REQUEST FOR INCIDENTAL HARASSMENT AUTHORIZATION UNDER THEMARINE MAMMAL PROTECTION ACT FOR THE KING PILE MARKERS PROJECT

COLUMBIA RIVER IN WASHINGTON AND OREGON

Submitted to:
Office of Protected Resources
National Marine Fisheries Service
National Oceanographic and Atmospheric Administration

AUGUST 2, 2019
U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT
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1.0 Description of Specified Activity

1.1 Introduction

The U.S. Army Corps of Engineers, Portland District (Corps) proposes to repair or replace up to ~~80~~ 70 king pile markers at 75 pile dike sites in the Columbia River system, which lie in both Oregon and Washington between river miles (RM) 41 and 137 (see Figure 1~~Figure 1~~). The existing king piles that require replacement are not functioning as intended, to be an aid to navigation by helping mariners avoid pile dikes during high water. Detailed maps of the individual pile dike fields needing king pile replacement are presented in appendix A of this report. This lack of visibility poses a safety concern to both recreational and commercial boaters along the Columbia River. Current king piles are either damaged, degraded to a point where they no longer provide a visual identifier, or missing completely. Replacement of the existing king piles will improve visibility of pile dikes and improve safety for Columbia River traffic.

Proposed repairs involve the driving and removal of piles using either vibratory or impact hammers. Pile driving is the primary activity of this repair, and the subject of this Incidental Harassment Authorization (IHA) request. The proposed project will occur in waters that support several marine mammal species. The Marine Mammal Protection Act of 1972 (MMPA) prohibits the taking of marine mammals; take is defined as to "harass, hunt, capture or kill, or attempt to harass, hunt, capture or kill," except under certain situations. Section 101 (a)(5)(D) allows for the issuance of an IHA, provided an activity results in negligible impacts on marine mammals and would not adversely affect subsistence use of these animals.

The project's timing and duration, and specific types of activities (such as pile driving) may result in the incidental taking by harassment (Level B take) of marine mammals protected under the MMPA. USACE Portland District is requesting an IHA for three marine mammal species: harbor seal (*Phoca viutlina*), Steller sea lion (*Eumetopias jubatus*), and California sea lion (*Zalophus californianus*) that may occur in the vicinity of the project. The 14 requested components of this application, as set out by 50 CFR 216.104, Submission of requests, are provided in Sections 1 through 14 below.

1.2 Project Purpose and Need

The Corps maintains pile dike fields and other in-water hydraulic control structures to improve navigation and reduce maintenance dredging. Pile dikes are permeable groins extending into the river and consist of two rows of untreated timber piling driven on 2.5-ft centers alternately placed on each side of horizontal spreader piles and tied together. Pile dike construction was initiated in 1885 in the lower Columbia River and most of the present-day dike system was built between 1917 and 1923 and between 1933 and 1939. There are currently 256 pile dikes, totaling 240,000 linear ft, in the existing dike system. Due to funding limitations, regular maintenance of these pile dikes has been proportionately limited.

The purpose of the Proposed Action is to repair and replace the missing king pile markers, to visibly distinguish associated pile dikes that may be inundated during high river levels.

Proposed repairs are needed to reduce risks to mariners navigating the lower Columbia River, while maintaining the federal navigation channel. Throughout its history this reach of the Columbia has provided a vital corridor for trade and travel, as it is one of the few rivers to penetrate the Cascade Mountains and provide access to the interior West.
In 2017, the Columbia & Lower Willamette Federal Navigation Channel was used to transport 47.5 million tons of cargo valued at $16 billion. The Columbia River is the nation's largest wheat export gateway and the third largest grain export corridor in the world.

Tonnage amounts refer to USACE Waterborne Commerce Statistics Center (WCSC) data for the Columbia & Lower Willamette Rivers below Vancouver, Washington and Portland, Oregon waterway as processed by the USACE Channel Portfolio Tool (CPT). Cargo values are estimated by the CPT based on the WCSC tonnage amounts multiplied by the national average commodity unit price ($ per ton) data derived from USA Trade Online.

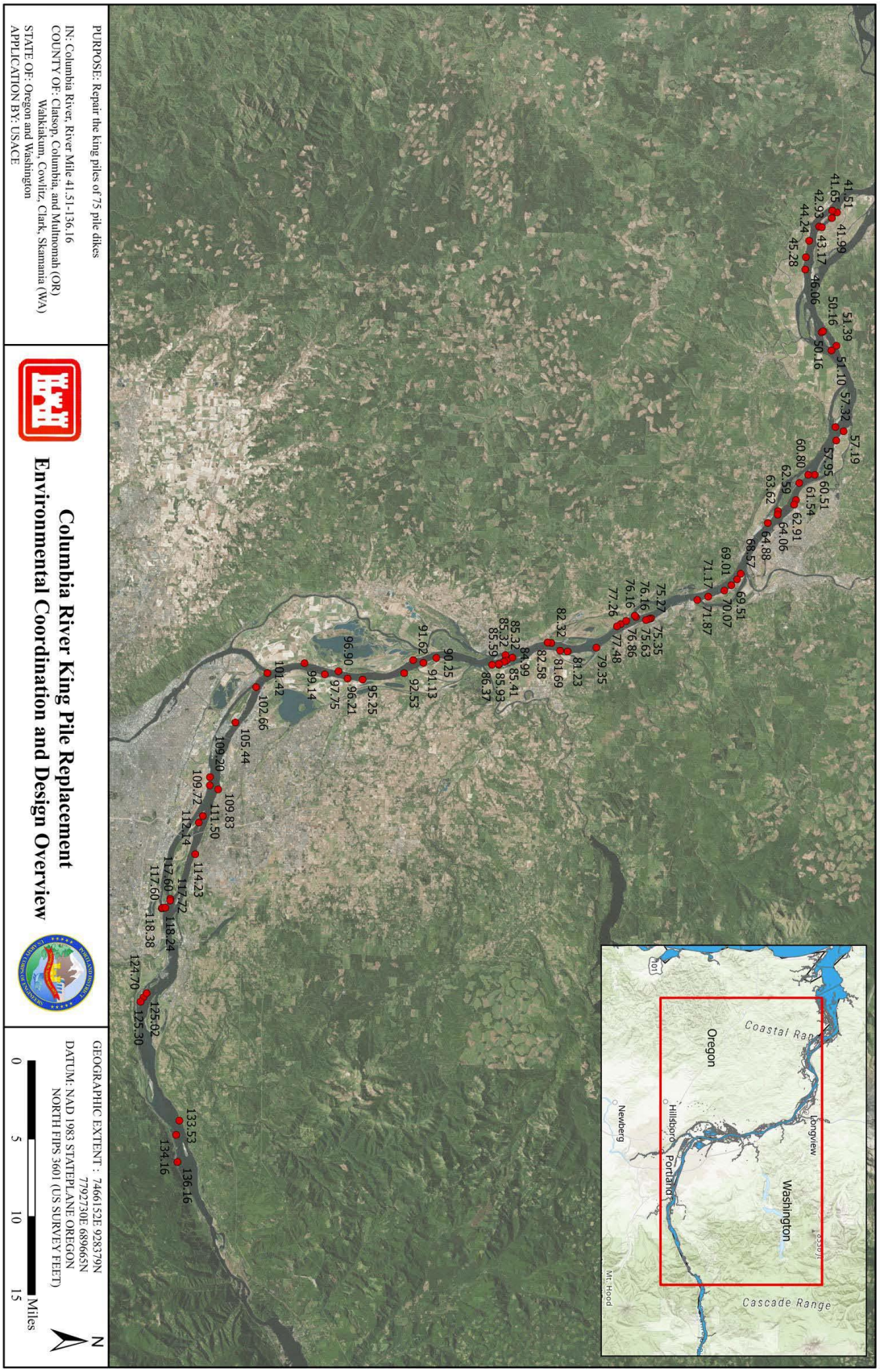

Figure 1. Overview map.

1.3 King Pile Markers (existing conditions)

King pile markers consist of one or more tall piles (up to about 20 feet above the Columbia River low water datum) marking the end of a pile dike for navigational safety (see Figure 2~~Figure 2~~). King piles were originally constructed as part of a cluster of piles called an outer dolphin. Columbia River pile dikes are permeable groins extending into the river and consist of two or three rows of vertical untreated timber pilings driven in staggered rows of 5-foot centers alternately placed on each side of horizontal spreader piles and fastened together. Rock placed at the base of the piles and at the shore connection help protect against scour. The purpose of pile dikes is to improve the conditions for navigation and reduce maintenance dredging in the federal channel.

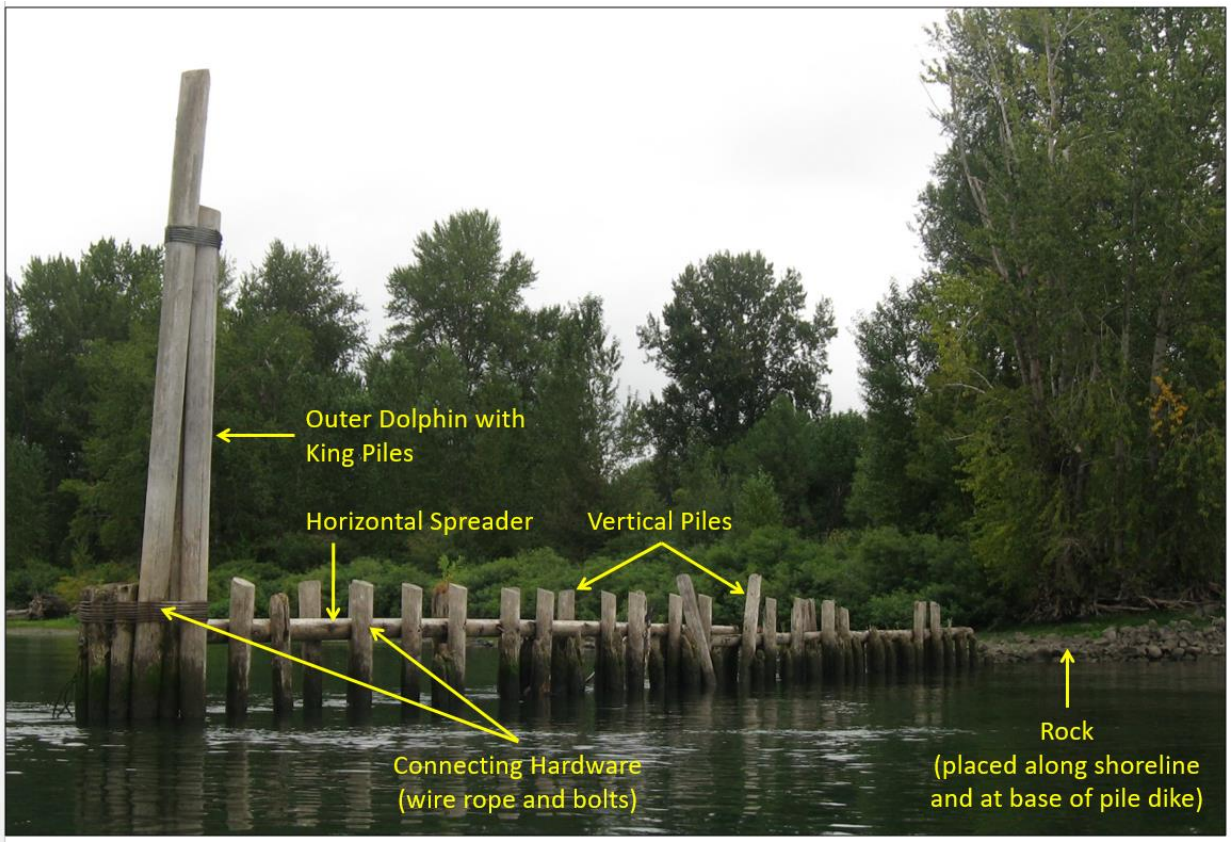

Figure 2. General features of existing Columbia River pile dikes.

Pile dikes in the Columbia River have deteriorated over time due to lack of maintenance. King pile markers, and in some cases outer dolphin clusters, have been damaged or are missing (see Figure 3~~Figure 3~~ for example of damaged pile dike). Pile dikes without king piles pose a navigational safety concern because submerged structural features are left unmarked and are not visible to mariners. The scope of this project is to replace king pile markers so the pile dikes are once again visually marked for navigational safety.

Figure 3. Pile dike missing king pile marker and outer dolphin.

Existing condition of the outer dolphin clusters vary where king piles are missing, along with the thickness of the scour protection rock at the base of pile dikes which depends on the depth of water during the original construction. The existing depth (relative to Columbia River low water datum) at the locations of missing king pile markers varies from less than 10 feet to greater than 30 feet, but is generally in the 20-30 foot range, possibly indicating scour protection rock thicknesses of up to 10 feet. Individual rock sizes are estimated to be between 1 to 2 feet in diameter. Below the scour protection rock, the river bed deposits consist of fine to medium-grained sand.

1.4 Construction Methods

Construction will consist of removing existing timber piles where necessary, driving new replacement piles, and adding scour protection rock around new piles as needed.
Each replacement king pile marker will consist of a single steel pipe pile of up to 24-inch diameter. Piles will be driven up to 30-35 feet of embedment. If piles cannot be driven through the existing scour protection rock, the marker will be offset. Scour protection rock (less than 25 cubic yards) may be placed around the base of any offset piles. The total estimated quantity of piles needed for this project is ~~80~~ 70 piles.

Figures 4-6 illustrate the general king pile marker design:

Figure 4~~Figure 4~~ depicts a single vertical marker. This single pile may be driven within or adjacent to an existing outer dolphin cluster of timber piles or as a stand-alone pile, if the outer dolphin cluster is missing.

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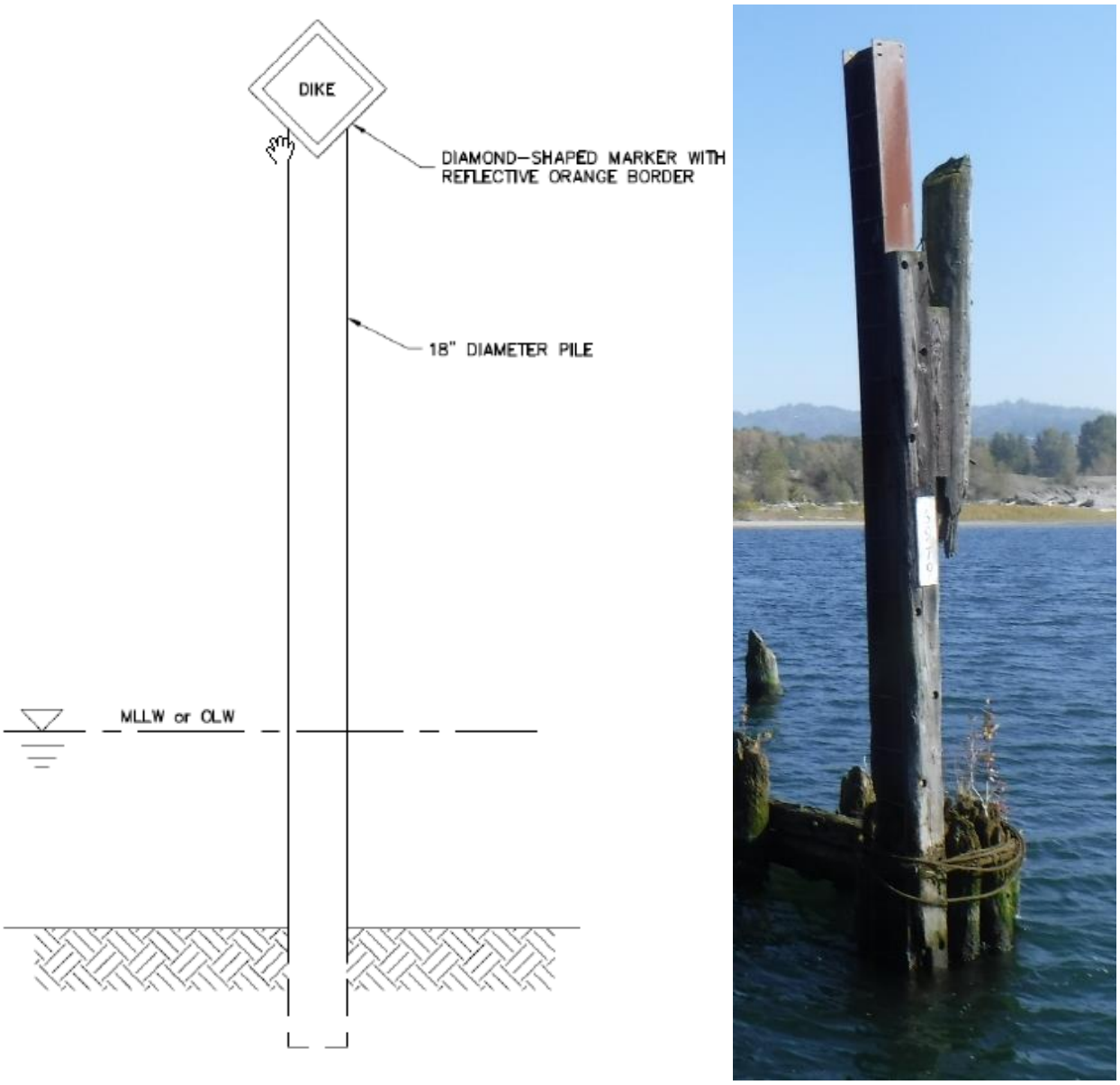

Figure 4. Single vertical timber, steel pipe pile, or steel H-pile marker configuration.

Barges will transport all materials (new piles, and scour protection rock) to and from the site and serve as staging platforms during construction. Barges will be moved by tugboats, then spudded or anchored into position.

At each king pile marker, piles will be installed using vibratory drivers (e.g., APE Model 200 vibratory driver or equivalent) and/or impact hammers (D-46-42 diesel impact hammer or equivalent) operated from a barge-mounted crane. Vibratory driving is the preferred method; however, impact driving may be necessary if piles cannot be driven to the necessary embedment depth using the vibratory method. Under the SLOPES IV BiOp (NMFS 2012a), impact driving

in the Columbia River is only allowed during the month of November, and must use an acoustic attenuation device (e.g., a bubble curtain). Piles are generally installed by a rig that supports the pile leads, raises the pile, and operates a driver (Figure ~~Figure 5~~). Driving shoes may be used.

Figure 5. Potential construction assembly for pile installation (Figure from Advanced American Construction).

If needed, placement of new scour protection rock at the base of the king pile marker will occur by means of a barge-based excavator and/or crane with a bucket that picks up rock from the materials barge and deposit it at the base of the king pile marker.

In the event that unusually difficult driving conditions are encountered, the contractor may temporarily excavate the minimum amount of existing scour protection rock needed (less than 25 CY) in order to drive the new pile. Excavation would occur by means of a barge-based excavator and/or crane with a bucket. The contractor will then reinstall the rock to provide scour protection for the new pile.

If it is necessary to impact-drive steel piles, a confined bubble curtain (e.g., a bubble ring surrounded by a non-metallic sleeve) will be employed to reduce underwater noise levels.

It is estimated that each pile will take up to one hour to install using vibratory methods with 30 minutes of that time being actual driving of the pile. Given the greater noise levels associated with impact pile driving, we estimate the maximum potential acoustic disturbance based on this method. Whether impact or vibratory methods are employed, one pile will be installed per pile dike location per day. Depending on weather and other logistical constraints, piles will be installed at up to 9 locations per day. For piles driven with an impact hammer, there are an estimated 550 strikes per pile, assuming a hammer energy rating of 55,000 ft-lbs and piles being driven through a combination of sand and rock (Bainbridge Island Ferry Terminal, WSDOT 2018a, 2018b). Actual pile driving rates will vary, and a typical day will likely involve fewer locations and fewer strikes.

The contractor may use multiple pile-driving and material barges to facilitate completion of work within the in-water work window. However, concurrent work will not occur in close enough proximity to cause overlapping noise disturbance isopleths. The minimal distance between work platforms will be based on the Level B disturbance zone corresponding to the method of pile driving (i.e., vibratory or impact) such that there would be no overlap in disturbance areas.

1.5 Acoustic Sources

The replacement of king piles has acoustic sources typical of in-water pile driving construction activities. Our analysis relies on past project analogues where acoustic monitoring and data collection were performed to estimate noise levels generated by the most likely construction methods and materials (Table 1). However detailed information is only provided for 24" steel shell vibratory driving and impact driving with attenuation are provided as an appendix to this application. This is the construction method with the highest noise levels and potential for effect.

Table 1. Construction Methods and Analogs

Material	Driving Method	Analog
24" Steel Pipe Pile	Impact/Attenuated	CalTrans 2015 Table I.2-1. Summary of Near-Source (10-Meter) Unattenuated Sound Pressure Levels for In-Water Pile Driving Using an Impact Hammer: 0.61-meter (24-inch) steel pipe pile in water ~15 meters deep w/ 7dB reduction for use of attenuation (as per Pauline, 2019 pers. Comm).
24" Steel Pipe Pile	Vibratory/Un-attenuated	From United States Navy. 2015. Proxy source sound levels and potential bubble curtain attenuation for acoustic modeling of nearshore marine pile driving at Navy installations in Puget Sound. Revised January 2015. Table 2-2.
15" Thick Walled Steel "H" Piling	Impact/Attenuated	Breakwater Construction at Ballena Isle Marina—Alameda, CA (I.4.3, CalTrans 2015)
12" Timber Pile	Impact (3,000 # drop hammer)	Port of Benicia, Benicia, CA (I.7.2, CalTrans 2015)
12" Timber pile	Vibratory	Naval Station Norfolk in Norfolk, Virginia (I.7.3, Caltrans 2015)

1.5.1 In-air Noise

As described above, no construction would occur on land. All repair work would occur in the Columbia River from barge-mounted cranes. Although test pile installation would result in some airborne noises, in-air noise was not a factor in assessing take because the Level B Zone of Influence (ZOI) for underwater noise extends farther. We assume any marine mammals impacted by noise is accounted for during the in-water noise assessment and therefore not subject to additional in-air take. Because of this in air noise levels are not discussed further in the analysis.

1.5.2 In-water Noise

Ambient in-water sound in the Proposed Action Area is affected by many factors including: wind and waves from the Pacific Ocean, commercial and recreational vessel use, sounds from resident aquatic animals, nearby landmasses, the ocean floor, currents, etc. A recent study of ambient ocean sound for Oregon's nearshore environment observed maximum and minimum levels of 136 dB referenced to a standard pressure level of one micro Pascal (re 1 µPa) and 95 dB re 1 µPa, respectively, with an average level of 113 dB re 1 µPa over a period of one year (Haxel et al. 2011). This level could vary given different recreational and commercial vessels; up to 150 dB for smaller fishing vessels (Hildebrand 2005), up to 186 dB for large vessels, 81 to 166 dB for empty tugs and barges and up to 170 dB for loaded tugs and barges (Richardson et al. 1995) within the frequencies between 20 and 5000 hertz (Hz). Dolphins and toothed whales produce broadband clicks of 125 to 173 dB within frequencies between one kilohertz (KHz) and 200 KHz and humpback whale songs can range between 144 and 174 dB (DOSITS 2012).

Pile driving for test piles may be done with either vibratory or impact hammer, but due to anticipated enrockment surrounding existing piles, impact hammers will likely be used. Pile driving noise will be intermittent, but could temporarily disturb marine mammals. Estimated in-water sound levels anticipated from vibratory installation and impact hammer installation of steel pipe piles are summarized in Table 2~~Table 2~~.

Table 2. Estimated Underwater Sound Pressure Levels Associated with Vibratory Pile Driving and Impact Hammer Pile Driving

Pile Type	Sound Pressure Level (SPL) (single strike)		
24-Inch Steel Pipe Piles w/impact hammer (attenuated)[1]	200 dB_{PEAK}	187 dB_{RMS}	171 dB_{SEL}
24-Inch Steel Pipe Piles w/vibratory (unattenuated)[2]	Not Available	161 dB_{RMS}	Not Available

[1] From Caltrans (2015) Acoustic data from CalTrans 2015 Table I.2-1. Summary of Near-Source (10-Meter) Unattenuated Sound Pressure Levels for In-Water Pile Driving Using an Impact Hammer: 0.61-meter (24-inch) steel pipe pile in water ~15 meters deep, w/ 7dB reduction for use of attenuation (as per NMFS 2019 pers. Comm).

[2] From United States Navy. 2015. Proxy source sound levels and potential bubble curtain attenuation for acoustic modeling of nearshore marine pile driving at Navy installations in Puget Sound. Prepared by Michael Slater, Naval Surface Warfare Center, Carderock Division, and Sharon Rainsberry, Naval Facilities Engineering Command Northwest. Revised January 2015. Table 2-2.

1.6 Best Management Practices, Mitigation and Impact Minimization Measures

General BMPs, mitigation and minimization measures that may be implemented for the project are described in Section 11 of this application.

2.0 Dates and Duration, Specified Geographic Region

2.1 Dates and Duration

Pile installation would be done during the 2019 in-water work window of 01 October through 30 November. Impact driving will only take place in November, as per NMFS 2012 SLOPES IV programmatic Biological Opinion. Since the pile driving in-water work window is approximately 61 days and pile installation activity could potentially occur on each day of that window, it is estimated that the project could require up to 61 days of in-water work in 2019. Pile installation will be conducted during standard daylight working hours, up to 12 hours a day. The contractor may request to run more than one floating plant/driver simultaneously, however, there would be no overlap in Level B disturbance areas. In this instance, the overall duration of the project could decrease, but the amount of work and associated potential for take would remain the same.

2.2 Specified Geographic Region

Construction sites are in the Columbia River system and lie in both Oregon and Washington (see Figure 1. Overview map.~~Figure 1. Overview map.~~). Pile dikes span between river miles (RM) 41 and 137.

3.0 Marine Mammal Species and Numbers

We identified approximately 3 species that have the potential to occur in the Columbia River system during project construction (Table 3~~Table 3~~). Marine mammals are, to varying degrees, susceptible to Level B (i.e., behavioral disturbance or temporary hearing threshold shift) harassment and the more severe Level A (i.e., non-serious injury or permanent threshold shift) harassment. Table 4~~Table 4~~ outlines the sound thresholds for each marine mammal group. We use this information in Section 4.0 to help assess the potential effects of proposed construction activities on species likely to be encountered in the project vicinity.

Table 3. Marine Mammal Species in the Vicinity of the lower Columbia River.

Species and Marine Mammal Group[1]	Estimated Stock(s) Abundance[2]	ESA* Status	MMPA** Status	Frequency of Occurrence[3]	Distribu-tional Range
Phocid pinnipeds					
Harbor seal (*Phoca vitulina richardii*) Oregon and Washington Coast Stock	24,732 (CV= 0.12)	Not listed	Non-strategic	Likely	Continental shelf (coastal and estuarine)
Otariid pinnipeds					
Steller sea lion (*Eumetopias jubatus*) Eastern U.S. Stock	16,318 – 23,309 pups; 45,428 – 59,711 non-pups	Not listed	Not depleted; Non-strategic	Seasonal (Sept – May)	Continental shelf
California sea lion (*Zalophus californianus*) U.S. Stock, Pacific Temperate Population	296,750	Not-listed	Not depleted; Non-strategic	Seasonal[4] (Sept – May)	Continental shelf

[1]Marine Mammal Groups distinguished by cell color as follows:

Phocid pinnipeds (PW)	Otariid pinnipeds (OW)

[2]NOAA/NMFS 2014 and 2018 marine mammal stock assessment reports. These annual stock assessment reports by region are available at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region; Stock assessment reports by species (e.g., *E. jubatus*, *O. orca*) are available at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock

[3]Frequency defined here in the range of:

- Rare – Few confirmed sightings, or the distribution of the species is near enough to the area that the species could occur there.
- Infrequent – Confirmed, but irregular sightings.
- Likely – Confirmed and regular sightings of the species in the stock area year-round.
- Seasonal – Confirmed and regular sightings of the species in the area on a seasonal basis.
- Unknown – Insufficient data to assess patterns in occurrence

[4]Although the largest influx of California sea lions occurs seasonally, there is some evidence that a few males may remain in Oregon throughout the year (Mate 1973)

Table 4. Marine Mammal Hearing Groups, Hearing Range, and Level B Disturbance Thresholds* Level B = behavioral disturbance or temporary hearing threshold shift.

Hearing Group	Generalized Hearing Range	In-Air Noise	Underwater Noise	
			Vibratory	Impulse
Phocid pinnipeds (PW) (true seals)	50 Hz – 86 kHz	90 dB	120 dB	160 dB
Otariid pinnipeds (OW) (sea lions and fur seals)	60 Hz – 39 kHz	100 dB	120 dB	160 dB

*All thresholds reported as the root mean square (RMS) sound pressure level (SPL_{RMS}) and decibels are referenced to 1 micro Pascal (1µPa); Reference: NOAA West Coast Fisheries (online guidance, accessed 03 January 2019) https://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

Table 5. Marine Mammal Hearing Groups and Level A Underwater Injury[1] Thresholds Level A = non-serious injury or permanent threshold shift.

Hearing Group	Vibratory	Impulse
	SEL_{cum}[2]	SEL_{cum}[2]
Phocid pinnipeds (PW) (true seals)	201 dB	185 dB
Otariid pinnipeds (OW) (sea lions and fur seals)	219 dB	203 dB

[1] Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2018)
[2] Cumulative sound exposure level (SEL_{cum}) for weighted permanent threshold shift (PTS) onset

4.0 Affected Species Status and Distribution

The species described in Section 4 include those who have some potential to be affected by the proposed action in Section 1.2. Proposed pile driving will take place in October and November, minimizing potential impacts to marine mammals that occur in the area seasonally. All stock estimates (Table 3) were derived from NOAA/NMFS most recent marine mammal stock assessment reports.

4.1 Steller Sea Lion (SSL)

Stellar sea lions (*Eumetopias jubatus*) are currently the most common marine mammal observed in the proposed action area. They are frequently observed between the river's mouth (RM 0) and the Bonneville Dam tailrace (RM 146). During the August – December monitoring period the number of individuals observed at Bonneville, and the arrival their timing, has been increasing and advancing respectively for the past decade. The maximum number of individuals observed during daily counts was 56 in 2016 (Tidwell et al. 2019). The Bonneville dam observation area is approximately 10 miles upstream of the nearest planned activity under this IHA.

The Columbia River South Jetty is the nearest major haulout in the lower river and is approximately 40 miles from the nearest pile driving activity for this project. Though it is frequently used by Steller sea lions for hauling out it is not designated critical habitat. Use occurs chiefly at the concrete block structure at the terminus, or head of the jetty, and at the emergent rubble mound comprised of the eroding jetty trunk near the terminus. California sea lions also use this area and can intermingle with Steller sea lions. Steller sea lions appear to out-compete California sea lions for the preferred haul out area.

4.2 California Sea Lion (CSL)

The population size of the U.S. stock of California sea lions (*Zalophus californianus*) is estimated at 296,750 animals (NOAA 2014).

As with Steller sea lions, according to ODFW (2014) most counts of California sea lions are also concentrated near the tip of the jetty, although sometimes haul out about halfway down the jetty. ODFW survey information (2007 and 2014) indicates that California sea lions are relatively less prevalent in the Pacific Northwest during June and July, though in the months just before and after their absence there can be several hundred using the South Jetty. More frequent WDFW surveys (2014) indicate greater numbers in the summer, and use remains concentrated to fall and winter months. Nearly all California sea lions in the Pacific Northwest are transient sub-adult and adult males, as females and young generally stay in California (ODFW 2014).

Although coast wide the population has grown, the numbers seen in the river and upstream at Bonneville dam during both the spring and fall/winter observation periods have decreased since 2003 (Figure ~~Figure 8~~). This may be in due to the California sea lion management activities that have been implemented to reduce their predation rates on salmon and steelhead. These activities include hazing of all California sea lions near the dam and fish ladders, as well as the lethal removal of the individuals with the highest predation rates. During the proposed work period there are few California sea lions observed at Bonneville, with the daily counts typically between zero and 3 individuals (Tidwell et al. 2019).

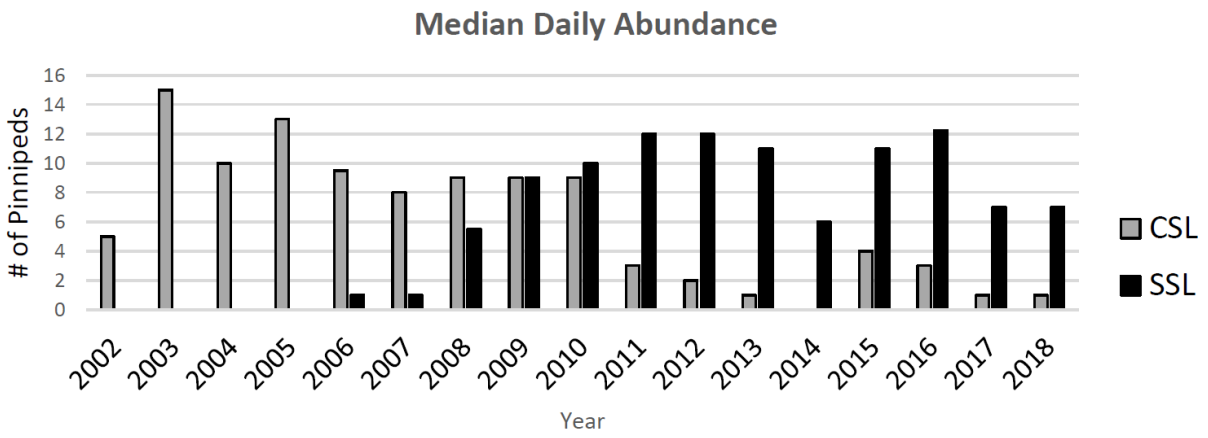

Figure 6. Annual median daily abundance of Steller sea lions (SSL) and California sea lions (CSL) at Bonneville Dam during the spring sampling period from 2002 to 2018 (from Tidwell et al. 2019).

4.3 Harbor Seal (HS)

Harbor seals (*Phoca vitulina richardii*) are one of the most abundant pinnipeds in Oregon and can typically be found in coastal marine and estuarine waters of the Oregon coast throughout the year. On land, they can be found on offshore rocks and islands, along shore, and on exposed flats in the estuary (Harvey 1987). Major haul-out sites with more than 500 individuals have been noted in the Columbia River and are downstream of Tongue Point, about 25 miles downstream of the nearest pile driving activities for this project (Jeffries 2000). In 2002, the estimated absolute abundance of harbor seals on the Oregon coast (excluding Hunters Island) was 10,087 (8,445-12,046 95% CI) animals (Brown et al. 2005).

Harbor seals are generally non-migratory, but local movements may vary with tides, weather, seasons, food resources, and reproductive behavior (NOAA 2013). They were historically hunted in Oregon as a nuisance to fishermen, however, their numbers have steadily increased since the passage of the MMPA in 1972 (Harvey 1987, Brown et al. 2005). While harbor seals are still subject to incidental take from commercial fisheries in the region, the overall mortality is relatively small and the Oregon/Washington Coast stock of harbor seals is not depleted under MMPA or listed under ESA (NOAA 2013).

Observations of harbor seals at Bonneville dam during the fall and winter observation periods are infrequent, with no observations in most years. Although three individuals were observed in 2006, since 2011 no more than a single individual has been counted (Tidwell et al. 2019).

5.0 Type of Incidental Take Authorization Requested

Under the MMPA, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as, "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as, "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." Under Section 101(a)(5)(D) of the MMPA, the U.S. Army Corps of Engineers – Portland District requests and Incidental Harassment Authorization (IHA) for marine mammals that may be affected by the installation of king pile markers in the Columbia River.

5.1 Disturbance Isopleths

The in-water effects of pile driving noise include potential Level A and Level B level effects on marine mammals. We used the following practical spreading loss equation to calculate the Level B disturbance distances in water:

$$D_{thresh-water} = D_0 * 10^{(\frac{SPL\ Estimate\ in\ dB_{RMS\ or\ Leq} - Disturbance\ threshold\ in\ dB}{\alpha})}$$

With D_0 reference measurement distance (10 meters), $D_{thresh\text{-}water}$ calculated distance from source to reach in-water threshold values, water disturbance threshold values from Table 4, and α = 15. Estimated sound pressure levels in water were referenced from Table 2~~Table 2~~, using the dB_{RMS} values for installing 24-inch steel piles with a vibratory hammer and 24-inch piles with an impact hammer. Examples of the resulting Level B isopleths at various pile locations are shown in Appendix B.

Table 6. In-water Monitoring and Stop-Work Zone Distances to Minimize Noise Effects on Marine Mammals

Noise Generation Type	**Level A Permanent Threshold Shift (PTS) Isopleth Distance (meters)**[1]		**Level B Disturbance (meters)**[2]
	Phocid Pinniped	Otariid Pinniped	All Groups
24" Steel Shell Impact attenuated[1]	56.9	4.1	631
24" Steel Shell Vibratory unattenuated[2]	2.6	0.2	5,412

[1] Calculated using NMFS technical tool and spreadsheet for estimating PTS levels associated with pile driving (NMFS 2018) Appendix C.
[2] Estimated using spreading loss equation and values referenced in table 2. Worksheet of calculations is in Appendix C.

5.2 Permanent Threshold Shift Isopleths

We utilized the NMFS technical guidance and tool for estimating Level A permanent threshold shift (PTS) isopleths, the area within which auditory damage could occur, calculated separately for each marine mammal hearing group (NMFS 2018, see Appendix C). The estimated isopleth distances were calculated using the un-weighted SPL RMS values from Table 2~~Table 2~~, with the following assumptions:

- In a 24-hour period, a single pile would be installed using an impact hammer per location
- The average number of strikes per pile is 550
- The average duration to install a single 24-inch pile is 30 minutes using vibratory hammer and an hour with an impact hammer
- The sound propagation (dB per Log [distance]) is the default value of 15(xLogR) for 24-inch steel pipe piles.

6.0 Take Estimates for Marine Mammals

As described in Section 1.3, no construction would occur on land, but instead would occur in the Columbia River from barge-mounted cranes. Pile installation would result in some airborne noises; however, in-air noise was not a factor in assessing take for in-water activities because the Level B ZOI for underwater noise extends farther. Examples representative of typical pile dike fields are provided in Appendix B of this report showing Level A and Level B isopleths for both phocid and otariid pinnipeds.

6.1 Level A Take

Level A injury (i.e., non-serious injury or permanent threshold shift**)** of any marine mammal is not anticipated during proposed project activities.

The maximum PTS isopleth distance for phocid pinnipeds is 56.9 meters during impact driving and 2.6 meters during vibratory driving. The maximum PTS isopleth distance for otariid pinnipeds is 4.1 meters for impact driving and <1 meter for vibratory driving. Both types of pinnipeds occur year-round in the project vicinity and could occur in October and November.

A minimum Level A Exclusion Zone of 10 meters will be strictly enforced during all vibratory pile driving for otariids to avoid them physically interacting with the construction equipment. Measures to stop work will be implemented should any marine mammals enter their species specific Level A Exclusion Zone. This precaution will help ensure marine mammals are not subject to auditory injury during proposed work.

6.2 Level B Take

This authorization is requesting incidental take for Level B (i.e., behavioral disturbance or temporary hearing threshold shift) marine mammal disturbance that may occur due to proposed project activities.

Given the normal distribution of whales that occur in the broader region, none are likely to enter the Columbia River and come within the Level B disturbance zone for proposed work, which is over 40 river miles from the ocean. In the rare event that any cetacean enters the Level B disturbance zone, which is 631 and 5,412 meters for impact and vibratory methods respectfully, pile driving will cease immediately and start up in accordance with the marine mammal monitoring plan. Based on the marine mammal monitoring procedures and the low likelihood of whales entering the action area, no Level B acoustical harassment is anticipated for these species.

Though all three species of pinnipeds are present in the river year-round, the likelihood of them being exposed to Level B harassment varies due to differences in abundance. Pinnipeds are typically concentrated at haul out sites (e.g. the MCR South jetty) and feeding areas where there are concentrations of salmon (e.g. Bonneville Dam), or in the case of harbor seals tributary mouths during the eulochon (*Thaleichthys pacificus*) run. Individual animals that occur in a work area are likely to be in transit between these two prominent haul-out sites. Potential take was estimated using the maximum daily number of individuals observed at Bonneville (Tidwell et al. 2019), multiplied by the total number of work days (61 days, see

Table ~~Table 6~~). For both California sea lions and harbor seals, we used a conservative estimate of 3 individuals since that was the maximum daily (CSL) or spring (HS) count observed during Bonneville surveys. This estimate assumes that if an animal transits the reach of river where driving takes place it will pass through the Level B isopleth since in most cases the radius would be larger than the width of the river (see Appendix B).

7.0 Anticipated Impact of the Activity

The proposed work should not cause any permanent damage to marine mammals that may be present in the area. Adhering to the in-water work window and further adherence to the marine mammal monitoring protocols will help ensure that there will be no Level A auditory damage caused during installation of test piles.

Temporary disturbance may occur to marine mammals that enter the Level B zone. The effects are limited to 3 species, and should not exceed the 61 days of work expected to occur (see

Table ~~Table 6~~). Marine mammal behavioral responses could include avoidance or altered foraging patterns, though these changes would likely be temporary. Overall project impacts have a negligible effect on harbor seals and California sea lions in the area, as estimated take will affect less than <<1% of the stock for either species. There is potential to affect ~~64~~-~~85~~% of the adult Eastern stock of Stellar sea lions. However, this is likely an overestimate since affected individuals would likely transit the area multiple times over the 61 day work period and be considered individual take events when it is in reality multiple disturbances to a single animal.

Table 7. Estimated pinniped exposure and take by species.

Species	Daily observation numbers at Bonneville Dam*	Total Work Days	Total take
California Sea Lion (*Zalophus. californianus*)	3	61	183
Stellar Sea Lion (*Eumetopias jubatus*)	~~56~~36	61	~~3,416~~2,196
Harbor Seal (*Phoca vitulina richardii*)	3	61	183
*~~From~~ Maximum daily count observed in October and November (Tidwell et al. ~~(~~2019~~),~~ Figure 1).			

8.0 Anticipated Impacts on Subsistence Uses

There are no relevant subsistence uses of the marine mammals implicated by this action.

9.0 Anticipated Impacts on Habitat

Test piles would be driven in the same location as currently existing pile dikes. Though some marine mammals may pass through the area, the pile dikes are not known habitat for any marine mammals; therefore, no modification to existing habitat is expected.

10.0 Anticipated Effects of Habitat Impacts on Marine Mammals

The proposed project would not result in a permanent adverse impact to marine mammal habitat.

11.0 Mitigation Measures to Protect Marine Mammals and Their Habitat

The construction contractors would be required to conduct construction activities using best management practices (BMPs) for in-water and land-based work. Some BMPs include but are not limited to:

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

- An air bubble system or other noise attenuation device shall be employed during impact installation unless the piles are driven in the dry or within less than 2 feet of water (WSDOT 2018a).
- The contractor will implement a soft-start procedure for impact pile driving activities. The objective of a soft-start is to provide a warning and/or give animals in close proximity to pile driving a chance to leave the area prior to an impact driver operating at full capacity thereby, exposing fewer animals to loud underwater and airborne sounds. A soft start procedure will be used at the beginning of each day that pile installation activities are conducted.
    - For impact driving, an initial set of three strikes would be made by the hammer at 40 percent energy, followed by a one minute wait period, then two subsequent three-strike sets at 40 percent energy, with one minute waiting periods, before initiating continuous driving.
- Monitoring of marine mammals shall take place starting 30 minutes before construction begins until 30 minutes after construction ends (see Section 13 for monitoring details).
- Before commencement of impact pile driving activities, USACE will establish a 5 meter and a 60 meter Level A Shutdown Zone to prevent auditory injury to sea lions and harbor seals, respectively.
- Before commencement of vibratory pile removal activities, an 10 meter Level A Shutdown Zone will be established to prevent injury to marine mammals.
- Before commencement of above water construction activities, USACE will establish a 10 meter Level A Exclusion Zone to prevent injury from physical interaction with construction equipment.
- Prior to initiating in-water pile driving or pile removal, USACE will establish the following Level B ZOIs for underwater noise.
    - The Level B ZOI for all pile driving activities will be established out to a line of sight distance of up to 631 meters from the pile for impact driving and up to 5,412 meters for vibratory driving.
    - In the unlikely case that a cetacean enters the Level B ZOI work will stop immediately until they leave the ZOI or are undetected for 15 minutes
    - If a pinneped enters the Level B ZOI, but does not enter Level A Exclusion Zone, a “take” will be recorded and the work will be allowed to proceed without cessation. Marine mammal behavior will be monitored and documented.
- Construction waste material used or stored on site will be confined, removed, and disposed of properly.
- The contractor will be provided, and will strictly adhere to the marine mammal monitoring plan (section 13 below)

12.0 Mitigation Measures to Protect Subsistence Uses

The proposed project will take place in the Columbia River in the states of Oregon and Washington. No activities will take place in or near a traditional hunting place, nor interfere with substance harvest.

13.0 Monitoring and Reporting

Impacts to marine mammals are likely to be temporary and negligible, and the mitigation measures described in Section 11 are meant to avoid and minimize impacts to the Lower Columbia River, ESA-listed species, and seal and sea lions to the maximum extent practicable. The following Monitoring and Reporting measures 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.

Monitoring

The Corps proposes the following monitoring protocols:

- Visual monitoring will be conducted by qualified, trained marine mammal observers (hereafter "observer") will be implemented during all pile installation/removal activities. An observer has prior training and experience conducting marine mammal monitoring or surveys, and who has the ability to identify marine mammal species and describe relevant behaviors that may occur in proximity to in-water construction activities.
- For all pile driving, a shutdown and disturbance zone will be monitored.
  - There will be one observer per location during all pile driving activities.
  - Monitoring will take place from 30 minutes prior to initiation through 30 minutes post-completion of pile driving.
  - The shutdown zone will include all areas where the underwater SPLs are anticipated to equal or exceed the Level A (injury). The shutdown zone will always be a minimum of 10 meters (33 feet) to prevent injury from physical interaction of marine mammals with construction equipment.
- Observers will be placed at the best vantage points practicable (from the construction barges, on shore, or by boat) to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown to the hammer operator.
- If sea-state conditions or weather restricts the observers' ability to make marine mammal observations within the injury shutdown zone (e.g., excessive wind, fog, or other conditions limiting visibility), impact pile installation will cease until conditions allow monitoring to resume. Vibratory pile installation will continue under these conditions.
- Prior to the start of pile driving, the shutdown zone will be monitored for 30 minutes to ensure that the shutdown zone is clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals.
- If a marine mammal approaches or enters the injury zone during pile driving, work will be halted and delayed until either the animal has voluntarily left and visually confirmed beyond the disturbance zone, or 15 minutes have passed without re-detection of the animal.

- If a marine mammal is observed in the acoustic disturbance zone, but not approaching or entering the shutdown zone, a "take" will be recorded and the work will be allowed to proceed without cessation. Marine mammal behavior will be monitored and documented.
- If a marine mammal approaches or enters a shutdown zone during pile driving, work will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.
- Use a hand-held or boat-mounted GPS device or rangefinder to verify the required monitoring distance from the project site.
- Scan the waters within the area of potential sound effects using binoculars (10x42 or similar) or spotting scopes (20-60 zoom or equivalent), and by making visual observations.
- If any species for which take is not authorized, such as killer whales or other cetaceans, are observed within the area of potential sound effects during or 30 minutes before pile driving, the observer(s) will immediately notify the on-site supervisor or inspector, and require that pile driving either not initiate or temporarily cease until the animals have moved outside of the area of potential sound effects.
- Conduct pile driving only during daylight hours from sunrise to sunset when it is possible to visually monitor marine mammals.
- Use a marine mammal observation sheet to record the species, date, and time of any marine mammal sightings. Record marine mammal behavior and any communication between the observer and the contractor during pile driving.
- If the Corps observes any dead or dying marine mammal species in the action area, regardless of known cause:
    - Record the species type (if known), date, time, and location of the observation
    - Take a photograph of the specimen
    - Immediately notify NOAA Fisheries.

The NMFS requires that at a minimum, the following information be collected on the sighting forms.

- Date and time that pile removal and/or installation begins and ends.
- Construction activities occurring during each observation period.
- Weather parameters (e.g., percent cover, visibility).
- Water conditions [e.g., sea state, tidal state (incoming, outgoing, slack, low, and high)].
- Species, numbers, and, if possible, sex and age class of marine mammals.
- Marine mammal behavior patterns observed, including bearing and direction of travel, and, if possible, the correlation to SPLs.
- Distance from pile removal and/or installation activities to marine mammals and distance from the marine mammal to the observation point.
- Locations of all marine mammal observations.

- Other human activity in the area.

The Corps will note in behavioral observations, to the extent practicable, if an animal has remained in the area during construction activities. Therefore, it may be possible to identify if the same animal or a different individuals are being taken. Collected data will be compiled following the end of each construction season at all jetties and submitted to NMFS.

According to NMFS Requirements, the Corps will include the following minimum qualifications for marine mammal observers:

- Visual acuity in both eyes (correction is permissible) sufficient to discern moving targets at the water's surface with ability to estimate target size and distance. Use of binoculars or spotting scope may be necessary to correctly identify the target.
- Advanced education in biological science, wildlife management, mammalogy or related fields (Bachelor's degree or higher is preferred).
- Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience).
- Experience or training in the field identification of marine mammals (cetaceans and pinnipeds).
- Sufficient training, orientation or experience with vessel operation and pile driving operations to provide for personal safety during observations.
- Writing skills sufficient to prepare a report of observations. Reports should include such information as number, type, and location of marine mammals observed; behavior of marine mammals in the area of potential sound effects during construction; dates and times when observations and in-water construction activities were conducted; dates and times when in-water construction activities were suspended because of marine mammals, etc.
- Ability to communicate orally, by radio, or in-person with project personnel to provide real time information on marine mammals observed in the area, as needed.

14.0 Suggested Means of Coordination

The Corps has met with staff from the West Coast Marine Mammal Stranding Network to discuss this project action. Based on their feedback, the Corps will continue to coordinate with the Marine Mammal Stranding Network and develop a stranding response plan prior to start of work. The Corps has also checked NMFS' interactive map and reviewed available information for other activities in the lower Columbia River.

The data recorded during marine mammal monitoring activities will be provided to NMFS in the monitoring reports. These reports will provide useful information regarding the presence of the marine mammals discussed in this document in the project area and their behavioral response to construction activities. The monitoring data collected will inform the Corps and NMFS staff and assist the evaluation of the potential effects of future projects of similar scope on the lower Columbia River. The Corps will also share the results of monitoring with Oregon Department of

Fish & Wildlife and Washington Department of Fish & Wildlife and upload the monitoring report into the Corps' public digital library.

The Corps will check NMFS' interactive IHA map prior to start of work and reach out to any others performing similar activities in the lower Columbia River to exchange monitoring data in real time if practicable to inform both activities. The Corps will also reach out to NMFS Northwest Fisheries Science Center Marine Mammal Ecology Team prior to initiating pile driving to notify them of the activity and gather any new information available on the location of marine mammals in the project area.

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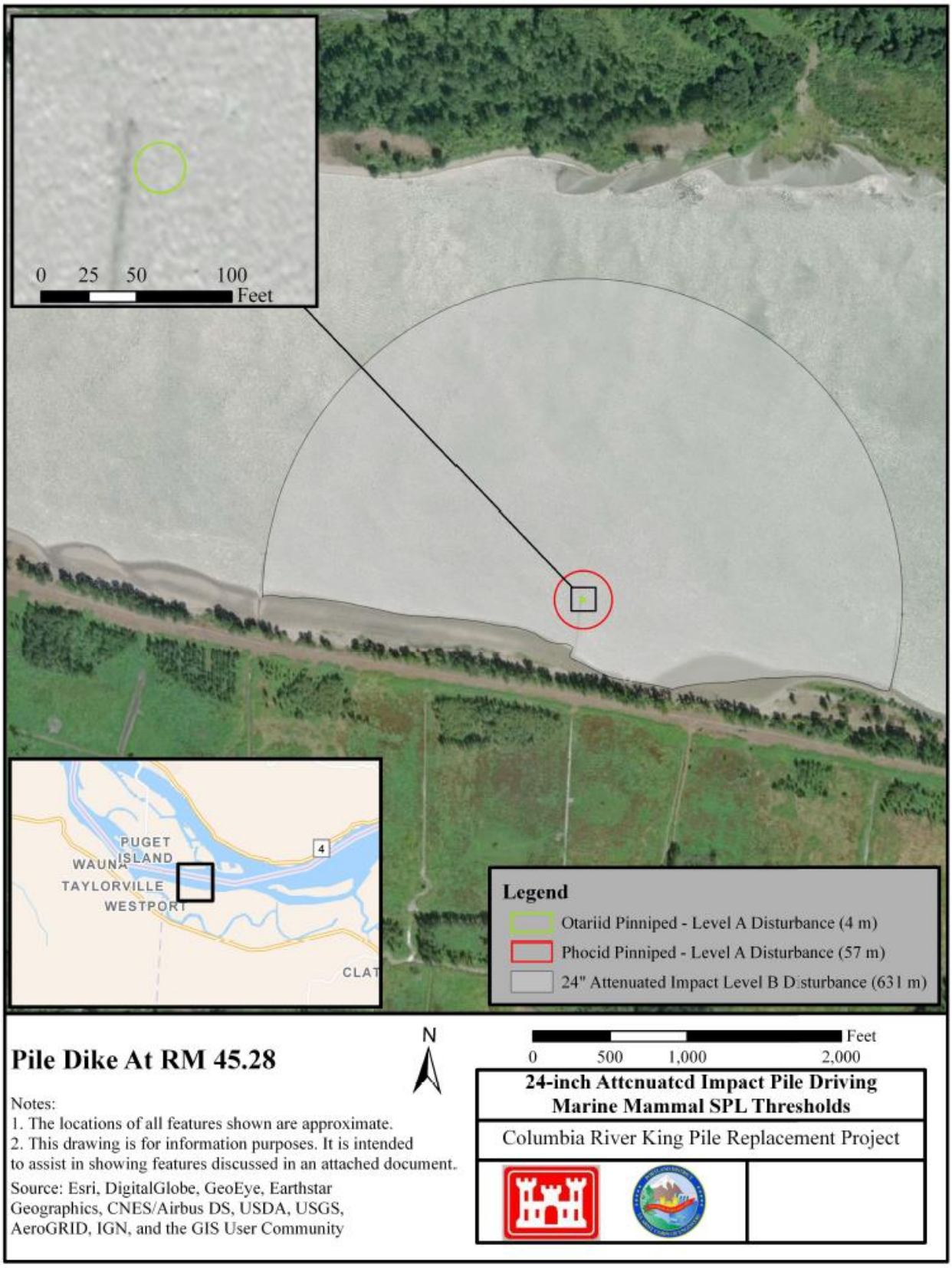
Appendix A:
Project area Maps

Appendix B:
Example Isopleth Figures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WAUNA
TAYLORVILLE
WESTPORT
4
CLAT
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Otariid Pinniped - Level A Disturbance (4 m)
Phocid Pinniped - Level A Disturbance (57 m)
24" Attenuated Impact Level B Disturbance (631 m)
Pile Dike At RM 45.28
N
Feet
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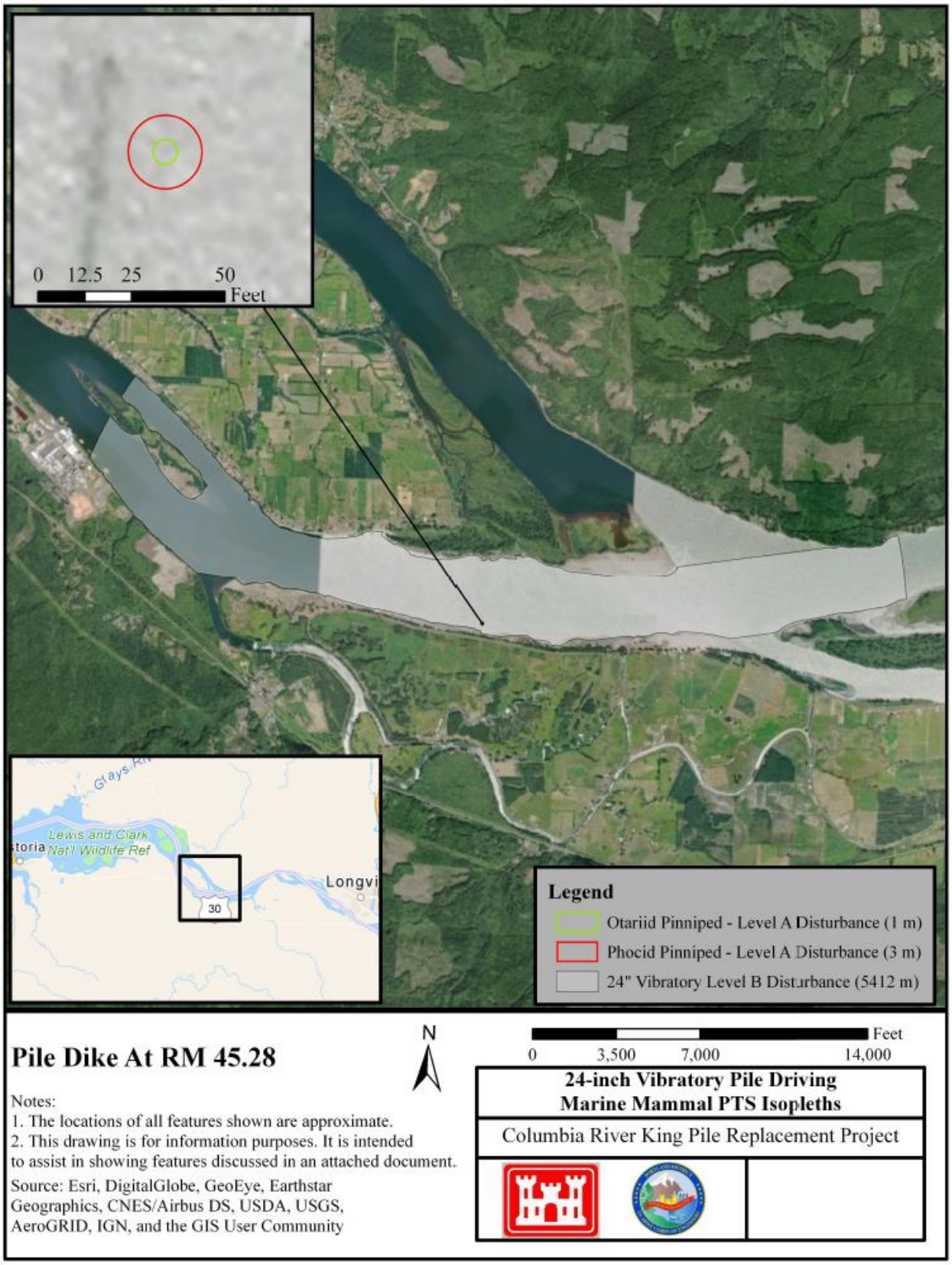
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
24-inch Attenuated Impact Pile Driving Marine Mammal SPL Thresholds
Columbia River King Pile Replacement Project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Lewis and Clark
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Legend
Otariid Pinniped - Level A Disturbance (1 m)
Phocid Pinniped - Level A Disturbance (3 m)
24" Vibratory Level B Disturbance (5412 m)
Pile Dike At RM 45.28
N
Feet
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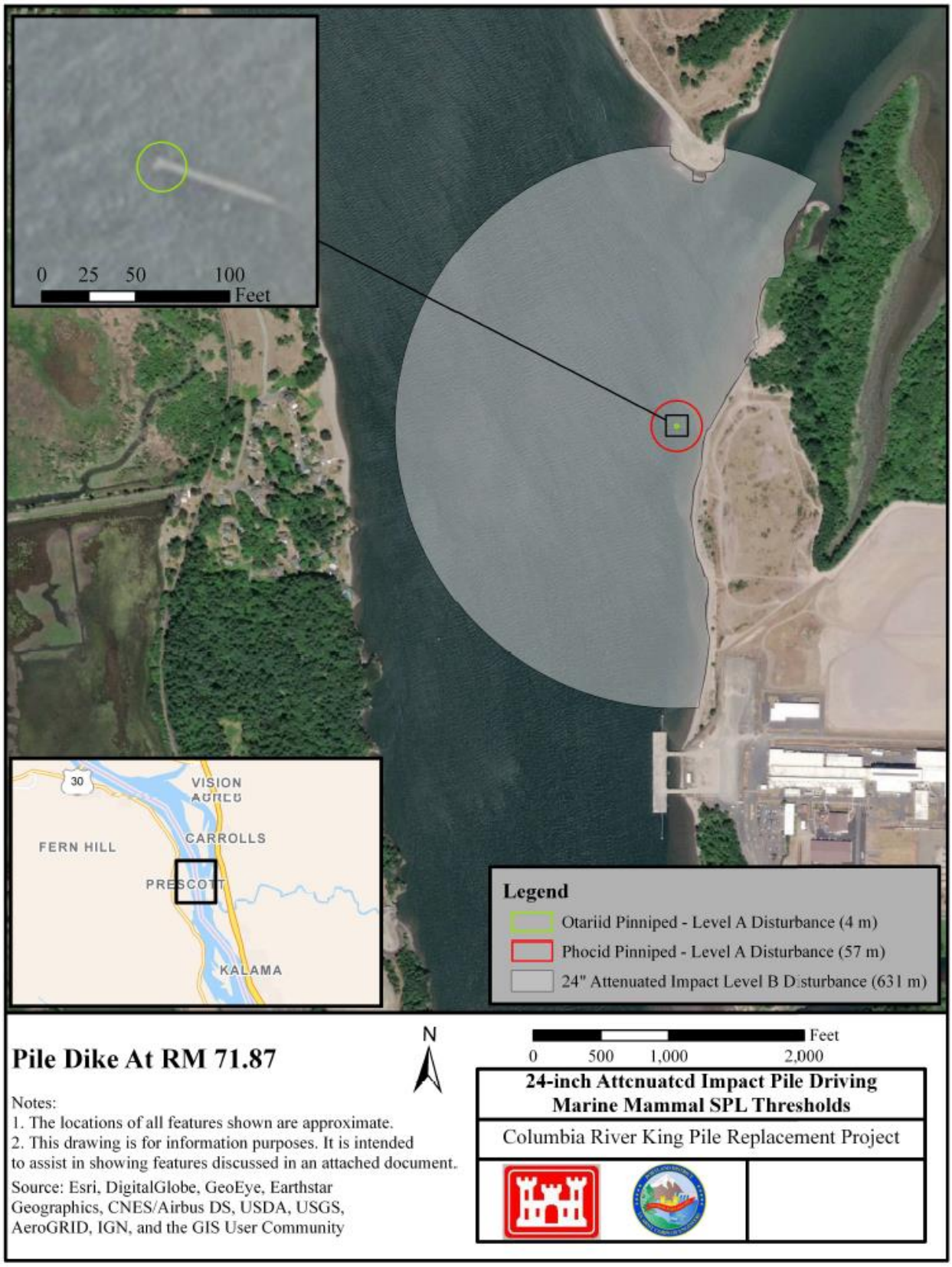
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
24-inch Vibratory Pile Driving
Marine Mammal PTS Isopleths
Columbia River King Pile Replacement Project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VISION
CARROLLS
FERN HILL
PRESCOTT
KALAMA
Legend
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Phocid Pinniped - Level A Disturbance (57 m)
24" Attenuated Impact Level B Disturbance (631 m)
Pile Dike At RM 71.87
N
Feet
0 500 1,000 2,000
24-inch Attenuated Impact Pile Driving
Marine Mammal SPL Thresholds
Columbia River King Pile Replacement Project
Notes:
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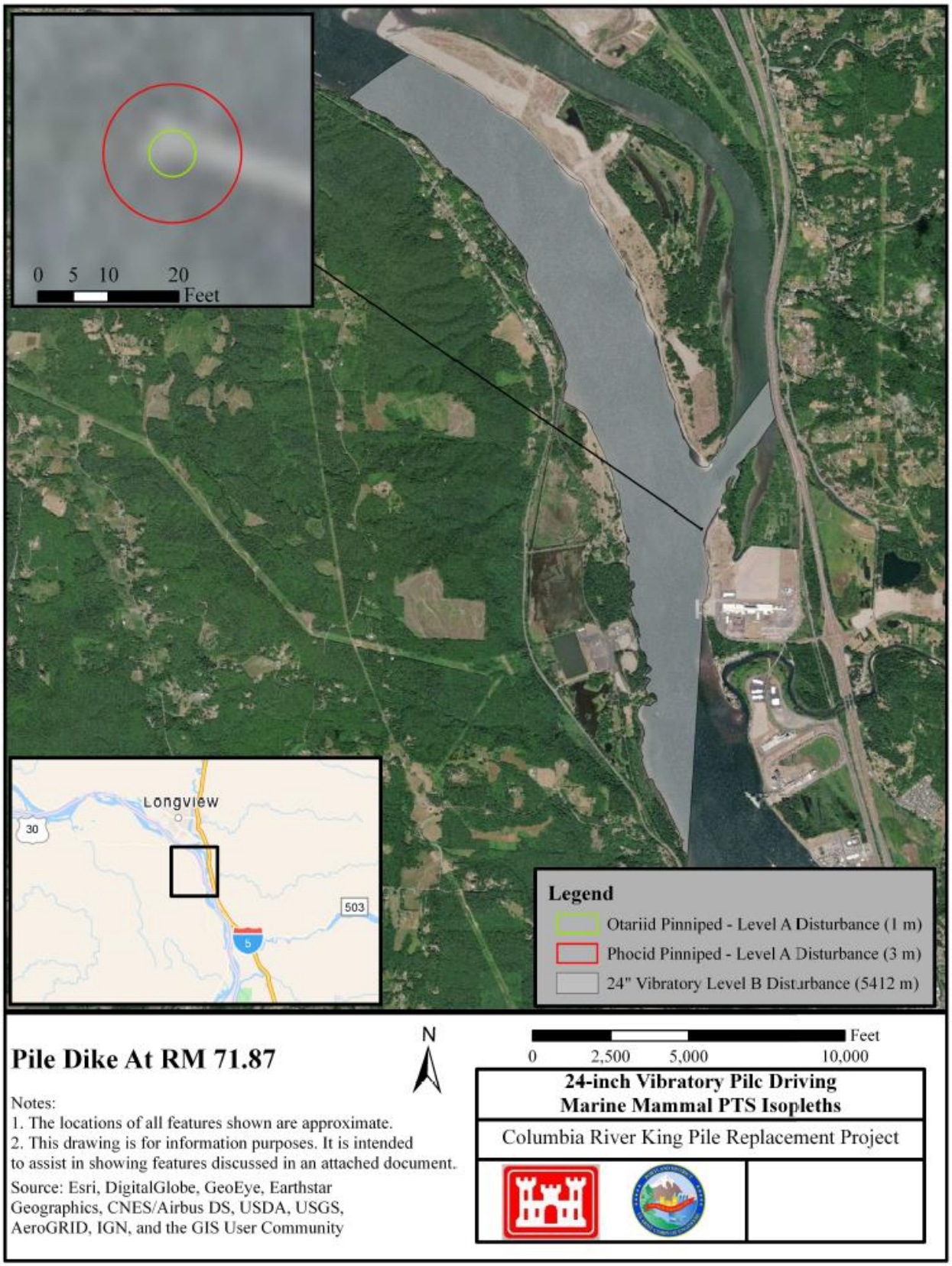
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Otariid Pinniped - Level A Disturbance (1 m)
Phocid Pinniped - Level A Disturbance (3 m)
24" Vibratory Level B Disturbance (5412 m)
Pile Dike At RM 71.87
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Feet
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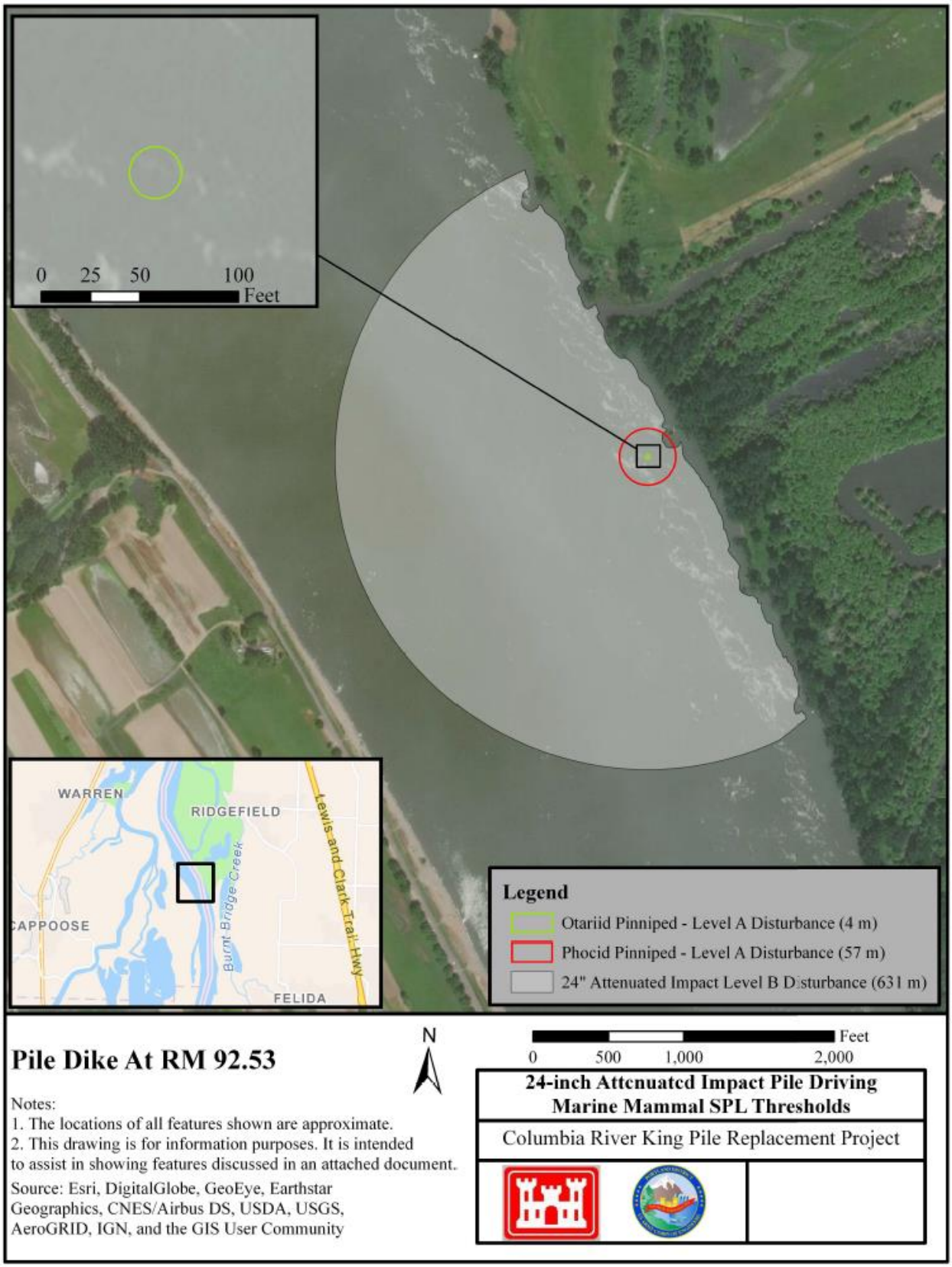
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
24-inch Vibratory Pile Driving
Marine Mammal PTS Isopleths
Columbia River King Pile Replacement Project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RIDGEFIELD
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Burnt Bridge Creek
CAPPOOSE
FELIDA
Legend
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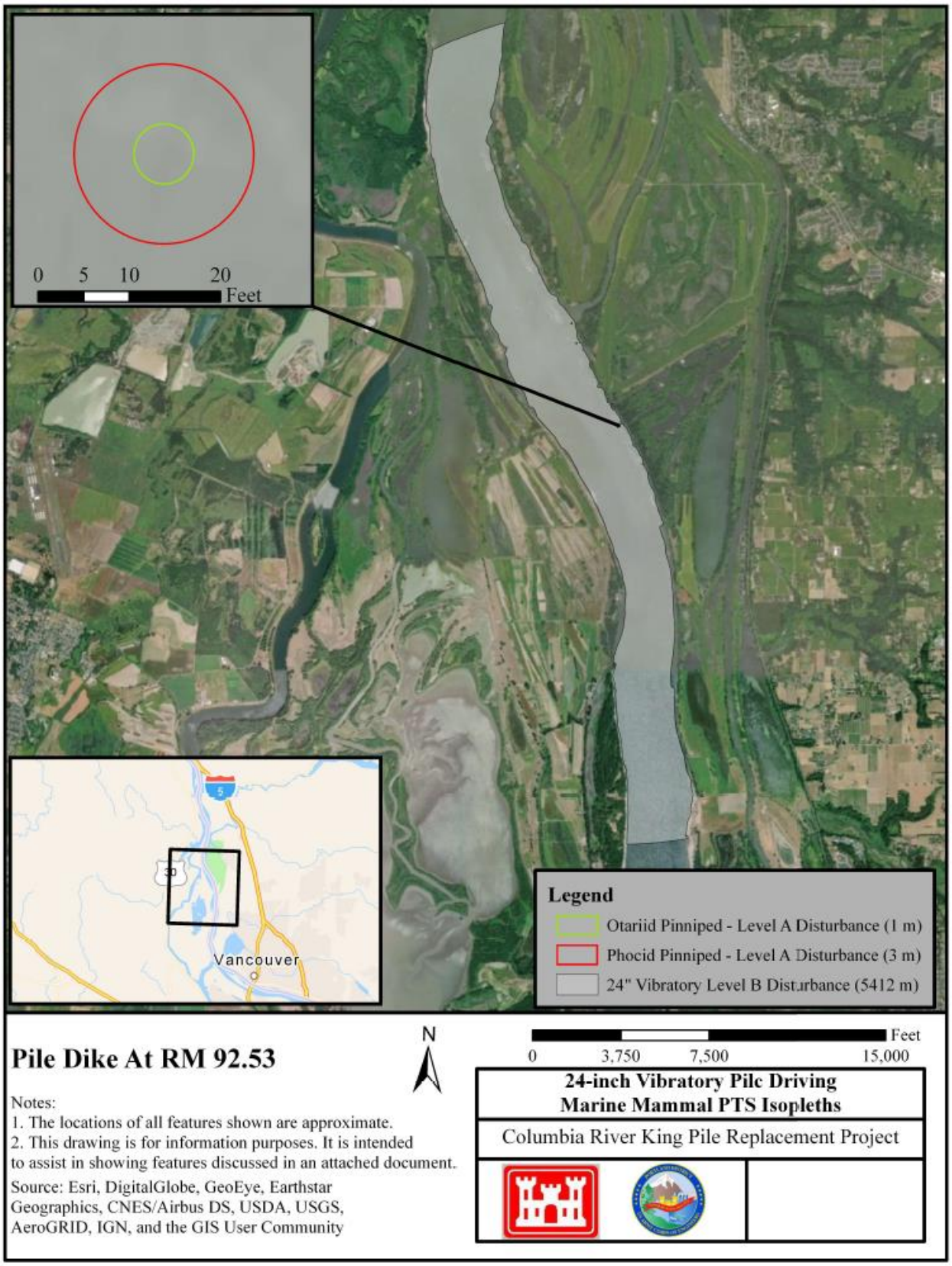
Phocid Pinniped - Level A Disturbance (57 m)
24" Attenuated Impact Level B Disturbance (631 m)
Pile Dike At RM 92.53
N
Feet
0 500 1,000 2,000
24-inch Attenuated Impact Pile Driving
Marine Mammal SPL Thresholds
Columbia River King Pile Replacement Project
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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Otariid Pinniped - Level A Disturbance (1 m)
Phocid Pinniped - Level A Disturbance (3 m)
24" Vibratory Level B Disturbance (5412 m)
Pile Dike At RM 92.53
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Feet
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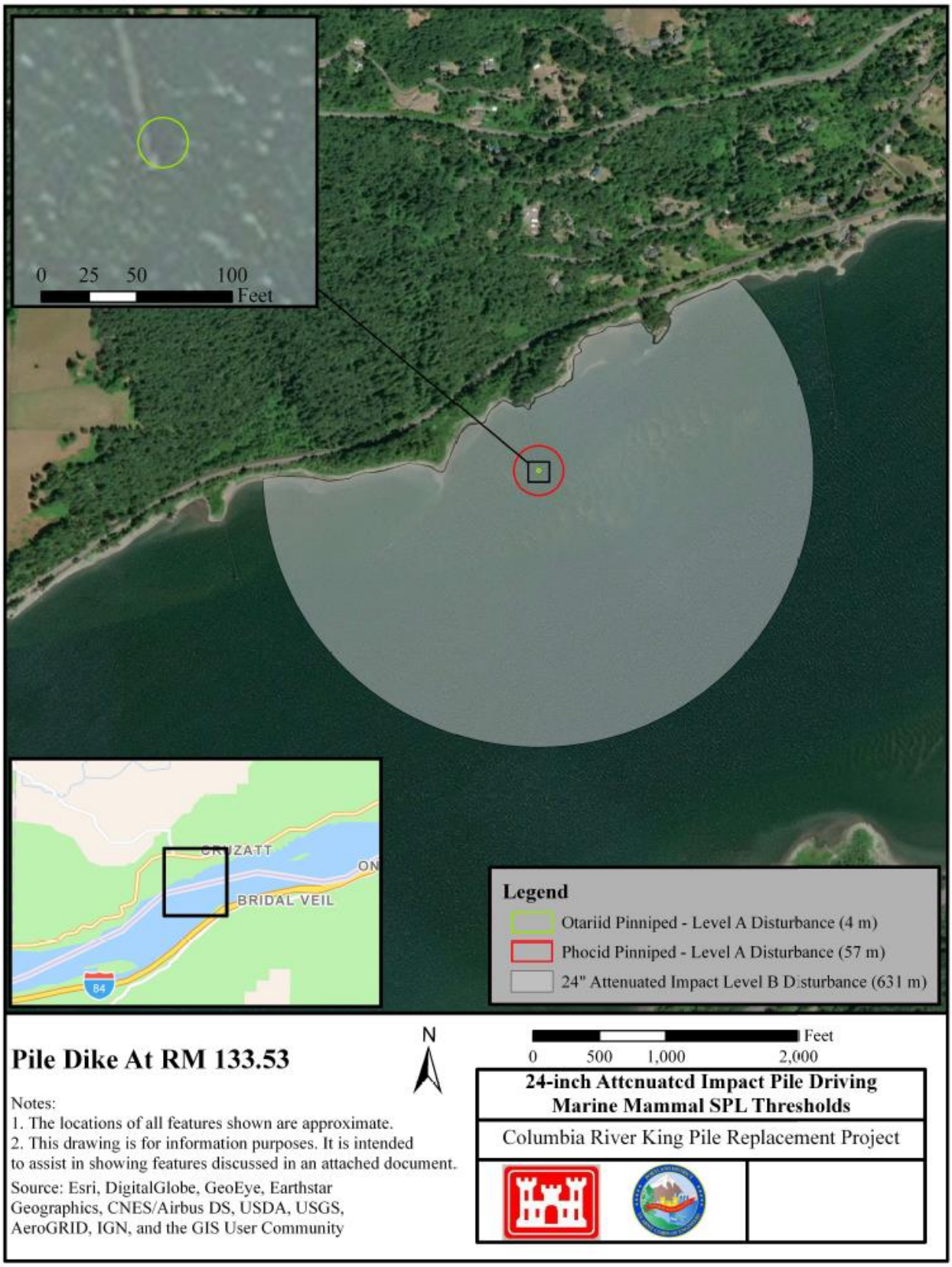
24-inch Vibratory Pile Driving
Marine Mammal PTS Isopleths
Columbia River King Pile Replacement Project
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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Phocid Pinniped - Level A Disturbance (57 m)
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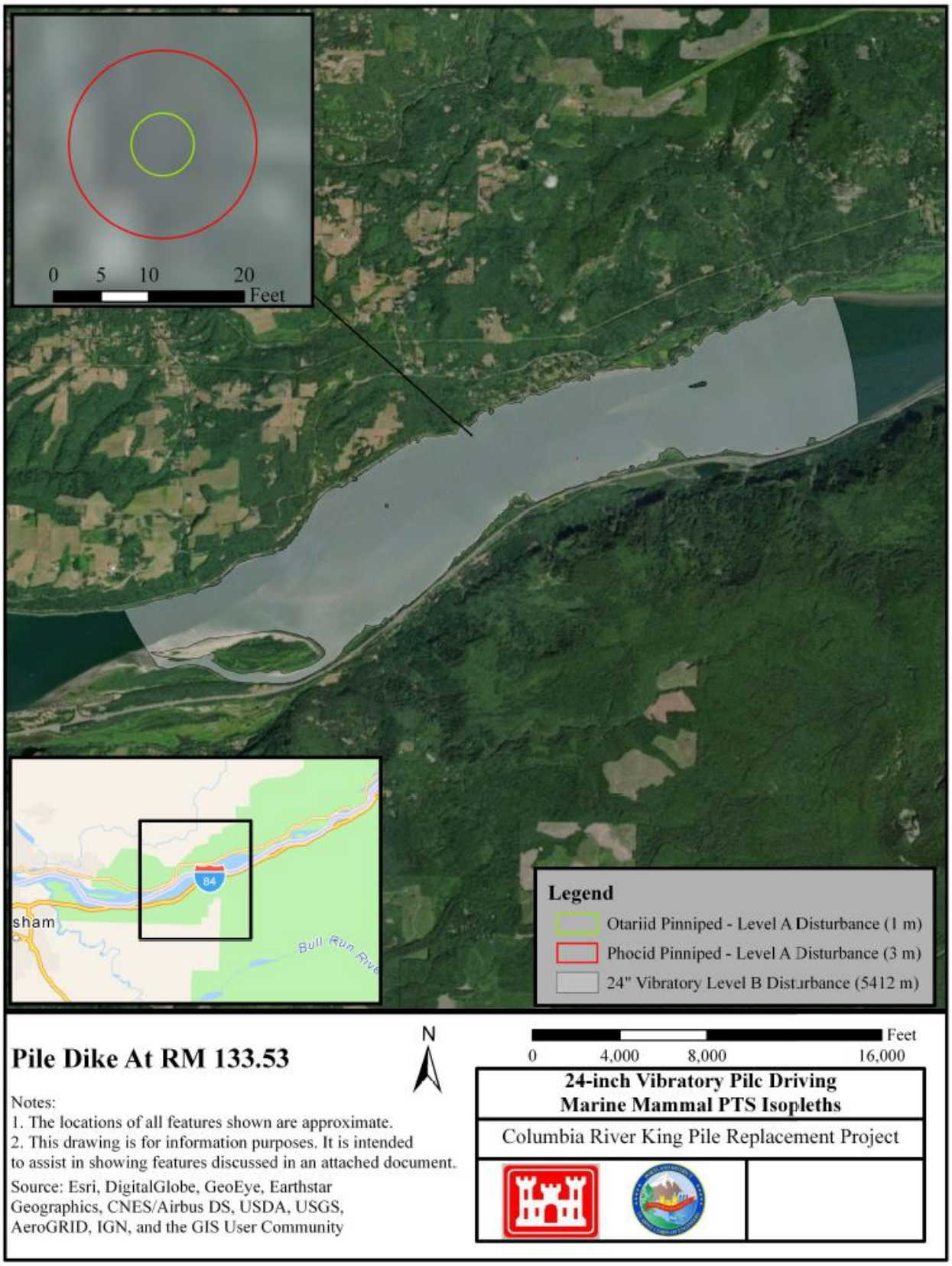
Pile Dike At RM 133.53
N
Feet
0 500 1,000 2,000
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
24-inch Attenuated Impact Pile Driving Marine Mammal SPL Thresholds
Columbia River King Pile Replacement Project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Feet
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Legend
Otariid Pinniped - Level A Disturbance (1 m)
Phocid Pinniped - Level A Disturbance (3 m)
24" Vibratory Level B Disturbance (5412 m)
Pile Dike At RM 133.53
N
Feet
0 4,000 8,000 16,000
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1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
24-inch Vibratory Pile Driving
Marine Mammal PTS Isopleths
Columbia River King Pile Replacement Project

Appendix C:
Noise Level Worksheets

Vibratory Pile Driving

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Weighting Factor Adjustment (kHz)¥	2.5	Default

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (RMS SPL)	161
Number of piles within 24-h period	1
Duration to drive a single pile (minutes)	30
Duration of Sound Production within 24-h period (seconds)	1800
10 Log (duration of sound production)	32.55
Propagation (xLogR)	15
Distance from source level measurement (meters)*	10

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

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**4.3**	**0.4**	**6.4**	**2.6**	**0.2**

Impact Pile Driving

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Weighting Factor Adjustment (kHz)¥	2	Default

E.1.2: ALTERNATIVE METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT)

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**198.4**

SEL_{cum}

Source Level (Single Strike SEL)	171
Number of strikes per pile	550
Number of piles per day	1
Propagation (xLogR)	15
Distance of single strike SEL measurement (meters)*	10

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

PK

Source Level (PK SPL)	200
Distance of source level measurement (meters)*	10
Source level at 1 meter	215.0

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

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**106.2**	**3.8**	**126.6**	**56.9**	**4.1**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**7.4**	**NA**	**NA**