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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XE490

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to the San Francisco Ferry Terminal Expansion Project, South Basin Improvements Project

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

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received a request from the San Francisco Bay Area Water Emergency Transportation Authority (WETA) for authorization to take marine mammals incidental to construction activities as part of a ferry terminal expansion and improvements project. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting public comment on its proposal to issue an incidental harassment authorization (IHA) to WETA to incidentally take marine mammals, by Level B harassment only, during the specified activity.

DATES: Comments and information must be received no later than [*insert date 30 days after date of publication in the FEDERAL REGISTER*].

ADDRESSES: Comments on this proposal should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910, and electronic comments should be sent to *ITP.mccue@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. All comments received are a part of the public record and will generally be posted to the Internet at *www.nmfs.noaa.gov/pr/permits/incidental/construction.html* without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Laura McCue, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Availability

An electronic copy of WETA's application and supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the Internet at: *www.nmfs.noaa.gov/pr/permits/incidental/construction.html*. In case of problems accessing these documents, please call the contact listed above.

National Environmental Policy Act

NMFS is currently conducting an analysis, pursuant to National Environmental Policy Act (NEPA), to determine whether or not this proposed activity may have a significant effect on the human environment. This analysis will be completed prior to the issuance or denial of this proposed IHA.

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 by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified area, the incidental, but not intentional, taking of small numbers of marine mammals, providing that certain findings are made and the necessary prescriptions are established.

The incidental taking of small numbers of marine mammals may be allowed only if NMFS (through authority delegated by the Secretary) finds that the total taking by the specified activity during the specified time period will (i) have a negligible impact on the species or stock(s) and (ii) not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). Further, the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking must be set forth, either in specific regulations or in an authorization.

The allowance of such incidental taking under section 101(a)(5)(A), by harassment, serious injury, death, or a combination thereof, requires that regulations be established. Subsequently, a Letter of Authorization may be issued pursuant to the prescriptions established in such regulations, providing that the level of taking will be consistent with the findings made for the total taking allowable under the specific regulations. Under section 101(a)(5)(D), NMFS may authorize such incidental taking by harassment only, for periods of not more than one year, pursuant to requirements and conditions contained within an IHA. The establishment of prescriptions through either specific regulations or an authorization requires notice and opportunity for public comment.

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, section 3(18) of 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 February 8, 2016, we received a request from WETA for authorization of the taking, by level B harassment only, of marine mammals, incidental to pile driving in association with the San Francisco Ferry Terminal Expansion Project, South Basin Improvements Project in San Francisco Bay, California. That request was modified to include additional species and additional monitoring and mitigation measures on March 28, 2016 and May 2, 2016, and a final version, which we deemed adequate and complete, was submitted on May 13, 2016, which included revised take numbers and additional mitigation measures. In-water work associated with the project is expected to be completed within 23 months. This proposed IHA is for the first phase of construction activities (July 1, 2016- December 31, 2016).

The use of both vibratory and impact pile driving is expected to produce underwater sound at levels that have the potential to result in behavioral harassment of marine mammals. Seven species of marine mammals have the potential to be affected by the specified activities: harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), Northern elephant seal (*Mirounga angustirostris*), Northern fur seal (*Callorhinus ursinus*), harbor porpoise (*Phocoena*

phocoena), gray whale (*Eschrichtius robustus*), and bottlenose dolphin (*Tursiops truncatus*). These species may occur year round in the action area.

Similar construction and pile driving activities in San Francisco Bay have been authorized by NMFS in the past. These projects include construction activities at the Exploratorium (75 FR 66065), pier 36 (77 FR 20361), and the Oakland Bay Bridge (71 FR 26750; 72 FR 25748; 74 FR 41684; 76 FR 7156; 78 FR 2371; 79 FR 2421; and 80 FR 43710).

Description of the Specified Activity

Overview

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) is expanding berthing capacity at the Downtown San Francisco Ferry Terminal (Ferry Terminal), located at the San Francisco Ferry Building (Ferry Building), to support existing and future planned water transit services operated on San Francisco Bay by WETA and WETA's emergency operations.

The Downtown San Francisco Ferry Terminal Expansion Project would eventually include phased construction of three new water transit gates and overwater berthing facilities, in addition to supportive landside improvements, such as additional passenger waiting and queuing areas, circulation improvements, and other water transit–related amenities. The new gates and other improvements would be designed to accommodate future planned water transit services between Downtown San Francisco and Antioch, Berkeley, Martinez, Hercules, Redwood City, Richmond, and Treasure Island, as well as emergency operation needs. According to current planning and operating assumptions, WETA will not require all three new gates (Gates A, F, and G) to support existing and new services immediately. As a result, WETA is planning that project construction will be phased. The first phase will include construction of Gates F and G, as well as other related improvements in the South Basin.

Dates and Duration

The total project is expected to require a maximum of 130 days of in-water pile driving. The project may require up to 23 months for completion; with a maximum of 106 days for pile driving in the first year. In-water activities are limited to occur between July 1 and November 30, 2016 and June 1 through November 30, 2017. If in-water work will extend beyond the effective dates of the IHA, a second IHA application will be submitted by WETA. This proposed authorization would be effective from July 1, 2016 to December 31, 2016.

Specific Geographic Region

The San Francisco ferry terminal is located in the western shore of San Francisco Bay (see Figure 1of WETA's application). The ferry terminal is five blocks north of the San Francisco Oakland Bay Bridge. More specifically, the south basin of the ferry terminal is located between Pier 14 and the ferry plaza. San Francisco Bay and the adjacent Sacramento-San Joaquin Delta make up one of the largest estuarine systems on the continent. The Bay has undergone extensive industrialization, but remains an important environment for healthy marine mammal populations year round. The area surrounding the proposed activity is an intertidal landscape with heavy industrial use and boat traffic.

Detailed Description of Activities

The project supports existing and future planned water transit services operated by WETA, and regional policies to encourage transit uses. Furthermore, the project addresses deficiencies in the transportation network that impede water transit operation, passenger access, and passenger circulation at the Ferry Terminal.

The project includes construction of two new water transit gates and associated overwater berthing facilities, in addition to supportive improvements, such as additional passenger waiting and queuing areas and circulation improvements in a 7.7-acre area (see Figure 1 in the WETA's application, which depicts the project area, and Figure 2, which depicts the project improvements). The project includes the following elements: (1) Removal of portions of existing deck and pile construction (portions will remain as open water, and other portions will be replaced); (2) Construction of two new gates (Gates F and G); (3) Relocation of an existing gate (Gate E); and (4) Improved passenger boarding areas, amenities, and circulation, including extending the East Bayside Promenade along Gates E, F, and G; strengthening the South Apron of the Agriculture Building; creating the Embarcadero Plaza; and installing weather protection canopies for passenger queuing.

Implementation of the project improvements will result in a change in the type and area of structures over San Francisco Bay. In some areas, structures will be demolished and then rebuilt. The project will require both the removal and installation of piles as summarized in Table 1. Demolition and construction could be completed within 23 months.

Table 1. Summary of Pile Removal and Installation.

Project Element	Pile Diameter	Pile Type	Method	Number of Piles/ Schedule
Demolition in the South Basin	12 to 18 inches	Wood and concrete	Pull or cut off 2 feet below mud line.	350 piles/30 days 2016
Removal of Dolphin Piles in the South Basin	36 inches	Steel: 140 to 150 feet in length	Pull out.	Four dolphin piles
Embarcadero Plaza and East Bayside Promenade	24 or 36 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	220 24- or 36-inch piles/65 days 2016

Gates E, F, and G Dolphin Piles	36 inches	Steel: 145 to 155 feet in length	Impact or Vibratory Driver	14 total: two at each of the floats for protection; two between each of the floats; and four adjacent to the breakwater.
Gate F and G Guide Piles	36 inches	Steel: 140 to 150 feet in length	Impact or Vibratory Driver	12 (6 per gate)/ 12 days 2017
Gate E Guide Piles	36 inches	Steel: 145 to 155 feet in length	Vibratory Driver for removal, may be reinstalled with an impact driver	Six piles will be removed and reinstalled/12 days 2017
Fender Piles	14 inches	Polyurethane-coated pressure-treated wood; 64 feet in length	Impact or Vibratory Driver	38/10 days 2016

Removal of Existing Facilities

As part of the project, the remnants of Pier 2 will be demolished and removed. This consists of approximately 21,000 square feet of existing deck structure supported by approximately 350 wood and concrete piles. In addition, four dolphin piles will be removed. Demolition will be conducted from barges. Two barges will be required: one for materials storage, and one outfitted with demolition equipment (crane, clamshell bucket for pulling of piles, and excavator for removal of the deck). Diesel-powered tug boats will bring the barges to the project area, where they will be anchored. Piles will be removed by either cutting them off two feet below the mud line or pulling the pile.

Construction of Gates and Berthing Structures

The new gates (Gates F and G) will be built similarly. Each gate will be designed with an entrance portal—a prominent doorway physically separating the berthing structures from the surrounding area. Berthing structures will be provided for each new gate, consisting of floats, gangways, and guide piles. The steel floats will be approximately 42 feet wide by 135 feet long. The steel truss gangways will be approximately 14 feet wide and 105 feet long. The gangway will be designed to rise and fall with tidal variations while meeting Americans with Disabilities Act (ADA) requirements. The gangway and the float will be designed with canopies, consistent with the current design of existing Gates B and E. The berthing structures will be fabricated off site and floated to the project area by barge. Six steel guide piles will be required to secure each float in place. In addition, dolphin piles may be used at each berthing structure to protect against the collision of vessels with other structures or vessels. A total of up to 14 dolphin piles may be installed.

Chock-block fendering will be added along the East Bayside Promenade, to adjacent structures to protect against collision. The chock-block fendering will consist of square, 12-inch-wide, polyurethane-coated, pressure-treated wood blocks that are connected along the side of the adjacent pier structure, and supported by polyurethane-coated, pressure-treated wood piles.
In addition, the existing Gate E float will be moved 43 feet to the east, to align with the new gates and East Bayside Promenade. The existing six 36-inch-diameter steel guide piles will be removed using vibratory extraction, and reinstalled to secure the Gate E float in place. Because of Gate E's new location, to meet ADA requirements, the existing 90-foot-long steel truss gangway will be replaced with a longer, 105-foot-long gangway.

Passenger Boarding and Circulation Areas

Several improvements will be made to passenger boarding and circulation areas. New deck and pile-supported structures will be built.

- An Embarcadero Plaza, elevated approximately 3 to 4 feet above current grade, will be created. The Embarcadero Plaza will require new deck and pile construction to fill an open-water area and replace existing structures that do not comply with Essential Facilities requirements.
- The East Bayside Promenade will be extended to create continuous pedestrian access to Gates E, F, and G, as well as to meet public access and pedestrian circulation requirements along San Francisco Bay. It will

extend approximately 430 feet in length, and will provide an approximately 25-foot-wide area for pedestrian circulation and public access along Gates E, F, and G. The perimeter of the East Bayside Promenade will also include a curbed edge with a guardrail.

- Short access piers, approximately 30 feet wide and 45 feet long, will extend from the East Bayside Promenade to the portal for each gate.
- The South Apron of the Agriculture Building will be upgraded to temporarily support access for passenger circulation. Depending on their condition, as determined during Final Design, the piles supporting this apron may need to be strengthened with steel jackets.
- Two canopies will be constructed along the East Bayside Promenade: one between Gates E and F, and one between Gates F and G. Each of the canopies will be 125 feet long and 20 feet wide. Each canopy will be supported by four columns at 35 feet on center, with 10-foot cantilevers at either end. The canopies will be constructed of steel and glass, and will include photovoltaic cells.

The new deck will be constructed on the piles, using a system of beam-and-flat-slab-concrete construction, similar to what has been built in the Ferry Building area. The beam-and-slab construction will be either precast or cast-in-place concrete (or a combination of the two), and approximately 2.5 feet thick. Above the structure, granite paving or a concrete topping slab will provide a finished pedestrian surface.

The passenger facilities, amenities, and public space improvements—such as the entrance portals, canopy structures, lighting, guardrails, and furnishings—will be surface-mounted on the pier structures after the new construction and repair are complete. The canopies and entrance portals will be constructed offsite, delivered to the site, craned into place by barge, and assembled onsite. The glazing materials, cladding materials, granite pavers, guardrails, and furnishings will be assembled onsite.

Dredging Requirements

The side-loading vessels require a depth of 12.5 feet below mean lower low water (MLLW) on the approach and in the berthing area. Based on a bathymetric survey conducted in 2015, it is estimated that the new Gates F and G will require dredging to meet the required depths. The expected dredging volumes are presented in Table 2. These estimates are based on dredging the approach areas to 123.5 feet below MLLW, and 2 feet of overdredge depth, to account for inaccuracies in dredging practices. The dredging will take approximately 2 months.

Table 2. Summary of Dredging Requirements.

Dredging Element	Summary
Initial Dredging	
Gate F	0.78 acre/6,006 cubic yards
Gate G	1.64 acres/14,473 cubic yards
Total for Gates F and G	2.42 acres/20,479 cubic yards
Staging	On barges
Typical Equipment	Clamshell dredge on barge; disposal barge; survey boat
Duration	2 months
Maintenance Dredging	
Gates F and G	5,000 to 10,000 cubic yards
Frequency	Every 3 or 4 years

Based on observed patterns of sediment accumulation in the Ferry Terminal area, significant sediment accumulation will not be expected, because regular maintenance dredging is not currently required to maintain operations at existing Gates B and E. However, some dredging will likely be required on a regular maintenance cycle beneath the floats at Gates F and G, due to their proximity to the Pier 14 breakwater. It is expected that maintenance dredging will be required every 3 to 4 years, and will require removal of approximately 5,000 to 10,000 cubic yards of material.

Dredging and disposal of dredged materials will be conducted in cooperation with the San Francisco Dredged Materials Management Office (DMMO), including development of a sampling plan, sediment characterization, a sediment removal plan, and disposal in accordance with the Long-Term Management Strategy for San Francisco Bay to ensure beneficial reuse, as appropriate. DMMO consultation is expected to begin in early 2016. Based on the results of the sediment analysis, the alternatives for placement of dredged materials will be evaluated, including disposal at the San Francisco Deep Ocean Disposal Site, disposal at an upland facility, or beneficial reuse. Selection of the disposal site will be reviewed and approved by the DMMO.

Description of Marine Mammals in the Area of the Specified Activity

There are seven marine mammal species which may inhabit or may likely transit through the waters nearby the Ferry Terminal, and which are expected to potentially be taken by the specified activity. These include the Pacific harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), Northern Elephant seal (*Mirounga angustirostris*), Northern fur seal (*Callorhinus ursinus*), harbor porpoise (*Phocoena phocoena*), gray whale (*Eschrichtius robustus*), and bottlenose dolphin (*Tursiops truncatus*). Multiple additional marine mammal species may occasionally enter the activity area in San Francisco Bay but would not be expected to occur in shallow nearshore waters of the action area. Guadalupe fur seals (*Arctocephalus townsendi*) generally do not occur in San Francisco Bay; however, there have been recent sightings of this species due to the El Niño event. Only single individuals of this species have occasionally been sighted inside San Francisco Bay, and their presence near the action area is considered unlikely. No takes are requested for this species, and mitigation measures such as a shutdown zone will be in effect for this species if observed approaching the Level B harassment zone. Although it is possible that a humpback whale (*Megaptera navaeangliae*) may enter San Francisco Bay and find its way into the project area during construction activities, their occurrence is unlikely. No takes are requested for this species, and mitigation measures such as a delay and shutdown procedure will be in effect for this species if observed approaching the Level

B harassment zone. Table 3 lists the marine mammal species with expected potential for occurrence in the vicinity of the SF Ferry terminal during the project timeframe and summarizes key information regarding stock status and abundance. Taxonomically, we follow Committee on Taxonomy (2014). Please see NMFS' Stock Assessment Reports (SAR), available at *www.nmfs.noaa.gov/pr/sars*, for more detailed accounts of these stocks' status and abundance. Please also refer to NMFS' website (*www.nmfs.noaa.gov/pr/species/mammals*) for generalized species accounts.

Table 3. Marine Mammals Potentially Present in the Vicinity of San Francisco Ferry Terminal.

Species	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Stock abundance (CV, N_{min}, most recent abundance survey)[2]	PBR[3]	Relative occurrence in Strait of Juan de Fuca; season of occurrence
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family Phocoenidae (porpoises)					
Harbor porpoise	San Francisco-Russian River	-; N	9,886 (0.51; 6,625; 2011)	66	Common
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family Delphinidae (dolphins)					
Bottlenose dolphin[5]	California coastal	-; N	323 (0.13; 290; 2005)	2.4	Rare
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family Eschrichtiidae					
Gray whale	Eastern N. Pacific	-; N	20,990 (0.05; 20,125; 2011)	624	Rare
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)					
Family Balaenopteridae					
Humpback whale	California/Oregon/ Washington stock	E; S	1,918	11	Unlikely
Order Carnivora – Superfamily Pinnipedia					
Family Otariidae (eared seals and sea lions)					
California sea lion	U.S.	-; N	296,750 (n/a; 153,337; 2011)	9,200	Common
Guadalupe fur seal[5]	Mexico to California	T; S	7,408 (n/a; 3,028; 1993)	91	Unlikely
Northern fur seal	California stock	-;N	14,050 (n/a; 7,524; 2013)	451	Unlikely

Family Phocidae (earless seals)					
Harbor seal	California	-; N	30,968 (n/a; 27,348; 2012)	1,641	Common; Year-round resident
Northern elephant seal	California breeding stock	-; N	179,000 (n/a; 81,368; 2010)	4,882	Rare

[1]ESA status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR (see footnote 3) or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2]CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For certain stocks, abundance estimates are actual counts of animals and there is no associated CV. The most recent abundance survey that is reflected in the abundance estimate is presented; there may be more recent surveys that have not yet been incorporated into the estimate.

[3]Potential biological removal, defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population size (OSP).

[4]These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.*, commercial fisheries, subsistence hunting, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value. All values presented here are from the draft 2015 SARs (*www.nmfs.noaa.gov/pr/sars/draft.htm*).

[5]Abundance estimates for these stocks are greater than eight years old and are therefore not considered current. PBR is considered undetermined for these stocks, as there is no current minimum abundance estimate for use in calculation. We nevertheless present the most recent abundance estimates and PBR values, as these represent the best available information for use in this document.

Below, for those species that are likely to be taken by the activities described,, we offer a brief introduction to the species and relevant stock as well as available information regarding population trends and threats, and describe any information regarding local occurrence.

Harbor seal

The Pacific harbor seal is one of five subspecies of *Phoca vitulina*, or the common harbor seal. There are five species of harbor seal in the Pacific EEZ: (1) California stock; (2) Oregon/ Washington coast stock; (3) Washington Northern inland waters stock; (4) Southern Puget Sound stock; and (5) Hood Canal stock. Only the California stock occurs in the action area and is analyzed in this document. The current abundance estimate for this stock is 30,968. This stock is not considered strategic or designated as depleted under the MMPA and is not listed under the ESA. PBR is 1,641 animals per year. The average annual rate of incidental commercial fishery mortality (30 animals) is less than 10% of the calculated PBR (1,641 animals); therefore, fishery mortality is considered insignificant (Allen and Angliss, 2013).

Although generally solitary in the water, harbor seals congregate at haulouts to rest, socialize, breed, molt. Habitats used as haul-out sites include tidal rocks, bayflats, sandbars, and sandy beaches (Zeiner et al., 1990). Haul-out sites are relatively consistent from year-to-year (Kopec and Harvey, 1995), and females have been recorded returning to their own natal haul-out when breeding (Cunningham et al., 2009). Long-term monitoring studies have been conducted at the largest harbor seal colonies in Point Reyes National Seashore and Golden Gate National Recreation Area since 1976. Castro Rocks and other haulouts in San Francisco Bay are part of the regional survey area for this study and have been included in annual survey efforts. Between 2007 and 2012, the average number of adults observed ranged from 126 to 166 during the breeding season (March through May), and from 92 to 129 during the molting season (June through July) (Truchinski et al., 2008; Flynn et al., 2009; Codde et al., 2010; Codde et al., 2011; Codde et al., 2012; Codde and Allen, 2015). Marine mammal monitoring at multiple locations inside San Francisco Bay was conducted by Caltrans from May 1998 to February 2002, and determined that at least 500 harbor seals populate San Francisco Bay (Green et al., 2002). This estimate is consistent with previous seal counts in the San Francisco Bay, which ranged from 524 to 641 seals from 1987 to 1999 (Goals Project, 2000). Although harbor seals haul-out at approximately 20 locations in San Francisco Bay, there are three locations that serve as primary locations: Mowry Slough in the south Bay, Corte Madera Marsh and Castro Rocks in the north Bay, and Yerba Buena Island in the central Bay (Grigg, 2008; Gibble, 2011). The main pupping areas in the San Francisco Bay are at Mowry Slough and Castro Rocks (Caltrans, 2012). Pupping season for harbor seals in San Francisco Bay spans from approximately March 15 through May 31, with pup numbers generally peaking in late April or May (Caretta et al 2015). Births of harbor seals have not been observed at Corte Madera Marsh and Yerba Buena Island, but a few pups have been seen at these sites. Harbor seals forage in shallow waters on a variety of fish and crustaceans that are present throughout much of San Francisco Bay, and therefore could occasionally be found foraging in the action area as well.

California sea lion

California sea lions range all along the western border of North America. The breeding areas of the California sea lion are on islands located in southern California, western Baja California, and the Gulf of California (Allen and Angliss 2015). Although California sea lions forage and conduct many activities in the water, they also use haul-outs. California sea lions breed in Southern California and along the Channel Islands during the spring. The current population estimate for California sea lions is 296,750 animals. This species is not considered strategic under the MMPA, and is not designated as depleted. This species is also not listed under the ESA. PBR is 9,200 (Caretta et al, 2015). Interactions with fisheries, boat collisions, human interactions, and entanglement are the main threats to this species (Caretta et al 2015).

El Niño affects California sea lion populations, with increased observations and strandings of this species in the area. Current observations of this species in CA have increased significantly over the past few years. Additionally, as a result of the large numbers of sea lion strandings in 2013, NOAA declared an unusual mortality event (UME). Although the exact causes of this UME are unknown, two hypotheses meriting further study include nutritional stress of pups resulting from a lack of forage fish available to lactating mothers and unknown disease agents during that time period.

In San Francisco Bay, sea lions haul out primarily on floating K docks at Pier 39 in the Fisherman's Wharf area of the San Francisco Marina. The Pier 39 haul out is approximately 1.5

miles from the project vicinity. The Marine Mammal Center (TMMC) in Sausalito, California has performed monitoring surveys at this location since 1991. A maximum of 1,706 sea lions was seen hauled out during one survey effort in 2009 (TMMC, 2015). Winter numbers are generally over 500 animals (Goals Project, 2000). In August to September, counts average from 350 to 850 (NMFS, 2004). Of the California sea lions observed, approximately 85 percent were male. No pupping activity has been observed at this site or at other locations in the San Francisco Bay (Caltrans, 2012). The California sea lions usually frequent Pier 39 in August after returning from the Channel Islands (Caltrans, 2013). In addition to the Pier 39 haul-out, California sea lions haul out on buoys and similar structures throughout San Francisco Bay. They mainly are seen swimming off the San Francisco and Marin shorelines within San Francisco Bay, but may occasionally enter the project area to forage.

Although there is little information regarding the foraging behavior of the California sea lion in the San Francisco Bay, they have been observed foraging on a regular basis in the shipping channel south of Yerba Buena Island. Foraging grounds have also been identified for pinnipeds, including sea lions, between Yerba Buena Island and Treasure Island, as well as off the Tiburon Peninsula (Caltrans, 2001).

Northern elephant seal

Northern elephant seals breed and give birth in California (U.S.) and Baja California (Mexico), primarily on offshore islands (Stewart et al. 1994), from December to March (Stewart and Huber 1993). Although movement and genetic exchange continues between rookeries, most elephant seals return to natal rookeries when they start breeding (Huber et al. 1991). The California breeding population is now demographically isolated from the Baja California population, and is the only stock to occur near the action area. The current abundance estimate for this stock is 179,000 animals, with PBR at 4,882 animals (Caretta et al 2015). The population is reported to have grown at 3.8% annually since 1988 (Lowry et al. 2014). Fishery interactions and marine debris entanglement are the biggest threats to this species (Caretta et al 2015). Northern elephant seals are not listed under the Endangered Species Act, nor are they designated as depleted, or considered strategic under the MMPA.

Northern elephant seals are common on California coastal mainland and island sites where they pup, breed, rest, and molt. The largest rookeries are on San Nicolas and San Miguel islands in the Northern Channel Islands. In the vicinity of San Francisco Bay, elephant seals breed, molt, and haul out at Año Nuevo Island, the Farallon Islands, and Point Reyes National Seashore (Lowry et al., 2014). Adults reside in offshore pelagic waters when not breeding or molting. Northern elephant seals haul out to give birth and breed from December through March, and pups remain onshore or in adjacent shallow water through May, when they may occasionally make brief stops in San Francisco Bay (Caltrans, 2015b). The most recent sighting was in 2012 on the beach at Clipper Cove on Treasure Island, when a healthy yearling elephant seal hauled out for approximately one day. Approximately 100 juvenile northern elephant seals strand in San Francisco Bay each year, including individual strandings at Yerba Buena Island and Treasure Island (fewer than 10 strandings per year) (Caltrans, 2015b). When pups of the year return in the late summer and fall to haul out at rookery sites, they may also occasionally make brief stops in San Francisco Bay.

Northern fur seal

Northern fur seals *(Callorhinus ursinus*) occur from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan. During the breeding season, approximately 74% of the worldwide population is found on the Pribilof Islands in the southern

Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Lander and Kajimura 1982). Of the seals in U.S. waters outside of the Pribilofs, approximately one percent of the population is found on Bogoslof Island in the southern Bering Sea, San Miguel Island off southern California (NMFS 2007), and the Farallon Islands off central California. Two separate stocks of northern fur seals are recognized within U.S. waters: an Eastern Pacific stock and a California stock (including San Miguel Island and the Farallon Islands). Only the California breeding stock is considered here since it is the only stock to occur near the action area. The current abundance estimate for this stock is 14,050 and PBR is set at 451 animals (Caretta et al 2015). This stock has grown exponentially during the past several years. Interaction with fisheries remains the top threat to this species (Caretta et al, 2015). This stock is not considered depleted or classified as strategic under the MMPA, and is not listed under the ESA.

Harbor porpoise

In the Pacific, harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska and across to Kamchatka and Japan (Gaskin 1984). Harbor porpoise appear to have more restricted movements along the western coast of the continental U.S. than along the eastern coast. Regional differences in pollutant residues in harbor porpoise indicate that they do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). That study also showed some regional differences within California (Allen and Angliss, 2014). Of the 10 stocks of Pacific harbor porpoise, only the San Francisco- Russian River stock is considered here since it is the only stock to occur near the action area. This current abundance estimate for this stock is 9,886 animals, with a PBR of 66 animals (Caretta et al 2015). Current population trends are not available for this stock. The main threats to this stock include fishery interactions. This stock is not designated as strategic or considered depleted under the MMPA, and is not listed under the ESA.

Gray whale

Once common throughout the Northern Hemisphere, the gray whale was extinct in the Atlantic by the early 1700s. Gray whales are now only commonly found in the North Pacific. Genetic comparisons indicate there are distinct "Eastern North Pacific" (ENP) and "Western North Pacific" (WNP) population stocks, with differentiation in both mtDNA haplotype and microsatellite allele frequencies (LeDuc et al. 2002; Lang et al. 2011a; Weller et al. 2013). Only the ENP stock occurs in the action area and is considered in this document. The current population estimate for this stock is 20,990 animals, with PBR at 624 animals (Caretta et al, 2015). The population size of the ENP gray whale stock has increased over several decades despite an UME in 1999 and 2000 and has been relatively stable since the mid-1990s. Interactions with fisheries, ship strikes, entanglement in marine debris, and habitat degradation are the main concerns for the gray whale population (Caretta et al 2015). This stock is not listed under the ESA, and is not considered a strategic stock or designated as depleted under the MMPA.

Bottlenose dolphin

Bottlenose dolphins are distributed worldwide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). There are genetic differences between the populations; based on nuclear and mtDNA analyses, there are no shared haplotypes between coastal and offshore animals and significant genetic differentiation between the two ecotypes was evident (Caretta et al 2008). California coastal bottlenose dolphins are found within about one kilometer of shore (Hansen, 1990; Carretta et al. 1998; Defran and Weller 1999) primarily from Point Conception south into Mexican waters, at least as far south as San Quintin, Mexico. Oceanographic events appear to influence the distribution of animals along the coasts of California and Baja California, Mexico, as indicated by El Niño events. There are three stocks of bottlenose dolphins in the Pacific: 1) California coastal stock, 2) California, Oregon, and Washington offshore stock, and 3) Hawaiian stock. Only the California coastal stock may occur in the action area. The current stock abundance estimate for the California coastal stock is 323 animals, with PBR at 2.4 animals (Caretta et al 2008). Pollutant levels in California are a threat to this species, and this stock may be vulnerable to disease outbreaks, particularly morbillivirus (Caretta et al 2008). This stock is not listed under the ESA, and is not considered strategic or designated as depleted under the MMPA.

Potential Effects of the Specified Activity on Marine Mammals and their Habitat

This section includes a summary and discussion of the ways that components of the specified activity (e.g., sound produced by pile driving) may impact marine mammals and their habitat. The *Estimated Take by Incidental Harassment* section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The *Negligible Impact Analysis* section will include an analysis of how this specific activity will impact marine mammals and will consider the content of this section, the *Estimated Take by Incidental Harassment* section and the *Proposed Mitigation* section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks. In the following discussion, we provide general background information on sound and marine mammal hearing before considering potential effects to marine mammals from sound produced by vibratory and impact pile driving.

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 hertz (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 and attenuate (decrease) 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 (SL) 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. Note that all underwater sound levels in this document are referenced to a pressure of 1 μPa and all airborne sound levels in this document are referenced to a pressure of 20 μPa.

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, 1983). 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.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson *et al*., 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown 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). A number of sources contribute to ambient sound, including the following (Richardson *et al*., 1995):

- Wind and waves: The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient noise for frequencies between 200 Hz and 50 kHz (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Surf noise becomes important near shore, with measurements collected at a distance of 8.5 km from shore showing an increase of 10 dB in the 100 to 700 Hz band during heavy surf conditions.

- Precipitation: Sound from rain and hail impacting the water surface can become an important component of total noise at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times.

- Biological: Marine mammals can contribute significantly to ambient noise levels, as can some fish and shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz.

- Anthropogenic: Sources of ambient noise related to human activity include transportation (surface vessels and aircraft), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Shipping noise typically dominates the total ambient noise for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly (Richardson *et al*., 1995). Sound from identifiable anthropogenic sources other than the activity of interest (*e.g.*, a passing vessel) is sometimes termed background sound, as opposed to ambient sound.

The sum of the various natural and anthropogenic sound sources at any given location and time – which comprise "ambient" or "background" sound – depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson *et al*., 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals.

The underwater acoustic environment at the ferry terminal is likely to be dominated by noise from day-to-day port and vessel activities. This is a highly industrialized area with high-use from small- to medium-sized vessels, and larger vessel that use the nearby major shipping channel. Underwater sound levels for water transit vessels, which operate throughout the day from the San Francisco Ferry Building ranged from 152 dB to 177 dB (WETA, 2003a). While there are no current measurements of ambient noise levels at the ferry terminal, it is likely that levels within the basin periodically exceed the 120 dB threshold and, therefore, that the high levels of anthropogenic activity in the basin create an environment far different from quieter habitats where behavioral reactions to sounds around the 120 dB threshold have been observed (*e.g*., Malme *et al*., 1984, 1988).

In-water construction activities associated with the project would include impact pile driving and vibratory pile driving. The sounds produced by these activities fall into one of two general sound types: pulsed and non-pulsed (defined in the following). The distinction between these two 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 sound sources (*e.g*., explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986; Harris, 1998; NIOSH, 1998; ISO, 2003; ANSI, 2005) 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 rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.*, rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems (such as those used by the U.S. Navy). The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

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). Vibratory hammers install piles by vibrating them and allowing the weight of the hammer to push them into the sediment. Vibratory hammers produce significantly 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 (Oestman *et al*., 2009). Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (Nedwell and Edwards, 2002; Carlson *et al*., 2005).

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals, and exposure to sound can have deleterious effects. To appropriately assess these potential effects, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g*., Richardson *et al*., 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al*. (2007) recommended that marine mammals be divided into functional hearing groups based on measured or estimated hearing ranges on the basis of available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. The lower and/or upper frequencies for some of these functional hearing groups have been modified from those designated by Southall *et al*. (2007). The functional groups and the associated frequencies are indicated below (note that these frequency ranges do not necessarily correspond to the range of best hearing, which varies by species):

- Low frequency cetaceans (13 species of mysticetes): functional hearing is estimated to occur between approximately 7 Hz and 25 kHz (up to 30 kHz in some species), with best hearing estimated to be from 100 Hz to 8 kHz (Watkins, 1986; Ketten, 1998; Houser *et al*., 2001; Au *et al*., 2006; Lucifredi and Stein, 2007; Ketten *et al*., 2007; Parks *et al*., 2007a; Ketten and Mountain, 2009; Tubelli *et al*., 2012);
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): functional hearing is estimated to occur between approximately 150 Hz and 160 kHz with best hearing from 10 to less than 100 kHz (Johnson, 1967; White, 1977; Richardson *et al*., 1995; Szymanski *et al*., 1999; Kastelein *et al*., 2003; Finneran *et al*., 2005a, 2009; Nachtigall *et al*., 2005, 2008; Yuen *et al*., 2005; Popov *et al*., 2007; Au and Hastings, 2008; Houser *et al*., 2008; Pacini *et al*., 2010, 2011; Schlundt *et al*., 2011);

- High frequency cetaceans (eight species of true porpoises, six species of river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; now considered to include two members of the genus *Lagenorhynchus* on the basis of recent echolocation data and genetic data [May-Collado and Agnarsson, 2006; Kyhn *et al*. 2009, 2010; Tougaard *et al*. 2010]): functional hearing is estimated to occur between approximately 200 Hz and 180 kHz (Popov and Supin, 1990a,b; Kastelein *et al*., 2002; Popov *et al*., 2005);
- Phocid pinnipeds in Water: functional hearing is estimated to occur between approximately 75 Hz and 100 kHz with best hearing between 1-50 kHz (Møhl, 1968; Terhune and Ronald, 1971, 1972; Richardson *et al*., 1995; Kastak and Schusterman, 1999; Reichmuth, 2008; Kastelein *et al*., 2009); and

Otariid pinnipeds in Water: functional hearing is estimated to occur between approximately 100 Hz and 48 kHz, with best hearing between 2-48 kHz (Schusterman *et al*., 1972; Moore and Schusterman, 1987; Babushina *et al*., 1991; Richardson *et al*., 1995; Kastak and Schusterman, 1998; Kastelein *et al*., 2005a; Mulsow and Reichmuth, 2007; Mulsow *et al*., 2011a, b).

The pinniped functional hearing group was modified from Southall *et al*. (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al*., 2006; Kastelein *et al*., 2009; Reichmuth *et al*., 2013).

As mentioned previously in this document, seven marine mammal species (three cetaceans and four pinnipeds) may occur in the project area. Of these three cetaceans, one is classified as a low-frequency cetacean (*i.e*. gray whale), one is classified as a mid-frequency cetacean (*i.e.*, bottlenose dolphin), and one is classified as a high-frequency cetaceans (*i.e*., harbor porpoise) (Southall *et al.*, 2007). Additionally, harbor seals, Northern fur seals, and Northern elephant seals are classified as members of the phocid pinnipeds in water functional hearing group while California sea lions are grouped under the Otariid pinnipeds in water functional hearing group. A species' functional hearing group is a consideration when we analyze the effects of exposure to sound on marine mammals.

Acoustic Impacts

Please refer to the information given previously (*Description of Sound Sources*) regarding sound, characteristics of sound types, and metrics used in this document. Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can potentially result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al*., 1995; Gordon *et al*., 2004; Nowacek *et al*., 2007; Southall *et al*., 2007; Gotz *et al*., 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal’s hearing range. We first describe specific manifestations of acoustic effects before providing discussion specific to WETA’s construction activities.

Richardson *et al*. (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal’s hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal, but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (i.e., when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

We describe the more severe effects (i.e., permanent hearing impairment, certain non-auditory physical or physiological effects) only briefly as we do not expect that there is a reasonable likelihood that WETA's activities may result in such effects (see below for further discussion). Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al*., 1999; Schlundt *et al*., 2000; Finneran *et al*., 2002, 2005b). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al*., 2007). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985).

When PTS occurs, there is physical damage to the sound receptors in the ear (i.e., tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al*., 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (e.g., Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals – PTS data exists only for a single harbor seal (Kastak *et al*., 2008) – but are assumed to be similar to those in humans and other terrestrial mammals. PTS typically occurs at exposure levels at least several decibels above (a 40-dB threshold shift approximates PTS onset; e.g., Kryter *et al*., 1966; Miller, 1974) that inducing mild TTS (a 6-dB threshold shift approximates TTS onset; e.g., Southall *et al*. 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS thresholds for impulse sounds (such as impact pile driving pulses as received close to the source) are at least 6 dB higher than the TTS threshold on a peak-pressure basis and PTS cumulative sound exposure level thresholds are 15 to 20 dB higher than TTS cumulative sound exposure level thresholds (Southall *et al*., 2007). Given the higher level of sound or longer exposure duration necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (e.g., change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al*., 2006; Southall *et al*., 2007; Zimmer and Tyack, 2007). WETA's activities do not involve the use of devices such as explosives or mid-frequency active sonar that are associated with these types of effects.

When a live or dead marine mammal swims or floats onto shore and is incapable of returning to sea, the event is termed a "stranding" (16 U.S.C. 1421h(3)). Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series (e.g., Geraci *et al*., 1999). However, the cause or causes of most strandings are unknown (e.g., Best, 1982). Combinations of dissimilar stressors may combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other would not be expected to produce the same outcome (e.g., Sih *et al*., 2004). For further description of stranding events see, e.g., Southall *et al*., 2006; Jepson *et al*., 2013; Wright *et al*., 2013.

1. *Temporary threshold shift* – TTS is the mildest form of hearing impairment that can occur during exposure to sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the data published at the time of this writing concern TTS elicited by exposure to multiple pulses of sound.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (i.e., recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale [*Delphinapterus leucas*], harbor porpoise, and Yangtze finless porpoise [*Neophocoena asiaeorientalis*]) and three species of pinnipeds (northern elephant seal, harbor seal, and California sea lion) exposed to a limited number of sound sources (i.e., mostly tones and octave-band noise) in laboratory settings (e.g., Finneran *et al*., 2002; Nachtigall *et al*., 2004; Kastak *et al*., 2005; Lucke *et al*., 2009; Popov *et al*., 2011). In general, harbor seals (Kastak *et al*., 2005; Kastelein *et al*., 2012a) and harbor porpoises (Lucke *et al*., 2009; Kastelein *et al*., 2012b) have a lower TTS onset than other measured pinniped or cetacean species. Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Southall *et al*. (2007) and Finneran and Jenkins (2012).

2. *Behavioral effects* – Behavioral disturbance may include a variety of effects, including subtle changes in behavior (e.g., minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (e.g., species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (e.g., Richardson *et al*., 1995; Wartzok *et al*., 2003; Southall *et al*., 2007; Weilgart, 2007; Archer *et al*., 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al*., 2012), and can vary depending on characteristics associated with the sound source (e.g., whether it is moving or stationary, number of sources, distance from the source). Please see Appendices B-C of Southall *et al*. (2007) for a review of studies involving marine mammal

behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al*., 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a "progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial," rather than as, more generally, moderation in response to human disturbance (Bejder *et al*., 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al*., 1995; NRC, 2003; Wartzok *et al*., 2003). Controlled experiments with captive marine mammals have showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al*., 1997; Finneran *et al*., 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; see also Richardson *et al*., 1995; Nowacek *et al*., 2007).

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (e.g., Lusseau and Bejder, 2007; Weilgart, 2007; NRC, 2005). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely, and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (e.g., Frankel and Clark, 2000; Costa *et al*., 2003; Ng and Leung, 2003; Nowacek *et al*.; 2004; Goldbogen et al., 2013a,b). Variations in dive behavior may reflect interruptions in biologically significant activities (e.g., foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (e.g., bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (e.g., Croll *et al*., 2001; Nowacek *et al*.; 2004; Madsen *et al*., 2006; Yazvenko *et al*., 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (e.g., Kastelein *et al*., 2001, 2005b, 2006; Gailey *et al*., 2007).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al*., 2000; Fristrup *et al*., 2003; Foote *et al*., 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al*., 2007b). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al*., 1994).

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al*., 1995). For example, gray whales are known to change direction – deflecting from customary migratory paths – in order to avoid noise from seismic surveys (Malme *et al*., 1984). Avoidance may be short-term, with animals returning to the area once the noise has ceased (e.g., Bowles *et al*., 1994; Goold, 1996; Stone *et al*., 2000; Morton and Symonds, 2002; Gailey *et al*., 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (e.g., Blackwell *et al*., 2004; Bejder *et al*., 2006; Teilmann *et al*., 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (e.g., directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (i.e., when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (e.g., Beauchamp and Livoreil, 1997; Fritz *et al*., 2002; Purser and Radford, 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (e.g., decline in body condition) and subsequent reduction in reproductive success, survival, or both (e.g., Harrington and Veitch, 1992; Daan *et al*., 1996; Bradshaw *et al*., 1998). However, Ridgway *et al*. (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al*., 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al*., 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

3. *Stress responses* – An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (e.g., Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (e.g., Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al*., 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and "distress" is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (e.g., Holberton *et al*., 1996; Hood *et al*., 1998; Jessop *et al*., 2003; Krausman *et al*., 2004; Lankford *et al*., 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al*., 2002b) and, more rarely, studied in wild populations (e.g., Romano *et al*., 2002a). For example, Rolland *et al*. (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales.

These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

4. *Auditory masking* – Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (e.g., those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al*., 1995). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (e.g., snapping shrimp, wind, waves, precipitation) or anthropogenic (e.g., shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (e.g., signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (e.g., sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions.

Under certain circumstances, marine mammals experiencing significant masking could also be impaired from maximizing their performance fitness in survival and reproduction. Therefore, when the coincident (masking) sound is man-made, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (e.g., Clark *et al*., 2009) and may result in energetic or other costs as animals change their vocalization behavior (e.g., Miller *et al*., 2000; Foote *et al*., 2004; Parks *et al*., 2007b; Di Iorio and Clark, 2009; Holt *et al*., 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al*., 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (e.g., Erbe, 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (e.g., Branstetter *et al*., 2013).

Masking affects both senders and receivers of acoustic signals and can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009). All anthropogenic sound sources, but especially chronic and lower-frequency signals (e.g., from vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

Acoustic Effects, Underwater

Potential Effects of Pile Driving Sound – The effects of sounds from pile driving might include one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson *et al*., 1995; Gordon *et al*., 2003; Nowacek *et al*., 2007; Southall *et al*., 2007). The effects of pile driving on marine mammals are dependent on several factors, including the type and depth of the animal; the pile size and type, and the intensity and duration of the pile driving sound; the substrate; the standoff distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the frequency, received level, and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment. In addition, substrates that are soft (e.g., sand) would absorb or attenuate the sound more readily than hard substrates (e.g., rock) which may reflect the acoustic wave. Soft porous substrates would also likely require less time to drive the pile, and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

In the absence of mitigation, impacts to marine species could be expected to include physiological and behavioral responses to the acoustic signature (Viada *et al*., 2008). Potential effects from impulsive sound sources like pile driving can range in severity from effects such as behavioral disturbance to temporary or permanent hearing impairment (Yelverton *et al*., 1973).

Hearing Impairment and Other Physical Effects— Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shifts. PTS constitutes injury, but TTS does not (Southall *et al*., 2007). Based on the best scientific information available, the SPLs for the construction activities in this project are far below the thresholds that could cause TTS or the onset of PTS: 180 dB re 1 μPa rms for odontocetes and 190 dB re 1 μPa rms for pinnipeds (Table 4).

Non-auditory Physiological Effects—Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.*, 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of pile driving, including some odontocetes and some pinnipeds, are especially unlikely to incur auditory impairment or non-auditory physical effects.

Disturbance Reactions

Responses to continuous sound, such as vibratory pile installation, have not been documented as well as responses to pulsed sounds. With both types of pile driving, it is likely that the onset of pile driving could result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include (Richardson *et al.,* 1995): changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haul-outs or rookeries). Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance (Thorson and Reyff, 2006). If a marine mammal responds to a stimulus by changing its behavior (*e.g*., through relatively minor changes in locomotion direction/speed or vocalization behavior), the response may or may not constitute taking at the individual level, and is unlikely to affect 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 animals, and if so potentially on the stock or species, could potentially be significant (*e.g*., Lusseau and Bejder, 2007; Weilgart, 2007).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

- Drastic changes in diving/surfacing patterns (such as those thought to cause beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Longer-term habitat abandonment due to loss of desirable acoustic environment; and
- Longer-term cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall *et al.*, 2007).

Auditory Masking

Natural and artificial sounds can disrupt behavior by masking. The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Because sound generated from in-water pile driving is mostly concentrated at low frequency ranges, it may have less effect on high frequency echolocation sounds made by porpoises. The most intense underwater sounds in the proposed action are those produced by impact pile driving. Given that the energy distribution of pile driving covers a broad frequency spectrum, sound from these sources would likely be within the audible range of marine mammals present in the project area. Impact pile driving activity is relatively short-term, with rapid pulses occurring for approximately fifteen minutes per pile. The probability for impact pile driving resulting from this proposed action masking acoustic signals important to the behavior and survival of marine mammal species is low. Vibratory pile driving is also relatively short-term, with rapid oscillations occurring for approximately one and a half hours per pile. It is possible that vibratory pile driving resulting from this proposed action may mask acoustic signals important to the behavior and survival of marine mammal species, but the short-term duration and limited affected area would result in insignificant impacts from masking. Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory and impact pile driving, and which have already been taken into account in the exposure analysis.

Acoustic Effects, Airborne - Pinnipeds that occur near the project site could be exposed to airborne sounds associated with pile driving that have the potential to cause behavioral harassment, depending on their distance from pile driving activities. Cetaceans are not expected to be exposed to airborne sounds that would result in harassment as defined under the MMPA.

Airborne noise will primarily be an issue for pinnipeds that are swimming or hauled out near the project site within the range of noise levels elevated above the acoustic criteria in Table 4. We recognize that pinnipeds in the water could be exposed to airborne sound that may result in behavioral harassment when looking with heads above water. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater sound. For instance, anthropogenic sound could cause hauled-out pinnipeds to exhibit changes in their normal behavior, such as reduction in vocalizations, or cause them to temporarily abandon the area and move further from the source. However, these animals would previously have been 'taken' as a result of exposure to underwater sound above the behavioral harassment thresholds, which are in all cases larger than those associated with airborne sound. Thus, the behavioral harassment of these animals is already accounted for in these estimates of potential take. Multiple instances of exposure to sound above NMFS' thresholds for behavioral harassment are not believed to result in increased behavioral disturbance, in either nature or intensity of disturbance reaction. Therefore, we do not believe that authorization of incidental take resulting from airborne sound for pinnipeds is warranted, and airborne sound is not discussed further here.

Anticipated Effects on Habitat

The proposed activities at the Ferry Terminal would not result in permanent negative impacts to habitats used directly by marine mammals, but may have potential short-term impacts to food sources such as forage fish and may affect acoustic habitat (see masking discussion above). There are no known foraging hotspots or other ocean bottom structure of significant biological importance to marine mammals present in the marine waters of the project area.

Therefore, the main impact issue associated with the proposed activity would be temporarily elevated sound levels and the associated direct effects on marine mammals, as discussed previously in this document. The primary potential acoustic impacts to marine mammal habitat are associated with elevated sound levels produced by vibratory and impact pile driving and removal in the area. However, other potential impacts to the surrounding habitat from physical disturbance are also possible.

Pile Driving Effects on Potential Prey (Fish)

Construction activities would produce continuous (i.e., vibratory pile driving sounds and pulsed (i.e. impact driving) sounds. Fish react to sounds that are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pile driving on fish, although several are based on studies in support of large, multiyear bridge construction projects (e.g., Scholik and Yan, 2001, 2002; Popper and Hastings, 2009). Sound pulses at received levels of 160 dB may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson *et al.,* 1992; Skalski *et al.,* 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality.

The most likely impact to fish from pile driving activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the short timeframe for the project.

Pile Driving Effects on Potential Foraging Habitat

The area likely impacted by the project is relatively small compared to the available habitat in San Francisco Bay. Avoidance by potential prey (i.e., fish) of the immediate area due to the temporary loss of this foraging habitat is also possible. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the San Francisco ferry terminal and nearby vicinity.

In summary, given the short daily duration of sound associated with individual pile driving events and the relatively small areas being affected, pile driving activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Thus, any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

Proposed Mitigation

In order to issue an IHA under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its 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.

Measurements from similar pile driving events were coupled with practical spreading loss to estimate zones of influence (ZOI; see Estimated Take by Incidental Harassment); these values were used to develop mitigation measures for pile driving activities at the ferry terminal. The ZOIs effectively represent the mitigation zone that would be established around each pile to prevent Level A harassment to marine mammals, while providing estimates of the areas within which Level B harassment might occur. In addition to the specific measures described later in this section, WETA would conduct briefings between construction supervisors and crews, marine mammal monitoring team, and WETA staff prior to the start of all pile driving activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

Monitoring and Shutdown for Pile Driving

The following measures would apply to WETA's mitigation through shutdown and disturbance zones:

Shutdown Zone – For all pile driving activities, WETA will establish a shutdown zone intended to contain the area in which SPLs equal or exceed the 180/190 dB rms acoustic injury criteria for cetaceans and pinnipeds, respectively. 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 of marine mammals (as described previously under Potential Effects of the Specified Activity on Marine Mammals, serious injury or death are unlikely outcomes even in the absence of mitigation measures). Modeled radial distances for shutdown zones are shown in Table 6. However, a minimum shutdown zone of 10 m will be established during all pile driving activities, regardless of the estimated zone. Vibratory pile driving activities are not predicted to produce sound exceeding the 180/190-dB Level A harassment threshold, but these precautionary measures are intended to prevent the already unlikely possibility of physical interaction with construction equipment and to further reduce any possibility of acoustic injury.

Disturbance Zone – Disturbance zones are the areas in which SPLs equal or exceed 160 and 120 dB rms (for impulse and continuous sound, respectively). 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 observers 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 instances of Level B harassment; disturbance zone monitoring is discussed in greater detail later (see Proposed Monitoring and Reporting). Nominal radial distances for disturbance zones are shown in Table 6. Given the size of the disturbance zone for vibratory pile driving, it is impossible to guarantee that all animals would be observed or to make comprehensive observations of fine-scale behavioral reactions to sound, and only a portion of the zone (*e.g.*, what may be reasonably observed by visual observers stationed within the turning basin) would be observed.

In order to document observed instances of harassment, monitors record all marine mammal observations, regardless of location. The observer's location, as well as the location of the pile being driven, is known from a GPS. The location of the animal is estimated as a distance from the observer, which is then compared to the location from the pile. It may then be estimated whether the animal was exposed to sound levels constituting incidental harassment on the basis of predicted distances to relevant thresholds in post-processing of observational and acoustic data, and a precise accounting of observed incidences of harassment created. This information may then be used to extrapolate observed takes to reach an approximate understanding of actual total takes.

Monitoring Protocols – Monitoring would be conducted before, during, and after pile driving activities. In addition, observers shall record all instances of marine mammal occurrence, regardless of distance from activity, and shall document any behavioral reactions in concert with distance from piles being driven. Observations made outside the shutdown zone will not result in shutdown; 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. Monitoring will take place from fifteen minutes prior to initiation through thirty minutes post-completion of pile driving activities. Pile driving activities include the time to install or remove a single pile or series of piles, as long as the time elapsed between uses of the pile driving equipment is no more than thirty minutes. Please see the Monitoring Plan (*www.nmfs.noaa.gov/pr/permits/incidental/construction.htm*), developed by WETA in agreement with NMFS, for full details of the monitoring protocols.

The following additional measures apply to visual monitoring:

(1) Monitoring will be conducted by qualified observers, who will be placed at the best vantage point(s) practicable to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown to the hammer operator. Qualified observers are typically trained biologists, with the following minimum qualifications:

- 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;

- Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience);

- Experience or training in the field identification of marine mammals, 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 marine mammals 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 marine mammals observed within a defined shutdown zone; and marine mammal behavior; and

- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

(2) Prior to the start of pile driving activity, the shutdown zone will be monitored for fifteen minutes to ensure that it is clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals; animals will be allowed to remain in the shutdown zone (*i.e.*, must leave of their own volition) and their behavior will be monitored and documented. The shutdown zone may only be declared clear, and pile driving started, when the entire shutdown zone is visible (*i.e.*, when not obscured by dark, rain, fog, *etc*.). In addition, if such conditions should arise during impact pile driving that is already underway, the activity would be halted.

(3) If a marine mammal approaches or enters the shutdown zone during the course of pile driving operations, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or fifteen minutes have passed

without re-detection of the animal. Monitoring will be conducted throughout the time required to drive a pile.

(4) Using delay and shut-down procedures, if a species for which authorization has not been granted (including but not limited to Guadalupe fur seals and humpback whales) or if a species for which authorization has been granted but the authorized takes are met, approaches or is observed within the Level B harassment zone, activities will shut down immediately and not restart until the animals have been confirmed to have left the area.

Soft Start

The use of a soft start procedure is believed to provide additional protection to marine mammals by warning or providing a chance to leave the area prior to the hammer operating at full capacity, and typically involves a requirement to initiate sound from the hammer at reduced energy followed by a waiting period. This procedure is repeated two additional times. It is difficult to specify the reduction in energy for any given hammer because of variation across drivers and, for impact hammers, the actual number of strikes at reduced energy will vary because operating the hammer at less than full power results in “bouncing” of the hammer as it strikes the pile, resulting in multiple “strikes.” For impact driving, we require an initial set of three strikes from the impact hammer at reduced energy, followed by a thirty-second waiting period, then two subsequent three strike sets. Soft start will be required at the beginning of each day’s impact pile driving work and at any time following a cessation of impact pile driving of thirty minutes or longer.

We have carefully evaluated WETA’s proposed mitigation measures and considered their effectiveness in past implementation to preliminarily determine whether they are likely to effect the least practicable 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: (1) the manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals, (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Any mitigation measure(s) we prescribe should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(1) Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

(2) A reduction in the number (total number or number at biologically important time or location) of individual marine mammals exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(3) A reduction in the number (total number or number at biologically important time or location) of times any individual marine mammal would be exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(4) A reduction in the intensity of exposure to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing the severity of behavioral harassment only).

(5) Avoidance or minimization of adverse effects to marine mammal habitat, paying particular attention to the prey base, blockage or limitation of passage to or from biologically

important areas, permanent destruction of habitat, or temporary disturbance of habitat during a biologically important time.

(6) For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of WETA's proposed measures, as well as any other potential measures that may be relevant to the specified activity, we have preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must 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 incidental take authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will 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.

Any monitoring requirement we prescribe should improve our understanding of one or more of the following:

- Occurrence of marine mammal species in action area (*e.g.*, presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of:

(1) Action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) Affected species (*e.g.*, life history, dive patterns); (3) Co-occurrence of marine mammal species with the action; or (4) Biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas).

- Individual responses to acute stressors, or impacts of chronic exposures (behavioral or physiological).
- How anticipated responses to stressors impact either: (1) Long-term fitness and survival of an individual; or (2) Population, species, or stock.
- Effects on marine mammal habitat and resultant impacts to marine mammals.
- Mitigation and monitoring effectiveness.

WETA’s proposed monitoring and reporting is also described in their Marine Mammal Monitoring Plan, on the Internet at *www.nmfs.noaa.gov/pr/permits/incidental/construction.htm*.

Visual Marine Mammal Observations

WETA will collect sighting data and behavioral responses to construction for marine mammal species observed in the region of activity during the period of activity. All observers (MMOs) will be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. WETA will monitor the shutdown zone and disturbance zone before, during, and after pile driving, with observers located at the best practicable vantage points. Based on our requirements, WETA would implement the following procedures for pile driving:

- MMOs would be located at the best vantage point(s) in order to properly see the entire shutdown zone and as much of the disturbance zone as possible.

- During all observation periods, observers will use binoculars and the naked eye to search continuously for marine mammals.
- If the shutdown zones are obscured by fog or poor lighting conditions, pile driving at that location will not be initiated until that zone is visible. Should such conditions arise while impact driving is underway, the activity would be halted.
- The shutdown and disturbance zones around the pile will be monitored for the presence of marine mammals before, during, and after any pile driving or removal activity.

Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. The monitoring biologists will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Any modifications to protocol will be coordinated between NMFS and WETA.

Data Collection

We require that observers use approved data forms. Among other pieces of information, WETA will record detailed information about any implementation of shutdowns, including the distance of animals to the pile and description of specific actions that ensued and resulting behavior of the animal, if any. In addition, WETA will attempt to distinguish between the number of individual animals taken and the number of incidences of take. We require that, at a minimum, the following information be collected on the sighting forms:

- Date and time that monitored activity begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters (*e.g.*, percent cover, visibility);
- Water conditions (*e.g.*, sea state, tide state);
- Species, numbers, and, if possible, sex and age class of marine mammals;

- Description of any observable marine mammal behavior patterns, including bearing and direction of travel, and if possible, the correlation to SPLs;
- Distance from pile driving activities to marine mammals and distance from the marine mammals to the observation point;
- Description of implementation of mitigation measures (*e.g.*, shutdown or delay);
- Locations of all marine mammal observations; and
- Other human activity in the area.

Reporting

A draft report would be submitted to NMFS within 90 days of the completion of marine mammal monitoring, or sixty days prior to the requested date of issuance of any future IHA for projects at the same location, whichever comes first. The report will include marine mammal observations pre-activity, during-activity, and post-activity during pile driving days, and will also provide descriptions of any behavioral responses to construction activities by marine mammals and a complete description of all mitigation shutdowns and the results of those actions and an extrapolated total take estimate based on the number of marine mammals observed during the course of construction. A final report must be submitted within thirty days following resolution of comments on the draft report.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, section 3(18) of 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]."

All anticipated takes would be by Level B harassment resulting from vibratory and impact pile driving and involving temporary changes in behavior. The proposed mitigation and monitoring measures are expected to minimize the possibility of injurious or lethal takes such that take by Level A harassment, serious injury, or mortality is considered discountable. However, it is unlikely that injurious or lethal takes would occur even in the absence of the planned mitigation and monitoring measures.

Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many animals are likely to be present within a particular distance of a given activity, or exposed to a particular level of sound. In practice, depending on the amount of information available to characterize daily and seasonal movement and distribution of affected marine mammals, it can be difficult to distinguish between the number of individuals harassed and the instances of harassment and, when duration of the activity is considered, it can result in a take estimate that overestimates the number of individuals harassed. In particular, for stationary activities, it is more likely that some smaller number of individuals may accrue a number of incidences of harassment per individual than for each incidence to accrue to a new individual, especially if those individuals display some degree of residency or site fidelity and the impetus to use the site (*e.g.*, because of foraging opportunities) is stronger than the deterrence presented by the harassing activity.

The area where the ferry terminal is located is not considered important habitat for marine mammals, as it is a highly industrial area with high levels of vessel traffic and background noise. While there are harbor seal haul outs within two miles of the construction activity at Yerba Buena Island, and a California sea lion haul out approximately 1.5 miles away at pier 39, behavioral disturbances that could result from anthropogenic sound associated with these activities are expected to affect only a relatively small number of individual marine mammals that may venture near the ferry terminal, although those effects could be recurring over the life of the project if the same individuals remain in the project vicinity. WETA has requested authorization for the incidental taking of small numbers of harbor seals, Northern elephant seals, Norther fur seals, California sea lions, harbor porpoise, bottlenose dolphin, and gray whales near the San Francisco Ferry Terminal that may result from pile driving during construction activities associated with the project described previously in this document.

In order to estimate the potential instances of take that may occur incidental to the specified activity, we must first estimate the extent of the sound field that may be produced by the activity and then consider in combination with information about marine mammal density or abundance in the project area. We first provide information on applicable sound thresholds for determining effects to marine mammals before describing the information used in estimating the sound fields, the available marine mammal density or abundance information, and the method of estimating potential instances of take.

Sound Thresholds

We use generic sound exposure thresholds to determine when an activity that produces sound might result in impacts to a marine mammal such that a take by harassment might occur. These thresholds (Table 4) are used to estimate when harassment may occur (*i.e.*, when an animal is exposed to levels equal to or exceeding the relevant criterion) in specific contexts; however, useful contextual information that may inform our assessment of effects is typically lacking and we consider these thresholds as step functions. NMFS is working to revise these acoustic guidelines; for more information on that process, please visit *www.nmfs.noaa.gov/pr/acoustics/guidelines.htm*.

Table 4. Current Acoustic Exposure Criteria.

Criterion	Definition	Threshold
Level A harassment (underwater)	Injury (PTS – any level above that which is known to cause TTS)	180 dB (cetaceans) / 190 dB (pinnipeds) (rms)
Level B harassment (underwater)	Behavioral disruption	160 dB (impulsive source) / 120 dB (continuous source) (rms)
Level B harassment (airborne)	Behavioral disruption	90 dB (harbor seals) / 100 dB (other pinnipeds) (unweighted)

Distance to Sound Thresholds

Underwater Sound Propagation Formula – Pile driving generates underwater noise that can potentially result in disturbance to marine mammals in the project area. Transmission loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

$TL = B * \log_{10}(R_1/R_2)$, where

R_1 = the distance of the modeled SPL from the driven pile, and

R_2 = the distance from the driven pile of the initial measurement.

This formula neglects loss due to scattering and absorption, which is assumed to be zero here. The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, most notably the water bathymetry and presence or absence of reflective or absorptive conditions including in-water structures and sediments. Spherical spreading occurs in a perfectly unobstructed (free-field) environment not limited by depth or water surface, resulting in a 6 dB reduction in sound level for each doubling of distance from the source (20*log[range]). Cylindrical spreading occurs in an environment in which sound propagation is bounded by the water surface and sea bottom, resulting in a reduction of 3 dB in sound level for each doubling of distance from the source (10*log[range]). A practical spreading value of 15 is often used under conditions, such as at the San Francisco Ferry Terminal, where water increases with depth as the receiver moves away from the shoreline, resulting in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions. Practical spreading loss (4.5 dB reduction in sound level for each doubling of distance) is assumed here.

Underwater Sound – The intensity of pile driving sounds is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. A number of studies, primarily on the west coast, have measured sound produced during underwater pile driving projects. However, these data are largely for impact driving of steel pipe piles and concrete piles as well as vibratory driving of steel pipe piles.

In order to determine reasonable SPLs and their associated effects on marine mammals that are likely to result from vibratory or impact pile driving at the ferry terminal, we considered existing measurements from similar physical environments (e.g. estuarine areas of soft substrate where water depths are less than 16 feet).

For 24- and 36-inch steel piles, projects include the driving of similarly sized piles at the Alameda Bay Ship and Yacht project; the Rodeo Dock Repair project; and the Amorco Wharf Repair project (Table 5). During impact pile-driving associated with these projects, measured sound levels averaged about 193 dB rms at 10m for 36-inch piles, and 190 dB rms at 10m for 24-inch piles (Caltrans, 2012). Bubble curtains will be used during the installation of these piles, which is expected to reduce noise levels by about 10 dB rms (Caltrans, 2015a). Impact driving of these piles would produce noise levels above the Level A 190 dB threshold for pinnipeds over a distance of 11 feet (4 meters) for 36-inch piles and over a distance of 7 feet (2 meters) for 24-

inch piles assuming practical spreading. Impact driving of steel piles would exceed the Level A 180 dB threshold for cetaceans over a distance of 52 feet (16 meters) for 36-inch piles, and 33 feet (or 10 meters) for 24-inch piles. It is estimated that an average of four of these piles would be installed per day.

Projects conducted under similar circumstances with similar piles were reviewed to approximate the noise effects of the 14-inch wood piles. The best match for estimated noise levels is from the impact driving of timber piles at the Port of Benicia (Table 5). Noise levels produced during this installation were an average of 170 dB peak, and 158 dB rms at 33 feet (10 meters) from the pile (Caltrans, 2015a). It is estimated that an average of four of these piles would be installed per day. Based on the above sound levels, installation of the 14-inch plastic-coated wood piles would not produce rms values above the Level A or Level B thresholds.

The best fit data for 24-inch-diameter steel shell piles comes from projects completed in Shasta County, California, and the Stockton Marina, Stockton, California (Table 5). For these projects, the typical noise levels for pile-driving events were 175 dB peak, and 163 dB rms at 33 feet (10 meters) (Caltrans, 2012).

A review of available acoustic data for pile driving indicates that Test Pile Program at Naval Base Kitsap at Bangor, Washington (Illingsworth and Rodkin, 2013) provides the best match data for vibratory installation of 36-inch piles (Table 5). For 36-inch-diameter piles driven by the Navy, the average level for all pile-driving events was 159 dB rms at 33 feet (10 meters). There was a considerable range in the rms levels measured across a pile-driving event; with measured values from 147 to 169 dB rms, the higher value is used in this analysis. It is estimated that an average of four of these piles would be extracted per day of pile driving during the proposed project. Based on the above sound levels, vibratory installation of the 24- and 36-inch steel pipe piles would produce rms values above the Level A and Level B thresholds (Table 6).

It is estimated that an average of four 14-inch polyurethane-coated wood piles would be installed per day of pile driving. The best match for estimated noise levels for vibratory driving of these piles is from the Hable River in Hampshire, England, where wooden piles were installed with this method (Table 5). Rms noise levels produced during this installation were on average 142 dB rms at 33 feet (10 meters) from the pile (Nedwell et al., 2005). Based on these measure levels, vibratory installation of the 14-inch polyurethane- coated wood-fender piles would not produce noise levels above the Level A 190 or 180 dB rms thresholds; however, the 120 dB RMS Level B threshold would be exceeded over a radius of 293 meters assuming practical spreading.

Approximately 350 wood and concrete piles, 12 to 18 inches in diameter, would be removed using a vibratory pile-driver. With the vibratory hammer activated, an upward force would be applied to the pile to remove it from the sediment. On average, 12 of these piles would be extracted per work day. Extraction time needed for each pile may vary greatly, but could require approximately 400 seconds (approximately 7 minutes) from an APE 400B King Kong or similar driver. The most applicable noise values for wooden pile removal from which to base estimates for the terminal expansion project are derived from measurements taken at the Port Townsend dolphin pile removal in the State of Washington (Table 5). During vibratory pile extraction associated with this project, measured peak noise levels were approximately 164 dB at 16 m, and the rms was approximately 150 dB (WSDOT, 2011). Applicable sound values for the removal of concrete piles could not be located, but they are expected to be similar to the levels produced by wooden piles described above, because they are similarly sized, nonmetallic, and will be removed using the same methods. Based on the above noise levels, vibratory extraction of the timber and concrete piles would not produce noise levels above the Level A 190 dB or 180 dB thresholds. The radius over which the Level B 120 dB rms threshold could be exceeded is approximately 1,920 feet (585 meters) assuming practical spreading.

Table 5. Underwater SPLs from monitored construction activities using vibratory and impact hammers.

Project and Location	Pile Size and Type	Hammer type/ method	Water depth (m)	Measured SPLs
the Alameda Bay Ship and Yacht project[1]	40-in Steel pipe	Impact driving	13	195 RMS at 10 m
the Rodeo Dock Repair project[1]	24- in steel pile	Impact driving	5	189 RMS at 10 m
the Amorco Wharf Repair project[1]	24- in steel pile	Impact driving	>12	190 RMS at 10 m
Port of Benicia[2]	Timber pile	n/a	11	170 dB RMS at 10 m
Shasta County, California[1]	24-inch steel pipe piles	Vibratory driving	>2	157, 159 RMS at 10 m
the Stockton Marina, Stockton, California[1]	20-inch- steel shell piles	Vibratory driving	3	169, 156 RMS at 10 m
Test Pile Program at Naval Base Kitsap at Bangor, WA[3]	36-inch TTP	Vibratory driving	n/a	159 dB RMS at 10 m
Hable River in Hampshire, England[4]	14-inch polyurethane-coated wood piles	Vibratory driving	n/a	142 dB RMS at 10 m
Port Townsend dolphin pile removal in the State of Washington[5]	Dolphin pile	Vibratory extraction	5	150 RMS at 16 m

[1] Caltrans, 2012
[2] Caltrans, 2015a
[3] Illingsworth and Rodkin, 2013
[4] Nedwell, 2015
[5] WSDOT, 2011

All calculated distances to, and the total area encompassed by, the marine mammal sound thresholds are provided in Table 6. No physiological responses are expected from pile-driving operations occurring during project construction. Vibratory pile extraction and driving does not generate high-peak sound-pressure levels commonly associated with physiological damage. Impact driving can produce noise levels in excess of the Level A thresholds, but only within 50 feet (15 meters) of impact-driving of 36-inch piles. The shutdown zone will be equivalent to the area over which Level A harassment may occur, including the 180 dB re 1 μPa (cetaceans) and 190 dB re 1 μPa (pinnipeds) isopleths (Table 6); however, a minimum 10 m shutdown zone will be applied to the these zones as a precautionary measure intended to prevent the already unlikely possibility of physical interaction with construction equipment and to further reduce any possibility of acoustic injury. The disturbance zones will be equivalent to the area over which Level B harassment may occur, including160 dB re 1 μPa (impact pile driving) and 120 dB re 1 μPa (vibratory pile driving) isopleths (Table 6).

Table 6. Distances to Relevant Underwater Sound Thresholds and Areas of Ensonification.

Project Element Requiring Pile Installation	Source Levels at 10 meters	Distance to Threshold (m)			Area for Level B Threshold (km^2)
	RMS	190 dB RMS [1]	180 dB RMS [1]	160/ 120 dB RMS [2]	
South Basin Pile Demolition and Removal					
18-Inch Wood Piles – Vibratory Driver	150	0	< 1	1,000	1.27
18-Inch Concrete Piles – Vibratory Driver	150	0	< 1	1,000	1.27
36-Inch Steel Piles – Vibratory Driver	170	< 1	2	18,478	86.52
Embarcadero Plaza and East Bayside Promenade and Gates E, F, and G Dolphin and Guide Piles					
36-Inch Steel Piles – Vibratory Driver	169	< 1	2	18,478	86.52
36-Inch Steel Piles – Impact Driver (BCA)3	198	4	16	341	0.18
24-Inch Steel Piles – Vibratory Driver	163	0	1	7,356	38.07
24-Inch Steel Piles – Impact Driver (BCA)	193	2	10	215	0.09
Fender Piles					
14-Inch Wood Piles- Vibratory Driver	142	0	0	293	0.14
14-Inch Wood Piles – Impact Driver	158	0	0	7	0

[1] For underwater noise, the Level A harassment threshold for cetaceans is 180 dB and 190 dB for pinnipeds.
[2] For underwater noise, the Level B harassment (disturbance) threshold is 160 dB for impulsive noise and typical ambient levels (120 dB) for continuous noise.

BCA Bubble curtain attenuation will be used during impact driving of steel piles.
dB decibels
RMS root mean square

Marine Mammal Densities

At-sea densities for marine mammal species have not be determined in San Francisco Bay; therefore, estimates here are determined by using observational data taken during marine mammal monitoring associated with the Richmond-San Rafael Bridge retrofit project, the San Francisco-Oakland Bay Bridge (SFOBB), which has been ongoing for the past 15 years, and anecdotal observational reports from local entities. It is not currently possible to identify all observed individuals to stock.

Description of Take Calculation

All estimates are conservative and include the following assumptions:

- All pilings installed at each site would have an underwater noise disturbance equal to the piling that causes the greatest noise disturbance *(i.e.*, the piling farthest from shore) installed with the method that has the largest ZOI. The largest underwater disturbance ZOI would be produced by vibratory driving steel piles. The ZOIs for each threshold are not spherical and are truncated by land masses on either side of the channel which would dissipate sound pressure waves.
- Exposures were based on estimated total of 106 work days. Each activity ranges in amount of days needed to be completed (Table 1). Note that impact driving is likely to occur only on days when vibratory driving occurs.
- In absence of site specific underwater acoustic propagation modeling, the practical spreading loss model was used to determine the ZOI.
- All marine mammal individuals potentially available are assumed to be present within the relevant area, and thus incidentally taken;
- An individual can only be taken once during a 24-h period; and,
- Exposures to sound levels at or above the relevant thresholds equate to take, as defined by the MMPA.

The estimation of marine mammal takes typically uses the following calculation:

For harbor seals and California sea lions: Level B exposure estimate = D (density) * Area of ensonification) * Number of days of noise generating activities.

For all other marine mammal species: Level B exposure estimate = N (number of animals) in the area * Number of days of noise generating activities.

To account for the increase in California sea lion density due to El Niño, the daily take estimated from the observed density has been increased by a factor of 10 for each day that pile driving occurs.

There are a number of reasons why estimates of potential instances of take may be overestimates of the number of individuals taken, assuming that available density or abundance estimates and estimated ZOI areas are accurate. We assume, in the absence of information supporting a more refined conclusion, that the output of the calculation represents the number of individuals that may be taken by the specified activity. In fact, in the context of stationary activities such as pile driving and in areas where resident animals may be present, this number represents the number of instances of take that may accrue to a smaller number of individuals, with some number of animals being exposed more than once per individual. While pile driving can occur any day throughout the in-water work window, and the analysis is conducted on a per day basis, only a fraction of that time (typically a matter of hours on any given day) is actually spent pile driving. The potential effectiveness of mitigation measures in reducing the number of takes is typically not quantified in the take estimation process. For these reasons, these take estimates may be conservative, especially if each take is considered a separate individual animal, and especially for pinnipeds.

The quantitative exercise described above indicates that no instances of Level A harassment would be expected, independent of the implementation of required mitigation measures. See Table 7 for total estimated instances of take.

Table 7. Calculations for Incidental Take Estimation.

Pile Type	Pile-Driver Type	# of driving Days	Estimated Take by Level B Harassment (take per day/total)						
			Harbor Seal	CA Sea Lion[1]	Northern Elephant Seal[2]	Harbor Porpoise[2]	Gray Whale[2]	Northern fur seal[2]	Bottlenose dolphin[2]
2016 Work Season									
Wood/concrete pile removal	Vibratory	30	1/30	10/300	NA	NA	NA	NA	NA
36-inch dolphin pile removal	Vibratory	1	27/26	110/110	NA	NA	NA	NA	NA
Embarcadero Plaza 36-inch steel piles OR	Vibratory[3]	65	26/1,690	110/7,150	NA	NA	NA	NA	NA
24-inch steel piles	Vibratory[3]	65	12/780	50/3,250	NA	NA	NA	NA	NA
14-inch wood pile	Vibratory[3]	10	1/10	10/100	NA	NA	NA	NA	NA
Project Total (2016) [3]		106	1,756	7,660	14	6	2	10	30
2017 Work Season									
Gate F and G Guide Piles (36-inch steel)	Vibratory[3]	12	1/12	4/48	NA	NA	NA	NA	NA
Gate E Guide Pile Removal (36-inch steel)	Vibratory	6	1/6	4/24	NA	NA	NA	NA	NA
Gate E Guide Pile Installation (36-inch steel)	Vibratory[3]	6	1/6	4/24	NA	NA	NA	NA	NA
Project Total (2017)		24	648[4]	2,640[4]	4	6	2	10	30

[1]1 To account for potential El Niño conditions, take calculated from at-sea densities for California sea lion has been increased by a factor of 10.
[2]Take is not calculated by activity type for these species with a low potential to occur, only a yearly total is given.
[2]Piles of this type may also be installed with an impact hammer, which would reduce the estimated take.
[3]This total assumes that 36-inch steel piles are used for the Embarcadero Plaza.

Description of Marine Mammals in the Area of the Specified Activity.

Harbor Seals

Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced at-sea density estimates for Pacific harbor seal of

0.78 animals per square mile (0.3 animals per square kilometer) for the summer season (Caltrans, 2015b). Using this density, the potential average daily take for the areas over which the Level B harassment thresholds may be exceeded are estimated in Table 8.

Table 8. Take Calculation for Harbor Seal.

Activity	Pile type	Density	Area (km^2)	Take estimate
Vibratory driving	24-in steel pile	0.78 (0.3 animal/km^2)	38.09	780
Vibratory driving and extraction	36-in steel pile	0.78 (0.3 animal/km^2)	86.52	1,690; 26
Vibratory extraction	Wood and concrete piles	0.78 (0.3 animal/km^2)	1.27	30
Vibratory driving	Wood piles	0.78 (0.3 animal/km^2)	0.14	10

A total of 1,756 harbor seal takes are estimated for 2016 (Table 7).

California sea lion

Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced at-sea density estimates for California sea lion of 0.31 animals per square mile (0.12 animal per square kilometer) for the summer season (Caltrans, 2015b). Using this density, the potential average daily take for the areas over which the Level B harassment thresholds may be exceeded (Table 10) is estimated in Table 9.

Table 9. Take Calculation for California Sea Lion.

Activity	Pile type	Density	Area (km^2)	Take Estimate
Vibratory driving and extraction	24-in steel pile	0.31 (0.12 animal/km^2)	38.09	3,250*
Vibratory driving and extraction	36-in steel pile	0.31 (0.12 animal/km^2)	86.52	7,150; 110*
Vibratory extraction	Wood and concrete piles	0.31 (0.12 animal/km^2)	1.27	300*
Vibratory driving	Wood piles	0.31 (0.12 animal/km^2)	0.14	100*

* All California sea lion estimates were multiplied by 10 to account for the increased occurrence of this species due to El Niño.

.All California sea lion estimates were multiplied by 10 to account for the increased occurrence of this species due to El Niño. A total of 7,660 California sea lion takes is estimated for 2016 (Table 7).

Northern elephant seal

Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced an estimated at-sea density for northern elephant seal of 0.16 animal per square mile (0.03 animal per square kilometer) (Caltrans, 2015b). Most sightings of northern elephant seal in San Francisco Bay occur in spring or early summer, and are less likely to occur during the periods of in-water work for this project (June/July through November). As a result, densities during pile driving for the proposed action would be much lower. Therefore, we estimate that it is possible that a lone northern elephant seal may enter the Level B harassment area once per week during pile driving, for a total of 14 takes in 2016 (Table 7).

Northern fur seal

During the breeding season, the majority of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean. On the coast of California, small breeding colonies are present at San Miguel Island off southern California, and the Farallon Islands off central California (Caretta et al 2014). Northern fur seal are a pelagic species and are rarely seen near the shore away from breeding areas. Juveniles of this species occasionally strand in San Francisco Bay, particularly during El Niño events, for example, during the 2006 El Niño event, 33 fur seals were admitted to the Marine Mammal Center (TMMC, 2016). Some of these stranded animals were collected from shorelines in San Francisco Bay. Due to the recent El Niño event, Northern fur seals are being observed in San Francisco bay more frequently, as well as strandings all along the California coast and inside San Francisco Bay; a trend that is expected to continue this summer through winter (TMMC, personal communication). Because sightings are normally rare; instances recently have been observed, but are not common, and based on estimates from local observations (TMMC, personal communication), it is estimated that ten Norther fur seals will be taken in 2016 (Table 7).

Harbor porpoise

In the last six decades, harbor porpoises were observed outside of San Francisco Bay. The few harbor porpoises that entered were not sighted past central Bay close to the Golden Gate Bridge. In recent years, however, there have been increasingly common observations of harbor porpoises in central, north, and south San Francisco Bay. Porpoise activity inside San Francisco Bay is thought to be related to foraging and mating behaviors (Keener, 2011; Duffy, 2015). According to observations by the Golden Gate Cetacean Research team as part of their multi-year assessment, over 100 porpoises may be seen at one time entering San Francisco Bay; and over 600 individual animals are documented in a photo-ID database. However, sightings are concentrated in the vicinity of the Golden Gate Bridge and Angel Island, north of the project area, with lesser numbers sighted south of Alcatraz and west of Treasure Island (Keener 2011). Harbor porpoise generally travel individually or in small groups of two or three (Sekiguchi, 1995).

Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced an estimated at-sea density for harbor porpoise of 0.01 animal per square mile (0.004 animal per square kilometer) (Caltrans, 2015b). However, this estimate would be an overestimate of what would actually be seen in the project area. In order to estimate a more realistic take number, we assume it is possible that a small group of individuals (three harbor porpoises) may enter the Level B harassment area on as many as two days of pile driving, for a total of six harbor porpoise takes per year (Table 7).

Gray whale

Historically, gray whales were not common in San Francisco Bay. The Oceanic Society has tracked gray whale sightings since they began returning to San Francisco Bay regularly in the late 1990s. The Oceanic Society data show that all age classes of gray whales are entering San Francisco Bay, and that they enter as singles or in groups of up to five individuals. However, the data do not distinguish between sightings of gray whales and number of individual whales (Winning, 2008). Caltrans Richmond-San Rafael Bridge project monitors recorded 12 living and two dead gray whales in the surveys performed in 2012. All sightings were in either the central or north Bay; and all but two sightings occurred during the months of April and May. One gray whale was sighted in June, and one in October (the specific years were unreported). It is estimated that two to six gray whales enter San Francisco Bay in any given year. Because construction activities are only occurring during a maximum of 106 days in 2016, it is estimated that two gray whales may potentially enter the area during the construction period, for a total of 2 gray whale takes in 2016 (Table 7).

Bottlenose dolphin

Since the 1982-83 El Niño, which increased water temperatures off California, bottlenose dolphins have been consistently sighted along the central California coast (Caretta et al 2008). The northern limit of their regular range is currently the Pacific coast off San Francisco and Marin County, and they occasionally enter San Francisco Bay, sometimes foraging for fish in

Fort Point Cove, just east of the Golden Gate Bridge. In the summer of 2015, a lone bottlenose dolphin was seen swimming in the Oyster Point area of South San Francisco (GGCR, 2016). Members of this stock are transient and make movements up and down the coast, and into some estuaries, throughout the year. Due to the recent El Niño event, bottlenose dolphins are being observed in San Francisco bay more frequently (TMMC, personal communication). Groups with an average group size of five animals enter the bay and occur near Yerba Buena Island once per week for a two week stint and then depart the bay (TMMC, personal communication). Assuming groups of five individuals may enter San Francisco Bay approximately three times during the construction activities, we estimate 30 takes of bottlenose dolphins for 2016 (Table 7).

Analyses and Preliminary Determinations

Negligible Impact Analysis

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.” A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of Level B harassment takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be “taken” through behavioral harassment, we consider other factors, such as the likely nature of any responses (*e.g*., intensity, duration), the context of any responses (*e.g*., critical reproductive time or location, migration), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and effects on habitat.

Pile driving activities associated with the ferry terminal construction project, as outlined previously, have the potential to disturb or displace marine mammals. Specifically, the specified activities may result in take, in the form of Level B harassment (behavioral disturbance) only, from underwater sounds generated from pile driving. Potential takes could occur if individuals of these species are present in the ensonified zone when pile driving occurs.

No injury, serious injury, or mortality is anticipated given the nature of the activities and measures designed to minimize the possibility of injury to marine mammals. The potential for these outcomes is minimized through the construction method and the implementation of the planned mitigation measures. Specifically, vibratory hammers will be the primary method of installation (impact driving is included only as a contingency), and this activity does not have the potential to cause injury to marine mammals due to the relatively low source levels produced (less than 180 dB) and the lack of potentially injurious source characteristics. Impact pile driving produces short, sharp pulses with higher peak levels and much sharper rise time to reach those peaks. If impact driving is necessary, implementation of soft start and shutdown zones significantly reduces any possibility of injury. Given sufficient “notice” through use of soft start (for impact driving), marine mammals are expected to move away from a sound source that is annoying prior to it becoming potentially injurious. WETA will also employ the use of 12-inch-thick wood cushion block on impact hammers, and use a bubble curtain as sound attenuation devices. Environmental conditions in San Francisco Ferry Terminal mean that marine mammal detection ability by trained observers is high, enabling a high rate of success in implementation of shutdowns to avoid injury.

WETA’s proposed activities are localized and of relatively short duration (a maximum of 106 days for pile driving in the first year). The entire project area is limited to the San Francisco ferry terminal area and its immediate surroundings. These localized and short-term noise exposures may cause short-term behavioral modifications in harbor seals, Northern fur seals, Northern elephant seals, California sea lions, harbor porpoises, bottlenose dolphins, and gray whales. Moreover, the proposed mitigation and monitoring measures are expected to reduce the likelihood of injury and behavior exposures. Additionally, no important feeding and/or reproductive areas for marine mammals are known to be within the ensonified area during the construction time frame.

The project also is not expected to have significant adverse effects on affected marine mammals' habitat. The project activities would not modify existing marine mammal habitat for a significant amount of time. The activities may cause some fish to leave the area of disturbance, thus temporarily impacting marine mammals' foraging opportunities in a limited portion of the foraging range; but, because of the short duration of the activities and the relatively small area of the habitat that may be affected, the impacts to marine mammal habitat are not expected to cause significant or long-term negative consequences.

Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from other similar activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring) (*e.g.*, Thorson and Reyff, 2006; Lerma, 2014). Most likely, individuals will simply move away from the sound source and be temporarily displaced from the areas of pile driving, although even this reaction has been observed primarily only in association with impact pile driving. Repeated exposures of individuals to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior due to the small ensonification area and relatively short duration of the project. Thus, even repeated Level B harassment of some small subset of the overall stock is unlikely to result in any significant realized decrease in fitness for the affected individuals, and thus would not result in any adverse impact to the stock as a whole.

In summary, this negligible impact analysis is founded on the following factors: (1) the possibility of injury, serious injury, or mortality may reasonably be considered discountable; (2) the anticipated instances of Level B harassment consist of, at worst, temporary modifications in behavior; (3) the presumed efficacy of the proposed mitigation measures in reducing the effects of the specified activity to the level of least practicable impact, and (4) the lack of important areas. In addition, these stocks are not listed under the ESA. In combination, we believe that these factors, as well as the available body of evidence from other similar activities, demonstrate that the potential effects of the specified activity will have only short-term effects on individuals. The specified activity is not reasonably expected to and is not reasonably likely to adversely affect the marine mammal species or stocks through effects on annual rates of recruitment or survival, and will therefore not result in population-level impacts.

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 proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from WETA's ferry terminal construction activities will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers Analysis

Table 10 details the number of instances that animals could be exposed to received noise levels that could cause Level B behavioral harassment for the proposed work at the ferry terminal project site relative to the total stock abundance. The numbers of animals authorized to be taken for all species would be considered small relative to the relevant stocks or populations even if each estimated instance of take occurred to a new individual – an extremely unlikely scenario. The total percent of the population (if each instance was a separate individual) for which take is requested is approximately nine percent for bottlenose dolphins, approximately six percent for harbor seals, less than three percent for California sea lions, and less than one percent for all other species (Table 10). For pinnipeds, especially harbor seals occurring in the vicinity of the ferry terminal, there will almost certainly be some overlap in individuals present day-to-day, and the number of individuals taken is expected to be notably lower. We preliminarily find that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Table 10. Estimated Numbers and Percentage of Stock That May Be Exposed to Level B Harassment

Species	Proposed Authorized Takes	Stock(s) Abundance Estimate[1]	Percentage of Total Stock (%)
Harbor Seal (*Phoca vitulina*) *California stock*	1,756	30,968	5.7
California sea lion (*Zalophus californianus*) *U.S. Stock*	7,660	296,750	2.6
Northern elephant seal (*Mirounga anustirostris*) *California breeding stock*	14	179,000	.0008
Northern fur seal (*Callorhinus ursinus*) *California stock*	10	14,050	.007
Harbor Porpoise (*Phocoena phocoena*) *San Francisco-Russian River Stock*	6	9,886	.006
Gray whale (*Eschrichtius robustus*) *Eastern North Pacific stock*	2	20,990	.001
Bottlenose dolphin (*Tursiops truncatus)* *California coastal stock*	30	323	9.3

[1] All stock abundance estimates presented here are from the draft 2015Pacific Stock Assessment Report

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, we have 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)

No marine mammal species listed under the ESA are expected to be affected by these activities. Therefore, we have determined that section 7 consultation under the ESA is not required.

National Environmental Policy Act (NEPA)

NMFS is currently conducting an analysis, pursuant to National Environmental Policy Act (NEPA), to determine whether or not this proposed activity may have a significant effect on the human environment. This analysis will be completed prior to the issuance or denial of this proposed IHA.

Proposed Authorization

As a result of these preliminary determinations, we propose to authorize the take of marine mammals incidental to WETA's Downtown San Francisco Ferry Terminal Expansion Project, South Basin Improvements Project, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. Specific language from the proposed IHA is provided next.

This section contains a draft of the IHA. The wording contained in this section is proposed for inclusion in the IHA (if issued).

1. This Incidental Harassment Authorization (IHA) is valid for one year from the date of issuance.

2. This IHA is valid only for pile driving activities associated with the Downtown San Francisco Ferry Terminal Expansion Project, South Basin Improvements Project in San Francisco Bay, CA.

3. General Conditions

(a) A copy of this IHA must be in the possession of WETA, its designees, and work crew personnel operating under the authority of this IHA.

(b) The species authorized for taking are summarized in Table 1.

(c) The taking, by Level B harassment only, is limited to the species listed in condition 3(b). See Table 1 for numbers of take authorized.

Table 1. Authorized Take Numbers.

Species	Authorized Take	
	Level A	**Level B**
Harbor seal	0	1,756
California sea lion	0	7,660
Northern elephant seal	0	14
Northern fur seal	0	10
Harbor porpoise	0	6
Gray whale	0	2
Bottlenose dolphin	0	30
Total	0	9,478

(d) The taking by injury (Level A harassment), serious injury, or death of the species listed in condition 3(b) of the Authorization or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA.

(e) WETA shall conduct briefings between construction supervisors and crews, marine mammal monitoring team, and WETA staff prior to the start of all pile driving activity, and when new personnel join the work.

4. Mitigation Measures

The holder of this Authorization is required to implement the following mitigation measures:

(a) For all pile driving, WETA shall implement a minimum shutdown zone of 10 m radius around the pile. If a marine mammal comes within or approaches the shutdown zone, such operations shall cease.

(b) 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 10 meters, operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions.

(c) WETA shall establish monitoring locations as described below. Please also refer to the Marine Mammal Monitoring Plan (see *www.nmfs.noaa.gov/pr/permits/incidental/construction.htm).*

i. For all pile driving activities, a minimum of two observers shall be deployed, with one positioned to achieve optimal monitoring of the shutdown zone and the second positioned to achieve optimal monitoring of surrounding waters of the ferry terminal and portions of San Francisco Bay. If practicable, the second observer should be deployed to an elevated position with clear sight lines to the ferry terminal.

ii. These observers shall record all observations of marine mammals, regardless of distance from the pile being driven, as well as behavior and potential behavioral reactions of the animals. Observations within the ferry terminal shall be distinguished from those in the nearshore waters of San Francisco Bay.

iii. All observers shall be equipped for communication of marine mammal observations amongst themselves and to other relevant personnel (*e.g.*, those necessary to effect activity delay or shutdown).

(c) Monitoring shall take place from fifteen minutes prior to initiation of pile driving activity through thirty minutes post-completion of pile driving activity. In the event of a delay or shutdown of activity resulting from marine mammals in the shutdown zone, animals shall be allowed to remain in the shutdown zone (*i.e.*, must leave of their own volition) and their behavior shall be monitored and documented. Monitoring shall occur throughout the time required to drive a pile. The shutdown zone must be determined to be clear during periods of good visibility (*i.e.*, the entire shutdown zone and surrounding waters must be visible to the naked eye).

(d) If a marine mammal approaches or enters the shutdown zone, all pile driving activities at that location shall be halted. If pile driving is halted or delayed due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or fifteen minutes have passed without re-detection of the animal.

(e) Using delay and shut-down procedures, if a species for which authorization has not been granted (including but not limited to Guadalupe fur seals and humpback whales) or if a species for which authorization has been granted but the authorized takes are met, approaches or is observed within the Level B harassment zone, activities will shut down immediately and not restart until the animals have been confirmed to have left the area.

(f) Monitoring shall be conducted by qualified observers, as described in the Monitoring Plan. Trained observers shall be placed from the best vantage point(s) practicable to monitor for marine mammals and implement shutdown or delay procedures when applicable through communication with the equipment operator. Observer training must be provided prior to project start and in accordance with the monitoring plan, and shall include instruction on species identification (sufficient to distinguish the species listed in 3(b)), description and categorization of observed behaviors and interpretation of behaviors that may be construed as being reactions to the specified activity, proper completion of data forms, and other basic components of biological monitoring, including tracking of observed animals or groups of animals such that repeat sound exposures may be attributed to individuals (to the extent possible).

(g) WETA shall use soft start techniques recommended by NMFS for impact pile driving. Soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced energy strike sets. Soft start shall be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for a period of thirty minutes or longer.

(h) Sound attenuation devices - Approved sound attenuation devices (e.g. bubble curtain, pile cushion) shall be used during impact pile driving operations. WETA shall implement the necessary contractual requirements to ensure that such devices are capable of achieving optimal performance, and that deployment of the device is implemented properly such that no reduction in performance may be attributable to faulty deployment.

(i) Pile driving shall only be conducted during daylight hours.

5. Monitoring

The holder of this Authorization is required to conduct marine mammal monitoring during pile driving activity. Marine mammal monitoring and reporting shall be conducted in accordance with the Monitoring Plan.

(a) WETA shall collect sighting data and behavioral responses to pile driving for marine mammal species observed in the region of activity during the period of activity. All observers shall be trained in marine mammal identification and behaviors, and shall have no other construction-related tasks while conducting monitoring.

(b) For all marine mammal monitoring, the information shall be recorded as described in the Monitoring Plan.

6. Reporting

The holder of this Authorization is required to:

(a) Submit a draft report on all monitoring conducted under the IHA within ninety days of the completion of marine mammal monitoring, or sixty days prior to the issuance of any subsequent IHA for projects at the San Francisco Ferry Terminal, whichever comes first. A final report shall be prepared and submitted within thirty days following resolution of comments on the draft report from NMFS. This report must contain the informational elements described in the Monitoring Plan, at minimum (see *www.nmfs.noaa.gov/pr/permits/incidental/construction.htm*), and shall also include:

i. Detailed information about any implementation of shutdowns, including the distance of animals to the pile and description of specific actions that ensued and resulting behavior of the animal, if any.

ii. Description of attempts to distinguish between the number of individual animals taken and the number of incidents of take, such as ability to track groups or individuals.

iii. An estimated total take estimate extrapolated from the number of marine mammals observed during the course of construction activities, if necessary.

(b) 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 this IHA, such as an injury (Level A harassment), serious injury, or mortality, WETA shall immediately cease the specified activities and report the incident to the Office of Protected Resources, NMFS, and the Southwest 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 WETA to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. WETA may not resume their activities until notified by NMFS.

ii. In the event that WETA discovers an injured or dead marine mammal, and the lead observer 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), WETA shall immediately report the incident to the Office of Protected Resources, NMFS, and the Southwest Regional Stranding Coordinator, NMFS.

The report must include the same information identified in 6(b)(i) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with WETA to determine whether additional mitigation measures or modifications to the activities are appropriate.

iii. In the event that discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, scavenger damage), WETA shall report the incident to the Office of Protected Resources, NMFS, and the Southwest Regional Stranding Coordinator, NMFS, within 24 hours of the discovery. WETA shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Request for Public Comments

We request comment on our analyses, the draft authorization, and any other aspect of this Notice of Proposed IHAs for WETA’s ferry terminal construction activities. Please include with your comments any supporting data or literature citations to help inform our final decision on WETA's request for an MMPA authorization.

Dated: May 19, 2016.

Perry F. Gayaldo,

Deputy Director,

Office of Protected Resources,

National Marine Fisheries Service.

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