36,308	2,178	93.2	2023
Pacific harbor seal[/a]	Oregon/Washington Coast	Not listed / Protected	24,732[/c]	undetermined[/c]	10.6	2014
Harbor porpoise[/a]	Central Oregon	Not listed / Protected	5,332	53	0	2023

Notes: /a Carretta et al. 2023, /b Young et al. 2023, /c population estimate, no current information on abundance is available to obtain a minimum population estimate or PBR for the Oregon/Washington Coast stock of harbor seals.

California sea lions, Steller sea lions, and harbor seals are the species most likely to occur within the immediate project vicinity. The nearest haul-out for pinniped species is for harbor seals across the river from the Station, approximately 500 m (1,640 ft) away (ODFW 2024b). California and Steller sea lions are predominantly present seasonally during the winter months numbering in the hundreds, and harbor seals are present year-round numbering in the thousands (NOAA 2024a; NOAA 2024b). Harbor porpoises may also transit the area year-round, though in very small numbers as compared to California sea lions, Steller sea lions, or harbor seals. Additional information regarding species abundance, range, status, and management is provided in Section 4.

Takes incidental to construction activities at the Station are anticipated for each of these species depending on the type of activity and distance from sound sources. Types and estimates of anticipated incidental takes for each species are described in greater detail in Sections 5 and 6.

Other marine mammal species considered for the project area include killer whales (*Orcinus orca*). Killer whales may be from different ecotypes which are genetically distinct and have different natural history (feeding, breeding, habitat) preferences. Killer whales in the project vicinity would be expected to be from the Southern Resident ESA-listed endangered distinct population segment (DPS) but could also be the transient or offshore ecotypes. This species is commonly observed along the Oregon coast at different times of the year. Killer whales occur in the Siuslaw river incidentally and have been opportunistically reported near and within the Siuslaw River mouth (KMTR 2016; Umpqua River Haven 2017). While there have been occasional sightings in the Siuslaw River near its mouth at certain times of the year, killer whales are more likely to be found outside of the river mouth and further offshore. For these reasons, takes of these species during project activities are not anticipated, and this application does not further evaluate impacts to these cetacean species.

4.0 AFFECTED SPECIES STATUS AND DISTRIBUTION

The following sections provide additional information on the species that have the greatest potential to be affected by project activities.

4.1 CALIFORNIA SEA LIONS

4.1.1 General Biology

California sea lions have broad front flippers, visible ear flaps, and long, narrow snouts. Adult males are typically larger and darker brown than females, which are smaller and can be blonder to more tan in color. They 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 four to five years old, and they have a lifespan of 20 to 30 years. They feed on squid, anchovies, mackerel, rockfish, and sardines and their movement often follows food supply patterns (NOAA 2024a). Male California sea lions bark to communicate with other males and females and are typically social animals (NOAA 2024a).

4.1.2 Distribution and Range

California sea lions are distributed along the west coast of North America from central Mexico to southeast Alaska. National Oceanic and Atmospheric Administration (NOAA) Fisheries Service (NOAA Fisheries) divides the California sea lion population into three stocks based on rookeries and the international border. The U.S. stock waters range from the U.S. border with Mexico to the border with Canada. California sea lions do not breed in Oregon; their primary breeding areas range from the Channel Islands in southern California to central Mexico. Males migrate in the winter to feeding areas along the Oregon coast, while most females typically remain in southern waters closer to the rookeries. Males then return south for the breeding season from late June to early August, so their population in Oregon is highest during the winter months from September through May. California sea lions haul out on sandy beaches and rocky coves in addition to man-made marine structures such as docks, jetties, and buoys (NOAA 2024a).

California sea lions, particularly adult males (DeRango et al. 2019), are most commonly present in Florence in late summer through the fall during the post breeding season, though also may occur in smaller numbers in winter and early spring (Wright et al. 2010). They may be transiting through the project area during the IWWW from November through February during their migrations.

4.1.3 Status, Population Trends, and Threats

California sea lions are not listed under the ESA and the U.S. stock is not considered strategic or depleted under the MMPA (Carretta et al. 2023). The minimum population estimate is 233,515 animals, with an estimated net productivity rate of 7% each year, but NOAA Fisheries notes that the population is capable of faster growth rates (Carretta et al. 2023). Threats to this species include incidental catch and entanglement in fishing gear, biotoxins resulting from harmful algal blooms, and human-caused injuries and mortalities, particularly as California sea lions are sometimes viewed as a nuisance by commercial fishermen (NOAA 2024a). Exposure to anthropogenic sound has also been found to incite a variety of behavioral responses in California sea lions (Carretta et al. 2023).

4.2 STELLER SEA LIONS

4.2.1 General Biology

The Steller sea lion is the largest member of the "eared seal" family, *Otariidae.* Steller sea lions are light blonde to reddish brown in appearance and slightly darker on the chest and abdomen. Males can grow to approximately 3 m (9 ft) and 2,000 pounds, while females grow to approximately 1.8 m (6 ft) and 700 pounds (ODFW 2024a). They have a lifespan of 20-30 years, and are opportunistic predators, foraging and feeding primarily at night on a wide variety of fishes such as herring, mackerel, rockfish, and salmon, bivalves, squid, octopus, and gastropods (NOAA 2024b). 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 off the coast of central and southern Oregon during the months of June and July, with a gestation period of about 11.5 months. Males reach sexual maturity between three and eight years of age and can live to be 20 years old, while females reproduce for the first time at four to six years and can live to be 30 (NOAA 2024b).

4.2.2 Distribution and Range

The Steller sea lion range extends along the Pacific Rim, from northern Japan to central California. Those inhabiting US waters have been divided into two DPSs: the Western US DPS and the Eastern US DPS (Young et al. 2023). The population known to occur near the Port of Florence is the Eastern DPS (ODFW 2024a).

Steller sea lions haul out 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, including large breeding areas at Three Arch Rocks (Oceanside), Orford Reef (Port Orford), and Rogue Reef (Gold Beach) (ODFW 2024a). The Oregon Department of Fisheries and Wildlife Marine Mammal Program Atlas of Steller sea lion haul-out sites lists 11 different haul-out locations, with only one, the Sea Lion Caves, located close to the project area (ODFW 2024c). The Sea Lion Caves are a privately owned

wildlife preserve located 17 kilometers (11 miles) north of Florence and a well-known, year-round Steller sea lion haul-out area. Hundreds of sea lions are reported to inhabit the caves during winter months, moving to the rookery areas on the rock ledges in front of the caves during spring and throughout summer. The Steller Sea Lion Research Initiative conducted a large-scale study on the seasonal haul-out abundance patterns in Oregon and northern California. Authors pointed out the importance of Sea Lion Caves as a wintertime haul-out site and nursery during winter and spring and speculate that they caves may be an important site due to protection from weather and ocean conditions as well as availability of prey at nearby Heceta Bank (Scordino 2006).

It is likely Steller sea lions could be present near or in the project vicinity during their peak abundance in the winter, though fall occurrences are possible, with their presence less likely during spring and summer months.

4.2.3 Status, Population Trends, and Threats

Steller sea lions are not listed under the ESA, nor are they considered depleted or strategic under the MMPA. The current minimum population estimate for the Eastern DPS in U.S. waters is 36,308 individuals (Young et al. 2023). The Eastern DPS population is now considered stable and slightly increasing in size (ODFW 2024a). NOAA Fisheries estimated the eastern stock increased at a rate of 4.25% per year between 1987 and 2017, driven by growth in pup counts in all regions. Because of this steady population growth, the Eastern DPS was delisted under the ESA in 2013 and is not considered depleted or strategic under the MMPA (Young et al. 2023; NOAA 2024b).

Threats to Steller sea lions include vessel strikes, contaminants/pollutants, habitat degradation, illegal hunting or shooting, and interactions with fisheries including entanglement and changes in availability of prey. Critical habitat associated with breeding and haul-out sites in Alaska, California, and Oregon was designated on August 27, 1993 (58 Federal Register [FR] 45269) but does not overlap the project impact area.

4.3 PACIFIC HARBOR SEALS

4.3.1 General Biology

The Pacific harbor seal is the most widespread and abundant resident pinniped in Oregon. Their bodies are gray with light and dark speckling and adults can be up to 2 m (6 ft) in length and 300 pounds in weight. The Pacific harbor seals are part of the “true seal” family, *Phocidae*, lack external ear flaps, and have short forelimbs (ODFW 2024a). They are fast, agile swimmers, and as social animals, they form groups of several hundred individuals onshore. They eat mostly fish, shellfish, and crustaceans, and are considered non-migratory but have been documented traveling up to 725 kilometers (450 miles) seasonally to forage or give birth (NOAA 2024c).

Harbor seals mate at sea generally in the warmer months, and pupping season is from mid-April to July (NOAA 2024c). Males reach sexual maturity at five to six years of age, females sexually mature at two to five years, and they have a lifespan of about 25-30 years. Females can give birth to one pup each year, which weigh about 10 pounds and can swim at birth. Females leave their pups at haul-outs or along sandy beaches while searching for food. In Oregon, pups are born in late March through April (ODFW 2024a).

4.3.2 Distribution and Range

Five stocks of harbor seals are found along the west coast of North America from Baja California, Mexico to the Bering Sea. Individuals found along the Oregon coast belong to the Oregon/Washington Coastal stock. In 2014, the population of Pacific harbor seals along the Oregon coast was estimated at 11,565 individuals (Wright 2014). In 1999, it was estimated that the entire Oregon/Washington Coastal stock of Pacific harbor seals consisted of about 24,732 animals, no more recent estimates are available (Carretta et al. 2023).

Harbor seals haul-out at low tide on sand bars in most bays and estuaries along the Oregon coast, including at the mouth of the Siuslaw River near the project vicinity. Harbor seals tend to haul out in groups and females sometimes raise their pups in nurseries for protection from predators (ODFW 2024a). The Oregon Department of Fisheries and Wildlife Marine Mammal Program harbor seal study map depicts haul-out sites for harbor seals in the mouth of the Siuslaw River on both the east and west bank, approximately 500 m north of the Station (ODFW 2024b). In the mid-1980s NOAA conducted a three-year study to assess the status of pinniped populations in Oregon and found in the Siuslaw River that harbor seal numbers peak during winter, suggesting that the river may be important winter feeding area (Brown et al. 1988). In addition, pupping was recorded in the Siuslaw River during May, however in small numbers when compared to the other known pupping locations.

4.3.3 Status, Population Trends, and Threats

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 (Carretta et al. 2023). Threats to this species include incidental capture in fishing gear, weirs, vessel strikes, pollutants/contaminants, and harassment by humans while hauled-out on land (NOAA 2024c).

4.4 HARBOR PORPOISE

4.4.1 General Biology

Harbor porpoise are dark gray to black with lighter undersides and are the smallest of the Northern Pacific cetaceans, growing up to 1.5 m (5 ft) and weighing up to 165 pounds. They prefer estuaries, bays, nearshore waters typically less than 200 m (650 ft) deep (ODFW 2024d). They transit near the surface of the water, coming up to breathe about every 30 seconds, and forage small fish such as sardines and herring. Harbor porpoises are shy animals and typically avoid boats and wakes unlike other porpoise species. Mating most often occurs in the summer and most births occur from May to July following a ten- to eleven-month gestation period (NOAA 2024d).

4.4.2 Distribution and Range

The Harbor porpoise is found throughout the temperate coastal waters of the Northern Hemisphere. Seasonal movement of harbor porpoises appears to be tied to prey availability and ice-free waters. (NOAA 2024d). In general, harbor porpoises are found in waters < 650 ft in depth (Holdman et al. 2019).

Harbor porpoises along the Oregon coast are considered to be composed of three stocks, a northern, central, and a southern population. Individuals near the project vicinity are part of the Central Oregon stock of harbor porpoises, which includes animals near Coos Bay, Oregon in the south to Lincoln City, Oregon in the north. The Central Oregon stock of harbor porpoises consists of about 7,492 individuals as of 2023 with a minimum population estimate of 5,332 porpoises (Carretta et al. 2023). An acoustic monitoring program deployed recording devices at locations on a reef and offshore of the central Oregon coast, approximately 4 kilometers (2.5 miles; reef) and 12 kilometers (7.5 miles; offshore) southwest of the Yaquina River inlet for a six-month period from May to October 2014. Harbor porpoises were detected on 96% and 93% of the total monitored days at the reef and offshore site respectively, with peak detections during June and July (Holdman et al. 2019). Harbor porpoises are considered likely to occur in small numbers in the project area.

4.4.3 Status, Population Trends, and Threats

Harbor porpoises are not listed under the ESA, nor are they considered depleted or strategic under the MMPA. The primary threats to harbor porpoises are entanglement, pollution, and ocean noise (NOAA 2024d). They are preyed upon by killer whales in the Pacific Northwest (ODFW 2024d). Harbor porpoises may transit through the project area throughout the proposed construction activities.

4.5 SUMMARY

California sea lions, Steller sea lions, Pacific harbor seals, and harbor porpoises are the marine mammals with the highest potential to be present within the project vicinity during construction activities. None of these marine mammals are ESA-listed as threatened or endangered or considered depleted or strategic under the MMPA. Three of the marine mammals listed (Steller sea lions, California sea lions, and Pacific harbor seals) have documented haul-out locations or breeding areas in waters proximal or adjacent to the project vicinity; the only species likely to occur within the vicinity of the project area is the harbor seal which has the closest haul out site of any pinniped in the area; there is a haul out site located approximately 500 m (1,640 ft) away (ODFW 2024b). All three of these pinniped species may be present incidentally or more regularly to rest, forage, or transit the area during the construction period. It is possible that all four species may be impacted by noise generated during in-water pile driving from November 1 to February 15, as well as during demolition activities or over-water construction during the rest of the application request period. Other than exposure to underwater and airborne sounds, they are not anticipated to be impacted in any other way during the project.

5.0 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

Under Section 101(a)(5)(D) of the MMPA, the USCG requests an IHA for the take of small numbers of marine mammals, by both Level A and Level B harassment, incidental to pile driving and construction or demolition activities related to the proposed project. Pile driving and demolition are expected to produce sound levels that exceed the acoustic tolerance thresholds of marine mammals that have the potential to occur within the project vicinity. The USCG requests an IHA for incidental take of marine mammals during these construction activities for one year (the second phase of the project activities beginning on November 1, 2025. Project activities are anticipated to continue through October 31, 2026.

The MMPA (50 Code of Federal Regulations [CFR] 216.3) defines harassment as any act of pursuit, torment, or annoyance that:

1. has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or,
2. 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).

Level A harassment may result in injury or death, whereas Level B harassment causes only disturbance. Modeling of both in-air and underwater acoustic impacts was performed to analyze the effects of the proposed activities on marine and terrestrial biota. The full acoustic analysis, which includes detailed descriptions of the modeling calculations approach, modeled scenarios, and model input values, can be found in Appendix B.

5.1 IN-AIR NOISE

Current NOAA Fisheries' 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 decibel (dB) root mean square (rms) re 20 micropascal (μPa) for harbor seals and at or above 100 rms dB re 20 μPa for all other pinniped species. In the recent NOAA 2024 guidelines update (NOAA 2024e), additional in-air acoustic thresholds for phocid pinnipeds and otariid pinnipeds have been added, which are summarized in Table 5-3.

Table 5-1 presents the types of construction equipment anticipated for the project and corresponding maximum sound pressure levels (L_{max}) used for modeling potential in-air noise impacts. Construction equipment is measured using A-Weighted dB units known as dBA.

Table 5-1. Construction Equipment Source Levels, L_{max} dBA

Phase	Construction Equipment	Quantity	Equipment Noise Level at 50 ft., L_{max} dBA	Usage Factor (%)
Mobilizing construction equipment, developing staging areas, barge landing areas, and construction of sheet or pipe pile installation through combination of auger predrilling and/or hydraulic press-in installation (Phase 1) / Demolition (Phase 2)	Excavator	2	89 dB / 85 dBA	100
	Hoe Ram	2	97 dB / 90 dBA	100
	Front-end Loader	2	93 dB / 82 dBA	100
	Bulldozer	2	89 dB / 85 dBA	100
	Dump Truck	2	93 dB / 84 dBA	100
Piling Removal (Phase 2)	Vibratory Hammer	1	96 dB / 87 dBA	100
	Excavator	1	89 dB / 85 dBA	100

Phase	Construction Equipment	Quantity	Equipment Noise Level at 50 ft., L_{max} dBA	Usage Factor (%)
	Dump Truck	2	93 dB / 84 dBA	100
	Crane	1	97 dB / 85 dBA	100
	Grader	2	92 dB / 86 dBA	100
In-water Construction of infrastructure (Phase 2)	Vibratory Hammer	1	96 dB / 87 dBA	100
	Impact Hammer	1	119 dB / 103 dBA	100
	Excavator	1	89 dB / 85 dBA	100
	Dump Truck	2	93 dB / 84 dBA	100
	Crane	1	97 dB / 85 dBA	100

Sources: FHWA 2006 and DEFRA 2005

5.2 UNDERWATER NOISE

The sound level estimates presented in this modeling study are expressed in terms of several metrics and apply the use of exposure durations to allow for interpretation relative to potential biological impacts on marine life. The National Oceanic and Atmospheric Administration National Marine Fisheries Service ("NOAA Fisheries") issued a Technical Guidance that provides acoustical thresholds and defines the threshold metrics (NOAA 2024e). The ISO 18405 Underwater Acoustics – Terminology (ISO 2017) provided a dictionary of underwater bioacoustics for standardized terminology. Table 5-2 provides a summary of the relevant metrics from both NOAA Fisheries (2024) and ISO (2017) that are used within this report.

Table 5-2. Summary of Acoustic Terminology

Metric	NOAA Fisheries (2024)	ISO (2017)		Reference Value
		Main Text	Equations and Tables	
Sound Pressure Level	SPL	SPL	L_p	dB re 1 μPa
Peak Sound Pressure Level	PK	Lpk	$L_{p,pk}$	dB re 1 μPa
Cumulative Sound Exposure Level	SEL_{cum} [1]	SEL	L_E	dB re 1 μPa^2·s

Note:
1 NOAA Fisheries (2024) describes the cumulative sound exposure level ("SEL_{cum}") metric over an accumulation period of 24-hours. Following the ISO standard, this will be identified as SEL in the text and L_E will be used in tables and equations of this report with the accumulation period identified.

This report follows the ISO (2017) standard terminology and symbols for the sound metrics unless stated otherwise. Below are descriptions of the relevant metrics and concepts that should help frame the discussion of acoustics in this document. The majority of the information in the following sections provides further insight into how data and modeling results have been presented in accordance with regulatory reporting requirements and established criteria.

NOAA Fisheries provided guidance for assessing the impacts of anthropogenic sound on marine mammals under their regulatory jurisdiction, which includes whales, dolphins, porpoises, seals, and sea lions, which was updated in 2024 (NOAA 2024e). The guidance specifically defines marine mammal

hearing groups, develops auditory weighting functions, and identifies the received levels, or acoustic threshold levels, above which individual marine mammals are predicted to experience temporary or permanent shifts in their hearing sensitivity, which is altogether referred to as noise-induced hearing loss (NIHL) (NOAA 2024e).

NIHL is defined as changes in normal auditory function that occur because of noise exposure, which can be temporary or permanent i.e., temporary threshold shift (TTS) and auditory injury (AUD INJ) (NOAA 2024e). Upon acute exposure to loud underwater sounds, marine fauna may experience TTS. For TTS, the hearing threshold may return to normal after some period of time. If sufficient recovery time is not allowed, the hearing threshold is permanently altered; this alteration is referred to as AUD INJ which is assessed using dual metrics of peak sound pressure level ($L_{p,pk}$) and cumulative sound exposure level ($L_{E,p,24h}$). Under draft NOAA guidance, any occurrence of TTS or AUD INJ constitutes a Level A harassment. The sound emitted by anthropogenic sound sources may induce TTS or AUD INJ in an animal in two ways 1) exposure to peak sound pressures may cause damage to the inner ear and is often an instantaneous impact, or 2) the accumulated sound energy the animal is exposed to (i.e., cumulative sound exposure) over the entire duration of a discrete or repeated noise exposure has the potential to induce unrecoverable auditory damage if it exceeds distinct underwater hearing threshold levels, which vary depending on species.

Recognizing that marine mammal species have distinct hearing capabilities in different frequency ranges, marine mammals are categorized as being part of distinct "hearing groups" in regulatory guidance in the U.S. (Southall et al. 2019; Finneran 2024; NOAA 2024e). The frequency content of the sound (Croll et al. 2001), amplitude, as well as distinct species auditory characteristics, each play a role in the susceptibility of a marine animal to NIHL. Sound outside the generalized hearing range of the animal would be unlikely to affect its hearing as the sound energy within the hearing range is deemed most harmful; however, the generalized hearing ranges presented here are a guide rather than an absolute limit. The five hearing groups applicable to underwater sound as defined in the latest regulatory guidance are defined below (Southall et al. 2019; Finneran 2024; NOAA 2024e).

- *Low-frequency (LF) cetaceans*—this group consists of all baleen whale species with a generalized hearing range of 7 Hz to 36 kHz.

- *High-frequency (HF) cetaceans*—includes delphinids, odontocetes, beaked whales, and bottlenose whales, with a generalized hearing range of 150 Hz to 160 kHz.

- *Very high-frequency (VHF) cetaceans*—incorporates all the true porpoises, the river dolphins, plus Kogia spp., Cephalorhynchid spp. (genus in the dolphin family Delphinidae), and two species of Lagenorhynchus (Peale's [*Lagenorhynchus australis*)] and hourglass dolphins [*L. cruciger*]) with a generalized hearing range of 200 Hz to 165 kHz.

- *Phocids pinnipeds (phocid carnivores underwater [PW] and phocid carnivores in-air [PA])*—consists of true seals with a generalized hearing range of 40 Hz to 90 kHz underwater and 42 Hz to 52 kHz in-air.

- *Otariids pinnipeds* —includes sea lions and fur seals with a generalized hearing range of 60 Hz to 68 kHz underwater and 90 Hz to 40 kHz in-air. These are termed other marine carnivores in water [OW] or in air (OA) by Southall et al. [2019] and includes otariids, as well as walrus [Family *Odobenide*], polar bear [*Ursus maritimus*], and sea and marine otters [Family *Mustelidae*]).

Within these generalized hearing ranges, the ability to hear sounds varies with frequency, as demonstrated by examining audiograms of hearing sensitivity (NOAA 2024e; Southall et al. 2019). To reflect higher noise sensitivities at particular frequencies, auditory weighting functions were developed for each functional hearing group that reflected the best available data on hearing ability (i.e., composite audiograms), susceptibility to noise-induced hearing loss, impacts of noise above effective quiet threshold on hearing, and data on equal latency derived from audiograms (NOAA 2024e). These weighting functions are applied to the received sound level to reflect the susceptibility of each hearing group to NIHL, which is not the same as the range of best hearing as above. California sea lions and Steller sea lions fall within the otariid pinniped hearing group, harbor seals fall within the phocid hearing group, and harbor porpoise are part of the very high-frequency cetacean hearing group.

Table 5-3 provides acoustic threshold levels at which AUD INJ (which constitutes a Level A take), TTS, and Behavioral Disturbance (which constitutes a Level B take) are expected to occur for each marine mammal hearing group from exposure to impulsive and non-impulsive signals (NOAA 2023, 2024e).

Table 5-3. Acoustic Threshold Levels for Marine Mammals

Hearing Groups	Impulsive Sounds			Non-Impulsive Sounds		
	AUD INJ Onset	TTS Onset	Behavior	AUD INJ Onset	TTS Onset	Behavior
UNDERWATER						
Low-frequency cetaceans	222 dB ($L_{p,pk}$) 183 ($L_{E, LF, 24h}$)	216 dB ($L_{p,pk}$) 168 dB ($L_{E, LF, 24h}$)	160 dB (L_p)	197 dB ($L_{E, LF, 24h}$)	177 dB ($L_{E, LF, 24h}$)	120 dB (L_p)
High-frequency cetaceans	230 dB ($L_{p,pk}$) 193 dB ($L_{E, HF, 24h}$)	224 dB ($L_{p,pk}$) 178 dB ($L_{E, HF, 24h}$)		201 dB ($L_{E, HF, 24h}$)	181 dB ($L_{E, HF, 24h}$)	
Very high-frequency cetaceans	202 dB ($L_{p,pk}$) 159 dB ($L_{E, VHF, 24h}$)	196 dB ($L_{p,pk}$) 144 dB ($L_{E, VHF, 24h}$)		181 dB ($L_{E, VHF, 24h}$)	161 dB ($L_{E, VHF, 24h}$)	
Phocid pinnipeds underwater	223 dB ($L_{p,pk}$) 183 dB ($L_{E, PW, 24h}$)	217 dB ($L_{p,pk}$) 168 dB ($L_{E, PW, 24h}$)		195 dB ($L_{E, PW, 24h}$)	175 dB ($L_{E, PW, 24h}$)	
Otariid pinnipeds underwater	230 dB ($L_{p,pk}$) 185 dB ($L_{E, OW, 24h}$)	224 dB ($L_{p,pk}$) 170 dB ($L_{E, OW, 24h}$)		199 dB ($L_{E, OW, 24h}$)	179 dB ($L_{E, OW, 24h}$)	
IN-AIR						
Phocid pinnipeds in-Air (PA)	162 dB ($L_{p,pk}$) 140 dB ($L_{E, PW, 24h}$)	156 dB ($L_{p,pk}$) 125 dB ($L_{E, PW, 24h}$)	90 dB (L_p)	154 dB ($L_{E, PW, 24h}$)	134 dB ($L_{E, PW, 24h}$)	90 dB (L_p)
Otariid pinnipeds in-air (OA	177 dB ($L_{p,pk}$) 163 dB ($L_{E, OW, 24h}$)	171 dB ($L_{p,pk}$) 148 dB ($L_{E, OW, 24h}$)	100 dB (L_p)	177 dB ($L_{E, OW, 24h}$)	157 dB ($L_{E, OW, 24h}$)	100 dB (L_p)

Sources: NOAA 2023, 2024e
AUD INJ = Auditory Injury
$L_{E, 24h}$ = cumulative sound exposure over a 24-hour period (dB re 1 μPa^2·s for underwater and dB re 20 μPa^2·s for in-air).
$L_{p,pk}$ = peak sound pressure (dB re 1 μPa for underwater and dB re 20 μPa for in-air);
L_p = root mean square sound pressure (dB re 1 μPa for underwater and dB re 20 μPa for in-air)
TTS = Temporary Threshold Shift

Table 5-4 presents a summary of construction and operational scenarios that are included as part of the proposed project activities.

Table 5-4. Underwater Acoustic Modeling Scenarios

Scenario	Description	Location (UTM Coordinates)	Hammer Energy (kilojoule)	Total Hammer Blows	Apparent Source Level (at 10 meters)[2]
1	Impact pile driving installation, diameter: 24-inch	409931 m, 4872709 m	160	45 blows per minute for 27 minutes (1,230 total blows)[1]	207 $L_{p,pk}$ 178 $L_{E,\ 1sec}$ 194 L_p
2	Impact pile driving installation, Diameter: 18-inch[3]	409931 m, 4872709 m	105	45 blows per minute for 21 minutes (924 total blows)[1]	203 $L_{p,pk}$ 171 $L_{E,\ 1sec}$ 182 L_p
3	Impact pile driving installation, Diameter: H-Pile 14x117	409931 m, 4872709 m	105	45 blows per minute for 13 minutes (570 total blows)[1]	200 $L_{p,pk}$ 166 $L_{E,\ 1sec}$ 178 L_p
4	Vibratory hammer pile installation, diameter: 24-inch	409931 m, 4872709 m	N/A	60 minutes	165 $L_{E,\ 1sec}$
5	Vibratory hammer pile installation, diameter: 18-inch[3]	409931 m, 4872709 m	N/A	45 minutes	158 $L_{E,\ 1sec}$
6	Vibratory hammer pile removal, Diameter: 24-inch	409931 m, 4872709 m	N/A	15 minutes	162 $L_{E,\ 1sec}$

Notes and Abbreviations:
[1] The total number of blows and duration represents the installation of three piles per day. The duration provided in minutes has been rounded to the nearest whole number.
[2] Source levels were based on similar pile installations published by CALTRANS (CALTRANS 2020)
[3] A 24-inch pile diameter was modeled to represent the worst-case project design levels for underwater noise ZOIs. Recent updates to the project design incorporate options for a 14-inch, or 16-20 inch pile diameters using the same hammer energy and number of blows. Reducing the pile diameter would result in the same or slightly lower noise levels and are covered by the modelled ZOIs.

6.0 TAKE ESTIMATES FOR MARINE MAMMALS

6.1 IN-AIR ACOUSTIC RESULTS

The Cadna-A® computer noise model was used to calculate sound pressure levels associated with project construction activities. The current International Organization for Standardization (ISO) standard for outdoor sound propagation, ISO 9613 Part 2, “Attenuation of Sound during Propagation Outdoors,” was used within Cadna-A®. Table 6-1 presents the predicted distances to the relevant in-air acoustic thresholds for harbor seals and other pinnipeds. Figure 6-1, Figure 6-2, and Figure 6-3 depict the in-air acoustic distance thresholds. All figures other than Figure 6-1 are related to Phase 2.

Sound levels during Phase 1 activities due to nearshore and over-water construction activities may cause behavioral disturbance to harbor seals if they are within 97 m (318 ft) and non-impulsive AUD INJ to harbor seals if they are within 1.8 m (6 ft). For other pinnipeds behavioral disturbance could occur within 26 m (85 ft).

During pile installation, sound levels during Phase 2 activities above the acoustic behavioral disturbance threshold for harbor seals may travel are far as 746 m (2,447 ft) and up to 7.6 m (25 ft) for impulsive AUD INJ. The behavioral acoustic threshold for all other pinnipeds will be exceeded up to 205 m (672 ft). This may result in avoidance of nearby waters by various marine mammals during noise producing in-air construction activities (i.e., pile installation) during Phase 2. However, since pile installation in-water threshold distances are larger than in-air, we assumed the threshold distances (1,117 m [3,665 ft]; Table 6-6) for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates.

Pile removal behavioral threshold distances are also shown in Table 6-1 (i.e., 430 m [1,410 ft] for harbor seals; 2.4 m [8 ft] for non-impulsive AUD INJ; 106 m [348 ft] for other pinnipeds). However, since pile removal in-water threshold distances are larger than in-air, we assumed the threshold distances (1,106 m [3,629 ft]; Table 6-6) for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates.

Table 6-1. In-air Acoustic Modeling Results - Distances of Maximum Disturbance, dB

Construction Phase	Phocid pinnipeds				Otariid pinnipeds			
	Impulsive AUD INJ		Non-Impulsive AUD INJ	Behavior	Impulsive AUD INJ		Non-Impulsive AUD INJ	Behavior
	162 dB ($L_{p,pk}$)	140 dB ($L_{E, PW, 24h}$)	154 dB ($L_{E, PW, 24h}$)	90 dB L_p	177 dB ($L_{p,pk}$)	163 dB ($L_{E, OW, 24h}$)	177 dB ($L_{E, OW, 24h}$)	100 dB L_p
Mobilizing construction equipment, developing staging areas, barge landing areas, and demolition	N/A	N/A	6 ft (1.8 m)	318 ft (97 m)	N/A	N/A	-[1]	85 ft (26 m)
Piling Removal	N/A	N/A	8 ft (2.4 m)	1,410 ft (430 m)	N/A	N/A	-[1]	348 ft (106 m)
Construction of tubular pile wall and offshore infrastructure	-[1]	25 ft (7.6m)	N/A	2,447 ft (746 m)	-[1]	-[1]	N/A	672 ft (205 m)

Sources: NOAA 2023, 2024e
$L_{E, 24h}$ = cumulative sound exposure over a 24-hour period (dB re 20 μPa^2·s).
$L_{p,pk}$ = peak sound pressure (dB re 20 μPa);
L_p = root mean square sound pressure (dB re 20 μPa)
N/A = Not applicable
[1] The threshold level is greater than the source level; therefore, distances are not generated.

6.2 UNDERWATER ACOUSTIC RESULTS

Underwater acoustic modeling was completed (see Appendix B) to assess distances to the various acoustic threshold levels for marine mammals identified in Section 5 for each scenario summarized in Table 5-3. The distances to each hearing groups' respective hearing thresholds resulting from impact pile driving (24-inch and 18-inch piles) are shown in Table 6-2.

Table 6-2. Marine Mammal AUD INJ Onset Criteria Threshold Distances (meters) for Impact Pile Driving

Pile Type	Scenario	Hearing Group a/									
		LF cetaceans		HF cetaceans		VHF cetaceans		Phocid pinnipeds		Otariid pinnipeds	
		222 dB $L_{p,pk}$[1,2]	183 dB $L_{E,24h}$[1,2]	230 dB $L_{p,pk}$[1,2]	193 dB $L_{E,24h}$[1,2]	202 dB $L_{p,pk}$[1,2]	159 dB $L_{E,24h}$[1,2]	223 dB $L_{p,pk}$[1,2]	183 dB $L_{E,24h}$[1,2]	230 dB $L_{p,pk}$[1,2]	185 dB $L_{E,24h}$[1,2]
24-inch Pile Impact	**Unmitigated**	**--**	**386**	**--**	**45**	**20**	**335**	**--**	**256**	**--**	**95**
	Mitigation (-5 dB)	--	215	--	24	8	237	--	121	--	56
18-inch Pile Impact	**Unmitigated**	**--**	**137**	**--**	**18**	**14**	**187**	**--**	**89**	**--**	**41**
	Mitigation (-5 dB)	--	74	--	--	5	112	--	46	--	21
H-Pile 14x117 Impact	**Unmitigated**	**--**	**52**	**--**	**--**	**--**	**96**	**--**	**35**	**--**	**18**
	Mitigation (-5 dB)	--	25	--	--	--	59	--	19	--	--

[1]NOAA 2024e
[2]Level A AUD INJ

The distances to each hearing groups' respective hearing thresholds resulting from vibratory pile driving and removal (24-inch and 18-inch piles) are shown in Table 6-3.

Table 6-3. Marine Mammal AUD INJ Onset Criteria Threshold Distances (meters) for Vibratory Hammer Pile Installation and Removal

Pile Type	Scenario	Hearing Group [a/]				
		LF cetaceans	HF cetaceans	VHF cetaceans	Phocid pinnipeds	Otariid pinnipeds
		197 dB $L_{E,24h}$[1,2]	201 dB $L_{E,24h}$[1,2]	181 dB $L_{E,24h}$[1,2]	195 dB $L_{E,24h}$[1,2]	199 dB $L_{E,24h}$[1,2]
24-inch Pile Installatio	**Unmitigated**	**29**	**14**	**58**	**39**	**17**
	Mitigation (-5 dB)	16	--	25	18	--
18-inch Installatio n	**Unmitigated**	**14**	**--**	**22**	**16**	**--**
	Mitigation (-5 dB)	--	--	10	--	--
24-inch Pile Removal	**Unmitigated**	**7**	**--**	**16**	**14**	**--**
	Mitigation (-5 dB)	--	--	21	--	--

[1]NOAA 2023, NOAA 2024e
[2]Level A/AUD INJ

Table 6-4 summarizes the distances to behavioral thresholds from impact pile driving. Results in both tables are presented without mitigation and with mitigation at a 5-dB reduction (attenuation). While mitigation measures and methods have not been finalized at this stage in project planning, the mitigation results are provided for informational purposes where the take calculations are based on unmitigated results. It is assumed that some form of noise mitigation, such as a bubble curtain, will be required for the duration of impact pile driving operations in accordance with federal regulations, including requirements of ESA consultation for coverage of listed fish species.

Tables 6-2 through 6-4 are intended to illustrate distance thresholds with the use of potential noise mitigation. The figures that follow (Figures 6-1 through 6-10) incorporate the findings for both the unmitigated and mitigated impact areas.

Noise modelling established the project ZOIs. A ZOI is the in-water area in which animals are exposed to sound levels emanating from a sound source that fall within acoustic thresholds for impacts. The Level A ZOI is known as the exclusion zone and is the spatial area in which physiological acoustic take can occur. The Level B ZOI is known as the Harassment Zone and is the spatial area in which marine mammals can have behavioral impacts or takes. As expected, the models predict the Level B Harassment ZOI as the largest spatial extent, while Level A Exclusion ZOIs are smaller and vary amongst marine mammal species hearing groups. Implementing noise mitigation techniques drastically decreases the radius of all ZOIs (Table 6-2). A summary of the AUD INJ onset distances for impact pile driving is provided in Table 6-2. A summary of the AUD INJ onset distances for vibratory pile driving (installation and removal) is provided in Table 6-3. A summary of the behavioral response onset distances for impact and vibratory pile driving (installation and removal) is provided in Table 6-4.

Per consultation with NMFS, level A harassment of otariids would not occur and therefore is not requested. It is anticipated that all four marine mammal species identified in this application could transit the Level B Harassment ZOI during pile driving activities. Underwater noise levels exceeding the

stated disturbance thresholds could alter pinniped behavior by causing them to alter their activities or to avoid the area entirely. However, seals and sea lions in the region that may be found within the Level B Harassment ZOI are likely habituated to vessel traffic and elevated marine acoustic noise due to their coexistence with marine traffic throughout the Siuslaw River and proximity to active harbors.

Table 6-4. Marine Mammals Behavioral Response Criteria Threshold Distances for Impact and Vibratory Pile Driving

Pile Type	Scenario	Marine Mammals Behavioral Threshold (meters)	
		160 dB L_p[1,2]	120 dB L_p[1,2]
		Impact	Vibratory
24-inch Pile (Installation)	**Unmitigated**	**717**	**1,117**
	Mitigation (-5 dB)	456	739
24-inch Pile (Removal)	**Unmitigated**	**NA**	**1,106**
	Mitigation (-5 dB)	NA	739
18-inch Pile	**Unmitigated**	**194**	**660**
	Mitigation (-5 dB)	94	417
H-Pile	**Unmitigated**	**110**	**NA**
	Mitigation (-5 dB)	58	NA

[1]NOAA 2023

[2]Level B Behavioral Disturbance

6.3 IMPACT SUMMARY

During construction, underwater and in-air noise will be generated by operation of construction equipment and related activities. Underwater incidental take may result from disturbance caused by elevated underwater sound levels. In-air takes are not expected (see Section 6.3.2.1). Underwater take would be temporary and localized (see Section 6.3.2.2).

6.3.1 Species Density

Species density data were sourced from the Pacific Navy Marine Species Density Database to estimate take for marine mammals (U.S. Navy 2019) (Table 6-5). The Marine Species Density Database incorporates analyzed literature and research for marine mammal density estimates per season for regions throughout the U.S. Take estimates for this application are based on regionally available population density estimates and site-specific knowledge. For all species density estimates, densities from the winter season and most applicable Oregon locations were used (U.S. Navy 2019):

- California sea lion density (0.6493 animals per km^2) was derived from the winter season and Offshore (0 to 40 km from shore) Oregon location (see Table 10-12 in U.S. Navy 2019).
- Steller sea lion density (0.2824 animals per km^2) derived from the winter season and Offshore (0 to 200 m isobath) Oregon location (see Table 10-7 in U.S. Navy 2019).

- Harbor seal density (0.3424 animals per km^2) derived from the winter season and Offshore (WA/OR) Oregon location (see Table 10-10 in U.S. Navy 2019).
- Harbor porpoise density (0.624 animals per km^2) derived from the winter season and Offshore Oregon location (see Table 8-1 and Figure 8-1 in U.S. Navy 2019).

Table 6-5. Summary of Density Estimates used in Take Calculations

Hearing Group	Species	Density (per km^2)[1]	
Otariid Pinnipeds	California sea lion	0.6493	Winter season and Offshore (0 to 40 km from shore) Oregon location (see Table 10-12 in U.S. Navy 2019).
Otariid Pinnipeds	Steller sea lion	0.2824	Winter season and Offshore (0 to 40 km from shore) Oregon location (see Table 10-12 in U.S. Navy 2019).
Phocid Pinnipeds	Pacific harbor seal	0.3424	Winter season and Offshore (WA/OR) Oregon location (see Table 10-10 in U.S. Navy 2019).
HF Cetaceans	Harbor porpoise	0.624	Winter season and Offshore Oregon location (see Table 8-1 and Figure 8-1 in U.S. Navy 2019)

[1]Density Species density data were sourced from the Pacific Navy Marine Species Density Database (U.S. Navy 2019).

6.3.2 Incidental Take Estimates

Incidental take for each activity is estimated by the following equation:

Incidental take estimate = species density * zone of influence area * duration of activity

This equation accounts for the acoustic thresholds above which NOAA Fisheries indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment, the area where sound is anticipated to exceed those thresholds, the density of occurrence of marine mammals within the threshold exceedance areas, and the duration of the noise producing activity. This equation is assumed to be a reasonable extrapolation for estimating takes, which relies on analytical calculation of the likelihood that a species is present in the area on a day activity is occurring. Level A take is estimated based on the likelihood (using the same equation or best professional judgment based on recent monitoring) that marine mammals would enter the Level A Exclusion ZOI without detection. For each species, the Marine Species Density Database density estimate is listed.

6.3.2.1 In-Air

We assume the majority of marine mammals that would be present in the in-air disturbance zones would have already entered the respective in-water disturbance isopleth during pile driving. For example, an animal hauled out or resting near construction activities will likely enter the water at some time during the day and will thereby experience Level B harassment from underwater sound. Thus, we

assume all animals hauled out are accounted for in the Level B take estimates. Since pile installation in-water threshold distances are larger than in-air, we assumed the threshold distances (1,117 m [3,665 ft]; Table 6-7) for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates for all species.

Although haul-out sites for harbor seals are known to exist withing the Siuslaw River, they are approximately 500 m (1,640 ft) from the Station which is outside the 97 m (318 ft) disturbance area (Table 6-1). It is also anticipated that pinnipeds would avoid the project area and not haul-out near the project area during project operations due to the disturbance. Sea lions are not known to haul out in the immediate vicinity of the project area. Based on these factors, no takes from in-air acoustic disturbance for hauled out seals or sea lions are anticipated from over water-water or nearshore construction activities during Phase 1. It is anticipated that pinnipeds would avoid the project area and not haul-out near the project area during noise-producing project operations, and exposures are not expected to be long enough for a take. Therefore, no takes are requested for Phase 1 activities.

6.3.2.2 Zone of Influence

Calculated areas for Level A and Level B ZOIs are provided for each construction scenario in Table 6-6 and Figure 6-4 through Figure 6-9. The most conservative Level A and Level B ZOIs in the take estimates are provided in Table 6-7 and Table 6-8. A summary of estimated takes is provided in Table 6-9. The Level A and Level B ZOIs for pile installation and removal known harbor seal haul out locations and proposed Protected Species Observer (PSO) location are provided in Figure 6-10 (pile installation) and Figure 6-11 (pile removal).

For the purposes of the take analysis specific to *pile installation*:

- Level A Exclusion ZOI assumed the threshold distances (i.e., 335 m [1,099 ft] for harbor porpoise, 256 m [840 ft] for harbor seal, and 95 m [312 ft] for California and Steller sea lions; Table 6-7) for underwater, unmitigated, 24-inch pile driving (impact) to account for most conservative take estimates for all species.
- Level B Harassment ZOI for all species assumed the threshold distances (1,117 m [3,665 ft]); Table 6-7) for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates.

For the purposes of the take analysis specific to *pile removal*:

- Level A Exclusion ZOI assumed the threshold distances (i.e., 16 m [52 ft] for harbor porpoise and 14 m [46 ft] for harbor seal) for underwater, unmitigated, 24-inch pile removal (vibratory) to account for most conservative take estimates for all species.
- Level B Harassment ZOI for all species assumed the threshold distances (1,106 m [3,629 ft]; Table 6-7) for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates.

Table 6-6. Summary of Level A Exclusion Zones and Level B Harassment Zones for each of the Scenarios

Scenario		Level B Harassment Zone Cetaceans, Otariid Pinnipeds and Phocid Pinnipeds (meters)	Level A Exclusion Zone VHF Cetacean (meters)	Level A Exclusion Zone Phocid Pinnipeds (meters)	Level A Exclusion Zone Otariid Pinnipeds(meters)
		Harbor porpoises California sea lions Steller sea lions Harbor seals	Harbor porpoises	Harbor seals	California sea lions Steller sea lions
1	Impact pile driving installation: 24-inch	717	335	256	95
2	Impact pile driving installation: 18-inch	194	187	89	41
3	Impact pile driving installation: H-Pile 14x117	110	96	35	18
4	Vibratory hammer pile installation: 24-inch	1,117	58	39	17
5	Vibratory hammer pile installation: 18-inch	660	22	16	NA
6	Vibratory hammer pile removal: 24-inch	1,106	16	14	NA

Table 6-7. Summary of Most Conservative Level A Exclusion Zones and Level B Harassment Zones for Pile Installation

Hearing Group	Species	Level A Exclusion Zone (meters)[1]	Level A Exclusion Zone Area (km^2)	Level B Harassment Zone (meters)[2]	Level B Harassment Zone Area (km^2)
VHF Cetaceans	Harbor porpoise	335	0.2197	1,117	1.0725
Phocid Pinnipeds	Harbor seal	256	0.1432		
Otariid Pinnipeds	California sea lion Steller sea lion	95	0.0365		

[1] Level A Exclusion ZOI assumed the threshold distances for unmitigated, 24-inch pile driving (impact) to account for most conservative take estimates for all species.
[2] Level B Harassment ZOI assumed the threshold distances for unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates for all species.

Table 6-8. Summary of Most Conservative Level A Exclusion Zones and Level B Harassment Zones for Pile Removal

Hearing Group	Species	Level A Exclusion Zone (meters)[1]	Level A Exclusion Zone Area (km^2)	Level B Harassment Zone (meters)[2]	Level B Harassment Zone Area (km^2)
VHF Cetaceans	Harbor porpoise	16	0.0087	1,106	1.0422
Phocid Pinnipeds	Harbor seal	14	0.0082		
Otariid Pinnipeds	California sea lion Steller sea lion	NA	NA		

[1] Level A Exclusion ZOI assumed the threshold distances for underwater, unmitigated, 24-inch pile removal (vibratory) to account for most conservative take estimates for all species.

[2] Level B Harassment ZOI for all species assumed the threshold distances for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates.

Tables 6-7, 6-8, and 6-9 are conservative, assuming the most conservative ZOIs and assuming the greatest number of days that pile installation and removal (28- and 20- non-consecutive days, respectively) may occur. While both Level A and Level B takes were estimated for conservation coverage of this project, Level A take estimates assume that marine mammals would enter the Level A Exclusion ZOI without detection. It is anticipated that nearly all takes incidental to project work will be behavioral harassment and result in avoidance of the project area before animals would get close enough to sound sources to induce injury, especially for the tight Level A Exclusion ZOI. For these reasons, the Level A and B take calculation for all marine mammals are likely overestimations.

The USCG will employ two PSOs and these observers will be positioned at a location to allow for adequate monitoring of the respective Level B Harassment ZOIs during piling removal and installation.

The USCG estimates very few, if any, of the estimate Level A takes would be realized since individuals will likely avoid the project area. Should the USCG use smaller pile diameters than the 24-inch worst-case project design which was the diameter modeled, any smaller piles would be covered by the ZOIs determined for the 24-inch underwater noise zones. Reducing the pile diameter would result in the same or slightly lower noise levels than those produced by the 24-inch piles.

The Level A and B take estimates for harbor porpoises reflect the estimated density for harbor porpoises distributed from the shore out to roughly 200 m (656 ft) (U.S. Navy 2019). Harbor porpoises prefer shelf waters and avoid vessels, so this estimate is likely much higher than their observed occurrence within the river, near the project area. For this reason, the USCG does not anticipate takes of harbor porpoises to approach or exceed those calculated.

The Level A and B take estimates for harbor seals, California sea lions and Steller sea lions consider seasonal population trends using regionally available estimates from the Pacific Navy Marine Species Density Database (U.S. Navy 2019).

Table 6-9. Summary of Take Estimates for Marine Mammals

Hearing Group/ Species	Density (per km²)[1]	*Pile Installation* [6]					*Pile Removal* [7]					*Total Take Estimate* [8]			
		Duration (days)	Level B ZOI Area (km²)	Level B Take Estimate	Level A ZOI Area (km²)	Level A Take Estimate	Duration (days)	Level B ZOI Area (km²)	Level B Take Estimate	Level A ZOI Area (km²)	Level A Take Estimate	Level B Take Estimate	Level A Take Estimate	Stock Abundance	% of Stock [9]
Otariid Pinnipeds California sea lion	0.6493[2]	28	1.0725	19.50	0.0365	0[10]	20	1.0422	13.53	NA	0	34	0	233,515	0.01 %
Otariid Pinnipeds Steller sea lion	0.2824[3]	28	1.0725	8.48	0.0365	0[10]	20	1.0422	5.89	NA	0	15	0	36,308	0.04 %
Phocid Pinnipeds Pacific harbor seal	0.3424[4]	28	1.0725	10.28	0.1432	1.37	20	1.0422	7.14	0.0082	0.06	18	2	24,732	0.08 %
VHF Cetaceans Harbor porpoise	0.624[5]	28	1.0725	18.74	0.2197	3.84	20	1.0422	13.01	0.0087	0.11	32	4	5,332	0.68 %

[1] Species density data was sourced from the Pacific Navy Marine Species Density Database (U.S. Navy 2019).
[2] California sea lion density (0.06493 animals per km²) derived from the winter season and Offshore (0 to 40 km from shore) Oregon location (see Table 10-12 in U.S. Navy 2019).
[3] Steller sea lion density (0.2824 animals per km²) derived from the winter season and Offshore (0 to 200 meter isobath) Oregon location (see Table 10-7 in U.S. Navy 2019).
[4] Harbor seal density (0.3424 animals per km²) derived from the winter season and Offshore (WA/OR) Oregon location (see Table 10-10 in U.S. Navy 2019).
[5] Harbor porpoise density (0.624 animals per km²) derived from the winter season and Offshore Oregon location (see Table 8-1 and Figure 8-1 in U.S. Navy 2019)
[6] For *Pile Installation* Level A Exclusion ZOI assumed the threshold distances for unmitigated, 24-inch pile driving (impact) to account for most conservative take estimates for all species, Level B Harassment ZOI for Pile Installation assumed the threshold distances for unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates for all species
[7] For *Pile Removal* Level A Exclusion ZOI assumed the threshold distances for underwater, unmitigated, 24-inch pile removal (vibratory) to account for most conservative take estimates for all species and Level B Harassment ZOI for all species assumed the threshold distances for underwater, unmitigated, 24-inch pile driving (vibratory) to account for most conservative take estimates.
[8] Level A and Level B take numbers are rounded up to the nearest whole number.
[9] Percent of stock is based on Level A plus Level B takes divided by stock abundance
[10] Per consultation with NMFS, Level A Harassment of otariids is not anticipated therefore take is not requested.

Figure 6-1. In-Air Acoustic Threshold Limits for Construction (Phase 1/ Year 1).

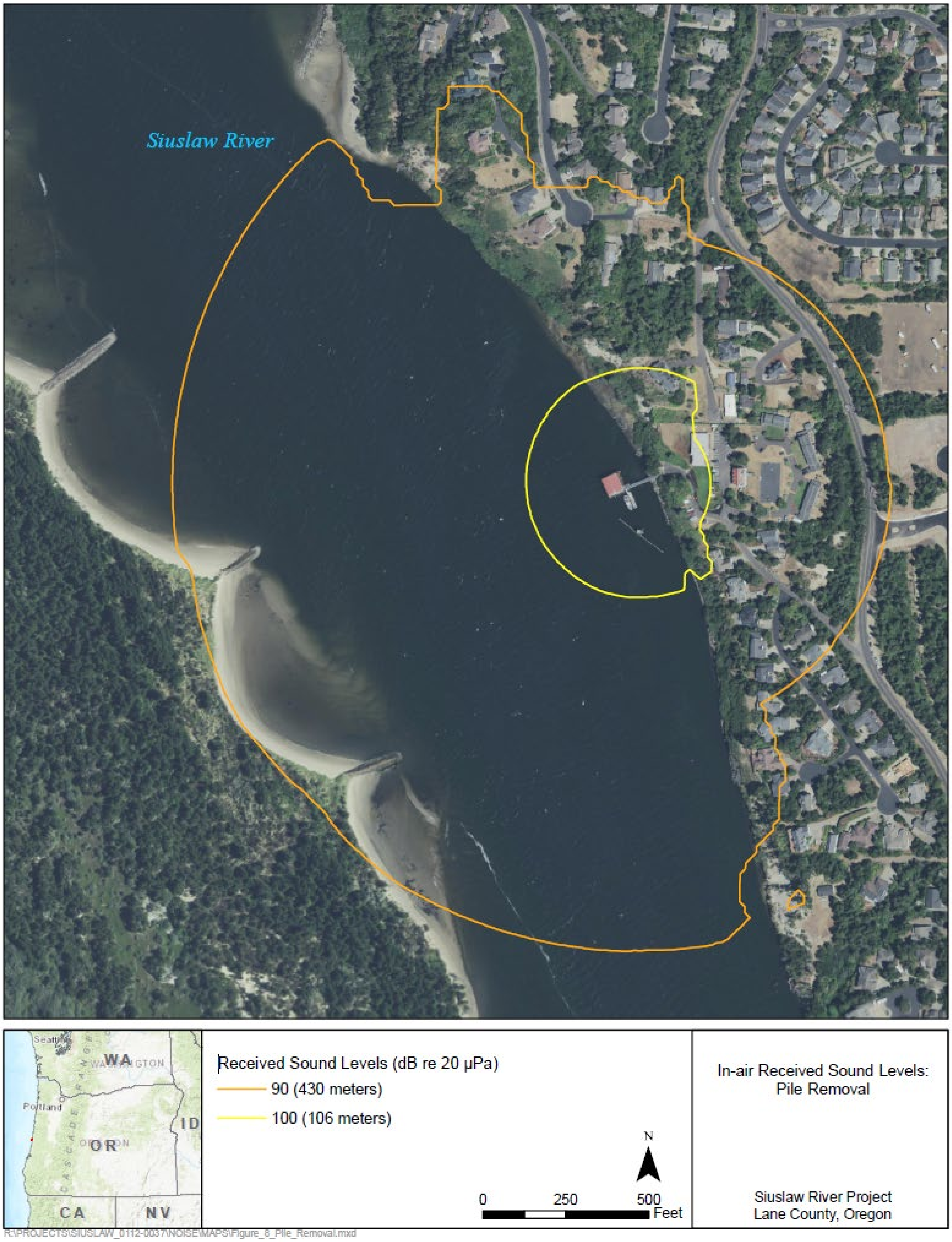

Figure 6-2. In-Air Acoustic Threshold Limits for Pile Removal (Phase 2/ Year 2).

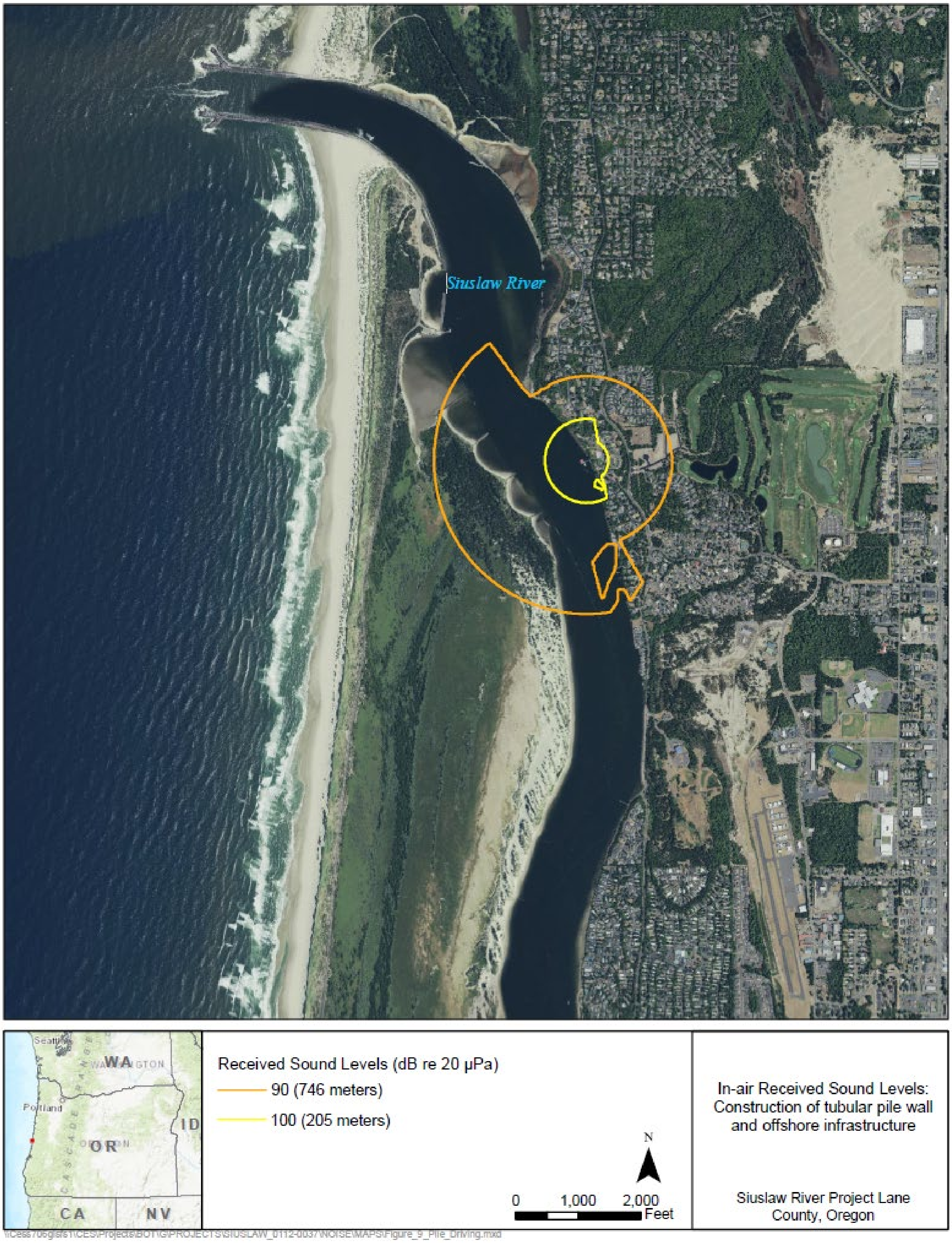

Figure 6-3. In-Air Acoustic Threshold Limits for Pile Installation (Phase 2/ Year 2).

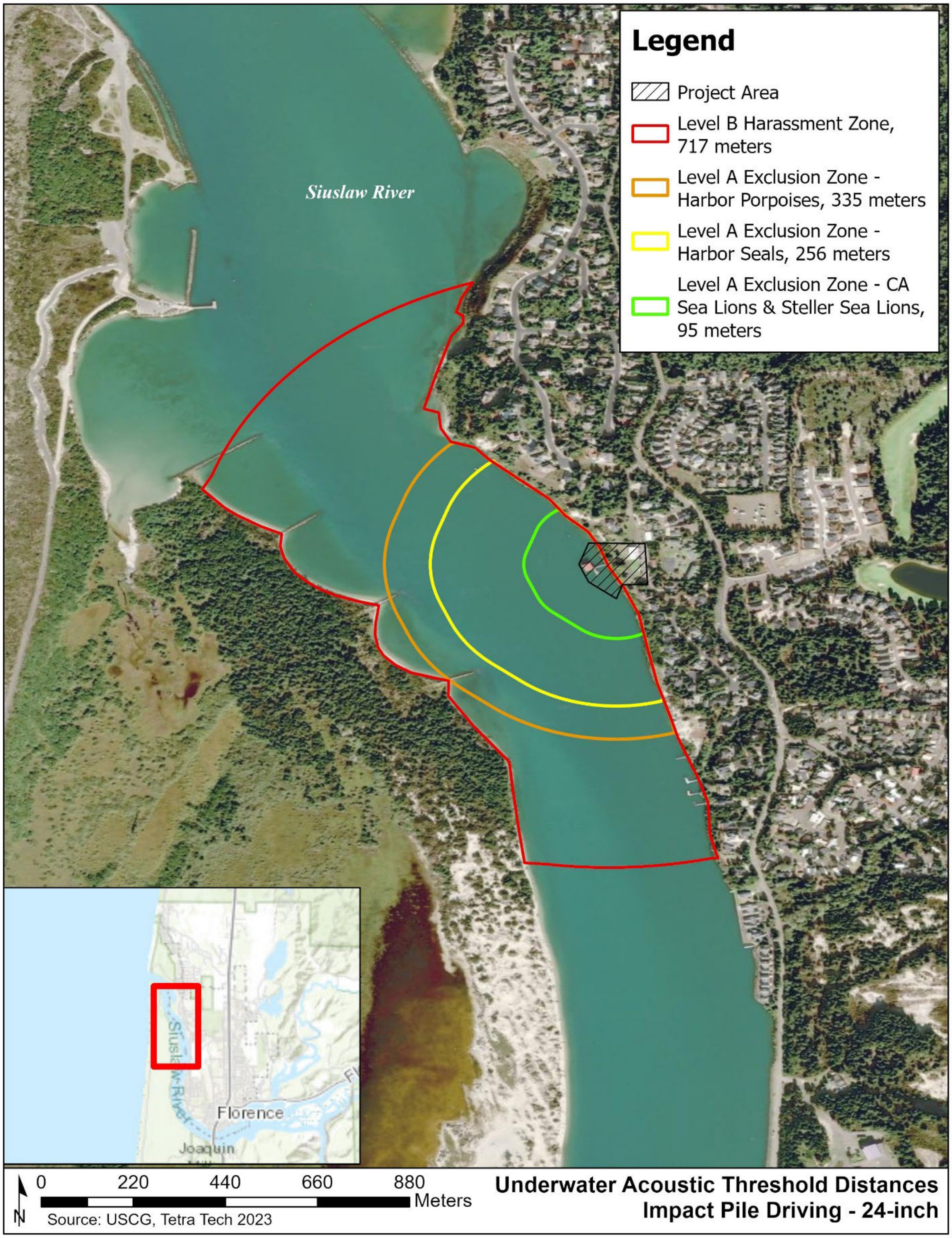

Figure 6-4. Underwater Acoustic Threshold Limits for Impact Pile Driving (Phase 2/ Year 2).

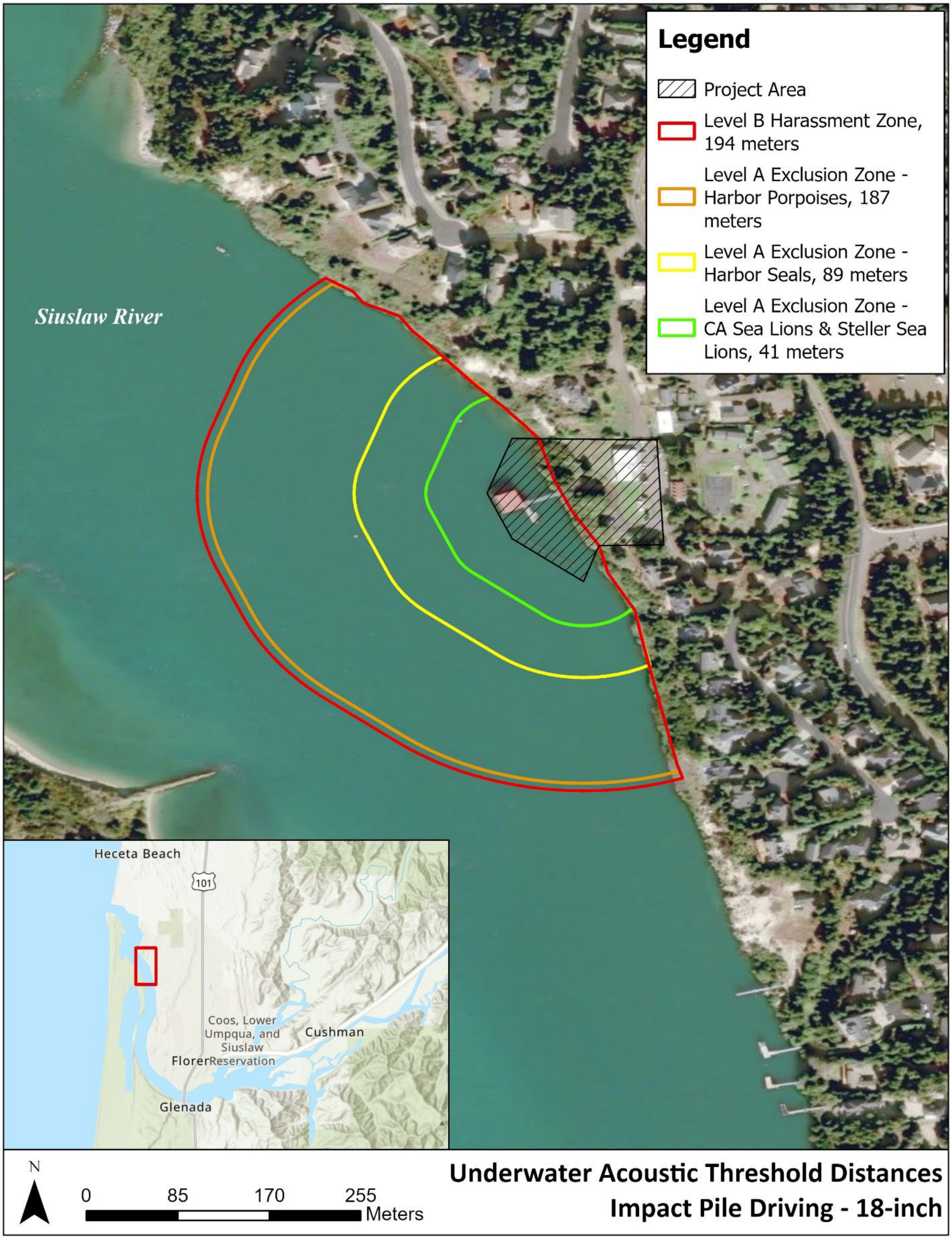

Figure 6-5. Underwater Acoustic Threshold Distances Impact Pile Driving (Phase 2/ Year 2).

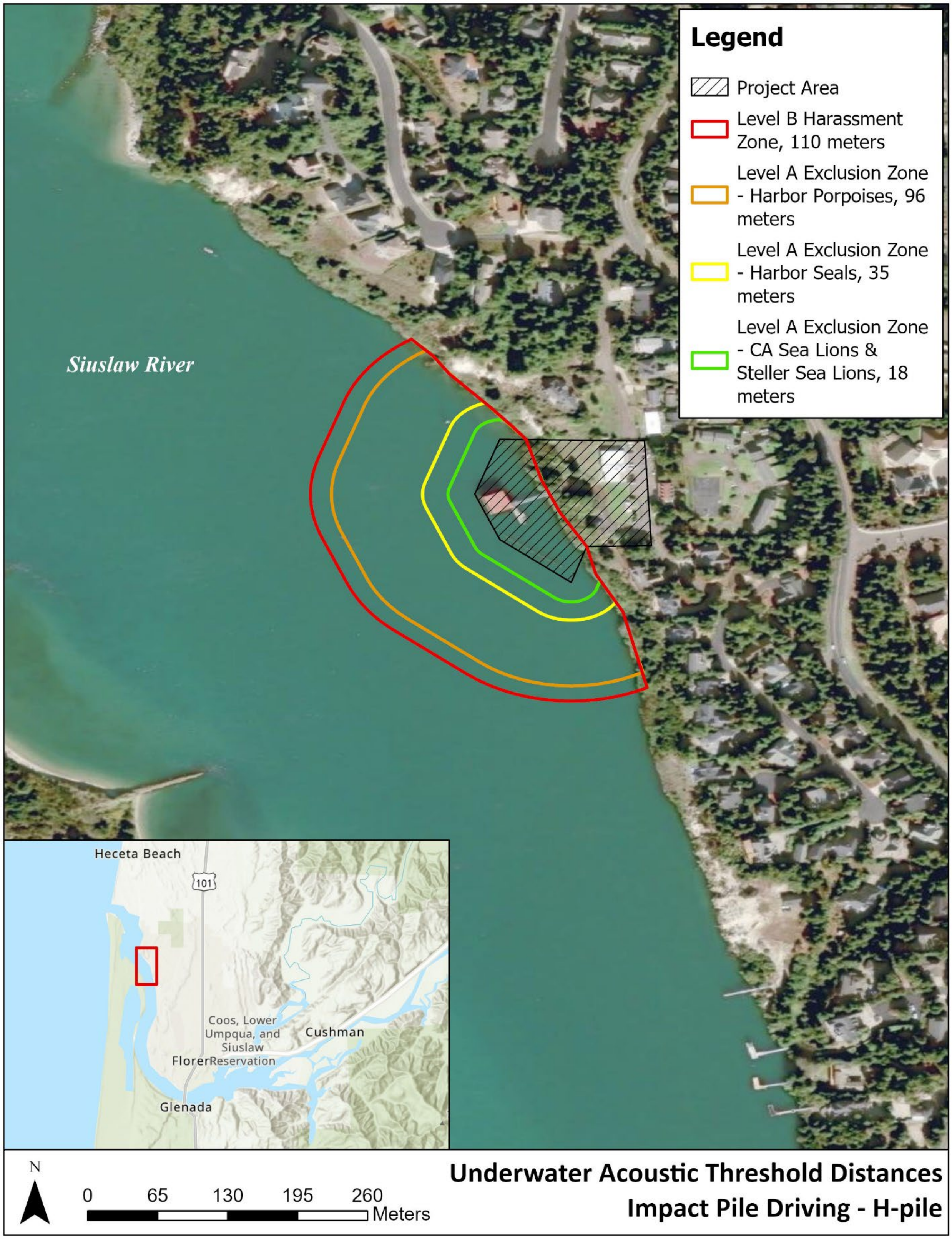

Figure 6-6. Underwater Acoustic Threshold Distances for Impact Pile Driving (Phase 2/ Year 2).

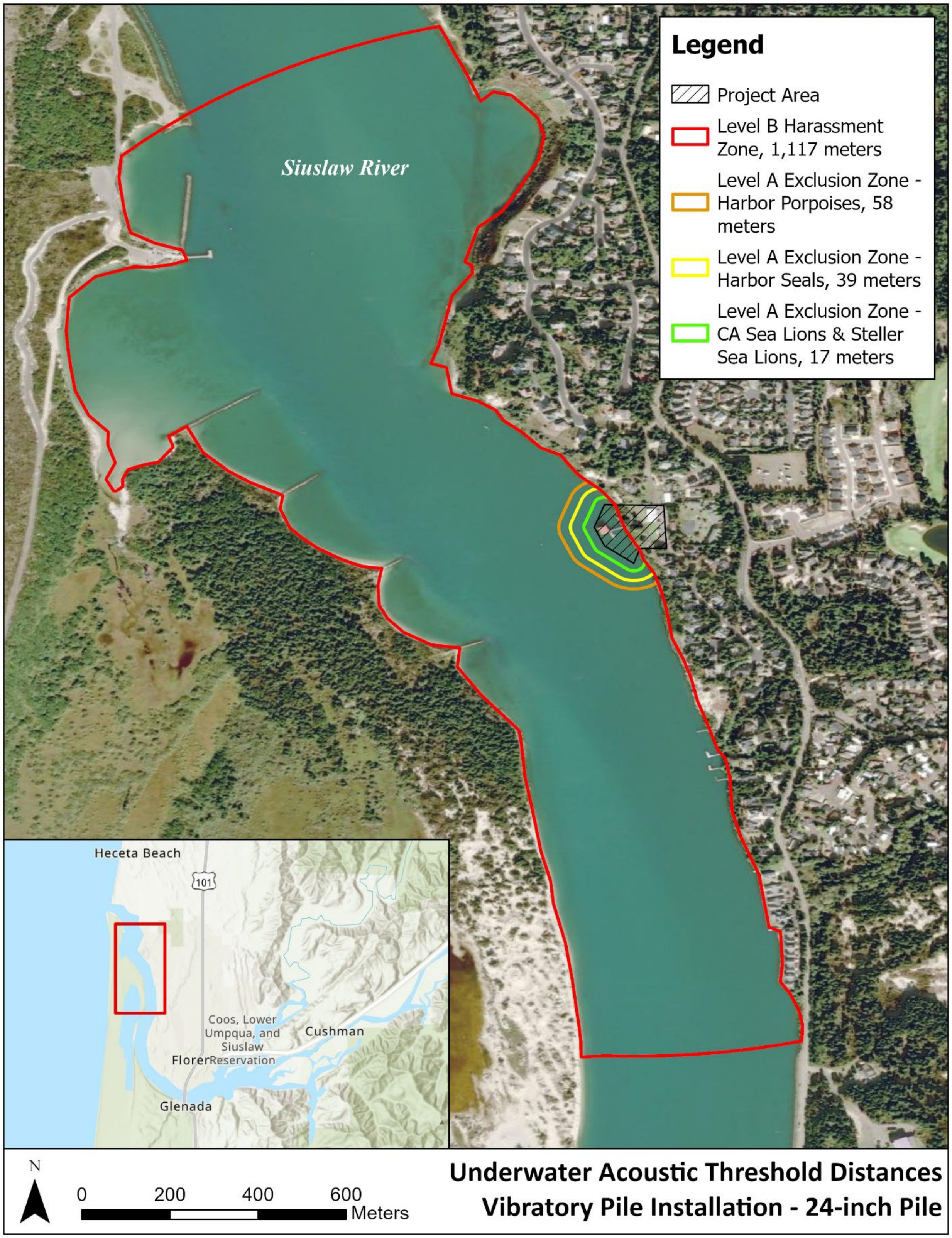

Figure 6-7. Underwater Acoustic Threshold Distances Vibratory Pile Installation (Phase 2/ Year 2).

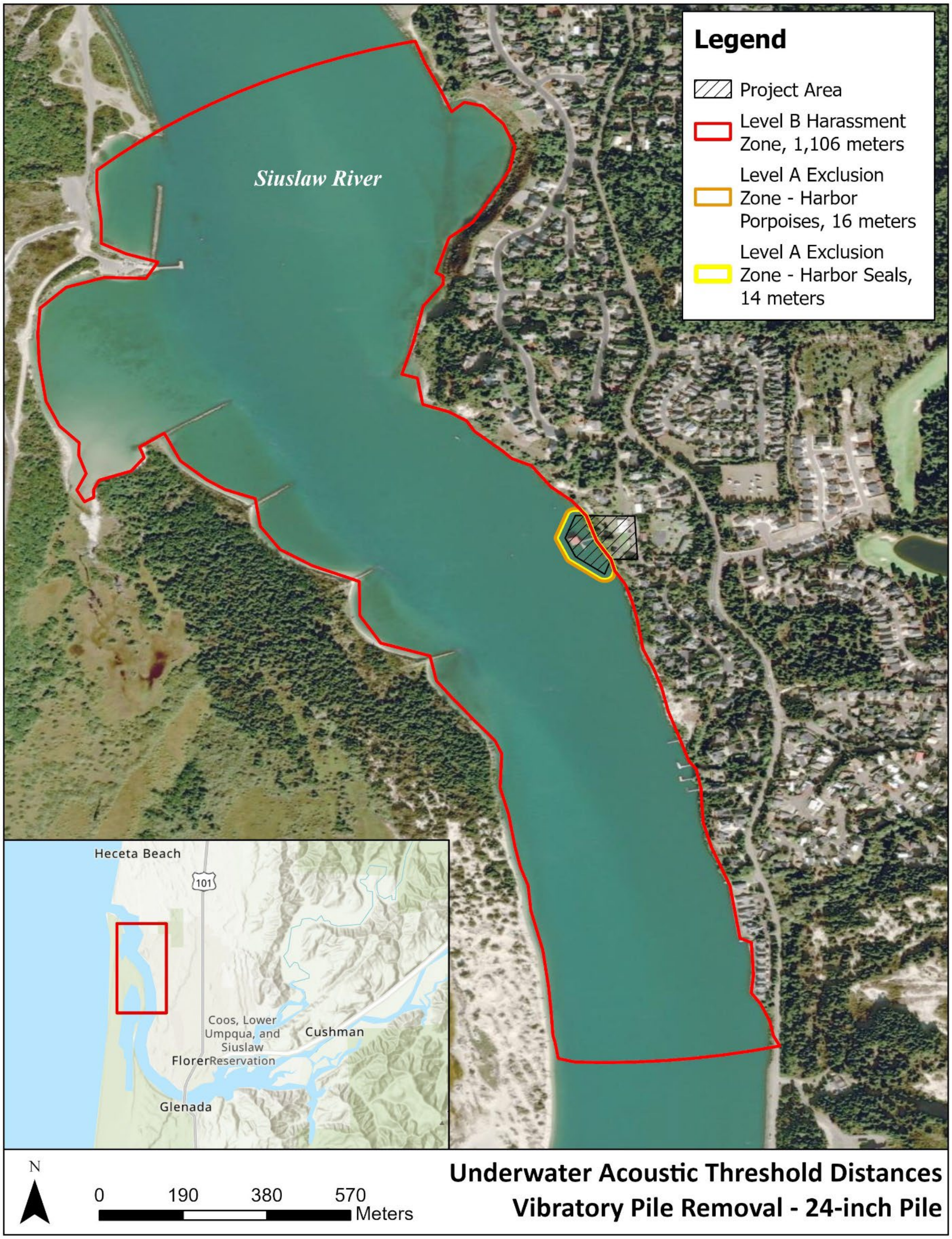

Figure 6-8. Underwater Acoustic Threshold Distances Vibratory Pile Removal (24-inch Pile) (Phase 2/ Year 2).

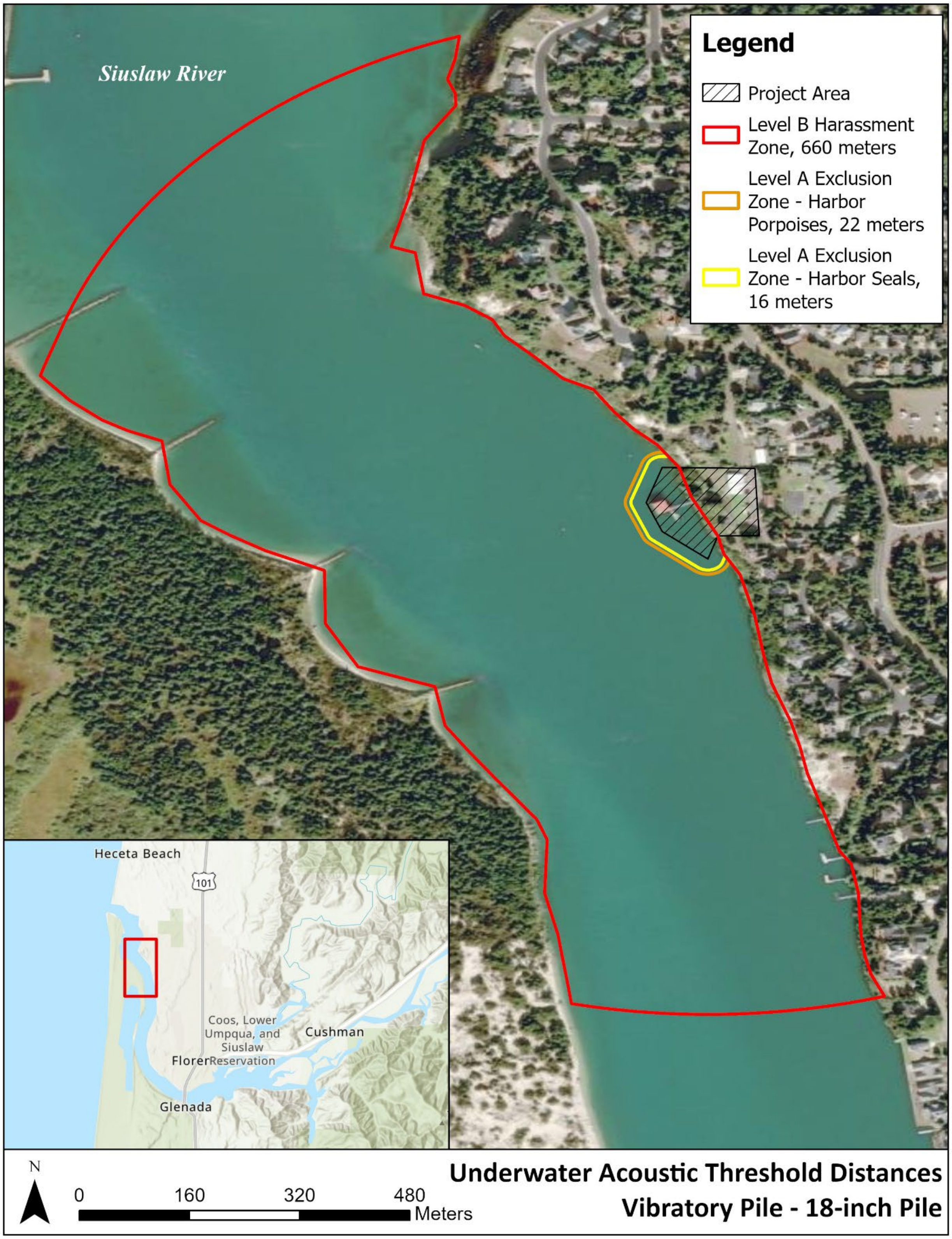

Figure 6-9. Underwater Acoustic Threshold Distances Vibratory Pile Installation (18-inch Pile) (Phase 2/ Year 2).

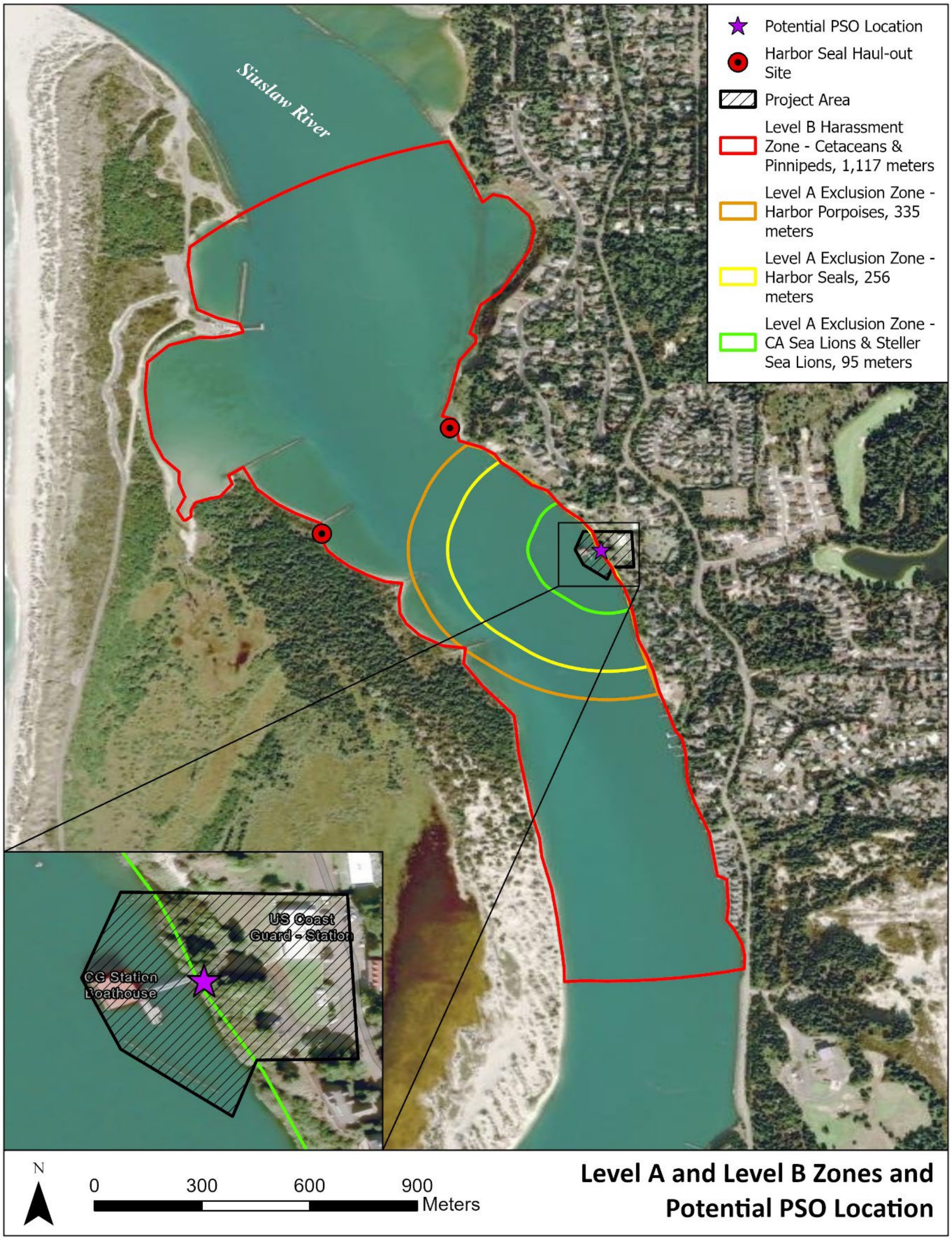

Figure 6-10. Level A and Level B Zones for Pile Installation and Potential PSO Location (Phase 2/ Year 2).

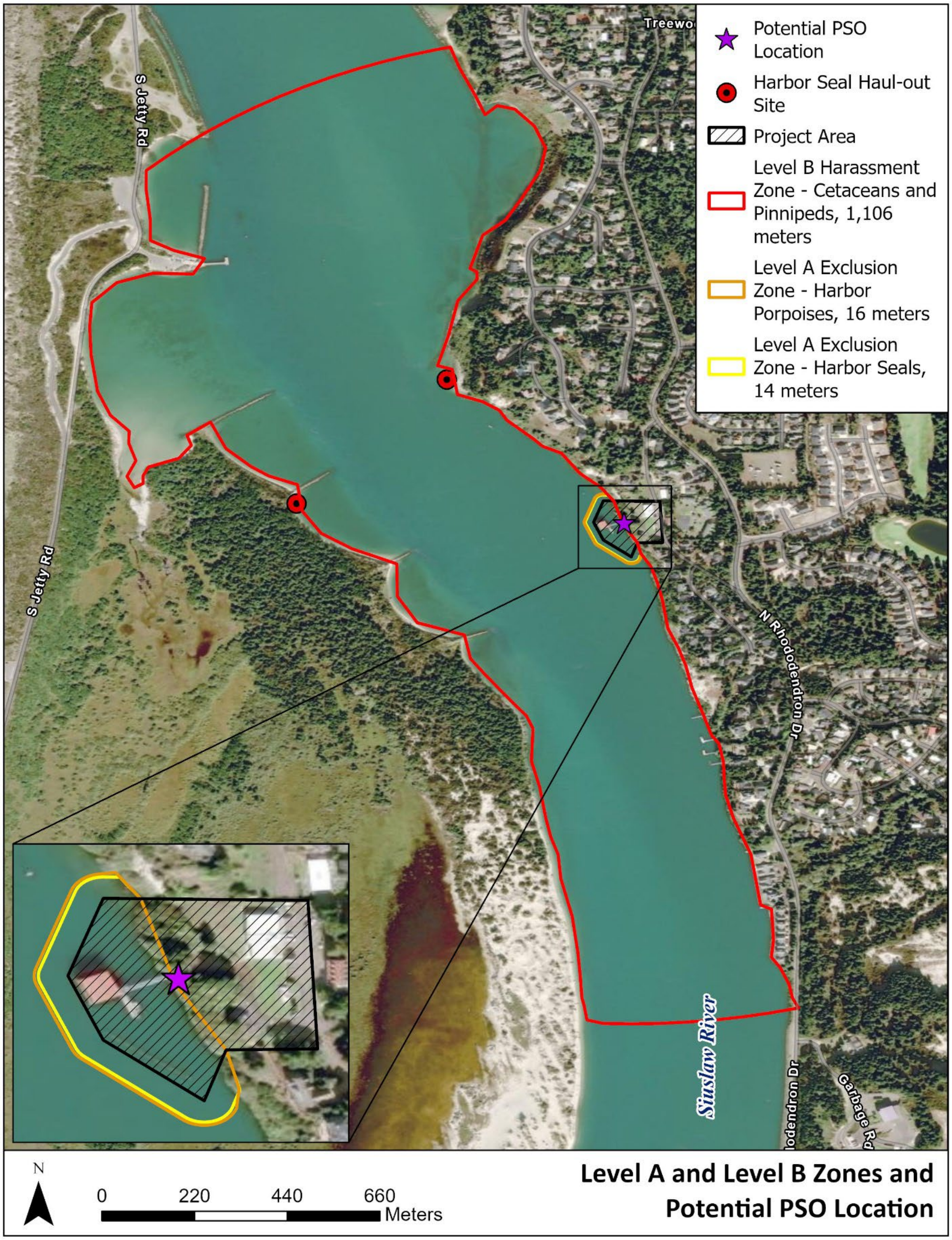

Figure 6-11. Level A and Level B Zones for Pile Removal and Potential PSO Location (Phase 2/ Year 2).

7.0 ANTICIPATED IMPACT OF THE ACTIVITY

Pile driving resulting in increased underwater noise is anticipated to have the greatest potential effect on marine mammals in the project vicinity. None of the species identified in this analysis are considered strategic stocks under the MMPA or listed under the ESA, and the level of incidental takes requested is not anticipated to increase the vulnerability of those stocks in the future. Each species has seen regular growth regionally in recent years, and no impacts to species abundance or population levels are anticipated as a result of the proposed project.

Repetitive, short-term displacement is likely to cause short-term disruptions in the normal behavioral patterns of animals in the vicinity of the project during active construction. However, disruption would be limited to working hours and designated seasonal work windows. Though all project-related activities and associated increased disturbances to marine mammals will be temporary, they will likely result in animals dispersing or avoiding the immediate project vicinity during period of project noise-producing activities. Seals and sea lions in the lower Siuslaw River are considered to be habituated to disturbances related to marine traffic, boaters, and other human activities regularly occurring and aside from the proposed action. The implementation of mitigation measures described in Section 11 will ensure the impacts on stock abundance and behavioral patterns of all species are temporary and minor.

8.0 ANTICIPATED IMPACTS ON SUBSISTENCE USES

The proposed activities described in this application will have no impacts of the availability of the species or stocks of California sea lions, Steller sea lions, Pacific harbor seals, or harbor porpoises for subsistence uses.

9.0 ANTICIPATED IMPACTS ON HABITAT

As previously discussed, California sea lions, Steller sea lions, Pacific harbor seals, and harbor porpoises may occur or be found transiting through the area during construction activities. 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 or indirect effects to marine mammals are expected from turbidity impacts.

There are no designated critical habitats within this area of the Siuslaw River for the species addressed in this application. The proposed activities will not result in permanent impacts to habitats used by marine mammals. While it will result in temporary changes in the acoustic environment, marine mammals in the lower Siuslaw River are considered to be habituated to marine vessels and active harbor activities. Some animals may experience a temporary loss of habitat as they avoid the immediate project area due to temporarily elevated noise levels; however, there is an abundance of

similar or better-quality habitat adjacent to the project area which animals that are locally displaced can move to and continue with normal feeding or transiting activities.

The most likely impact to marine mammal habitat would be indirect, resulting from impact hammer pile-driving direct effects on prey fish species and from minor impacts to the immediate substrate during installation of piles that may affect water quality in the short term. Long-term effects of any prey displacements are not expected to occur or affect the overall fitness of the pinnipeds present since similar numbers and types of prey species are available in proximity to the project area; thus, effects on habitat will be minor and will terminate at the end of the proposed construction actions.

Fish populations in the Siuslaw River that serve as pinniped prey could be affected by noise from in-water pile driving. The project may also have temporary effects on salmonids and other fish species due to changes in turbidity and the potential resuspension of contaminants. All in-water work will occur during the designated and agreed upon in-water work window to avoid and minimize effects on fish species. Additional analysis of impacts to fish is included in the Biological Assessment as prepared for the project's Section 7 ESA consultation with NOAA Fisheries and U.S. Fish and Wildlife Service.

The project is not anticipated to have measurable effects on the distribution or abundance of potential marine mammal prey species because any adverse effects on prey will be temporary, there are other quality foraging habitats in lower the Siuslaw River, and mitigation measures will be incorporated to ensure protection of fish and other prey species during active construction.

Impacts to seal and sea lion habitat and prey species availability are expected to be minor and temporary. The area likely impacted by construction is relatively small compared to the available habitat in this river. The most likely impact is to fish and prey species from the construction actions, and these will be temporary, such as minor 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. Therefore, the impacts on pinniped habitat and prey availability during construction are expected to be negligible.

10.0 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

The proposed project is not anticipated to result in significant loss or adverse modification of habitat for marine mammals or their food sources. Any effects of the proposed project on marine mammal habitat are expected to be short-term and minor. The greatest impact on marine mammals associated with the proposed actions will be a temporary avoidance of habitat and potential displacement of prey species because of elevated noise levels. The proposed project is not expected to have any habitat-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, and mitigation measures will be in place to reduce effects.

11.0 MITIGATION MEASURES TO PROTECT MARINE MAMMALS AND THEIR HABITAT

The following mitigation measures will be employed by the selected construction contractor during all construction activities to avoid and minimize impacts to species protected under the MMPA and their habitats to the maximum extent practicable. Any additional measures required by other federal regulatory processes, including those resulting from Section 7 ESA consultation, will be implemented, and incorporated as necessary.

11.1 GENERAL CONSTRUCTION MEASURES

All construction activities will be performed in accordance with approved plans and specifications developed by the selected design-build contractor. In addition, the following general construction measures will be adhered to:

- All work will 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 necessary regulatory permits acquired by the USCG.
- All equipment to be used for construction activities will be cleaned and inspected prior to arriving at the project site to confirm that 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 staging area at least 150 ft or more from the water. 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.
- Any other stationary equipment, including generators, operated within 150 ft 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 will occur during daylight hours to ensure proper monitoring for marine mammals.
- Placement of floating silt curtains or similar in-water turbidity barriers around the in-water work area to prevent migration of disturbed fine sediments.
- Implementation of a turbidity monitoring framework consistent with the Oregon Department of Environmental Quality 401 water quality certification permit terms and conditions and ESA consultation conservation measures.
- Implementation of a Stormwater Pollution Prevention Plan (SWPPP).
- Implementation of a Spill Prevention, Containment, and Countermeasure (SPCC) plan. Maintain a current copy of approved SPCC plan on-site for the duration of the project and ensure that no work or staging occurs prior to implementing the plan. The approved plan will provide site- and project-specific details identifying potential sources of pollutants, exposure pathways, spill response protocols, protocols for routine inspection fueling and maintenance of equipment, preventative and protective equipment and materials, and emergency notification and reporting protocols. Ensure that all workers understand the plan and response and reporting standards.
- Absorbent materials will be employed if petrochemical sheen is observed and kept in place until sheen dissipates.

- An in-water debris boom and oil adsorbent boom will be deployed around all active work areas and equipment during construction and demolition to ensure containment of materials, wastes, debris, and/or contaminants. Care will be taken to prevent debris from entering the water during demolition and construction, and debris will be removed promptly if it does enter the water. Any contaminated wastes will be disposed of at a properly permitted disposal site.
- Creosote pile removal BMPs will be employed to prevent creosote release into the environment and include vibratory extraction methods, keeping extraction equipment out of the water, and use of a containment basin on the barge where removed piles will be placed and temporarily stored.
- Utilize BMPs for controlling pollution from ship mooring and fueling facilities during operations.
- Implement a site-specific TESC plan to minimize erosion and sedimentation with site appropriate BMPs.
- Install and maintain appropriate TESC measures prior to disturbance to avoid and minimize effects to waterbodies, wetlands, and stormwater treatment facilities resulting from clearing, grading, and management of site drainage. This may include placement of silt fencing, wattles, dewatering sediment basin(s), or other protective barriers to ensure that soils are not introduced into waterways.
- Revegetation and mulching of disturbed land areas to minimize sediment runoff during precipitation events.
- The construction contractor will limit the amount of soil disturbance to that which can be adequately controlled via implementable BMPs.
- Construction entrances will contain either rock pads or tire wash facilities to prevent tracking of soil onto local roadways and to prevent the potential for sedimentation and turbidity of receiving waters as a result of runoff from roadways.
- Stockpile areas will be contained and protected by erosion control measures such as silt fencing and straw bales. Stockpiles shall also be covered if inclement weather is forecast.
- Appropriate stockpile and staging areas will be identified and approved prior to construction.

11.2 PILE REMOVAL AND INSTALLATION BMPS

The following mitigation measures will be implemented to minimize disturbance during pile removal and installation activities:

- USCG shall conduct briefings and trainings between construction supervisors and crews, marine mammal monitoring team, and USCG staff prior to the start of all construction work, and when new personnel join the work to explain responsibilities, communication procedures, marine mammal monitoring protocols, and operational procedures.
- Placement of bubble curtains, properly configured for the water velocity, around 100% of the piling perimeter and full water column when using impact hammers for piling installation.
- Noise and vibration mitigation through use of devices to muffle equipment, use of quieter equipment, and proper maintenance of marine vessels and equipment.
- If at any time during construction, the pile removal and installation parameters covered under this IHA are exceeded, such as changes in pile material, types or sizes, changes in seasonal time of year of work, activities resulting in increased noise levels which change the calculated distances (acoustic isopleths), or change the area of the Level A or Level B ZOIs, then that

activity will cease and USCG, or their representative, will contact NOAA Fisheries staff immediately to determine what, if any, course of action needs to be taken.

- Monitoring of marine mammals will take place starting 30 minutes before construction begins and continuing until 30 minutes after construction ends. In-water work will only commence once observers have declared the Level A Exclusion ZOIs clear of marine mammals.
- Prior to initiating construction activities, USCG will establish Level A Exclusion ZOIs and Level B Harassment ZOIs to monitor for individual activity types based on noise levels.
- If the Level A Exclusion ZOIs are obscured by fog or poor lighting conditions, pile installation activities will not be initiated until the entire zones are visible.
- A monitoring plan will be implemented. The monitoring plan will include a definition of the ZOIs, the Level A Exclusion ZOIs, Level B Harassment ZOIs, data collection and reporting requirements, and specific procedures that must be adhered in the event a mammal is encountered or taken.
- Take of unauthorized species (i.e., species for which incidental take is not authorized) must be avoided by ceasing construction activity before the animal enters either the Level A Exclusion ZOIs or the Level B Harassment ZOIs.

11.2.1 Water Quality

- Placement of floating silt curtains or similar in-water turbidity barriers around the in-water work area to prevent migration of disturbed fine sediments.
- Best engineering and management practices will be employed to minimize water column discharges.
- Implementation of a turbidity monitoring framework consistent with the Oregon Department of Environmental Quality 401 water quality certification, permit terms and conditions, and ESA consultation conservation measures.
- Implementation of a SWPPP.
- Implement a site-specific TESC plan to minimize erosion and sedimentation with site appropriate BMPs.
- Install and maintain appropriate TESC measures prior to disturbance to avoid and minimize effects to waterbodies, wetlands, and stormwater treatment facilities resulting from clearing, grading, and management of site drainage. This may include placement of silt fencing, wattles, dewatering sediment basin(s), or other protective barriers to ensure that soils are not introduced into waterways.
- Revegetation and mulching of disturbed areas to minimize runoff of fines during precipitation events.
- The construction contractor will limit the amount of soil disturbance to that which can be adequately controlled via constructible BMPs.
- Construction entrances will contain either rock pads or tire wash facilities to prevent tracking of soil onto local roadways and to prevent the potential for sedimentation and turbidity of receiving waters resulting from runoff from roadways.
- Stockpile areas will be contained and protected by erosion control measures such as silt fencing and straw bales. Stockpiles shall also be covered if inclement weather is forecast.
- Appropriate stockpile and staging areas will be identified and approved prior to construction.

11.2.2 Noise and Vibration

- Placement of bubble curtains, properly configured for the water velocity, around 100% of the piling perimeter and full water column when using impact hammers for piling installation. The bubble curtains will meet NOAA's specifications, as follows:
  - The bubble curtain must distribute air bubbles around 100 percent of the piling circumference for the full depth of the water column.
  - The lowest bubble ring must be in contact with the substrate for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent substrate contact. No parts of the ring or other objects shall prevent full substrate contact.
  - Air flow to the bubblers must be balanced around the circumference of the pile.
- A soft-start technique will be used during pile driving to allow fish (and marine mammals) to vacate the area before the pile driver reaches full power. For vibratory hammers, the contractor will initiate the driving for 15 seconds at reduced energy followed by a 1-minute waiting period. This procedure shall be repeated two additional times before continuous driving is started. For impact driving, an initial set of three strikes will be made by the hammer at 40 percent energy, followed by a 1-minute waiting period, then two subsequent three-strike sets before initiating continuous driving.
- Noise and vibration mitigation through use of devices to muffle equipment, use of quieter equipment, and proper maintenance of marine vessels and equipment.

11.2.3 Hazardous Materials

- Implementation of a SPCC plan. Maintain a current copy of approved SPCC plan on-site for the duration of the project and ensure that no work or staging occurs prior to implementing the plan. The approved plan provides site- and project-specific details identifying potential sources of pollutants, exposure pathways, spill response protocols, protocols for routine inspection fueling and maintenance of equipment, preventative and protective equipment and materials, and emergency notification and reporting protocols. Ensure that all workers understand the plan and response and reporting standards.
- Absorbent materials will be employed if petrochemical sheen is observed and kept in place until sheen dissipates.
- Clean and inspect all equipment to be used for the construction activities prior to arriving at the project site. Ensure that no potentially hazardous materials are exposed, no leaks are present, and that equipment is properly functioning.
- An in-water debris boom and oil adsorbent boom will be deployed around all active work areas and in-water equipment during construction and demolition to ensure containment of materials, wastes, debris, and/or contaminants. Care will be taken to prevent debris from entering the water during demolition and construction, and debris will be removed promptly if it does enter the water. Any contaminated wastes will be disposed of at a properly permitted disposal site.
- Pile removal BMPs will be employed to prevent potential contaminant release into the environment and include vibratory extraction methods, keeping extraction equipment out of the water, and use of a containment basin on the barge where removed piles will be placed and temporarily stored.
- Staging area and storage areas will be designated to store materials, fuel, and equipment. Equipment will be staged at least 150 ft from any natural water body or wetland to avoid contamination of water bodies or sediments.

- Utilize BMPs for controlling pollution from ship mooring and fueling facilities during MLB operations.

11.2.4 Habitat Disturbance or Alteration

- To control spread of non-native species, construction equipment will be washed before mobilization, and clean fill material will be required as necessary. The contractor will be required to inspect marine Existing non-native or invasive species will be controlled as feasible on the site to promote native vegetation growth and dominance.
- Riparian vegetation will be preserved to the extent practicable while still allowing constructability.
- Tree removals shall be mitigated per applicable local land use ordinances.
- Disturbed soils shall be seeded with native species immediately as construction phasing allows.

11.2.5 Collision

- All vessels will be restricted to 10 knots (~11.5 mph) speed over ground limit or less where required by the City of Florence in the Siuslaw River estuary.
- A vessel-platform monitoring zone of 139 m (500 ft) will be maintained for all marine mammals during vessel movement and transit activities.

12.0 MONITORING AND REPORTING

The following Monitoring and Reporting measures 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.

1. Minimum monitoring zones will be established during in-water work at the Station.
2. PSOs: USCG will employ qualified PSOs, with two PSOs at a time to monitor project vicinity for marine mammals. Qualifications for PSOs include:
    a. Visual acuity sufficient for discerning moving targets at the water's surface with ability to estimate target (species sighted) 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.
    c. Experience or training in the field identification of marine mammal species and preferably, age classes and behavioral state.
    d. Experience and ability to conduct field observations and collect data according to assigned protocols.
    e. Writing skills sufficient to prepare a report of observations that would include the number and type of marine mammals observed, the behavior of marine mammals in the project vicinity during project activities, dates and times when observations were conducted, and descriptions of in-water construction activities including dates, durations, and specific tasks.

   f. Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
   g. Ability to communicate with project personnel to provide real-time information on marine mammals observed in the Level A and B ZOIs as necessary.
3. Marine mammal monitoring during pile driving and removal must be conducted by NOAA Fisheries-approved PSOs and according to applicable federal regulations. In addition, the following may be required:
   a. The USCG must submit PSO CVs for approval by NOAA Fisheries prior to the onset of pile driving.
   b. PSOs present during pile driving must not be assigned other tasks during the specified monitoring period.
   c. If a team of two or more PSOs is required for monitoring activities, a lead observer will be designated who has prior experience working as a marine mammal observer during construction. The responsibilities of the lead observer will include, but are not limited to, scheduling rotations and reporting any incidents to the designated authorities at USCG and NOAA Fisheries.
4. PSOs will be present on-site during in-water work construction activities following a schedule agreed upon by NOAA Fisheries and the USCG.
5. PSOs will use binoculars to monitor marine mammal presence within the Level A and B harassment zones per the following protocols:
   a. The limits of the Level A Exclusion ZOIs and Level B Harassment ZOIs will be defined prior to initiating construction activities.
   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 longer than 15 minutes 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. PSOs will document the following if marine mammals are observed in the project vicinity:
      i. Species of observed marine mammals;
      ii. Number of observed marine mammal individuals;
      iii. Life stages (age classes) of marine mammals observed;
      iv. Behavioral activities, including any feeding, of observed marine mammals, in both presence and absence of activities;
      v. Location within the project vicinity;
      vi. Animals' reaction (if any) to pile-driving activities or other construction-related stressors; and
      vii. Overall effectiveness of mitigation measures.
6. The USCG will provide NOAA Fisheries with a draft monitoring report not later than 90 days following the end of construction activities. This report will detail the monitoring protocol, summarize the data recorded during monitoring, and estimate the number of marine mammals that may have been harassed or taken.
7. If comments are received from the NOAA Fisheries West Coast Regional Administrator or NOAA Fisheries Office of Protected Resources on the draft report, a final report will be

submitted to NOAA Fisheries within 30 days thereafter. If no comments are received from NOAA Fisheries, the draft report will be considered to be the final report.

8. In the unanticipated event that the construction activities clearly cause the take of a marine mammal in a manner prohibited by the requested authorization, such as an injury, serious injury, or mortality, the USCG will immediately cease all operations and report the incident to the Supervisor of Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NOAA Fisheries, and the West Coast Regional Stranding Coordinators. The report will include the following information:
    a. Time, date, and location (latitude/longitude) of the incident;
    b. Description of the incident;
    c. Status of all sound sources used in the 24 hours preceding the incident;
    d. Environmental conditions (e.g., wind speed and direction, cloud cover, visibility, and water depth);
    e. Description of marine mammal observations in the 24 hours preceding the incident;
    f. Species identification or description of the animal(s) involved, including life stage; the fate of the animal(s);
    g. Photographs or video footage of the animal, if available; and
    h. Discussion of all coordination with NOAA Fisheries during construction, as well as any changes or approved modifications implemented during construction.
    i. Activities will not resume until NOAA Fisheries is able to review the circumstances of the prohibited take. NOAA Fisheries will work with the USCG to determine what is necessary to minimize the likelihood of further prohibited takes and confirm MMPA compliance. Activities may not be resumed until notified by NOAA Fisheries via letter, email, or telephone.
9. In the event that the USCG 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, the USCG will immediately report the incident to the Supervisor of the Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NOAA Fisheries, and the West Coast Regional Stranding Coordinators. The report must include the same information identified above. Activities may continue while NOAA Fisheries reviews the circumstances of the incident, and NOAA Fisheries will work with the USCG to determine whether modifications in the activities are appropriate.
10. In the event that the USCG 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), the USCG will report the incident to the Supervisor of the Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NOAA Fisheries, and the West Coast Regional Stranding Coordinators within 24 hours of the discovery. The USCG will provide photographs or video footage if available or other documentation of the stranded animal sighting to NOAA Fisheries and the Marine Mammal Stranding Network. The USCG can continue its operations under such a case.

13.0 SUGGESTED MEANS OF COORDINATION

In-water noise generated by pile installation is the primary issue of concern relative to the marine mammals potentially within the project vicinity. Pinniped monitoring will be conducted to collect information on the presence of marine mammals within the Level A and Level B ZOIs for the project. The monitoring report, which will include a discussion of any behavioral changes in marine mammals resulting from the proposed in-water work, will be submitted to NOAA Fisheries, and subsequently will be available for public review. In this way, future applicants that undertake similar projects can use applicable monitoring data to inform project designs and minimize the take of marine mammals associated with pile driving and removal activities. The monitoring data will inform NOAA Fisheries and future permit applicants about the behavior and adaptability of pinnipeds for future projects of a similar nature.

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APPENDIX A. PROJECT DRAWINGS

U.S. COAST GUARD
FACILITY DESIGN &
CONSTRUCTION CENTER
DETACHMENT SEATTLE

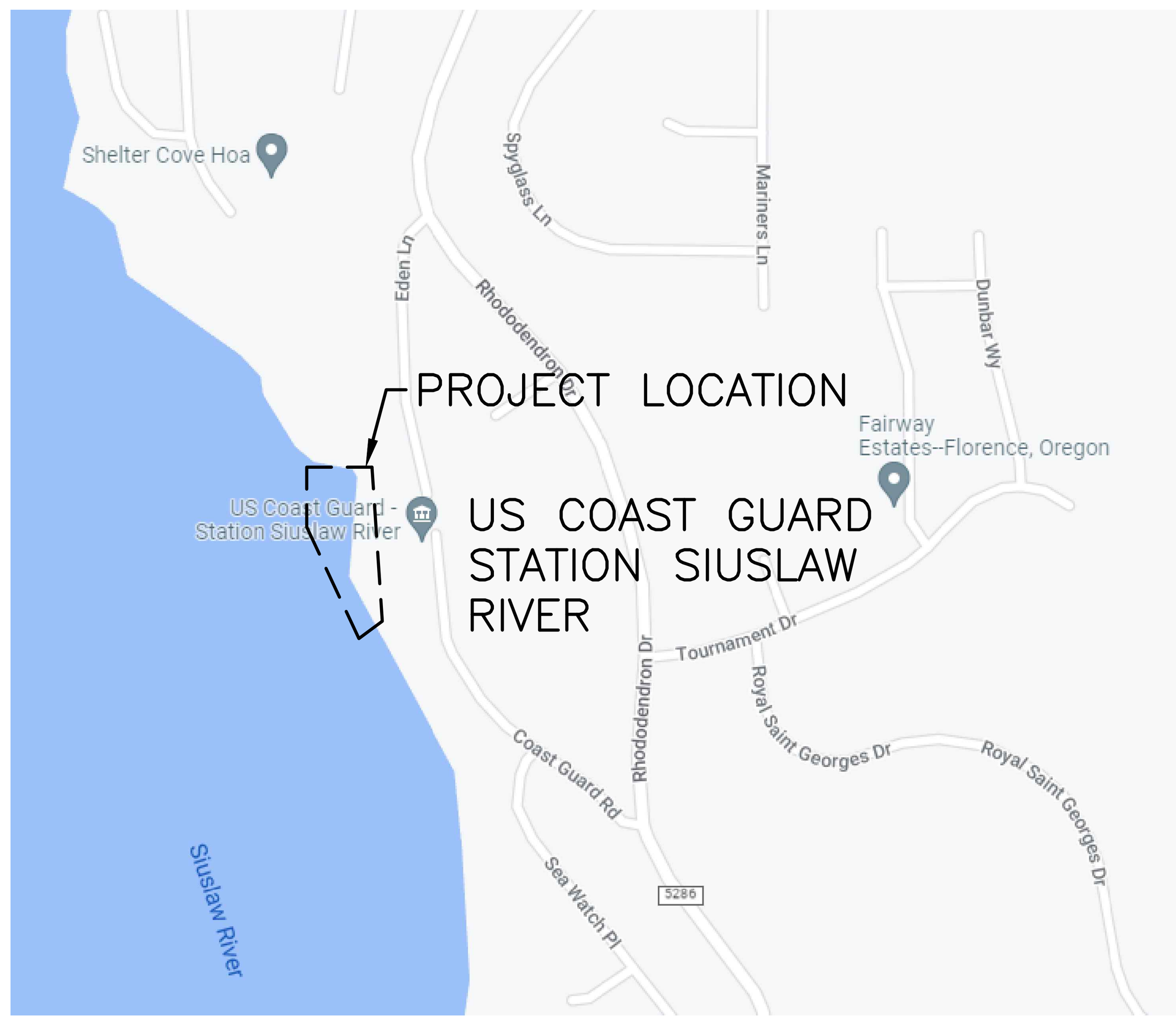
2000 CENTER STREET
SUITE 303
BERKELEY, CA 94704
PHONE: 510-835-2761

Appledore Marine Engineering, LLC
600 State Street,
Suite E
Portsmouth, NH 03801

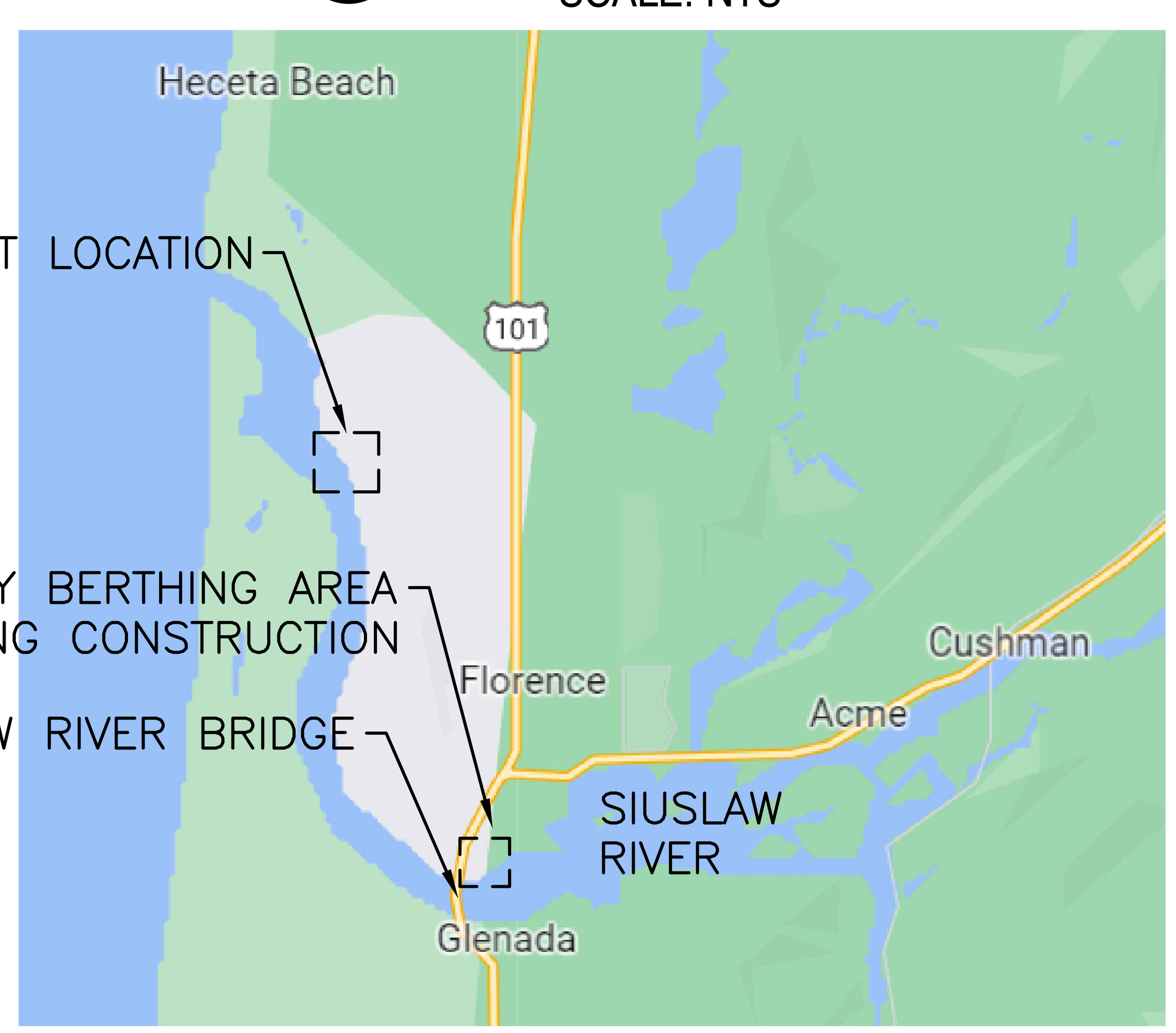
6021 12th St E,
Suite 200
Fife, WA 98424

USCG STA SIUSLAW – FLORENCE, OR STA SIUSLAW RIVER CONSTRUCT COVERED MOORINGS AND CORRECT SHORELINE EROSION

P/N 13-5067032



VICINITY MAP
SCALE: NTS



LOCATION MAP
SCALE: NTS

PROJECT SCOPE IS DIVIDED INTO BASE BID, BID ALTERNATES, AND BID OPTIONS, AS INDICATED. ITEMS NOT NOTED OTHERWISE ARE CONTAINED IN BASE BID. SEE BID SHEET FOR MORE INFORMATION.

INDEX

REGISTERED PROFESSIONAL ENGINEER
ROSA CHEN
No. 89236PE
Exp. 12/31/25
CIVIL
STATE OF OREGON

CDR W. APPROVER
APPROVING OFFICER DATE

T. DIRECTOR
TECHNICAL DIRECTOR DATE

B. CHIEF
BRANCH CHIEF DATE

U.S.C.G.
US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	50% SUBMITTAL	10/25/2023
	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: AS SHOWN
SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94704 510-835-2761
A/E PROJECT NO.: P501210111
CONSULTING A/E: –

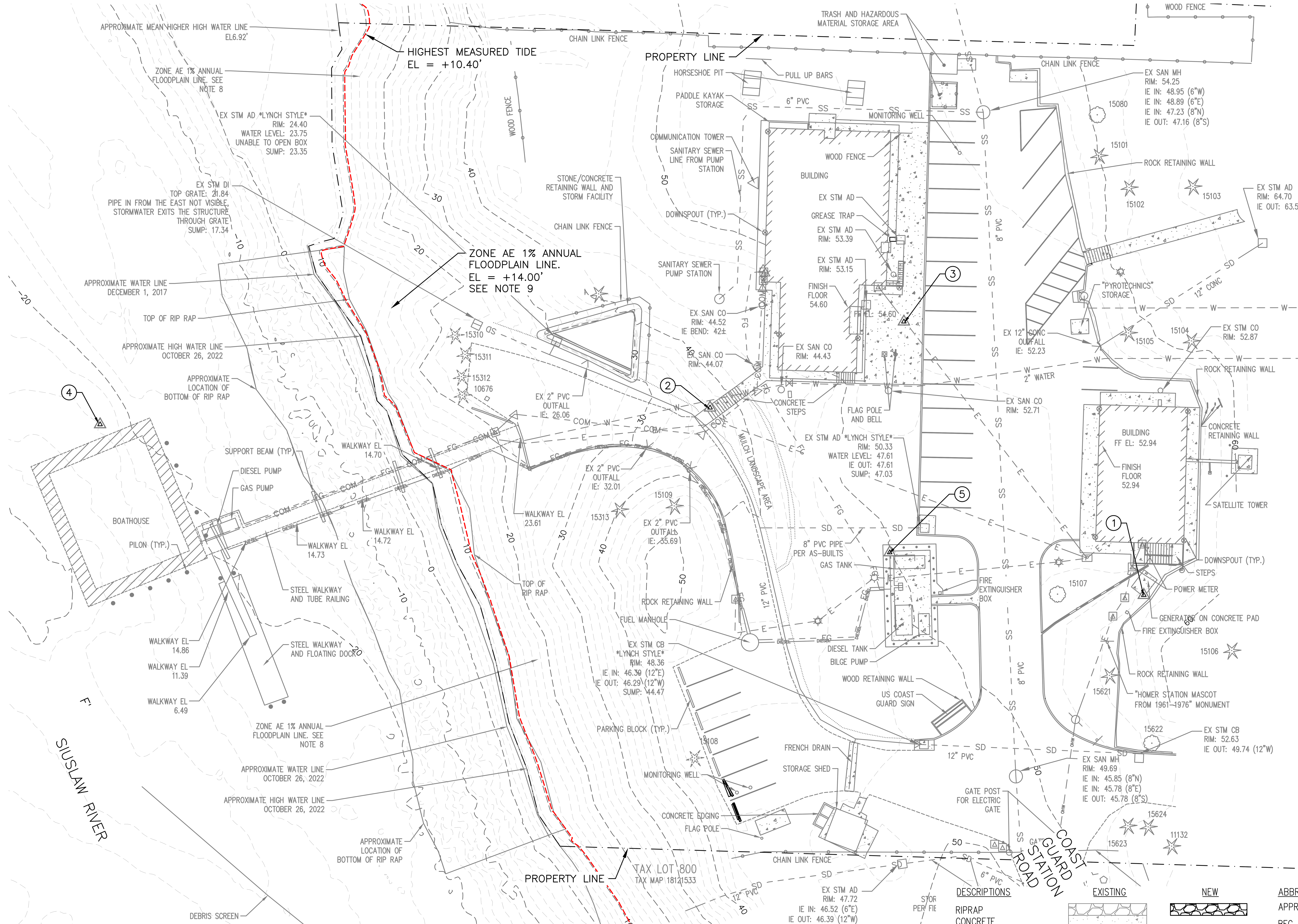
USCG FD&CC DET SEATTLE 915 SECOND AVE, RM 2664 SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: RC
DRAWN BY: AJR
EDITED BY: AJR
CHECKED BY: JML

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032G001
USCG FILENAME 5067032G001.DWG
SHEET 1 OF 108

COVERED MOORINGS, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
GENERAL
COVER SHEET

SHEET ID
COVERED MOORINGS AND SHORELINE EROSION
G-001

SOLICITATION NO.: –
CONTRACT NO.: –



NOTES:

1. UTILITIES SHOWN ARE BASED ON AS-BUILT INFORMATION PROVIDED BY THE US COAST GUARD, ONSITE INSPECTION, INFORMATION PROVIDED TO THE FIELD SURVEYORS ON SITE WHILE CONDUCTING THE FIELD SURVEY. AND BY MARK IT OUT, LLC. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND LOCATES REPRESENT THE ONLY UTILITIES IN THE AREA. CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS PRIOR TO BEGINNING CONSTRUCTION.
2. TOPOGRAPHIC SURVEY WAS PREPARED BY AKS ENGINEERING & FORESTRY, LLC. FIELD WORK WAS CONDUCTED NOVEMBER 29–30, DECEMBER 1–5 2017, OCTOBER 24–26 AND NOVEMBER 15–16, 2022.
3. VERTICAL DATUM: VERTICAL DATUM: IS BASED ON GPS OBSERVATIONS USING THE TRIMBLE NOW NETWORK AND CHECKED AGAINST NGS OPUS SOLUTIONS (NAVD 88).
4. HORIZONTAL DATUM: A LOCAL DATUM PLANE SCALED FROM OREGON STATE PLANE SOUTH 3602 NAD83(2011) EPOCH 2010.0000 BY HOLDING A PROJECT MEAN GROUND COMBINED SCALE FACTOR OF 0.9999976618 AT A CALCULATED CENTRAL PROJECT POINT WITH GRID VALUES OF NORTH 871827.477 AND EAST 3968383.409. WITH A MERIDIAN CONVERGENCE ANGLE OF −2°28'42". THE STATE PLANE COORDINATES WERE DERIVED FROM THE TRIMBLE VRS NOW NETWORK. COORDINATE VALUES ARE IN INTERNATIONAL FEET.
5. THIS IS NOT A PROPERTY BOUNDARY SURVEY TO BE RECORDED WITH THE COUNTY SURVEYOR. BOUNDARIES MAY BE PRELIMINARY.
6. BUILDING FOOTPRINTS ARE MEASURED TO SIDING UNLESS NOTED OTHERWISE. CONTACT SURVEYOR WITH QUESTIONS REGARDING BUILDING TIES.
7. CONTOUR INTERVAL IS 2 FEET.
8. TREES WITH DIAMETER OF 6" AND GREATER ARE SHOWN. TREE DIAMETERS WERE MEASURED UTILIZING A DIAMETER TAPE AT BREAST HEIGHT. TREE INFORMATION IS SUBJECT TO CHANGE UPON ARBORIST INSPECTION.
9. ZONE AE FLOODPLAIN LINE SHOWN BY MAPPING A BASE FLOOD ELEVATION (BFE) OF 14.0 FEET NAVD88 OVER THE SURVEYED CONTOURS. THE BFE IS PER FEMA FIRM 41039C0938G WITH AN EFFECTIVE DATE OF 6–5–2020.
10. THE BATHYMETRIC SURVEY DATA ARE REPRESENTATIVE OF THE BOTTOM ELEVATIONS AT THE TIME OF THE SURVEY AND MAY CHANGE AT ANY TIME FOLLOWING THE SURVEY.
11. HYDROGRAPHIC DATA WERE COLLECTED IN ACCORDANCE WITH THE U.S. ARMY CORPS OF ENGINEERS HYDROGRAPHIC SURVEYING MANUAL EM 1110–2–1003 (NOVEMBER 2013).
12. HYDROGRAPHIC DATA WERE COLLECTED WITH AN R2SONIC 2024 MULTI-BEAM ECHOSOUNDER OPERATING AT 400 KHZ AND AN APPLANIX POS/MV WAVEMASTER II INERTIAL MOTION UNIT.

TREE TABLE

TREE NUMBER	TYPE	DBH (IN.)
11132	CONIFEROUS	10
15080	DECIDUOUS	6,21
15101	CONIFEROUS	13,14,16
15102	CONIFEROUS	10,13,15
15103	CONIFEROUS	8,10,10,14
15104	CONIFEROUS	12,12,13
15105	CONIFEROUS	15
15106	CONIFEROUS	17
15107	DECIDUOUS	15

TREE TABLE

TREE NUMBER	TYPE	DBH (IN.)
15108	CONIFEROUS	15
15109	CONIFEROUS	8
15310	CONIFEROUS	19
15311	CONIFEROUS	8,16
15312	CONIFEROUS	13,15
15313	CONIFEROUS	20
15314	CONIFEROUS	14
15621	CONIFEROUS	18
15622	DECIDUOUS	10
15623	CONIFEROUS	9
15624	CONIFEROUS	9,10,10,12

CONTROL POINTS

POINT #	NORTHING	EASTING	ELEVATION
1	871769.3910	3968518.9560	52.90
2	871838.1230	3968359.8430	36.09
3	871869.5080	3968430.9410	53.22
4	871831.9890	3968136.1380	10.22
5	871784.9890	3968425.7390	50.73

ADDITIONAL TOPO LEGEND

EXISTING:
- DECIDUOUS TREE
- CONIFEROUS TREE
- FIRE HYDRANT
- WATER BLOWOFF
- WATER METER
- WATER VALVE
- STORM DRAIN CLEAN OUT
- STORM DRAIN CATCH BASIN
- STORM DRAIN AREA DRAIN
- STORM DRAIN MANHOLE
- GAS METER
- GAS VALVE
- GUY WIRE ANCHOR
- DOUBLE CHECK VALVE
- AIR RELEASE VALVE
- SANITARY SEWER CLEAN OUT
- SANITARY SEWER MANHOLE
- SIGN
- STREET LIGHT
- MAILBOX
- UTILITY POLE
- POWER VAULT
- POWER JUNCTION BOX
- POWER PEDESTAL
- COMMUNICATIONS VAULT
- COMMUNICATIONS JUNCTION BOX
- COMMUNICATIONS RISER

DESCRIPTIONS (EXISTING / NEW)

RIPRAP
CONCRETE
POWER LINE (E)
FUEL LINE (DIESEL)
NATURAL GAS LINE (FG)
COMMUNICATION LINE (COM)
WATER LINE (W)
SANITARY SEWER LINE (SS)
STORM DRAIN LINE (SD)
DITCH FLOW LINE
TRENCH DRAIN
PROPERTY LINE
RETAINING WALL
SHEETPILE WALL
DOCK GUIDE
STORM DRAIN INLET
OUTFALL
TREE

ABBREVIATIONS

APPROX.	APPROXIMATE
BEG	BEGIN
BHW	TIE-BACK BULKHEAD WALL
GRD	GROUND
(E)	EXISTING
EL	ELEVATION
FG	FINISHED GRADE
MHHW	MEAN HIGH HIGH WATER
(N)	NEW
TW	TOP OF WALL
TYP	TYPICAL

SCALE 0 20 40 60 FEET
1" = 20'

SOLICITATION NO.: –
CONTRACT NO.: –

U.S.C.G.
US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	50% SUBMITTAL	10/25/2023
	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: AS SHOWN
SCALE: AS SHOWN

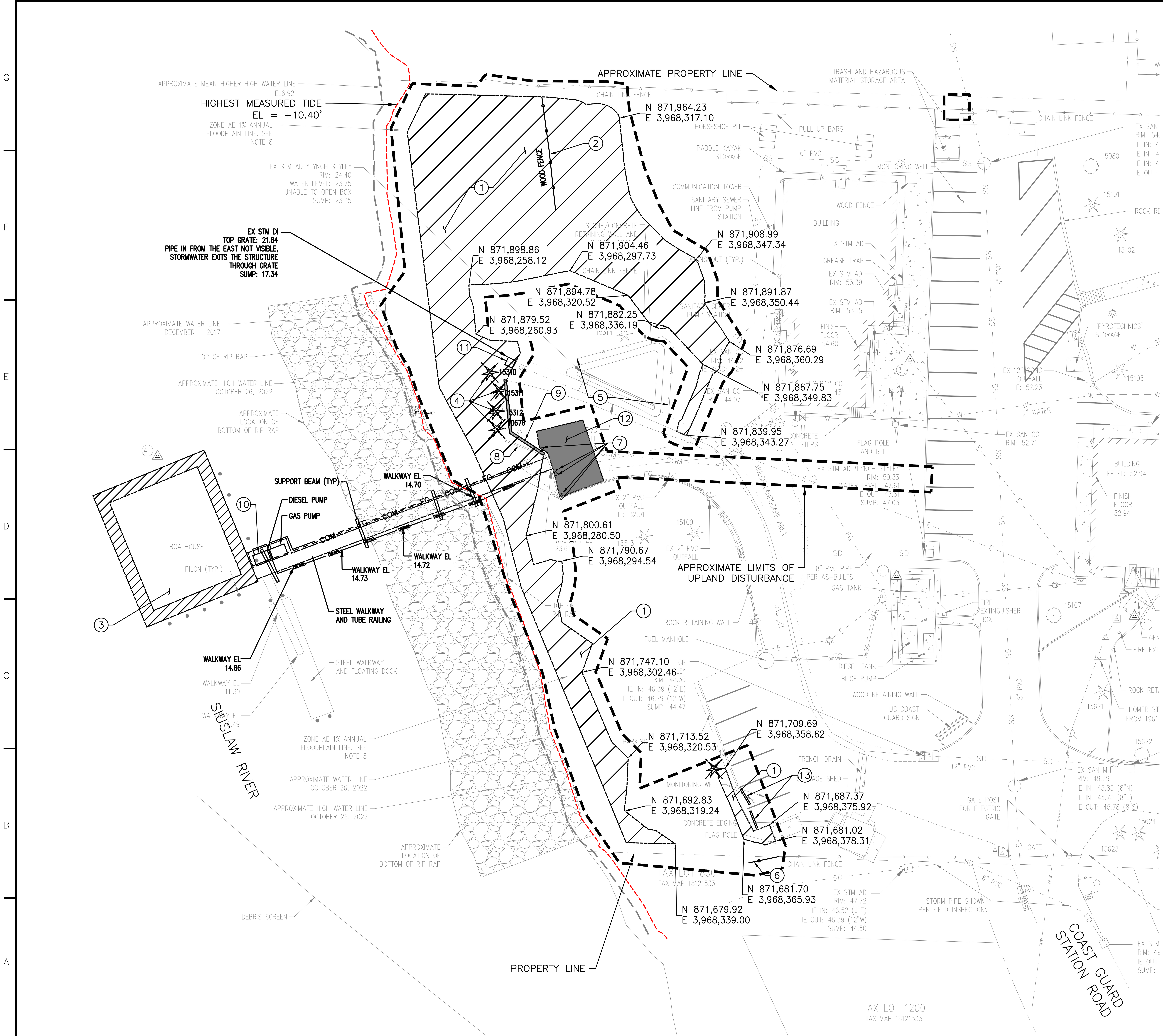
A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94704 510-835-2761
A/E PROJECT NO.: P501210111
CONSULTING A/E: –

USCG FD&CC DET SEATTLE 915 SECOND AVE, RM 2664 SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: RC
DRAWN BY: AJR
EDITED BY: AJR
CHECKED BY: JML

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032V100
USCG FILENAME 5067032V100.DWG
SHEET 5 OF 108

COVERED MOORINGS, SHORELINE EROSION STATION SIUSLAW RIVER
FLORENCE OR
CIVIL
EXISTING CONDITIONS SURVEY

SHEET ID
COVERED MOORINGS AND SHORELINE EROSION
V-100



GENERAL NOTES

1. SEE LAYOUT ON SHEET CS-100.
2. SEE UTILITY PLANS FOR MORE INFORMATION.
3. ALL TREES EXISTING TO REMAIN SHALL BE PROTECTED IN PLACE. SEE LANDSCAPE SHEETS FOR TREE PROTECTION DETAILS.

KEY NOTES

1. CLEAR AND GRUB.
2. REMOVE WOOD FENCE.
3. SEE WD101 FOR WATERFRONT DEMOLITION.
4. REMOVE TREE.
5. PROTECT WOOD FENCE IN PLACE.
6. REMOVE PORTION OF CHAIN LINK FENCE AND POST.
7. REMOVE AND CAP UTILITY LINE. SEE GENERAL NOTE 2.
8. PROTECT RETAINING WALL AND ROAD PAVEMENT IN PLACE.
9. SAWCUT AC PAVEMENT.
10. REMOVE, STORE AND REPLACE DIESEL AND GAS FUEL DISPENSERS IN-KIND.
11. REMOVE DRAINAGE OUTFALL STRUCTURE.
12. REMOVE AC PAVEMENT.
13. REMOVE WHEEL STOP.

LEGEND

- CLEAR AND GRUB
- REMOVE AC PAVEMENT
- REMOVE TREE (SEE SHEET G-002 FOR EXISTING TREE TABLE)

REGISTERED PROFESSIONAL ENGINEER ROSA CHEN No. 89236PE Exp. 12/31/25 CIVIL STATE OF OREGON

U.S.C.G. US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	100% SUBMITTAL	02/09/2024
	50% SUBMITTAL	10/25/2023

PLOTTING SCALE: AS SHOWN | SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94704 510-835-2761
A/E PROJECT NO.: P502121-011
CONSULTING A/E: -

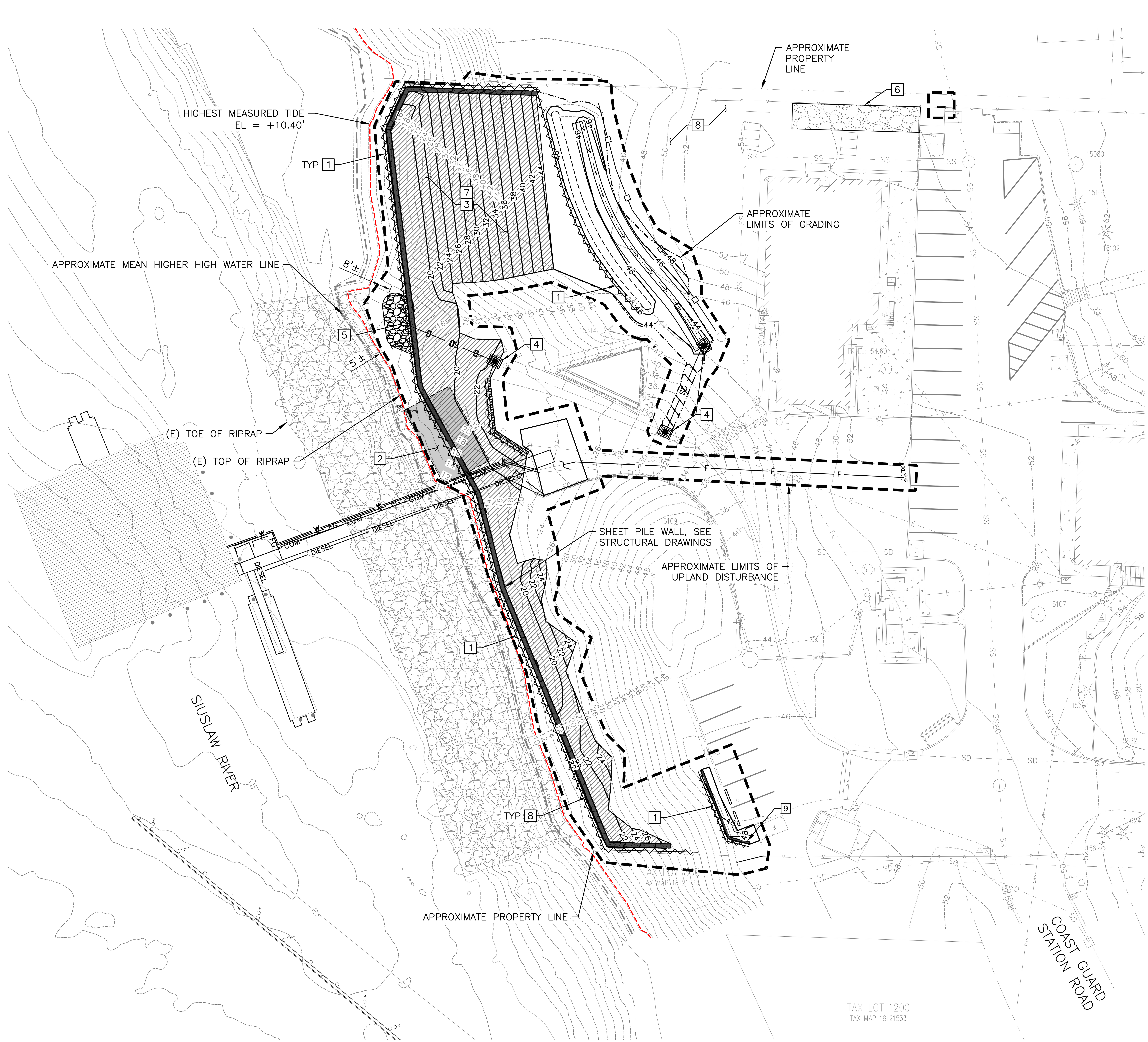
USCG FD&CC DET SEATTLE 915 SECOND AVE, RM 2664 SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: RC | DRAWN BY: AJR | CHECKED BY: JML
EDITED BY: AJR

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032CD100
USCG FILENAME 5067032CD100.DWG
SHEET 6 OF 108

COVERED MOORINGS, SHORELINE EROSION STATION SIUSLAW RIVER
FLORENCE OR
CIVIL
DEMOLITION PLAN

SHEET ID
SHORELINE EROSION
CD100

SOLICITATION NO.: -
CONTRACT NO.: -



GENERAL NOTES

1. ALL EROSION CONTROL MEASURES MUST BE INSTALLED PRIOR TO ANY SITE EXCAVATION OR REGRADING. ALL DISTURBED AREAS ON THE SITE, NOT COVERED BY BUILDINGS OR PAVEMENT, MUST BE STABILIZED WITH LOAM, SEED, AND MULCH, OR OTHER METHODS, AS REQUIRED BY THE SITE-SPECIFIC EROSION AND SEDIMENT CONTROL PLAN.
2. CONSTRUCTION MUST NOT BEGIN UNTIL ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES, AS SPECIFIED ON THE PLANS, HAVE BEEN INSTALLED.
3. PERIMETER EROSION CONTROL MUST BE INSTALLED AS DIRECTED BY THE ENGINEER TO RETAIN SEDIMENT WITHIN THE SITE BOUNDARY DURING EACH PHASE OF CONSTRUCTION.
4. PROVIDE NO MORE THAN TWO STABILIZED CONSTRUCTION ENTRANCES.
5. STOCK PILES EXPOSED FOR MORE THAN 14 DAYS MUST BE TEMPORARILY SEEDED FOR EROSION CONTROL.
6. EROSION AND SEDIMENTATION CONTROL MEASURES PER OREGON DEPARTMENT OF TRANSPORTATION STANDARD DRAWINGS, LATEST VERSION UNLESS OTHERWISE NOTED.
7. FOR CONSTRUCTION TRUCK ACCESS, ANY UNPAVED AREA USED WILL REQUIRE A GRAVEL ROAD TO ENABLE TRUCK TRAFFIC. PROVIDE A 6-INCH THICK GRANULAR WORK PAD OF CLEAN, CRUSHED ROCK PLACED OVER A SAND SUBGRADE. REMOVE GRAVEL ROAD AT THE END OF CONSTRUCTION AND ESTABLISH VEGETATION AT EMBANKMENT TO MATCH THE PROPOSED LAYOUT AND REESTABLISH TURF IN THE FLAT AREAS TO MATCH EXISTING. NEED FOR TRUCK ACCESS AND EXACT PATH IS SUBJECT TO CONTRACTOR'S NEED AND WORK PLAN.
8. TEMPORARY SLOPES SHALL HAVE A MAXIMUM SLOPE NOT TO EXCEED 1.5 HORIZ: 1. VERT AND WILL ONLY REDUCE THE RISK OF A MAJOR SLOPE FAILURE.
9. "FULL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE SHOWN. SEE WATERFRONT STRUCTURAL DRAWINGS FOR MORE INFORMATION.

#KEY NOTES

1. SEDIMENT BARRIER OR SEDIMENT FENCE PER OREGON STANDARD DRAWINGS RD1030 OR RD1040. SEE SHEET CE501.
2. TEMPORARY 20'X33' STAGING AREA DURING WALL CONSTRUCTION. SEE CG100 FOR FINAL GRADES.
3. SLOPE AND CHANNEL MATTING USING WESTERN GREEN C700BN BIONET OR APPROVED EQUIVALENT. INSTALLATION PER OREGON STANDARD DRAWING RD1055. USE LONG TERM (36 MONTHS FUNCTIONAL LONGEVITY) DOUBLE NET, FULLY BIODEGRADABLE EROSION CONTROL BLANKET.
4. INLET PROTECTION PER OREGON STANDARD DRAWING RD1010 AND RD1015. SEE SHEET CE502.
5. 10'x20' SCOUR BASIN/ENERGY DISSIPATER PER OREGON STANDARD DRAWING RD1050. SEE SHEET CE501.
6. STABILIZED CONSTRUCTION ENTRANCE PER DETAIL 4/CE501. COORDINATE LOCATION WITH USCG. RE-ESTABLISH TURF AFTER CONSTRUCTION.
7. PROVIDE FULLY BIODEGRADABLE SEDIMENT BARRIER TYPE 8 (COMPOST FILTER SOCK) PER OREGON STANDARD DRAWING RD1032. SEE SHEET CE502. SPACE AT 25' WITH SEDIMENT BARRIERS AT TOP AND BOTTOM OF EMBANKMENT.
8. CONSTRUCTION ACCESS ROAD, SEE GENERAL NOTE 7.
9. "PROVIDE UPPER RETAINING WALL" BID ALTERNATE SHOWN. SEE CG100 FOR INFORMATION ON "NO UPPER RETAINING WALL" BID ALTERNATE.

SCALE 0 20 40 60 FEET
1" = 20'

REGISTERED PROFESSIONAL ENGINEER
ROSA CHEN
No. 89236PE
Exp. 12/31/25
CIVIL
STATE OF OREGON

U.S.C.G.
US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	50% SUBMITTAL	10/25/2023
	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: AS SHOWN | SCALE: AS SHOWN

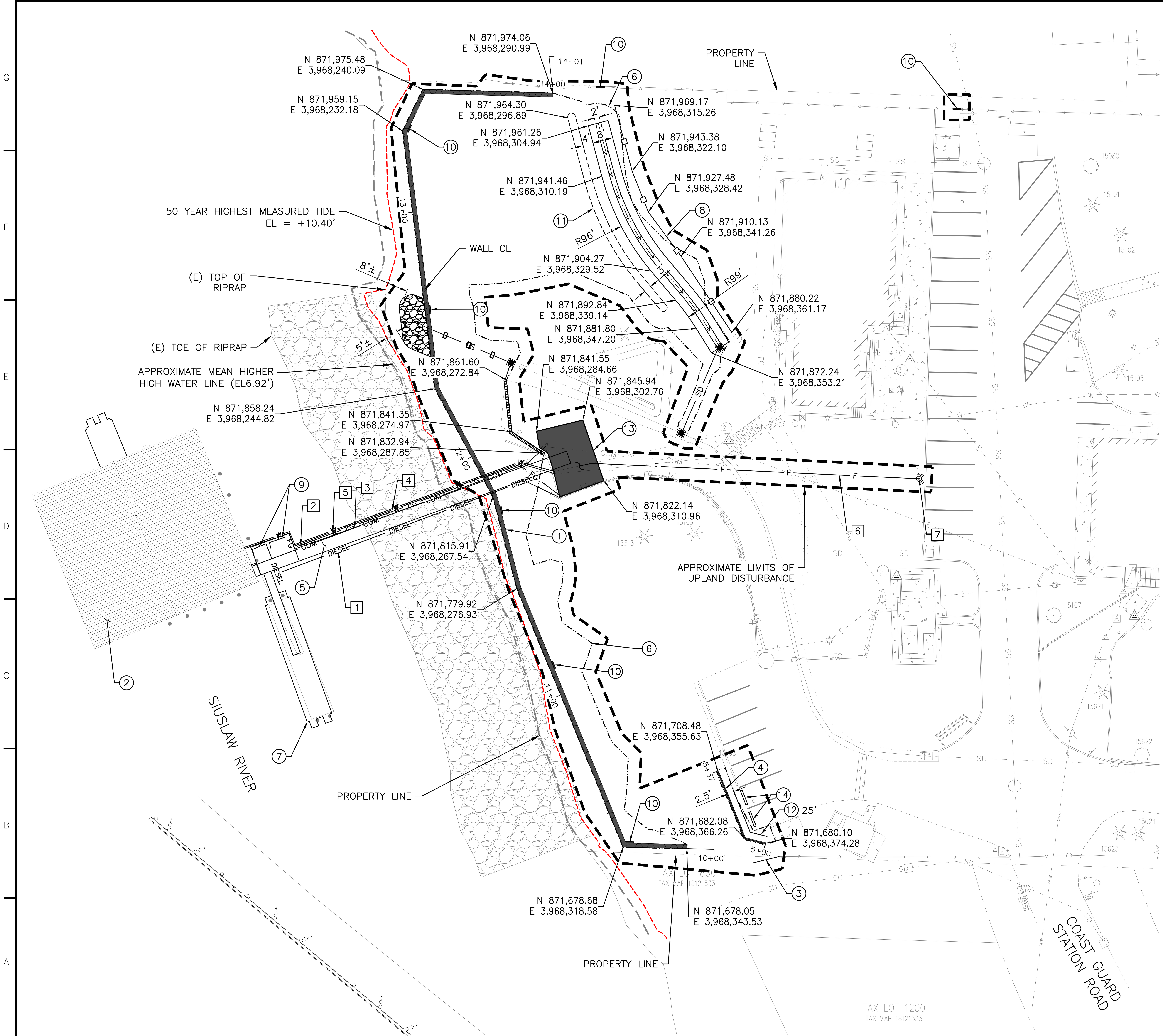
A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94704 510-835-2761
A/E PROJECT NO.: P501210111
CONSULTING A/E: – –

USCG FD&CC DET SEATTLE 915 SECOND AVE, RM 2664 SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: RC
DRAWN BY: AJR
EDITED BY: AJR
CHECKED BY: JML

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032CE100
USCG FILENAME 5067032CE100.DWG
SHEET 7 OF 108

COVERED MOORINGS, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
CIVIL
EROSION AND SEDIMENTATION CONTROL PLAN

SHEET ID
SHORELINE EROSION
CE100



GENERAL NOTES

1. EXISTING BACKGROUND INFORMATION IS FROM TOPOGRAPHIC SURVEY PERFORMED ON NOVEMBER 2022 BY AKS. CONTRACTOR SHALL VERIFY EXISTING CONDITIONS PRIOR TO START OF WORK. SEE NOTES 3 AND 4 ON V-100 FOR DATUM.
2. SEE SHEET CG100 FOR GRADING AND DRAINAGE PLAN.
3. SEE SHEET V-100 FOR SURVEY NOTES AND LEGEND.
4. ALL TREES EXISTING TO REMAIN SHALL BE PROTECTED IN PLACE. SEE LANDSCAPE SHEETS FOR TREE PROTECTION DETAILS.
5. EXISTING DOCK UTILITIES SHALL BE CAPPED AND REMOVED TO ALLOW DEMOLITION AND RECONSTRUCTION OF THE RAMP AND BOAT HOUSE. NEW UTILITIES TO BE REPLACED IN-KIND ON THE RAMP. SURVEY AND PROVIDE EXISTING UTILITY LAYOUT CONFIGURATION PRIOR TO START OF DEMOLITION INCLUDING ROUTING, SIZE AND MATERIALS OF PIPING AND STRUCTURES, AS WELL AS PICTURES. NEW UTILITIES TO MATCH THE GENERAL ROUTING OF THE EXISTING UTILITIES UNLESS OTHERWISE NOTED.
6. UTILITY TRENCHING PER DETAIL 2/CS501.
7. "FULL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE SHOWN. SEE WATERFRONT STRUCTURAL DRAWINGS FOR MORE INFORMATION.

#KEY NOTES

1. SHEET PILE WALL, SEE CG100, S-100 & S-400.
2. COVERED MOORING, SEE WS SHEETS.
3. FENCE PER DETAIL 1/CS501.
4. TOP OF SLOPE RETAINING WALL, SEE CG100 & S-100. "PROVIDE UPPER RETAINING WALL" BID ALTERNATE SHOWN. SEE CG100 FOR INFORMATION ON "NO UPPER RETAINING WALL" BID ALTERNATE
5. STEEL WALKWAY, SEE WS SHEETS.
6. APPROXIMATE LIMITS OF GRADING.
7. CONCRETE FLOATING DOCK, SEE WS SHEETS.
8. WOOD PICKET FENCE SIMILAR TO EXISTING.
9. REMOVED AND REINSTALLED IN-KIND GASOLINE AND DIESEL FUEL DISPENSERS WITH HOSE REELS. CONTACT MASCOTT EQUIPMENT AT 800-452-5019 OR APPROVED EQUIVALENT FUEL VENDOR FOR TESTING AFTER REINSTALLATION.
10. SIGNAGE AS NOTED PER SHEET CS502.
11. BERM, SEE GRADING PLAN.
12. 42" HANDRAIL SIMILAR TO ODOT BR246 "PEDESTRIAN RAIL" LOCATED 12" FROM RETAINING WALL AND EMBEDDED IN 12" DIAMETER CONCRETE FOOTING WITH MINIMUM 3' OF POST EMBEDMENT.
13. REPLACE ASPHALT PAVEMENT IN KIND. MATCH EXISTING ASPHALT AND AGGREGATE BASE THICKNESS.
14. REPLACE WHEEL STOP IN KIND.

#UTILITY KEY NOTES

REPLACE THE FOLLOWING EXISTING UTILITY LINES IN-KIND.

1. DIESEL LINE. REMOVE AND REPLACE DOUBLE-WALLED DIESEL LINE – 4" FIBERGLASS OUTER PIPE AND 2-1/2" SCHEDULE 40SS PIPE.
2. FUEL GASOLINE LINE. REMOVE AND REPLACE DOUBLE-WALLED UNLEADED GASOLINE LINE – 4" FIBERGLASS OUTER PIPE AND 2-1/2" SCHEDULE 40SS PIPE.
3. COMMUNICATION LINE. SEE ELECTRICAL PLANS.
4. POWER LINE. SEE ELECTRICAL PLANS.
5. 1-1/2" WATER LINE WITH INSULATION.
6. FIRE LINE, SEE FX101. REPLACE PAVEMENT, CURBS AND GUTTERS, AND LANDSCAPING IN KIND.
7. FIRE DEPARTMENT CONNECTION, SEE FX101.

SCALE 0 20 40 60 FEET
1" = 20'

REGISTERED PROFESSIONAL ENGINEER — ROSA CHEN — No. 89236PE — CIVIL — STATE OF OREGON — Exp. 12/31/25

U.S.C.G. — US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	100% SUBMITTAL	02/09/2024
	50% SUBMITTAL	10/25/2023

PLOTTING SCALE: AS SHOWN | SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS, 2000 CENTER ST., BERKELEY, CA 94704, 510-835-2761
A/E PROJECT NO.: P501210011
CONSULTING A/E: –

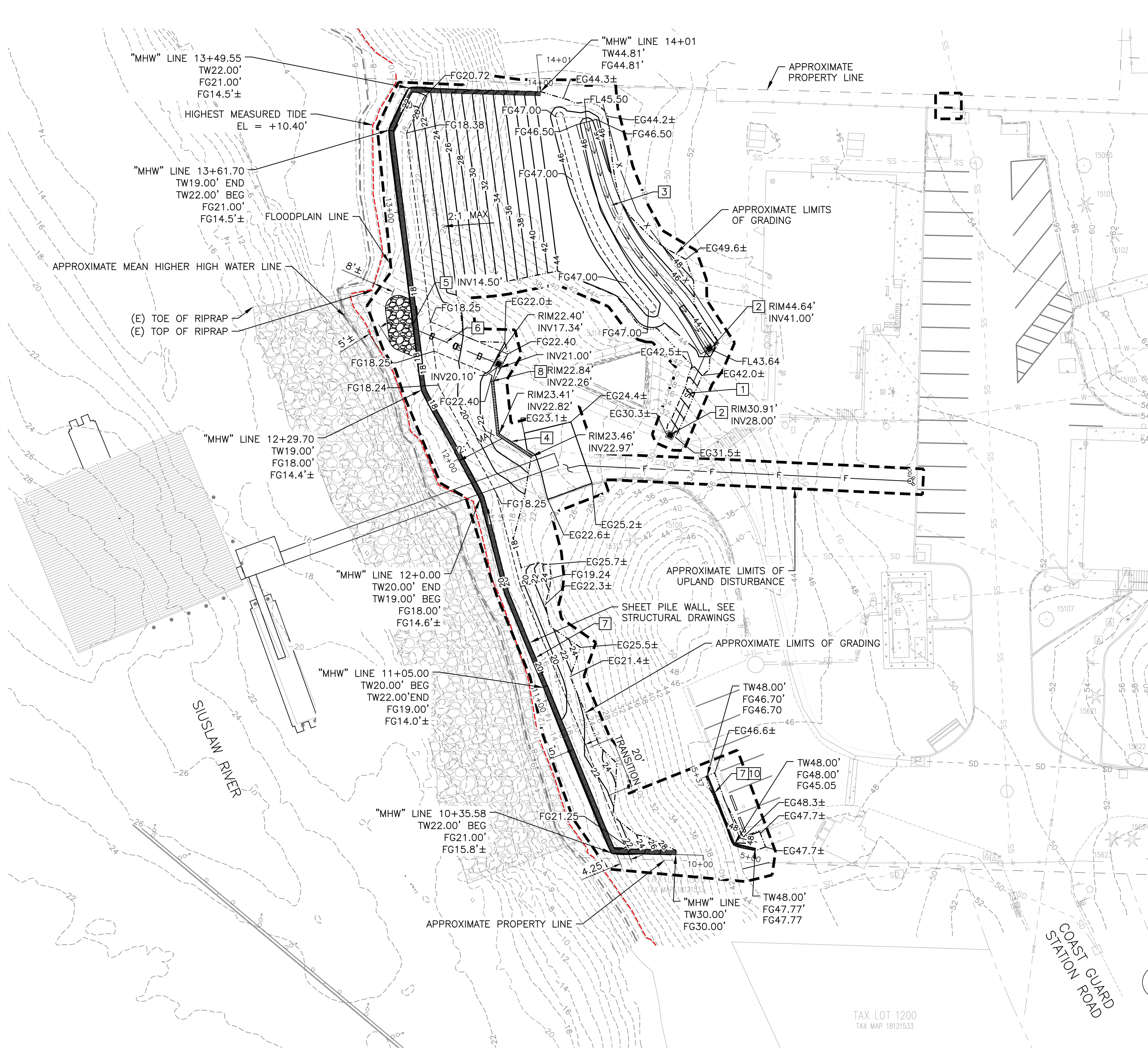
USCG FD&CC DET SEATTLE, 915 SECOND AVE, RM 2664, SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: RC | DRAWN BY: AJR
EDITED BY: AJR | CHECKED BY: JML

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032CS100
USCG FILENAME 5067032CS100.DWG
SHEET 10 OF 108

COVERED MOORINGS, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
CIVIL
CIVIL SITE & UTILITY PLAN

SHEET ID
SHORELINE EROSION
CS100

SOLICITATION NO.: –
CONTRACT NO.: –



GENERAL NOTES

1. EXISTING BACKGROUND INFORMATION IS FROM TOPOGRAPHIC SURVEY PERFORMED ON NOVEMBER 2022 BY AKS. CONTRACTOR SHALL VERIFY EXISTING CONDITIONS PRIOR TO START OF WORK. SEE NOTES 3 AND 4 ON V-100 FOR DATUM.
2. CONTOUR INTERVAL IS 2 FEET.
3. SEE SHEETS E-001 THROUGH E-611 FOR ELECTRICAL PLANS.
4. "FULL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE SHOWN. SEE WATERFRONT STRUCTURAL DRAWINGS FOR MORE INFORMATION

KEY NOTES

1. 12" STORM DRAIN PIPE.
2. STORM DRAIN INLET PER DETAIL 1/CG501.
3. SURFACE SWALE WITH GRAVEL BOTTOM PER DETAIL 3/CG501.
4. 6" WIDE 0.5% PRE SLOPED CONCRETE TRENCH DRAIN.
5. OUTFALL STRUCTURE THROUGH WALL PER DETAIL 2/CG501. PROVIDE 12" THICK, CLASS 100 RIPRAP ENERGY DISSIPATER.
6. 12" RCP AT-GRADE WITH CONCRETE ANCHORS PER DETAIL 4/CG501.
7. RETAINING WALL – PROVIDE WEEP HOLE AND DRAINAGE AT WALL, TYP.
8. 6" VERTICAL OUTLET ENDCAP AT TRENCH DRAIN.
9. BID OPTION: SAWCUT AND REMOVE EXISTING ASPHALT TO ALLOW FOR 2:1 EMBANKMENT SLOPE, PROVIDE A REDWOOD HEADER AT EDGE OF REMAINING ASPHALT AND RESTRIPE AREA FOR PARALLEL PARKING STALLS AS SHOWN.
10. "PROVIDE UPPER RETAINING WALL" BID ALTERNATE SHOWN.

1 "NO UPPER RETAINING WALL" BID ALTERNATE
NOT TO SCALE

SCALE 1" = 20' (0, 20, 40, 60 FEET)

REGISTERED PROFESSIONAL ENGINEER — ROSA CHEN — No. 89236PE — Exp. 12/31/25 — CIVIL — STATE OF OREGON

U.S.C.G. — US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	100% SUBMITTAL	02/09/2024
	50% SUBMITTAL	10/25/2023

PLOTTING SCALE: AS SHOWN — SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS, 2000 CENTER ST., BERKELEY, CA 94704, 510-835-2761
A/E PROJECT NO.: P501210111
CONSULTING A/E: –

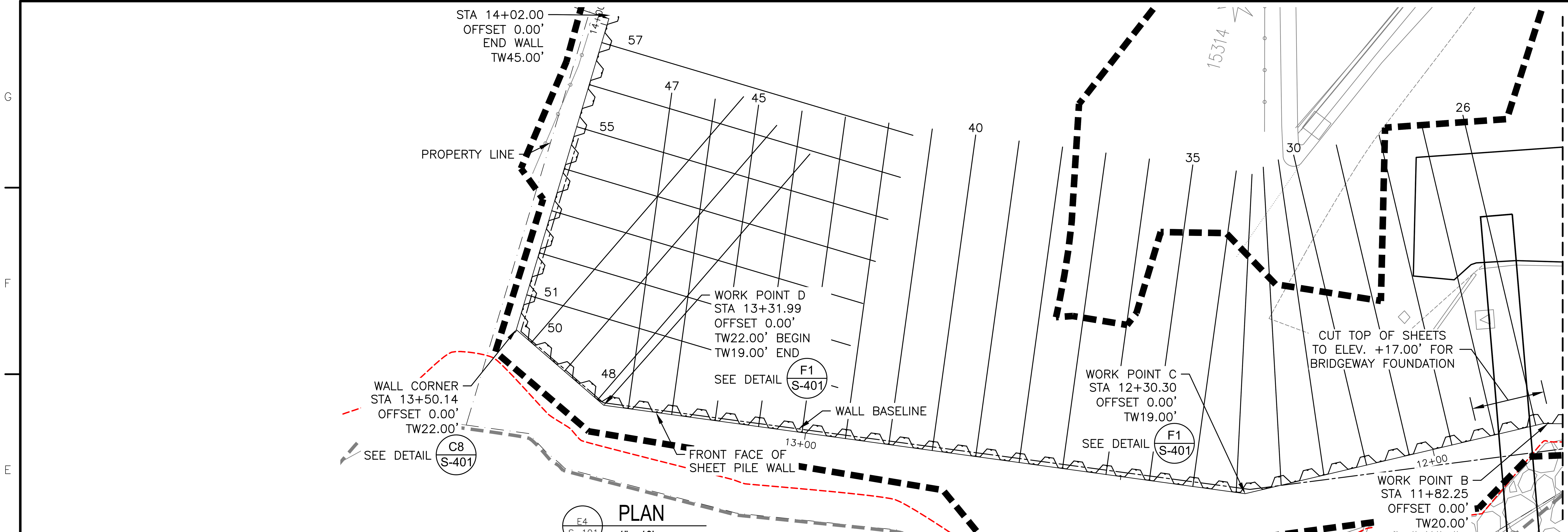
USCG FD&CC DET SEATTLE, 915 SECOND AVE, RM 2664, SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: RC
DRAWN BY: AJR
CHECKED BY: JML
EDITED BY: AJR

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032CG100
USCG FILENAME 5067032CG100.DWG
SHEET 14 OF 108

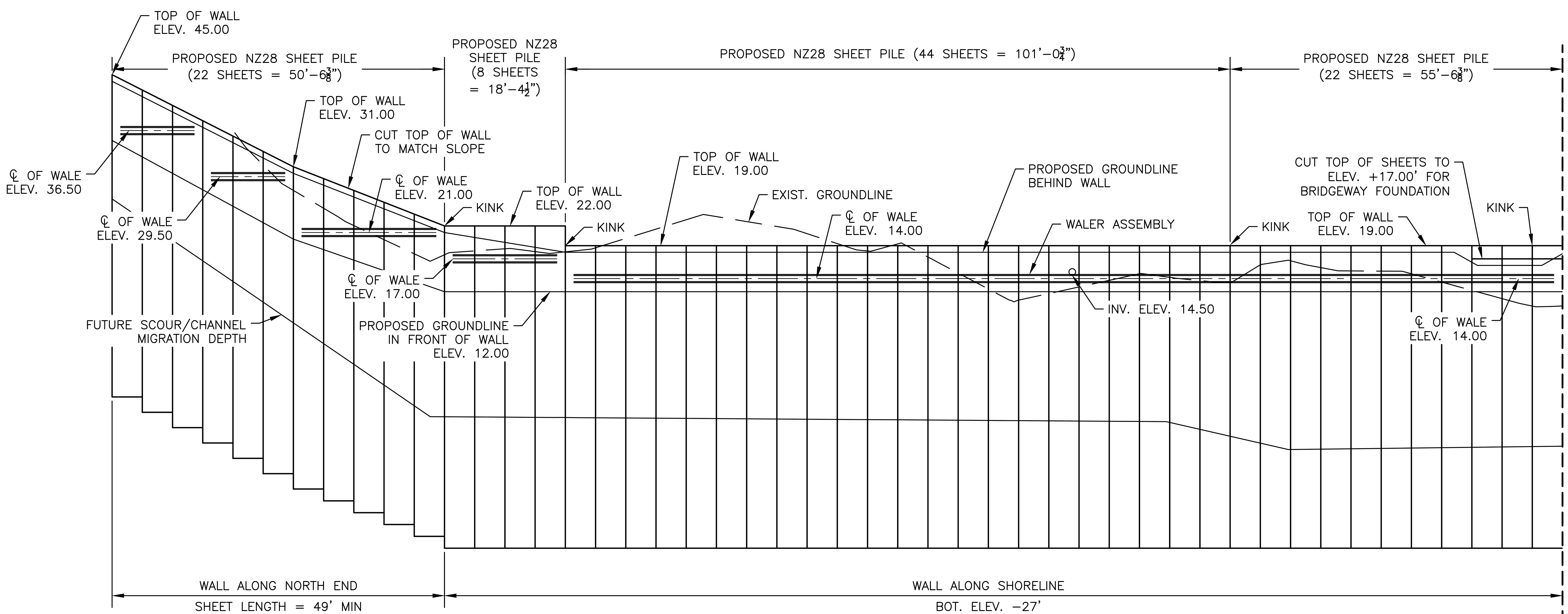
COVERED MOORINGS, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
CIVIL
GRADING & DRAINAGE PLAN

SHEET ID
SHORELINE EROSION
CG100

SOLICITATION NO.: –
CONTRACT NO.: –



E4 S-101 PLAN
1" = 10'



A3 S-101 UNFOLDED ELEVATION
1" = 10'

NOTE:

BRIDGEWAY NOT SHOWN IN UNFOLDED ELEVATION FOR CLARITY

SCALE 1" = 10' (0, 10, 20, 30 FEET)

U.S.C.G. CE
US COAST GUARD CIVIL ENGINEERING

ANNA M. DUKES, S.E.
NO. 081-005598
EXP. DATE 11/30/2024

MARK	DESCRIPTION	DATE
	100% SUBMITTAL	02/09/2024
	50% SUBMITTAL	10/25/2023

PLOTTING SCALE: AS SHOWN | SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS
2000 CENTER ST., BERKELEY, CA 94704
510-835-2761
A/E PROJECT NO.: P501210111
CONSULTING A/E: -

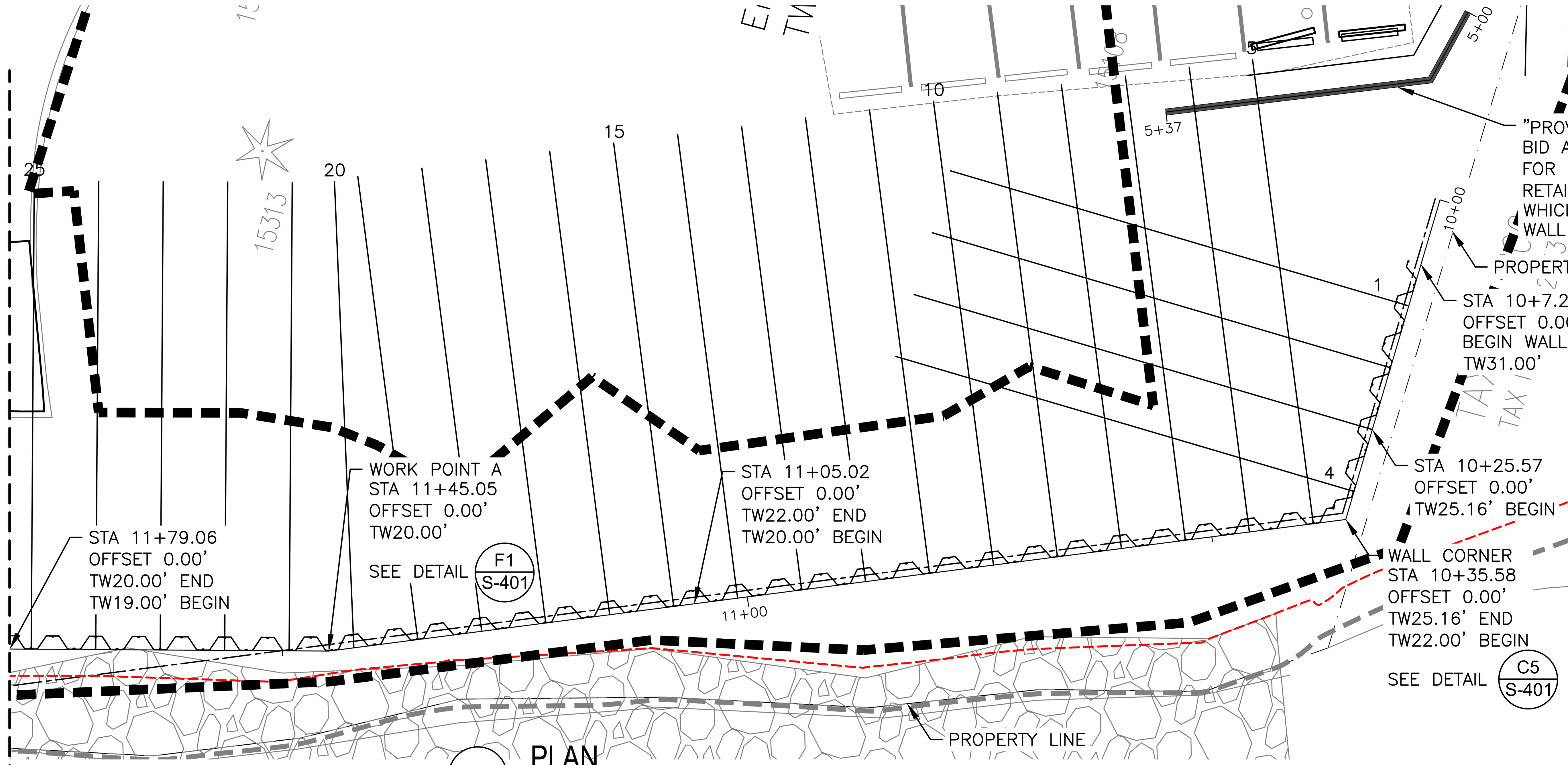
USCG FD&CC DET SEATTLE
915 SECOND AVE, RM 2664
SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: CG
DRAWN BY: MD
CHECKED BY: AMD
EDITED BY: IS

USCG PROJECT NO. 5067032
USCG DRAWING NO. 50670325101
USCG FILENAME -
SHEET 22 OF 108

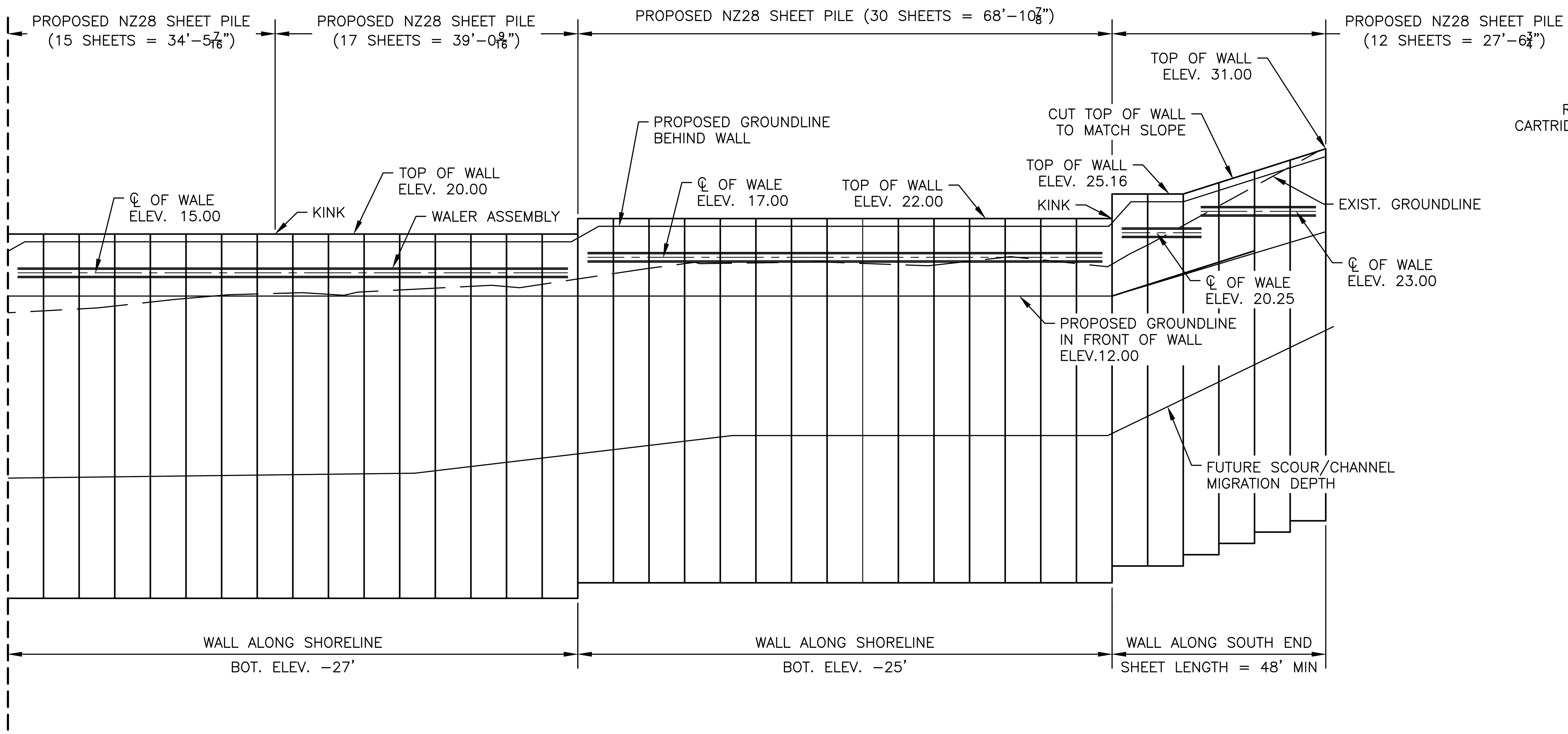
COVERED MOORINGS, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
STRUCTURAL
WALL PLAN AND ELEV. - 1

SHEET ID
SHORELINE EROSION
S-101

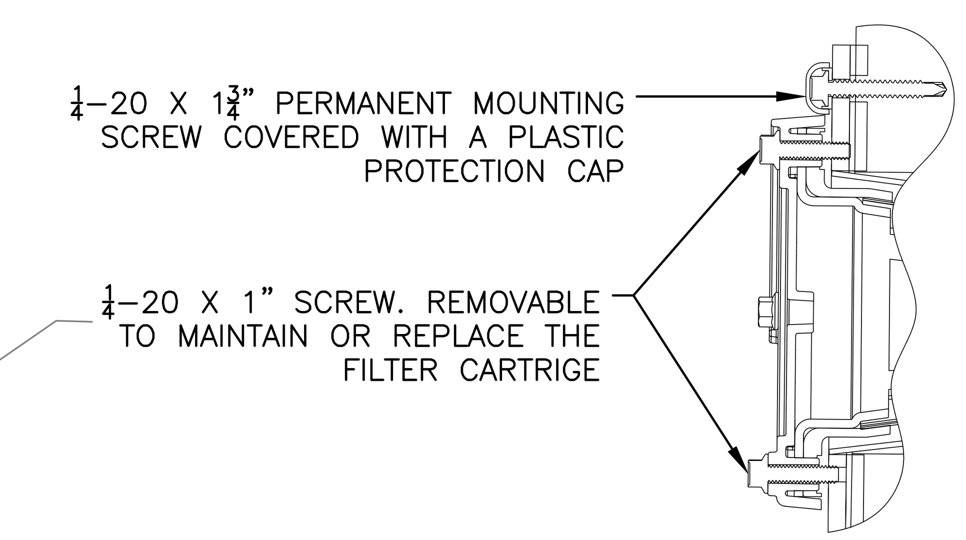
SOLICITATION NO.: -
CONTRACT NO.: -



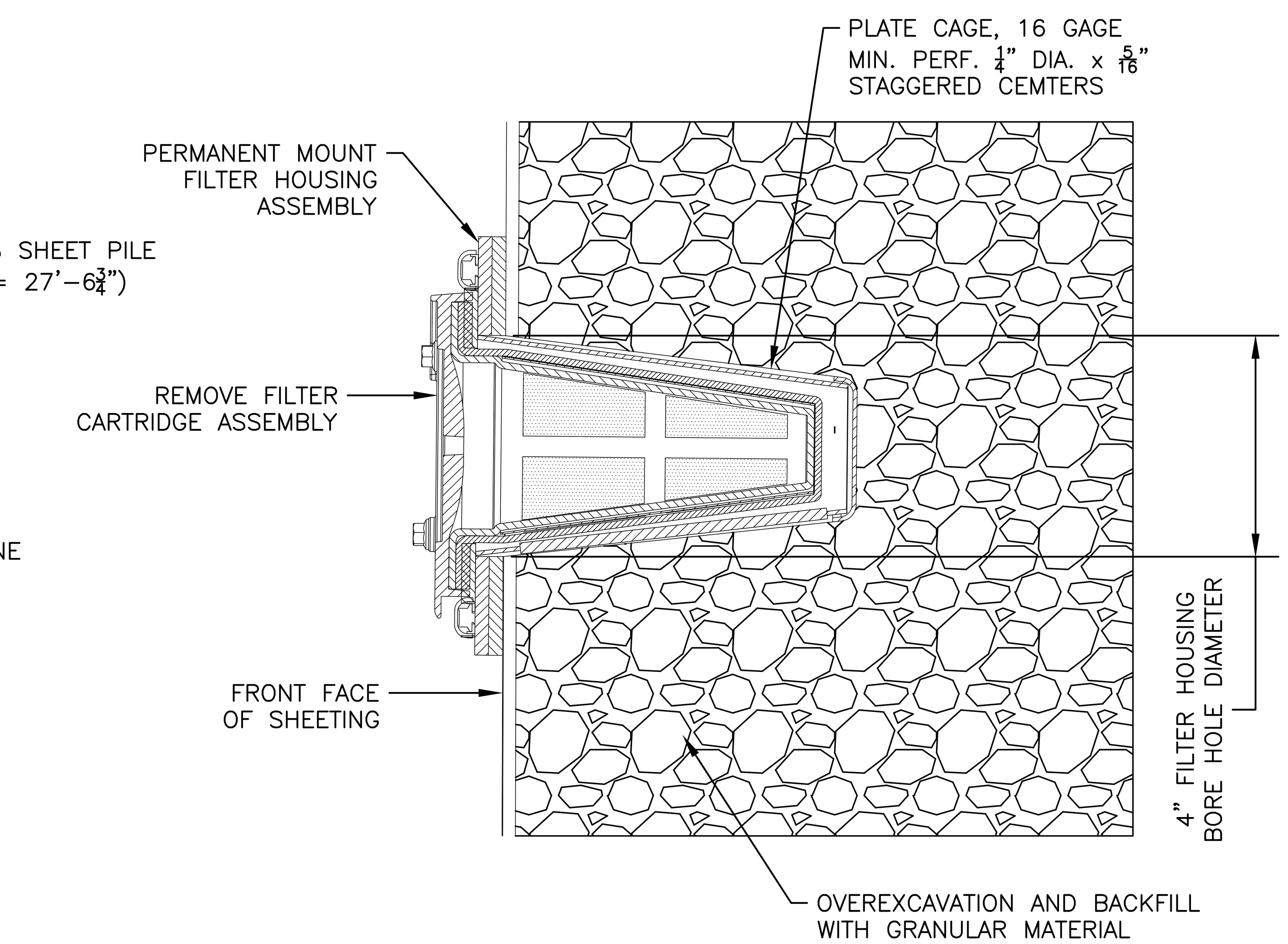
E3 S-102 PLAN
1" = 10'



A3 S-102 UNFOLDED ELEVATION
1" = 10'



A4 S-102 CORED WEEP HOLE ASSEMBLY MOUNTING DETAIL
NTS



A5 S-102 SECTION THRU CORED WEEP HOLE ASSEMBLY
NTS

NOTE:

BRIDGEWAY NOT SHOWN IN UNFOLDED ELEVATION FOR CLARITY

SCALE 1" = 10' (0, 10, 20, 30 FEET)

ANNA M. DUKES, S.E.
NO. 081-005598
EXP. DATE 11/30/2024

U.S.C.G. US COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
	50% SUBMITTAL	10/25/2023
	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: AS SHOWN | SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94704 510-835-2761
A/E PROJECT NO.: P501210111
CONSULTING A/E: -

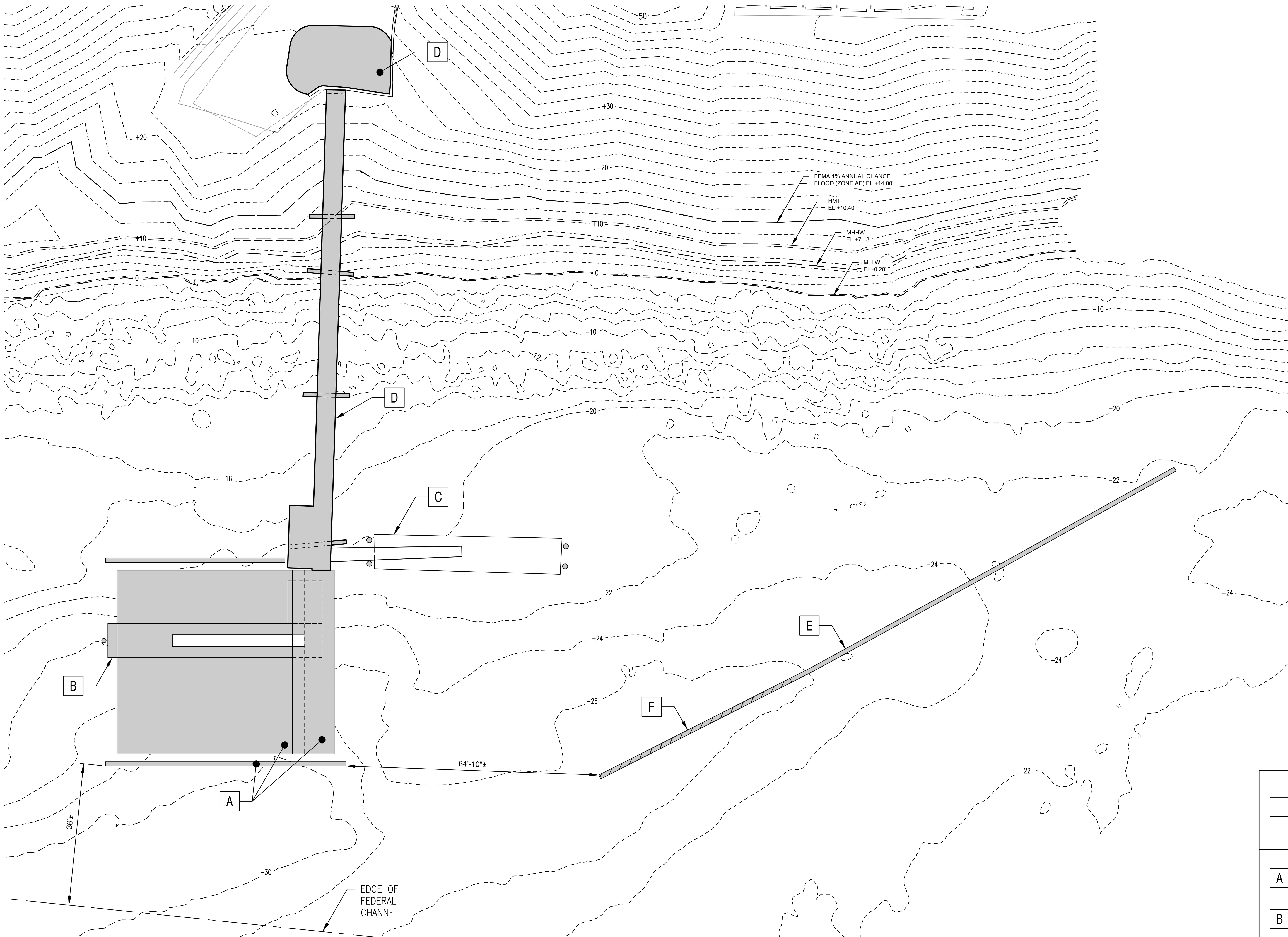
USCG FD&CC DET SEATTLE 915 SECOND AVE, RM 2664 SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: CG
DRAWN BY: MD
EDITED BY: IS
CHECKED BY: AMD

USCG PROJECT NO. 5067032
USCG DRAWING NO. 50670325102
USCG FILENAME -
SHEET 23 OF 108

COVERED MOORINGS, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
STRUCTURAL
WALL PLAN AND ELEV. - 2

SHEET ID
SHORELINE EROSION
S-102

SOLICITATION NO.: -
CONTRACT NO.: -



WATERFRONT DEMOLITION WORK PLAN

SCALE: 1"=15'-0"

NOTES:

1. THE DEMOLITION PLANS AND DETAILS DEPICTED ARE BASED ON REFERENCE DRAWINGS LISTED. SELECT DETAILS ARE SHOWN FOR SCHEMATIC PURPOSE ONLY. ACTUAL EXISTING CONDITIONS AND DETAILS MAY VARY. OTHER DETAILS ARE FURTHER DEPICTED IN THE REFERENCE DRAWINGS.

LEGEND

- LIMITS OF REMOVAL AND REINSTALLATION
- GENERAL LIMITS OF DEMOLITION
- LIMITS OF DEMOLITION FOR "PARTIAL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE
- 2' CONTOURS
- 10' CONTOURS

WATERFRONT DEMOLITION WORK PLAN KEYNOTES:

(KEYNOTES ARE NON-SEQUENTIAL)

- **A** REMOVE BOATHOUSE FOUNDATION, MEZZANINE, ENCLOSURE, AND STABILIZATION FRAMES. (SEE SHEETS WD401–WD402)
- **B** REMOVE INTERIOR FLOATING DOCK AND GUIDE PILES; REMOVE AND REINSTALL GANGWAY. (SEE SHEET WD403)
- **C** BASE BID: REMOVE AND REINSTALL EXTERIOR GANGWAY "EXTERIOR FLOATING DOCK GUIDE PILE REPLACEMENT" BID OPTION: REMOVE EXTERIOR GUIDE PILES; REMOVE AND REINSTALL EXTERIOR FLOATING DOCK. (SEE SHEET WD404)
- **D** REMOVE BRIDGE, INCLUDING PILES, SUPERSTRUCTURE, DECK, AND PAVEMENT AND FILL AT APPROACH. (SEE SHEETS WD405–WD406)
- **E** "FULL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE: REMOVE ENTIRE DEBRIS SCREEN, INCLUDING PILES AND HORIZONTAL STRAKES. (SEE SHEET WD407)
- **F** "PARTIAL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE: REMOVE DEBRIS SCREEN WITHIN THE LIMITS DEPICTED, INCLUDING PILES AND HORIZONTAL STRAKES IN THIS AREA. (SEE SHEET WD407)

U.S. COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
-	100% SUBMITTAL	02/09/2024
-	50% SUBMITTAL	10/25/2023

PLOTTING SCALE: 1:1 — SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS, 2000 CENTER ST., BERKELEY, CA 94707, 510-835-2761
A/E PROJECT NO.: P501021011
CONSULTING A/E: APPLEDORE MARINE ENGINEERING, LLC, PORTSMOUTH, NEW HAMPSHIRE 03801

USCG FD&CC DET SEATTLE, 945 SECOND AVE, RM 2664, SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: MDM/SND — DRAWN BY: AMD/MDM
EDITED BY: MDM — CHECKED BY: SND/KFR

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032WD101
USCG FILE NAME 5067032WD101.DWG
SHEET 30 OF 108

COVER MOORING, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR

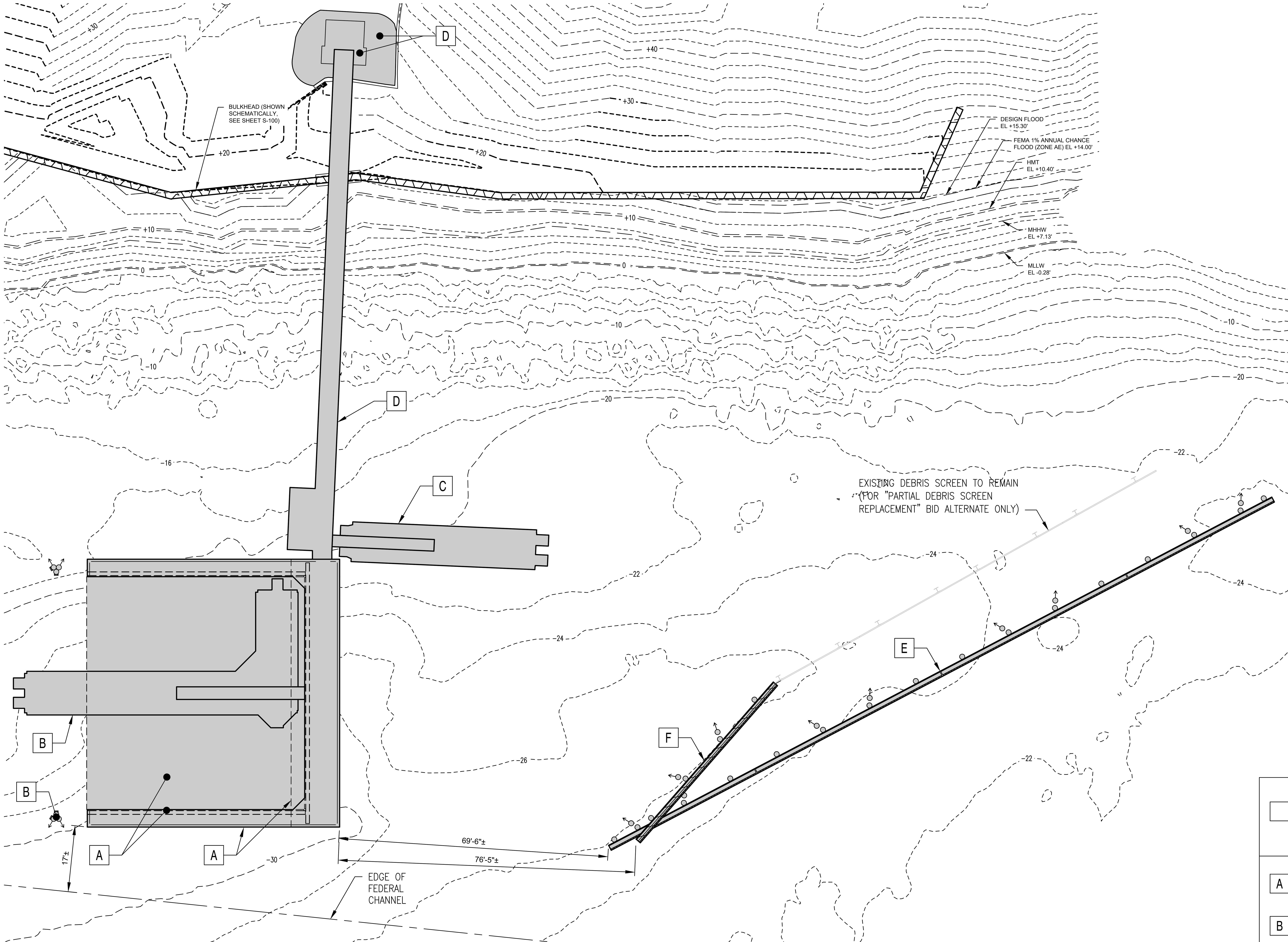
WATERFRONT STRUCTURAL

WATERFRONT DEMOLITION WORK PLAN

SHEET ID

COVERED MOORINGS

WD101



WATERFRONT STRUCTURAL WORK PLAN

SCALE: 1"=15'-0"

0 15' 30'

LEGEND

- GENERAL LIMITS OF WORK
- LIMITS OF WORK FOR "PARTIAL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE
- 2' CONTOURS
- 10' CONTOURS

WATERFRONT STRUCTURAL WORK PLAN KEYNOTES:

(KEYNOTES ARE NON-SEQUENTIAL)

A	PROVIDE BOATHOUSE FOUNDATION, ENCLOSURE, MEZZANINE, AND WAVESCREEN. (SEE SHEETS WS102–WS108)
B	PROVIDE INTERIOR FLOATING DOCK, DOLPHINS, AND GUIDE PILES; REINSTALL EXISTING GANGWAY. (SEE SHEET WS109)
C	BASE BID: REINSTALL EXISTING EXTERIOR FLOATING DOCK AND GANGWAY. (SEE SHEET WS110) "EXTERIOR FLOATING DOCK GUIDE PILE REPLACEMENT" BID OPTION: PROVIDE GUIDE PILES. (SEE SHEET WS110)
D	PROVIDE BRIDGE AND APPROACH. (SEE SHEET WS111)
E	"FULL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE: PROVIDE DEBRIS SCREEN. (SEE SHEET WS112)
F	"PARTIAL DEBRIS SCREEN REPLACEMENT" BID ALTERNATE: PROVIDE 53'-9" DEBRIS SCREEN. (SEE SHEET WS112)

U.S.C.G. U.S. COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
-	50% SUBMITTAL	10/25/2023
-	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: 1:1 SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94707 510-835-2761
A/E PROJECT NO.: P5010210111
CONSULTING A/E: APPLEDORE MARINE ENGINEERING, LLC PORTSMOUTH, NEW HAMPSHIRE 03801

USCG FD&CC DET SEATTLE 945 SECOND AVE, RM 2664 SEATTLE, WASHINGTON 98174-1011
PROJECT ENGINEER: LOUIE LIU
DESIGNED BY: MDM/SND
DRAWN BY: AMD/MDM
EDITED BY: MDM
CHECKED BY: SND/KFR

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032WS101
USCG FILE NAME 5067032WS101.DWG
SHEET 40 OF 108

COVER MOORING, SHORELINE EROSION STATION SIUSLAW RIVER FLORENCE OR

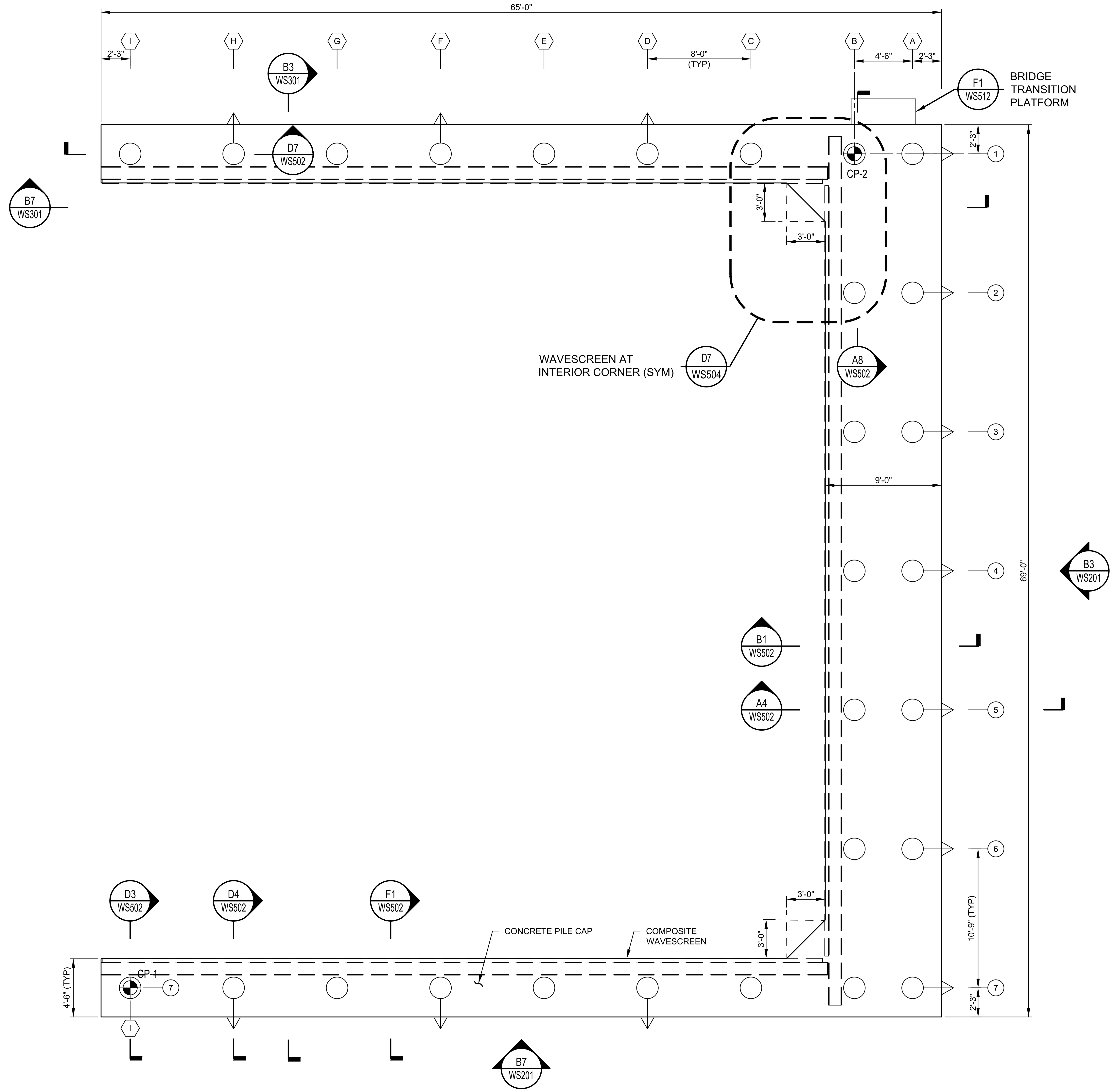
WATERFRONT STRUCTURAL

WATERFRONT STRUCTURAL WORK PLAN

SHEET ID

COVERED MOORINGS

WS101



FOUNDATION PLAN

SCALE: 1"=5'-0"

ID	NORTHING	EASTING
CP-1	871815.452	3968089.898
CP-2	871788.108	3968170.821

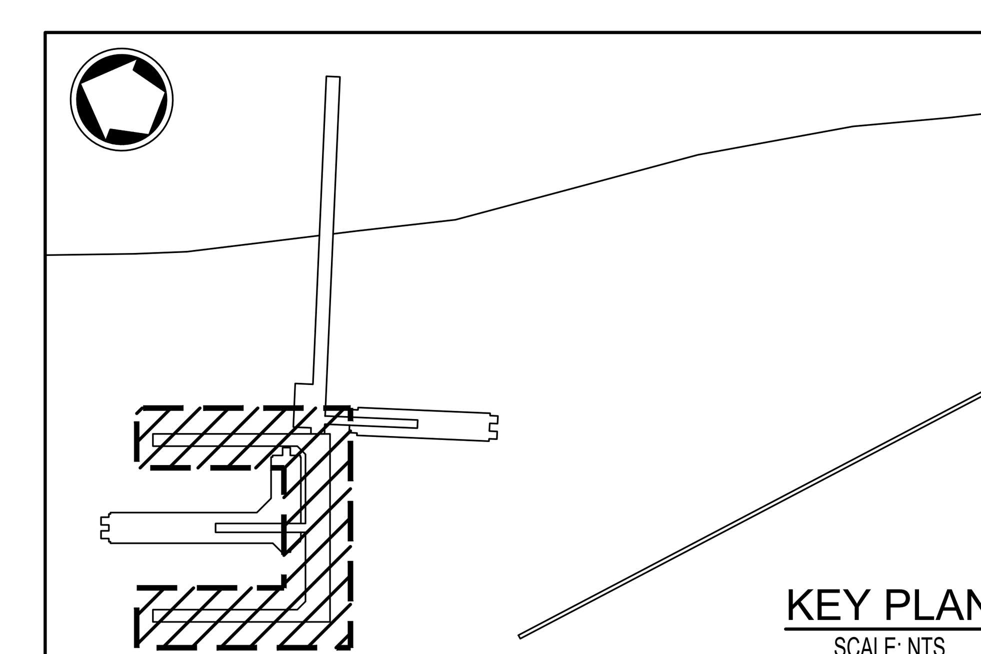
CONTROL POINT COORDINATES

NOTE:

1. LISTED NORTHINGS AND EASTINGS ARE IN INTERNATIONAL FEET AND ARE BASED ON THE OREGON STATE COORDINATE REFERENCE SYSTEM.

LEGEND:

- (1) BENT DESIGNATION
- (A) ROW DESIGNATION
- PLUMB CONCRETE-FILLED STEEL PP20x0.625
- BATTERED CONCRETE-FILLED STEEL PP20x0.625
- CP-6 CONTROL POINT (TAKEN AT PILE CENTER)



KEY PLAN

SCALE: NTS

U.S.C.G.

U.S. COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
-	50% SUBMITTAL	10/25/2023
-	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: 1:1

SCALE: AS SHOWN

A/E COMPANY:
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2000 CENTER ST., BERKELEY, CA 94707
510-835-2761

A/E PROJECT NO.:
P501020111

CONSULTING A/E:
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EDITED BY:
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CHECKED BY:
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USCG PROJECT NO.
5067032

USCG DRAWING NO.
5067032WS102

USCG FILE NAME
5067032WS102.DWG

SHEET 41 OF 108

COVER MOORING, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR

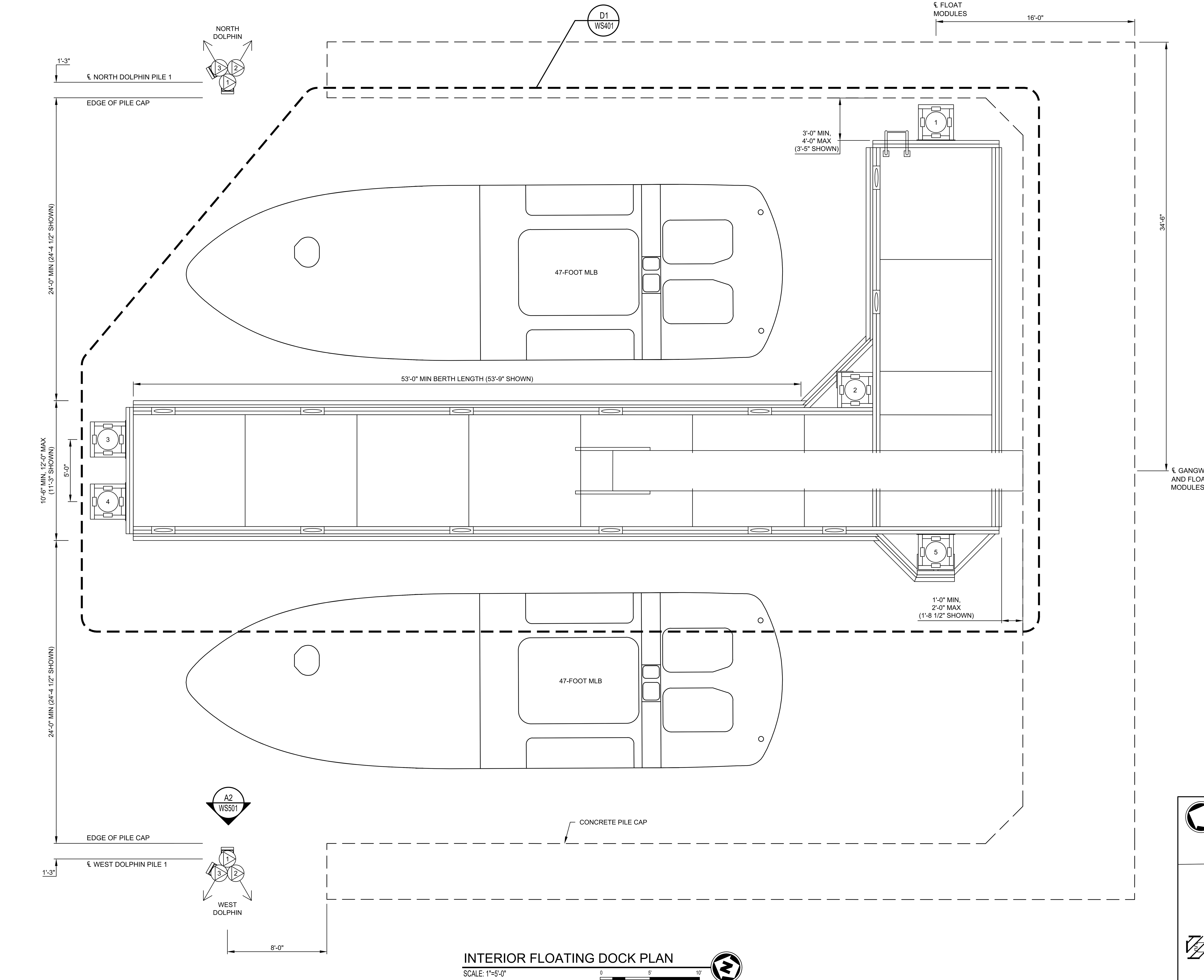
WATERFRONT STRUCTURAL

BOATHOUSE FOUNDATION PILE PLAN

SHEET ID

COVERED MOORINGS

WS102

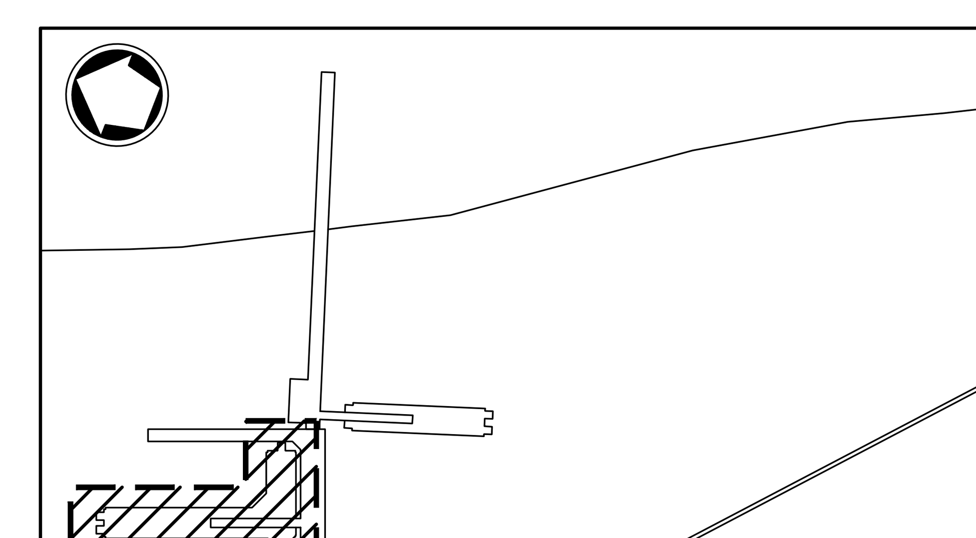


INTERIOR FLOATING DOCK PLAN

SCALE: 1"=5'-0"

LEGEND:

①	PILE DESIGNATION
○	PLUMB CONCRETE-FILLED STEEL PP20x0.625
▷	PLUMB CONCRETE-FILLED STEEL PP16x0.500
▷→	BATTERED CONCRETE-FILLED STEEL PP16x0.500



KEY PLAN

SCALE: NTS

U.S. COAST GUARD
CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
-	100% SUBMITTAL	02/09/2024
-	50% SUBMITTAL	10/25/2023

PLOTTING SCALE: 1:1 | SCALE: AS SHOWN

A/E COMPANY:
TRANSYSTEMS
2000 CENTER ST., BERKELEY, CA 94707
510-835-2761

A/E PROJECT NO.:
P5010210111

CONSULTING A/E:
APPLEDORE MARINE ENGINEERING, LLC
PORTSMOUTH, NEW HAMPSHIRE 03801

USCG FD&CC DET SEATTLE
945 SECOND AVE, RM 2664
SEATTLE, WASHINGTON 98174-1011

PROJECT ENGINEER:
LOUIE LIU

DESIGNED BY: MDM/SND
DRAWN BY: AMD/MDM
EDITED BY: MDM
CHECKED BY: SND/KFR

USCG PROJECT NO.
5067032

USCG DRAWING N0.
5067032WS109

USCG FILE NAME
5067032WS109.DWG

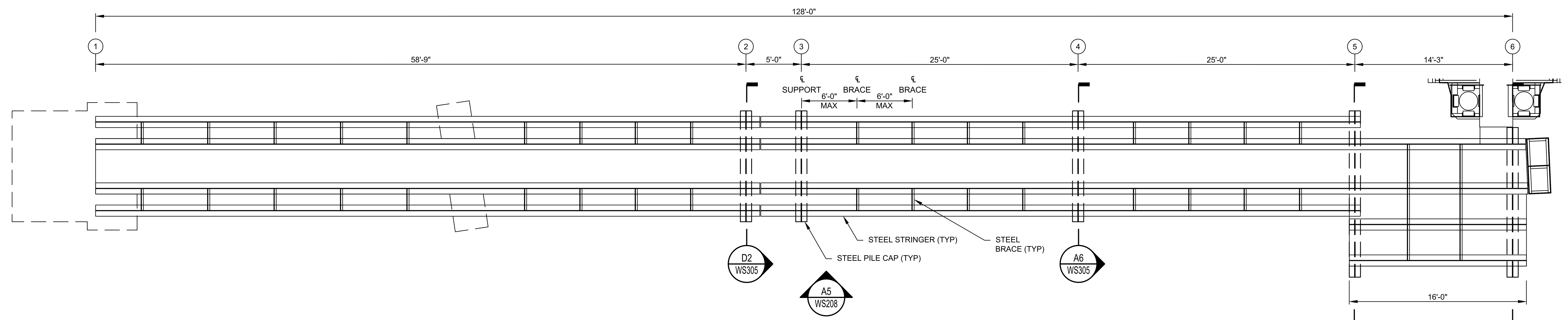
SHEET 48 OF 108

COVER MOORING, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR

WATERFRONT STRUCTURAL

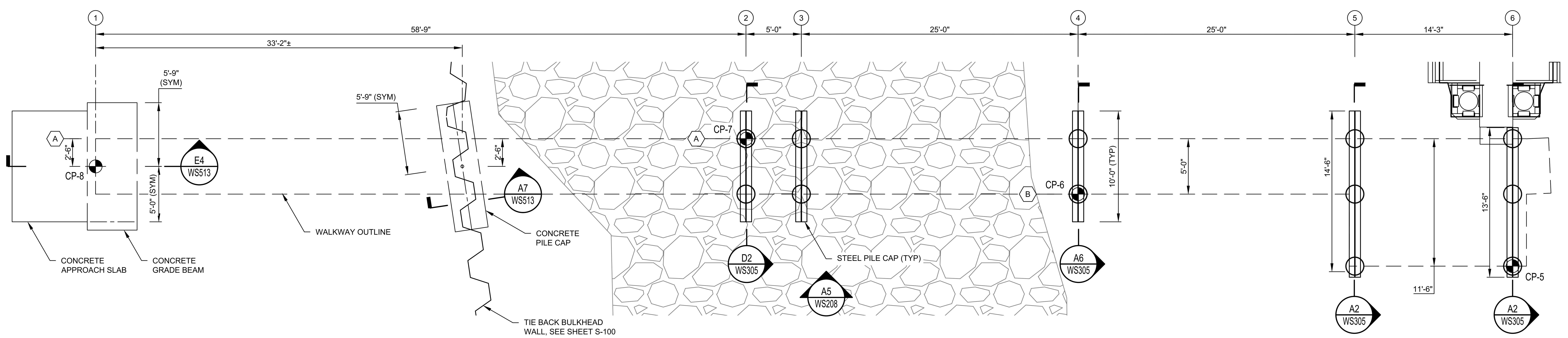
INTERIOR FLOATING DOCK PLAN

SHEET ID
COVERED MOORINGS
WS109



BRIDGE FRAMING PLAN

SCALE: 3/16"=1'-0"



BRIDGE PILE PLAN

SCALE: 3/16"=1'-0"

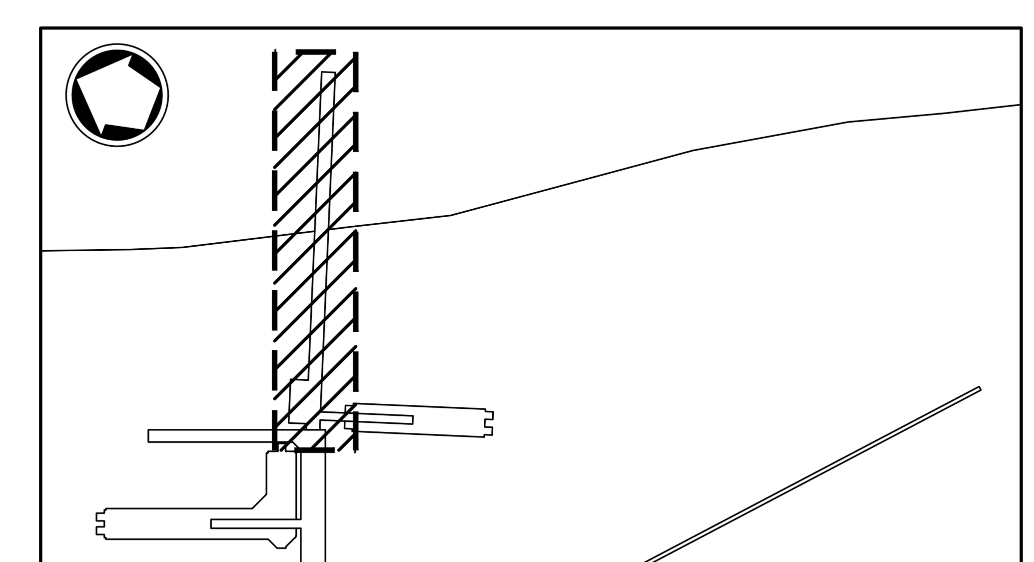
CONTROL POINT COORDINATES		
ID	NORTHING	EASTING
CP-5	871796.563	3968173.839
CP-6	871803.739	3968212.971
CP-7	871809.194	3968242.892
CP-8	871831.442	3968297.324

NOTE:

1. LISTED NORTHINGS AND EASTINGS ARE IN INTERNATIONAL FEET AND ARE BASED ON THE OREGON STATE COORDINATE REFERENCE SYSTEM.

LEGEND:

- (1) BENT DESIGNATION
- (A) ROW DESIGNATION
- ◯ PLUMB CONCRETE-FILLED STEEL PP20x0.625
- CP-6 CONTROL POINT (TAKEN AT PILE CENTER)



KEY PLAN

SCALE: NTS

U.S.C.G. CE
U.S. COAST GUARD CIVIL ENGINEERING

MARK	DESCRIPTION	DATE
-	50% SUBMITTAL	10/25/2023
-	100% SUBMITTAL	02/09/2024

PLOTTING SCALE: 1:1 SCALE: AS SHOWN

A/E COMPANY: TRANSYSTEMS 2000 CENTER ST., BERKELEY, CA 94707 510-835-2761
A/E PROJECT NO.: P501230111
CONSULTING A/E: APPLEDORE MARINE ENGINEERING, LLC PORTSMOUTH, NEW HAMPSHIRE 03801

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DESIGNED BY: MDM/SND
DRAWN BY: AMD/MDM
EDITED BY: MDM
CHECKED BY: SND/KFR

USCG PROJECT NO. 5067032
USCG DRAWING NO. 5067032WS111
USCG FILE NAME 5067032WS111.DWG
SHEET 50 OF 108

COVER MOORING, SHORELINE EROSION
STATION SIUSLAW RIVER
FLORENCE OR
WATERFRONT STRUCTURAL
BRIDGE PILE AND FRAMING PLAN

SHEET ID
COVERED MOORINGS
WS111

APPENDIX B. ACOUSTIC ANALYSIS

USCG Station Siuslaw River Project

Acoustic Assessment

Prepared for: United States Coast Guard

Prepared by:

TETRA TECH

Tetra Tech, Inc.
10 Post Office Square, 11th Floor
Boston, Massachusetts 02109

September 2024

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FIGURES

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ACRONYMS AND ABBREVIATIONS

dB	decibel
dB re 1 µPa	decibels referenced at one micropascal
dB re 1 $\mu Pa^2 \cdot s$	decibels referenced at one squared micropascal-second
dB/km	decibels per kilometer
HF	high frequency
Hz	Hertz
kHz	kilohertz
km	kilometer
LF	low frequency
L_{PK}	peak sound pressure
m	meter
m/s	meter per second
MF	mid-frequency
MMPA	Marine Mammal Protection Act
MWD	Maintenance and Weapons Division
NOAA Fisheries	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
Project	Siuslaw River Station
PTS	permanent threshold shift
rms	root-mean-square
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SPL	sound pressure level
SPL_{rms}	sounds pressure level root-mean-square
TSHD	Trailer Suction Hopper Dredger
TTS	temporary threshold shift
U.S.	United States
USFWS	United States Fish and Wildlife Service
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
µPa	micropascal
λ	wavelength

A.1 INTRODUCTION

The U.S. Coast Guard (USCG) is proposing to correct shoreline erosion and replace the covered mooring and appurtenant offshore structures at the USCG Station Siuslaw River in Florence, Oregon (Project). The Project includes onshore stormwater infrastructure improvements, shoreline stabilization with the installation of steel interlocking pile wall, and offshore infrastructure demolition and replacement in the same footprint as the existing offshore infrastructure.

The existing station is located atop a sand bluff on the east riverbank at river mile (RM) 1.5 of the Siuslaw River approximately three miles north-northwest of the downtown waterfront of the City of Florence, Lane County, Oregon. This study is focused on the USCG Station Siuslaw River property, including onshore and offshore areas, and the temporary mooring area that is proposed for use during construction (Figure 1).

This acoustic assessment report includes analyses of both in-air and underwater acoustic impacts associated with the waterside and landside construction operations of the Project. In-air acoustic impacts associated with the Project that have been assessed include pile driving during waterside construction and phased construction activities during landside improvements. Underwater acoustic impacts were also evaluated for pile driving and drilling activities, which have the potential to cause acoustic harassment to marine species. Relevant regulatory criteria are presented as well as acoustic modeling inputs and methodologies. The objectives of this modeling study are the following:

1. Predict ranges to in-air acoustic thresholds for harbor seals and other pinnipeds; and,
2. Predict ranges to underwater acoustic thresholds that could result in auditory injury (Level A Take) or behavioral disruption (Level B Behavior) of marine mammals, sea turtles, and fishes during construction and operations of the Project.

The threshold ranges were modeled and are presented both in tabular format and as sound contour figures.

Figure 1 Project Overview

A.1.1 Acoustic Concepts and Terminology

A.1.1.1 In-air Acoustics

All sounds originate from a source, such as motor vehicles on a roadway or lawn mowers. Energy is required to produce sound and this sound energy is transmitted through the air in the form of sound waves—tiny, quick oscillations of pressure just above and just below atmospheric pressure. These oscillations, or sound pressures, impinge on the ear, creating the sound we hear. A sound source is defined by a sound power level (abbreviated “L_W”), which is independent of any external factors. By definition, sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts.

A source sound power level cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source outside the acoustic and geometric near-field. A sound pressure level (abbreviated “L_P”) is a measure of the sound wave fluctuation at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. The sound pressure level in decibels (dB) is the logarithm of the ratio of the sound pressure of the source to the reference sound pressure of 20 microPascals (μPa), multiplied by 20. The range of sound pressures that can be detected by a person with normal hearing is very wide, ranging from about 0 decibels on the A-weighted scale (dBA) (or 20 μPa) for very faint sounds at the threshold of hearing, to nearly 120 dBA (or 20 million μPa) for extremely loud sounds such as a jet during takeoff at a distance of 200 feet.

Broadband sound includes sound energy summed across the entire audible frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum can be completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves. Typically, the frequency analysis examines 11 octave bands ranging from 16 Hz (low) to 16,000 Hz (high); however, further definition can also be provided on a one third octave band basis, which are one-third of an octave wide. Because the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system and is represented in dBA.

Sound levels can be measured, modeled and presented in various formats. The sound metrics that were employed in the following noise assessment have the following definitions:

- L_{eq}: Conventionally expressed in dBA, the L_{eq} is the energy-averaged, A-weighted sound level for the complete time period. It is defined as the steady, continuous sound level over a specified time, which has the same total sound energy as the actual varying sound levels over the specified period;
- L_n: This descriptor identifies the sound level that is exceeded “n” percent of the time over a measurement period (e.g., L_{90} = sound level exceeded 90 percent of the time). The sound level exceeded for a small percent of the time, L_{10}, closely corresponds to short-term, higher-level, intrusive noises (such as vehicle pass-by noise near a roadway). The sound level exceeded for a large percent of the time, L_{90}, closely corresponds to continuous, lower-level background noise (such as continuous noise from a distant industrial facility). L_{50} is the level exceeded 50 percent of the time and is typically referred to the median sound level over a given period;
- L_{max}: The maximum sound level (L_{max}) can be used to quantify the maximum instantaneous sound pressure level over a given measurement period or maximum sound generated by a source.

Table 1 presents estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness. Table 2 presents additional reference information on terminology used in the report.

Table 1. Sound Pressure Levels and Relative Loudness of Typical Noise Sources and Soundscapes

Noise Source or Acoustic Environment	Sound Level (dBA)	Subjective Impression
Garbage disposal, food blender (2 feet), or Pneumatic drill (50 feet)	80	Loud
Vacuum cleaner (10 feet)	70	Moderate
Passenger car at 65 mph (25 feet)	65	
Large store air-conditioning unit (20 feet)	60	
Light auto traffic (100 feet)	50	Quiet
Quiet rural residential area with no activity	45	
Bedroom or quiet living room or Bird calls	40	Faint
Typical wilderness area	35	
Quiet library, soft whisper (15 feet)	30	Very quiet
Wilderness with no wind or animal activity	25	Extremely quiet
High-quality recording studio	20	
Acoustic test chamber	10	Just audible
	0	Threshold of hearing

Table 2. Acoustic Terms and Definitions

Term	Definition
Noise	Typically defined as unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. Sound pressure is measured in decibels referenced to 20 microPascals, the approximate threshold of human perception to sound at 1,000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in decibels referenced to picowatts (one trillionth of a watt). Noise specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.
Equivalent Sound Level (L_{eq})	The L_{eq} is the continuous equivalent sound level, defined as the single sound pressure level that, if constant over the stated measurement period, would contain the same sound energy as the actual monitored sound that is fluctuating in level over the measurement period.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies. To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.
Unweighted Decibels (dBL)	Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear are presented as dBL in this report.

Table 2. Acoustic Terms and Definitions

Term	Definition
Propagation and Attenuation	Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity, and atmospheric conditions.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hz and is typically divided into center frequencies ranging from 31 to 8,000 Hz.
Broadband Noise	Noise which covers a wide range of frequencies within the audible spectrum, i.e., 200 to 2,000 Hz.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hz or kilohertz (kHz). For example, 100 Hz is a rate of one hundred times (or cycles) per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.

A.1.1.2 Underwater Acoustics

Sound behaves differently in the underwater environment a opposed to the in-air environment; therefore, it is important to provide some context regarding how sound is analyzed in the underwater environment. Underwater sound levels are not equivalent to in-air sound levels, with which most readers would be more familiar. An underwater sound pressure level (SPL or L_p) of 150 decibels (dB) referenced to 1 micropascal (re 1 μPa) is not equivalent to an in-air sound pressure level of 150 dB re 20 μPa due to the differences in density and speed of sound between water and air, and the different reference pressures that are used to calculate the dB levels, i.e., 1 μPa for water and 20 μPa for air. Similar to the in-air environment, underwater sound levels can be presented either as overall broadband levels or as frequency-dependent levels showing the frequency content of a source in terms of full or one third octave bands; however, sound levels would not be represented as dBA but dBL since potential impacts to humans are not being evaluated underwater.

The sound level estimates presented in this modeling study are expressed in terms of several metrics and apply the use of exposure durations to allow for interpretation relative to potential biological impacts on marine life. The National Oceanic and Atmospheric Administration National Marine Fisheries Service ("NOAA Fisheries") issued technical guidance that provides acoustical thresholds and defines the threshold metrics (NOAA Fisheries 2024). The ISO 18405 Underwater Acoustics – Terminology (ISO 2017) provided a dictionary of underwater bioacoustics for standardized terminology. Table 3 provides a summary of the relevant metrics from both NOAA Fisheries (2024) and ISO (2017) that are used within this report.

Table 3. Summary of Acoustic Terminology

Metric	NOAA Fisheries (2024)	ISO (2017)		Reference Value
		Main Text	Equations and Tables	
Sound Pressure Level	SPL	SPL	L_p	dB re 1 μPa
Peak Sound Pressure Level	PK	Lpk	$L_{p,pk}$	dB re 1 μPa
Cumulative Sound Exposure Level	SEL_{cum} [1]	SEL	L_E	dB re 1 μPa^2·s

Metric	NOAA Fisheries (2024)	ISO (2017)		Reference Value
		Main Text	Equations and Tables	

Note:
1 NOAA Fisheries (2024) describes the cumulative sound exposure level ("SEL_{cum}") metric over an accumulation period of 24-hour period. Following the ISO standard, this will be identified as SEL in the text and LE will be used in tables and equations of this report with the accumulation period identified.

This report follows the ISO (2017) standard terminology and symbols for the sound metrics unless stated otherwise. Below are descriptions of the relevant metrics and concepts that should help frame the discussion of acoustics in this document. The majority of the information in the following sections provides further insight into how data and modeling results have been presented in accordance with regulatory reporting requirements and established criteria.

Peak sound pressure (Lpk or $L_{p,pk}$; dB re 1 μPa) is the maximum instantaneous noise level over a given event and is calculated using the level of the squared sound pressure from zero-to-peak within the wave. The peak sound pressure level is commonly used as a descriptor for impulsive sound sources. At high intensities, the Lpk can be a valid criterion for assessing whether a sound is potentially injurious; however, since it does not take into account the pulse duration or bandwidth of a signal, it is not a good indicator of loudness or potential for masking effects. The Lpk can be calculated using the formula below. Impulses are characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures.

$$L_{p,pk} = 10\, log_{10}\left[\frac{max(|p^2(t)|)}{p_0^2}\right]\ dB \tag{1}$$

Sound pressure level ("SPL or L_p"; dB re 1 μPa) is the root-mean-square (rms) sound pressure level in a stated frequency band over a specified time window. It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure. The SPL is calculated by taking the square root of the average of the square of the pressure waveform over the duration of the time period. The SPL is also known as the quadratic mean and is a statistical measure of the magnitude of a varying quantity. Given a measurement of the time-varying sound pressure from a given sound source, the SPL is computed according to the following formula where p^2 is the mean squared sound pressure and p_0^2 is the reference value of mean-square sound pressure, which is 1 μPa^2.

$$L_p = 10\, log_{10}\left(\frac{1}{T}\int_T p^2(t)dt/p_0^2\right)\ dB \tag{2}$$

Sound exposure level ("SEL or L_E"; dB re 1 μPa^2·s) is similar to the SPL but further specifies the sound pressure over a specified time interval or event, for a specified frequency range. The SEL for a single event is calculated by taking the time-integral of the squared sound pressure, E_p, over the full event duration:

$$L_E = 10\, log_{10}\left(\int_{T_{100}} p^2(t)dt/T_0 p_0^2\right)\ dB \tag{3}$$

The SEL represents the total acoustic energy received at a given location. Unless otherwise stated, SELs for impulsive noise sources presented in this report, i.e., impact hammer pile-driving, refer to a single pulse. In addition, SEL can be calculated as a cumulative metric over periods with multiple acoustic events. In the case of impulsive sources like impact piling, SEL describes the summation of energy for the entire impulse normalized to 1 second and can be expanded to represent the summation of energy from multiple pulses. The latter is written SEL_{cum} denoting that it represents the cumulative sound exposure level. Sound exposure level is often used in the assessment of marine mammal and fish injury/physiological impacts over a 24-hour time period. The SEL_{cum} (dB re 1 μPa^2·s) can be computed by summing (in linear units) the SEL of N individual events:

$$L_{E,N} = 10\,log_{10}\left(\sum_{i=1}^{N} 10^{\frac{SEL_i}{10}}\right)\ dB \qquad (4)$$

A.1.1.3 Sound Propagation in Shallow Waters

Seawater Absorption

Absorption in the underwater environment involves a process of conversion of acoustic energy into heat and thereby represents a true loss of acoustic energy to the water. The primary causes of absorption have been attributed to several processes, including viscosity, thermal conductivity, and chemical reactions involving ions in the seawater. The absorption of sound energy by water contributes to the attenuation (or reduction) in sound linearly with range and is given by an attenuation coefficient in units of decibels per kilometer (dB/km). This absorption coefficient is computed from empirical equations and increases with the square of frequency. For example, for typical open-ocean values (temperature of 50 degrees Fahrenheit (°F) [10 degrees Celsius (°C)], pH of 8.0, and a salinity of 35 practical salinity units), the equations presented by Francois and Garrison (1982a and 1982b) yield the following values for seawater absorption: 0.001 dB/km at 100 Hertz (Hz), 0.06 dB/km at 1 kilohertz (kHz), 0.96 dB/km at 10 kHz, and 33.6 dB/km at 100 kHz. Thus, low frequencies are favored for long-range propagation. Seawater absorption was accounted for in the acoustic modeling according to the Fisher and Simmons (1977) calculation methodology. Site-specific sound speed profile information was input to the Project modeling analysis, resulting in a site-specific sound attenuation rate.

Scattering and Reflection

Scattering of sound from the surface and bottom boundaries and from other objects is difficult to quantify and is site-specific but is extremely important in characterizing and understanding the received sound field. Reflection, refraction, and diffraction from gas bubbles and other inhomogeneities in the propagating medium serve to scatter sound and will affect propagation loss and occur even in relatively calm waters. If boundaries are present, whether they are “real” like the surface of the sea or “internal” like changes in the physical characteristics of the water, they affect sound propagation. The acoustic intensity received depends on the losses due to the path length as well as the amount of energy reflected from each interface. Multiple reflections may occur as the sound reflects alternately from the bottom and the sea surface resulting in constructive and/or destructive interference patterns. Reflections occurring between the sea floor and surface are accounted for in the Project acoustic modeling analysis.

Changes in direction of the sound due to changes of sound velocity are known as refraction. The speed of sound is not constant with depth and range but depends on the temperature, pressure, and salinity. Of the three factors, the greatest impact on sound velocity is temperature. The change in the direction of the sound wave with changes in velocity can produce many complex sound paths. When there is a negative temperature gradient, sound speed decreases with depth, and sound rays bend sharply downward. This condition is common near the surface of the sea. At some horizontal distance from the sound source, beyond where the rays bend downward, is a region in which sound intensity is negligible, which is called a shadow zone. Refraction may also produce sound channels that can trap the sound and allow a signal to travel great distances with minimal loss in energy; for example, the underwater channels are known as the Sound Fixing and Ranging channel, sometimes called the deep sound channel, which allows marine mammal communications to travel great distances.

Since the inhomogeneities in water are very small compared to the wavelength of the signal, this attenuation effect will mostly contribute when the signals encounter changes in bathymetries and propagate through the sea floor and the subsurface. For varying bathymetry, the calculation complexity increases as individual portions of the signal are scattered differently. However, if the acoustic wavelength is much greater than the scale of the seabed non-uniformities, as is most often the case for low-frequency sounds, then the effect of scattering on propagation loss becomes somewhat less important than other factors. Also, scattering loss occurring at the surface due to wave action will increase at higher sea states. For reflection from the

sea surface, it is assumed that the surface is smooth. While a rough sea surface would increase scattering (and hence transmission loss) at higher frequencies, the scale of surface roughness is insufficient to have a significant effect on sound propagation in the near field relative to the source.

Seabed Absorption

Seabed sediment characteristics influence propagation loss in shallow water due to the repeated reflections and scattering at the water/seafloor interface. For underwater acoustic analysis, shallow water is typically defined as water depths less than 656 feet (ft; 200 meters [m]). Depending on the sediment properties, sound may be absorbed or reflected. For example, fine-grained silt and clay absorb sound efficiently, while sand, gravel, and bedrock are more reflective. To model these effects, the most important parameters to consider are the sediment density, sound speed, and acoustic attenuation.

The acoustic properties of different sediment types display a much greater range of variation than the acoustic properties of seawater. A good understanding of these properties and their spatial variation is useful for accurate modeling. Oftentimes it is challenging to obtain site-specific data characterizing the seafloor; however, a sediment characterization report (Shannon and Wilson 2018) was completed in support of the Project with details regarding the relevant speed of sound and geoacoustic properties by sediment depth given in Section A.4.3.2 of this report and Appendix B.

Cut-off Frequency

Sound propagation in shallow water is essentially a normal mode where a sound wave moves sinusoidally and has its own frequency and the sound channel is an acoustic waveguide. Each mode is a standing wave in the vertical direction that propagates in the horizontal direction at a frequency-dependent speed. Each mode has a cutoff frequency, below which no sound propagation is possible. The cutoff frequency is determined based on the type of bottom material and water column depth. This limiting frequency can also be calculated if the speed of sound in the sediment ($C_{sediment}$) is known (Au and Hastings 2008) and seasonal temperature variation of the speed of sound of the seawater (C_{water}) is known using the following equation:

$$f_c = \frac{C_{water}}{4h} / \sqrt{1 - (C_{water})^2/(C_{sediment})^2} \qquad (8)$$

Where: f_c = critical frequency
C_{water} = speed of sound of water
$C_{sediment}$ = speed of sound in sediment
h = water depth in the direction of sound propagation

The speed of sound in sediment is higher than in water. In water, it is approximated at 1,500 meters/second (m/s). Values for speed of sound in sediment will range from 1,575 m/s in silt sediment to 1,650 m/s in predominantly sandy areas. As a general rule, sound traveling in shallower water will be subject to a higher cutoff frequency and a greater attenuation rate than sound propagating in deeper water.

Figure 2 graphically presents the cut-off frequency for different bottom material types (represented as separate lines on the figure) plotted as a function of water depth (x-axis) and cut-off frequency (y-axis). For the Project acoustic modeling analysis, the concept of cut-off frequency is incorporated into the modeling calculations through the characterization of sediment properties within the seabed.

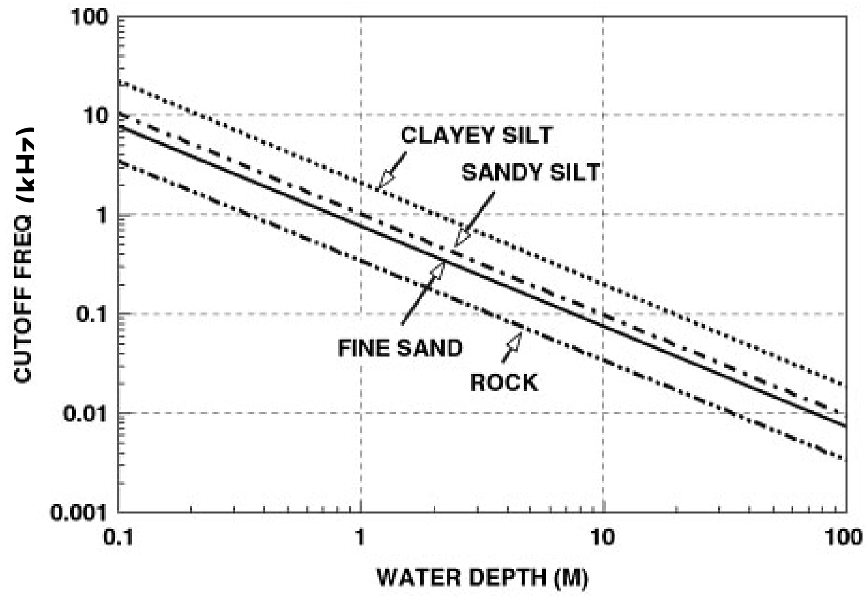

Figure 2 Cut-off Frequencies for Different Bottom Materials (AU and Hastings 2008)

A.2 REGULATORY CRITERIA AND SCIENTIFIC GUIDELINES

A.2.1 In-air Acoustic Criteria

There following local criteria is applicable to the Project; however, noise thresholds for the behavioral disturbance of harbor seals at 90 dB rms and all other pinnipeds at 100 dB rms have been identified by NOAA Fisheries and those thresholds are considered in this analysis. The NOAA 2024 guidelines update in-air acoustic thresholds for phocid pinnipeds and otariid pinnipeds, which are summarized in Table 4 (NOAA Fisheries 2024).

A.2.1.1 Florence City Code

The City of Florence has established noise regulations within the City Code Title 6, Section 6-1-2-3: Unnecessary Noise. The City Code limits noise at the boundary of a noise sensitive property to the following:

- 50 dBA between the hours of 10:00 p.m. and 7:00 a.m.,
- 60 dBA between the hours of 7:00 a.m. and 10:00 p.m., or
- Is plainly audible between the hours of 10:00 p.m. and 7:00 a.m. within a noise sensitive unit, which is not the source of the sound.

Equipment commonly used in construction including hammers, saws, pile drivers, earth moving equipment, compressors and similar equipment are not limited during daytime hours but must comply with the nighttime noise limits (10:00 p.m. – 7:00 a.m.).

A.2.2 Underwater Acoustic Criteria

The Marine Mammal Protection Act (MMPA) of 1972 provides for the protection of all marine mammals. The MMPA prohibits, with certain exceptions, the “take” of marine mammals. The term “take,” as defined in Section 3 (16 U.S.C. § 1362 (13)) of the MMPA, means “to harass, hunt, capture, or kill, or attempt to

harass, hunt, capture, or kill any marine mammal". NOAA Fisheries has jurisdiction for overseeing the MMPA regulations as they pertain to most marine mammals; however, the U.S. Fish and Wildlife Service (USFWS) has jurisdiction over a select group of marine mammals including manatees, otters, walruses, and polar bears. Generally, NOAA Fisheries is responsible for issuing take permits under MMPA, upon a request, for authorization of incidental but not intentional "taking" of small numbers of marine mammals by U.S. citizens or agencies who engage in a specified activity (other than commercial fishing) within a specified geographical region. "Harassment" was further defined in the 1994 amendments to the MMPA, with the designation of two levels of harassment: Level A and Level B. By definition, Level A harassment is any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock, while Level B harassment is any act of pursuit, torment, or annoyance which 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. NOAA Fisheries defines the threshold level for Level B harassment at 160 dB SPL for impulsive sound, averaged over the duration of the signal and at 120 dB SPL for non-impulsive sound, with no relevant acceptable distance specified.

NOAA Fisheries provided guidance for assessing the impacts of anthropogenic sound on marine mammals under their regulatory jurisdiction, which includes whales, dolphins, porpoises, seals, and sea lions, and updated this guidance in 2024 (NOAA Fisheries 2024). The guidance specifically defines marine mammal hearing groups; develops auditory weighting functions; and identifies the received levels, or acoustic threshold levels, above which individual marine mammals are predicted to experience temporary or permanent shifts in their hearing sensitivity, which is altogether referred to as noise-induced hearing loss (NIHL; NOAA Fisheries 2024).

NIHL is defined as changes in normal auditory function that occur as a consequence of noise exposure, which can be temporary or permanent i.e., temporary threshold shift (TTS) and auditory injury (AUD INJ) (NOAA Fisheries 2024). Upon acute exposure to loud underwater sounds, marine fauna may experience TTS. For TTS, the hearing threshold may return to normal after some period of time. If sufficient recovery time is not allowed, the hearing threshold is permanently altered; this alteration is referred to as AUD INJ. AUD INJ is assessed using dual metrics of peak sound pressure level ($L_{p,pk}$) and cumulative sound exposure level ($L_{E,p,24h}$). Under this guidance, any occurrence of TTS or AUD INJ constitutes a Level A harassment. The sound emitted by anthropogenic sound sources may induce TTS or AUD INJ in an animal in two ways: exposure to peak sound pressures may cause damage to the inner ear and is often an instantaneous impact; the accumulated sound energy the animal is exposed to (i.e., cumulative sound exposure) over the entire duration of a discrete or repeated noise exposure has the potential to induce unrecoverable auditory damage if it exceeds distinct underwater hearing threshold levels, which vary depending on species.

Recognizing that marine mammal species have distinct hearing capabilities in different frequency ranges, marine mammals are categorized as being part of distinct "hearing groups" in regulatory guidance in the U.S. (Southall et al. 2019; Finneran 2024; NOAA Fisheries 2024). The frequency content of the sound (Croll et al. 2001) amplitude, as well as distinct species auditory characteristics, each play a role in the susceptibility of a marine animal to NIHL. Sound outside the generalized hearing range of the animal would be unlikely to affect its hearing as the sound energy within the hearing range is deemed most harmful; therefore, the generalized hearing ranges presented here are a guide rather than an absolute limit. The five hearing groups applicable to underwater sound as defined in the latest regulatory guidance are defined below (Southall et al. 2019; Finneran 2024; NOAA Fisheries 2024).

- *Low-frequency (LF) cetaceans*—this group consists of all baleen whale species with a generalized hearing range of 7 Hz to 36 kHz.

- *High-frequency (HF) cetaceans*—includes delphinids, odontocetes, beaked whales, and bottlenose whales, with a generalized hearing range of 150 Hz to 160 kHz.

- *Very high-frequency (VHF) cetaceans*—incorporates all the true porpoises, the river dolphins, plus Kogia spp., Cephalorhynchid spp. (genus in the dolphin family Delphinidae), and two species of Lagenorhynchus (Peale's and hourglass dolphins) with a generalized hearing range of 200 Hz to 165 kHz.

- *Phocids pinnipeds (PW underwater and PA in-air)*—consists of true seals with a generalized hearing range of 40 Hz to 90 kHz underwater and 42 Hz to 52 kHz in-air.

- *Otariids pinnipeds (OW underwater and PA in-air)*—includes sea lions and fur seals with a generalized hearing range of 60 Hz to 68 kHz underwater and 90 Hz to 40 kHz in-air (termed Other marine carnivores in water by Southall et al. [2019] and includes otariids, as well as walrus [Family *Odobenide*], polar bear [*Ursus maritimus*], and sea and marine otters [Family *Mustelidae*]).

Within these generalized hearing ranges, the ability to hear sounds varies with frequency, as demonstrated by examining audiograms of hearing sensitivity (NOAA Fisheries 2024; Southall et al. 2019). To reflect higher noise sensitivities at particular frequencies, auditory weighting functions were developed for each functional hearing group that reflected the best available data on hearing ability (i.e., composite audiograms), susceptibility to noise-induced hearing loss, impacts of noise above effective quiet threshold on hearing, and data on equal latency derived from audiograms (NOAA Fisheries 2024). These weighting functions are applied to the received sound level to reflect the susceptibility of each hearing group to NIHL, which is not the same as the range of best hearing as above. Figure 3 shows auditory weighting functions for the hearing groups described above.

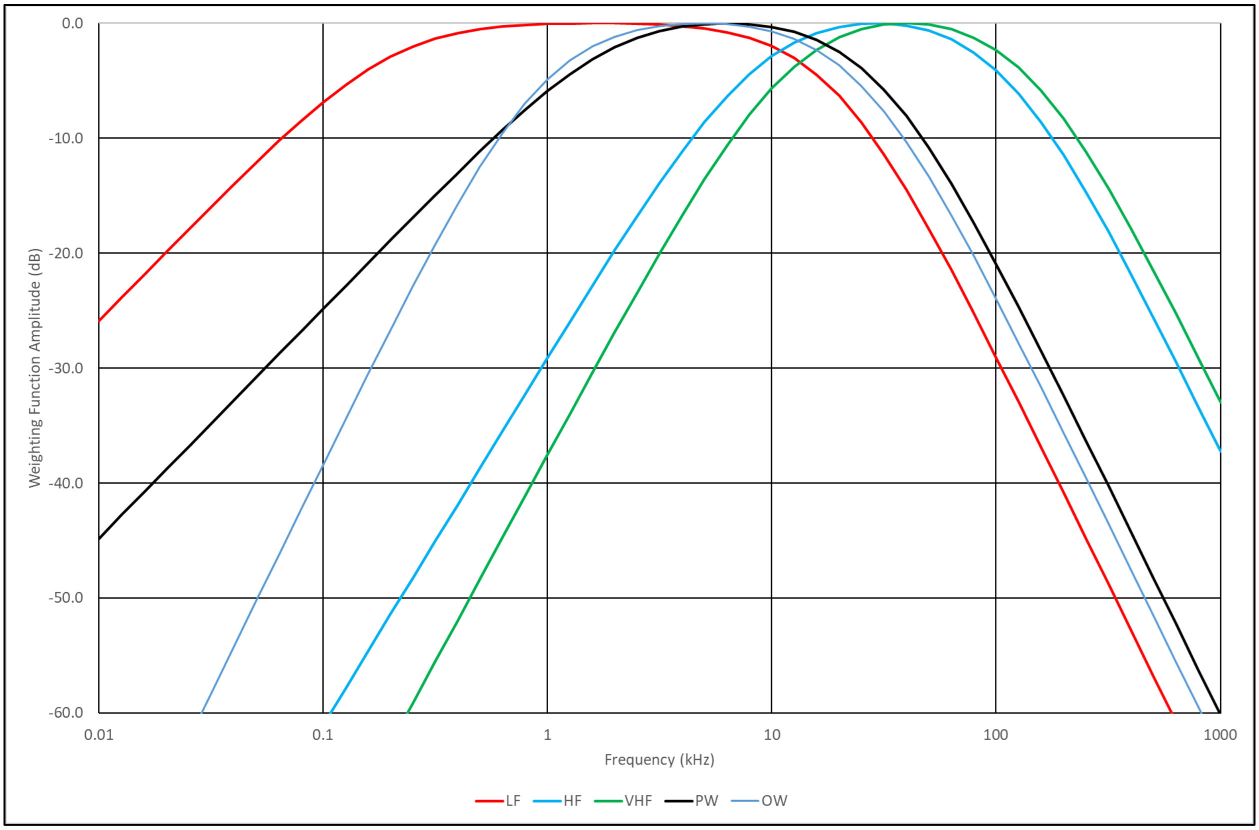

Figure 3 Auditory Weighting Functions for Cetaceans (Low-frequency, Mid-frequency, and High-frequency Species), Pinnipeds in water from NOAA Fisheries (2024)

Table 4 provides acoustic threshold levels at which AUD INJ (which constitutes a Level A take), TTS, and Behavioral Disturbance (which constitutes a Level B take) are expected to occur for each marine mammal hearing group from exposure to impulsive and non-impulsive signals (NOAA Fisheries 2023a, 2024).

Table 4. Acoustic Threshold Levels for Marine Mammals

Hearing Groups	Impulsive Sounds			Non-Impulsive Sounds		
	AUD INJ Onset	TTS Onset	Behavior	AUD INJ Onset	TTS Onset	Behavior
UNDERWATER						
Low-frequency cetaceans	222 dB ($L_{p,pk}$) 183 ($L_{E, LF, 24h}$)	216 dB ($L_{p,pk}$) 168 dB ($L_{E, LF, 24h}$)	160 dB (L_p)	197 dB ($L_{E, LF, 24h}$)	177 dB ($L_{E, LF, 24h}$)	120 dB (L_p)
High-frequency cetaceans	230 dB ($L_{p,pk}$) 193 dB ($L_{E, HF, 24h}$)	224 dB ($L_{p,pk}$) 178 dB ($L_{E, HF, 24h}$)		201 dB ($L_{E, HF, 24h}$)	181 dB ($L_{E, HF, 24h}$)	
Very high-frequency cetaceans	202 dB ($L_{p,pk}$) 159 dB ($L_{E, VHF, 24h}$)	196 dB ($L_{p,pk}$) 144 dB ($L_{E, VHF, 24h}$)		181 dB ($L_{E, VHF, 24h}$)	161 dB ($L_{E, VHF, 24h}$)	

Hearing Groups	Impulsive Sounds			Non-Impulsive Sounds		
	AUD INJ Onset	TTS Onset	Behavior	AUD INJ Onset	TTS Onset	Behavior
Phocid pinnipeds underwater	223 dB ($L_{p,pk}$) 183 dB ($L_{E,\ PW,\ 24h}$)	217 dB ($L_{p,pk}$) 168 dB ($L_{E,\ PW,\ 24h}$)		195 dB ($L_{E,\ PW,\ 24h}$)	175 dB ($L_{E,\ PW,\ 24h}$)	
Otariid pinnipeds underwater	230 dB ($L_{p,pk}$) 185 dB ($L_{E,\ OW,\ 24h}$)	224 dB ($L_{p,pk}$) 170 dB ($L_{E,\ OW,\ 24h}$)		199 dB ($L_{E,\ OW,\ 24h}$)	179 dB ($L_{E,\ OW,\ 24h}$)	
IN-AIR						
Phocid pinnipeds in-Air (PA)	162 dB ($L_{p,pk}$) 140 dB ($L_{E,\ PW,\ 24h}$)	156 dB ($L_{p,pk}$) 125 dB ($L_{E,\ PW,\ 24h}$)	90 dB (L_p)	154 dB ($L_{E,\ PW,\ 24h}$)	134 dB ($L_{E,\ PW,\ 24h}$)	90 dB (L_p)
Otariid pinnipeds in-air (OA	177 dB ($L_{p,pk}$) 163 dB ($L_{E,\ OW,\ 24h}$)	171 dB ($L_{p,pk}$) 148 dB ($L_{E,\ OW,\ 24h}$)	100 dB (L_p)	177 dB ($L_{E,\ OW,\ 24h}$)	157 dB ($L_{E,\ OW,\ 24h}$)	100 dB (L_p)

Sources: NOAA Fisheries 2023a, 2024
$L_{E,\ 24h}$ = cumulative sound exposure over a 24-hour period (dB re 1 μPa^2·s for underwater and dB re 20 μPa^2·s for in-air).
$L_{p,pk}$ = peak sound pressure (dB re 1 μPa for underwater and dB re 20 μPa for in-air);
L_p = root mean square sound pressure (dB re 1 μPa for underwater and dB re 20 μPa for in-air)

In a cooperative effort between federal and state agencies, interim criteria were developed to assess the potential for injury and behavioral response of fishes due to sound exposure from impact pile driving. These dual interim acoustic thresholds, which are relative to the size of the fish, were established by the Fisheries Hydroacoustic Working Group (FHWG 2008). The interim acoustic thresholds have been recommended and subsequently adopted by NOAA Fisheries including the NOAA Greater Atlantic Regional Fisheries Office (GARFO) as standards for assessing the potential effects of exposure to elevated levels of underwater sound produced during pile driving on ESA-listed fishes (NOAA Fisheries 2023b). The acoustic thresholds for fishes as per FHWG 2008 are presented in Table 5.

Table 5. Acoustic Threshold Levels for Fish, Injury and Behavior

Hearing Group	Impulsive Signals		Non-impulsive Signals		Behavior (Impulsive and Non-impulsive)
	Physical Injury	Temporary Threshold Shift Onset	Injury	Temporary Threshold Shift Onset	
Fishes	206 dB ($L_{p,pk}$) 187 dB ($L_{E,\ 24h}$)	--	--	--	150 dB (L_p)

Sources: NOAA Fisheries 2023a,
$L_{E,\ 24h}$ = cumulative sound exposure over a 24-hour period (dB re 1 μPa^2·s);
$L_{p,pk}$ = peak sound pressure (dB re 1 μPa);
L_p = root mean square sound pressure (dB re 1 μPa)

A working group organized under the ANSI-Accredited Standards Committee S3, Subcommittee 1, Animal Bioacoustics, was established to develop interim sound exposure guidelines for fish and sea turtles based on the way these species detect sound (Popper et al. 2014). The Working Group identified three types of fishes (based on mechanism of sound detection), sea turtles, and fish eggs and larvae that may be affected by vibrations in the seafloor. The categories include fishes with no swim bladder or other gas chamber (e.g., dab and other flatfish) that detect sound using particle motion and occasionally detect sound pressure; fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume but detect sound using particle motion (e.g., Atlantic salmon); and fishes with a swim bladder that is involved

in hearing (e.g., Atlantic cod, herring and relatives, etc.) that detect sound using particle motion and sound pressure. Table 6 and Table 7 set out those acoustic threshold levels for onset of mortality, potential mortal injury, recoverable injury, TTS, masking, and behavioral disturbance due to pile driving and shipping/continuous sources, respectively, for fishes, sea turtles, and fish eggs and larvae. These guidelines are presented as dual criteria, as described earlier in the subsection. While the guidelines in the tables below make recommendations based on what is known about fish and their hearing sensitivity, guideline numbers are only provided when available from the literature.

Table 6. Acoustic Threshold Levels for Fish for Onset of Mortality, Potential Mortal Injury, Recovery Injury, TTS, and Masking due to Pile Driving

Hearing Groups	Impulsive Sounds	Impairment			
	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behavior
Fishes without swim bladders	> 213 dB ($L_{p,pk}$) > 219 dB ($L_{E,\ 24h}$)	> 213 dB ($L_{p,pk}$) > 216 dB ($L_{E,\ 24h}$)	> 186 dB ($L_{E,\ 24h}$)	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fishes with swim bladder not involved in hearing	207 dB ($L_{p,pk}$) 210 dB ($L_{E,\ 24h}$)	207 dB ($L_{p,pk}$) 203 dB ($L_{E,\ 24h}$)	>186 dB ($L_{E,\ 24h}$)	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fishes with swim bladder involved in hearing	207 dB ($L_{p,pk}$) 207 dB ($L_{E,\ 24h}$)	207 dB ($L_{p,pk}$) 203 dB ($L_{E,\ 24h}$)	186 dB ($L_{E,\ 24h}$)	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate
Eggs and larvae	207 dB ($L_{p,pk}$) 210 dB ($L_{E,\ 24h}$)	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Sources: Popper et al. 2014,
$L_{E,\ 24h}$ = cumulative sound exposure over a 24-hour period (dB re 1 μPa^2·s);
$L_{p,pk}$ = peak sound pressure (dB re 1 μPa);
L_p = root mean square sound pressure (dB re 1 μPa)
PTS = permeant threshold shift;
N = near (10s of meters);
I = intermediate (100s of meters);
F = far (1000s of meters);

Table 7. Acoustic Threshold Levels for Fish for Onset of Mortality, Potential Mortal Injury, Recovery Injury, TTS, and Masking due to Shipping/Continuous Sources

Hearing Groups	Impulsive Sounds	Impairment			
	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behavior
Fishes without swim bladders	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low

Hearing Groups	Impulsive Sounds	Impairment			
	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behavior
Fishes with swim bladder not involved in hearing	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fishes with swim bladder involved in hearing	(N) Low (I) Low (F) Low	170 dB ($L_{p,rms}$) for 48h	158 dB ($L_{p,rms}$) for 12h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Sources: Popper et al. 2014,
$L_{E,\,24h}$ = cumulative sound exposure over a 24-hour period (dB re 1 μPa^2·s);
$L_{p,pk}$ = peak sound pressure (dB re 1 μPa);
L_p = root mean square sound pressure (dB re 1 μPa)
PTS = permeant threshold shift;
N = near (10s of meters);
I = intermediate (100s of meters);
F = far (1000s of meters);

A.3 EXISTING AMBIENT CONDITIONS

Primary sources of in-air noise within the community are residential roadways and in-water sources (e.g., boats). There are no applicable noise regulations that require collection of ambient sound data to demonstrate Project compliance.

Underwater sound associated with natural sources is generated by physical and biological processes. Examples of physical sound sources are tectonic seismic activity, wind, and waves; examples of biological sound sources are the vocalizations of marine species. There can be a strong temporal and/or seasonal variability in sounds from biological sources due to the fluctuation in presence of marine species throughout the year associated with activities such as migration. The ambient underwater sound at frequencies above 1 kHz is largely due to waves, wind, and heavy precipitation (Simmonds et al. 2004). Surface wave interaction and breaking waves with spray have been identified as significant sources of ambient sound. Wind-induced bubble oscillations and cavitation are also near-surface sound sources. Major storms can give rise to underwater sound at 40 Hz to 50 kHz due to intense wind forcing, which can propagate over long distances at low frequencies, and can be comparable to noise from distant shipping (Zhao et al. 2014; Wilson and Makris 2008). At areas within distances of 4 to 5 nm (8 to 10 km) of the shoreline, surf noise will be prominent in the frequencies ranging up to a few hundred Hz (Richardson et al. 2013).

A considerable amount of background noise may also be caused by biological activities. Aquatic animals generate sounds for communication, echolocation, prey manipulation, and as byproducts of other activities such as feeding. Biological sound production usually follows seasonal and diurnal patterns, dictated by variations in the activities and abundance of the vocal animals. The frequency content of underwater biological sounds ranges from less than 10 Hz to beyond 150 kHz. Source levels show a great variation, ranging from below 50 dB to more than 230 dB SPL_{rms} re 1 μPa at 1 m, such as sperm whale echolocation clicks (Wahlberg 2008). Likewise, there is a significant variation in other source characteristics such as the duration, temporal amplitude, frequency patterns, and the rate at which sounds are repeated (Wahlberg

2008). Typical underwater ambient sound levels show a frequency dependency in relation to different sound sources. This is best described in the Wenz curves, which describe the contribution of sources at different frequencies (Wenz 1962).

Anthropogenic noise sources can consist of contributions related to industrial development, offshore oil industry activities, naval or other military operations, and marine research. A predominant contributing anthropogenic noise source is generated by commercial ships and recreational watercraft. Noise from these vessels dominates coastal waters and emanates from the ships' propellers and other dynamic positioning (DP) propulsion devices such as thrusters. The sound generated from main engines, gearboxes, and generators transmitted through the hull of the vessel into the water column is considered a secondary sound source to that of vessel propulsion systems, as is the use of sonar and depth sounders which occur at generally high frequencies and attenuate rapidly. Typically, shipping vessels produce frequencies below 1 kHz, although smaller vessels such as fishing, recreational, and leisure craft may generate sound at somewhat higher frequencies (Simmonds et al. 2004).

A.4 ACOUSTIC MODELING METHODOLOGY

In-air and Underwater acoustic model simulations were conducted for primary noise-generating activities occurring during Project construction and operations. The following subsections describe the modeling calculations approach, modeled scenarios, and model input values.

A.4.1 In-air Acoustic Modeling Methodology

A.4.1.1 In-air Acoustic Modeling Software

The Cadna-A® computer noise model was used to calculate sound pressure levels associated with Project construction activities. An industry standard, Cadna-A® was developed by DataKustik GmbH to provide an estimate of sound levels at distances from sources of known emission. It is used by acousticians and acoustic engineers because it has the capability to accurately describe noise emission and propagation from complex facilities and developments consisting of various equipment, and it in most cases yields conservative sound pressure level results.

The current International Organization for Standardization (ISO) standard for outdoor sound propagation, ISO 9613 Part 2, "Attenuation of Sound during Propagation Outdoors," was used within Cadna-A®. The method described in this standard calculates sound attenuation under weather conditions that are favorable for sound propagation, such as for downwind propagation or atmospheric inversion, conditions that are typically considered worst case. The calculation of sound propagation from source to receiver locations consists of full octave-band sound frequency algorithms that incorporate the following physical effects:

- Geometric spreading wave divergence
- Reflection from surfaces
- Atmospheric absorption at 10 degrees Celsius and 70 percent relative humidity
- Screening by topography and obstacles
- Effects of terrain features including relative elevations of noise sources
- Sound power levels from stationary and mobile sources
- Locations of noise-sensitive land use types
- Intervening objects including buildings and barrier walls to the extent included in a project's design
- Ground effects due to areas of pavement and unpaved ground
- Sound power at multiple frequencies
- Source directivity factors
- Multiple noise sources and source type (point, area, and/or line

Topographical information was imported into the acoustic model using the official U.S. Geological Survey digital elevation dataset to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 standard accounts for ground absorption rates by assigning a numerical coefficient of G=0 for acoustically hard, reflective surfaces and G=1 for absorptive surfaces and soft ground. If the ground is hard-packed dirt, which is typically found in industrial complexes, pavement, bare rock or for sound traveling over water, the absorption coefficient is defined as G=0 to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in vegetation, including suburban lawns and agricultural fields (both fallow with bare soil and planted with crops), will be acoustically absorptive and aid in sound attenuation (i.e., G=1.0). A mixed (semi-reflective) ground factor of G=0.5 was used in the Project acoustic modeling analysis. In addition to geometrical divergence, attenuation factors include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. To be conservative, sound attenuation through foliage and diffraction around and over existing anthropogenic structures such as buildings was ignored.

A.4.2 Underwater Acoustic Modeling Methodology

A.4.2.1 Underwater Acoustic Modeling Software

Underwater sound propagation modeling was completed using dBSea, a software developed by Marshall Day Acoustics for the prediction of underwater noise in a variety of environments. The model is built by importing bathymetry data and placing noise sources in the environment. Each source can consist of equipment chosen from either the standard or user-defined databases. Noise mitigation methods may also be included. The user has control over the seabed and water properties including sound speed profile, temperature, salinity, and current. Noise levels are calculated to the extent of the bathymetry area. To examine results in more detail, levels may be plotted in cross-sections, or a detailed spectrum may be extracted at any point in the calculation area. Levels are calculated in third octave bands from 12.5 Hz to 20 kHz. Please refer to Appendix B for additional details on the modeling principles and assumptions.

A.4.3 Modeling Environment

The accuracy of underwater noise modeling results is largely dependent on the sound source characteristics and the accuracy of the intrinsically dynamic data inputs and assumptions used to describe the medium between the path and receiver, including sea surface conditions, water column, and sea bottom. Depending on the sound source under review, it was approximated as a point source or a line source, composed of multiple points, extending downward into the water column. Furthermore, determining sound emissions for the various sources are based on a combination of factors, including known properties (e.g., hammer energy) as well as consulting empirical data. The exact information required can never be obtained for all possible modeling situations, particularly for long-range acoustic modeling of temporally varying sound sources where uncertainties in model inputs increase at greater propagation distances from the source. Model input variables incorporated into the calculations are further described in the following subsections.

A.4.3.1 Bathymetry

For geometrically shallow water (i.e., less than 200 m), sound propagation is dominated by boundary effects. Bathymetry data represent the three-dimensional nature of the subaqueous land surface and was obtained from the United States Army Corps of Engineers (USACE) Hydrographic Surveys (USACE 2023) website, which provides a data base of bathymetry surveys for rivers and lakes. The data obtained from the USACE Hydrographic Surveys was merged with additional bathymetric data obtained from the National Geophysical Data Center 2003 U.S. Coastal Relief Model Volume 8 (NOAA Satellite and Information Service 2003) to fully characterize the bathymetry within the Project area.

The horizontal resolution of from the National Geophysical Data Center 2003 U.S. Coastal Relief Model has an approximate grid spacing of 73 meters. National Geophysical Data Center's U.S. Coastal Relief Model provides the first comprehensive view of the U.S. coastal zone, integrating offshore bathymetry with land topography into a seamless representation of the coast. The U.S. Coastal Relief Model spans the U.S. east and west coasts, the northern coast of the Gulf of Mexico, Puerto Rico, and Hawaii, reaching out to, and in places even beyond, the continental slope. The Geophysical Data System is an interactive database management system developed by the National Geophysical Data Center for use in the assimilation, storage and retrieval of geophysical data. Geophysical Data System software manages several types of data including marine trackline geophysical data, hydrographic survey data, aeromagnetic survey data, and gridded bathymetry/topography.

The bathymetric data were sampled by creating a fan of radials at a given angular spacing. This grid was then used to determine depth points along each modeling radial transect. The underwater acoustic modeling takes place over these radial planes in set increments depending on the acoustic wavelength and the sampled depth. These radial transects were used for modeling underwater acoustic impacts during both the construction and operation phases of the Project, with each radial centered on the given Project sound source or activity.

A.4.3.2 Sediment Characteristics

Sediment type (e.g., hard rock, sand, mud, clay) directly impacts the speed of sound of the sediment as it is a part of the medium in which sound propagates. The geoacoustic properties with information on the compositional data of the surficial sediments were informed by site-specific geophysical and geotechnical data presented in the sediment characterization report (Shannon and Wilson 2018). The sediment layers used in the modeling and the main geoacoustic properties are defined in Table 7. The term “compressional” refers to the fact that particle motion of the sound wave is in the same direction as propagation. The term “compressional sound speed” refers to the speed of sound in the sediment along the direction of acoustic propagation. The term “compressional attenuation” refers to how much sound (dB) is lost per wavelength (λ) of the signal. Lastly, density (ρ) is the physical density of the sediment.

Table 7 provides geoacoustic properties for compressional waves. Acoustical parameters of shear waves are not included in the acoustical modeling. Bottom reflection loss occurs when sound energy interacts with the sediment at the bottom and therefore, dependent on the geoacoustic properties of the sediments and water column. Shear wave speed and attenuation can be important parameters for bottom loss based on the depth, but typically negligible since they are small as compared to the water column sound speed, and compressional wave speed and attenuation parameters (Jensen 2011). By no including acoustic parameters of shear waves, the acoustic modeling results are expected to be more conservative and representative of the propagation conditions in the Project area.

Table 8. Geoacoustic Properties of Sub-bottom Sediments as a Function of Depth

Seabed Layer (m)	Material	Geoacoustic Properties
0 to 10	Silt	Cp = 1575 m/s αs (dB/λ) = 1.0 dB/ λ ρ = 1700 kg/m^3
10 to 20	Sand-silt	Cp = 1612 m/s αs (dB/λ) = 0.9 dB/ λ ρ = 1800 kg/m^3
20 <	Sand	Cp = 1650 m/s αs (dB/λ) = 0.8 dB/ λ ρ = 1900 kg/m^3

Seabed Layer (m)	Material	Geoacoustic Properties
Sources: Shannon & Wilson 2021 and Jensen 2011		

A.4.3.3 Seasonal Sound Speed Profiles

The speed of sound in sea water depends on the temperature T (°C), salinity S (parts per thousand [“ppt”]), and depth D (meters), and can be described using sound speed profiles. Oftentimes, a homogeneous or mixed layer of constant velocity is present in the first few meters. It corresponds to the mixing of superficial water through surface agitation. There can also be other features such as a surface channel, which corresponds to sound velocity increasing from the surface down. This channel is often due to a shallow isothermal layer appearing in winter conditions but can also be caused by water that is very cold at the surface. In a negative sound gradient, the sound speed decreases with depth, which results in sound refracting downward, which may result in increased bottom losses with distance from the source. In a positive sound gradient as predominantly present in the winter season, sound speed increases with depth and the sound is, therefore, refracted upward, which can aid in long-distance sound propagation. Pile-driving will take place in the daytime. The construction timeframe for in-water work is from November to February. For the construction modeling scenarios, the average sound speed profile for the construction period was used in the model. The speed of sound profile information was obtained using the NOAA Sound Speed Manager software incorporating the World Ocean Atlas 2009 extension algorithms. Additional details pertaining to the sound speed profile sensitivity analysis conducted for the Project can be found in Appendix B.

A.4.3.4 Threshold Range Calculations

To determine the ranges to the defined threshold isopleths a maximum received level-over-depth approach was used. This approach uses the maximum received level that occurs within the water column at each horizontal sampling point. Both the R_{max} and the $R_{95\%}$ ranges were calculated for each of the regulatory thresholds. The R_{max} is the maximum range in the model at which the sound level calculated. The $R_{95\%}$ is the maximum range at which a sound level was calculated excluding 5% of the R_{max}. The $R_{95\%}$ excludes major outliers or protruding areas associated with the underwater acoustic modeling environment. Regardless of shape of the calculated isopleths the predicted range encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified level. All ranges to injury thresholds presented in the Underwater Acoustic Assessment Report are presented in terms of the $R_{95\%}$ range.

A.5 ACOUSTIC MODELING SCENARIOS

Construction of the proposed project landside and waterside improvements needed to ensure the Station can fully and safely meet its mission is anticipated to occur over an approximate two-year duration, depending on environmental and regulatory requirements and timing for the various work types. In-water work will occur during the preferred window of November 1 to February 28.

A.5.1 In-air Acoustics

Project construction is expected to include the following three phases:

1. Mobilizing construction equipment, developing staging areas, barge landing areas, and demolition;
2. Removal of existing piles;
3. Construction of tubular pile wall and offshore infrastructure

Acoustic emission levels for activities associated with Project construction were based upon typical ranges of energy equivalent noise levels at construction sites, as documented by the Federal Highway Administration (FHWA 2006) and the Department for Environment, Food, and Rural Affairs (Defra 2005). Typically, construction activity is also characterized by usage load rating, which is the fraction of time the equipment is operated over the specified working timeframe; however, for the purposes of this assessment the usage load rating was assumed to be 100 percent for all equipment. Therefore, the acoustic analysis conservatively assumes that all construction equipment will operate continuously and concurrently at their maximum sound levels throughout construction.

Received sound levels will fluctuate, depending on the construction activity, equipment type, and distance between noise source and receiver. Construction sound will be attenuated as distance from the source increases. Other factors, such as vegetation, terrain, and obstacles such as buildings will act to further limit the impact of construction noise levels, but they were not considered in the analysis. Information pertaining to construction schedule, numbers of equipment, and equipment type was obtained by USCG. Table 8 presents the types of construction equipment and corresponding maximum sound level (L_{max}) used in the model.

Table 9. Construction Equipment Source Levels, L_{max} dBA

Phase	Construction Equipment[1]	Quantity	Octave Band Sound Pressure Level (Hz) dB[2]								Equipment Noise Level at 50 ft. L_{max}
			63	125	250	500	1,000	2,000	4,000	8,000	
Mobilizing construction equipment, developing staging areas, barge landing areas, and demolition;	Excavator	2	81	84	80	80	81	78	75	70	89 dB / 85 dBA
	Hoe Ram	2	95	86	84	85	84	85	80	75	97 dB / 90 dBA
	Front-end Loader	2	92	84	83	77	76	74	71	62	93 dB / 82 dBA
	Bulldozer	2	85	83	78	79	84	72	67	60	89 dB / 85 dBA
	Dump Truck	2	89	91	81	79	80	77	73	66	93 dB / 84 dBA
Piling Removal	Vibratory Hammer	1	89	88	85	78	90	88	83	73	96 dB / 87 dBA
	Excavator	1	81	84	80	80	81	78	75	70	89 dB / 85 dBA
	Dump Truck	2	89	91	81	79	80	77	73	66	93 dB / 84 dBA
	Crane	1	95	90	86	82	79	75	68	63	97 dB / 85 dBA
	Grader	2	88	87	83	79	84	78	74	65	92 dB / 86 dBA
Construction of tubular pile wall and offshore infrastructure	Impact Hammer	1	118	110	89	93	90	96	95	97	119 dB / 103 dBA
	Excavator	1	81	84	80	80	81	78	75	70	89 dB / 85 dBA
	Dump Truck	2	89	91	81	79	80	77	73	66	93 dB / 84 dBA
	Crane	1	95	90	86	82	79	75	68	63	97 dB / 85 dBA
	Grader	2	88	87	83	79	84	78	74	65	92 dB / 86 dBA

[1]Equipment usage percentage was assumed 100% for all equipment.

[2]Octave band data is based on Defra 2005 and adjusted to the broadband levels provided by FHWA 2004.

A.5.2 Underwater Acoustics

The representative acoustic modeling scenarios were derived from descriptions of the expected construction activities through consultations between the Project design and engineering teams. The modeled scenarios were chosen to reflect where potential underwater noise impacts of marine species were anticipated and include impact hammer, vibratory hammer, and drilling associated with pile installation. All modeling scenarios occur at a representative location, which was selected so that the effects of sound propagation at the range of water column depths occurring within the project area could be best observed.

A summary of construction and operational scenarios included in the underwater acoustic modeling analysis is provided in Table 9. The pile diameters selected for the impact pile driving modeling scenarios were based on maximum Project design considerations provided by the USCG. The subsections that follow provide more detailed information about the parameters used to model the noise sources associated with each scenario.

Table 10. Underwater Acoustic Modeling Scenarios

Scenario	Description	Location (UTM Coordinates)	Hammer Energy (kilojoule) a/	Total Hammer Blows / Duration	Source Level (at 10 meter)[2]
1	Impact pile driving installation, diameter: 24-inch	409931 m, 4872709 m	160	45 blows per minute for 27 minutes (1,230 total blows)[1]	207 $L_{p,pk}$ 178 $L_{E,\ 1sec}$ 194 L_p
2	Impact pile driving installation, diameter: 18-inch[4]	409931 m, 4872709 m	105	45 blows per minute for 21 minutes (924 total blows)[1]	203 $L_{p,pk}$ 171 $L_{E,\ 1sec}$ 182 L_p
3	Impact pile driving installation, diameter: H-Pile 14x117	409931 m, 4872709 m	105	45 blows per minute for 13 minutes (570 total blows)[1]	200 $L_{p,pk}$ 166 $L_{E,\ 1sec}$ 178 L_p
4	Vibratory hammer pile installation, diameter: 24-inch	409931 m, 4872709 m	N/A	60 minutes[1]	165 $L_{E,\ 1sec}$
5	Vibratory hammer pile installation, diameter: 18-inch	409931 m, 4872709 m	N/A	45 minutes[1]	158 $L_{E,\ 1sec}$
6	Vibratory hammer pile removal, diameter: 24-inch	409931 m, 4872709 m	N/A	15 minutes[1]	162 $L_{E,\ 1sec}$

[1] The total number of blows and duration represents the installation of three piles per day. The duration provided in minutes has been rounded to the nearest whole number.

[2] Source levels were based on similar pile installations published by CALTRANS (CALTRANS 2020)

[3] The drilling source level was derived based on several reference studies (Guan, S. et al., 2020 and Austin, M. et al., 2018)

[4] An 18-inch pile diameter was modeled to represent the worst-case project design. Recent updates to the project design incorporate a 16-inch pile diameter using the same hammer energy and number of blows. Reducing the pile diameter would result in the same or slightly lower noise levels.

A.5.3 Impact Pile Driving

Impact pile driving involves weighted hammers that pile into the river floor. Different methods for lifting the weight include hydraulic, steam, or diesel. The acoustic energy is created upon impact; the energy travels into the water along different paths (1) from the top of the pile where the hammer hits, through the air, into the water; (2) from the top of the pile, down the pile, radiating into the air while traveling down the pile, from air into water; (3) from the top of the pile, down the pile, radiating directly into the water from the length of pile below the waterline; and (4) down the pile radiating into the ground, traveling through the ground and radiating back into the water. Near the pile, acoustic energy arrives from different paths with different associated phase and time lags, which creates a pattern of destructive and constructive interference. Further away from the pile, the water and seafloor born energy are the dominant pathways. The underwater noise generated by a pile-driving strike depends primarily on the following factors:

1. The impact energy and type of pile driving hammer;
2. The size and type of the pile;
3. Water depth; and
4. Subsurface hardness in which the pile is being driven.

The acoustic energy radiated into the aquatic environment by a struck pile is directly correlated to the kinetic energy that the impact hammer imparts to it. Engineering considerations about pile penetration and load bearing capacity dictate that the impact hammer energy must be matched to the pile and to the resistance of the underlying substrate (Parola 1970). Greater hammer impact energy is required for larger diameter piles to achieve the desired load bearing capacity. The water depth also has a strong influence on the acoustic energy propagation in the water column. As water depth increased the farther the sound will propagate. The site presented in Table 9 has a depth of 3 meters, which is representative of the project area where pile driving will occur.

The 24-inch pile, 15-inch pile, and H-Pile driving scenarios were modeled using a vertical array of sources spaced at a 0.5-meter array, distributing the sound emissions from pile driving throughout the water column. The vertical array was assigned third-octave band sound characteristics adjusted for site-specific parameters discussed above including expected hammer energy and number of blows. Third octave band center frequencies from 12.5 Hz up to 20 kHz were used in the modeling. The spectra used in the modeling is shown below in Figure 4. This spectrum is based data for similar pile diameters (NAVFAC 2017) and is scaled to the broadband source levels presented in Table 9.

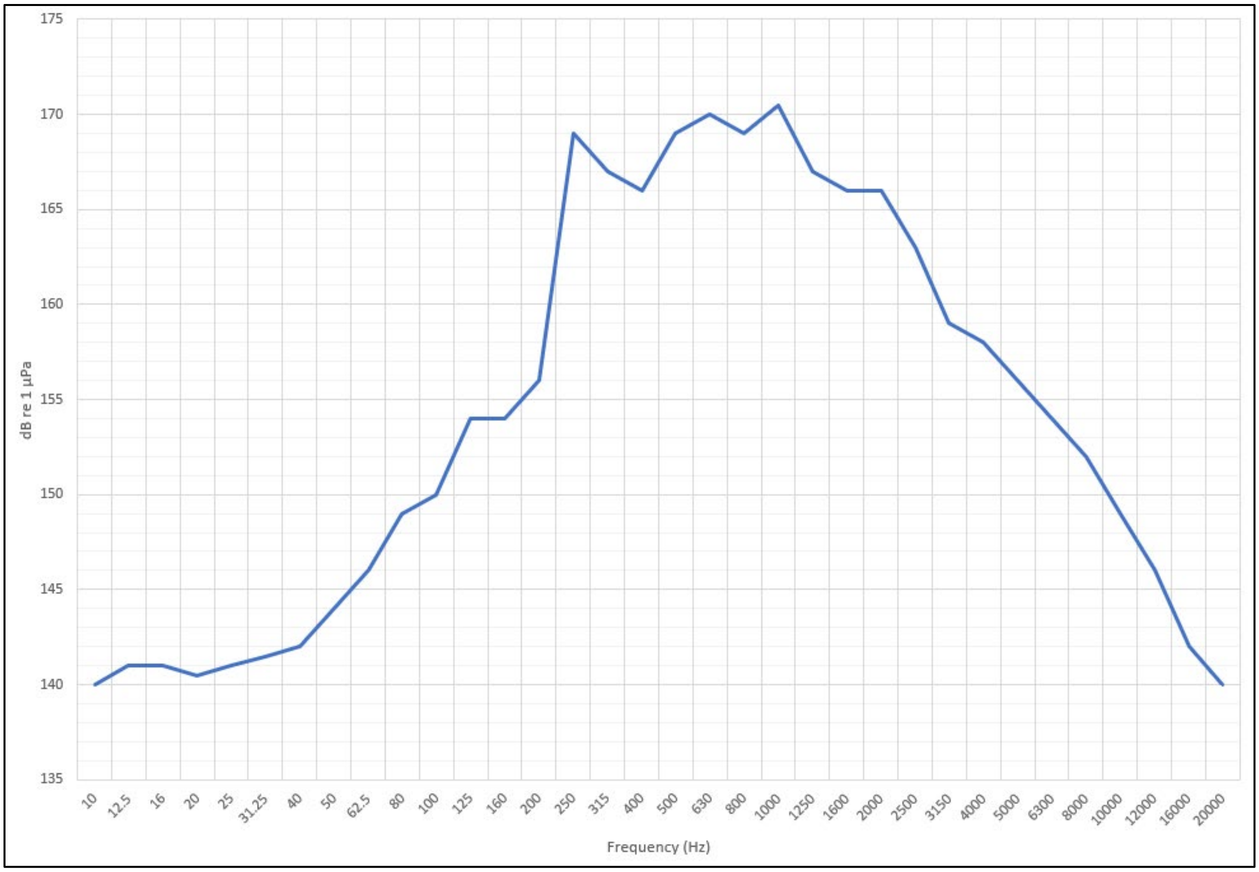

Figure 4 Impact Pile Driving Spectral Source Level at 10 m (NAVFAC 2017)

A.5.4 Vibratory Hammer Pile Installation and Removal

A vibratory hammer will be used for removal of existing piles and installation of new piles. Vibratory hammers remove and install piling into the ground by applying a rapidly alternating force to the pile. This is generally accomplished by rotating eccentric weights about shafts. Each rotating eccentric produces a force acting in a single plane and directed toward the centerline of the shaft. The weights are set off-center of the axis of rotation by the eccentric arm. If only one eccentric arm is used, in one revolution, force will be exerted in all directions giving the system significant lateral whip. To avoid this problem, the eccentric arms are paired so the lateral forces cancel each other, leaving only axial force for the pile.

In general, vibratory pile-driving is less noisy than impact pile-driving. Modeling was accomplished using adjusted one-third-octave band vibratory hammer source levels from measurements of a similar pile diameter (NAVFAC 2017) and activities (i.e., installation versus removal) and adjusted to the broadband source levels presented in Table 9. The frequency distribution of the vibratory hammer for pile installation and removal is displayed in Figure 5.

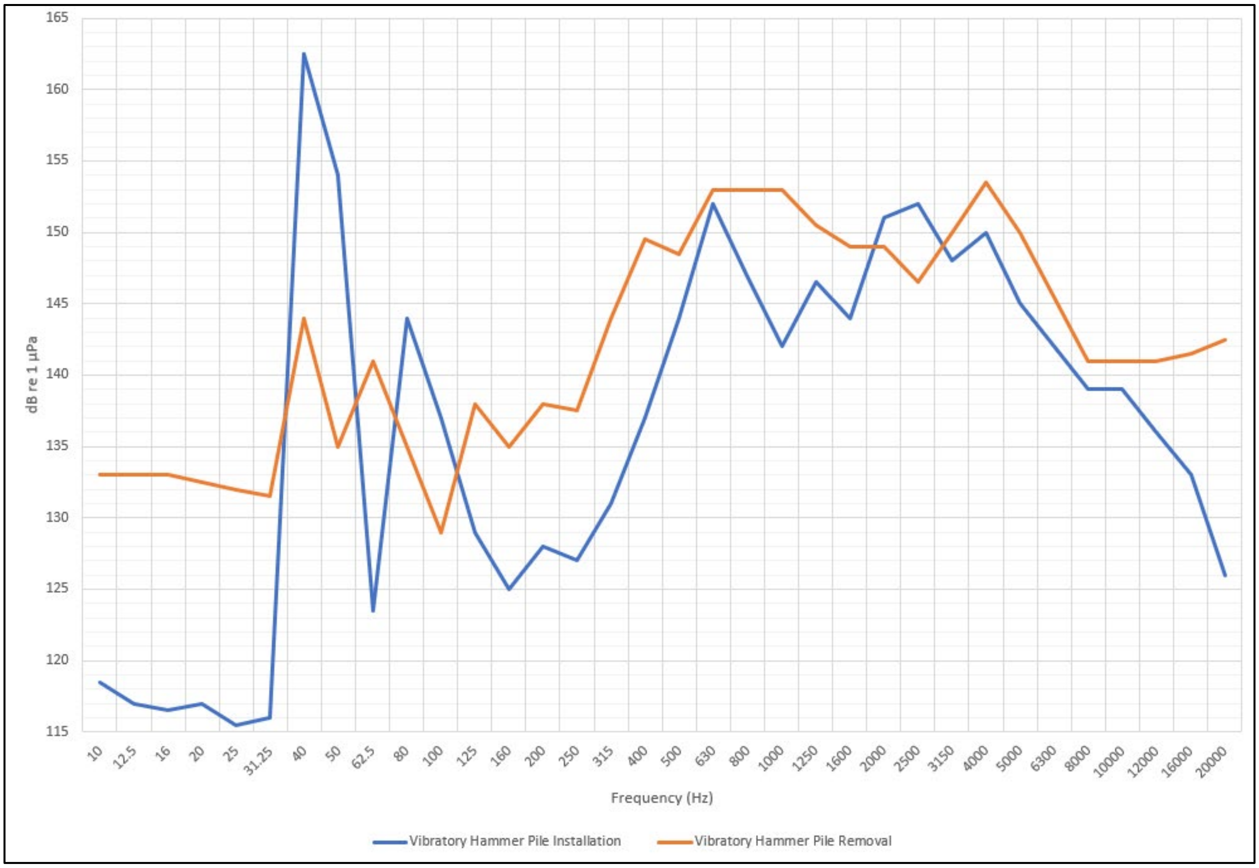

Figure 5 Vibratory Hammer Spectral Source Level at 10 m (NACFAC 2017)

A.5.5 Drilling Installation of Piles

If pile driving for the entire piling installation is not possible due to the presence of rock or hard soil in some lower part of the substrate, the drive and drill method may be used. If the pile meets refusal, the pile may be drilled out a couple of meters below the pile tip. Then piling will be re-established and piled to its final position. If refusal appears again, the driving/drilling will continue until the pile has reached its final position. Measurements of drilling are largely from oil and gas production and noise produced by drilling is non-impulsive and in the low frequency range of 20 - 1,000 Hz (Austin, M. et al 2018). Additional measurements for down-the-hole (DTH) pile driving activities have been documented in multiple studies. DTH pile driving uses a combination of percussive and drilling mechanisms. The measurements show that most of the acoustic energy is below 2 kHz and source levels can range from 140 dB L_p to 180 dB L_p (Guan, S. et al 2020).

Modeling was accomplished using adjusted one-third-octave band drilling source levels from measurements (Austin, M. et al. 2018) and adjusted to the broadband source levels presented in Table 9. The frequency distribution of the drilling is displayed in Figure 6.

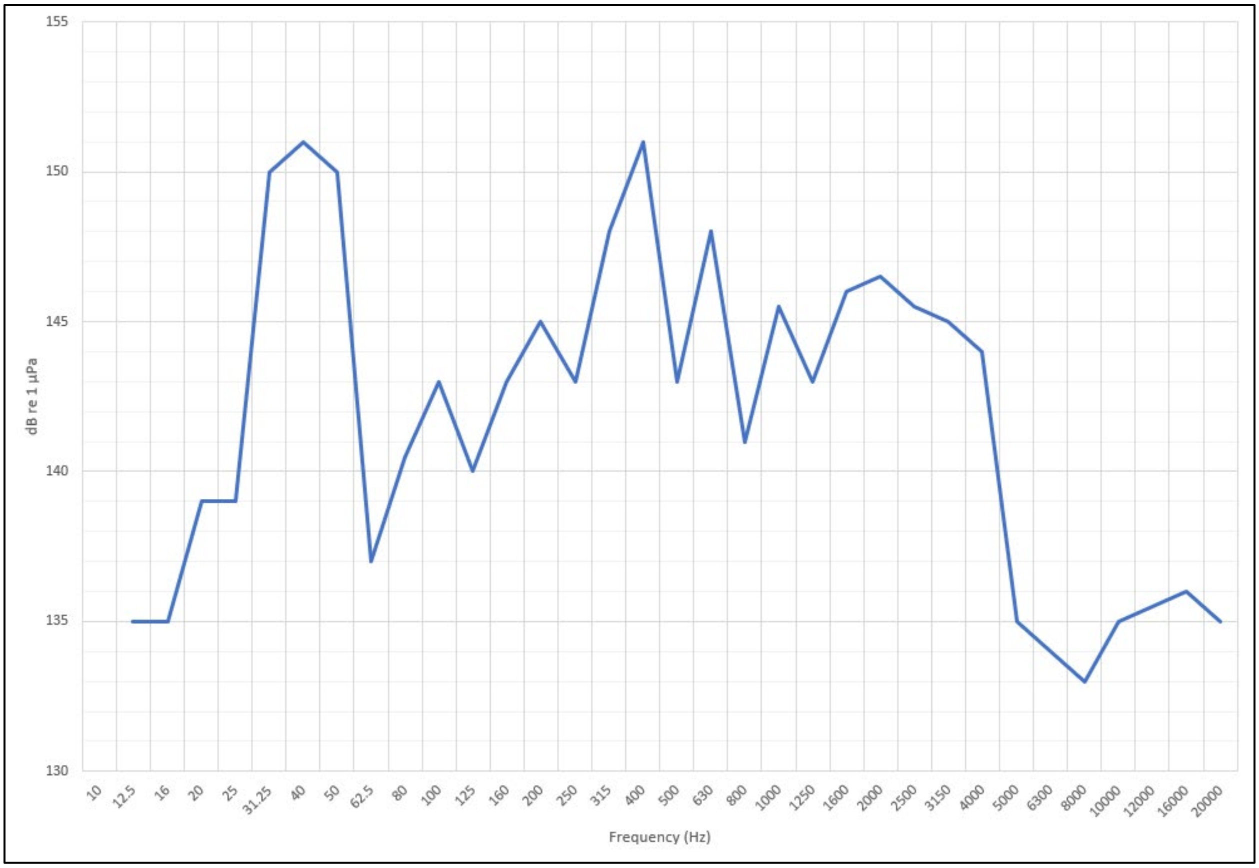

Figure 6 Drilling Spectral Source Level at 10 m (Austin, M. et al 2018)

A.6 NOISE MITIGATION

Devices may be considered to mitigate pile driving sound levels. There are several types of sound attenuation devices including bubble curtains, cofferdams, isolation casings (also called temporary noise attenuation piles), and cushion blocks. The most commonly considered mitigation strategy is the use of bubble curtains. Bubble curtains create a column of air bubbles rising around a pile from the substrate to the water surface. Because air and water have a substantial impedance mismatch, the bubble curtain acts as a reflector. In addition, the air bubbles absorb and scatter sound waves emanating from the pile, thereby reducing the sound energy. Bubble curtains may be confined or unconfined. These systems may be deployed in series, such as a double bubble curtain with two rings of bubbles encircling a pile. Attenuation levels also vary by type of system, frequency band, and location. Small bubble curtains have been measured to reduce sound levels from 5 dB to more than 10 dB but are highly dependent on depth of water and current, and configuration and operation of the curtain (Koschinski and Lüdemann 2013, Bellmann 2014, Austin et al. 2016, CALTRANS 2020).

Effectiveness of bubble curtains is variable and depends on many factors, including the bubble layer thickness, the total volume of injected air, the size of the bubbles relative to the sound wavelength, and whether the curtain is completely closed. High current conditions can limit the effectiveness of bubble curtains by sweeping the air bubbles away from the pile (Elmer et al. 2006). As water depth increases, the opportunity for current-based disruption of the bubble curtain increases. In general, bubble curtain effectiveness decreases as the water depth increases (Bellmann et al. 2017).

With studies reporting variable achievable attenuation rates for bubble curtains, to represent the use of bubble curtains as a mitigation option in the modeling, a range of potential sound reduction was applied to the modeled sound fields associated with impact pile driving. An attenuation factor of 5 dB was applied to all scenarios to evaluate potential mitigated underwater noise impacts. The results for the mitigation factors are provided for informational purposes only and the take calculations will be based on the unmitigated results.

A.7 RESULTS

A.7.1 In-air Acoustics

The equipment from Table 7 and corresponding sound information was entered into the CadnaA® model and received sound levels associated with each phase of construction were evaluated. The construction of the Project is expected to occur between the hours of 7:00 a.m. and 10:00 p.m. and will not be limited by to the City of Florence daytime noise thresholds limits. However, if nighttime (10:00 p.m. to 7:00 a.m.) construction is expected then mitigation measures will need to be evaluated to comply with the City of Florence Code.

Table 10 shows the maximum distance to the relevant NOAA Fisheries in-air 90 dB rms (harbor seal) and 100 dB rms (other pinnipeds) disturbance criteria for the different phases of construction. Figures 7 through 9 consist of sound contour plots showing potential noise impacts to harbor seals and other pinnipeds at each construction location as color-coded noise isopleths at 90 rms dB and 100 rms dB intervals. The noise contours are graphical representations of the cumulative noise expected during normal construction of the equipment operating simultaneously and shows how the maximum construction noise will be distributed over the surrounding area. The contour lines shown are analogous to elevation contours on a topographic map, i.e., the noise contours are continuous lines of equal noise level around some source, or sources, of noise. Table 10 presents the predicted distances to the relevant 90 dB rms in-air acoustic threshold for harbor seals and 100 dB rms in-air acoustic threshold for other pinnipeds. The tabulated results and sound contour plots are independent of the existing acoustic environment and are representative of expected Project construction sound levels only.

Table 11. In-air Acoustic Modelling Results - Distances of Maximum Disturbance, dB

Construction Phase	PA				OA			
	Impulsive AUD INJ		Non-Impulsive AUD INJ	Behavior	Impulsive AUD INJ		Non-Impulsive AUD INJ	Behavior
	162 dB (Lp,pk)	140 dB (LE, PW, 24h)	154 dB (LE, PW, 24h)	90 dB L_p	177 dB (Lp,pk)	163 dB (LE, OW, 24h)	177 dB (LE, OW, 24h)	100 dB L_p
Mobilizing construction equipment, developing staging areas, barge landing areas, and demolition	N/A	N/A	6 ft (1.8 m)	318 ft (97 m)	N/A	N/A	-[1]	85 ft (26 m)
Piling Removal	N/A	N/A	8 ft (2.4 m)	1,410 ft (430 m)	N/A	N/A	-[1]	348 ft (106 m)
Construction of tubular pile wall and offshore infrastructure	-[1]	25 ft (7.6m)	N/A	2,447 ft (746 m)	-[1]	-[1]	N/A	672 ft (205 m)

Sources: NOAA Fisheries 2023a, 2024
$L_{E,\,24h}$ = cumulative sound exposure over a 24-hour period (dB re 20 µPa^2·s).
$L_{p,pk}$ = peak sound pressure (dB re 20 µPa);
L_p = root mean square sound pressure (dB re 20 µPa)
N/A = Not applicable
[1] The threshold level is greater than the source level; therefore, distances are not generated.

Figure 7
In-air Received Sound Levels:
Mobilizing construction equipment, developing staging areas, barge landing areas, and demolition

Siuslaw River Project
Lane County, Oregon

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Received Sound Levels (dB re 20 μPa)

90

100

N

0 250 500 Feet

Figure 8
In-air Received Sound Levels:
Pile Removal

Siuslaw River Project
Lane County, Oregon

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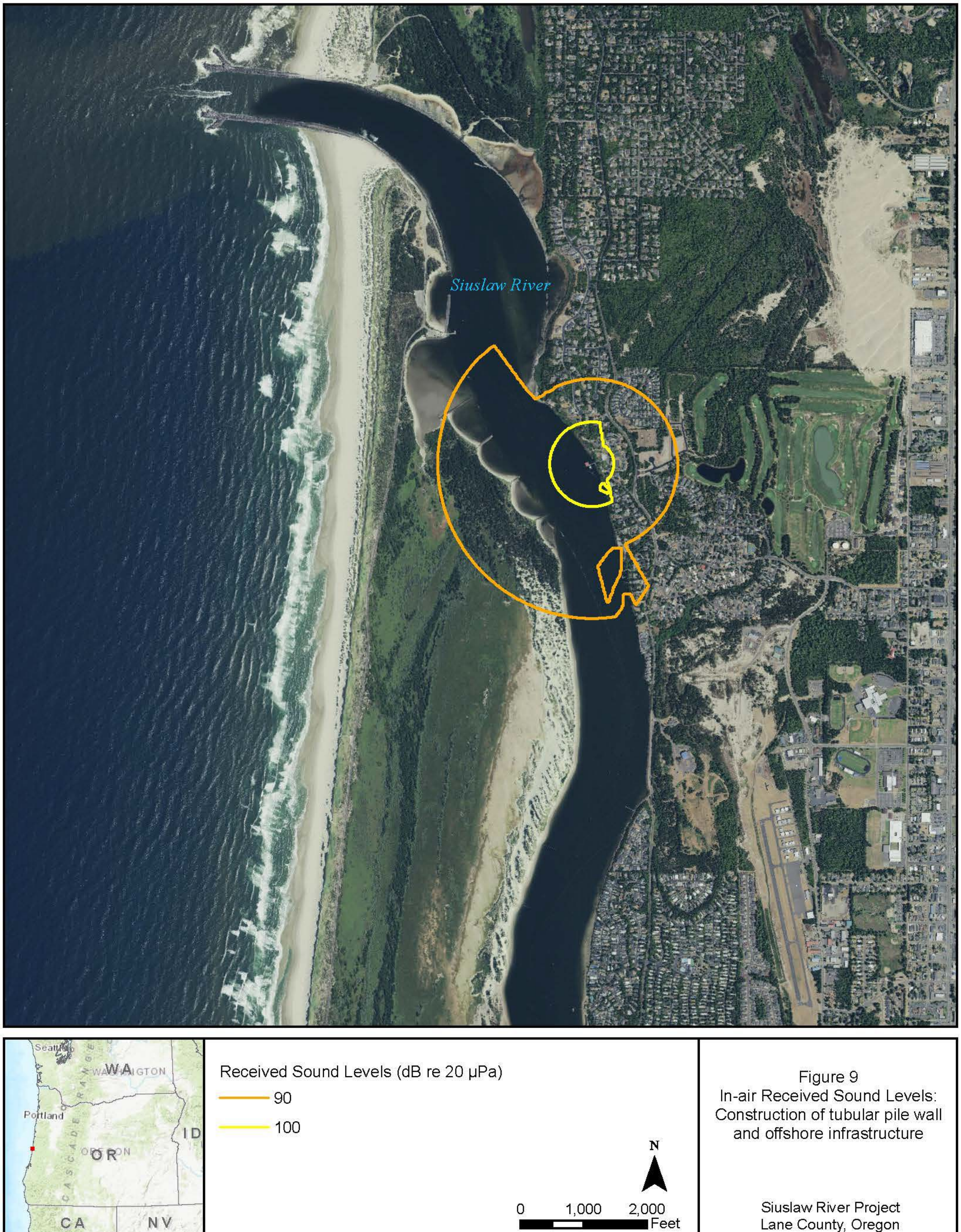

Figure 9
In-air Received Sound Levels:
Construction of tubular pile wall
and offshore infrastructure

Siuslaw River Project
Lane County, Oregon

\\Cess706gisfs1\CES\Projects\BOT\G\PROJECTS\SIUSLAW_0112-0037\NOISE\MAPS\Figure_9_Pile_Driving.mxd

A.7.2 Underwater Acoustics

As indicated earlier, using dBSea and site-specific parameters related to the marine environment and Project sound source characteristics, acoustic modeling was completed to assess distances to the various acoustic threshold levels identified in Section A.2.2. The analyzed modeling scenarios are described in Table 9 and include:

- Scenario 1: Impact pile driving installation for a 24-inch pile diameter
- Scenario 2: Impact pile driving installation for an 18-inch pile diameter
- Scenario 3: Impact pile driving installation for a H-pile
- Scenario 4: Vibratory hammer installation for a 24-inch pile diameter
- Scenario 5: Vibratory hammer installation for an 18-inch pile diameter
- Scenario 6: Vibratory hammer removal for a 24-inch pile diameter
- Scenario 7: Drilling operations

All these activities were modeled at a representative location within the Project Area. The underwater acoustic modeling results of each of the scenarios are provided in the sections below. Results are presented without mitigation and with mitigation at a 5-dB attenuation. Noise mitigation requirements and methods have not been finalized at this stage of permitting; therefore, the mitigation results are provided for informational purposes and the take calculations will be based on the unmitigated results.

Appendix A summarizes the R_{95} distances for the Lpk, SPL, and SEL metrics. The results of the analysis will be used to inform development of evaluation and mitigation measures that will be applied during construction and operation of the Project, in consultation with NOAA Fisheries and any additional appropriate regulatory agencies. The Project will obtain the necessary permits to address potential impacts to marine mammals, sea turtles, and other fisheries resources and will establish appropriate and practicable mitigation and monitoring measures through discussions with regulatory agencies. Figures 10 through 16 show the unweighted and unmitigated underwater received sound pressure levels for each scenario. Underwater sound pressure level ranges are displayed in 5 dB increments and sound propagation characteristics are shown, as applicable, throughout the project area and beyond.

A.7.2.1 Impact Pile Driving Results

Marine Mammal Injury and Behavioral Onset Results

The results for marine mammal injury and behavioral onset for the impact pile driving scenarios are shown in Table 11 for the applicable SEL, Lpk, and SPL metrics. The results display trends that are expected, such as increasingly reduced distances as greater levels of noise mitigation are applied. In addition, the smallest distances to thresholds were observed for the Lpk acoustic thresholds while the largest distances were observed for the 160 dB SPL for the marine mammal behavioral criteria. The largest distance was modeled to be 717 meters corresponding to the 160 dB SPL marine mammal behavioral criterion without mitigation for the installation of the 24-inch pile diameter.

Fish Injury and Behavioral Onset Results

The results for fish injury and behavioral onset results for fish with no swim bladder, fish with a swim bladder not involved in hearing, fish with swim bladder involved in hearing, eggs and larvae, small fish, and large fish are shown in Table 12. All distance to threshold values were low (i.e., less than 100 meters) except for

the distances to the 187 dB SEL, 183 dB SEL injury, and 150 dB SPL behavioral thresholds with the largest distance of 1,305 meters occurring for unmitigated distance to the 150 dB SPL acoustic threshold for the installation of the 24-inch pile diameter.

Table 12. Marine Mammal Injury and Behavioral Onset Criteria Threshold Distances (meters) for Impact Pile-Driving

Hearing Group	Metric	Threshold (dB)	Impact Hammer		Impact Hammer		Impact Hammer	
			Hammer Energy - 160 kJ		Hammer Energy - 105 kJ		Hammer Energy - 105 kJ	
			Pile Diameter – 24 in		Pile Diameter – 18 in		Pile Diameter – H-Pile	
			Attenuation (dB)		Attenuation (dB)		Attenuation (dB)	
			0	5	0	5	0	5
Low-frequency cetaceans	$L_{E,24hr}$ [1,3]	183	386	215	137	74	52	25
	$L_{p,pk}$ [1,3]	222	-[5]	-[5]	-[5]	-[5]	-[5]	-[5]
High-frequency cetaceans	$L_{E,24hr}$ [1,3]	193	45	24	18	-[5]	-[5]	-[5]
	$L_{p,pk}$ [1,3]	230	-[5]	-[5]	-[5]	-[5]	-[5]	-[5]
Very high-frequency cetaceans	$L_{E,24hr}$ [1,3]	159	335	237	187	112	96	59
	$L_{p,pk}$ [1,3]	202	20	8	14	5	-[5]	-[5]
Phocid pinnipeds	$L_{E,24hr}$ [1,3]	183	256	121	89	46	35	19
	$L_{p,pk}$ [1,3]	223	-[5]	-[5]	-[5]	-[5]	-[5]	-[5]
Otariid pinnipeds underwater	$L_{E,24hr}$ [1,3]	185	95	56	41	21	18	-[5]
	$L_{p,pk}$ [1,3]	230	-[5]	-[5]	-[5]	-[5]	-[5]	-[5]
Marine Mammal Behavior	L_p [2,4]	160	717	456	194	94	110	58

[1] NOAA Fisheries 2024

[2] NOAA Fisheries 2023a

[3] Level A/AUD INJ

[4] Level B/ Behavioral Disturbance

[5] The threshold level is greater than the source level; therefore, distances are not generated.

Table 13. Fish Injury and Behavioral Onset Criteria Threshold Distances (meters) for Impact Pile-Driving

Hearing Group	Metric	Threshold (dB)	Impact Hammer Hammer Energy - 160 kJ Pile Diameter – 24 in Attenuation (dB)		Impact Hammer Hammer Energy - 105 kJ Pile Diameter – 18 in Attenuation (dB)		Impact Hammer Hammer Energy - 105 kJ Pile Diameter – H-Pile Attenuation (dB)	
			0	5	0	5	0	5
Fish: no swim bladder	$L_{E,24hr}$ [1,2]	219	-[6]	-[6]	-[6]	-[6]	-[6]	-[6]
	$L_{p,pk}$ [1,2]	213	4	-[6]	1	-[6]	-[6]	-[6]
Fish: swim bladder is not involved in hearing	$L_{E,24hr}$ [1,2]	210	9	4	-[6]	-[6]	-[6]	-[6]
	$L_{p,pk}$ [1,2]	207	9	5	6	2	3	-[6]
Fish: swim bladder involved in hearing	$L_{E,24hr}$ [1,2]	207	17	7	3	-[6]	-[6]	-[6]
	$L_{p,pk}$ [1,2]	207	9	5	6	2	3	-[6]
Eggs and larvae	$L_{E,24hr}$ [1,2]	210	9	4	-[6]	-[6]	-[6]	-[6]
	$L_{p,pk}$ [1,2]	207	9	5	6	2	3	-[6]
Small fish	$L_{E,24hr}$ [3,4]	183	407	236	146	74	52	25
	$L_{p,pk}$ [3,4]	206	14	6	7	2	4	-[6]
	L_p [5]	150	1,305	1,052	560	350	387	226
Large fish	$L_{E,24hr}$ [3,4]	187	262	130	88	42	27	17
	$L_{p,pk}$ [3,4]	206	14	6	7	2	4	-[6]
	L_p [5]	150	1,305	1,052	560	350	387	226

[1] Popper et al. 2014

[2] Mortality and Potential Mortal Injury

[3] NOAA Fisheries 2023b

[4] Small fish are fish less than 2 grams in weight. Large fish are 2 grams or larger.

[5] GARFO 2016

[6] The threshold level is greater than the source level; therefore, distances are not generated.

A.7.2.2 Vibratory Hammer Pile Installation and Removal Results

Marine Mammal Injury and Behavioral Onset Results

The results for marine mammal injury and behavioral onset for the vibratory hammer pile installation and removal scenarios are shown in Table 13 for the applicable SEL and SPL metrics. The results are as expected, such as increased reduction in distances as greater levels of noise mitigation are applied. In addition, the smallest distances to thresholds were observed for the SEL acoustic thresholds while the largest distances were observed for the 120 dB SPL Marine Mammal criteria. The largest distance was modeled to be 1,117 meters corresponding to the 120 dB SPL criterion without mitigation for the installation of the 24-inch pile diameter.

Fish Injury and Behavioral Onset Results

The results for fish injury and behavioral onset results for small fish and large fish are shown in Table 14. All distance to threshold values were low (i.e., less than 150 meters). The largest distance of 139 meters occurred for unmitigated distance to the 183 dB SEL acoustic threshold for the installation of the 24-inch pile diameter.

Table 14. Marine Mammal Injury and Behavioral Onset Criteria Threshold Distances (meters) for Vibratory Hammer Pile Installation and Removal

Hearing Group	Metric	Threshold (dB)	Vibratory Hammer Pile Installation Pile Diameter – 24 in Attenuation (dB)		Vibratory Hammer Pile Installation Pile Diameter – 18 in Attenuation (dB)		Vibratory Hammer Pile Removal Pile Diameter – 24 in Attenuation (dB)	
			0	5	0	5	0	5
Low-frequency cetaceans	$L_{E,24hr}$ [1,2]	197	29	16	14	-[4]	7	-[4]
High-frequency cetaceans	$L_{E,24hr}$ [1,2]	201	14	-[4]	-[4]	-[4]	-[4]	-[4]
Very high-frequency cetaceans	$L_{E,24hr}$ [1,2]	181	58	25	22	10	16	21
Phocid pinnipeds	$L_{E,24hr}$ [1,2]	195	39	18	16	-[4]	14	-[4]
Otariid pinnipeds underwater	$L_{E,24hr}$ [1,2]	199	17	-[4]	-[4]	-[4]	-[4]	-[4]
Marine Mammal Behavior	L_p [1,3]	120	1,117	739	660	417	1,106	739

[1] NOAA Fisheries 2023a, 2024

[2] Level A/AUD INJ

[3] Level B/ Behavioral Disturbance

[4] The threshold level is greater than the source level; therefore, distances are not generated.

Table 15. Fish Injury and Behavioral Onset Criteria Threshold Distances (meters) for Vibratory Hammer Pile Installation and Removal

Hearing Group	Metric	Threshold (dB)	Vibratory Hammer Pile Installation Pile Diameter – 24 in Attenuation (dB)		Vibratory Hammer Pile Installation Pile Diameter – 18 in Attenuation (dB)		Vibratory Hammer Pile Removal Pile Diameter – 24 in Attenuation (dB)	
			0	5	0	5	0	5
Small fish	$L_{E,24hr}$ [3,4]	183	139	88	66	36	57	27
	L_p [5]	150	77	42	28	17	57	27
Large fish	$L_{E,24hr}$ [3,4]	187	90	52	42	21	30	18
	L_p [5]	150	77	42	28	17	57	27

[1] Popper et al. 2014

[2] Mortality and Potential Mortal Injury

[3] Stadler and Woodbury 2009

[4] Small fish are fish less than 2 grams in weight. Large fish are 2 grams or larger.

[5] GARFO 2016

[6] The threshold level is greater than the source level; therefore, distances are not generated.

A.7.2.3 Drilling Operations Results

Marine Mammal Injury and Behavioral Onset Results

The results for marine mammal injury and behavioral onset for the drilling operations scenario are shown in Table 15 for the applicable SEL and SPL metrics. The results are as expected, including increasingly reduced distances as greater levels of noise mitigation are applied. In addition, the smallest distances to thresholds were observed for the SEL acoustic thresholds while the largest distances were observed for the 120 dB SPL Marine Mammal criteria. The largest distance was modeled to be 701 meters corresponding to the 120 dB SPL criterion without mitigation.

Fish Injury and Behavioral Onset Results

The results for fish injury and behavioral onset results for small fish and large fish are shown in Table 16. All distance to threshold values were low (i.e., less than 100 meters). The largest distance of 98 meters occurred for unmitigated distance to the 183 dB SEL acoustic threshold.

Table 16. Marine Mammal Injury and Behavioral Onset Criteria Threshold Distances (meters) for Drilling Operations

Hearing Group	Metric	Threshold (dB)	Drilling Pile Installation Pile Diameter – 24 in Attenuation (dB) 0
Low-frequency cetaceans	$L_{E,24hr}$ [1,2]	197	16
High-frequency cetaceans	$L_{E,24hr}$ [1,2]	201	-[4]
Very high-frequency cetaceans	$L_{E,24hr}$ [1,2]	181	28
Phocid pinnipeds	$L_{E,24hr}$ [1,2]	195	16
Otariid pinnipeds underwater	$L_{E,24hr}$ [1,2]	199	-[4]
Marine Mammal Behavior	L_p [1,3]	120	701

[1] NOAA Fisheries 2024

[2] Level A/AUD INJ

[3] Level B/Behavioral Disturbance

[4] The threshold level is greater than the source level; therefore, distances are not generated.

Table 17. Fish Injury and Behavioral Onset Criteria Threshold Distances (meters) for Drilling Operations

Hearing Group	Metric	Threshold (dB)	Drilling Pile Installation Pile Diameter – 24 in Attenuation (dB) 0
Small fish	$L_{E,24hr}$ [3,4]	183	98
	L_p [5]	150	39
Large fish	$L_{E,24hr}$ [3,4]	187	61
	L_p [5]	150	39

[1] Popper et al. 2014

[2] Mortality and Potential Mortal Injury

[3] Stadler and Woodbury 2009

[4] Small fish are fish less than 2 grams in weight. Large fish are 2 grams or larger.

[5] GARFO 2016

[6] The threshold level is greater than the source level; therefore, distances are not generated.

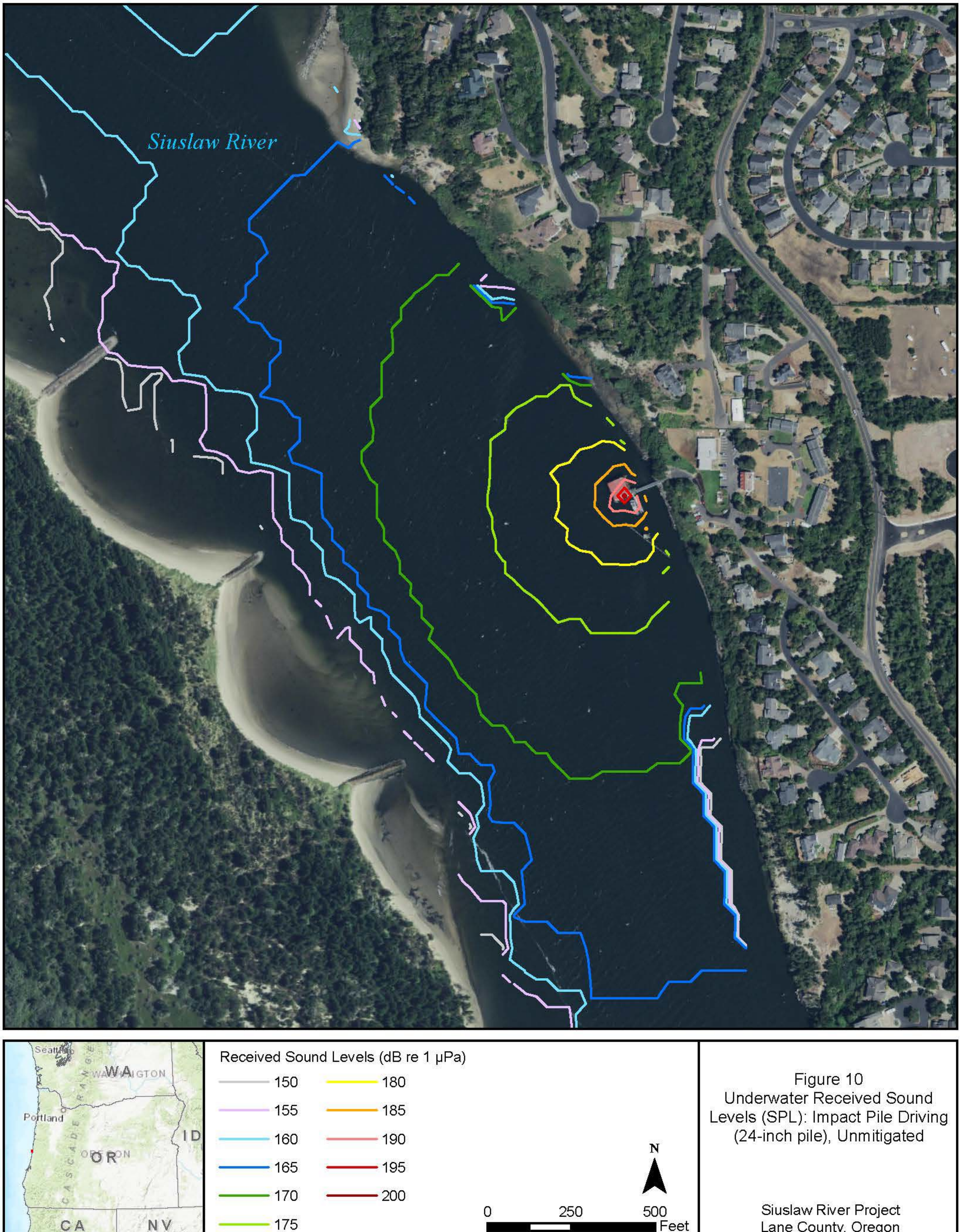

Figure 10
Underwater Received Sound Levels (SPL): Impact Pile Driving (24-inch pile), Unmitigated

Siuslaw River Project
Lane County, Oregon

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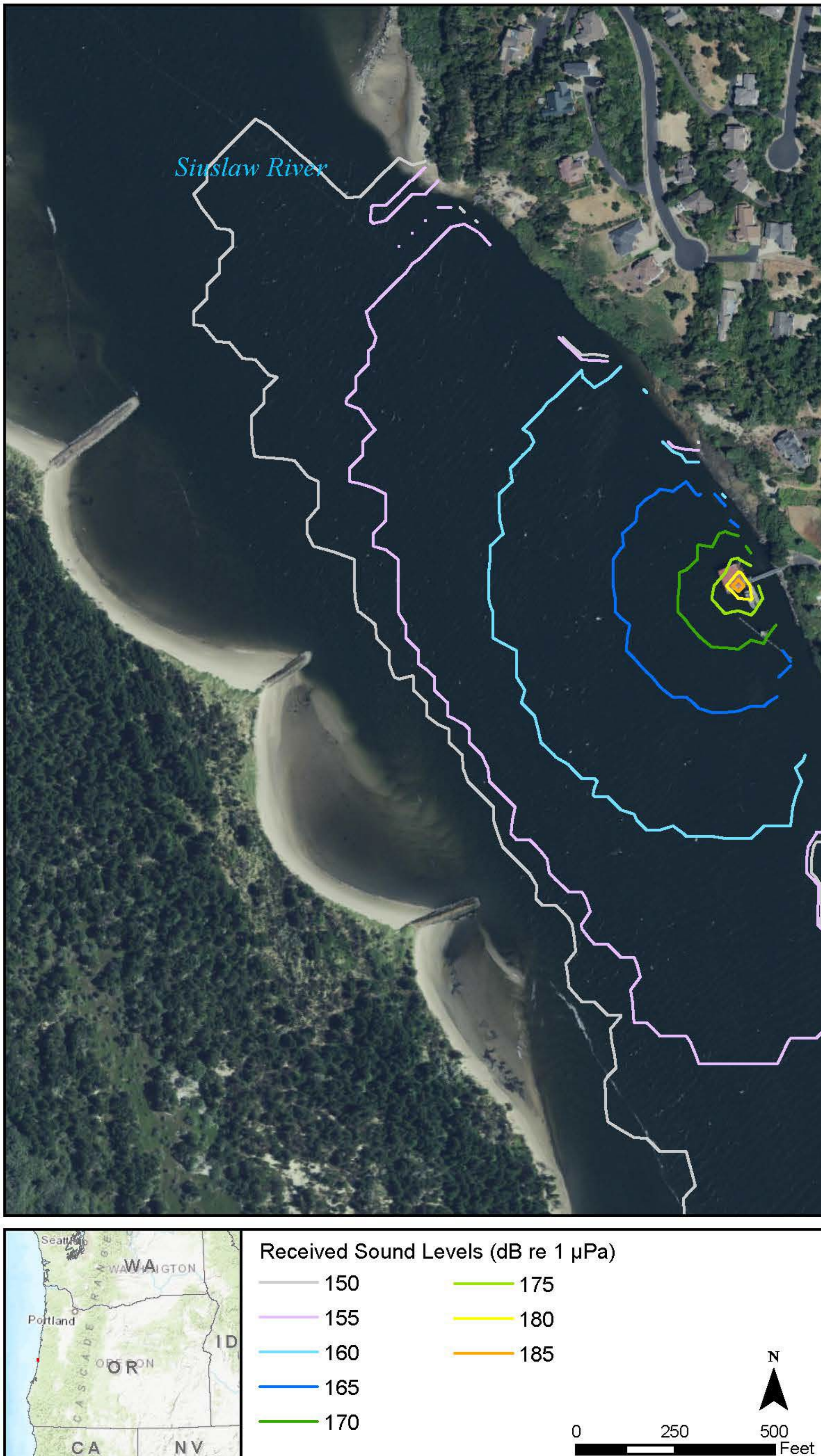

Figure 11
Underwater Received Sound Levels (SPL): Impact Pile Driving (18-inch pile), Unmitigated

Siuslaw River Project
Lane County, Oregon

\\Cess706gisfs1\CES\Projects\BOT\G\PROJECTS\SIUSLAW_0112-0037\NOISE\MAPS\Figure_11_Impact_Pile_18.mxd

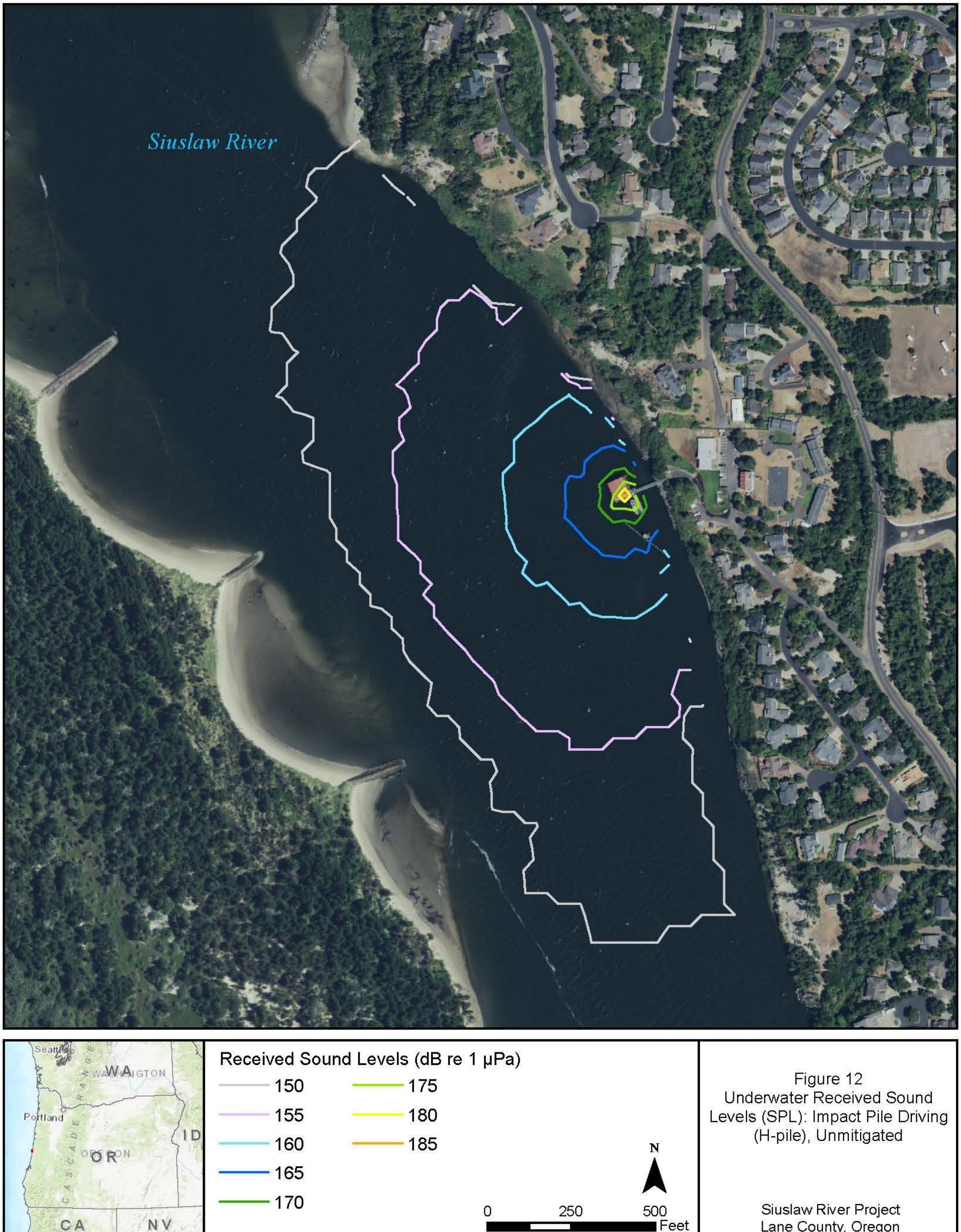

Figure 12
Underwater Received Sound Levels (SPL): Impact Pile Driving (H-pile), Unmitigated

\\Cess706gisfs1\CES\Projects\BOTG\PROJECTS\SIUSLAW_0112-0037\NOISE\MAPS\Figure_12_Impact_H_Pile.mxd

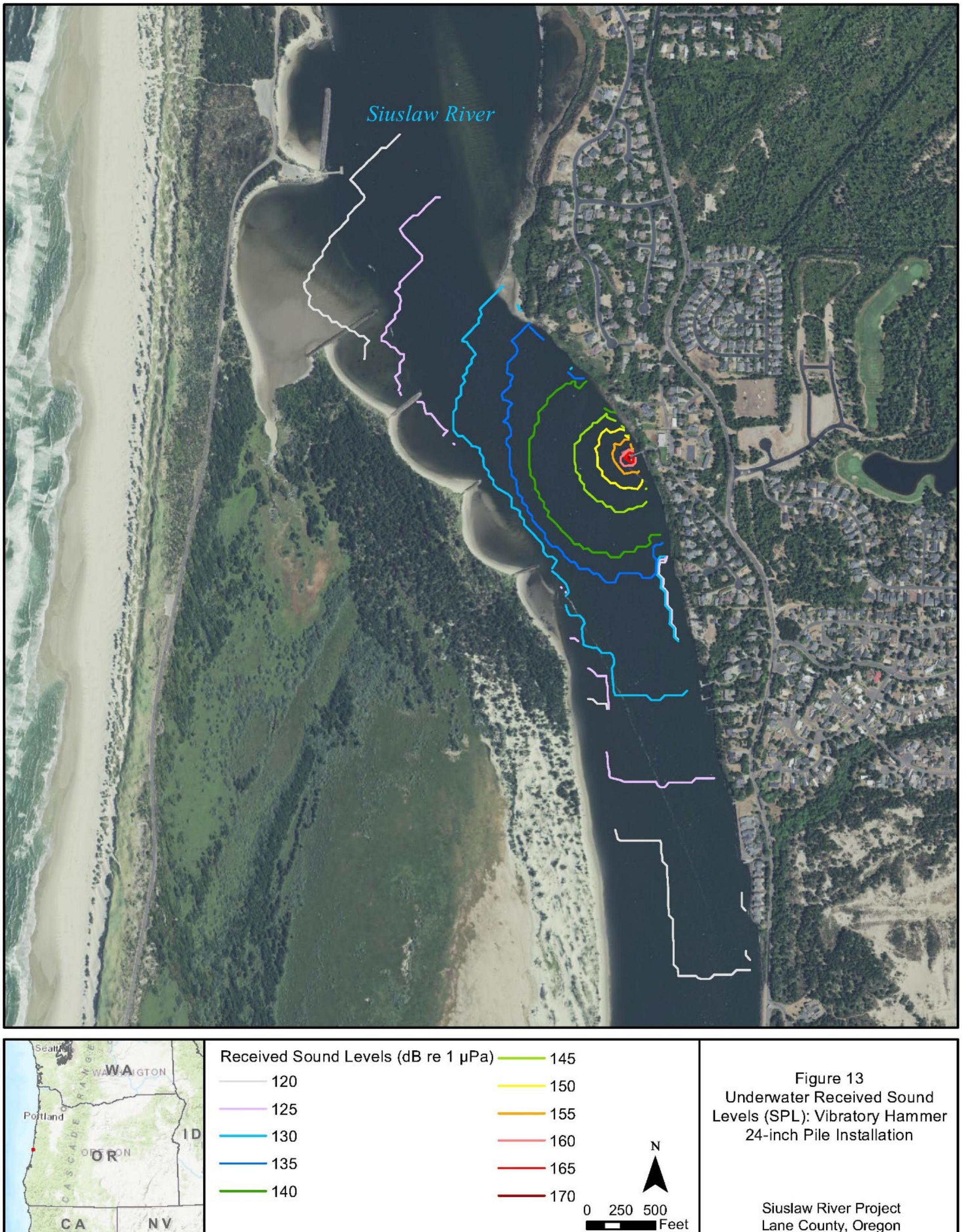

Figure 13
Underwater Received Sound Levels (SPL): Vibratory Hammer 24-inch Pile Installation

Siuslaw River Project
Lane County, Oregon

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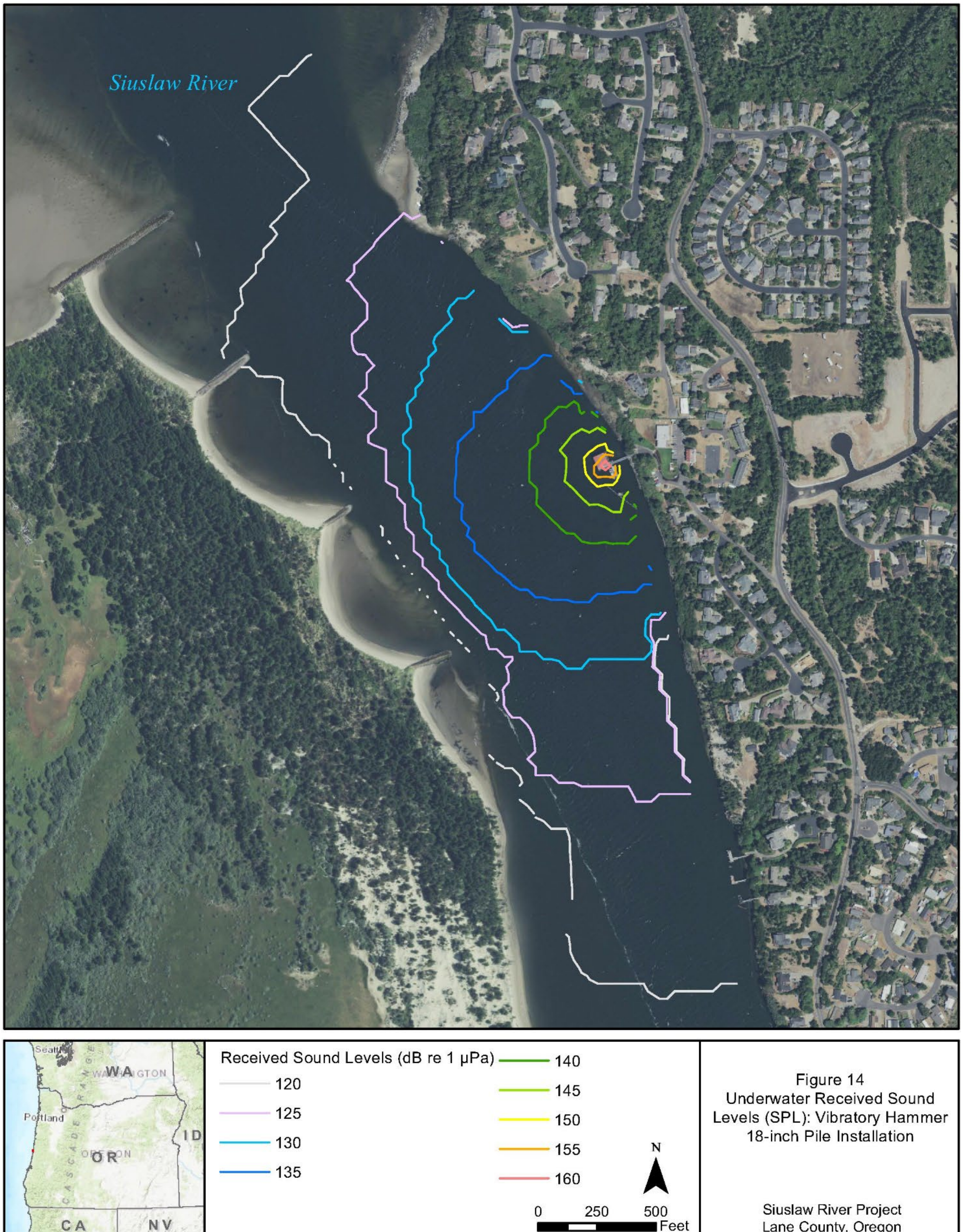

Figure 14
Underwater Received Sound Levels (SPL): Vibratory Hammer 18-inch Pile Installation

Siuslaw River Project
Lane County, Oregon

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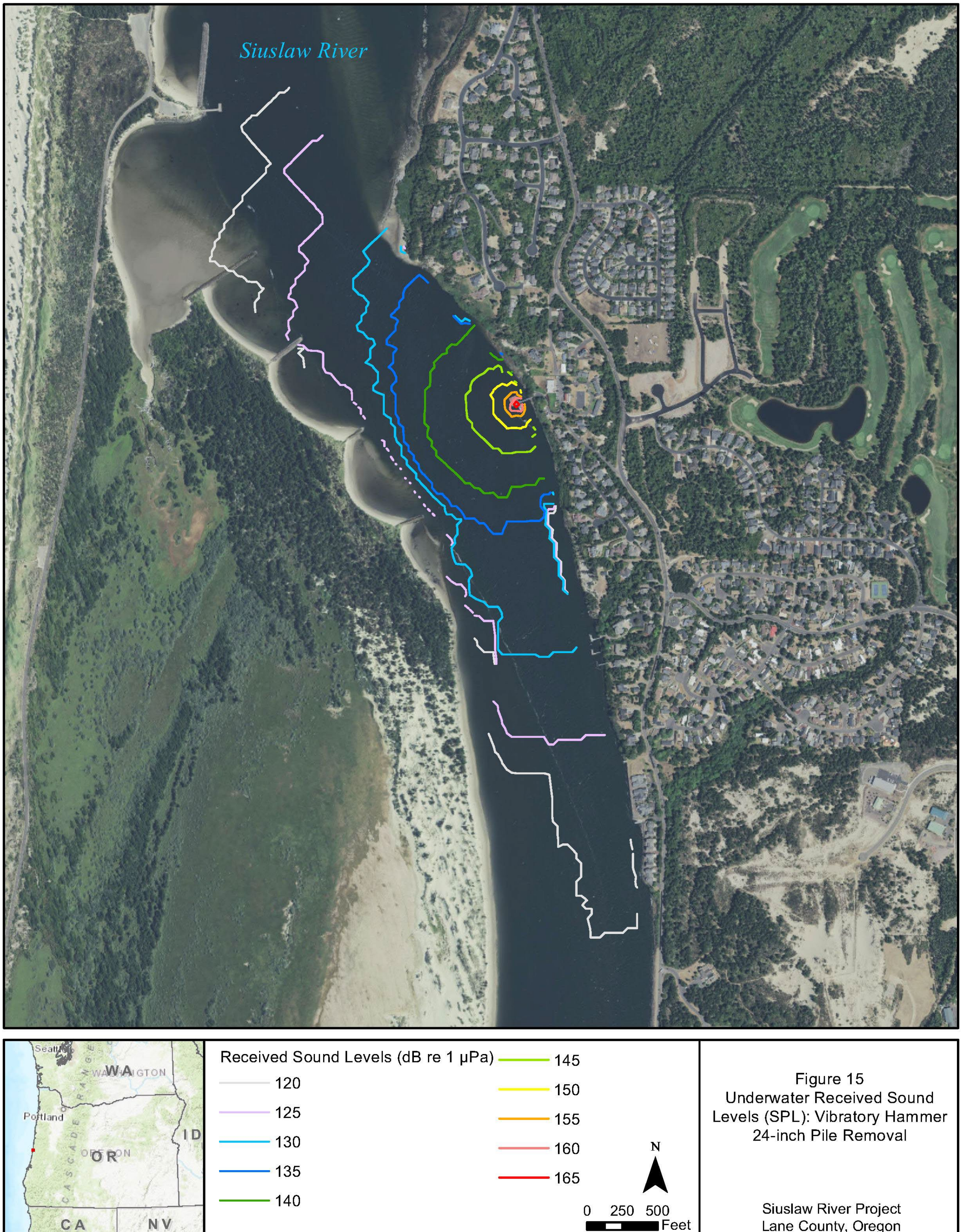

Figure 15
Underwater Received Sound Levels (SPL): Vibratory Hammer 24-inch Pile Removal

Siuslaw River Project
Lane County, Oregon

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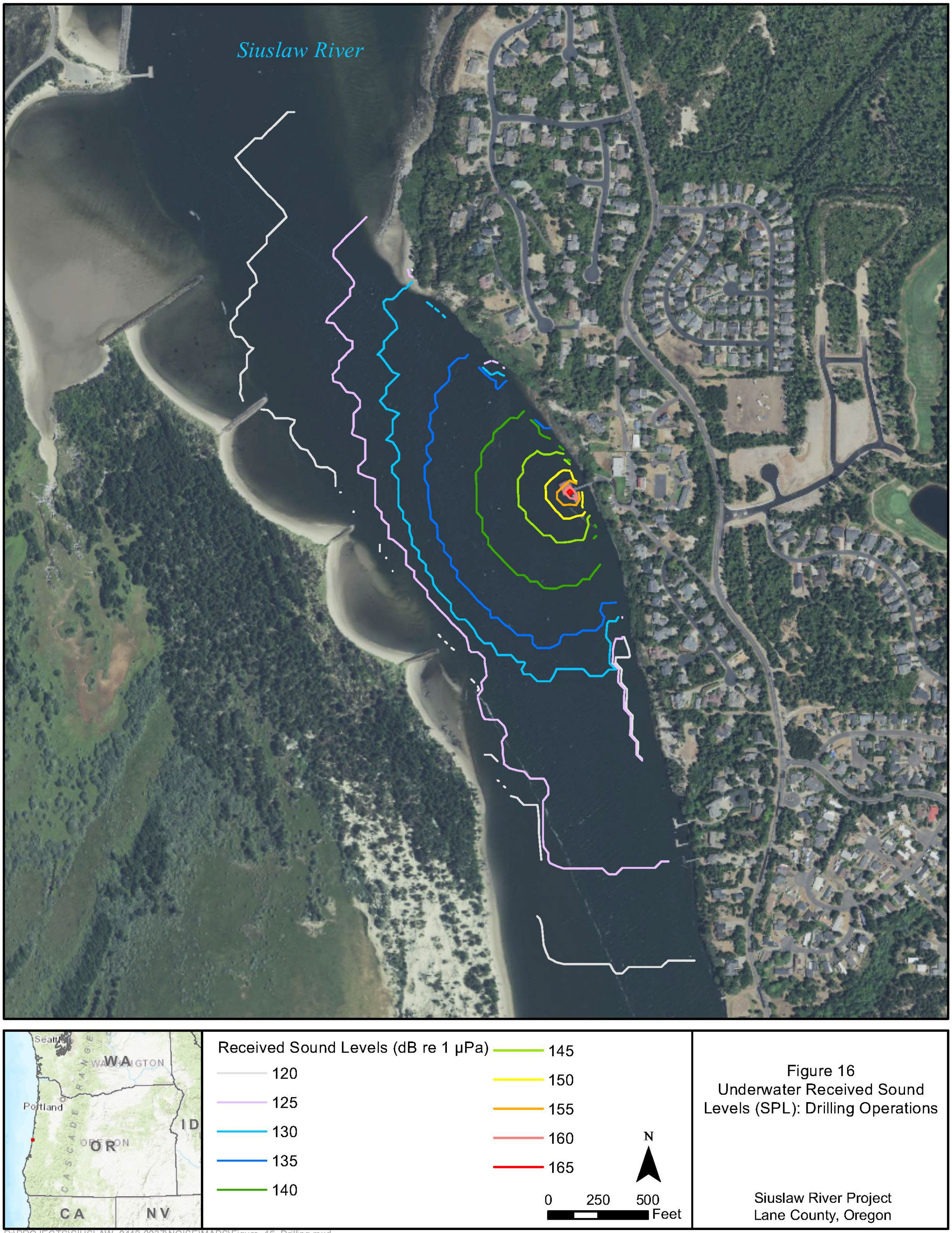

Figure 16
Underwater Received Sound Levels (SPL): Drilling Operations

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APPENDIX A: Summary of Acoustic Distances

IMPACT PILE DRIVING SUMMARY TABLES

Peak Sound Pressure Thresholds

Table A-1 Summary of $R_{95\%}$ ranges (in meters) to Lpk due to impact pile driving of 24-inch Pile

Attenuation (dB)	$L_{p,pk}$ dB re 1 µPa											
	232	230	226	220	219	218	213	210	207	206	202	200
0	0	0	0	0	0	0	4	7	9	14	20	25
5	0	0	0	0	0	0	0	2	5	6	9	16

Table A-2 Summary of $R_{95\%}$ ranges (in meters) to Lpk due to impact pile driving of 18-inch Pile

Attenuation (dB)	$L_{p,pk}$ dB re 1 µPa											
	232	230	226	220	219	218	213	210	207	206	202	200
0	0	0	0	0	0	0	0	3	6	7	14	17
5	0	0	0	0	0	0	0	0	0	2	6	8

Table A-3 Summary of $R_{95\%}$ ranges (in meters) to Lpk due to impact pile driving of H-Pile

Attenuation (dB)	$L_{p,pk}$ dB re 1 µPa											
	232	230	226	220	219	218	213	210	207	206	202	200
0	0	0	0	0	0	0	0	0	3	4	8	9
5	0	0	0	0	0	0	0	0	0	0	3	5

SPL Thresholds

Table A-4 Summary of $R_{95\%}$ ranges (in meters) to SPL due to impact pile driving of 24-inch Pile

Attenuation (dB)	L_p dB re 1 µPa								
	210	200	190	180	175	170	160	150	140
0	0	2	17	67	125	251	717	1305	1443
5	0	0	7	28	67	125	433	1051	1439

Table A-5 Summary of $R_{95\%}$ ranges (in meters) to SPL due to impact pile driving of 18-inch Pile

Attenuation (dB)	L_p dB re 1 µPa								
	210	200	190	180	175	170	160	150	140
0	0	0	0	14	23	49	194	560	1196
5	0	0	0	10	14	23	94	350	915

Table A-6 Summary of $R_{95\%}$ ranges (in meters) to SPL due to impact pile driving of H-Pile									
Attenuation (dB)	**L_p dB re 1 μPa**								
	210	**200**	**190**	**180**	**175**	**170**	**160**	**150**	**140**
0	0	0	0	6	16	26	110	387	997
5	0	0	0	0	6	16	55	226	632

SEL Thresholds (Unweighted)

Table A-7 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to impact pile driving of 24-inch Pile								
Attenuation (dB)	**$L_{E,24hr}$ dB re 1 μPa²·s**							
	220	**219**	**210**	**207**	**200**	**187**	**183**	**180**
0	0	0	9	17	43	249	387	510
5	0	0	4	7	21	124	224	326

Table A-8 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to impact pile driving of 18-inch Pile								
Attenuation (dB)	**$L_{E,24hr}$ dB re 1 μPa²·s**							
	220	**219**	**210**	**207**	**200**	**187**	**183**	**180**
0	0	0	0	3	15	83	138	214
5	0	0	0	0	11	40	74	102

Table A-9 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to impact pile driving of H-Pile								
Attenuation (dB)	**$L_{E,24hr}$ dB re 1 μPa²·s**							
	220	**219**	**210**	**207**	**200**	**187**	**183**	**180**
0	0	0	0	0	3	27	52	83
5	0	0	0	0	0	17	25	40

SEL Thresholds (Weighted)

Table A-10 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to impact pile driving of 24-inch Pile					
Attenuation (dB)	**$L_{E,24hr}$ dB re 1 μPa²·s**				
	LF 183	**HF 193**	**VHF 159**	**PW 183**	**OW 185**
0	386	43	319	243	90
5	215	23	225	115	53

Table A-11 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to impact pile driving of 18-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 µPa²·s				
	LF 183	HF 193	VHF 159	PW 183	OW 185
0	130	17	178	84	39
5	70	0	107	43	20

Table A-12 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to impact pile driving of H-Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 µPa²·s				
	LF 183	HF 193	VHF 159	PW 183	OW 185
0	50	0	91	34	17
5	24	0	56	18	0

VIBRATORY HAMMER SUMMARY TABLES

SPL Thresholds

Table A-13 Summary of $R_{95\%}$ ranges (in meters) to SPL due to vibratory hammer installation of 24-inch Pile

Attenuation (dB)	L_p dB re 1 µPa									
	210	200	190	180	175	170	160	150	140	120
0	0	0	0	0	0	2	21	77	216	1117
5	0	0	0	0	0	0	14	42	119	702

Table A-14 Summary of $R_{95\%}$ ranges (in meters) to SPL due to vibratory hammer installation of 18-inch Pile

Attenuation (dB)	L_p dB re 1 µPa									
	210	200	190	180	175	170	160	150	140	120
0	0	0	0	0	0	0	6	27	100	660
5	0	0	0	0	0	0	0	17	60	417

Table A-15 Summary of $R_{95\%}$ ranges (in meters) to SPL due to vibratory hammer removal of 24-inch Pile

Attenuation (dB)	L_p dB re 1 µPa									
	210	200	190	180	175	170	160	150	140	120
0	0	0	0	0	0	0	17	57	195	1106
5	0	0	0	0	0	0	6	27	105	702

SEL Thresholds (Unweighted)

Table A-16 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to vibratory hammer installation of 24-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 µPa²·s						
	220	219	210	200	187	183	180
0	0	0	0	19	90	139	204
5	0	0	0	8	52	88	107

Table A-17 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to vibratory hammer installation of 18-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 µPa²·s						
	220	219	210	200	187	183	180
0	0	0	0	5	42	66	90
5	0	0	0	0	21	35	52

Table A-18 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to vibratory hammer removal of 24-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 μPa²·s						
	220	219	210	200	187	183	180
0	0	0	0	4	30	57	89
5	0	0	0	0	18	27	44

SEL Thresholds (Weighted)

Table A-19 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to vibratory hammer installation of 24-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 μPa²·s				
	LF 197	HF 201	VHF 181	PW 195	OW 199
0	29	14	58	39	16
5	16	0	25	18	0

Table A-20 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to vibratory hammer installation of 18-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 μPa²·s				
	LF 197	HF 201	VHF 181	PW 195	OW 199
0	14	0	22	15	0
5	0	0	10	0	0

Table A-21 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to vibratory hammer removal of 24-inch Pile

Attenuation (dB)	$L_{E,24hr}$ dB re 1 μPa²·s				
	LF 197	HF 201	VHF 181	PW 195	OW 199
0	7	0	16	14	0
5	0	0	0	0	0

DRILLING OPERATIONS SUMMARY TABLES

SPL Thresholds

Table A-22 Summary of $R_{95\%}$ ranges (in meters) to SPL due to Drilling Operations

Attenuation (dB)	L_p dB re 1 μPa									
	210	200	190	180	175	170	160	150	140	120
0	0	0	0	0	0	0	14	39	144	701

SEL Thresholds (Unweighted)

Table A-23 Summary of $R_{95\%}$ ranges (in meters) to unweighted Cumulative SEL due to Drilling Operations

Attenuation (dB)	$L_{E,24hr}$ dB re 1 μPa²·s						
	220	219	210	200	187	183	180
0	0	0	0	14	61	98	144

SEL Thresholds (Weighted)

Table A-24 Summary of $R_{95\%}$ ranges (in meters) to Cumulative SEL for marine mammal functional hearing groups due to Drilling Operations

Attenuation (dB)	$L_{E,24hr}$ dB re 1 μPa²·s				
	LF 197	HF 201	VHF 181	PW 195	OW 199
0	16	26	16	0	0

APPENDIX B: Underwater Sound Propagation Modeling Inputs

Underwater Sound Propagation Modeling Methodology

Tetra Tech has developed a reliable and effective approach to evaluating underwater acoustic impacts from pile driving as well as other in-water activities. The underwater noise modeling methodology used to evaluate the Project pile driving activities is described below.

Underwater Sound Propagation Modeling

Tetra Tech uses dBSea for underwater sound propagation modeling. dBSea is a software program developed by Marshall Day Acoustics for the prediction of underwater noise. The three-dimensional model is built by importing bathymetry data and placing noise sources in the environment. Each source can consist of equipment chosen from either the standard or user-defined databases. Noise mitigation methods may also be included. The user has control over the seabed and water properties including sound speed profile ("SSP"), temperature, salinity, and current.

Noise levels are calculated throughout the entire Project Area and displayed in three dimensions. Levels are calculated in third octave bands. For the Project, two different solvers are used for the low- and high-frequency ranges:

- dBSeaModes (Normal Modes Method): The normal models are calculated for each water depth, based on sediment properties and water SSP. The sound field is calculated based on coupling between the calculated modes across the interfaces between different depths. The calculation is of the adiabatic, single forward scattering type. The overlying space is modelled as a vacuum. dBeaModes is suitable where the frequency is low and/or the water depth is shallow. The sediment layer is extended down well below the depth of the water column, with the attenuation rapidly increasing at the lowest depths. In this way, there are no modes where energy is reflected from the very bottom of the sediment layer (the space underneath the bottom of the sediment is also a vacuum).
- dBSeaRay (Ray Tracing Method): The dBSeaRay solver forms a solution by tracing rays from the source to the receiver. Many rays leave the source covering a range of angles, and the sound level at each point in the receiving field is calculated by coherently summing the components from each ray. This is currently the only computationally efficient method at high frequencies.

The specific parameters used in the modeling analysis are described below.

Calculation Grid and Source Solution Setup

The calculation grid and source solution setup are based on the resolution and extents of the bathymetry data. The calculations within dBSea are made along each radial for each range point and depth point. Radials are generated from the source location out to the extent of the bathymetry area. The range points are generated along each radial and are evenly spaced out (range step). However, this spacing does not change if the source is moved. The number of "Radial slices" and "Range points" are entered, which represents the number of radial solution slices for each source and the evaluation range points along those slices (Figure B-1). The range points are determined based on the width and length of the modeled area as well as the required range step resolution (Equation 1).

$$Range\ Points = \frac{\sqrt{Width^2+length^2}}{\text{Range Step}} \quad (5)$$

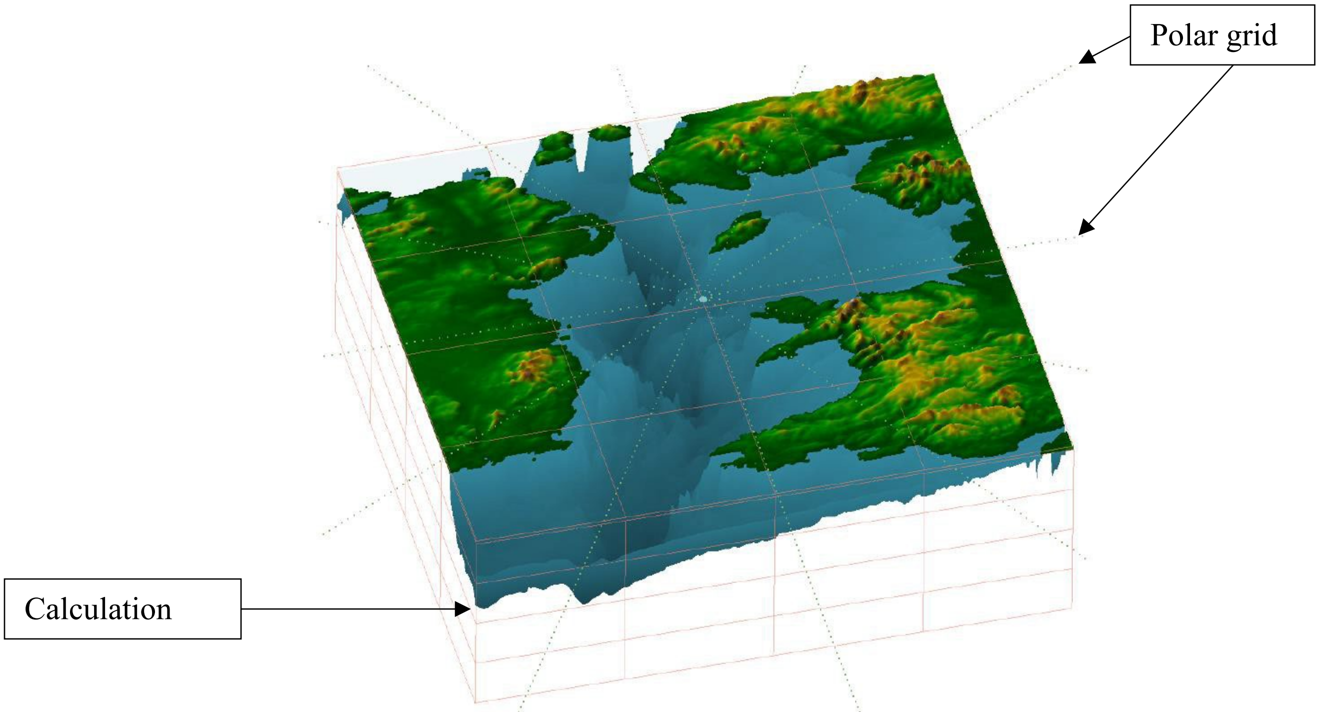

Figure B-1 Example Radial Solution Points

dBSea source solution calculations are completed along the radials (polar grid) based on the defined range and depth points. The calculation grid (cartesian) is filled from the polar grid using the nearest neighbor sampling, i.e., a point in the calculation results grid takes the value of the closest point in the polar grid. The calculation steps in dBSea are summarized below:

- Calculations are done in the polar grid (radials) at multiple depths, which are the same depths as the (cartesian) calculation grid.
- The calculation of the polar grid is smoothed with a triangular kernel, the width of which is selected by the user.
- The results of the cartesian grid is filled by the nearest neighbor sampling from the calculated polar grid using an inverse distance.

The more radials and range points used, the less interpolation needed for the cartesian grid. Because the calculation happens in the polar grid, while the results grid is cartesian, every point in the cartesian grid is "filled" depending on what point of the polar grid it is closest to (Figure B-2).

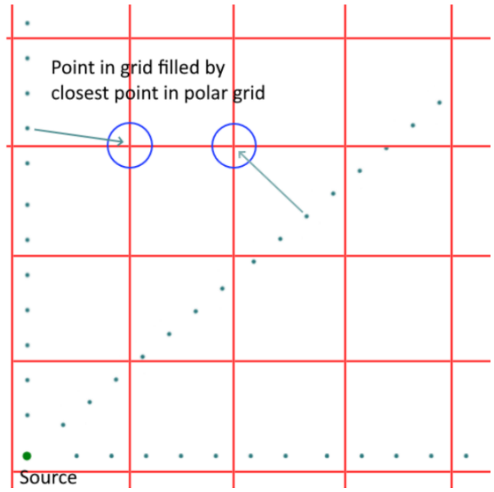

Figure B-2 Example Cartesian Grid Calculation

The underwater acoustic modeling analysis for the Project used a split solver, with dBSeaModes evaluating the 12.5 Hz to 1 kHz range and dBSeaRay addressing the 1.2 kHz to 20 kHz range. The radial resolution was 10-degree intervals to the extent of the bathymetry. The specific parameters used in the modeling analysis are described below.

Bathymetry

Bathymetry data for the Siuslaw River was obtained from the obtained from the United States Army Corps of Engineers (USACE) Hydrographic Surveys website provides a data base of bathymetry surveys for rivers and lakes. This data was combined with data from the National Geophysical Data Center and a US Coastal Relief Model (NOAA Satellite and Information Service 2020) to create a full model that covered a 7 km by 7 km total area. In the vicinity of the project area the water depth ranges from 0 to 2 meters near the shoreline and 5 to 10 meters near the center of the river.

Sediment Characteristics

The geoacoustic properties including compositional data of the surficial sediments were informed by site by site-specific geophysical and geotechnical data presented in the sediment characterization report (Shannon & Wilson 2018). The sediment profile is presented in Table 1. The geoacoustic properties given in Table 1 were directly input into dBSea for each defined sediment layer. Each sediment layer is entered directly into dBSea. The parameters entered for each sediment layer is bulleted below:

- Sediment layer depth (provided by the client)
- Material name (provide by the client)
- Speed of sound (meters/second)
- Density (kilograms per cubic meter)
- Attenuation (dB/wavelength)

The acoustic parameters (speed of sound, density, and attenuation) are typically taken from Jensen et al. (2011), Hamilton (1976, 1982), and Hamilton and Bachman (1982).

Table 2. Geoacoustic Properties of Sub-bottom Sediments as a Function of Depth

Depth	Speed of Sound	Geoacoustic Properties
0 to 10	Silt	Cp = 1575 m/s αs (dB/λ) = 1.0 dB/ λ ρ = 1700 kg/m³
10 to 20	Sand-silt	Cp = 1612 m/s αs (dB/λ) = 0.9 dB/ λ ρ = 1800 kg/m³
20 <	Sand	Cp = 1650 m/s αs (dB/λ) = 0.8 dB/ λ ρ = 1900 kg/m³

Sources: Shannon & Wilson 2018 and Jensen 2011

Speed of Sound Profile

Sound speed profile information for the year was obtained per month for the construction period. The speed of sound profile was obtained using the NOAA Sound Speed Manager software incorporating the World Ocean Atlas 2009 extension algorithms. Pile-driving will take place from November to February, and only taking place in the daytime. For the construction modeling scenarios, the average sound speed profile for the construction period was used in the model. The average sound speed profile was directly inputted into the dBSea model, and the input is shown in Figure B-3.

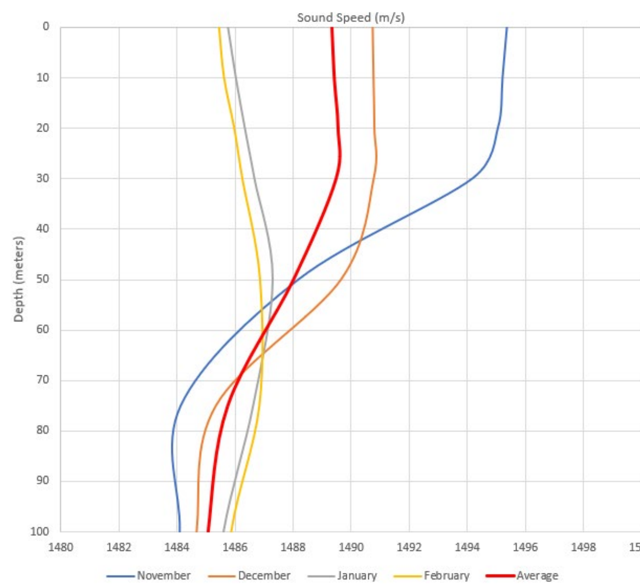

Figure B-3. Sound Speed Profile

Pile Driving Sound Source Characterization

The pile-driving sound source level was represented using three different metrics: peak sound level (“Lpk”), sound exposure level (“SEL”), and sound pressure level (“SPL”). The sound source spectrum is entered for each one-third octave band from 12.5 Hz to 20kHz.

For the Lpk underwater acoustic modeling scenario, the pile-driving sound source was represented as a point source at mid-water depth. The Lpk scenario evaluates a single pile-driving strike.

For the SEL underwater acoustic modeling scenario, the pile-driving sound source was represented by a moving source, which accounts for the speed of sound of steel for the pile itself. The pile-driving scenarios were modeled using a vertical array of point sources spaced at 0.5-meter intervals. Using the SEL level calculated by the empirical model, the SEL sound source is calculated using the following equation to distribute the sound emissions across the vertical array:

$$L_{E,N} = L_{E,\,1\,strike} + 10Log(N) \qquad (6)$$

Where: N is the number strikes

$L_{E,\ 1\ strike}$ is obtained from CALTRANS published data (CALTRANS 2020)

The SPL underwater acoustic modeling scenario is set up identical to the SEL underwater acoustic modeling scenario. The difference regarding the SPL underwater acoustic modeling scenario is that the total number of anticipated pile-driving blows in the 24-hour assessment period is not incorporated into the calculation. For the SPL underwater acoustic modeling scenario, only a single pile-driving strike is evaluated.

Vibratory Hammer and Dredging Sound Source Characterization

The vibratory hammer and dredging sources were modeled as a point source at mid-water depth. The source spectrums were entered for each one-third octave band from 12.5 Hz to 20 kHz.

Time Domain Considerations

Tetra Tech also recognizes the effect time has on pile driving sound. As Bellman (2020) reports, the noise of a single strike is thus temporally stretched with increasing distance. Additionally, the amplitude decreases steadily with the distance to the source, so that the signal-to-noise-ratio continuously decreases. Figure 5 from Bellman (2020) illustrates the change in signal over time.

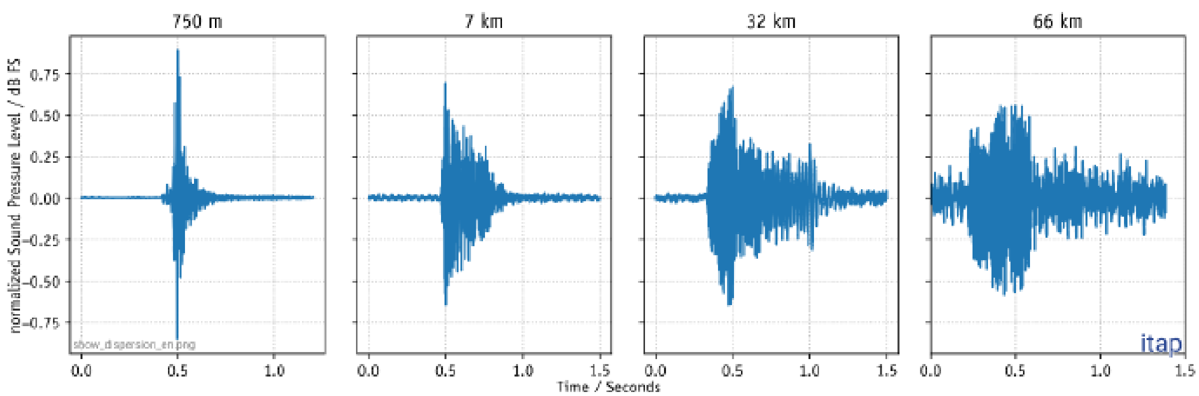

Figure 5. Time signal of a single strike, measured in different distances to the pile-driving activity (Bellman 2020)

The L_{PK} levels tend to decrease faster than the SEL sound levels as the propagation occurs. There are mixed views on whether the impulsivity of signals decrease over time, suggesting that non-impulsive limits should be applied to assess underwater acoustic impacts. While impulsivity may decrease, it is still observed that the rise times associated with impulsive signals are maintained (Martin et al. 2020). This is especially true when considering the narrow temporal windows (high temporal resolution) of many cetaceans and after application of weightings, excluding lower frequencies.

dBSea can account for the effects of the time domain using two different mechanisms. If time series information is available for use in the modelling analysis, it can be directly loaded into dBSea and used as sound source. The gaussian beam raytracer (dBSeaRay) will calculate the paths and arrival times from the source to all receiver points in the scenario for all the rays emitted from the source. At every receiver point, the transmission loss, phase inversion from the surface, loss to the sediment, and time of arrival is stored. This information is used to convolve all ray-arrivals into a single signal at that point. This means that each receptor point will receive a signal from many perceived origins and at various arrival times

(depending on the length of the path travelled). This tends to "smooth" out and stretch the received signal at greater ranges or with more reflections.

Alternatively, if time series data are not known or available, dBSea can include a crest factor, which is a way to incorporate impulsiveness information into the source. The crest factor indicates the dB level above the rms level of the highest peak in the signal. It is applied when assessing peak levels and is applied to all frequency bands. Application of the crest factor is generally expected to yield more conservative results relative to using a time series for characterizing pile-driving sound source levels. Since time series data for the Project's pile-driving activities were not available at the time of the modelling analysis, Tetra Tech used the conservative crest application methodology.

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