AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 217

[Docket No. 110801455–2197–01]

RIN 0648–BB16

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Columbia River Crossing Project, Washington and Oregon

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS has received a request from the Department of Transportation's Federal Transit Authority (FTA) and Federal Highway Administration (FHWA), on behalf of the Columbia River Crossing project (CRC), for authorization to take marine mammals incidental to bridge construction and demolition activities at the Columbia River and North Portland Harbor, Washington and Oregon, over the course of 5 years from approximately July 2013 through June 2018. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is proposing regulations to govern that take and requests information, suggestions, and comments on these proposed regulations.

DATES: Comments and information must be received no later than May 21, 2012.

ADDRESSES: You may submit comments on this document, identified by 110801455–2197–01, by any of the following methods:

- Electronic Submission: Submit all electronic public comments via the Federal e-Rulemaking Portal *www.regulations.gov.* To submit comments via the e-Rulemaking Portal, first click the Submit a Comment icon, then enter 110801455–2197–01 in the keyword search. Locate the document you wish to comment on from the resulting list and click on the Submit a Comment icon on the right of that line.
- Hand delivery or mailing of comments via paper or disc should be addressed to Tammy Adams, Acting Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910.

Comments regarding any aspect of the collection of information requirement contained in this proposed rule should be sent to NMFS via one of the means provided here and to the Office of Information and Regulatory Affairs, NEOB–10202, Office of Management and Budget, Attn: Desk Office, Washington, DC 20503, *OIRA@omb.eop.gov.*

Instructions: Comments must be submitted by one of the above methods to ensure that the comments are received, documented, and considered by NMFS. Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (e.g., name, address) submitted voluntarily by the sender will be publicly accessible. Do not submit confidential business information, or otherwise sensitive or protected information. NMFS will accept anonymous comments (enter N/A in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

A copy of CRC's application, and other supplemental documents, may be obtained by writing to the address specified above (see **ADDRESSES**), calling the contact listed above (see **FOR FURTHER INFORMATION CONTACT**), or visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* A Draft Environmental Impact Statement (DEIS) on the Columbia River Crossing project, authored by the FTA and FHWA, is available for viewing at *http://www.columbiarivercrossing.org/.*

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined 'negligible impact' in 50 CFR 216.103 as ''* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

Except with respect to certain activities not pertinent here, the MMPA defines 'harassment' as: ''any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [''Level A harassment'']; or (ii) 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 [''Level B harassment''].''

Summary of Request

On November 22, 2010, NMFS received a complete application from CRC requesting authorization for take of three species of marine mammal incidental to construction and demolition activities in the Columbia River and North Portland Harbor, Washington and Oregon. CRC has requested regulations to be effective for the period of 5 years from approximately July 2013 through June 2018; portions of the project that may result in incidental take of marine mammals are anticipated to potentially last until March 2021. Marine mammals would be exposed to various operations, including pile driving and removal, demolition of existing structures, and the presence of construction-related vessels. Because the specified activities have the potential to take marine mammals present within the action area, CRC requests authorization to incidentally take, by Level B harassment only, Steller sea lions (*Eumetopias jubatus*), California sea lions (*Zalophus californianus*), and harbor seals (*Phoca vitulina*).

Description of the Specified Activity

CRC is proposing a multimodal transportation project along a 5-mile section of the Interstate 5 (I–5) corridor connecting Vancouver, Washington, and Portland, Oregon. There are significant congestion, safety, and mobility problems in the CRC project area. The existing northbound bridge was built in 1917, and the southbound bridge was added in 1958. These bridges have been classified as functionally obsolete because they do not meet current or future demands for interstate service, resulting in congestion-related delays. Assuming that no changes are made, the daily congestion period is projected to grow from the current 6 hours to 15 hours by 2030 (CRC, 2008). In addition, this section of I–5 has an accident rate more than double that of similar urban highways. Narrow lanes, short on-ramps, and non-standard shoulders on the bridges contribute to accidents. When bridge lifts occur to allow passage of river traffic, all vehicular traffic is stopped, resulting in delays on connecting roadways and adding to unsafe driving conditions.

Current public transit service between Vancouver and Portland is limited to bus service constrained by the limited capacity in the I–5 corridor and is subject to the same congestion as other vehicles, which affects transit reliability and operations. Bicycle and pedestrian facilities are currently substandard in much of the project area.

Seismic safety is also an important issue. Recent geotechnical studies have shown that the sandy soil under the mainstem Columbia River bridges would likely liquefy to a depth of 85 ft (26 m) during an earthquake greater than magnitude 8.0. This could cause irreparable damage to the bridges and potential loss of human life.

To remedy these deficiencies, the CRC project proposes:

- Replacement of the existing Columbia River bridges with two new structures;
- Widening of the existing North Portland Harbor Bridge, and construction of three new structures across the harbor; and
- Demolition of existing Columbia River bridges.

The new Columbia River crossing would carry traffic on two separate pier-supported bridges and would include a new light rail transit (LRT) line and improved bicycle/pedestrian facilities, using a stacked alignment that would reduce the number of in-water piers in the Columbia River by approximately one-third from alternative designs. CRC proposes six in-water pier complexes for a total of twelve piers for the Columbia River bridges.

CRC proposes to widen the existing I–5 southbound bridge over North Portland Harbor, and would add three new bridges adjacent to the existing bridges. From east to west, these structures would carry:

- A three-lane northbound collector-distributor (CD) ramp carrying local traffic;
- Northbound and southbound I–5 on the widened existing bridge across the North Portland Harbor;
- Southbound CD ramps carrying local traffic; and
- LRT combined with a bicycle/pedestrian path.

Each bridge would have four or five in-water bents, consisting of one to three drilled shafts. A bent is part of a bridge's substructure, composed of a rigid frame commonly made of reinforced concrete or steel that supports a vertical load and is placed transverse to the length of a structure. Bents are commonly used to support beams and girders. Each vertical member of a bent may be called a column, pier or pile. The horizontal member resting on top of the columns is a bent cap. The columns stand on top of some type of foundation or footer that is usually hidden below grade. A bent commonly has at least two or more vertical supports.

The permanent in-water piers of both the Columbia River and North Portland Harbor crossings would be constructed using drilled shafts, rather than impact-driven piles. However, the project would require numerous temporary in-water structures to support equipment and materials during the course of construction, which may require the use of temporary impact-driven piles. These structures would include work platforms, work bridges, and tower cranes. Project construction would require the installation and removal of approximately 1,500 temporary steel piles.

The existing Columbia River bridges would be demolished after the new Columbia River bridges have been constructed and after associated interchanges are operating. The existing Columbia River bridges would be demolished in two stages: (1) Superstructure demolition and (2) substructure demolition. In-water demolition would be accomplished either within cofferdams or with the use of diamond wire/wire saw. A full description of the activities proposed by CRC is described in the following sections.

Region of Activity

The Region of Activity is located within the Lower Columbia River sub-basin. The Columbia River and its tributaries are the dominant aquatic system in the Pacific Northwest. The Columbia River originates on the west slope of the Rocky Mountains in Canada and flows approximately 1,200 mi (1,931 km) to the Pacific Ocean, draining an area of approximately 219,000 mi^2 (567,207 km^2) in Washington, Oregon, Idaho, Montana, Wyoming, Nevada, and Utah. Saltwater intrusion from the Pacific Ocean extends approximately 23 mi (37 km) upstream from the river mouth at Astoria, Oregon. Coastal tides influence the flow rate and river level up to Bonneville Dam at river mile (RM) 146 (RKm 235) (USACE, 1989).

The project area is highly altered by human disturbance, and urbanization extends to the shoreline. There has been extensive removal of streamside forests and wetlands. Riparian areas have been further degraded by construction of dikes and levees and the placement of stream bank armoring. For several decades, industrial, residential, and upstream agricultural sources have contributed to water quality degradation in the river. Additionally, existing levels of disturbance are high due to heavy commercial shipping traffic.

The I–5 bridges are located at RM 106 (RKm 171) of the Columbia River. From north to south, the I–5 bridges cross the Columbia River from Vancouver, Washington, to Hayden Island in Portland, Oregon. From Hayden Island, a single I–5 bridge crosses North Portland Harbor to the mainland in Portland, Oregon. The North Portland Harbor is a large side channel of the Columbia River that flows between the southern bank of Hayden Island and the Oregon mainland. The channel branches off the Columbia River approximately 2 RM (3 RKm) upstream (east) of the existing bridge site, and flows approximately 5 RM (8 RKm) downstream (west) before rejoining the mainstem Columbia River (please see Figure 2–2 of CRC's application). The Region of Activity has been defined as the area of the Columbia River and North Portland Harbor in which marine mammals may be directly impacted by sound generated by in-water construction activities, i.e., the area in which modeling indicates that underwater sound generated by the project would be greater than 120 dB re: 1 μPa root mean square (rms; all underwater sound discussed in this document is referenced to 1 μPa).

Due to the curvature of the river and islands present, underwater sound from pile installation would encounter land before it reaches modeled distances to the 120 dB disturbance threshold. Sound from pile installation could not extend beyond Sauvie Island, approximately 5.5 RM (8.9 RKm) downstream, and Lady Island, 12.5 RM (20 RKm) upstream; thus, this distance represents the extent of the Region of Activity downstream and upstream of CRC project construction activities. This distance encompasses the Columbia River from approximately RM 101 to 118 (RKm 163 to 190). Within North Portland Harbor, the maximum distance that underwater sound could extend would be 3.5 mi (5.6 km) downstream and 1.9 mi (3.1 km) upstream of CRC project construction activities.

Dates of Activity

CRC has requested regulations governing the incidental take of marine mammals for the 5-year period from July 2013 through June 2018. Construction activities for both the Columbia River and North Portland Harbor bridges are estimated to begin in July 2013. Construction activities for the Columbia River bridges are estimated to end in 2017, while construction activities for the North Portland Harbor bridges are estimated to end in 2016. Demolition of the existing Columbia River bridges is expected to occur for eighteen months, from approximately September 2019 until March 2021. However, some demolition could possibly occur during the proposed 5-year authorization period. Table 1 provides an overview of the anticipated CRC project timeline and sequencing of project elements. Funding would be a significant factor in determining the overall sequencing and construction duration. Contractor schedules, weather, materials, and equipment could also influence construction duration. CRC would seek additional authorization under the MMPA for any in-water work continuing beyond the expiration of the proposed rule.

The existing in-water work window for this portion of the Columbia River and North Portland Harbor, developed to reduce construction impacts to Endangered Species Act (ESA)-listed fish species, is November 1 through February 28. Because of the large amount of in-water work required, the CRC project would not be able to complete the in-water work during this time period. Therefore, CRC has requested a variance to the in-water work window established by the Oregon and Washington Departments of Fish and Wildlife (ODFW and WDFW, respectively). Most in-water construction activities are proposed to occur year-round, although impact pile driving would occur only from September 15 to April 15. The rationale for CRC's proposed variance takes into account project hydroacoustic impacts in relation to run timing for ESA-listed fish species. The project's timing for impact pile driving overlaps with pinniped presence (primarily January through May) from approximately January through April 15.

TABLE 1—PROPOSED TIMING OF IN-WATER WORK

[CR = Columbia River; NPH = North Portland Harbor]

Activity	Description	Activity duration	Timing
1. Install small-diameter piles (less than or equal to 48 in (1.2 m)) with impact methods [1].	Small-diameter piles would be used in the construction of temporary work bridges/platforms, tower cranes, and support platforms.	45 min/day (impact hammer operation) with up to 7.5 min/week of unattenuated driving in CR and 5 min/week of unattenuated driving in NPH. 138 days in CR, 134 days in NPH	Only within approved extended in-water work window of September 15 through April 15 each year.
2. Install small-diameter piles with non-impact methods.	Small-diameter piles would be used in the construction of temporary work bridges/platforms, barge moorings, tower cranes, and oscillator support platforms.	Length of work day is subject to local sound ordinances, however could be up to 24 hours/day. 138 days in CR, 134 days in NPH	Year-round provided work does not violate water quality standards.[2]
3. Extract small-diameter piles (not including cofferdams).	Removal of small-diameter piles would be done using vibratory equipment or direct pull.	Length of work day is subject to local sound ordinances, however could be up to 24 hours/day.	Year-round provided work does not violate water quality standards.
4. Install/remove cofferdam for construction of Columbia River bridges.	Used to construct piers nearest to shore in the Columbia River (Pier complexes 2 and 7). Steel sheet pile sections to be installed by non-impact means to form a cofferdam. Sheet pile removal can be direct pull or use a vibratory hammer.	Cofferdams could be in place for a maximum of 250 work days each. Installation and dewatering of each cofferdam would not take more than 65 work days; cofferdam removal would not take more than 25 work days. Length of work day is subject to local sound ordinances.	Year-round provided work does not violate water quality standards.
5a. Install large-diameter drilled shaft casings (greater than or equal to 72 in (1.8 m)) using vibratory hammer, rotator, or oscillator outside of a cofferdam.	Used to construct piers and bents not immediately adjacent to shore in the Columbia River and North Portland Harbor.	CR: 110–120 days/pier complex .. NPH: approximately 8 days/shaft.	Year-round provided work does not violate water quality standards.
5b. Install large-diameter drilled shaft casings using vibratory hammer, rotator, or oscillator inside of a water- or sand-filled cofferdam.	Used to construct piers and bents nearest to shore in the Columbia River and North Portland Harbor.	CR pier complexes 2 and 7: approximately 84 days each. NPH: approximately 8 days/shaft.	Year-round provided work does not violate water quality standards.
6. Clean out shafts and place reinforcing and concrete inside steel casings.	Applies to all piers and shafts. All activities/materials would be contained within the casings and have no contact with the water.	CR: 110–120 days/pier complex .. NPH: approximately 8 days/shaft.	Year-round provided work does not violate water quality standards.

TABLE 1—PROPOSED TIMING OF IN-WATER WORK—Continued

[CR = Columbia River; NPH = North Portland Harbor]

Activity	Description	Activity duration	Timing
7a. Perform placement of reinforcement and concrete for a cast-in-place pile cap.	Possible construction method for shaft cap at pier complexes 2 and 7. All activities and materials would be contained within forms and would have no contact with the water. The bottom of the pier caps may sit below the mud line.	Estimate 95 work days per pier ...	Year-round. For pier caps nearest shore: year-round if work occurs within a de-watered cofferdam.
7b. Place a prefabricated pile cap, form, pile template, or similar element into the water.	At CR pier complexes 3–6. Potentially at pier complexes 2 and 7. Assume contact with the water surface, but not with the riverbed.	100 work days per pier	For deep water piers: year-round provided work does not violate water quality standards. For piers nearest shore: year-round if work occurs within a de-watered cofferdam.
8. Install and remove cofferdam for demolition of existing Columbia River bridges.	Steel sheet pile sections would be installed with a vibratory hammer or pushed in, to form a cofferdam. Sheet pile removal can be direct pull or with a vibratory hammer. More than one cofferdam is to be in use at a time.	Approximately 370 days .... Installation: 10 work days per pier, Demolition: 20 work days per pier, Removal: 10 work days per pier.	Year-round provided work does not violate water quality standards.
9a. Perform wire saw/diamond wire cutting outside of a cofferdam at or below the water surface.	Used throughout for demolition of existing bridges to cut concrete piers into manageable pieces. These pieces would then be loaded onto barges and transported off site.	Pier cutting and removal to take approximately 7 work days per pier.	Year-round provided work does not violate water quality standards.
9b. Perform wire saw/diamond wire cutting or a hydraulic breaker inside of a cofferdam.	Used for demolition of the existing Columbia River bridges. Used in water to cut concrete piers into manageable pieces. Cofferdam would not be dewatered.	Pier cutting and removal to take approximately 7 work days per pier.	Year-round provided work does not violate water quality standards.
10. Remove material from river bed.	Old pier/bent foundations or riprap from North Portland Crossing would be removed if obstructing construction. Would use bucket dredge.	Less than 7 work days during the published standard in-water work window per pier.	No variance requested. November 1 to February 28.
10a. Spot remove debris and riprap from river bed.	Guided removal (likely underwater diver assisted) of specific pieces of debris or large riprap only in the location where the shaft would be drilled. In North Portland Harbor only. Would use bucket dredge.	Up to 2 hrs/day. Less than 7 work days.	Year-round provided work does not violate water quality standards.

Note: Proposed timing is contingent upon obtaining an in-water work variance from all relevant regulatory agencies.

[1] To reduce number of impact pile strikes, temporary piles that are load-bearing would be vibrated to refusal, then driven and proofed with an impact hammer to confirm load-bearing capacity.

[2] In the event water quality monitoring determines that work exceeds water quality standards, all in-water work would be suspended until corrective measures can be implemented.

Description of the Activity—Columbia River Bridges

The project would construct two new bridges across the Columbia River downstream (to the west) of the existing interstate bridges. Each of the structures would range from approximately 91 to 136 ft (28–41 m) wide, with a gap of approximately 15 ft (5 m) between them. The over-water length of each new mainstem bridge would be approximately 2,700 ft (823 m).

The Columbia River bridges would consist of six in-water pier complexes of two piers each, for a total of twelve in-water piers. Piers 3–6 would each have separate structures for the northbound and southbound bridges. Each pier would consist of up to nine 10-ft-diameter (3 m) drilled shafts topped by a shaft cap (see Figure 1–4 of CRC's application for illustration). Pier complexes 2 through 7 are in-water, beginning on the Oregon side. Pier complex 1 would be on land in Oregon, while pier complex 8 would be on land in Washington. Portions of pier complex 7 occur in shallow water (less than 20 ft [6 m] deep). The basic configuration of these bridges, the span lengths, and the layout of the bridges relative to the Columbia River shoreline and navigation channels are illustrated in Figure 1–2 of CRC's application.

The proposed Columbia River mainstem crossing design uses dual stacked bridge structures, which reduces the number of in-water piers in the Columbia River by approximately one-third compared with alternative designs, and greatly reduces both the temporary construction impacts and the permanent effects of in-water piers. The western structure would carry southbound I–5 traffic on the top deck, with LRT on the lower deck. The eastern structure would carry northbound I–5 traffic on the top deck, with bicycle/pedestrian traffic on the lower deck.

At each pier complex, sequencing would occur as listed below. Details of each activity are presented in following sections.

- Install temporary cofferdam (applies to pier complexes 2 and 7 only).
- Install temporary piles to moor barges and to support temporary work platforms (at pier complexes 3 through 6) and work bridges (at pier complexes 2 and 7).
- Install drilled shafts for each pier complex.
- Remove work platform or work bridge and associated piles.
- Install shaft caps at the water level.
- Remove cofferdam (applies to pier complexes 2 and 7 only).
- Erect tower crane.
- Construct columns on the shaft caps.
- Build bridge superstructure spanning the columns.
- Remove tower crane.
- Connect superstructure spans with mid-span closures.
- Remove barge moorings.

A construction sequence was developed for building the new Columbia River bridges and demolishing the existing structures (see Figure 1–5 of CRC's application). Once a construction contract is awarded, the contractor may sequence the construction in a way that may not conform exactly to the proposed schedule but that best utilizes the materials, equipment, and personnel available to perform the work. However, the amount of in-water work that can be conducted at any one time is limited, and is based on three factors:

1. The amount of equipment available to build the project would likely be limited. Based on equipment availability, the CRC engineering team estimates that only two drilled shaft operations could occur at any time.

2. The physical space the equipment requires at each pier would be substantial. The estimated sizes of the work platforms/bridges and associated barges are shown in Appendix A of CRC's application. This is a conceptual design developed by the CRC project team to provide a maximum area of impact. The actual work platforms would be designed by the contractor; therefore, actual sizes would be determined at a later date. The overlap of work platforms/bridges and barge space limits the amount and type of equipment that can operate at a pier complex at one time.

3. The U.S. Coast Guard has required that one navigation channel be open at all times during construction, to the extent feasible.

All the activities listed above may occur at more than one pier complex at a time. Please see Appendix A of CRC's application for conceptual diagrams of the construction sequence.

Temporary Structures—Pier complexes 2 and 7 would each require one temporary cofferdam. Cofferdams would consist of interlocking sections of sheet piles to be installed with a vibratory hammer or with press-in methods. Cofferdams would be removed using a vibratory hammer or direct pull.

Additionally, the project would include numerous temporary in-water structures to support equipment and materials during the course of construction. These structures would include work platforms, work bridges, and tower cranes. They would be designed by the contractor after a contract is awarded, but prior to construction.

Work platforms, which would surround the future location of each shaft cap, would be constructed at pier complexes 3 through 6. A conceptual design of a temporary in-water work platform may be found in CRC's application (Figure 11 of Appendix A). Work bridges would be installed at pier complexes 2 and 7 so that equipment can access these pier complexes directly from land. Temporary work bridges would be placed only on the landward side of these pier complexes. The bottom of the temporary work platforms and bridges would be a few feet above the water surface. The decks of the temporary work structures would be constructed of large, untreated wood beams to accommodate large equipment, such as 250-ton cranes. After drilled shafts and shaft caps have been constructed, the temporary work platforms and their support piles would be removed.

After work platforms/bridges are removed at a given pier complex, one tower crane would be constructed between each pair of adjacent piers that makes up the pier complex. The crane would construct the bridge columns and the superstructure. Following construction of the columns and superstructure, the tower cranes and their support piles would be removed.

Steel pipe piles would be used to support the temporary support structures. In addition, four temporary piles could surround each of the drilled shafts. Due to the heavy equipment and stresses placed on the support structures, all of these temporary piles would need to be load-bearing. Load-bearing piles would be installed using a vibratory hammer and then proofed with an impact hammer to ensure that they meet project specifications demonstrating load-bearing capacity. The number and size of temporary piles for these structures is listed in Table 2.

TABLE 2—SUMMARY OF STEEL PIPE PILES AND TEMPORARY STRUCTURES REQUIRED FOR CONSTRUCTION OF COLUMBIA RIVER BRIDGES

Structure	Number	Pile diameter	Pile length	Piles per structure	Total number of piles	Duration present in water (days-each)
Work platforms/bridges.	6	18–24 in (0.5–0.6 m)	70–90 ft (21–27 m)	100	600	260–315.
		42–48 in (1.1–1.2 m)	120 ft (37 m)	32	192	
Tower cranes	6	42–48 in	120 ft	8	48	150–275.
Barge moorings.	N/A	18–24 in	70–90 ft	Varies	80	120/mooring.
Barges (cumulative, at a single time).	Up to 12.	N/A	N/A	N/A	N/A	Varies.
Total	Varies				920	

Barges would be used as platforms to conduct work activities and to haul materials and equipment to and from the work site. Barges would be moored to non-load-bearing steel pipe piles and adjacent to temporary work structures. Several types and sizes of barges would be used for bridge construction. The type and size of a barge would depend on how the barge is used. No more than twelve barges are estimated to be moored or active in the Columbia River at any one time throughout the construction period. Barges would be moored around each pier complex. Approximately eighty mooring piles would be installed over the life of the project, each in place for approximately 120 work days. Mooring piles would be vibrated into the sediment until refusal. Vibratory installation would take between 5–30 minutes per pile.

The number of temporary platforms or bridges in the Columbia River at one time would vary between zero and three during construction. Up to four work platforms and two work bridges would be required to install drilled shafts and construct shaft caps. Each work platform/bridge would require 22 to 25 work days to install. Each work platform/bridge would be in place for approximately 260 to 315 work days. Each tower crane would require approximately two work days to drive support piles and an additional thirteen work days to construct the platform. Each tower crane would be in place for approximately 150 to 275 work days.

Load-bearing piles (used for work platforms/bridges and tower cranes) would be vibrated to refusal (approximately 5–30 minutes per pile), then driven and proofed with an impact hammer to confirm load-bearing capacity. An average of six temporary piles would be installed per day using vibratory installation to set the piles, and up to two impact drivers to proof them. Rates of installation would be determined by the type of installation equipment, substrate, and required load-bearing capacity of each pile. Temporary piles would be installed and removed throughout the construction process. No more than two impact pile drivers would operate at one time. Use of two impact pile drivers would primarily occur within a single pier complex.

In general, temporary piles would extend only into the alluvium to an approximate depth of 70 to 120 ft (21–37 m). Standard pipe lengths are 80 to 90 ft (24–27 m), so some piles may need to be spliced to achieve these depths.

Estimated pile installation specifications are provided in Table 3. The number of pile strikes was estimated by Washington Department of Transportation (WSDOT) geotechnical and CRC project engineers, based on information from past projects and knowledge of site sediment conditions. The actual number of pile strikes would vary depending on the type of hammer, the hammer energy used, and substrate composition. The strike interval of 1.5 seconds (forty strikes per minute) is also estimated from past projects and is based on use of a diesel hammer. This estimate is within the typical range of 35–52 strikes per minute for diesel hammers (HammerSteel, 2009). As shown in Table 3, for any one 12-hour daily pile driving period, less than 1 hour of pile driving would occur. Please see Table 8 for a summary of time required for vibratory driving.

TABLE 3—PILE STRIKE SUMMARY FOR CONSTRUCTION IN COLUMBIA RIVER

Pile Size	Estimated piles installed per day	Estimated strikes per pile	Estimated maximum strikes per day	Hours of pile driving per 12-hr daily pile driving work period*
18–24 in (0.5–0.6 m)	2	300	600	0.25
42–48 in (1.1–1.2 m)	4	300	1,200	0.50
Total	6	N/A	1,800	0.75

* This scenario assumes just one pile being driven at a time. During construction, up to two piles may be driven at the same time in the Columbia River. If this were to occur, the strike numbers would stay the same, but the actual driving time would decrease.

A sound attenuation device (*i.e.,* bubble curtain) would be used during all impact pile driving, with the exception of periods when the device would be turned off to measure its effectiveness, in accordance with the hydroacoustic monitoring plan. A period of up to 7.5 min per week of pile driving without the use of an attenuation device has been allocated in analyses of project impacts, to allow for this study of mitigation effectiveness, as well as for instances when the device might fail. If the attenuation device fails, pile driving activities would shut down as soon as practicable and resolution of the problem would occur; however, some amount of unattenuated driving may occur before shut-down can safely occur. By incorporating this time into the analysis, the project may still proceed in the event of an equipment failure without exceeding analyzed thresholds. With the exception of hydroacoustic monitoring, intentional impact pile driving without a sound attenuation device is not proposed nor would it be authorized. In addition, to limit hydroacoustic impacts to marine mammals, there would be, at minimum, a consecutive 12-hour period without impact pile driving for every 24-hour day.

Permanent Structures—In-water drilled shaft construction is accomplished by installing large diameter steel casing to a specified depth (up to −270 ft (−82 m) North American Vertical Datum of 1988) to the top of the competent geological layer, which is the Troutdale Formation in the project area. The top layer of river substrate is composed of loose to very dense alluvium (primarily sand and some fines), beneath which is approximately 20 ft (6 m) of dense gravel, underlain by the Troutdale Formation.

A vibratory hammer, oscillator, or rotator would be used to advance a casing. If casings are installed by a vibratory hammer, installation is estimated to be 1 work day per casing. If casings need to be welded together, 1 work day is estimated for the weld. No more than two casings are estimated per shaft. Soil would be removed from inside the casing and transferred onto a barge as the casing is advanced, and the soil would be deposited at an approved upland site. Drilling would continue below the casing approximately 30 ft (9 m) into the Troutdale Formation to a specified tip elevation. After excavating soil from inside the casing, reinforcing steel would be installed into the shaft and then the shaft would be filled with concrete.

During construction of the drilled shafts, uncured concrete would be poured into water-filled steel casings, creating a mix of concrete and water. As the concrete is poured into the casing, it would displace this highly alkaline mixture. The project would implement best management practices (BMPs) to contain the mixture and ensure that it does not enter any surface water body. Once contained, the water would be treated to meet state water quality standards and either released to a wastewater treatment facility or discharged to a surface water body. The steel casing may or may not be removed, depending on the installation method. Figures 1–6 through 1–9 of CRC's application depict typical drilled shaft operations and equipment.

The total duration of the permanent shaft installation could vary considerably depending on the type of installation equipment used, the quantity of available installation equipment, and actual soil conditions. Installation of each drilled shaft is estimated to take approximately 10 days. With the limited in-water work window for impact pile driving and construction phasing constraints, the total duration of drilled shaft installation would be approximately thirty months. For each of the in-water pier complexes (Piers 2–7), six to nine shafts would be drilled. For piers 3–6, which would support separate northbound and southbound bridges, this means a minimum of 48 drilled shafts. For piers 2 and 7, which would support a unified structure, there would be a minimum of twelve drilled shafts. At minimum, there would be an overall total of 72 drilled shafts.

Precast shaft caps would be placed on top of the drilled shafts. Installation of the shaft caps would require cranes, work barges, and material barges. Columns would be constructed of cast-in-place reinforced concrete or precast concrete. Column construction is estimated to take 120 days for each pier complex. Construction of columns would require cranes, work barges, and material barges in the river year-round. The superstructure would be constructed of structural steel, cast-in-place concrete, or precast concrete. Precast elements would be fabricated at a casting yard.

Description of the Activity—North Portland Harbor Bridges

The existing North Portland Harbor bridge would be upgraded to meet current seismic standards. The seismic retrofit activities would consist solely of minor modifications to the bent caps and girders that would not require in-water work. In addition, four new bridge structures would be constructed across North Portland Harbor. The bridges, illustrated in Figure 1–12 of CRC's application are, from west to east: the LRT/pedestrian/bicycle bridge, I–5 southbound off-ramp, I–5 southbound on-ramp, existing mainline, and I–5 northbound on-ramp.

The existing North Portland Harbor bridge was constructed in the early 1980s of prestressed concrete girders and reinforced concrete bents. The bents are supported by driven steel pilings. Two previous bridges, constructed in 1917 and 1958, were built at the same location as the current bridge, but may not have been fully removed during subsequent replacement efforts. These bridges had reinforced concrete bents supported on timber piles. Some of this material may still be present, but this would not be confirmed until construction begins. Some removal of previous bridge elements is anticipated prior to installation of the new bridge shafts. Removal of remnant bridge elements would be with a clamshell dredge. The five new or improved bridges over the North Portland Harbor would range from approximately 900–1,000 ft (274–305 m) over water, and would range from 40–150 ft (12–46 m) in width. Bridge widths would vary due to merging of lanes on some structures.

Construction is expected to be sequential, beginning with either of the most nearshore bents of a given bridge and proceeding to the adjacent bent. The actual sequencing would be determined by the contractor once a construction contract is awarded. No more than three of the five bridges are likely to have in-water work occurring simultaneously. For the bents closest to shore, construction would occur from work bridges. At the other in-water bents, as described for Columbia River bridges, construction would likely occur from barges and support platforms. General construction activities to build the bents and superstructure are similar to those for the Columbia River bridges, except that shaft caps would not be used and bridge decks would be placed on girders instead of balanced cantilevers. General sequencing of the construction of a single bridge appears below. Some of these activities may occur simultaneously at separate bents.

- Construct support platforms and work bridges using vibratory and impact pile drivers.
- Vibrate temporary piles for barge moorings.
- Extract large pieces of debris as needed to allow casings to advance.
- Install drilled shafts at each bent.
- Construct columns on the drilled shafts.
- Construct a bent cap or crossbeam on top of the columns at a bent location.
- Erect bridge girders on the bent caps or crossbeams.
- Place the bridge deck on the girders.
- Remove temporary work bridges, support platforms, and supporting piles.

Temporary Structures—At the bents closest to shore, up to nine temporary work bridges would be constructed to support equipment for drilled shafts. In addition, at each of the 31 bent locations, one support platform would be constructed, each consisting of four load-bearing piles. The bridges and support platforms would be designed by the contractor after a contract is awarded, but prior to construction. The number and size of piles for temporary in-water work structures are listed in Table 4.

TABLE 4—APPROXIMATE NUMBER OF STEEL PIPE PILES REQUIRED FOR CONSTRUCTION OF NORTH PORTLAND HARBOR BRIDGES

Structure	Number	Pile diameter	Pile length	Piles per structure	Total number of piles	Duration present in water (days-each)
Work bridges	9	18–24 in (0.5–0.6 m)	70–120 ft (21–37 m)	25	225	20–42.
Support platforms	31	36–48 in (0.9–1.2 m)	120 ft	4	124	10–34.
Barge moorings	N/A	36–48 in	120 ft	N/A	216	30/mooring.
Barges (cumulative, at a single time).	Up to 9	N/A	N/A	N/A	N/A	10–34.
Total	Varies				565	

As with the mainstem Columbia River bridges, temporary piles would be required to support in-water work bridges or to moor barges during construction of the North Portland Harbor bridges. Unlike the Columbia River bridges, cofferdams are not necessary. Piles used for the temporary work bridges and the support platforms must be load bearing. They would first be vibrated to refusal, and then proofed with an impact hammer to confirm load-bearing capacity. An average of three load-bearing piles would be installed per day using vibratory installation to set the piles, with one impact driver to proof. Rates of installation would be determined by the type of installation equipment, substrate, and required load-bearing capacity of each pile.

Temporary mooring piles would be installed and removed throughout the construction process. Installation of these mooring piles could occur year-round and at any time during sufficient visibility. These piles would be installed using vibratory methods only. In general, temporary piles would extend only into the alluvium to an estimated depth of 70 to 120 ft (21–37 m). Standard pipe lengths are 80 to 90 ft (24–27 m), so some piles may need to be welded to achieve the lengths required to drive them to these depths. Estimated pile installation specifications are provided in Table 5. Estimates of required number of strikes per pile and total strikes are the same as for the Columbia River. However, only one impact driver at a time would be used. Impact pile driving is proposed to occur only during a modified in-water work period from approximately September 15 to April 15. No impact pile driving would occur outside of the approved dates.

As discussed for Columbia River, a sound attenuation device (i.e., bubble curtain) would be used during all impact pile driving, with the exception of periods when the device would be turned off to measure its effectiveness, in accordance with the hydroacoustic monitoring plan. A period of up to 5 minutes per week of pile driving without the use of an attenuation device has been allocated in analyses of project impacts for North Portland Harbor, to allow for this study of mitigation effectiveness, as well as for instances when the device might fail. If the attenuation device fails, pile driving activities would shut down as soon as practicable and resolution of the problem would occur; however, some amount of unattenuated driving may occur before shut-down can safely occur. By incorporating this time into the analysis, the project may still proceed in the event of an equipment failure without exceeding analyzed thresholds. With the exception of hydroacoustic monitoring, intentional impact pile driving without a sound attenuation device is not proposed nor would it be authorized. In addition, to limit hydroacoustic impacts to marine mammals, there would be, at minimum, a consecutive 12-hour period without impact pile driving for every 24-hour day. Please see Table 8 for a summary of time required for vibratory driving.

TABLE 5—PILE STRIKE SUMMARY FOR CONSTRUCTION IN NORTH PORTLAND HARBOR

Pile size	Estimated piles installed per day	Estimated strikes per pile	Estimated maximum strikes per day	Hours of pile driving per 12-hr daily pile driving work period
18–24 in (0.5–0.6 m)	3	300	900	0.375
36–48 in (0.9–1.2 m)	3	300	900	0.375
Total	6	N/A	1,800	0.75

Barges would be used as platforms for conducting work activities and to haul materials and equipment to and from the work site. Barges would be moored with steel pipe piles adjacent to temporary work bridges or bents. Several types and sizes of barges would be used according to specific function. No more than nine barges are estimated to be present in North Portland Harbor at any one time during the construction period.

Following installation of the drilled shafts, the temporary work structures and their support piles would be removed through vibratory methods. Other temporary piles would be installed to moor barges adjacent to the new bents. These non-load bearing piles would be installed through vibratory methods only. The installation of steel pipe piles would occur throughout the construction period. Steel piles would be installed and removed during the multi-year construction of the temporary support structures. Although the project would use over 500 piles in the North Portland Harbor, only 100 to 200 piles are estimated to be in the water at any one time.

Debris Removal—Debris from previous structures, including foundations from the 1917 and 1953 bridges, may be present in North Portland Harbor at some locations where drilled shafts would be installed. This debris is likely to consist of large rock or old concrete. Because casings cannot advance through this type of material, it must be removed. Removal would consist of capturing the debris in a clamshell bucket. Capture of sediment would be limited. Debris would be placed in an upland location, and disposed of at a landfill if appropriate. Debris removal activities would be limited to the designated in-water work window of November 1 through February 28. Removal activities would take no more than 10 days over the course of construction.

Before debris removal begins, divers would pinpoint the location of the material. Debris removal would only occur in the precise locations where material overlaps with the footprint of the new shafts, greatly minimizing the areal extent of the activity. The amount of material in this location is unknown; however, assuming a worst-case scenario (that the area of the material is the same as the footprint of the drilled shafts), the project would remove debris in no more than 31 locations over an area of roughly 2,433 ft^2 (226 m^2). No more than 90 yd^3 (69 m^3) of material would be removed. If any items are found during excavation that contain potential contaminants (e.g., buried drums, car bodies containing petroleum products), activities to control and clean up contaminants would be implemented in accordance with the project's approved Spill Prevention, Control, and Countermeasures (SPCC) plan.

Permanent Structures—In-water drilled shaft construction for the North Portland Harbor would occur as described for the Columbia River bridges. Installation of each drilled shaft is estimated to take approximately 10 days. However, the total duration of this activity could vary considerably depending on the type of equipment used, the quantity of available equipment, and on-site soil conditions. The total duration of drilled shaft installation would be approximately eighteen months. A maximum of 31 shafts would be installed for the North Portland Harbor bridges. Each bridge would have four to seven spans, each a maximum of 255 ft (78 m) long. Each new bridge would have three to five in-water bents, consisting of one to three 10-ft diameter (3 m) drilled shafts. Unlike the Columbia River piers, shafts would not be topped by a shaft cap. Current designs place all of the bents in shallow water (less than 20 ft (6 m) deep).

Columns would be constructed of cast-in-place reinforced concrete. Construction of cast-in-place columns would require cranes, work barges, and material barges continuously throughout this period. The superstructure would consist of girders and a deck. Girders would be constructed of structural steel, cast-in-place concrete, or precast concrete. Precast girders may be fabricated at a casting yard. A cast-in-place concrete deck would be placed on the girders.

Description of the Activity—Columbia River Bridge Demolition

The existing Columbia River bridges would be demolished after the new Columbia River bridges have been constructed and after associated interchanges are operating. The existing Columbia River bridges would be demolished in two stages: (1) Superstructure demolition and (2) substructure demolition.

Demolition of the superstructure would begin with removal of the counterweights. The lift span would be locked into place and the counterweights would be cut into pieces and transferred off-site via truck or barge. Next, the lift towers would be cut into manageable pieces and loaded onto barges by a crane. Prior to removal of the trusses, the deck would be removed by cutting it into manageable pieces; these pieces would be transported by barge or truck or by using a breaker, in which case debris would be caught on a barge or other containment system below the work area. After demolition of the concrete deck, trusses would be lifted off of their bearings and onto barges and transferred to a shoreline dismantling site.

The existing Columbia River bridge structures comprise eleven pairs of steel through-truss spans with reinforced concrete decks, including one pair of movable spans over the primary navigation channel and one pair of 531-ft long (162 m) span trusses. The remaining nine pairs of trusses range from 265 to 275 ft (81–84 m) in length. In addition to the trusses, there are reinforced concrete approach spans (over land) on either end of the bridges.

Nine sets of the eleven existing Columbia River bridge piers are below the ordinary high water (OHW) level and are supported on a total of approximately 1,800 driven timber piles. Demolition methods are not finalized; however, the final design would consider factors such as pier depth, safety, phasing constraints, and impacts to aquatic species. Demolition of the concrete piers and timber piling foundations would be accomplished using one of two methods:

1. After removal of the trusses, a cofferdam would be installed at each of the nine in-water bridge piers to contain demolition activities. Cofferdams would not be dewatered. The piers would be broken up and removed from within the cofferdam. Timber piles that pose a navigation hazard would then be extracted or cut off below the mud line.

2. A diamond wire/wire saw would be used to cut the piers into manageable chunks that would be transported offsite. Cofferdams would not be used. Timber piles would then be extracted or cut off below the mud line. With either method, the pieces of the piers would be removed via barge.

Although maintenance personnel regularly inspect the existing bridge, the timber piles located underneath the existing piers are inaccessible and have not been inspected. Therefore, it is unknown whether these timber piles have been treated with creosote, but given their age and intended purpose, it is assumed that they have been so treated. Only piles that could pose a navigation hazard would be removed or cut off below the mud line. These piles include those that are present in the proposed navigation channels and any that extend above the surface of the river bed. Piles would be removed (using a vibratory extractor, direct pull, or clam shell dredge) or cut off below the mud line using an underwater saw. The exact number of piles to be removed is unknown.

A conceptual demolition sequence was determined based on the amount of equipment likely available to build the project and the physical space the equipment requires at each pier. The sequence is provided in Appendix A, Figures 12–16 of CRC's application. The actual construction sequence would be determined by the contractor once a construction contract is awarded. Demolition would occur after the new Columbia River replacement bridges are built. Demolition activities would take approximately eighteen months, from approximately September 2019 until March 2021. However, some demolition activities could occur during the period of this proposed rule.

Temporary Structures—Temporary cofferdams would be required to isolate work activities and temporary piles would be installed to anchor work and material barges during demolition of the spans and in-water piers. If the diamond wire/wire saw is not used, a temporary cofferdam consisting of interlocking sections of sheet piles would be used to isolate demolition activities at each of the nine in-water piers. Sheet piles for cofferdams would be installed with a vibratory hammer or a press-in method. Up to three cofferdams would be in place at any given time. Sheet piles would be removed using a vibratory hammer or direct pull.

Barges would be used as platforms to perform the demolition and to haul materials and equipment to and from the work site. Several types and sizes of barges are anticipated to be used for bridge demolition. The type and size of each barge would depend on how the barge is used. Up to six stationary or moving barges are expected to be present at any one time during bridge demolition. Over 300 steel pipe piles would be used to anchor and support the work and material barges necessary for demolition. Table 6 summarizes temporary pile use during bridge demolition. All temporary piles would be installed using a vibratory hammer or push-in method. They would be extracted using vibratory methods or direct pull. Piles would be installed and removed continuously throughout the demolition process.

TABLE 6—SUMMARY OF BARGES AND TEMPORARY PILES USED IN BRIDGE DEMOLITION

Application	Locations	Barges per location	Piles per barge	Total piles	Duration in water (days/location)
Span removal	9	4–6	4	160	30
Pier demolition	9	4	4	144	30
Total			304		

Equipment required for bridge demolition includes barge-mounted cranes/hammers or hydraulic rams. Vibratory hammers would be used to install and remove sheet piles for cofferdams and pipe piles for barge moorings. New permanent piles would not be required for demolition of the Columbia River bridges.

Method of Incidental Taking

Vibratory and impact pile installation and removal, and steel casing installation, may result in behavioral disturbance, constituting Level B harassment. Project construction would require the installation and removal of approximately 1,500 temporary steel piles. In addition to pile and casing installation, behavioral disturbance could also be caused by increased activity and vessel traffic, airborne sound from the equipment and human work activity, as well as underwater sound from debris removal, vessels, and physical disturbance.

Table 7 summarizes the extent, timing, and duration of impact pile driving. Impact pile driving is expected to take place only within a 31-week in-water work window, ranging from September 15 to April 15 over the bridge construction period. There would be a total of about 138 days of impact pile driving in the Columbia River and about 134 days of impact pile driving in North Portland Harbor for the entire project from the start of bridge construction in 2013 to its anticipated completion in 2017 (approximately 4.25 years for both Columbia River and North Portland Harbor Bridges). Impact pile driving in the mainstem Columbia River would occur at more than one pier complex on about 1–2 days total during the course of the approximately 4-year construction period. Impact pile driving would be restricted to approximately 45 minutes per 12-hour work day. A sound attenuation device would generally be used for all impact pile driving, with the exception of weekly testing of the attenuation device, requiring that some impact hammering occur with the device turned off in order to compare produced sound with that produced while the device is on. This would occur for a maximum of 7.5 minutes per week. Each work day would include a period of at least 12 consecutive hours with no impact pile driving in order to minimize disturbance to aquatic animals. Impact pile driving would only occur during daylight hours. Airborne sound effects from impact pile driving would occur on the same schedule as described in Table 7.

TABLE 7—SUMMARY OF IMPACT PILE DRIVING

Pile size	Columbia River		North Portland Harbor	
	Duration	Days	Duration	Days
18–24 in (without attenuation device)	7.5 min/week	38	2.5–5 min/week	18
18–24 in (with attenuation device)	45 min/day	138	45 min/day	72
36–48 in (without attenuation device)	7.5 min/week	38	2.5–5 min/week	31
36–48 in (with attenuation device)	45 min/day	138	45 min/day	62

Table 8 summarizes the extent, timing, and duration of vibratory installation of pipe pile and sheet pile. Vibratory installation of pipe pile is likely to occur throughout the entire 5-year duration of the proposed regulations period during construction of all new in-water piers or bents and for installation of mooring piles. Vibratory installation of sheet pile would only occur in the Columbia River during construction of the new Columbia River bridges and demolition of the existing Columbia River bridges. This activity would occur intermittently throughout the construction and demolition period. Vibratory activity is not restricted to an in-water work window, and therefore may take place during any time of the year. If steel casings for drilled shafts are vibrated into place, the CRC project design team estimates that installation of the 10-ft-diameter casings would take approximately 90 days in the Columbia River and 31 days in North Portland Harbor.

TABLE 8—SUMMARY OF VIBRATORY PILE DRIVING

Pile type	Columbia River		North Portland Harbor	
	Duration	Days	Duration	Days
Pipe pile	Up to 5 hours/day	1,470–1,620	Up to 5 hours/day	334
Sheet pile	Up to 24 hours/day	99	N/A	N/A
Steel casings		90		31

Debris removal is not certain to occur, but is included to present the fullest disclosure of potential effects. It is possible that debris removal would occur in North Portland harbor at the location of each of the new piers where there is anecdotal evidence that riprap occurs within the pier footprints. The exact quantity of this material is unknown, but as a worst-case scenario this activity would remove approximately 90 yd^3 (69 m^3) of material over an area of approximately 2,433 ft^2 (226 m^2) from all piers combined. Debris removal would produce sound through use of a bucket dredge, for up to 12 hours per day for a maximum of 7 days during the November 1–February 28 in-water work window each year.

Description of Sound Sources

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in Hz or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds, which is why the lower frequency sound associated with the proposed activities would attenuate more rapidly in shallower water. Amplitude is the height of the sound pressure wave or the 'loudness' of a sound and is typically measured using the decibel (dB) scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards). It is a logarithmic unit that accounts for large variations in amplitude; therefore, relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs; the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Rms is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1975). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in all directions away from the source (similar to ripples on the surface of a pond), except in cases where the source is directional. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

The underwater acoustic environment consists of ambient sound, defined as environmental background sound levels lacking a single source or point (Richardson *et al.,* 1995). The ambient underwater sound level of a region is defined by the total acoustical energy being generated by known and unknown sources, including sounds from both natural and anthropogenic sources. These sources may include physical (e.g., waves, earthquakes, ice, atmospheric sound), biological (e.g., sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (e.g., vessels, dredging, aircraft, construction). Known sound levels and frequency ranges associated with anthropogenic sources similar to those that would be used for this project are summarized in Table 9. Details of each of the sources are described in the following text.

TABLE 9—REPRESENTATIVE SOUND LEVELS OF ANTHROPOGENIC SOURCES

Sound source	Frequency range (Hz)	Underwater sound level (dB re 1 μPa)	Reference
Small vessels	250–1,000	151 dB rms at 1 m	Richardson *et al.,* 1995.
Tug docking gravel barge	200–1,000	149 dB rms at 100 m (328 ft)	Blackwell and Greene, 2002.
Vibratory driving of 72-in (1.8 m) steel pipe pile.	10–1,500	180 dB rms at 10 m (33 ft)	Caltrans, 2007.
Impact driving of 36-in (0.9 m) steel pipe pile.	10–1,500	195 dB rms at 10 m	WSDOT, 2007.
Impact driving of 66-in (1.7 m) CISS [1] piles.	100–1,500	195 dB rms at 10 m	Reviewed in Hastings and Popper, 2005.

[1] CISS = cast-in-steel-shell.

The CRC project would produce underwater sound through installation of piles for temporary in-water work platforms and temporary barge moorings, and vibratory installation of steel casings for drilled shafts. Piles would be installed by using impact and/or vibratory hammers, or by press-in techniques that do not produce notable underwater sound.

Several types of impact hammers are commonly used to install in-water piles: air-driven, steam-driven, diesel-driven, and hydraulic. Impact hammers operate by repeatedly dropping a heavy piston onto a pile to drive the pile into the substrate. Sound generated by impact hammers is characterized by rapid rise times and high peak levels, a potentially injurious combination (Hastings and Popper, 2005). Table 10 summarizes observed underwater sound levels generated by driving various types and sizes of piles. Sound generated by impact pile driving is highly variable, based on site-specific conditions such as substrate, water depth, and current. Sound levels may also vary based on the size of the pile, the type of pile, and the energy of the hammer.

TABLE 10—SUMMARY OF OBSERVED UNDERWATER SOUND LEVELS GENERATED BY IMPACT PILE DRIVING

Pile size, in (m)	Driver type	dB Peak	dB rms
12 (0.3)	Impact	208	191

TABLE 10—SUMMARY OF OBSERVED UNDERWATER SOUND LEVELS GENERATED BY IMPACT PILE DRIVING—Continued

Pile size, in (m)	Driver type	dB Peak	dB rms
14 (0.4)	Impact	[1] 195	[1] 180
16 (0.4)	Impact	[2] 200	[2] 187
24 (0.6)	Impact	212	189
30 (0.8)	Impact	212	195
36 (0.9)	Impact	214	201
60 (1.5)	Impact	210	195
66 (1.7)	Impact	210	195
96 (2.4)	Impact	220	205
126 (3.2)	Impact	[3] 213	[3] 202
150 (3.8)	Impact	[4] 200	[4] 185
12	Vibratory	171	155
24 (sheet), typical	Vibratory	175	160
24 (sheet), loudest	Vibratory	182	165
36 (typical)	Vibratory	180	170
36 (loudest)	Vibratory	185	175
72 (typical) (1.8)	Vibratory	183	170
72 (loudest)	Vibratory	195	180

Source: Caltrans, 2009
Note: Sound levels measured at a distance of 10 m except where indicated by the following footnotes: [1] 30 m; [2] 9 m; [3] 11 m; [4] 100 m.

Vibratory hammers install piles by vibrating them and allowing the weight of the hammer to push them into the sediment. Vibratory hammers produce much less sound than impact hammers. Peak SPLs may be 180 dB or greater, but are generally 10 to 20 dB lower than SPLs generated during impact pile driving of the same-sized pile (Caltrans, 2009). Rise time is slower, reducing the probability and severity of injury (USFWS, 2009), and sound energy is distributed over a greater amount of time (Nedwell and Edwards, 2002; Carlson *et al.,* 2001).

Vibratory hammers cannot be used in all circumstances. In some substrates, the capacity of a vibratory hammer may be insufficient to drive the pile to load-bearing capacity or depth (Caltrans, 2009). Additionally, some vibrated piles must be 'proofed' (i.e., struck with an impact hammer) for several seconds to several minutes in order to verify the load-bearing capacity of the pile (WSDOT, 2008).

Table 10 outlines typical sound levels produced by installation of various types of pile using a vibratory pile driver. Note that peak sound levels range from 171 to 195 dB, whereas peak sound levels generated by impact pile driving range from 195 to 220 dB.

Impact and vibratory pile driving are the primary in-water construction activities associated with the project. The sounds produced by these activities fall into one of two sound types: pulsed and non-pulsed (defined in next paragraph). Impact pile driving produces pulsed sounds, while vibratory pile driving produces non-pulsed sounds. The distinction between these two general sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (e.g., Ward, 1997 in Southall *et al.,* 2007). Please see Southall *et al.* (2007) for an in-depth discussion of these concepts.

Pulsed sounds (e.g., explosions, gunshots, sonic booms, seismic pile driving pulses, and impact pile driving) are brief, broadband, atonal transients (ANSI, 1986; Harris, 1998) and occur either as isolated events or repeated in some succession. Pulsed sounds are all 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. Pulsed sounds generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds (which may be intermittent or continuous) can be tonal, broadband, or both. Some of these non-pulse sounds can be transient signals of short duration but without the essential properties of pulses (e.g., rapid rise time). Examples of non-pulse sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems. The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

Sound Attenuation Devices

Sound levels can be greatly reduced during impact pile driving using sound attenuation devices. There are several types of sound attenuation devices including bubble curtains, cofferdams, and isolation casings. Three types of attenuation devices are described here.

Bubble curtains create a column of air bubbles rising around a pile from the substrate to the water surface. The air bubbles absorb and scatter sound waves emanating from the pile, thereby reducing the sound energy. Bubble curtains may be confined or unconfined. An unconfined bubble curtain may consist of a ring seated on the substrate and emitting air bubbles from the bottom. An unconfined bubble curtain may also consist of a stacked system, that is, a series of multiple rings placed at the bottom and at various elevations around the pile. Stacked systems may be more effective than non-stacked systems in areas with high current and deep water (Caltrans, 2009).

A confined bubble curtain contains the air bubbles within a flexible or rigid sleeve made from plastic, cloth, or pipe. Confined bubble curtains generally offer higher attenuation levels than unconfined curtains because they may physically block sound waves and they prevent air bubbles from migrating away from the pile. For this reason, the confined bubble curtain is commonly used in areas with high current velocity (Caltrans, 2009). In Oregon, confined bubble curtains are typically required where current velocity is 0.6 m/s or greater (NMFS, 2008a).

Cofferdams are often used during construction for isolating the in-water work area, but may also be used as a sound attenuation device. Dewatered cofferdams may provide the highest levels of sound reduction of any attenuation device; however, they do not eliminate underwater sound because sound can be transmitted through the substrate (Caltrans, 2009). Cofferdams that are not dewatered provide very limited reduction in sound levels.

An isolation casing is a hollow pipe that surrounds the pile, isolating it from the in-water work area. The casing is dewatered before pile driving. This device provides levels of sound attenuation similar to that of bubble curtains; however, attenuation rates are not as great as those achieved by cofferdams because the dewatered area between the pile and the water column is generally much smaller (Caltrans, 2009).

Both environmental conditions and the characteristics of the sound attenuation device may influence the effectiveness of the device. According to Caltrans (2009):

- In general, confined bubble curtains attain better sound attenuation levels in areas of high current than unconfined bubble curtains. If an unconfined device is used, high current velocity may sweep bubbles away from the pile, resulting in reduced levels of sound attenuation.
- Softer substrates may allow for a better seal for the device, preventing leakage of air bubbles and escape of sound waves. This increases the effectiveness of the device. Softer substrates also provide additional attenuation of sound traveling through the substrate.
- Flat bottom topography provides a better seal, enhancing effectiveness of the sound attenuation device, whereas sloped or undulating terrain reduces or eliminates its effectiveness.
- Air bubbles must be close to the pile; otherwise, sound may propagate into the water, reducing the effectiveness of the device.
- Harder substrates may transmit ground-borne sound and propagate it into the water column.

The literature presents a wide array of observed attenuation results (see, e.g., WSF, 2009; WSDOT, 2008; USFWS, 2009; Caltrans, 2009). The variability in attenuation levels is due to variation in design, as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. WSDOT personnel have observed that, on average, unconfined bubble curtains typically achieve 9 dB of attenuation while confined bubble curtains achieve 12 dB. Caltrans (2009) offers the following generalizations:

- For steel or concrete pile 24 in (0.6 m) in diameter or less, bubble curtains would generally reduce sound levels by 5 dB.
- For steel pile measuring 24 to 48 in (0.6–1.2 m), bubble curtains may reduce sound levels by about 10 dB.
- For piles greater than 48 in diameter, bubble curtains may reduce sound levels by about 20 dB.
- As a general rule, reductions of greater than 10 dB cannot be reliably predicted.

Sound Thresholds

Since 1997, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might result in impacts to a marine mammal such that a take by harassment or injury might occur (NMFS, 2005b). To date, no studies have been conducted that examine impacts to marine mammals from pile driving sounds from which empirical sound thresholds have been established. Current NMFS practice regarding exposure of marine mammals to high level sounds is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB rms or above, respectively, are considered to have been taken by Level A (i.e., injurious) harassment. Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds at or above 160 dB rms for impulse sounds (e.g., impact pile driving) and 120 dB rms for non-pulsed sound (e.g., vibratory pile driving), but below injurious thresholds. For airborne sound, pinniped disturbance from haul-outs has been documented at 100 dB (unweighted) for pinnipeds in general, and at 90 dB (unweighted) for harbor seals. NMFS uses these levels as guidelines to estimate when harassment may occur.

Distance to Sound Thresholds

The extent of project-generated sound both in and over water was calculated for the locations where pile driving would occur in the Columbia River and North Portland Harbor. The extent of underwater sound was modeled for several pile driving scenarios:

- For two sizes of pile: 18- to 24-in (0.5–0.6 m) pile and 36- to 48-in (0.9–1.2 m) pile.
- For single impact pile drivers operating both with and without an attenuation device. Use of an attenuation device was assumed to decrease initial SPLs by 10 dB (see discussion previously in this document).
- For vibratory driving of pipe pile and sheet pile.

Underwater Sound—Models may be used to estimate the distances and areas within which sound is likely to exceed certain threshold levels. Please note that the results of such modeling are described here to provide a frame of reference for the reader. Actual distances and areas within which sound is likely to exceed certain threshold levels are known from collection of site-specific hydroacoustic monitoring data (see 'Test Pile Project', later in this document).

In the absence of site-specific data, the practical spreading loss model may be used for determining the extent of sound from a source (Davidson, 2004; Thomsen *et al.,* 2006). The model assumes a logarithmic coefficient of 15, which equates to sound energy decreasing by 4.5 dB with each doubling of distance from the source. To calculate the loss of sound energy from one distance to another, the following formula is used:

$$\text{Transmission Loss (dB)} = 15 \log(D_1/D_0)$$

D_1 is the distance from the source for which SPLs need to be known, and D_0 is the distance from the source for which SPLs are known (typically 10 m from the pile). This model also solves for the distance at which sound attenuates to various decibel levels (e.g., a threshold or background level). The following equation solves for distance:

$$D_1 = D_0 \times 10^{(TL/15)}$$

where TL stands for transmission loss (the difference in decibel levels between D_0 and D_1). For example, using the distance to an injury threshold (D_1), the area of effect is calculated as the area of a circle, πr^2, where r (radius) is the distance to the threshold or background. If a landform or other shadowing element interrupts the spread of sound within the threshold distance, then the area of effect truncates at the location of the shadowing element.

Sound levels are highly dependent on environmental site conditions. Therefore, published hydroacoustic monitoring data for projects with similar site conditions as the CRC project were considered. WSDOT and the California Department of Transportation (Caltrans) have compiled hydroacoustic monitoring data from in-water impact pile driving. No projects with hydroacoustic monitoring data and similar site conditions were identified in the Columbia River.

A review of WSDOT and Caltrans projects containing in-water pile driving found projects in California had the most similar substrates and depths; however, only one project used 48-in pile, the largest size in the CRC project. This work occurred in the Russian River, which was only 15 m wide and 0.6 m deep at the project location. Therefore, the results are not applicable to the CRC project. Instead, data from projects that drove 36-in pile were used, using the highest sound levels encountered as proxy values for 48-in pile.

Maximum measured sound levels from 36-in steel pile installation were 201 dB rms (WSDOT, 2008), as shown in Table 10. Site conditions for this project, in Puget Sound, are somewhat comparable to the Columbia River, as both are large, with similar depths. The maximum source level from the next largest pile size, 60-in (1.5-m) pile, was 195 dB rms at 10 m. As such, the use of data from the 36-in pile measurements provides a more conservative estimate. The CRC project would also drive 18- to 24-in diameter steel pile. Conservatively, the highest recorded value of 189 dB rms for this range of pile sizes was used (see Table 10).

No studies were available that measured site-specific initial sound levels generated by vibratory pile driving in the Region of Activity. However, Table 10 outlines a range of typical sound levels produced by vibratory pile driving as measured by Caltrans during hydroacoustic monitoring of several construction projects (Caltrans, 2009). A worst-case scenario of installing 48-in steel pipe pile (the largest pile size to be used on the CRC project) at the loudest measured SPLs was considered, however, as there were no data for 48-in pile, it was assumed that sound levels for 48-in pile would be intermediate between those levels generated by 36-in pile and 72-in (1.8-m) pile. Typical values for both 36- and 72-in pile were 170 dB, while the loudest values were 175 dB for 36-in pile and 180 dB for 72-in pile. Thus, 175 dB was considered an appropriate value for initial SPLs for vibratory driving of pipe pile. The project may also install sheet pile, in the Columbia River only. In general, installation of sheet pile produces lower SPLs than pipe pile. Using data presented in Table 10, an initial SPL of approximately 160 dB rms at a distance of 15 m was assumed. Table 11 shows the calculated distances required for underwater sound to attenuate to relevant thresholds, as per the practical spreading model (please see Figures B–1 to B–6 of CRC's application for graphical depictions of threshold distances discussed here).

TABLE 11—CALCULATED DISTANCES TO SOUND THRESHOLDS

Threshold	Pile size	Distance to threshold (without attenuation device) (m)	Distance to threshold (with attenuation device)* (m)
Injury: 190 dB rms	18–24 in	9	2
Harassment: 160 dB rms	18–24 in	858	185
Injury: 190 dB rms	36–48 in	54	12
Harassment: 160 dB rms	36–48 in	5,412	1,166
Harassment: 120 dB rms	36–72 in	23,208	n/a
Harassment: 120 dB rms	24-in sheet pile	6,962	n/a

* 10 dB reduction in SPLs assumed from use of attenuation device.

Landforms in the Columbia River and North Portland Harbor would block underwater sound well before it reaches certain calculated distances. Table 12 shows actual site-specific values for the maximum distance within which sound is likely to exceed a given threshold level until contact with landforms. Categories not listed in Table 12 would remain the same as shown in Table 11.

TABLE 12—ACTUAL DISTANCES TO SOUND THRESHOLDS

Threshold	Pile size	Location*	Upstream (m)	Downstream (m)
Harassment: 160 dB rms	36–48 in (without attenuation)	NPH	3,058	5,412
Harassment: 120 dB rms	36–72 in	CR	20,166	8,851
Harassment: 120 dB rms	36–72 in	NPH	3,058	5,632

* NPH = North Portland Harbor; CR = Columbia River.

Airborne Sound—For calculating the levels and extent of project-generated airborne sound, a point sound source and hard-site conditions were assumed because pile drivers would be stationary, and work would largely occur over open water and adjacent to an urbanized landscape. Thus, calculations assumed that pile driving sound would attenuate at a rate of 6 dB per doubling distance, based on a spherical spreading model. The following formula was used to determine the distances at which pile-driving sound attenuates to the 90 dB rms and 100 dB rms (re: 20 µPa; all airborne SPLs discussed here are referenced to 20 µPa) airborne disturbance thresholds:

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

where D_1 is the distance from the pile at which sound attenuates to the threshold value, D_0 is the distance from the pile at which the initial SPLs were measured, and α is the variable for soft-site or hard-site conditions. These calculations used $\alpha = 20$ for hard-site conditions.

The estimate of initial sound level is based on the results of monitoring performed by WSDOT during pile driving at Friday Harbor Ferry Terminal (Laughlin, 2005b). The results showed airborne rms sound levels of 112 dB taken at 160 ft (49 m) from the source during impact pile driving. This project drove 24-in steel pipe pile, which is only half the size of the largest pile proposed for use in the CRC project. However, airborne sound levels are independent of the size of the pile (CRC, 2010), and therefore the sound levels encountered at Friday Harbor are applicable to the CRC project.

The model used 112 dB rms at 160 ft from the source as the initial sound level for a single pile driver. Because multiple pile drivers would not strike piles synchronously, operation of multiple pile drivers would not generate sound louder than that of a single pile driver. Therefore, initial sound levels for multiple pile drivers were assumed to be the same as for a single pile driver. The CRC project is not likely to use an airborne sound-attenuation device. Sound generated by impact pile driving in the Columbia River and North Portland Harbor is likely to exceed the 100 dB rms airborne disturbance threshold within 195 m of the source and is likely to exceed the 90 dB rms airborne disturbance threshold within 650 m of the source.

Debris Removal—Debris removal may occur in North Portland Harbor at the location of each of the new piers where there is anecdotal evidence that riprap occurs within the pier footprints. Debris removal in the North Portland Harbor, if it occurs, is likely to create sound at or above the 120-dB disturbance threshold for continuous sound in underwater portions of the Region of Activity.

Few studies have been conducted on sound emissions produced by underwater debris removal. A review of the literature indicates that underwater debris removal would produce sound in the range of 135 dB to 147 dB at 10 m (Dickerson *et al.,* 2001; OSPAR, 2009; Thomsen *et al.,* 2009).

Underwater debris removal is not expected to generate significant airborne sound. The air-water interface creates a substantial sound barrier and reduces the intensity of underwater sound waves by a factor of more than 1,000 when they cross the water surface. The above-water environment is, thus, virtually insulated from the effects of underwater sound (Hildebrand, 2005). Therefore, underwater debris removal is not expected to measurably increase ambient airborne sound. Underwater sound from debris removal would likely attenuate to the 120-dB underwater disturbance threshold for continuous sound within 631 m of the source. This activity would occur for only 7 days, during the in-water work window.

Test Pile Project

In February 2011, CRC conducted a test pile project in order to acquire geotechnical and sound propagation data to assess site-specific characteristics and verify the modeling results discussed in the preceding section, and to assess mitigation measures related to pile installation activities planned for the CRC project. Please see CRC's Test Pile Hydroacoustic Monitoring Report for detailed analysis (**SUPPLEMENTARY INFORMATION**).

Engineering objectives included the following:

• Determine strike numbers necessary to install piles to reach load-bearing capacity with an impact hammer;

• Identify suitable equipment and materials and verify production rates for pile installation;

• Determine the feasibility of vibratory installation methods; and

• Validate geotechnical and engineering calculations.

Environmental objectives included the following:

• Determine the underwater sound levels resulting from vibratory installation of temporary piles in the predominant substrate types found at typical mid-channel depths at the project site;

• Determine the underwater sound levels resulting from impact installation of temporary piles in the predominant substrate types found at typical mid-channel depths at the project site;

• Determine the effectiveness of two sound attenuation strategies (unconfined and confined bubble curtains) during impact pile driving;

• Determine the transmission loss of pile installation sound for both impact and vibratory installation;

• Determine the extent of construction sound impacts in-air for impact pile driving; and

• Determine the extent of turbidity plumes resulting from vibratory and impact pile installation and extraction, and from unconfined and confined bubble curtain operation.

Test pile operations consisted of impact driving or vibratory driving at six pile locations using 24- and 48-in piles. A confined or unconfined bubble curtain was tested during each pile installation. Background sound level monitoring was successfully conducted between January 27 and February 3, 2011. The background sound level at fifty percent cumulative distribution function (CDF) on the Washington (north) side of the river was found to be 110 dB, while the background level at fifty percent CDF on the Oregon (south) side of the river was slightly higher at 117 dB.

Hydroacoustic monitoring was successfully conducted during test pile construction activities February 11–21, 2011. Rms pressure levels associated with vibratory driving varied widely pile to pile; subsurface driving conditions are the likely cause of this variability. For impact driving, average sound levels were derived for both 24-in and 48-in piles. Impact driving on 48-in piles was, on average, 10 dB louder than driving on 24-in piles.

Measured sound levels for both vibratory driving and impact driving were similar to those expected as outlined previously in this document. For vibratory driving, the maximum observed sound level was 181 dB, only slightly louder than the anticipated maximum sound level (180 dB). For impact driving, observed unattenuated rms sound levels for 24-in piles were 191 dB, slightly louder than anticipated (189 dB). Unattenuated rms sound levels for 48-in piles (201 dB) were as anticipated. The average rms pressure level for vibratory pile extraction was 173 dB, and did not appear to vary with pile size. The 173 dB observed for extraction was slightly less than the 176 dB average observed during pile installation. The variance of the pressure levels was also less, with extraction values ranging from 167–176 dB while installation values ranged from 157–181 dB.

Open curtain attenuation methods reduced the sound levels for 48-in piles 11 dB on average, and 9 dB on average for 24-in piles. Confined curtain attenuation methods reduced the sound levels for 48-in piles 13 dB on average, and 8.5 dB on average for 24-in piles. Open bubble curtain attenuation was similar to confined curtain attenuation at 10 m downstream; however, the effectiveness of the open bubble curtain appeared to be significantly less upstream when compared to downstream, likely due to the effect of current on the open bubble curtain. The observed effectiveness of both open and confined bubble curtains at attenuating peak amplitudes (8–13 dB) was approximately as anticipated (10 dB).

Transmission loss was analyzed for both vibratory driving and impact driving. Transmission loss for vibratory driving was in line with the practical spreading model, as anticipated. However, this analysis is based on results from only one pile; for two of the piles, the signal could not be distinguished from background noise at 200 m, while for a third pile, the signal could not be distinguished from background noise at 800 m. Thus, transmission loss could not be calculated for those piles, although energy from those piles clearly showed rapid attenuation. Transmission loss for impact driving was in line with the practical spreading model at the 200-m range, but steadily increased toward spherical spreading with increasing range, resulting in greater than anticipated transmission loss.

The data for transmission loss associated with vibratory driving suggest that the majority of the energy occurs in frequencies below 1,000 Hz, with energy levels gradually falling off at higher frequencies (CRC, 2011). For vibratory installation in this study, driving of two piles produced energy that could not be distinguished from background by 200 m, while the signal from a third could not be detected at the 800 m station. The signal was distinguishable from background sound levels at approximately 800 m for only one of the piles, indicating that distance to the threshold would likely be less than the modeling results predicted. However, background sound levels during pile driving were higher than those measured previously. It is possible that increased background levels resulted from sound associated with the project, instrumentation, or some other source. Nevertheless, data indicate that transmission loss for vibratory driving is approximately in conformance with practical spreading loss. Piles were generally installed or extracted during the test pile study in less than 5 minutes (ranging from less than 1 minute to less than 10 minutes, for all but one outlier).

Measured, site-specific values were either substantially similar to assumed values or, in the case of transmission loss or realized attenuation from use of bubble curtains in certain circumstances, the assumed values described previously in this document were more conservative than the actual values. As such, those values remain valid but likely represent a significantly more conservative scenario than would realistically occur. Actual distances to be monitored for potential injury or harassment of pinnipeds would be based on the results of in-situ hydroacoustic monitoring, where relevant, and are discussed in greater detail in 'Proposed Mitigation', later in this document.

Comments and Responses

On December 15, 2010, NMFS published a notice of receipt of an application for a Letter of Authorization (LOA) in the **Federal Register** (75 FR 78228) and requested comments and information from the public for 30 days. NMFS did not receive any substantive comments.

Description of Marine Mammals in the Area of the Specified Activity

Marine mammal species that have been observed within the Region of Activity consist of the harbor seal, California sea lion, and Steller sea lion. Pinnipeds follow prey species into freshwater up to, primarily, the Bonneville Dam (RM 145, RKm 233) in the Columbia River, but also to Willamette Falls in the Willamette River (RM 26, RKm 42). The Willamette River enters the Columbia River approximately 5 mi (8 km) downstream of the CRC project area and is within the Region of Activity. Harbor seals rarely, but occasionally, transit the Region of Activity. The eastern population of the Steller sea lion is listed as threatened under the ESA and as depleted and strategic under the MMPA. Neither the California sea lion nor the harbor seal is listed under the ESA, nor are they considered depleted or strategic under the MMPA.

The sea lions use this portion of the river primarily for transiting to and from Bonneville Dam, which concentrates adult salmonids and sturgeon returning to natal streams, providing for increased foraging efficiency. The U.S. Army Corps of Engineers (USACE) has conducted surface observations to evaluate the seasonal presence, abundance, and predation activities of pinnipeds in the Bonneville Dam tailrace each year since 2002. This monitoring program was initiated in response to concerns over the potential impact of pinniped predation on adult salmonids passing Bonneville Dam in the spring. An active sea lion hazing, trapping, and permanent removal program was in place below the dam from 2008 through 2010. Much of the information presented in this application is based on research conducted as part of the Bonneville Dam sea lion program.

Pinnipeds remain in upstream locations for a couple of days or longer, feeding heavily on salmon, steelhead, and sturgeon (NOAA 2008), although the occurrence of harbor seals near Bonneville Dam is much lower than sea lions (Stansell *et al.,* 2009). Sea lions congregate at Bonneville Dam during the peaks of salmon return, from March through May each year, and a few California sea lions have been observed feeding on salmonids in the area below Willamette Falls during the spring adult fish migration (NOAA, 2008).

There are no pinniped haul-out sites in the Region of Activity. The nearest haul-out sites, shared by harbor seals and California sea lions, are near the Cowlitz River/Carroll Slough confluence with the Columbia River, approximately 45 mi (72 km) downriver from the Region of Activity (Jeffries *et al.,* 2000). The nearest known haul-out for Steller sea lions is a rock formation (Phoca Rock) near RM 132 (RKm 212) approximately 8 mi (13 km) downstream of Bonneville Dam and 26 mi (42 km) upstream from the Region of Activity. Steller sea lions are also known to haul out on the south jetty at the mouth of the Columbia River, near Astoria, Oregon. There are no pinniped rookeries located in or near the Region of Activity.

Harbor Seal

Species Description—Harbor seals, which are members of the Phocid family (true seals), inhabit coastal and estuarine waters and shoreline areas from Baja California, Mexico to western Alaska. For management purposes, differences in mean pupping date (i.e., birthing) (Temte, 1986), movement patterns (Jeffries, 1985; Brown, 1988), pollutant loads (Calambokidis *et al.,* 1985) and fishery interactions have led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng, 1988). The three distinct stocks are: (1) Inland waters of Washington (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), (2) outer coast of Oregon and Washington, and (3) California (Carretta *et al.* 2007b). The seals in the Region of Activity are from the outer coast of Oregon and Washington stock.

The average weight for adult seals is about 180 lb (82 kg) and males are typically slightly larger than females. Male harbor seals weigh up to 245 lb (111 kg) and measure approximately 5 ft (1.5 m) in length. The basic color of harbor seals' coat is gray and mottled but highly variable, from dark with light color rings or spots to light with dark markings (NMFS, 2008c).

Status—In 1999, the population of the Oregon/Washington coastal stock of harbor seals was estimated at 24,732 animals (Carretta *et al.,* 2007a). Although this abundance estimate represents the best scientific information available, per NMFS stock assessment policy it is not considered current because it is more than 8 years old. This harbor seal stock includes coastal estuaries (Columbia River) and bays (Willapa Bay and Grays Harbor). Both the Washington and Oregon portions of this stock are believed to have reached carrying capacity and the stock is within its optimum sustainable population level (Jeffries *et al.,* 2003; Brown *et al.,* 2005). Because there is no current estimate of minimum abundance, potential biological removal (PBR) cannot be calculated for this stock. However, the level of human-caused mortality and serious injury is less than ten percent of the previous PBR of 1,343 harbor seals per year (Carretta *et al.,* 2007), and human-caused mortality is considered to be small relative to the stock size. Therefore, the Oregon and Washington outer coast stock of harbor seals are not classified as a strategic stock under the MMPA.

Behavior and Ecology—Harbor seals are non-migratory with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp, 1944; Fisher, 1952; Bigg, 1969, 1981). They are not known to make extensive pelagic migrations, although some long distance movement of tagged animals in Alaska (174 km), and along the U.S. west coast (up to 550 km), have been recorded (Pitcher and McAllister, 1981; Brown and Mate, 1983; Herder, 1986). Harbor seals are coastal species, rarely found more than 12 mi (20 km) from shore, and frequently occupy bays, estuaries, and inlets (Baird, 2001). Individual seals have been observed several miles upstream in coastal rivers. Ideal harbor seal habitat includes haul-out sites, shelter during the breeding periods, and sufficient food (Bjorge, 2002).

Harbor seals haul out on rocks, reefs, beaches, and ice and feed in marine, estuarine, and occasionally fresh waters. Harbor seals display strong fidelity for haul-out sites (Pitcher and Calkins, 1979; Pitcher and McAllister, 1981), although human disturbance can affect haul-out choice (Harris *et al.,* 2003). Group sizes range from small numbers of animals on intertidal rocks to several thousand animals found seasonally in coastal estuaries. The harbor seal is the most commonly observed and widely distributed pinniped found in Oregon and Washington (Jeffries *et al.,* 2000; ODFW, 2010). Harbor seals use hundreds of sites to rest or haul out along the coast and inland waters of Oregon and Washington, including tidal sand bars and mudflats in estuaries, intertidal rocks and reefs, beaches, log booms, docks, and floats in all marine areas of the two states. Numerous harbor seal haul-out sites are found on intertidal mudflats and sand bars from the mouth of the lower Columbia River to Carroll Slough at the confluence of the Cowlitz and Columbia Rivers.

Harbor seals mate at sea and females give birth during the spring and summer, although the pupping season varies by latitude. Pupping seasons vary by geographic region with pups born in coastal estuaries (Columbia River, Willapa Bay, and Grays Harbor) from mid-April through June and in other areas along the Olympic Peninsula and Puget Sound from May through September (WDFW, 2000). Suckling harbor seal pups spend as much as forty percent of their time in the water (Bowen *et al.,* 1999).

They can be found throughout the year at the mouth of the Columbia River. Peak harbor seal abundances in the Columbia River occur during the winter and spring when a number of upriver haul-out sites are used. Peak abundances and upriver movements in the winter and spring months are correlated with spawning runs of eulachon (*Thaleichthys pacificus*) smelt and out-migration of salmonid smolts. Harbor seals are infrequently observed at Bonneville Dam or in the Region of Activity. In 2009 and again in 2010, two harbor seals were observed at the dam (Stansell *et al.,* 2009; Stansell and Gibbons, 2010), and observations of harbor seals at Bonneville Dam have ranged from one to three per year from 2002 to 2010.

Within the Region of Activity, there are no known harbor seal haul-out sites. The nearest known haul-out sites to the Region of Activity are located at Carroll Slough at the confluence of the Cowlitz and Columbia Rivers approximately 45 mi (72 km) downriver of the Region of Activity. The low number of observations of harbor seals at Bonneville Dam over the years, combined with the fact that no pupping or haul-out locations are within or upstream from the Region of Activity, suggest that very few harbor seals transit through the Region of Activity (Stansell *et al.,* 2010).

Acoustics—In air, harbor seal males produce a variety of low-frequency (less than 4 kHz) vocalizations, including snorts, grunts, and growls. Male harbor seals produce communication sounds in the frequency range of 100–1,000 Hz (Richardson *et al.,* 1995). Pups make individually unique calls for mother recognition that contain multiple harmonics with main energy below 0.35 kHz (Bigg, 1981; Thomson and Richardson, 1995). Harbor seals hear nearly as well in air as underwater and have lower thresholds than California sea lions (Kastak and Schusterman, 1998). Kastak and Schusterman (1998) reported airborne low frequency (100 Hz) sound detection thresholds at 65 dB for harbor seals. In air, they hear frequencies from 0.25–30 kHz and are most sensitive from 6–16 kHz (Richardson, 1995; Terhune and Turnbull, 1995; Wolski *et al.,* 2003).

Adult males also produce underwater sounds during the breeding season that typically range from 0.25–4 kHz (duration range: 0.1 s to multiple seconds; Hanggi and Schusterman 1994). Hanggi and Schusterman (1994) found that there is individual variation in the dominant frequency range of sounds between different males, and Van Parijs *et al.* (2003) reported oceanic, regional, population, and site-specific variation that could be vocal dialects. In water, they hear frequencies from 1–75 kHz (Southall *et al.,* 2007) and can detect sound levels as weak as 60–85 dB within that band. They are most sensitive at frequencies below 50 kHz; above 60 kHz sensitivity rapidly decreases.

California Sea Lions

Species Description—California sea lions are members of the Otariid family (eared seals). The species, *Zalophus californianus,* includes three subspecies: *Z. c. wollebaeki* (in the Galapagos Islands), *Z. c. japonicus* (in Japan, but now thought to be extinct), and *Z. c. californianus* (found from southern Mexico to southwestern Canada; referred to here as the California sea lion) (Carretta *et al.,* 2007). The breeding areas of the California sea lion are on islands located in southern California, western Baja California, and the Gulf of California (Carretta *et al.,* 2007). These three geographic regions are used to separate this subspecies into three stocks: (1) The U.S. stock begins at the U.S./Mexico border and extends northward into Canada, (2) the Western Baja California stock extends from the U.S./Mexico border to the southern tip of the Baja California peninsula, and (3) the Gulf of California stock which includes the Gulf of California from the southern tip of the Baja California peninsula and across to the mainland and extends to southern Mexico (Lowry *et al.,* 1992).

The California sea lion is sexually dimorphic. Males may reach 1,000 lb (454 kg) and 8 ft (2.4 m) in length; females grow to 300 lb (136 kg) and 6 ft (1.8 m) in length. Their color ranges from chocolate brown in males to a lighter, golden brown in females. At around 5 years of age, males develop a bony bump on top of the skull called a sagittal crest. The crest is visible in the dog-like profile of male sea lion heads, and hair around the crest gets lighter with age.

Status—The U.S. stock of California sea lions is estimated at 238,000 and the minimum population size of this stock is 141,842 individuals (Carretta *et al.,* 2007). These numbers are from counts during the 2001 breeding season of animals that were ashore at the four major rookeries in southern California and at haul-out sites north to the Oregon/California border. Sea lions that were at-sea or hauled-out at other locations were not counted (Carretta *et al.,* 2007). The stock has likely reached its carrying capacity and, even though current total human-caused mortality is unknown (due a lack of observer coverage in the California set gillnet fishery that historically has been the largest source of human-caused mortalities), California sea lions are not considered a strategic stock under the

MMPA because total human-caused mortality is still likely to be less than the PBR.

Behavior and Ecology—During the summer, California sea lions breed on islands from the Gulf of California to the Channel Islands and seldom travel more than about 31 mi (50 km) from the islands (Bonnell *et al.,* 1983). The primary rookeries are located in the California Channel Islands (Le Boeuf and Bonnell, 1980; Bonnell and Dailey, 1993). Their distribution shifts to the northwest in fall and to the southeast during winter and spring, probably in response to changes in prey availability (Bonnell and Ford, 1987).

The non-breeding distribution extends from Baja California north to Alaska for males, and encompasses the waters of California and Baja California for females (Reeves *et al.,* 2008; Maniscalco *et al.,* 2004). In the non-breeding season, an estimated 3,000 to 5,000 adult and sub-adult males migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island from September to May (Jeffries *et al.,* 2000) and return south the following spring (Mate, 1975; Bonnell *et al.,* 1983). During migration, they are occasionally sighted hundreds of miles offshore (Jefferson *et al.,* 1993). Females and juveniles tend to stay closer to the rookeries (Bonnell *et al.,* 1983).

California sea lions do not breed in Oregon. Though a few young animals may remain in Oregon during summer months, most return south for the breeding season (ODFW, 2010). Male California sea lions are commonly seen in Oregon from September through May. During this time period California sea lions can be found in many bays, estuaries and on offshore sites along the coast, often hauled-out in the same locations as Steller sea lions. Some pass through Oregon to feed along coastal waters to the north during fall and winter months (ODFW, 2010).

California sea lions feed on a wide variety of prey, including many species of fish and squid (Everitt *et al.,* 1981; Roffe and Mate, 1984; Antonelis *et al.,* 1990; Lowry *et al.,* 1991). In some locations where salmon runs exist, California sea lions also feed on returning adult and out-migrating juvenile salmonids (London, 2006). Sexual maturity occurs at around 4–5 years of age for California sea lions (Heath, 2002). California sea lions are gregarious during the breeding season and social on land during other times.

California sea lions are known to occur in several areas of the Columbia River during much of the year, except the summer breeding months of June through August. Approximately 1,000 California sea lions have been observed at haul-out sites at the mouth of the Columbia River, while approximately 100 individuals have been observed in past years at the Bonneville Dam between January and May prior to returning to their breeding rookeries in California at the end of May (Stansell, 2010). The nearest known haul-out sites to the Region of Activity are near the Cowlitz River/Carroll Slough confluence with the Columbia River, approximately 45 mi (72 km) downriver of the Region of Activity (Jeffries *et al.,* 2000).

The USACE's intensive sea lion monitoring program began as a result of the 2000 Federal Columbia River Power System (FCRPS) biological opinion, which required an evaluation of pinniped predation in the tailrace of Bonneville Dam. The objective of the study was to determine the timing and duration of pinniped predation activity, estimate the number of fish caught, record the number of pinnipeds present, identify and track individual California sea lions, and evaluate various pinniped deterrents used at the dam (Tackley *et al.,* 2008a). The study period for monitoring was January 1 through May 31, beginning in 2002. During the study period, pinniped observations began after consistent sightings of at least one animal occurred. Tackley *et al.* (2008a) note that sightings began earlier each year from 2002 to 2004. Although some sightings were reported earlier in the season, full-time observations began March 21 in 2002, March 3 in 2003, and February 24 in 2004 (Tackley *et al.,* 2008a). In 2005 observations began in April, but in 2006 through 2010 observations began in January or early February (Tackley *et al.,* 2008a, 2008b; Stansell *et al.,* 2009; Stansell and Gibbons, 2010). In 2009, 54 California sea lions were observed at Bonneville Dam, the fewest since 2002 (Stansell *et al.,* 2009). However, in 2010, 89 California sea lion individuals were observed at Bonneville Dam (Stansell *et al.,* 2010). In addition, up to four California sea lions have been observed at Bonneville Dam during the September–January period in recent years (CRC, 2010).

Up to eight California sea lions have been observed in recent years feeding on salmonids in the Willamette River below Willamette Falls (NOAA, 2008). The earliest known report of California sea lions at Willamette Falls was in 1975, when two sea lions were reported taking salmon and hindering fish passage at the fish ladder. Other than the 1975 sighting, there were no reports of sea lions at Willamette Falls until the late 1980s when personnel at the fish ladder reported California sea lion sightings below the falls. California sea lions were sighted sporadically near the falls until 1995 when they began occurring almost daily from February through late May (Scordino, 2010).

California sea lion arrival and departure dates at Bonneville Dam are compiled in Table 13 from the reports listed in the preceding paragraph. If arrival and departure dates were not available, the timing of surface observations within the January through May study period were recorded. Because regular observations in the study period generally began as California sea lions were observed below Bonneville Dam, and sometimes reports stated that observations stopped as sea lion numbers dropped, the observation dates only give a general idea of first arrival and departure. Because tracking data indicate that sea lions travel at fast rates between hydrophone locations above and below the CRC project area, dates of first arrival at Bonneville Dam and departure from the dam are assumed to coincide closely with potential passage timing through the CRC project area.

TABLE 13—ARRIVAL AND DEPARTURE DATES FOR CALIFORNIA SEA LIONS BELOW BONNEVILLE DAM

	2002	2003	2004	2005	2006	2007	2008 [3]	2009	2010
Arrival	[1] 3–21	[1] 3–03	[1] 2–24	[1] 4–11/1–21	2–09	1–08	[1] 1–11	[1] 1–14	[1] 1–08
Departure	[1] 5–24	[1] 6–02	[1] 5–30	[1] 5–31/6–10	6–02	[2] 5–26	[1] 5–31	[4] 5–19	6–04

[1] Dates are dates observations were taken and not when sea lions were first seen. In 2005 through 2007, observations were made intermittently until sea lions were seen consistently (Tackley *et al.,* 2008a). In 2005, surface observations were made from April 11 through May 31. However, the first California sea lion arrived January 21 and departed on June 10 (Tackley *et al.,* 2008a).

[2] A single sighting was made on November 7 (Tackley *et al.,* 2008a).

[3] Three California sea lions were observed between September and December 2008. These observations were opportunistic and outside the regular observation period of January through May (Stansell *et al.,* 2009).

[4] Observations ended because few sea lions were present. One California sea lion was in the Bonneville Dam forebay through at least August 11 (Stansell *et al.,* 2009).

Based on the information presented in Table 13, California sea lions have generally been observed at Bonneville Dam between early January and early June, although beginning in 2008, a few individuals have been noted at the dam as early as September and as late as August. Therefore, the majority of California sea lions are expected to pass the project site beginning in early January through early June. Stansell and Gibbons (2010) and Stansell *et al.* (2009) show that California sea lion abundance below Bonneville Dam peaks in April, when it drops through about the end of May. In 2010, California sea lions stayed below the dam until almost mid-June, which was late historically and enters into the time they normally depart for southern breeding grounds. Wright *et al.* (2010) reported a median start date for the southbound migration from the Columbia River to the breeding grounds of May 20 (range: May 7 to May 27; n = 8 sea lions).

The highest number of California sea lions observed in the Bonneville Dam tailrace over the last 9 years was 104 in 2003 (Stansell *et al.,* 2010). However, Tackley *et al.* (2008a) noted that numbers of sea lions estimated from early study years were likely underestimated, because the observers' ability to uniquely identify individuals increased over the years. In addition, the high number of 104 individuals present below the dam in 2003 occurred prior to hazing (2005) or permanent removal (2008) activities began. The high for the 2008 through 2010 time period is a minimum of 89 individuals in a year (Stansell *et al.,* 2010).

The Pacific States Marine Fisheries Commission (PSMFC) leads a tagging and tracking program for California sea lions, observing that the transit time for California sea lions between Astoria and Bonneville Dam is 30–36 hours upstream, and 15 hours downstream (CRC, 2010). ODFW studied the migration of male California sea lions during the nonbreeding season by satellite tracking 26 sea lions captured in the lower Columbia River over the course of three non-breeding seasons between November and May in 2003–04, 2004–05, and 2006–07.

Fourteen of the sea lions had previously been observed in the Columbia River ('river type') and twelve animals were 'unknown' types. Wright *et al.* (2010) found there was considerable within and between individual variation in spatial and temporal movements, which presumably reflected variation in foraging behavior. Many sea lions repeatedly alternated between several haul-out sites throughout the non-breeding season.

Twenty of the 26 satellite-tagged sea lions remained within the waters of Oregon and Washington during the time they were monitored; the remainder made forays north to British Columbia or south to California. All fourteen of the previously known 'river' sea lions were later documented upriver (either by tracking or direct observation); none of the twelve 'unknown' animals were detected upriver. Southward departure dates from the Columbia River ranged from May 7 to June 17. Travel time to the breeding grounds ranged from 12 to 21 days. Only one animal was tracked back to the Columbia River; it returned on August 18 after a 21-day trip from San Miguel Island (Wright *et al.,* 2010). Movement of sea lions to the base of Bonneville Dam to forage on salmonids was documented in only a fraction of the sea lions tracked, which suggested that the problem of pinniped predation on Columbia River salmonid stocks should be addressed primarily at upriver sites such as Bonneville Dam rather than in the estuary where sea lions of many behavioral types co-occur (Wright *et al.,* 2010).

Acoustics—On land, California sea lions make incessant, raucous barking sounds; these have most of their energy at less than 2 kHz (Schusterman *et al.,* 1967). Males vary both the number and rhythm of their barks depending on the social context; the barks appear to control the movements and other behavior patterns of nearby conspecifics (Schusterman, 1977). Females produce barks, squeals, belches, and growls in the frequency range of 0.25–5 kHz, while pups make bleating sounds at 0.25–6 kHz. California sea lions produce two types of underwater sounds: Clicks (or short-duration sound pulses) and barks (Schusterman *et al.,* 1966, 1967; Schusterman and Baillet, 1969). All of these underwater sounds have most of their energy below 4 kHz (Schusterman *et al.,* 1967).

The range of maximal hearing sensitivity for California sea lions underwater is between 1–28 kHz (Schusterman *et al.,* 1972). Functional underwater high frequency hearing limits are between 35–40 kHz, with peak sensitivities from 15–30 kHz (Schusterman *et al.,* 1972). The California sea lion shows relatively poor hearing at frequencies below 1 kHz (Kastak and Schusterman, 1998). Peak hearing sensitivities in air are shifted to lower frequencies; the effective upper hearing limit is approximately 36 kHz (Schusterman, 1974). The best range of sound detection is from 2–16 kHz (Schusterman, 1974). Kastak and Schusterman (2002) determined that hearing sensitivity generally worsens with depth—hearing thresholds were lower in shallow water, except at the highest frequency tested (35 kHz), where this trend was reversed. Octave band sound levels of 65–70 dB above the animal's threshold produced an average temporary threshold shift (TTS; discussed later in POTENTIAL EFFECTS OF THE SPECIFIED ACTIVITY ON MARINE MAMMALS) of 4.9 dB in the California sea lion (Kastak *et al.,* 1999).

Steller Sea Lions

Species Description—Steller sea lions are the largest members of the Otariid (eared seal) family. Steller sea lions show marked sexual dimorphism, in which adult males are noticeably larger and have distinct coloration patterns from females. Males average approximately 1,500 lb (680 kg) and 10 ft (3 m) in length; females average about 700 lb (318 kg) and 8 ft (2.4 m) in length. Adult females have a tawny to silver-colored pelt. Males are characterized by dark, dense fur around their necks, giving a mane-like appearance, and light tawny coloring over the rest of their body (NMFS, 2008a). Steller sea lions are distributed mainly around the coasts to the outer continental shelf along the North Pacific Ocean rim from northern Hokkaido, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to California. The population is divided into the western and the eastern distinct population segments (DPSs) at 144° W (Cape Suckling, Alaska). The western DPS includes Steller sea lions that reside in the central and western Gulf of Alaska, Aleutian Islands, as well as those that inhabit coastal waters and breed in Asia (e.g., Japan and Russia). The eastern DPS extends from California to Alaska, including the Gulf of Alaska.

Status—Steller sea lions were listed as threatened range-wide under the ESA in 1990. After division into two DPSs, the western DPS was listed as endangered under the ESA in 1997, while the eastern DPS remained classified as threatened. Animals found in the Region of Activity are from the eastern DPS (NMFS, 1997a; Loughlin, 2002; Angliss and Outlaw, 2005). The eastern DPS breeds in rookeries located in southeast Alaska, British Columbia, Oregon, and California. While some pupping has been reported recently along the coast of Washington, there are no active rookeries in Washington. A final revised species recovery plan addresses both DPSs (NMFS, 2008a).

NMFS designated critical habitat for Steller sea lions in 1993. Critical habitat is associated with breeding and haul-out sites in Alaska, California, and Oregon, and includes so-called 'aquatic zones' that extend 3,000 ft (900 m) seaward in state and federally managed waters from the baseline or basepoint of each major rookery in Oregon and California (NMFS, 2008a). Three major rookery sites in Oregon (Rogue Reef, Pyramid Rock, and Long Brown Rock and Seal Rock on Orford Reef at Cape Blanco) and three rookery sites in California (Ano Nuevo I, Southeast Farallon I, and Sugarloaf Island and Cape Mendocino) are designated critical habitat (NMFS, 1993). There is no designated critical habitat within the Region of Activity.

Factors that have previously been identified as threats to Steller sea lions include reduced food availability, possibly resulting from competition with commercial fisheries; incidental take and intentional kills during commercial fish harvests; subsistence take; entanglement in marine debris; disease; pollution; and harassment. Steller sea lions are also sensitive to disturbance at rookeries (during pupping and breeding) and haul-out sites.

The Recovery Plan for the Steller Sea Lion (NMFS, 2008a) states that the overall abundance of Steller sea lions in the eastern DPS has increased for a sustained period of at least three decades, and that pup production has increased significantly, especially since the mid-1990s. Between 1977 and 2002, researchers estimated that overall abundance of the eastern DPS had increased at an average rate of 3.1 percent per year (NMFS, 2008a; Pitcher *et al.,* 2007). NMFS' most recent stock assessment report estimates that population for the eastern DPS is a minimum of 52,847 individuals; this estimate is not corrected for animals at sea, and actual population is estimated to be within the range 58,334 to 72,223 (Allen and Angliss, 2010). The minimum count for Steller sea lions in Oregon and Washington was 5,813 in 2002 (Pitcher *et al.,* 2007; Allen and Angliss, 2010). Counts in Oregon have shown a gradual increase from 1,486 animals in 1976 to 4,169 animals in 2002 (NMFS, 2008b).

The abundance of the eastern DPS of Steller sea lions is increasing throughout the northern portion of its range (southeast Alaska and British Columbia), and stable or increasing in the central portion (Oregon through central California). Surveys indicate that pup production in Oregon increased at 3 percent per year from 1990–2009, while pup production in California increased at 5 percent per year between 1996 and 2009, with the number of non-pups reported as stable. The best available information indicates that, overall, the eastern DPS has increased from an estimated 18,040 animals in 1979 to an estimated 63,488 animals in 2009; therefore the overall estimated rate of increase for this period is 4.3 percent per year (NMML, 2012).

In the far southern end of Steller sea lion range (Channel Islands in southern California), population declined significantly after the 1930s—probably due to hunting and harassment (Bartholomew and Boolootian, 1960; Bartholomew, 1967)—and several rookeries and haul-outs have been abandoned. The lack of recolonization at the southernmost portion of the range (e.g., San Miguel Island rookery), despite stability in the non-pup portion of the overall California population, is likely a response to a suite of factors including changes in ocean conditions (e.g., warmer temperatures) that may be contributing to habitat changes that favor California sea lions over Steller sea lions (NMFS, 2007) and competition for space on land, and possibly prey, with species that have experienced explosive growth over the past three decades (California sea lions and northern elephant seals [*Mirounga angustirostris*]). Although recovery in California has lagged behind the rest of the DPS, this portion of the DPS' range has recently shown a positive growth rate (NMML, 2012). While non-pup counts in California in the 2000s are only 34 percent of pre-decline counts (1927–47), the population has increased significantly since 1990.

Despite the abandonment of certain rookeries in California, pup production at other rookeries in California has increased over the last 20 years and, overall, the eastern DPS has increased at an average annual growth rate of 4.3 percent per year for 30 years. Even though these rookeries might not be recolonized, their loss has not prevented the increasing abundance of Steller sea lions in California or in the eastern DPS overall.

Because the eastern DPS of Steller sea lion is currently listed as threatened under the ESA, it is therefore designated as depleted and classified as a strategic stock under the MMPA. However, the eastern DPS has been considered a potential candidate for removal from listing under the ESA by the Steller sea lion recovery team and NMFS (NMFS, 2008), based on observed annual rates of increase. Although the stock size has increased, the status of this stock relative to its Optimum Sustainable Population (OSP) size is unknown. The overall annual rate of increase of the eastern stock has been consistent and long-term, and may indicate that this stock is reaching OSP.

Behavior and Ecology—Steller sea lions forage near shore and in pelagic waters. They are capable of traveling long distances in a season and can dive to approximately 1,300 ft (400 m) in depth. They also use terrestrial habitat as haul-out sites for periods of rest, molting, and as rookeries for mating and pupping during the breeding season. At sea, they are often seen alone or in small groups, but may gather in large rafts at the surface near rookeries and haul-outs. Steller sea lions prefer the colder temperate to sub-arctic waters of the North Pacific Ocean. Haul-outs and rookeries usually consist of beaches (gravel, rocky or sand), ledges, and rocky reefs. In the Bering and Okhotsk Seas, sea lions may also haul-out on sea ice, but this is considered atypical behavior (NOAA, 2010a).

Steller sea lions are gregarious animals that often travel or haul out in large groups of up to 45 individuals (Keple, 2002). At sea, groups usually consist of female and subadult males; adult males are usually solitary while at sea (Loughlin, 2002). In the Pacific Northwest, breeding rookeries are located in British Columbia, Oregon, and northern California. Steller sea lions form large rookeries during late spring when adult males arrive and establish territories (Pitcher and Calkins, 1981). Large males aggressively defend territories while non-breeding males remain at peripheral sites or haul-outs. Females arrive soon after and give birth. Most births occur from mid-May through mid-July, and breeding takes place shortly thereafter. Most pups are weaned within a year. Non-breeding individuals may not return to rookeries during the breeding season but remain at other coastal haul-outs (Scordino, 2006).

Steller sea lions are opportunistic predators, feeding primarily on fish and cephalopods, and their diet varies geographically and seasonally (Bigg, 1985; Merrick *et al.,* 1997; Bredesen *et al.,* 2006; Guenette *et al.,* 2006). Foraging habitat is primarily shallow, nearshore and continental shelf waters; freshwater rivers; and also deep waters (Reeves *et al.,* 2008; Scordino, 2010).

In Oregon, Steller sea lions are found on offshore rocks and islands. Most of these haul-out sites are part of the Oregon Islands National Wildlife Refuge and are closed to the public (ODFW, 2010). Oregon is home to the largest breeding site in U.S. waters south of Alaska, with breeding areas at Three Arch Rocks (Oceanside), Orford Reef (Port Orford), and Rogue Reef (Gold Beach). Steller sea lions are also found year-round in smaller numbers at Sea Lion Caves and at Cape Arago State Park.

Although Steller sea lions occur primarily in coastal habitat in Oregon and Washington, they are present year-round in the lower Columbia River, usually downstream of the confluence of the Cowlitz River (ODFW, 2008). However, adult and subadult male Steller sea lions have been observed at Bonneville Dam, where they prey primarily on sturgeon and salmon that congregate below the dam. In 2002, the USACE began monitoring seasonal presence, abundance, and predation activities of marine mammals in the Bonneville Dam tailrace (Tackley *et al.,* 2008b). Steller sea lions have been documented every year since 2003; observations have steadily increased to 75 Steller sea lions in 2010, the most on record and almost triple the number of the previous year (26 individuals) (Stansell *et al.,* 2009, 2010).

Steller sea lions use the Columbia River for travel, foraging, and resting as they move between haul-out sites and the dam. There are no known haul-out sites within the portions of the Region of Activity occurring in the Columbia River, Willamette River, or North Portland Harbor. The nearest known haul-out in the Columbia River is a rock formation (Phoca Rock) approximately 8 mi (13 km) downstream of Bonneville Dam (approximately 26 mi (42 km) upstream from the project site). Steller sea lions are also known to haul out on the south jetty at the mouth of the Columbia River, near Astoria, Oregon. There are no rookeries located in or near the Region of Activity. The nearest Steller sea lion rookery is on the northern Oregon coast at Oceanside (ODFW, 2010), approximately 70 mi (113 km) south of Astoria, i.e., more than 150 mi (240 km) from the Region of Activity.

Steller sea lions arrive at the dam in late fall (Tackley *et al.,* 2008b), although occasionally individuals are sighted near Bonneville Dam in the months of September, October, and November (Stansell *et al.,* 2009, 2010). Steller sea lions are present at the dam through May, and can travel between the dam and the mouth of the Columbia River several times during these months (Tackley *et al.,* 2008b). Table 14 compiles data from surface observations by the USACE for the Bonneville Dam tailrace. If arrival and departure dates were not available, the timing of surface observations within the January through May study period were recorded. Because regular observations in the study period generally began when California sea lions are observed below Bonneville Dam, and sometimes reports stated that observations stopped as sea lion numbers dropped, the observation dates only give a general idea of first arrival and departure for Steller sea lions. Because tracking data indicate that sea lions travel at fast rates between hydrophone locations above and below the CRC project area (Brown *et al.,* 2010), dates of first arrival at Bonneville Dam and departure from the dam are assumed to coincide closely with potential passage timing through the CRC project area.

TABLE 14—ARRIVAL AND DEPARTURE DATES FOR STELLER SEA LIONS BELOW BONNEVILLE DAM

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Arrival	n/a	[1] 3–03	[1] 2–24	[1] 4–11	[1,2] 2–10	[1,2] 1–08	[1,3] 1–11	[1,4] 1–14	[1,6] 1–08
Departure	n/a	[1] 6–02	[1] 5–30	[1] 5–31	[1,2] 5–31	[1,2] 5–26	[1] 5–31	[5] 5–19	6–04

[1] Dates are dates observations were taken and not when sea lions were first seen. Observations were made in 2002, but no Steller sea lions were observed. In 2005 through 2007, observations were made intermittently until sea lions were seen consistently (Tackley *et al.,* 2008a). Observation dates for 2006–07 from Scordino 2010.

[2] In 2006 and 2007 Steller sea lions were seen regularly in the tailrace area from January to early March. Report notes anecdotal information on sightings of Steller sea lions in November and December. Report states that after March when hazing activities began, fewer Steller sea lions were observed through May (Tackley *et al.,* 2008a).

[3] Steller sea lions were known to be catching and consuming sturgeon in the Bonneville Dam tailrace and farther downstream as early as November 2007 (Tackley *et al.,* 2008b).

[4] Steller sea lions were known to be catching and consuming sturgeon in the Bonneville Dam tailrace and farther downstream as early as October 2008 (Stansell *et al.,* 2009).

[5] Observations ended because few sea lions were present.

[6] Steller sea lions were observed downriver of the Bonneville Dam tailrace as early as September 2009 (Stansell *et al.,* 2010).

Based on the information presented in Table 14, Steller sea lions are expected to pass the project site beginning with a few individuals as early as September and most individuals in January through early June. Stansell *et al.* (2009, 2010) show that Steller sea lion abundance below Bonneville Dam increases through approximately mid-April, and then drops through about the end of May.

ODFW tagged eight Steller sea lions with acoustic and/or satellite-linked transmitters from March 30 through May 4, 2010 (Wright, 2010a). Data show that the eight individuals only made one or two roundtrips from Bonneville during the months they were tracked. This study is ongoing and more information will be available in the future to determine both the number of roundtrips from Bonneville and the time to transit between Bonneville and the mouth of the Columbia River. Although transit times between the mouth of the Columbia River and Bonneville Dam are not available for Steller sea lions, they are available for California sea lions. The PSMFC leads a tagging and tracking program for California sea lions, which has observed that the transit time for California sea lions between Astoria and Bonneville Dam is 30–36 hours upstream and 15 hours downstream (CRC, 2010). Similar transit times are assumed here for Steller sea lions. Steller sea lions have generally been observed at Bonneville Dam between early January and late May, although individuals have been noted at the dam as early as September (Stansell *et al.,* 2010). Thus, Steller sea lions are likely to be transiting in the Columbia River and North Portland Harbor during the time that in-water work would take place.

Acoustics—Like all pinnipeds, the Steller sea lion is amphibious; while all foraging activity takes place in the water, breeding behavior is carried out on land in coastal rookeries (Mulsow and Reichmuth 2008). On land, territorial male Steller sea lions regularly use loud, relatively low-frequency calls/roars to establish breeding territories (Schusterman *et al.,* 1970; Loughlin *et al.,* 1987). The calls of females range from 0.03 to 3 kHz, with peak frequencies from 0.15 to 1 kHz; typical duration is 1.0 to 1.5 sec (Campbell *et al.,* 2002). Pups also produce bleating sounds. Individually distinct vocalizations exchanged between mothers and pups are thought to be the main modality by which reunion occurs when mothers return to crowded rookeries following foraging at sea (Mulsow and Reichmuth, 2008).

Mulsow and Reichmuth (2008) measured the unmasked airborne hearing sensitivity of one male Steller sea lion. The range of best hearing sensitivity was between 5 and 14 kHz. Maximum sensitivity was found at 10 kHz, where the subject had a mean threshold of 7 dB. The underwater hearing threshold of a male Steller sea lion was significantly different from that of a female. The peak sensitivity range for the male was from 1 to 16 kHz, with maximum sensitivity (77 dB re: 1µPa-m) at 1 kHz. The range of best hearing for the female was from 16 to above 25 kHz, with maximum sensitivity (73 dB re: 1µPa-m) at 25 kHz. However, because of the small number of animals tested, the findings could not be attributed to either individual differences in sensitivity or sexual dimorphism (Kastelein *et al.,* 2005).

Background on Marine Mammal Hearing

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data, Southall *et al.* (2007) designate functional hearing groups for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low frequency cetaceans (mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 22 kHz;
- Mid-frequency cetaceans (dolphins, larger toothed whales, beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High frequency cetaceans (true porpoises, river dolphins, *Kogia* sp.): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and
- Pinnipeds in water: functional hearing is estimated to occur between approximately 75 Hz and 75 kHz, with the greatest sensitivity between approximately 700 Hz and 20 kHz.

As mentioned previously in this document, three species of pinnipeds are likely to occur in the Region of Activity.

Potential Effects of the Specified Activity on Marine Mammals

CRC's in-water construction and demolition activities (e.g., pile driving and removal) introduce sound into the marine environment, and have the potential to have adverse impacts on marine mammals. The potential effects of sound from the proposed activities associated with the CRC project may include one or more of the following: Tolerance; masking of natural sounds; behavioral disturbance; non-auditory physical effects; and temporary or permanent hearing impairment (Richardson *et al.,* 1995). However, for reasons discussed later in this document, it is unlikely that there would be any cases of temporary or permanent hearing impairment resulting from these activities. As outlined in previous NMFS documents, the effects of sound on marine mammals are highly variable, and can be categorized as follows (based on Richardson *et al.,* 1995):

- The sound may be too weak to be heard at the location of the animal (i.e., lower than the prevailing ambient sound level, the hearing threshold of the animal at relevant frequencies, or both);
- The sound may be audible but not strong enough to elicit any overt behavioral response;
- The sound may elicit reactions of varying degrees and variable relevance to the well being of the marine mammal; these can range from temporary alert responses to active avoidance reactions such as vacating an area until the stimulus ceases, but potentially for longer periods of time;
- Upon repeated exposure, a marine mammal may exhibit diminishing responsiveness (habituation), or disturbance effects may persist; the latter is most likely with sounds that are highly variable in characteristics and unpredictable in occurrence, and associated with situations that a marine mammal perceives as a threat;
- Any anthropogenic sound that is strong enough to be heard has the potential to result in masking, or reduce the ability of a marine mammal to hear biological sounds at similar frequencies, including calls from conspecifics and underwater environmental sounds such as surf sound;
- If mammals remain in an area because it is important for feeding, breeding, or some other biologically important purpose even though there is chronic exposure to sound, it is possible that there could be sound-induced physiological stress; this might in turn have negative effects on the well-being or reproduction of the animals involved; and
- Very strong sounds have the potential to cause a temporary or permanent reduction in hearing sensitivity, also referred to as threshold shift. In terrestrial mammals, and presumably marine mammals, received sound levels must far exceed the animal's hearing threshold for there to be any temporary threshold shift (TTS). For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound. Received sound levels must be even higher for there to be risk of permanent hearing impairment (PTS). In addition, intense acoustic or explosive events may cause trauma to tissues associated with organs vital for hearing, sound production, respiration and other functions. This trauma may include minor to severe hemorrhage.

Tolerance

Numerous studies have shown that underwater sounds from industrial activities are often readily detectable by marine mammals in the water at distances of many kilometers. However, other studies have shown that marine mammals at distances more than a few kilometers away often show no apparent response to industrial activities of various types (Miller *et al.,* 2005). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound from sources such as airgun pulses or vessels under some conditions, at other times, mammals of all three types have shown no overt reactions (e.g., Malme *et al.,* 1986; Richardson *et al.,* 1995; Madsen and Mohl, 2000; Croll *et al.,* 2001; Jacobs and Terhune, 2002; Madsen *et al.,* 2002;

Miller *et al.,* 2005). In general, pinnipeds seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al.* (1995) found that vessel sound does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al.* (1995) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels, and Brueggeman *et al.* (1992) observed ringed seals (*Pusa hispida*) hauled out on ice pans displaying short-term escape reactions when a ship approached within 0.16–0.31 mi (0.25–0.5 km).

Masking

Masking is the obscuring of sounds of interest to an animal by other sounds, typically at similar frequencies. Marine mammals are highly dependent on sound, and their ability to recognize sound signals amid other sound is important in communication and detection of both predators and prey. Background ambient sound may interfere with or mask the ability of an animal to detect a sound signal even when that signal is above its absolute hearing threshold. Even in the absence of anthropogenic sound, the marine environment is often loud. Natural ambient sound includes contributions from wind, waves, precipitation, other animals, and (at frequencies above 30 kHz) thermal sound resulting from molecular agitation (Richardson *et al.,* 1995).

Background sound may also include anthropogenic sound, and masking of natural sounds can result when human activities produce high levels of background sound. Conversely, if the background level of underwater sound is high (e.g., on a day with strong wind and high waves), an anthropogenic sound source would not be detectable as far away as would be possible under quieter conditions and would itself be masked. Ambient sound is highly variable on continental shelves (Thompson, 1965; Myrberg, 1978; Chapman *et al.,* 1998; Desharnais *et al.,* 1999). This results in a high degree of variability in the range at which marine mammals can detect anthropogenic sounds.

Although masking is a phenomenon which may occur naturally, the introduction of loud anthropogenic sounds into the marine environment at frequencies important to marine mammals increases the severity and frequency of occurrence of masking. For example, if a baleen whale is exposed to continuous low-frequency sound from an industrial source, this would reduce the size of the area around that whale within which it can hear the calls of another whale. The components of background noise that are similar in frequency to the signal in question primarily determine the degree of masking of that signal. In general, little is known about the degree to which marine mammals rely upon detection of sounds from conspecifics, predators, prey, or other natural sources. In the absence of specific information about the importance of detecting these natural sounds, it is not possible to predict the impact of masking on marine mammals (Richardson *et al.,* 1995). In general, masking effects are expected to be less severe when sounds are transient than when they are continuous. Masking is typically of greater concern for those marine mammals that utilize low frequency communications, such as baleen whales and, as such, is not likely to occur for pinnipeds in the Region of Activity.

Disturbance

Behavioral disturbance is one of the primary potential impacts of anthropogenic sound on marine mammals. Disturbance can result in a variety of effects, such as subtle or dramatic changes in behavior or displacement, but the degree to which disturbance causes such effects may be highly dependent upon the context in which the stimulus occurs. For example, an animal that is feeding may be less prone to disturbance from a given stimulus than one that is not. For many species and situations, there is no detailed information about reactions to sound.

Behavioral reactions of marine mammals to sound are difficult to predict because they are dependent on numerous factors, including species, maturity, experience, activity, reproductive state, time of day, and weather. If a marine mammal does react to an underwater sound by changing its behavior or moving a small distance, the impacts of that change may not be important to the individual, the stock, or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be important. In general, pinnipeds seem more tolerant of, or at least habituate more quickly to, potentially disturbing underwater sound than do cetaceans, and generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris *et al.,* 2001; Reiser *et al.,* 2009).

Because the few available studies show wide variation in response to underwater and airborne sound, it is difficult to quantify exactly how pile driving sound would affect pinnipeds. The literature shows that elevated underwater sound levels could prompt a range of effects, including no obvious visible response, or behavioral responses that may include annoyance and increased alertness, visual orientation towards the sound, investigation of the sound, change in movement pattern or direction, habituation, alteration of feeding and social interaction, or temporary or permanent avoidance of the area affected by sound. Minor behavioral responses do not necessarily cause long-term effects to the individuals involved. Severe responses include panic, immediate movement away from the sound, and stampeding, which could potentially lead to injury or mortality (Southall *et al.,* 2007).

Southall *et al.* (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound in water and reported that the limited data suggest exposures between approximately 90 and 140 dB generally do not appear to induce strong behavioral responses in pinnipeds, while higher levels of pulsed sound, ranging between 150 and 180 dB, will prompt avoidance of an area. It is important to note that among these studies, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded more strongly at lower levels than did animals in the field. Again, contextual issues are the likely cause of this difference. For airborne sound, Southall *et al.* (2007) note there are extremely limited data suggesting very minor, if any, observable behavioral responses by pinnipeds exposed to airborne pulses of 60 to 80 dB; however, given the paucity of data on the subject, we cannot rule out the possibility that avoidance of sound in the Region of Activity could occur.

In their comprehensive review of available literature, Southall *et al.* (2007) noted that quantitative studies on behavioral reactions of pinnipeds to underwater sound are rare. A subset of only three studies observed the response of pinnipeds to multiple pulses of underwater sound (a category of sound types that includes impact pile driving), and were also deemed by the authors as having results that are both measurable and representative. However, a number of studies not used by Southall et al. (2007) provide additional information, both quantitative and anecdotal, regarding the reactions of pinnipeds to multiple pulses of underwater sound.

- Harris *et al.* (2001) observed the response of ringed, bearded (*Erignathus barbatus*), and spotted seals (*Phoca largha*) to underwater operation of a single air gun and an eleven-gun array. Received exposure levels were 160 to 200 dB. Results fit into two categories. In some instances, seals exhibited no response to sound. However, the study noted significantly fewer seals during operation of the full array in some instances. Additionally, the study noted some avoidance of the area within 150 m of the source during full array operations.
- Blackwell *et al.* (2004) is the only cited study directly related to pile driving. The study observed ringed seals during impact installation of steel pipe pile. Received underwater SPLs were measured at 151 dB at 63 m. The seals exhibited either no response or only brief orientation response (defined as ''investigation or visual orientation''). It should be noted that the observations were made after pile driving was already in progress. Therefore, it is possible that the low-level response was due to prior habituation.
- Miller *et al.* (2005) observed responses of ringed and bearded seals to a seismic air gun array. Received underwater sound levels were estimated at 160 to 200 dB. There were fewer seals present close to the sound source during air gun operations in the first year, but in the second year the seals showed no avoidance. In some instances, seals were present in very close range of the sound. The authors concluded that there was ''no observable behavioral response'' to seismic air gun operations.

During a Caltrans installation demonstration project for retrofit work on the East Span of the San Francisco Oakland Bay Bridge, California, sea lions responded to pile driving by swimming rapidly out of the area, regardless of the size of the pile-driving hammer or the presence of sound attenuation devices (74 FR 63724).

Jacobs and Terhune (2002) observed harbor seal reactions to acoustic harassment devices (AHDs) with source level of 172 dB deployed around aquaculture sites. Seals were generally unresponsive to sounds from the AHDs. During two specific events, individuals came within 141 and 144 ft (43 and 44 m) of active AHDs and failed to demonstrate any measurable behavioral response; estimated received levels based on the measures given were approximately 120 to 130 dB.

Costa *et al.* (2003) measured received sound levels from an Acoustic Thermometry of Ocean Climate (ATOC) program sound source off northern California using acoustic data loggers placed on translocated elephant seals. Subjects were captured on land, transported to sea, instrumented with archival acoustic tags, and released such that their transit would lead them near an active ATOC source (at 0.6 mi depth [939 m]; 75-Hz signal with 37.5-Hz bandwidth; 195 dB maximum source level, ramped up from 165 dB over 20 min) on their return to a haul-out site. Received exposure levels of the ATOC source for experimental subjects averaged 128 dB (range 118 to 137) in the 60- to 90-Hz band. None of the instrumented animals terminated dives or radically altered behavior upon exposure, but some statistically significant changes in diving parameters were documented in nine individuals. Translocated northern elephant seals exposed to this particular non-pulse source began to demonstrate subtle behavioral changes at exposure to received levels of approximately 120 to 140 dB.

Several available studies provide information on the reactions of pinnipeds to non-pulsed underwater sound. Kastelein *et al.* (2006) exposed nine captive harbor seals in an approximately 82 x 98 ft (25 x 30 m) enclosure to non-pulse sounds used in underwater data communication systems (similar to acoustic modems). Test signals were frequency modulated tones, sweeps, and bands of sound with fundamental frequencies between 8 and 16 kHz; 128 to 130 ±3 dB source levels; 1- to 2-s duration (60–80 percent duty cycle); or 100 percent duty cycle. They recorded seal positions and the mean number of individual surfacing behaviors during control periods (no exposure), before exposure, and in 15-min experimental sessions (n = 7 exposures for each sound type). Seals generally swam away from each source at received levels of approximately 107 dB, avoiding it by approximately 16 ft (5 m), although they did not haul out of the water or change surfacing behavior. Seal reactions did not appear to wane over repeated exposure (i.e., there was no obvious habituation), and the colony of seals generally returned to baseline conditions following exposure. The seals were not reinforced with food for remaining in the sound field.

Reactions of harbor seals to the simulated sound of a 2-megawatt wind power generator were measured by Koschinski *et al.* (2003). Harbor seals surfaced significantly further away from the sound source when it was active and did not approach the sound source as closely. The device used in that study produced sounds in the frequency range of 30 to 800 Hz, with peak source levels of 128 dB at 1 m at the 80- and 160-Hz frequencies.

Ship and boat sound do not seem to have strong effects on seals in the water, but the data are limited. When in the water, seals appear to be much less apprehensive about approaching vessels. Some would approach a vessel out of apparent curiosity, including noisy vessels such as those operating seismic airgun arrays (Moulton and Lawson, 2002). Gray seals (*Halichoerus grypus*) have been known to approach and follow fishing vessels in an effort to steal catch or the bait from traps. In contrast, seals hauled out on land often are quite responsive to nearby vessels. Terhune (1985) reported that northwest Atlantic harbor seals were extremely vigilant when hauled out and were wary of approaching (but less so passing) boats. Suryan and Harvey (1999) reported that Pacific harbor seals commonly left the shore when powerboat operators approached to observe the seals. Those seals detected a powerboat at a mean distance of 866 ft (264 m), and seals left the haul-out site when boats approached to within 472 ft (144 m).

Southall *et al.* (2007) also compiled known studies of behavioral responses of marine mammals to airborne sound, noting that studies of pinniped response to airborne pulsed sounds are exceedingly rare. The authors deemed only one study as having quantifiable results.

- Blackwell *et al.* (2004) studied the response of ringed seals within 500 m of impact driving of steel pipe pile. Received levels of airborne sound were measured at 93 dB at a distance of 63 m. Seals had either no response or limited response to pile driving. Reactions were described as ''indifferent'' or ''curious.''

Efforts to deter pinniped predation on salmonids below Bonneville Dam began in 2005, and have used Acoustic Deterrent Devices (ADDs), boat chasing, above-water pyrotechnics (cracker shells, screamer shells or rockets), rubber bullets, rubber buckshot, and beanbags (Stansell *et al.,* 2009). Review of deterrence activities by the West Coast Pinniped Program noted ''USACE observations from 2002 to 2008 indicated that increasing numbers of California sea lions were foraging on salmon at Bonneville Dam each year, salmon predation rates increased, and the deterrence efforts were having little effect on preventing predation'' (Scordino, 2010). In the USACE status report through May 28, 2010, boat hazing was reported to have limited, local, short term impact in reducing predation in the tailrace, primarily from Steller sea lions. ODFW and the WDFW reported that sea lion presence did not appear to be significantly influenced by boat-based activities and several ''new'' sea lions (initially unbranded or unknown from natural markings) continued to forage in the observation area in spite of shore- and boat-based hazing. They suggested that hazing was not effective at deterring naive sea lions if there were large numbers of experienced sea lions foraging in the area (Brown *et al.,* 2010). Observations on the effect of ADDs, which were installed at main fishway entrances in 2007, noted that pinnipeds were observed swimming and eating fish within 20 ft (6 m) of some of the devices with no deterrent effect observed (Tackley *et al.,* 2008a, 2008b; Stansell *et al.,* 2009, 2010). Many of the animals returned to the area below the dam despite hazing efforts (Stansell *et al.,* 2009, Stansell and Gibbons, 2010). Relocation efforts to Astoria and the Oregon coast were implemented in 2007; however, all but one of fourteen relocated animals returned to Bonneville Dam within days (Scordino, 2010).

No information on in-water sound levels of hazing activities at Bonneville Dam has been published other than that ADDs produce underwater sound levels of 205 dB in the 15 kHz range (Stansell *et al.,* 2009). Durations of boat-based hazing events were reported at less than 30 minutes for most of the 521 boat-based events in 2009, but ranged up to 90 minutes (Brown *et al.,* 2009). Durations of boat-based hazing events were not reported for 2010. However, 280 events occurred over 44 days during a five-month period using a total of 4,921 cracker shells, 777 seal bombs, and 97 rubber buckshot rounds (Brown *et al.,* 2010). Based on knowledge of in-water sound from construction activities, the CRC project believes that sound levels from in-water construction and demolition activities that pinnipeds would be potentially exposed to are not as high as those produced by hazing techniques.

In addition, sea lions are expected to quickly traverse through and not remain in the project area. Tagging studies of California sea lions indicate that they pass hydrophones upriver and downriver of the CRC project site quickly. Wright *et al.* (2010) reported minimum upstream and downstream transit times between the Astoria haul-out and Bonneville Dam (river distance approximately 20 km) were 1.9 and 1 day, respectively, based on fourteen trips by eleven sea lions. The transit speed was calculated to be 4.6 km/hr in the upstream direction and 8.8 km/hr in the downstream direction. Data from the six individuals acoustically tagged in 2009 show that they made a combined total of eleven upriver or downriver trips quickly through the CRC project site to or from Bonneville Dam and Astoria (Brown *et al.,* 2009). Data from four acoustically tagged California sea lions in 2010 also indicate that the animals move though the area below Bonneville Dam down to the receivers located below the CRC project site rapidly both in the upriver or downriver directions (Wright, 2010). Although the data apply to California sea lions, Steller sea lions and harbor seals similarly have no incentive to stay near the CRC project area, in contrast with a strong incentive to quickly reach optimal foraging grounds at the Bonneville Dam, and are thus expected to also pass the project area quickly. Therefore, pinnipeds are not expected to be exposed to a significant duration of construction sound.

It is possible that deterrence of passage through the project area could be a concern. However, given the 800-m width of the Columbia River and the rarity of impact pile driving on opposite sides of the river (approximately 1–2 days total throughout the approximately 4-year construction period), passage should not be hindered. Vibratory installation or removal of piles at more than one pier complex would likely occur at the same time on occasion during construction and demolition. During construction and demolition, space limitations due to barge size and limitations on the amount of equipment available are anticipated to be limiting factors for the contractor. Vibratory installation of steel casings, pipe piles, and sheet piles are calculated to exceed behavioral disturbance thresholds at large distances; thus, the entire width of the channel would be affected by sound above the disturbance threshold even if only one pier complex was being worked on. However, because these sound levels are lower than those produced by ADDs at Bonneville Dam—which have shown only limited efficacy in deterring pinnipeds—and because pinnipeds transiting the Region of Activity will be highly motivated to complete transit, deterrence of passage is not anticipated to occur.

Debris Removal—The reactions of pinnipeds to sound from debris removal (a non-pulsed sound) have received virtually no study. Previous studies indicate that dredging sound has resulted in avoidance reactions in marine mammals; however, the number of studies is small and limited to only a handful of locations. Thomsen *et al.* (2009) caution that, given the limited number of studies, the existing published data may not be representative and that it is therefore impossible to extrapolate the potential effects from one area to the next.

In a review of the available literature regarding the effects of dredging sound on marine mammals, Richardson *et al.* (1995) found studies only related to whales and porpoises, and none related to pinnipeds. The review did, however, find studies related to the response of pinnipeds to ''other construction activities'', which may be applicable to dredging sound. Three studies of ringed seals during construction of artificial islands in Alaska showed mostly mild reactions ranging from negligible to temporary local displacement. Green and Johnson (1983, as cited in Richardson *et al.* [1995]) observed that some ringed seals moved away from the disturbance source within a few kilometers of construction. Frost and Lowry (1988, as cited in Richardson *et al.* [1995]) and Frost *et al.* (1988, as cited in Richardson *et al.,* 1995) noted that ringed seal density within 3.7 km of construction was less than seal density in areas located more than 3.7 km away. Harbor seals in Kachemak Bay, Alaska, continued to haul out despite construction of hydroelectric facilities located 1,600 m away. Finally, Gentry and Gilman (1990) reported that the strongest reaction to quarrying operations on St. George Island in the Bering Sea was an alert posture when heavy equipment occurred within 100 m of northern fur seals.

There are no established levels of underwater debris removal sound shown to cause injury to pinnipeds. However, since the maximum expected debris removal sound levels on the CRC project are below the established injury threshold, it is unlikely that this activity would produce sound levels that are injurious to pinnipeds. Additionally, the limited body of literature does not include any reports of injuries caused by sound from underwater excavation. Debris removal sound is likely to exceed the disturbance threshold for only a short distance from the source (approximately 631 m). Specific responses to sound above this level may range from no response to avoidance to minor disruption of migration and/or feeding. Alternatively, pinnipeds may become habituated to elevated sound levels (NMFS, 2005; Stansell, 2009). This is consistent with the literature, which reports only the following behavioral responses to these types of sound sources: No reaction, alertness, avoidance, and habituation. NMFS (2005) posits that continuous sound levels of 120 dB rms may elicit responses such as avoidance, diving, or changing foraging locations.

Debris removal is only estimated to occur for up to 7 days over the 4-year construction period in North Portland Harbor. If this activity overlaps with pinniped presence, behavioral disturbance is expected to be brief and temporary, and restricted to individuals that are transiting the North Portland Harbor portion of the Region of Activity. Because many of the individual pinnipeds transiting the Region of Activity are already habituated to hazing at Bonneville Dam and to high levels of existing noise throughout the lower Columbia River, it is expected that they would not be especially sensitive to a marginal increase in existing noise. Thus, due to the short duration of this sound, its location only in North Portland Harbor and the high level of existing disturbance throughout the lower Columbia River, sound generated from debris removal is not expected to result in disturbance that would rise to the level of Level B harassment.

Vessel Operations—Various types of vessels, including barges, tug boats, and small craft, would be present in the Region of Activity at various times. Vessel traffic would continually traverse the in-water CRC project area, with activities centered on Piers 2 through 7 of the Columbia River and the new North Portland Harbor bents. Such vessels already use the Region of Activity in moderately high numbers; therefore, the vessels to be used in the Region of Activity do not represent a new sound source, only a potential increase in the frequency and duration of these sound source types.

There are very few controlled tests or repeatable observations related to the reactions of pinnipeds to vessel noise. However, Richardson *et al.* (1995) reviewed the literature on reactions of pinnipeds to vessels, concluding overall that pinnipeds showed high tolerance to vessel noise. One study showed that, in water, sea lions tolerated frequent approach of vessels at close range. Because the Region of Activity is heavily traveled by commercial and recreational craft, it seems likely that pinnipeds that transit the Region of Activity are already habituated to vessel noise, thus the additional vessels that would occur as a result of CRC project activities would likely not have an additional effect on these pinnipeds. Therefore, CRC project vessel noise in the Region of Activity is unlikely to rise to the level of Level B harassment.

Physical Disturbance—Vessels, in-water structures, and over-water structures have the potential to cause physical disturbance to pinnipeds, although in-water and over-water structures would cover no more than 20 percent of the entire channel width at one time (CRC, 2010). As previously mentioned, various types of vessels already use the Region of Activity in high numbers. Tug boats and barges are slow moving and follow a predictable course. Pinnipeds would be able to easily avoid these vessels while transiting through the Region of Activity, and are likely already habituated to the presence of numerous vessels, as the lower Columbia River and North Portland Harbor receive high levels of commercial and recreational vessel traffic. Therefore, vessel strikes are extremely unlikely and, thus, discountable. Potential encounters would likely be limited to brief, sporadic behavioral disturbance, if any at all. Such disturbances are not likely to result in a risk of Level B harassment of pinnipeds transiting the Region of Activity.

Hearing Impairment and Other Physiological Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. Non-auditory physiological effects might also occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that may occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds, particularly at higher frequencies. Non-auditory physiological effects are not anticipated to occur as a result of CRC activities. The following subsections discuss the possibilities of TTS and PTS.

TTS—TTS, reversible hearing loss caused by fatigue of hair cells and supporting structures in the inner ear, is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends.

NMFS considers TTS to be a form of Level B harassment rather than injury, as it consists of fatigue to auditory structures rather than damage to them. Pinnipeds have demonstrated complete recovery from TTS after multiple exposures to intense sound, as described in the studies below (Kastak *et al.,* 1999, 2005). The NMFS-established 190-dB criterion is not considered to be the level above which TTS might occur. Rather, it is the received level above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals became available, one could not be certain that there would be no injurious effects, auditory or otherwise, to pinnipeds. Therefore, exposure to sound levels above 190 dB does not necessarily mean that an animal has incurred TTS, but rather that it may have occurred. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound.

Human non-impulsive sound exposure guidelines are based on exposures of equal energy (the same sound exposure level [SEL]; SEL is reported here in dB re: 1 μPa^2-s/re: 20 μPa^2-s for in-water and in-air sound, respectively) producing equal amounts of hearing impairment regardless of how the sound energy is distributed in time (NIOSH, 1998). Until recently, previous marine mammal TTS studies have also generally supported this equal energy relationship (Southall *et al.,* 2007). Three newer studies, two by Mooney *et al.* (2009a,b) on a single bottlenose dolphin (*Tursiops truncatus*) either exposed to playbacks of U.S. Navy mid-frequency active sonar or octave-band sound (4–8 kHz) and one by Kastak *et al.* (2007) on a single California sea lion exposed to airborne octave-band sound (centered at 2.5 kHz), concluded that for all sound exposure situations, the equal energy relationship may not be the best indicator to predict TTS onset levels. Generally, with sound exposures of equal energy, those that were quieter (lower SPL) with longer duration were found to induce TTS onset more than those of louder (higher SPL) and shorter duration. Given the available data, the received level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB SEL in order to produce brief, mild TTS.

In free-ranging pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. However, systematic TTS studies on captive pinnipeds have been conducted (e.g., Bowles *et al.,* 1999; Kastak *et al.,* 1999, 2005, 2007; Schusterman *et al.,* 2000; Finneran *et al.,* 2003; Southall *et al.,* 2007). Specific studies are detailed here:

- Finneran *et al.* (2003) studied responses of two individual California sea lions. The sea lions were exposed to single pulses of underwater sound, and experienced no detectable TTS at received sound level of 183 dB peak (163 dB SEL).

There were three studies conducted on pinniped TTS responses to non-pulsed underwater sound. All of these studies were performed in the same lab and on the same test subjects, and, therefore, the results may not be applicable to all pinnipeds or in field settings.

- Kastak and Schusterman (1996) studied the response of harbor seals to non-pulsed construction sound, reporting TTS of about 8 dB. The seal was exposed to broadband construction sound for 6 days, averaging 6 to 7 hours of intermittent exposure per day, with SPLs from just approximately 90 to 105 dB.
- Kastak *et al.* (1999) reported TTS of approximately 4–5 dB in three species of pinnipeds (harbor seal, California sea lion, and northern elephant seal) after underwater exposure for approximately 20 minutes to sound with frequencies ranging from 100–2,000 Hz at received levels 60–75 dB above hearing threshold. This approach allowed similar effective exposure conditions to each of the subjects, but resulted in variable absolute exposure values depending on subject and test frequency. Recovery to near baseline levels was reported within 24 hours of sound exposure.
- Kastak *et al.* (2005) followed up on their previous work, exposing the same test subjects to higher levels of sound for longer durations. The animals were exposed to octave-band sound for up to 50 minutes of net exposure. The study reported that the harbor seal experienced TTS of 6 dB after a 25-minute exposure to 2.5 kHz of octave-band sound at 152 dB (183 dB SEL). The California sea lion demonstrated onset of TTS after exposure to 174 dB and 206 dB SEL.

Southall *et al.* (2007) reported one study on TTS in pinnipeds resulting from airborne pulsed sound, while two studies examined TTS in pinnipeds resulting from airborne non-pulsed sound:

- Bowles *et al.* (unpubl. data) exposed pinnipeds to simulated sonic booms. Harbor seals demonstrated TTS at 143 dB peak and 129 dB SEL. California sea lions and northern elephant seals experienced TTS at higher exposure levels than the harbor seals.
- Kastak *et al.* (2004) used the same test subjects as in Kastak *et al.* 2005, exposing the animals to non-pulsed sound (2.5 kHz octave-band sound) for 25 minutes. The harbor seal demonstrated 6 dB of TTS after exposure to 99 dB (131 dB SEL). The California sea lion demonstrated onset of TTS at 122 dB and 154 dB SEL.
- Kastak *et al.* (2007) studied the same California sea lion as in Kastak *et al.* 2004 above, exposing this individual to 192 exposures of 2.5 kHz octave-band sound at levels ranging from 94 to 133 dB for 1.5 to 50 min of net exposure duration. The test subject experienced up to 30 dB of TTS. TTS onset occurred at 159 dB SEL. Recovery times ranged from several minutes to 3 days.

The sound level necessary to cause TTS in pinnipeds depends on exposure duration; with longer exposure, the level necessary to elicit TTS is reduced (Schusterman *et al.,* 2000; Kastak *et al.,* 2005, 2007). For very short exposures (e.g., to a single sound pulse), the level necessary to cause TTS is very high (Finneran *et al.,* 2003). Impact pile driving associated with CRC would produce maximum underwater pulsed sound levels estimated at 210 dB peak and 176 dB SEL with 10 dB of attenuation from an attenuation device (214 dB peak and 186 dB SEL without an attenuation device). Summarizing existing data, Southall *et al.* (2007) assume that pulses of underwater sound result in the onset of TTS in pinnipeds when received levels reach 212 dB peak or 171 dB SEL. They did not offer criteria for non-pulsed sounds. These recommendations are presented in order to discuss the likelihood of TTS occurring during the CRC project. The literature does not allow conclusions to be drawn regarding levels of underwater non-pulsed sound (e.g., vibratory pile installation) likely to cause TTS. With a sound attenuation device, TTS is not likely to occur based on estimated source levels from the CRC project. Without a sound attenuation device, it is estimated that the extent of the area in which underwater sound levels could potentially cause TTS is somewhere in between the extent of where the injury threshold occurs and the extent of where the disturbance threshold occurs (described previously in this document).

Impact pile driving would produce initial airborne sound levels of approximately 112 dB peak at 160 ft (49 m) from the source, as compared to the level suggested by Southall *et al.* (2007) of 143 dB peak for onset of TTS in pinnipeds from multiple pulses of airborne sound. It is not expected that airborne sound levels would induce TTS in individual pinnipeds.

Although underwater sound levels produced by the CRC project may exceed levels produced in studies that have induced TTS in pinnipeds, there is a general lack of controlled, quantifiable field studies related to this phenomenon, and existing studies have had varied results (Southall *et al.,* 2007). Therefore, it is difficult to extrapolate from these data to site-specific conditions for the CRC project. For example, because most of the studies have been conducted in laboratories, rather than in field settings, the data are not conclusive as to whether elevated levels of sound would cause pinnipeds to avoid the Region of Activity, thereby reducing the likelihood of TTS, or whether sound would attract pinnipeds, increasing the likelihood of TTS. In any case, there are no universally accepted standards for the amount of exposure time likely to induce TTS. Lambourne (in CRC, 2010) posits that, in most circumstances, free-roaming Steller sea lions are not likely to remain in areas subjected to high sound levels long enough to experience TTS unless there is a particularly strong attraction, such as an abundant food source. While it may be inferred that TTS could theoretically result from the CRC project, it is impossible to quantify the magnitude of exposure, the duration of the effect, or the number of individuals likely to be affected. Exposure is likely to be brief because pinnipeds use the Region of Activity for transiting, rather than breeding or hauling out. In summary, it is expected that elevated sound would have only a negligible probability of causing TTS in individual seals and sea lions.

PTS—When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges.

There is no specific evidence that exposure to underwater industrial sounds can cause PTS in any marine mammal (see Southall *et al.,* 2007). However, given the possibility that marine mammals might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to industrial activities might incur PTS. Richardson *et al.* (1995) hypothesized that PTS caused by prolonged exposure to continuous anthropogenic sound is unlikely to occur in marine mammals, at least for sounds with source levels up to approximately 200 dB. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage in terrestrial mammals. Studies of relationships between TTS and PTS thresholds in marine mammals are limited; however, existing data appear to show similarity to those found for humans and other terrestrial mammals, for which there is a large body of data. PTS might occur at a received sound level at least several decibels above that inducing mild TTS.

Southall *et al.* (2007) propose that sound levels inducing 40 dB of TTS may result in onset of PTS in marine mammals. The authors present this threshold with precaution, as there are no specific studies to support it. Because direct studies on marine mammals are lacking, the authors base these recommendations on studies performed on other mammals. Additionally, the authors assume that multiple pulses of underwater sound result in the onset of PTS in pinnipeds when levels reach 218 dB peak or 186 dB SEL. In air, sound levels are assumed to cause PTS in pinnipeds at 149 dB peak or 144 dB SEL (Southall *et al.,* 2007). Sound levels this high are not expected to occur as a result of the proposed activities.

The potential effects to marine mammals described in this section of the document do not take into consideration the proposed monitoring and mitigation measures described later in this document (see the PROPOSED MITIGATION and PROPOSED MONITORING AND REPORTING sections). It is highly unlikely that marine mammals would receive sounds strong enough (and over a sufficient duration) to cause PTS (or even TTS) during the proposed CRC activities. When taking the mitigation measures proposed for inclusion in the regulations into consideration, it is highly unlikely that any type of hearing impairment would occur as a result of CRC's proposed activities.

Anticipated Effects on Marine Mammal Habitat

Construction activities would likely impact pinniped habitat in the Columbia River and North Portland Harbor by producing temporary disturbances, primarily through elevated levels of underwater sound, reduced water quality, and physical habitat alteration associated with the structural footprint of the CRC bridges. Other potential temporary changes are passage obstruction and changes in prey species distribution during construction. Permanent changes to habitat would be produced primarily through the presence of new bridge piers in the Columbia River and in North Portland Harbor and removal of the existing piers in the Columbia River. A limited amount of debris removal in the North Portland Harbor may occur.

The underwater sounds would occur as short-term pulses (i.e., minutes to hours), separated by virtually instantaneous and complete recovery periods. These disturbances are likely to occur several times a day for up to a week, 2–14 weeks per year, for 6 years (5 years of activity would be authorized under this rule). Water quality impairment would also occur as short-term pulses (i.e., minutes to hours) during construction, most likely due to erosion during precipitation events, and would continue due to stormwater runoff for the design life of CRC. Physical habitat alteration due to modification and replacement of existing in-water and over-water structures would also occur intermittently during construction, and would remain as the final, as-built project footprint for the design life of CRC.

Elevated levels of sound may be considered to affect the in-water habitat of pinnipeds via impacts to prey species or through passage obstruction (discussed later). However, due to the timing of the in-water work and the limited amount of pile driving that may occur on a daily basis, these effects on pinniped habitat would be temporary and limited in duration. Very few harbor seals are likely to be present in any case, and any pinnipeds that do encounter increased sound levels would primarily be transiting the action area in route to or from foraging below Bonneville Dam where fish concentrate, and thus unlikely to forage in the action area in anything other than an opportunistic manner. The direct loss of habitat available during construction due to sound impacts is expected to be minimal.

Impacts to Prey Species

Fish are the primary dietary component of pinnipeds in the Region of Activity. The Columbia River and North Portland Harbor provides migration and foraging habitat for sturgeon and lamprey, migration and spawning habitat for eulachon, and migration habitat for juvenile and adult salmon and steelhead, as well as some limited rearing habitat for juvenile salmon and steelhead.

Impact pile driving would produce a variety of underwater sound levels. Underwater sound caused by vibratory installation would be less than impact driving (Caltrans, 2009; WSDOT, 2010b). Oscillating and rotating steel casements for drilled shafts are not likely to elevate underwater sound to a level that is likely to cause injury or that would cause adverse changes to fish behavior on a long-term basis.

Literature relating to the impacts of sound on marine fish species can be divided into categories which describe the following: (1) Pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or a result of anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead ultimately to the pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on fish and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fish. Popper *et al.* (2003/2004) also published a paper that reviews the effects of anthropogenic sound on the behavior and physiology of fish. Please see those sources for more detail on the potential impacts of sound on fish.

Underwater sound pressure waves can injure or kill fish (e.g., Reyff, 2003; Abbott and Bing-Sawyer, 2002; Caltrans, 2001; Longmuir and Lively, 2001; Stotz and Colby, 2001). Fish with swim bladders, including salmon, steelhead, and sturgeon, are particularly sensitive to underwater impulsive sounds with a sharp sound pressure peak occurring in a short interval of time (Caltrans, 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the underpressure component of the wave passes through the fish. The pneumatic pounding may rupture capillaries in the internal organs as indicated by observed blood in the abdominal cavity and maceration of the kidney tissues (Caltrans, 2001). Although eulachon lack a swim bladder, they are also susceptible to general pressure wave injuries including hemorrhage and rupture of internal organs, as described above, and damage to the auditory system. Direct take can cause instantaneous death, latent death within minutes after exposure, or can occur several days later. Indirect take can occur because of reduced fitness of a fish, making it susceptible to predation, disease, starvation, or inability to complete its life cycle. Effects to prey species are summarized here and are outlined in more detail in NMFS' biological opinion.

There are no physical barriers to fish passage within the Region of Activity, nor are there fish passage barriers between the Region of Activity and the Pacific Ocean. The proposed project would not involve the creation of permanent physical barriers; thus, long-term changes in pinniped prey species distribution are not expected to occur.

Nevertheless, impact pile-driving would likely create a temporary migration barrier to all life stages of fish using the Columbia River and North Portland Harbor, although this would be localized. Cofferdams and temporary in-water work structures also may create partial barriers to the migration of juvenile fish in shallow-water habitat. Impacts to fish species distribution would be temporary during in-water work and hydroacoustic impacts from impact pile driving would only occur for limited periods during the day and only during the in-water work window established for this activity in conjunction with ODFW, WDFW, and NMFS. The overall effect to the prey base for pinnipeds is anticipated to be insignificant.

Prey may also be affected by turbidity, contaminated sediments, or other contaminants in the water column. The CRC project involves several activities that could potentially generate turbidity in the Columbia River and North Portland Harbor, including pile installation, pile removal, installation and removal of cofferdams, installation of steel casings for drilled shafts, and debris removal. Because these actions would take place in a sandy substrate and would be limited to a small area and a brief portion of the work period, the increase in turbidity is expected to be small. Turbidity is not expected to cause mortality to fish species in the Region of Activity, and effects would probably be limited to temporary avoidance of the discrete areas of elevated turbidity (anticipated to be no more than 300 ft [91 m] from the source) for approximately 4–6 hours at a time (CRC, 2010), or effects such as abrasion to gills and alteration in feeding and migration behavior for fish close to the activity. Therefore, turbidity would likely have only insignificant effects to fish and, thus, insignificant effects on pinnipeds.

The CRC project would minimize, avoid, or contain much of the potential sources of contamination, minimizing the risk of exposure to prey species of pinnipeds. The CRC project team would, in advance of in-water work, perform an extensive search for evidence of contamination, pinpointing the location, extent, and concentration of the contaminants. Then, BMPs would be implemented to ensure that the CRC project: (1) Avoids areas of contaminated sediment or (2) enables responsible parties to initiate cleanup activities for contaminated sediments occurring from construction activities within the Region of Activity. These BMPs would be developed and implemented in coordination with regulatory agencies. Because the CRC project would identify the locations of contaminated sediments and use BMPs to ensure that they do not become mobilized, there is little risk that the prey base of pinnipeds would be significantly affected by or exposed to contaminated sediments.

Though treatment of runoff would occur, the ability to remove pollutants to a level without effect upon fish or that does not synergistically combine with other sources is technologically limited and unfeasible. Exposure to these ubiquitous contaminants even in low concentrations is likely to affect the survival and productivity of salmonid juveniles in particular (e.g., Loge *et al.,* 2006; Hecht *et al.,* 2007; Johnson *et al.,* 2007; Sandahl *et al.,* 2007; Spromberg and Meador, 2006). Short-term exposure to contaminants such as pesticides and dissolved metals may disrupt olfactory function (Hecht, 2007) and interfere with associated behaviors such as foraging, anti-predator responses, reproduction, imprinting (odor memories), and homing (the upstream migration to natal streams). The toxicity of these pollutants varies with water quality speciation and concentration. Regarding dissolved heavy metals, Santore *et al.* (2001) indicate that the presence of natural organic matter and changes in pH and hardness affect the potential for toxicity (increase and decrease). Additionally, organics (living and dead) can adsorb and absorb other pollutants such as polycyclic aromatic hydrocarbons (PAHs). The variables of organic decay further complicate the path and cycle of pollutants.

The release of contaminants is likely to occur. Wind and water erosion is likely to entrain and transport soil from disturbed areas, contributing fine sediments that are likely to contain pollutants, and the use of heavy equipment, including stationary equipment like generators and cranes, also creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, coolants, and other contaminants may occur. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain PAHs, which are acutely toxic to salmonids and other aquatic organisms at high levels of exposure and cause sublethal adverse effects on aquatic organisms at lower concentrations (Heintz *et al.,* 1999, 2000; Incardona *et al.,* 2004, 2005, 2006).

However, due to the relatively small amount of time that any heavy equipment would be in the water and the use of proposed conservation measures, including site restoration after construction is complete, any increase in contaminants is likely to be small, infrequent, and limited to the construction period. In-water and near-water construction would employ numerous BMPs and would comply with all required regulatory permits to ensure that contaminants do not enter surface water bodies. In the unlikely event of accidental release, BMPs and a Pollution Control and Contamination Plan (PCCP) would be implemented to ensure that contaminants are prevented from spreading and are cleaned up quickly. Therefore, contaminants are not likely to significantly affect fish and, thus, effects on pinnipeds are also likely to be insignificant.

Physical Loss of Prey Species Habitat

The project would lead to temporary physical loss of approximately 20,700 ft^2 (2,508 m^2) of shallow-water habitat. Project elements responsible for temporary physical loss include the footprint of the numerous temporary piles associated with in-water work platforms, work bridges, tower cranes, oscillator support piles, cofferdams, and barge moorings in the Columbia River and North Portland Harbor.

The in-water portions of the new structures would result in the permanent physical loss of approximately 250 ft^2 (23 m^2) of shallow-water habitat at pier complex 7 in the Columbia River. Demolition of the existing Columbia River structures would permanently restore about 6,000 ft^2 (557 m^2) of shallow-water habitat, and removal of one large overwater structure would permanently restore about 600 ft^2 (56 m^2) of shallow-water habitat. Overall, there would be a net permanent gain of about 5,345 ft^2 (497 m^2) of shallow-water habitat in the Columbia River (CRC, 2010). At North Portland Harbor, there would be a permanent net loss of about 2,435 ft^2

(218 m^2) of shallow-water habitat at all of the new in-water bridge bents. Note that all North Portland Harbor impacts are in shallow water.

Physical loss of shallow-water habitat is of particular concern for rearing of subyearling migrant salmonids. In theory, in-water structures that completely block the nearshore may force these juveniles to swim into deeper-water habitats to circumvent them. Deep-water areas represent lower quality habitat because predation rates are higher there. Studies show that predators such as walleye (*Stizostedion vitreum*), northern pike-minnow (*Ptychocheilus oregonensis*), and other predatory fish occur in deepwater habitat for at least part of the year (e.g., Johnson, 1969; Ager, 1976; Paragamian, 1989; Wahl, 1995; Pribyl *et al.,* 2004). In the case of the CRC project, in-water portions of the structures would not pose a complete blockage to nearshore movement anywhere in the Region of Activity. Although these structures would cover potential rearing and nearshore migration areas, the habitat is not rare and is not of particularly high quality. Juveniles would still be able to use the abundant shallow-water habitat available for miles in either direction. Neither the permanent nor the temporary structures would necessarily force juveniles into deeper water, and therefore pose no definite added risk of predation.

To the limited extent that the proposed actions do increase risk of predation, pinnipeds may accrue minor benefits. Alterations to adult eulachon and salmon behavior may make them more vulnerable to predation. Changes in cover that congregate fish or cause them to slow or pause migration would likely attract pinnipeds, which may then forage opportunistically. While individual pinnipeds are likely to take advantage of such conditions, it is not expected to increase overall predation rates across the run. Aggregating features would be small in comparison to the channel, and ample similar opportunities exist throughout the lower Columbia River.

Physical loss of shallow-water habitat would have only negligible effects on foraging, migration, and holding of salmonids that are of the yearling age class or older. These life functions are not dependent on shallow-water habitat for these age classes. Furthermore, the lost habitat is not of particularly high quality. There is abundant similar habitat immediately adjacent along the shorelines of the Columbia River and throughout North Portland Harbor. The lost habitat represents only a small fraction of the remaining habitat available for miles in either direction. There would still be many acres of habitat for yearling or older age-classes of salmonids foraging, migrating, and holding in the Region of Activity. Physical loss of shallow-water habitat would have only negligible effects on eulachon and green sturgeon for the same reason. Thus, the effects to these elements of pinniped habitat would be minimal.

The CRC project would cause a temporary physical loss of approximately 16,635 ft^2 (1,545 m^2) of deep-water habitat, consisting chiefly of coarse sand with a small proportion of gravel. CRC project elements responsible for temporary physical loss include the cofferdams and numerous temporary piles associated with in-water work platforms and moorings. The in-water portions of the new structures would result in the permanent physical loss of approximately 6,300 ft^2 (585 m^2) of deep-water habitat at pier complexes 2 through 7 in the Columbia River. Demolition of the existing Columbia River piers would permanently restore about 21,000 ft^2 (1,951 m^2) of deep-water habitat. Overall, there would be a net permanent gain of about 15,000 ft^2 (1,394 m^2) of deep-water habitat in the Columbia River.

Although there would be a temporary net physical loss of deep-water habitat, this is not expected to have a significant impact on prey species. The lost habitat is not rare or of particularly high quality, and there is abundant similar habitat in immediately adjacent areas of the Columbia River and for many miles both upstream and downstream. The lost habitat would represent a very small fraction (less than one percent) of the remaining habitat available. Additionally, the in-water portions of the permanent and temporary in-water structures would occupy no more than about one percent of the width of the Columbia River. Therefore, the structures would not be likely to pose a physical barrier to fish migration.

In addition, compensatory mitigation for direct permanent habitat loss to jurisdictional waters from permanent pier placement would occur in accordance with requirements set by USACE, Oregon Department of State Lands (DSL), Washington Department of Ecology, ODFW, and WDFW. To meet these requirements, CRC is proposing to restore habitat in the lower Lewis River and lower Hood River. At the Hood River site, one mile of a historic side channel would be reconnected to the lower Hood River and an existing 21-acre (8.5-ha) wetland, resulting in habitat benefits to salmonids and eulachon. At the Lewis River site, restoration of 18.5 acres (7.5 ha) of side channels would occur between the lower Lewis River and the lower Columbia River, resulting in habitat benefits to salmonid and other native species. Therefore, permanent habitat loss is expected to have a negligible impact to habitat for pinniped prey species.

Due to the small size of the impact relative to the remaining habitat available, and the permanent benefits from habitat restoration, both temporary and permanent physical habitat loss are likely to be insignificant to fish and, thus, to the habitat and foraging opportunities of pinnipeds.

Passage Obstruction

The new overwater bridge structures would permanently decrease the overall footprint of piers below the OHW in the Columbia River and permanently increase the overall footprint of the piers below the OHW in North Portland Harbor. The permanent changes would be to riverine habitat; no pinniped haul-out sites or rookeries would be affected. The effects to habitat in the action area would not result in significant changes to pinniped passage. Therefore, permanent changes due to bridge piers would not significantly affect pinnipeds.

There are a variety of temporary structures that could potentially obstruct passage of pinnipeds including barges, moorings, tower cranes, cofferdams, and work platforms. Although there would be many such structures in the Region of Activity, they would cover no more than twenty percent of the entire channel width at one time. There would still be ample room for pinnipeds to navigate around these structures while transiting the action area. Pinnipeds may need to slightly alter their course as they move through the construction area to avoid these structures, but there is no potential for physical structures to completely block upstream or downstream movement. Due to the small size of the structures relative to the remaining portion of the river available, delays to pinniped movements would be negligible. Therefore, the effect of in-water and overwater structures on the ability of pinnipeds to pass upstream and downstream would be insignificant.

The impact of temporary and permanent habitat changes from bridge construction is expected to be minimal to pinnipeds. The effects to pinnipeds from temporary and permanent habitat changes are summarized below.

• *Sound disturbance:* Temporary modification of habitat during in-water construction from elevated levels of sound may affect pinniped foraging; however, very few seals are in the Region of Activity and most sea lions are swimming upriver to forage below Bonneville Dam. Sound disturbance would not be continuous, would only occur temporarily as animals pass through the area and would be in the form of Level B harassment only.

• *Passage obstruction:* The permanent changes to the overall footprint of the bridges in the Columbia River and North Portland Harbor would not affect pinniped breeding habitat or haul-out sites and would not affect passage significantly. Temporary structures during construction would not cover more than twenty percent of the entire channel and are not likely to significantly affect the ability of pinnipeds to pass through the construction area or delay their movements.

• *Changes in prey distribution and quality:* The CRC project is likely to impact a small percentage of all salmon and steelhead runs that swim through the Region of Activity as a result of in-water work including pile installation. This impact would be temporary and would only occur during construction of the bridges in the Columbia River and North Portland Harbor and during demolition of the existing Columbia River Bridges. BMPs and minimization measures would avoid or limit the extent of the impact to prey species from sound, changes to water quality, and temporary structures. Short-term impacts to the prey base from project work do not represent a large part of the pinniped prey base in comparison to prey available through the entirety of their foraging range, which includes the Columbia River from Bonneville Dam to the mouth and foraging grounds off the Pacific Coast. Overall, effects to the prey base would be temporary, limited to the in-water work period over the CRC project duration, and would not cause measurable changes in the distribution or quality of prey available to pinnipeds.

• *Physical changes to prey species habitat:* The new bridge structures would permanently decrease the overall footprint of piers below the OHW in the Columbia River and permanently increase the overall footprint of the piers below the OHW in North Portland Harbor. Habitat mitigation for direct permanent habitat loss to fish from permanent pier placement would occur in the lower Lewis River and lower Hood River and would provide long-term benefits to fish species in the lower Columbia River, resulting in long-term benefits to the pinniped prey base. Therefore, permanent habitat loss is expected to have a negligible impact to habitat for pinniped prey species. Temporary physical loss of habitat from temporary structures would only occur during the period of in-water work in the Columbia River and North Portland Harbor. These temporary losses are not expected to significantly affect the prey base for pinnipeds.

In conclusion, NMFS has preliminarily determined that CRC's proposed activities are not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or on the food sources that they utilize.

Proposed Mitigation

In order to issue an incidental take authorization under section 101(a)(5)(A) of the MMPA, NMFS must, where applicable, set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant). NMFS and CRC worked to devise a number of mitigation measures designed to minimize impacts to marine mammals to the level of least practicable adverse impact, described in the following.

The results from hydroacoustic monitoring during the test pile project, as well as results from modeling the zones of influence (ZOIs) (both described previously in this document and in following sections), were used to develop mitigation measures for CRC pile driving and removal activities. ZOIs are often used to effectively represent the mitigation zone that would be established around each pile to prevent Level A harassment of marine mammals. In addition to the specific measures described later, CRC would employ the following general mitigation measures:

• All work would be performed according to the requirements and conditions of the regulatory permits issued by federal, state, and local governments. Seasonal restrictions, e.g., work windows, would be applied to the project to avoid or minimize potential impacts to protected species (including marine mammals) based on agreement with, and the regulatory permits issued by, DSL, WDFW, and USACE in consultation with ODFW, the U.S. Fish and Wildlife Service (USFWS), and NMFS.

• Briefings would be conducted between the CRC project construction supervisors and the crew, marine mammal observer(s), and acoustical monitoring team prior to the start of all pile-driving activity, and when new personnel join the work, to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures. The CRC project would contact the Bonneville Dam marine mammal monitoring team to obtain information on the presence or absence of pinnipeds prior to initiating pile driving in any discrete pile driving time period described in the project description.

• CRC would comply with all applicable equipment sound standards and ensure that all construction equipment has sound control devices no less effective than those provided on the original equipment (i.e., equipment may not have been modified in such a way that it is louder than it was initially).

• Permanent foundations for each in-water pier would be installed by means of drilled shafts. This approach significantly reduces the amount of impact pile driving, the size of piles, and amount of in-water sound.

• Installation of piles using impact driving may only occur between September 15 and April 15 of the following year.

• On an average work day, six piles could be installed using vibratory installation to set the piles, with impact driving then used to drive the piles to refusal per project specifications to meet load-bearing capacity requirements. This method reduces the number of daily pile strikes by over ninety percent.

• No more than two impact pile drivers may be operated simultaneously within the same water body channel.

• In waters with depths more than 2 ft (0.67 m), a bubble curtain or other sound attenuation measure would be used for impact driving of pilings, except when testing device performance. As described previously, testing of the sound attenuation device would occur approximately weekly. This would require up to 7.5 minutes of unattenuated driving per week. If a bubble curtain or similar measure is used, it would distribute small air bubbles around 100 percent of the piling perimeter for the full depth of the water column. Any other attenuation measure (e.g., temporary sound attenuation pile) must provide 100 percent coverage in the water column for the full depth of the pile. A performance test of the sound attenuation device in accordance with the approved hydroacoustic monitoring plan would be conducted prior to any impact pile driving. If a bubble curtain or similar measure is utilized, the performance test would confirm the calculated pressures and flow rates at each manifold ring.

- For in-water heavy machinery work other than pile driving (e.g., standard barges, tug boats, barge-mounted excavators, or clamshell equipment used to place or remove material), if a marine mammal comes within 50 m (164 ft), operations shall cease and/or vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions.

Monitoring and Shutdown

Shutdown Zones—For all pile driving and removal activities, a shutdown zone (defined as, at minimum, the area in which SPLs equal or exceed 190 dB rms) would be established. The purpose of a shutdown zone is to define an area within which shutdown of activity would occur upon sighting of a marine mammal (or in anticipation of an animal entering the defined area), thus preventing injury, serious injury, or death of marine mammals. Although hydroacoustic data from the test pile project indicate that radial distances to the 190-dB threshold would be less than 50 m, shutdown zones would conservatively be set at a minimum 50 m. This precautionary measure is intended to further reduce any possibility of injury to marine mammals by incorporating a buffer to the 190-dB threshold within the shutdown area. Please see the discussion of ''Distance to Sound Thresholds'' and ''Test Pile Project'' under Description of Sound Sources, previously in this document.

Disturbance Zones—For all pile driving and removal activities, a disturbance zone would be established. Disturbance zones are typically defined as the area in which SPLs equal or exceed 160 or 120 dB rms (for impact and vibratory pile driving, respectively). However, when the size of a disturbance zone is sufficiently large as to make monitoring of the entire area impracticable (as in the case of the 120-dB zone here), the disturbance zone may be defined as some area that may reasonably be monitored. Here, the disturbance zone is defined for monitoring purposes as an area of 800 m radius. Disturbance zones provide utility for monitoring conducted for mitigation purposes (i.e., shutdown zone monitoring) by establishing monitoring protocols for areas adjacent to the shutdown zones. Monitoring of disturbance zones enables PSOs to be aware of and communicate the presence of marine mammals in the project area but outside the shutdown zone and thus prepare for potential shutdowns of activity. However, the primary purpose of disturbance zone monitoring is for documenting incidents of Level B harassment; disturbance zone monitoring is discussed in greater detail later (see Proposed Monitoring and Reporting).

Monitoring Protocols—Initial monitoring zones are based on worst case values measured during the test pile project and with the attenuation device operating during impact driving, and are presented in Table 15. A minimum distance of 50 m is used for all shutdown zones, even if actual or initial calculated distances are less. A maximum distance of 800 m is used for all disturbance zones for vibratory pile driving, even if actual or calculated values are greater. Monitoring of the full disturbance zone for these activities is impracticable. The data collected during the test pile project consistently support the belief that the coefficient of transmission loss increases with increasing range from the source pile, out to at least 800 m. To provide the best estimate of transmission loss at a specific range, the data were interpolated to one meter increments using a quadratic interpolation routine. To establish a disturbance zone for impact pile driving, an iterative solution was computed based on the interpolated transmission loss data.

TABLE 15—DISTANCE TO INITIAL SHUTDOWN AND DISTURBANCE MONITORING ZONES FOR IN-WATER SOUND IN THE COLUMBIA RIVER AND NORTH PORTLAND HARBOR

Pile type	Hammer type	Distance to monitoring zones (m) [1]		
		190 dB [2]	160 dB [2]	120 dB [2]
18–24 in steel pipe [3]	Impact	50	258	N/A
36–48 in steel pipe [4]	Impact	50	582	N/A
48-in steel pipe	Vibratory	50	N/A	800
120-in steel casing	Vibratory	50	N/A	800
Sheet pile	Vibratory	50	N/A	800

[1] Monitoring zones based on worst case values measured during test pile project and with the attenuation device operating during impact driving. A minimum distance of 50 m is used for all shutdown zones, even if actual or initial calculated distances are less. A maximum distance of 800 m is used for all disturbance zones for vibratory pile driving, even if actual or calculated values are greater. For modeled values, see Tables 11 and 12.

[2] All values unweighted and relative to 1 μPa.

[3] For 24-in pile, test pile data show a worst case source level of 191 dB rms with a worst-case attenuation of 8 dB and transmission loss coefficient based on quadratic interpolation of test pile data of 16.3.

[4] For 48-in pile, test pile data show a worst case source level of 201 dB RMS with a worst-case attenuation of 11 dB, and transmission loss coefficient based on quadratic interpolation of test pile data of 17.0.

Data from the test pile project suggest that the majority of the energy from vibratory driving occurs in frequencies below 1,000 Hz, with energy levels gradually falling off at higher frequencies (CRC, 2011). For vibratory installation during the test pile study, the energy was not distinguishable above background levels by 800 m (2,625 ft) for all but one pile. Therefore, although transmission loss data were not conclusive—only one pile produced a signal that could be distinguished at all three monitoring stations, above background sound that was much higher than was previously measured for the action area—the modeled results for vibratory driving are validated by the empirical data, and it is likely that actual distances to the 120-dB threshold would be much less than modeled values. Piles were generally installed or extracted during the test pile study in less than 10 minutes. Vibratory extraction of piles would conservatively be treated similarly to vibratory installation, with similar monitoring zones. As described previously in this document (see section on ''Test Pile Project''), a maximum SPL of 181 dB for vibratory installation was recorded, while a maximum SPL of 176 dB was recorded for vibratory extraction.

The vibratory installation of steel casings and sheet piles was not measured as part of the test pile project. As noted in Table 11, modeled distance to the 120-dB isopleths resulting from vibratory installation of sheet pile was significantly less than that for vibratory installation of pipe pile. No published information is available on vibratory installation of 120-in (3 m) steel casings, which would be installed for drilled shafts. Published information from Caltrans (2007) shows that driving of 36-in pile produced up to 175 dB rms while driving of 72-in pile produced up to 180 dB rms, both measured at 5 m from the pile. By extrapolating from these published values, CRC assumes the energy imparted through a larger casing would be up to 10 dB rms (an order of magnitude) higher than the highest value for a 72-in pile. In the absence of specific data, the initial disturbance zone for vibratory installation of steel casings and sheet pile would be established at 800 m, as described previously for vibratory pile driving.

In order to accomplish appropriate monitoring for mitigation purposes, CRC would have an observer stationed on each active pile driving barge to closely monitor the shutdown zone as well as the surrounding area. In addition, CRC would post one shore-based observer, whose primary responsibility would be to record pinnipeds in the disturbance zone and to alert barge-based observers to the presence of pinnipeds in the disturbance zone, thus creating a redundant alert system for prevention of injurious interaction as well as increasing the probability of detecting pinnipeds in the disturbance zone. CRC estimates that shore-based observers would be able to scan approximately 800 m (upstream and downstream) from the available observation posts; therefore, shore-based observers would be capable of monitoring the agreed-upon disturbance zone. Visibility would be somewhat reduced by the existing bridges in the upstream direction.

As described, at least two observers would be on duty during all pile driving/removal activity. The first observer would be positioned on a work platform or barge where the entire 50 m shutdown zone is clearly visible, with the second shore-based observer positioned to observe the disturbance zone from either the north or south bank of the river, depending on where the work platform or barge is positioned. Protocols would be implemented to ensure that coordinated communication of sightings occurs between observers in a timely manner.

When pile driving/removal is occurring simultaneously at multiple sites, each site would have one observer dedicated to monitoring the shutdown zone for that site. Depending on the location of activity sites and the spacing of equipment, additional shore-based observers may be required to provide complete observational coverage of each site's disturbance zone. That is, each site would have at least one observer, while one or multiple shore-based observers may be required.

In summary:

• CRC would implement a minimum shutdown zone of 50 m radius around all pile driving and removal activity, including installation of steel casings. The 50-m shutdown zone provides a buffer for the 190-dB threshold but is also intended to further avoid the risk of direct interaction between marine mammals and the equipment.

• CRC would have a redundant monitoring system, in which one observer would be stationed on each pile driving barge, while one or multiple observers would be shore-based, as required to provide complete observational coverage of the reduced disturbance zone for each pile driving/removal site. The former would be capable of providing comprehensive monitoring of the proposed shutdown zones, and would likely be able to effectively monitor a distance, in both directions, of approximately 800 m (the distance for the vibratory pile driving disturbance zone). These observers' first priority would be shutdown zone monitoring in prevention of injurious interaction, with a secondary priority of counting takes by Level B harassment in the disturbance zone. The additional shore-based observer(s) would be able to monitor the same distances, but their primary responsibility would be counting of takes in the disturbance zone and communication with barge-based observers to alert them to pinniped presence in the action area.

• The shutdown and disturbance zones would be monitored throughout the time required to drive a pile. If a marine mammal is observed within the disturbance zone, a take would be recorded and behaviors documented. However, that pile segment would be completed without cessation, unless the animal approaches or enters the shutdown zone, at which point all pile driving activities would be halted.

• All shutdown and disturbance zones would either be based on empirical, site-specific data, or would initially be based on data for similar sources. For all activities, in-situ hydroacoustic monitoring would be conducted to either verify or determine the actual distances to these threshold zones, and the size of the zones would be adjusted accordingly based on received SPLs. As noted previously, the minimum shutdown zone would always be 50 m.

The following measures would apply to visual monitoring:

• If a small boat is used for monitoring, the boat would remain 50 yd (46 m) from swimming pinnipeds in accordance with NMFS marine mammal viewing guidelines (NMFS, 2004).

• If vibratory installation of steel pipe piles or casings occurs after dark, monitoring would be conducted with a night vision scope and/or other suitable device. Impact driving would only occur during daylight hours.

• If the shutdown zone is obscured by fog or poor lighting conditions, pile driving would not be initiated until the entire shutdown zone is visible. Work that has been initiated appropriately in conditions of good visibility may continue during poor visibility.

• The shutdown zone would be monitored for the presence of pinnipeds before, during, and after any pile driving activity. The shutdown zone would be monitored for 30 minutes prior to initiating the start of pile driving. If pinnipeds are present within the shutdown zone prior to pile driving, the start of pile driving would be delayed until the animals leave the shutdown zone of their own volition, or until 15 minutes elapse without resighting the animal(s).

• Monitoring would be conducted using binoculars. When possible, digital video or still cameras would also be used to document the behavior and response of pinnipeds to construction activities or other disturbances.

• Each observer would have a radio or cell phone for contact with other monitors or work crews. Observers would implement shut-down or delay procedures when applicable by calling for the shut-down to the hammer operator.

• A GPS unit or electric range finder would be used for determining the observation location and distance to pinnipeds, boats, and construction equipment.

Monitoring would be conducted by qualified observers. In order to be considered qualified, observers must meet the following criteria:

• Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars 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 required).
• 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 pinnipeds, including the identification of behaviors.
• Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
• Writing skills sufficient to prepare a report of observations including but not limited to the number and species of pinnipeds observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury from construction sound of pinnipeds observed within a defined shutdown zone; and pinniped behavior.
• Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on pinnipeds observed in the area as necessary.

Hydroacoustic Monitoring—Hydroacoustic monitoring would be conducted to determine actual values and distances to relevant acoustic thresholds, including for vibratory installation of steel casings and sheet piles. The initial disturbance zones would then be adjusted as appropriate on the basis of that information. If new zones are established based on SPL measurements, NMFS requires each new zone be based on the most conservative measurement (i.e., the largest zone configuration). Vibratory installation of steel pipe and sheet pile is not anticipated to produce underwater sound above the 190-dB injury threshold, while vibratory installation of steel casings is estimated to produce SPLs of 190 dB at a maximum distance of 5 m from the source. However, a minimum 50 m shutdown zone would be established for these activities as for impact driving. Table 15 shows initial distances for shutdown and disturbance zones for these activities.

Ramp-Up and Shutdown

The objective of a ramp-up is to alert any animals close to the activity and allow them time to move away, which would expose fewer animals to loud sounds, including both underwater and above water sound. This procedure also ensures that any pinnipeds missed during shutdown zone monitoring would move away from the activity and not be injured. Although impact driving would occur from September 15 through April 15, and vibratory driving would occur year-round, ramp-up would be required only from January 1 through June 15 of any year, during the period of greatest potential overlap with pinniped presence in the project area. The following ramp-up procedures would be used for in-water pile installation:

• A ramp-up technique would be used at the beginning of each day's in-water pile driving activities or if pile driving has ceased for more than 1 hour.

• If a vibratory driver is used, contractors would be required to initiate sound from vibratory hammers for 15 seconds at reduced energy followed by a 1-minute waiting period. The procedure would be repeated two additional times before full energy may be achieved.

• If a non-diesel impact hammer is used, contractors would be required to provide an initial set of strikes from the impact hammer at reduced energy, followed by a 1-minute waiting period, then two subsequent sets. The reduced energy of an individual hammer cannot be quantified because they vary by individual drivers. Also, the number of strikes would vary at reduced energy because raising the hammer at less than full power and then releasing it results in the hammer ''bouncing'' as it strikes the pile, resulting in multiple ''strikes''.

• If a diesel impact hammer is used, contractors would be required to turn on the sound attenuation device (e.g., bubble curtain or other approved sound attenuation device) for 15 seconds prior to initiating pile driving to flush pinnipeds from the area.

The shutdown zone would also be monitored throughout the time required to drive a pile (or install a steel casing). If a pinniped is observed approaching or entering the shutdown zone, piling operations would be discontinued until the animal has moved outside of the shutdown zone. Pile driving would resume only after the animal is determined to have moved outside the shutdown zone by a qualified observer or after 15 minutes have elapsed since the last sighting of the animal within the shutdown zone.

Work Zone Lighting

If work occurs at night, temporary lighting would be used in the night work zones. During overwater construction, the contractor would use directional lighting with shielded luminaries to control glare and direct light onto work area, not surface waters.

Additional Mitigation Measures

In addition, NMFS and CRC, together with other relevant regulatory agencies, have developed a number of mitigation measures designed to protect fish through prevention or minimization of turbidity and disturbance and introduction of contaminants, among other things. These measures have been prescribed under the authority of statutes other than the MMPA, and are not a part of this proposed rulemaking. However, because these measures minimize impacts to pinniped prey species (either directly or indirectly, by minimizing impacts to prey species' habitat), they are summarized briefly here. Additional detail about these measures may be found in CRC's application.

Timing restrictions would be used to avoid in-water work when ESA-listed fish are most likely to be present. Fish entrapment would be minimized by containing and isolating in-water work to the extent possible, through the use of drilled shaft casings and cofferdams. The contractor would provide a qualified fishery biologist to conduct and supervise fish capture and release activity to minimize risk of injury to fish. All pumps must employ fish screen that meet certain specifications in order to avoid entrainment of fish. A qualified biologist would be present during all impact pile driving operations to observe and report any indications of dead, injured, or distressed fishes, including direct observations of these fishes or increases in bird foraging activity.

CRC would work to ensure minimum degradation of water quality in the project area, and would require the contractor to prepare a Water Quality Sampling Plan for conducting water quality monitoring for all projects occurring in-water in accordance with specific conditions. The Plan shall identify a sampling methodology as well as method of implementation to be reviewed and approved by the engineer. In addition, the contractor would prepare a Spill Prevention, Control, and Countermeasures (SPCC) Plan prior to beginning construction. The SPCC Plan would identify the appropriate spill containment materials; as well as the method of implementation. All equipment to be used for construction activities would be cleaned and inspected prior to arriving at the project site, to ensure no potentially hazardous materials are exposed, no leaks are present, and the equipment is functioning properly. Equipment that would be used below OHW would be identified; daily inspection and cleanup procedures would insure that identified equipment is free of all external petroleum-based products. Should a leak be detected on heavy equipment used for the project, the equipment must be immediately removed from the area and not used again until adequately repaired.

The contractor would also be required to prepare and implement a Temporary Erosion and Sediment Control (TESC) Plan and a Source Control Plan for project activities requiring clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation. The BMPs in the plans would be used to control sediments from all vegetation removal or ground-disturbing activities.

Conclusions

NMFS has carefully evaluated the applicant's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

- The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals;
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and
- The practicability of the measure for applicant implementation.

Based on our evaluation, NMFS has preliminarily determined that the mitigation measures proposed from both NMFS and CRC provide the means of effecting the least practicable adverse impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. The proposed rule comment period will afford the public an opportunity to submit recommendations, views, and/or concerns regarding this action and the proposed mitigation measures.

Proposed Monitoring and Reporting

In order to issue an incidental take authorization (ITA) for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must, where applicable, set forth ''requirements pertaining to the monitoring and reporting of such taking''. The MMPA implementing regulations at 50 CFR 216.104(a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that would result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

CRC proposed a marine mammal monitoring plan in their application (see Appendix D of CRC's application). The plan may be modified or supplemented based on comments or new information received from the public during the public comment period. All methods identified herein have been developed through coordination between NMFS and the design and environmental teams at CRC. The methods are based on the parties' professional judgment supported by their collective knowledge of pinniped behavior, site conditions, and proposed project activities. Because pinniped monitoring has not previously been conducted at this site, aspects of these methods may warrant modification. Any modifications to this protocol would be coordinated with NMFS. A summary of the plan, as well as the proposed reporting requirements, is contained here.

The intent of the monitoring plan is to:

- Comply with the requirements of the MMPA as well as the ESA section 7 consultation;
- Avoid injury to pinnipeds through visual monitoring of identified shutdown zones and shut-down of activities when animals enter or approach those zones; and
- To the extent possible, record the number, species, and behavior of pinnipeds in disturbance zones for pile driving and removal activities.

As described previously, monitoring for pinnipeds would be conducted in specific zones established to avoid or minimize effects of elevated levels of sound created by the specified activities. Shutdown zones would not be less than 50 m, while initial disturbance zones would be based on site-specific data. Zones may be modified on the basis of actual recorded SPLs from acoustic monitoring.

Visual Monitoring

The established shutdown and disturbance zones would be monitored by qualified marine mammal observers for mitigation purposes, as well as to document marine mammal behavior and incidents of Level B harassment, as described here. CRC's marine mammal monitoring plan (see Appendix D of CRC's application) would be implemented, requiring collection of sighting data for each pinniped observed during the proposed activities for which monitoring is required, including impact or vibratory installation of steel pipe or sheet pile or steel casings. A qualified biologist(s) would be present on site at all times during impact pile driving or vibratory installation or removal of steel pile or casings. Disturbance zones, briefly described previously under Proposed Mitigation, are discussed in greater depth here.

Disturbance Zone Monitoring—Disturbance zones, described previously in Proposed Mitigation, are defined in Table 15 for underwater sound. Monitoring zones for Level B harassment from airborne sound would be 650 m for harbor seals and 196 m for sea lions (corresponding to the anticipated extent of airborne sound reaching 90 and 100 dB, respectively). The size of the disturbance zone for vibratory pile installation or extraction would be approximately 800 m in both the upstream and downstream directions, corresponding with the area that can reasonably be monitored by a shore-based observer. Any sighted animals outside of this area would be recorded as takes, but it is impossible to guarantee that all animals would be observed or to make observations of fine-scale behavioral reactions to sound throughout this zone. Nevertheless, because any animals transiting the action area (and the larger disturbance zone) would pass through the monitored area, all animals may potentially be observed, and use of the smaller disturbance zone for monitoring purposes does not necessarily mean that a significant number of harassed animals would not be observed. Monitoring of disturbance zones would be implemented as described previously.

The monitoring biologists would document all pinnipeds observed in the monitoring area. Data collection would include a count of all pinnipeds observed by species, sex, age class, their location within the zone, and their reaction (if any) to construction activities, including direction of movement, and type of construction that is occurring, time that pile driving begins and ends, any acoustic or visual disturbance, and time of the observation. Environmental conditions such as wind speed, wind direction, visibility, and temperature would also be recorded. No monitoring would be conducted during inclement weather that creates potentially hazardous conditions, as determined by the biologist, nor would monitoring be conducted when visibility is significantly limited, such as during heavy rain or fog. During these times of inclement weather, in-water work that may produce sound levels in excess of 190 dB rms would be halted; these activities would not commence until monitoring has started for the day.

All monitoring personnel must have appropriate qualifications as identified previously, with qualifications to be certified by CRC (see Proposed Mitigation). These qualifications include education and experience identifying pinnipeds in the Columbia River and the ability to understand and document pinniped behavior. All monitoring personnel would meet at least once for a training session sponsored by CRC. Topics would include: Implementation of the protocol, identifying marine mammals, and reporting requirements.

All monitoring personnel would be provided a copy of the LOA and final biological opinion for the project. Monitoring personnel must read and understand the contents of the LOA and biological opinion as they relate to coordination, communication, and identifying and reporting incidental harassment of pinnipeds.

Hydroacoustic Monitoring

Hydroacoustic monitoring would be conducted on a representative number of piles or casings, according to protocols developed and approved by NMFS and USFWS. The number, size, and location of piles or casings monitored would represent the variety of substrates and depths, as necessary, in both the Columbia River and North Portland Harbor. Hydroacoustic monitoring would be conducted as necessary to measure representative source levels for impact and vibratory installation and removal of piles and casings. Measurements would represent a worst-case for size, depth, and substrate for all materials and installation methods. For standard underwater sound monitoring, one hydrophone positioned at 10 m from the pile is used. Some additional initial monitoring at several distances from the pile is anticipated to determine site-specific transmission loss and directionality of sound. This data would be used to establish the radii of the shutdown and disturbance zones for pinnipeds.

One hydrophone would be placed at between 1 and 3 m above the bottom at a distance of 10 m from each pile being monitored. Hydrophones placed upriver and downriver (at the 200-, 400- and 800-meter distances) would be placed at a depth greater than 5 m below the water surface or placed 1–3 meters above the bottom. A weighted tape measure would be used to determine the depth of the water. Each hydrophone would be attached to a nylon cord or a steel chain if the current is swift enough to cause strumming of the line. The nylon cord or chain would be attached to an anchor that would keep the line the appropriate distance from each pile. The nylon cord or chain would be attached to a buoy or raft at the surface and checked regularly to maintain the tightness of the line. The distances would be measured by a tape measure, where possible, or a range-finder for those hydrophones that are distant from the pile. There would be a direct line of sight between the pile and the hydrophone in all cases. GPS coordinates would be recorded for each hydrophone location.

When the river velocity is greater than 1 m/s, a flow shield around each hydrophone would be used to provide a barrier between the irregular, turbulent flow and the hydrophone. River velocity would be measured concurrent to sound measurements. If velocity is greater than 1 m/s, a correlation between sound levels and current speed would be made to determine whether the data is valid and should be included in the analysis. Hydrophone calibrations would be checked at the beginning of each day of monitoring activity. Prior to the initiation of pile driving, the hydrophones would be placed at the appropriate distances and depth as described.

Prior to and during the pile driving activity environmental data would be gathered such as wind speed and direction, air temperature, humidity, surface water temperature, water depth, wave height, weather conditions, and other factors that could contribute to influencing the underwater sound levels (e.g., aircraft, boats). Start and stop time of each pile driving event and the time at which the bubble curtain or functional equivalent is turned on and off would be recorded. The chief construction inspector would supply the acoustics specialist with a description of the substrate composition, hammer model and size, hammer energy settings and any changes to those settings during the piles being monitored, depth pile driven, blows per foot for the piles monitored, and total number of strikes to drive each pile that is monitored.

Proposed Reporting

Reports of data collected during monitoring would be submitted to NMFS weekly. The reporting would include:

• All data described previously under monitoring, including observation dates, times, and conditions; and
• Correlations of observed behavior with activity type and received levels of sound, to the extent possible.

CRC would also submit a report(s) concerning the results of all acoustic monitoring. Acoustic monitoring reports would include:

• Size and type of piles.
• A detailed description of any sound attenuation device used, including design specifications.
• The impact hammer energy rating used to drive the piles, make and model of the hammer(s), and description of the vibratory hammer.
• A description of the sound monitoring equipment.
• The distance between hydrophones and depth of water at the hydrophone locations.
• The depth of the hydrophones.
• The distance from the pile to the water's edge.
• The depth of water in which the pile was driven.
• The depth into the substrate that the pile was driven.
• The physical characteristics of the bottom substrate into which the piles were driven.
• The total number of strikes to drive each pile.
• The background sound pressure level reported as the fifty percent CDF, if recorded.
• The results of the hydroacoustic monitoring, including the frequency spectrum, ranges and means including the standard deviation/error for the peak and rms SPL's, and an estimation of the distance at which rms values reach the relevant marine mammal thresholds and background sound levels. Vibratory driving results would include the maximum and overall average rms calculated from 30-s rms values during the drive of the pile.
• A description of any observable pinniped behavior in the immediate area and, if possible, correlation to underwater sound levels occurring at that time.

An annual report on marine mammal monitoring and mitigation would be submitted to NMFS, Office of Protected Resources, and NMFS, Northwest Regional Office. The annual reports would summarize information presented in the weekly reports and include data collected for each distinct marine mammal species observed in the project area, including descriptions of marine mammal behavior, overall numbers of individuals observed, frequency of observation, and any behavioral changes and the context of the changes relative to activities would also be included in the annual reports. Additional information that would be recorded during activities and contained in the reports include: Date and time of marine mammal detections, weather conditions, species identification, approximate distance from the source, and activity at the construction site when a marine mammal is sighted.

In addition to annual reports, NMFS proposes to require CRC to submit a draft comprehensive final report to NMFS, Office of Protected Resources, and NMFS, Northwest Regional Office, 180 days prior to the expiration of the regulations. This comprehensive technical report would provide full documentation of methods, results, and interpretation of all monitoring during the first 4.5 years of the regulations. A revised final comprehensive technical report, including all monitoring results during the entire period of the regulations, would be due 90 days after the end of the period of effectiveness of the regulations.

Adaptive Management

The final regulations governing the take of marine mammals incidental to the specified activities at CRC would contain an adaptive management component. In accordance with 50 CFR 216.105(c), regulations for the proposed activity must be based on the best available information. As new information is developed, through monitoring, reporting, or research, the regulations may be modified, in whole or in part, after notice and opportunity for public review. The use of adaptive management would allow NMFS to consider new information from different sources to determine if mitigation or monitoring measures should be modified (including additions or deletions) if new data suggest that such modifications are appropriate.

The following are some of the possible sources of applicable data:

• Results from CRC's monitoring from the previous year;

• Results from general marine mammal and sound research; or

• Any information which reveals that marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent LOAs.

If, during the effective dates of the regulations, new information is presented from monitoring, reporting, or research, these regulations may be modified, in whole or in part, after notice and opportunity of public review, as allowed for in 50 CFR 216.105(c). In addition, LOAs would be withdrawn or suspended if, after notice and opportunity for public comment, the Assistant Administrator finds, among other things, that the regulations are not being substantially complied with or that the taking allowed is having more than a negligible impact on the species or stock, as allowed for in 50 CFR 216.106(e). That is, should substantial changes in marine mammal populations in the project area occur or monitoring and reporting show that CRC actions are having more than a negligible impact on marine mammals, then NMFS reserves the right to modify the regulations and/or withdraw or suspend LOAs after public review.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: ''any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) 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 [Level B harassment].'' Take by Level B harassment only is anticipated as a result of CRC's proposed activities. Take of marine mammals is anticipated to be associated with the installation and removal of piles and installation of steel casings, via impact and vibratory methods, and debris removal. No take by injury, serious injury, or death is anticipated.

Assumptions regarding numbers of pinnipeds and number of round trips per individual per year in the Region of Activity are based on information from ongoing pinniped research and management activities conducted in response to concern over California sea lion predation on fish populations concentrated below Bonneville Dam. An intensive monitoring program has been conducted in the Bonneville Dam tailrace since 2002, using surface observations to evaluate seasonal presence, abundance, and predation activities of pinnipeds. Minimum estimates of the number of pinnipeds present in the tailrace from 2002 through 2011 are presented in Table 16. Bonneville Dam is the first dam on the river, located at RKm 235, and is upriver of the CRC project site, which is located at approximately RKm 170. The primary California sea lion haul-out in the Columbia River is located in the Columbia River estuary in Astoria, approximately 151 RKm downstream of the project. This haul-out is the site of trapping and tagging for research and monitoring of pinnipeds that reach the Bonneville Dam tailrace.

TABLE 16—MINIMUM ESTIMATED TOTAL NUMBERS OF PINNIPEDS PRESENT AT BONNEVILLE DAM FROM 2002 THROUGH 2011

Species	2002	2003	2004	2005 **	2006	2007	2008	2009	2010	2011
California sea lion	30	104	99	81	72	71	82	54	89	54
Steller sea lion *	0	3	3	4	11	9	39	26	75	89
Harbor seal	1	2	2	1	3	2	2	2	2	1

Data from Stansell *et al.* 2010, pers. comm. Stansell, 2011.

* Animals not uniquely identified through 2007. Numbers through 2007 represent the highest number seen on any one day for each year (Tackley *et al.,* 2008a).

** Regular observations did not begin until March 18 in 2005; minimum estimate should likely be considered somewhat higher than these numbers (Tackley *et al.,* 2008a).

Monitoring began as a result of the 2000 FCRPS biological opinion, which required an evaluation of pinniped predation in the tailrace of Bonneville Dam. The objective of the study was to determine the timing and duration of pinniped predation activity, estimate the number of fish caught, record the number of pinnipeds present, identify and track individual California sea lions, and evaluate various pinniped deterrents used at the dam (Tackley *et al.,* 2008a). The study period for monitoring was January 1 through May 31, beginning in 2002. During the study period pinniped observations began after consistent sightings of at least one animal occurred. Tackley *et al.* (2008a) notes that sightings began earlier each year from 2002 to 2004. Although some sightings were reported earlier in the season, full-time observations began March 21 in 2002, March 3 in 2003, and February 24, 2004 (Tackley *et al.,* 2008a). In 2005 observations began in April, but in 2006 through 2010 observations began in January or early February (Tackley *et al.,* 2008a, b; Stansell *et al.,* 2009; Stansell and Gibbons, 2010). California sea lion and Steller sea lion arrival and departure dates at Bonneville Dam are compiled from the reports above and were detailed previously in Table 13 and Table 14. If arrival and departure dates were not available, the timing of surface observations within the January through May study period were recorded. Because regular observations in the study period generally began as sea lions were observed below Bonneville Dam, and sometimes reports stated that observations stopped as sea lion numbers dropped, the observation dates only give a general idea of first arrival and departure. Because acoustic telemetry data indicate that sea lions travel at fast rates between hydrophone locations above and below the CRC project area (see Brown *et al.,* 2010), dates of first arrival at Bonneville Dam and departure from the dam are assumed to coincide closely with potential passage timing through the CRC project area. Table 17 details observation effort by year; data is not yet available for observations in 2011.

TABLE 17—HOURS OF OBSERVATION FOR PINNIPEDS AT THE BONNEVILLE DAM TAILRACE, BY YEAR

2002	2003	2004	2005	2006	2007	2008	2009	2010
662	1,356	553	1,108	3,647	4,433	5,131	3,455	3,609

Pinniped species presence is determined by likelihood of occurrence near the CRC project construction activities based on general abundance at Bonneville Dam and the number of times individuals are estimated to make the trip to and from the dam in a year. Individuals observed at the dam are known to have passed the project site at least once; however, not all individuals that pass the project site would go all the way to the dam, although it is expected that the vast majority would. Therefore, the use of abundances at Bonneville Dam in estimating take would produce a slight underestimation. These estimates also assume that all pinnipeds that pass the project site would be exposed to project activities (e.g., pile installation would be occurring every time an individual passes the project site). However, project activities that may impact pinnipeds would not occur 24 hours a day; therefore, this assumption results in an overestimate of exposures. Table 18 summarizes the estimated take.

Harbor Seal

During most of the year, it is possible that small numbers of adults and subadults of both sexes may be expected to transit through the Region of Activity. In general, harbor seals remain close to haul-out sites when foraging and resting. As described previously, there are no known harbor seal haul-out sites within or near the Region of Activity, with the nearest known haul-out sites at least 45 mi (72 km) downstream. Pupping sites are generally restricted to coastal estuaries and other areas along the Olympic Peninsula and Puget Sound.

One to three harbor seals were documented below the dam in all 9 years of surface observations. Estimates are minimums and are based on observations made only within the January through May timeframe, although harbor seals have been observed in very low numbers year-round near Bonneville Dam (Tackley *et al.,* 2008a). However, based on salmon and steelhead run timing, as well as lamprey and smelt timing, seals would most likely occur during the same January through May period when sea lions are present. Based on the preceding information, CRC estimates a minimum of one to three adult or subadult harbor seals would be potentially exposed to in-water project activities each year. Based on the limited data available, CRC assumes that the number of individuals that actually pass by the CRC project area would be slightly higher than the highest minimum observed at the dam. CRC therefore conservatively estimates six individuals per year may potentially pass the project site. This may overestimate the number in some years. However, based on the consistency in the data, the number of individuals that have the potential to be exposed to project activities is likely to remain small in future years.

The number of round trips made per individual year is difficult to discern from the limited data available. Because harbor seals are not uniquely identified in the observations at Bonneville Dam, repeat observations of the same individual may have been reported on different observation days. Only one to three harbor seals have been observed at Bonneville Dam in any year (although this may represent greater than three individuals). One may safely assume that each individual completes at least one round-trip past the project site, although it may be more; because of the lack of data regarding seal movement to and from the dam, it is difficult to justify a number of round-trips per individual. We do know that harbor seals occur only infrequently at the dam and, therefore, only a limited number of round-trips could occur per individual. CRC conservatively estimates that each individual may make up to two round-trips.

Based on known pupping and haul-out locations, and the low number of observations of harbor seals at Bonneville Dam over the years, it is likely that very few harbor seals transit through the Region of Activity, and that those that do are subadults or adults. CRC conservatively estimates that up to six subadult or adult harbor seals (double the maximum number observed at Bonneville Dam to date) may transit the Region of Activity up to four times per year (two round-trips).

California Sea Lion

California sea lions are observed in the winter and spring (January through May) with only a limited number of exceptions. No haul-out sites are located within the Region of Activity and no breeding or pupping occurs in the Region of Activity. All animals documented in the Columbia River have been adult or juvenile males (Jeffries *et al.,* 2000). Table 16 presents numbers of California sea lions observed at Bonneville Dam. Numbers are presented as minimums, because not all sea lions are able to be uniquely identified in all observations and therefore may not be in the count. Tackley *et al.* (2008) noted that individuals were not uniquely identified prior to 2008; thus, the numbers of sea lions estimated from 2002 through 2007 were likely underestimated. During those years, Tackley *et al.* (2008) estimate that an additional 15 to 35 California sea lions may have been present, but observers were not able to uniquely identify them and therefore they are not represented in the counts. In addition, the high number of 104 individuals present below the dam in 2003 occurred prior to hazing (started in 2005) or permanent removal (2008–2010) activities. CRC believes the high number is not representative of current levels, due to extensive efforts to deter sea lions.

Permanent removal of forty individuals occurred from 2008–2010 (Stansell *et al.,* 2010). In 2010, the number of individual sea lions observed was a minimum of 89 individuals. Of the 89 individuals, fourteen were removed (Stansell *et al.,* 2010). Typically, the percentage of individuals making their first appearance at Bonneville Dam has been approximately thirty percent; however, in 2010 the percentage of new individuals was approximately 65 percent (51 were first time visitors below the dam) (Stansell *et al.,* 2010). The removal program is currently suspended by court order, further complicating the estimation of sea lion abundance at the dam in future years. Trends are particularly hard to discern because numbers passing the project site would be a reflection of the number of returning sea lions, numbers of sea lions successfully removed in future years (should the program be resumed), and numbers of new sea lions, none of which may be estimated on the basis of data indicating clear trends.

Based on 2010 data, new animals would likely largely replace those removed (e.g., in 2010, fourteen animals were removed and 51 were first time visitors below the dam) and still possibly result in an overall increase in California sea lion numbers. It is possible that a more effective method of deterrence will be developed in the future, or continued removal efforts will result in the number of California sea lions stabilizing or decreasing in future years. However, spring Chinook (*Oncorhynchus tshawytscha*) returns to the Columbia River in 2010 were the third largest on record since 1938 (CBB 2010), based on a preliminary summary (ODFW and WDFW 2010). If the numbers remain high or increase, it is possible that the numbers of sea lions foraging near Bonneville Dam may increase.

CRC estimates that the number of sea lions passing the project site would be approximately 89 individuals (the minimum high count since significant effort toward sea lion deterrence began) annually. There is a substantial amount of uncertainty in this estimate; therefore, NMFS presents the take estimate with the caveat that the estimate of California sea lions potentially present in each year of in-water project work may need to be adapted using the most recent data and trends available in future years (see Adaptive Management).

CRC examined satellite-linked and acoustic tracking reports of California sea lions to help estimate the number of times individual sea lions may pass the CRC project site. Tracking has been conducted on an almost annual basis since 2004. Based on data from 100 to 150 animals, annual California sea lion round trips to the dam range from one to five trips per individual (CRC, 2010). Movements of 26 satellite-tagged sea lions captured in the Columbia River during three non-breeding seasons (2003–04, 2004–05, and 2006–07) are described by Wright *et al.* (2010). Duration below the Bonneville Dam ranged from 2 to 43 days (Wright *et al.,* 2010). The authors noted that movements of sea lions captured in the Columbia River varied considerably within and across individuals, and that estimating the mean number of trips to Bonneville Dam in a given season is problematic given that many animals were tagged after they may have already made one or more such trips (Wright *et al.,* 2010). In 2009, six California sea lions were tagged in early April with acoustic transmitters, and four of those tagged had relatively long datasets (approximately 1–1.5 months) (Brown *et al.,* 2009). After tagging, three of the animals made one round trip from Astoria to Bonneville Dam, and one made two round trips prior to final departure from Bonneville Dam by the end of May (Brown *et al.,* 2009). The animals may have made additional trips prior to tagging in early April. Data from five animals tagged in 2010 indicate that at least one to four round-trips were made to Bonneville Dam from Astoria (Brown *et al.* 2010). Four animals were tagged in March or April for 22 to 51 days. Of these four individuals, two made at least four trips, one made two trips and one made one trip. The fifth animal was tagged in May at the end of the season and departed immediately after capture. Again, the preliminary data do not include trips taken prior to tagging.

Based on past data, the estimated number of times an individual sea lion would pass the CRC project site ranges from at least two to ten times per year (one to five roundtrips per year). However, the actual number is quite variable from individual to individual. Therefore, based on the data available, CRC conservatively estimates a maximum of ten trips (five round-trips) past the project site annually.

In summary, CRC conservatively estimates that up to 89 California sea lions may travel through the Region of Activity, annually, in future years. The nearest haul-out site is 45 mi (72 km) from the Region of Activity, California sea lion hazing efforts at Bonneville Dam are expected to continue, and there is no information indicating that a large increase in the numbers of California sea lions traveling up the Columbia River to Bonneville Dam is likely. Each California sea lion could be behaviorally harassed ten times per year (five round-trips).

Steller Sea Lion

Exposure of Steller sea lions to elevated sound levels in the Region of Activity is likely to occur from November through May, when primarily adult and subadult male Steller sea lions typically forage at Bonneville Dam. Steller sea lions are known to migrate through the Region of Activity as they transit between the dam and the ocean during this time period, often making multiple round-trip journeys. Beginning in 2008, individual sea lions have also been present during September or October, but in low numbers (Stansell *et al.,* 2009, 2010; Tackley *et al.,* 2008b). Therefore, exposure during fall months is possible in very low numbers, but less likely.

There are no Steller sea lion haul-outs or breeding sites in the Region of Activity. The nearest known haul-out is located approximately 26 mi (42 km) upstream of the CRC project area, and the nearest breeding site is located more than 200 mi (322 km) from the CRC project area (NMFS, 2008b). Therefore, elevated sound levels would have no effect on individuals at breeding or haul-out sites.

Similar to California sea lions, projections of Steller sea lion numbers estimated to pass the CRC project site during construction in future years are impossible to make with a high degree of confidence. Unlike California sea lions, ESA-listed Steller sea lions have not been subject to removal programs. Regular observations from 2002 through 2011 showed an increase in minimum numbers observed from 0 to 89 individuals, even though hazing efforts at the fish ladder entrances started in 2005 and vessel-based hazing began in 2006 (Scordino, 2010; Tackley *et al.,* 2008a; Stansell *et al.,* 2009). In 2010, the minimum number observed of 75 individuals was approximately triple the 2009 minimum of 26 individuals (Stansell and Gibbons, 2010); however, the 2009 minimum was reduced by one third from the 2008 minimum of 39.

The minimum number of animals projected in future years would be expected to be at least 89 individuals and may continue to increase based on recent past trends. However, there is very little certainty in this estimate, especially when it is projected into the future. It is possible a more effective method of deterrence would be developed in the future and the number of Steller sea lions may stabilize or decrease in future years. However, if trends in the numbers of fish continue, it is also possible that the number of Steller sea lions present would continue to increase.

Acoustic and satellite-linked tracking data for Steller sea lions in the Columbia River are only available for six individuals, and most were only tracked for one month beginning at the end of March or during April of 2010 (CRC, 2010). Additional data are available from two individuals that were tagged with only satellite-linked transmitters (which do not provide in-river movement data). From the limited dataset, seven individuals made one round trip from marine areas, and one individual made two round trips (Wright, 2010a). The number of round trips made earlier in the season, prior to tagging, is not included in the estimate and could increase the number of trips per individual. Like California sea lions, considerable variation within and across individuals may exist. Acoustic and satellite-linked data collection efforts will continue in the future and will better inform the estimate of number of round-trips Steller sea lions are likely to make past the CRC project area.

Summary

Based on past data, the number of times an individual Steller sea lion would pass the CRC project site ranges from a minimum of two to four times per year (one to two round-trips). Therefore, CRC estimates that individuals may transit the Region of Activity six times per year (three round-trips). As for California sea lions, the significant uncertainty associated with these estimates may require adaptation of the estimates using the most recent data and trends available (see Adaptive Management). Based on trends in Steller sea lions identified below Bonneville Dam in recent years, CRC conservatively estimates a tripling of the minimum of 75 individuals seen in 2010, to 225 individuals that may transit the project site six times (three round-trips) each per year.

TABLE 18—ESTIMATED NUMBER OF INDIVIDUALS EXPOSED TO PROPOSED ACTIVITIES PER YEAR

Species	Sex/age class affected	Estimated number of individuals per year	Estimated number of exposures per individual per year *	Total estimated take per year
Harbor seal	Adult males or females	6	4 (2 round-trips)	24
California sea lion	Subadult or adult males	89	10 (5 round-trips)	890
Steller sea lion	Subadult or adult males	225	6 (3 round-trips)	1,350

* It is assumed that individuals exposed to CRC's proposed activities would be in transit to/from Bonneville Dam to forage. Trips to Bonneville Dam are assumed to be round-trips to/from the mouth of the Columbia River.

Negligible Impact and Small Numbers Analyses and Preliminary Determination

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.'' In making a negligible impact determination, NMFS considers a variety of factors, including but not limited to: (1) The number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the takes occur.

Incidental take, in the form of Level B harassment only, is likely to occur primarily as a result of pinniped exposure to elevated levels of sound caused by impact and vibratory installation and removal of pipe and sheet pile and steel casings. No take by injury, serious injury, or death is anticipated or would be authorized. By incorporating the proposed mitigation measures, including pinniped monitoring and shut-down procedures described previously, harassment to individual pinnipeds from the proposed activities is expected to be limited to temporary behavioral impacts. CRC assumes that all individuals traveling past the project area would be exposed each time they pass the area and that all exposures would cause disturbance. NMFS agrees that this represents a worst-case scenario and is therefore sufficiently precautionary. There are no pinniped haul-outs or rookeries located within or near the Region of Activity. The nearest haul-out for California sea lions and harbor seals is approximately 45 mi (72 km) downriver from the Region of Activity, while the nearest known haul-out for Steller sea lions is approximately 26 mi (42 km) upstream from the Region of Activity.

The shutdown zone monitoring proposed as mitigation, and the small size of the zones in which injury may occur, makes any potential injury of pinnipeds extremely unlikely, and therefore discountable. Because pinniped exposures would be limited to the period they are transiting the disturbance zone, with potential repeat exposures (on return to the mouth of the Columbia River) separated by days to weeks, the probability of experiencing TTS is also considered unlikely.

These activities may cause individuals to temporarily disperse from the area or avoid transit through the area. However, existing traffic sound, commercial vessels, and recreational boaters already occur in the area. Thus, it is likely that pinnipeds are habituated to these disturbances while transiting the Region of Activity and would not be significantly hindered from transit. Behavioral changes are expected to potentially occur only when an animal is transiting a disturbance zone at the same time that the proposed activities are occurring.

In addition, it is unlikely that pinnipeds exposed to elevated sound levels would temporarily avoid traveling through the affected area, as they are highly motivated to travel through the action area in pursuit of foraging opportunities upriver (NMFS, 2008e). Sea lions have shown increasing habituation in recent years to various hazing techniques used to deter the animals from foraging in the Bonneville tailrace area, including acoustic deterrent devices, boat chasing, and above-water pyrotechnics (Stansell *et al.,* 2009). Many of the individuals that travel to the tailrace area return in subsequent years (NMFS, 2008). Therefore, it is likely that pinnipeds would continue to pass through the action area even when sound levels are above disturbance thresholds.

Although pinnipeds are unlikely to be deterred from passing through the area, even temporarily, they may respond to the underwater sound by passing through the area more quickly, or they may experience stress as they pass through the area. Sea lions already move quickly through the lower river on their way to foraging grounds below Bonneville Dam (transit speeds of 4.6 km/hr in the upstream direction and 8.8 km/hr in the downstream direction [Brown *et al.,* 2010]). Any increase in transit speed is therefore likely to be slight. Another possible effect is that the underwater sound would evoke a stress response in the exposed individuals, regardless of transit speed. However, the period of time during which an individual would be exposed to sound levels that might cause stress is short given their likely speed of travel through the affected areas. In addition, there would be few repeat exposures for individual animals. Thus, it is unlikely that the potential increased stress would have a significant effect on individuals or any effect on the population as a whole.

Therefore, NMFS finds it unlikely that the amount of anticipated disturbance would significantly change pinnipeds' use of the lower Columbia River or significantly change the amount of time they would otherwise spend in the foraging areas below Bonneville Dam. Pinniped usage of the Bonneville Dam foraging area, which results in transit of the action area, is a relatively recent learned behavior resulting from human modification (i.e., fish accumulation at the base of the dam). Even in the unanticipated event that either change was significant and animals were displaced from foraging areas in the lower Columbia River, there are alternative foraging areas available to the affected individuals. NMFS does not anticipate any effects on haul-out behavior because there are no proximate haul-outs within the areas affected by elevated sound levels. All other effects of the proposed action are at most expected to have a discountable or insignificant effect on pinnipeds, including an insignificant reduction in the quantity and quality of prey otherwise available.

Any adverse effects to prey species would occur on a temporary basis during project construction. Given the large numbers of fish in the Columbia River, the short-term nature of effects to fish populations, and extensive BMPs and minimization measures designed by NMFS in cooperation with CRC to protect fish during construction, as well as conservation and habitat mitigation measures that would continue into the future, the project is not expected to have significant effects on the distribution or abundance of potential prey species in the long term. All project activities would be conducted using the BMPs and minimization measures, which are described in detail in NMFS' biological opinion, pursuant to section 7 of the ESA, on the effects of the CRC project on ESA-listed species. Therefore, these temporary impacts are expected to have a negligible impact on habitat for pinniped prey species.

A detailed description of potential impacts to individual pinnipeds was provided previously in this document. The following sections put into context what those effects mean to the respective populations or stocks of each of the pinniped species potentially affected.

Harbor Seal

The Oregon/Washington coastal stock of harbor seals consisted of about 25,000 animals in 1999 (Carretta *et al.,* 2007). As described previously, both the Washington and Oregon portions of this stock have reached carrying capacity and are no longer increasing, and the stock is believed to be within its OSP level (Jeffries *et al.,* 2003; Brown *et al.,* 2005). The estimated take of 24 individuals per year by Level B harassment is small relative to a stable population of approximately 25,000 (0.1 percent), and is not expected to impact annual rates of recruitment or survival of the stock.

California Sea Lion

The U.S. stock of California sea lions was estimated to be 238,000 in the 2007 Stock Assessment Report and may be at carrying capacity, although more data are needed to verify that determination (Carretta *et al.,* 2007). Generally, California sea lions in the Pacific Northwest are subadult or adult males (NOAA, 2008). The estimated take of 890 individuals per year is small relative to a population of approximately 238,000 (0.4 percent), and is not expected to impact annual rates of recruitment or survival of the stock.

Steller Sea Lion

The total population of the eastern DPS of Steller sea lions is estimated to be within a range from approximately 58,334 to 72,223 animals with an overall annual rate of increase of 3.1 percent throughout most of the range (Oregon to southeastern Alaska) since the 1970s (Allen and Angliss, 2010). In 2006, the NMFS Steller sea lion recovery team proposed removal of the eastern stock from listing under the ESA based on its annual rate of increase. CRC's take estimate is conservative, assuming a three-fold increase above the largest minimum count in 2010. An increase of this magnitude occurred from 2009 to 2010, and so may be warranted; however, that 1-year increase is not necessarily a reliable indicator of future trends and so may result in an overestimate of future take. The total estimated take of 1,350 individuals per year is small compared to a population of approximately 65,000 (2.1 percent).

For California and Steller sea lions, individuals that may be disturbed would be males, so the anticipated behavioral harassment is not expected to impact recruitment or survival of the stock. For all species, because the type of incidental harassment is not expected to actually remove individuals from the population or decrease significantly their ability to feed or breed, this amount of incidental harassment is anticipated to have a negligible impact on the stock.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that CRC's proposed activities would result in the incidental take of small numbers of marine mammals, by Level B harassment only, and that the total taking from CRC's proposed activities would have a negligible impact on the affected species or stocks.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

On January 19, 2011, NMFS concluded consultation with FHWA and FTA under section 7 of the ESA on the proposed activities in the Columbia River and North Portland Harbor and issued a biological opinion. The finding of that consultation was that the proposed activities may adversely affect but are not likely to jeopardize the continued existence of the eastern DPS of Steller sea lions as well as a number of ESA-listed fish. NMFS has preliminarily determined that issuance of these regulations and subsequent LOAs would not have any impacts beyond those analyzed in the 2011 biological opinion.

National Environmental Policy Act (NEPA)

CRC released a Draft Environmental Impact Statement (EIS) for the proposed activities in May 2008. The draft EIS analyzed the potential environmental and community effects of five alternatives against the project's goals, as identified in the Statement of Purpose and Need. The Final EIS, released in September 2011, described additional analysis of potential environmental and community effects of the project and incorporated the comments received on the Draft EIS and public input received at more than 950 community briefings, workshops and public meetings. Following a 30-day review period, the CRC federal oversight agencies (FHWA and FTA) selected an alternative for the project and signed a record of decision (ROD) on December 7, 2011. Further information about CRC's NEPA process, as well as the EIS and ROD, is available at *www.columbiarivercrossing.com.* Because NMFS was not a cooperating agency in the development of CRC's EIS, NMFS will conduct a separate NEPA analysis for issuance of authorizations pursuant to section 101(a)(5)(A) of the MMPA for the activities proposed by CRC.

Information Solicited

NMFS requests interested persons to submit comments, information, and suggestions concerning the request and the content of the proposed regulations to govern the taking described herein (see **ADDRESSES**).

Classification

The Office of Management and Budget (OMB) has determined that this proposed rule is not significant for purposes of Executive Order 12866.

Pursuant to section 605(b) of the Regulatory Flexibility Act (RFA), the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration (SBA) that this proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. The SBA defines small entity as a small business, small organization, or a small governmental jurisdiction. Applying this definition, there are no small entities that are impacted by this proposed rule. This proposed rule impacts only the activities of CRC, which has submitted a request for authorization to take marine mammals incidental to bridge construction within the Columbia River, over the course of 5 years. CRC is a joint project of ODOT and WSDOT, in cooperation with FHWA and FTA. Project staff coordinates with state and local agencies in both Oregon and Washington, and also collaborates with federal agencies and tribal governments. CRC is not considered to be a small governmental jurisdiction under the RFA's definition. Under the RFA, governmental jurisdictions are considered to be small if they are ''governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than 50,000, unless an agency establishes, after opportunity for public comment, one or more definitions of such term which are appropriate to the activities of the agency and which are based on such factors as location in rural or sparsely populated areas or limited revenues due to the population of such jurisdiction, and publishes such definition(s) in the **Federal Register**.'' Because this proposed rule impacts only the activities of CRC, which is not considered to be a small entity within SBA's definition, the Chief Counsel for Regulation certified that this proposed rule will not have a significant economic impact on a substantial number of small entities. As a result of this certification, a regulatory flexibility analysis is not required and none has been prepared.

Notwithstanding any other provision of law, no person is required to respond to nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act (PRA) unless that collection of information displays a currently valid OMB control number. This proposed rule contains collection-of-information requirements subject to the provisions of the PRA. These requirements have been approved by OMB under control number 0648–0151 and include applications for regulations, subsequent LOAs, and reports. Send comments regarding any aspect of this data collection, including suggestions for reducing the burden, to NMFS and the OMB Desk Officer (see **ADDRESSES**).

List of Subjects in 50 CFR Part 217

Exports, Fish, Imports, Indians, Labeling, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation.

Dated: April 10, 2012.

Alan D. Risenhoover,

Acting Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, 50 CFR part 217 is proposed to be amended as follows:

PART 217—REGULATIONS GOVERNING THE TAKE OF MARINE MAMMALS INCIDENTAL TO SPECIFIED ACTIVITIES

1. The authority citation for part 217 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.*

2. Subpart V is added to part 217 to read as follows:

Subpart V—Taking of Marine Mammals Incidental to Columbia River Crossing Project, Washington and Oregon

Sec.

Subpart V—Taking of Marine Mammals Incidental to Columbia River Crossing Project, Washington and Oregon

§ 217.210 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to Columbia River Crossing (CRC) and those persons it authorizes to conduct activities on its behalf for the taking of marine mammals that occurs in the area outlined in paragraph (b) of this section and that occurs incidental to bridge construction and demolition associated with the CRC project.

(b) The taking of marine mammals by CRC may be authorized in a Letter of Authorization (LOA) only if it occurs in the Columbia River or North Portland Harbor, in the states of Washington and Oregon.

§ 217.211 Effective dates.

[Reserved]

§ 217.212 Permissible methods of taking.

(a) Under LOAs issued pursuant to § 216.106 and § 217.216 of this chapter, the Holder of the LOA (hereinafter ''CRC'') may incidentally, but not intentionally, take marine mammals within the area described in § 217.210(b) of this chapter, provided the activity is in compliance with all terms, conditions, and requirements of the regulations in this subpart and the appropriate LOA.

(b) The incidental take of marine mammals under the activities identified in § 217.210(a) of this chapter is limited to the indicated number of Level B harassment takes of the following species:

(1) Harbor seal (*Phoca vitulina*)—120 (an average of 24 annually)

(2) California sea lion (*Zalophus californianus*)—4,450 (an average of 890 annually)

(3) Steller sea lion (*Eumetopias jubatus*)—6,750 (an average of 1,350 annually)

§ 217.213 Prohibitions.

Notwithstanding takings contemplated in § 217.212(b) of this chapter and authorized by a LOA issued under § 216.106 and § 217.216 of this chapter, no person in connection with the activities described in § 217.210 of this chapter may:

(a) Take any marine mammal not specified in § 217.212(b) of this chapter;

(b) Take any marine mammal specified in § 217.212(b) of this chapter other than by incidental, unintentional Level B Harassment;

(c) Take a marine mammal specified in § 217.212(b) of this chapter if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(d) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or a LOA issued under § 216.106 and § 217.216 of this chapter.

§ 217.214 Mitigation.

(a) When conducting the activities identified in § 217.210(a) of this chapter, the mitigation measures contained in the LOA issued under § 216.106 and § 217.216 of this chapter must be implemented. These mitigation measures include:

(1) General Conditions:

(i) Briefings shall be conducted between the CRC project construction supervisors and the crew, marine mammal observer(s), and acoustical monitoring team prior to the start of all pile driving activity, and when new personnel join the work, to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures. The CRC project shall contact the Bonneville Dam marine mammal monitoring team to obtain information on the presence or absence of pinnipeds prior to initiating pile driving in any discrete pile driving time period described in the project description.

(ii) CRC shall comply with all applicable equipment sound standards and ensure that all construction equipment has sound control devices no less effective than those provided on the original equipment.

(iii) For in-water heavy machinery work other than pile driving (e.g., standard barges, tug boats, barge-mounted excavators, or clamshell equipment used to place or remove material), if a marine mammal comes within 50 m of such activity, operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions.

(2) Pile Installation:

(i) Permanent foundations for each in-water pier shall be installed by means of drilled shafts.

(ii) All piles shall be installed using vibratory driving to the extent possible. Installation of piles using impact driving may only occur between September 15 and April 15 of the following year, during daylight hours only. No more than two impact pile drivers may be operated simultaneously within the same water body channel.

(iii) In waters with depths more than 2 ft (0.67 m), a bubble curtain or other sound attenuation measure shall be used for impact driving of pilings. If a bubble curtain or similar measure is used, it shall distribute small air bubbles around 100 percent of the piling perimeter for the full depth of the water column. Any other attenuation measure (e.g., temporary sound attenuation pile) must provide 100 percent coverage in the water column for the full depth of the pile. A performance test of the sound attenuation device in accordance with the approved hydroacoustic monitoring plan shall be conducted prior to any impact pile driving. If a bubble curtain or similar measure is utilized, the performance test shall confirm the calculated pressures and flow rates at each manifold ring.

(3) Shutdown and Monitoring:

(i) Shutdown zone: For all impact pile driving and vibratory pile driving and removal, or installation of steel casings, shutdown zones shall be established. These zones shall include all areas where underwater sound pressure levels (SPLs) are anticipated to equal or exceed 190 dB re: 1 μPa rms. Shutdown zones shall be established on the basis of existing worst-case site-specific data for 24- or 48-in steel pile, as appropriate, collected by CRC with NMFS approval, and shall be adjusted as indicated by the results of acoustic monitoring conducted during the specified activities, but shall not be less than 50 m radius.

(ii) Disturbance zone: For all impact pile driving and vibratory pile driving or removal, disturbance zones shall be established. For impact pile driving, these zones shall include all areas where underwater SPLs are anticipated to equal or exceed 160 dB re: 1 μPa rms, and shall be established on the basis of existing worst-case site-specific data for 24- or 48-in steel pile, as appropriate, collected by CRC with NMFS approval. The zones shall be adjusted as indicated by the results of acoustic monitoring conducted during the specified activities. The actual size of the zone for vibratory pile driving and removal that includes all areas where underwater SPLs equal or exceed 120 dB re: 1 μPa rms shall be empirically determined and reported by CRC, and on-site biologists shall be aware of the size of this zone. However, because of its large size, monitoring of the entire zone may not be required but shall be conducted as described in paragraph (v) of this section.

(A) Initial disturbance zones for vibratory installation or removal of steel pipe pile and sheet pile and vibratory installation of steel casings shall be set at 800 m. In-situ acoustic monitoring shall be performed to determine the actual distances to these zones, and the size of the zones shall be adjusted accordingly based on worst-case site-specific data for vibratory installation of steel sheet pile and steel casings, but the area to be visually monitored shall not be larger than 800 m.

(B) [Reserved]

(iii) Airborne sound: Disturbance zones for pile driving and removal activity and steel casing installation, to include all areas where airborne SPLs are anticipated to equal or exceed 90 dB re: 20 μPa rms or 100 dB re: 20 μPa rms (for harbor seals and sea lions, respectively), shall be established. These zones shall be adjusted accordingly based on worst-case site-specific data collected during acoustic monitoring of the specified activities.

(iv) The shutdown and disturbance zones shall be monitored throughout the time required to drive a pile. If a marine mammal is observed within or approaching the shutdown zone, activity shall be halted as soon as it is safe to do so, until the animal is observed exiting the shutdown zone or 15 minutes has elapsed. If a marine mammal is observed within the disturbance zone, a take shall be recorded and behaviors documented.

(v) Monitoring of shutdown and disturbance zones shall occur for all pile driving and removal and steel casing installation activities. The following measures shall apply:

(A) Shutdown and disturbance zones shall be monitored from a work platform, barge, or other vantage point. If a small boat is used for monitoring, the boat shall remain 50 yd (46 m) from swimming pinnipeds. CRC shall at all times employ, at minimum, one Protected Species Observer (PSO) to be located on each barge or work platform engaging in pile driving or removal or steel casing installation and, at minimum, one PSO to be based on shore or at another appropriate vantage point, as determined by CRC. If a single shore-based PSO is unable to provide full observational coverage of disturbance zones when multiple pile driving or removal or steel casing installation activities are occurring simultaneously, additional shore-based PSOs shall be stationed so that such coverage is attained. For vibratory pile driving and removal or steel casing installation, CRC shall maintain comprehensive observation of a maximum disturbance zone of 800 m radial distance.

(B) If the shutdown zone is obscured by fog or poor lighting conditions, pile driving or removal or steel casing installation shall not be initiated until the entire shutdown zone is visible. Pile driving or removal or steel casing installation may continue under such conditions if properly initiated.

(C) The shutdown zone shall be monitored for the presence of pinnipeds before, during, and after any pile driving activity. The shutdown zone shall be monitored for 30 minutes prior to initiating the start of pile driving and for 30 minutes following the completion of pile driving. If pinnipeds are present within the shutdown zone prior to pile driving, the start of pile driving shall be delayed until the animals leave the shutdown zone of their own volition or until 15 minutes has elapsed without observing the animal.

(4) Ramp-up

(i) A ramp-up technique shall be used at the beginning of each day's in-water pile driving activities and if pile driving resumes after it has ceased for more than 1 hour.

(ii) If a vibratory driver is used, contractors shall be required to initiate sound from vibratory hammers for 15 seconds at reduced energy followed by a 1-minute waiting period. The procedure shall be repeated two additional times before full energy may be achieved.

(iii) If a non-diesel impact hammer is used, contractors shall be required to provide an initial set of strikes from the impact hammer at reduced energy, followed by a 1-minute waiting period, then two subsequent sets.

(iv) If a diesel impact hammer is used, contractors shall be required to turn on the sound attenuation device for 15 seconds prior to initiating pile driving.

(5) Additional mitigation measures as contained in a LOA issued under § 216.106 and § 217.216 of this chapter.

(b) [Reserved]

§ 217.215 Requirements for monitoring and reporting.

(a) Visual Monitoring Program: (1) CRC shall employ PSOs during in-water construction and demolition activities. All PSOs must receive advance NMFS approval after a review of their qualifications and NMFS-approved training. The PSOs shall be responsible for visually locating marine mammals in the shutdown and disturbance zones and, to the extent possible, identifying the species. PSOs shall record, at minimum, the following information:

(i) A count of all pinnipeds observed by species, sex, and age class.

(ii) Their location within the shutdown or disturbance zone, and their reaction (if any) to construction activities, including direction of movement.

(iii) Activity that is occurring at the time of observation, including time that pile driving begins and ends, any acoustic or visual disturbance, and time of the observation.

(iv) Environmental conditions, including wind speed, wind direction, visibility, and temperature.

(2) Monitoring shall be conducted using appropriate binoculars. When possible, digital video or still cameras shall also be used to document the behavior and response of pinnipeds to construction activities or other disturbances.

(3) Each monitor shall have a radio or cell phone for contact with other monitors or work crews. Observers shall implement shut-down or delay procedures when applicable by calling for the shut-down to the hammer operator.

(4) A GPS unit or electric range finder shall be used for determining the observation location and distance to pinnipeds, boats, and construction equipment.

(5) No monitoring shall be conducted during inclement weather that creates potentially hazardous conditions, as determined by the biologist on-site. No monitoring shall be conducted when visibility in the shutdown zone is significantly limited, such as during heavy rain or fog. During these times of inclement weather, in-water work that may produce sound levels in excess of 190 dB rms must be halted; these activities may not commence until appropriate monitoring of the shutdown zone can take place.

(b) Reporting—CRC must implement the following reporting requirements:

(1) Reports of data collected during monitoring shall be submitted to NMFS weekly. The reports shall include:

(i) All data required to be collected during monitoring, as described under 217.215(a) of this chapter, including observation dates, times, and conditions; and

(ii) Correlations of observed behavior with activity type and received levels of sound, to the extent possible.

(2) CRC shall also submit a report(s) concerning the results of all acoustic monitoring. Acoustic monitoring reports shall include:

(i) Size and type of piles.

(ii) A detailed description of any sound attenuation device used, including design specifications.

(iii) The impact hammer energy rating used to drive the piles, make and model of the hammer(s), and description of the vibratory hammer.

(iv) A description of the sound monitoring equipment.

(v) The distance between hydrophones and depth of water at the hydrophone locations.

(vi) The depth of the hydrophones.

(vii) The distance from the pile to the water's edge.

(viii) The depth of water in which the pile was driven.

(ix) The depth into the substrate that the pile was driven.

(x) The physical characteristics of the bottom substrate into which the piles were driven.

(xi) The total number of strikes to drive each pile.

(xii) The background sound pressure level reported as the fifty percent cumulative distribution function, if recorded.

(xiii) The results of the hydroacoustic monitoring, including the frequency spectrum, ranges and means including the standard deviation/error for the peak and rms SPLs, and an estimation of the distance at which rms values reach the relevant marine mammal thresholds and background sound levels. Vibratory driving results shall include the maximum and overall average rms calculated from 30-s rms values during the drive of the pile.

(xiv) A description of any observable pinniped behavior in the immediate area and, if possible, correlation to underwater sound levels occurring at that time.

(3) Reporting Injured or Dead Marine Mammals

(i) In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by a LOA (if issued), such as an injury (Level A harassment), serious injury, or mortality, CRC shall immediately cease the specified activities and report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Northwest Regional Stranding Coordinator, NMFS. The report must include the following information:

(A) Time and date of the incident;

(B) Description of the incident;

(C) Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);

(D) Description of all marine mammal observations in the 24 hours preceding the incident;

(E) Species identification or description of the animal(s) involved;

(F) Fate of the animal(s); and

(G) Photographs or video footage of the animal(s).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with CRC to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. CRC may not resume their activities until notified by NMFS.

(ii) In the event that CRC 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 (e.g., in less than a moderate state of decomposition), CRC shall immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Northwest Regional Stranding Coordinator, NMFS.

The report must include the same information identified in 217.215(b)(3)(i) of this chapter. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with CRC to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that CRC 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 LOA (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), CRC shall report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Northwest Regional Stranding Coordinator, NMFS, within 24 hours of the discovery. CRC shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

(4) Annual Reports.

(i) An annual report summarizing all pinniped monitoring and construction activities shall be submitted to NMFS, Office of Protected Resources, and NMFS, Northwest Regional Office (specific contact information to be provided in LOA) each year.

(ii) The annual reports shall include data collected for each distinct marine mammal species observed in the project area. Description of marine mammal behavior, overall numbers of individuals observed, frequency of observation, and any behavioral changes and the context of the changes relative to activities shall also be included in the annual reports. Additional information that shall be recorded during activities and contained in the reports include: Date and time of marine mammal detections, weather conditions, species identification, approximate distance from the source, and activity at the construction site when a marine mammal is sighted.

(5) Five Year Comprehensive Report.

(i) CRC shall submit a draft comprehensive final report to NMFS, Office of Protected Resources, and NMFS, Northwest Regional Office (specific contact information to be provided in LOA) 180 days prior to the expiration of the regulations. This comprehensive technical report shall provide full documentation of methods, results, and interpretation of all monitoring during the first 4.5 years of the activities conducted under the regulations in this Subpart.

(ii) CRC shall submit a revised final comprehensive technical report, including all monitoring results during the entire period of the LOAs, 90 days after the end of the period of effectiveness of the regulations to NMFS, Office of Protected Resources, and NMFS, Northwest Regional Office (specific contact information to be provided in LOA).

§ 217.216 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations, CRC must apply for and obtain a LOA.

(b) A LOA, unless suspended or revoked, may be effective for a period of time not to exceed the expiration date of these regulations.

(c) If an LOA expires prior to the expiration date of these regulations, CRC must apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA, CRC must apply for and obtain a modification of the LOA as described in § 217.217 of this chapter.

(e) The LOA shall set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact (i.e., mitigation) on the species, its habitat, and on the availability of the species for subsistence uses; and

(3) Requirements for monitoring and reporting.

(f) Issuance of the LOA shall be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under these regulations.

(g) Notice of issuance or denial of a LOA shall be published in the **Federal Register** within 30 days of a determination.

§ 217.217 Renewals and Modifications of Letters of Authorization.

(a) A LOA issued under § 216.106 and § 217.216 of this chapter for the activity identified in § 217.210(a) of this chapter shall be renewed or modified upon request by the applicant, provided that: (1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision in § 217.217(c)(1) of this chapter), and (2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

(b) For LOA modification or renewal requests by the applicant that include changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in § 217.217(c)(1) of this chapter) that do not change the findings made for the regulations or result in no more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the **Federal Register**, including the associated analysis illustrating the change, and solicit public comment before issuing the LOA.

(c) A LOA issued under § 216.106 and § 217.216 of this chapter for the activity identified in § 217.210(a) of this chapter may be modified by NMFS under the following circumstances:

(1) Adaptive Management—NMFS may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with CRC regarding the practicability of the modifications) if doing so creates a

reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in the preamble for these regulations.

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA:

(A) Results from CRC's monitoring from the previous year(s).

(B) Results from other marine mammal and/or sound research or studies.

(C) Any information that reveals marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent LOAs.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS will publish a notice of proposed LOA in the **Federal Register** and solicit public comment.

(2) Emergencies—If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in § 217.212(b) of this chapter, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within 30 days of the action.

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