Revised Request for Incidental Harassment Authorization for Waterfront Repairs at U.S. Coast Guard Station Monterey Monterey, California

Contract No. HSCG50-14-D-PSL002
Task Order No. HSCG88-16-J- PQQ094

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July 2017

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ACRONYMS AND ABBREVIATIONS

AOI	Area of Influence
CDFW	California Department of Fish and Wildlife
dB	Decibels
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
HAPC	Habitat Area of Particular Concern
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometers
km^2	square kilometers
Lmax	maximum noise level
LOA	Letter of Authorization
MBNMS	Monterey Bay National Marine Sanctuary
MMPA	Marine Mammal Protection Act
NCCOS	National Center for Coastal Ocean Science
NMFS	National Marine Fisheries Service
NM	nautical miles
NOAA	National Oceanic and Atmospheric Administration
PCFG	Pacific Coast Feeding Group
PVC	polyvinyl chloride
RMS	root mean square
SPL	sound-pressure Level
UME	unusual mortality event
U.S.	United States
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WFA	Weighting factor adjustment

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SECTION 1
DESCRIPTION OF THE ACTIVITY

1.1 INTRODUCTION

U.S. Coast Guard (USCG) Station Monterey is located at 100 Lighthouse Avenue at the southern end of Monterey Bay in Monterey, California. Station Monterey occupies an upland site and adjacent waterside structures including a 1,700-foot breakwater, a wharf constructed over the breakwater, and floating docks to the east of the wharf. The USCG intends to conduct maintenance on the existing wharf which is used to berth vessels that are critical to support Station Monterey's mission.

The wharf is constructed of timber and steel material and is supported by 64 piles. In 1995, 47 of the original timber piles were replaced with 14-inch steel pipe piles and the remaining 17 timber piles had polyvinyl chloride (PVC) pile wraps installed. The 17 remaining timber piles are bearing piles that have exceeded their service life partially due to marine bores and the harsh marine environment to which they are exposed, and they need to be replaced. A detailed description of the Proposed Action is provided in Section 1.2 below.

The area including the breakwater, wharf, floating docks, and adjacent waters are used by a variety of marine species and wildlife including seabirds, reptiles, invertebrates, and marine mammals. Species observed include California sea lions, Pacific harbor seals, harbor porpoises, Risso's dolphins, bottlenose dolphins, southern sea otters, and—in rare instances—gray whales, humpback whales, and killer whales (i.e., West Coast transient, eastern North Pacific offshore, or southern resident stocks).

1.2 PROPOSED ACTION

The proposed replacement of the 17 timber piles requires removal of the existing timber deck, replacing stringers, steel pipe caps, steel support beams, and hardware in order to access the timber piles. The timber piles, approximately 16 to 18 inches in diameter, will be removed using a vibratory extractor. Each timber pile will be replaced with a 14-inch steel pipe pile installed using a vibratory hammer (the preferred method) and each pipe pile will be positioned and installed in the footprint of the extracted timber pile. Pile proofing will be conducted via impact hammer. If, due to substrate or breakwater armor, a pipe pile is unable to be driven to 30 feet below the mud line using a vibratory hammer, then an impact hammer will be used; and if the pile cannot be driven with an impact hammer, the pipe pile would be posted onto the armor stone. The steel pipe piles would not be filled with concrete. Materials and hardware removed to allow access to conduct pile work would be replaced with in-kind materials.

Pile-driving activities are expected to occur for an estimated minimum of three (3) days and a maximum of eight (8) days of the total construction time. It is assumed that driving time would be approximately 20 minutes per pile for vibratory or impact pile driving. It is assumed that vibratory extraction of the existing piles would take approximately 10 minutes per pile. Pile driving and extraction would therefore result in an estimated of 240 minutes per day; 510 minutes for the total project or approximately 8.5 hours of underwater and airborne noise generation from pile driving/extraction activities over the course of the project construction.

Pile extraction and pile driving activities are expected to result in take of marine mammals as these activities exceed the National Marine Fisheries Service (NMFS) underwater and airborne noise threshold levels for marine mammals. It is anticipated that incidental take by Level B harassment, as defined by Title 50, Code of Federal Regulations, Part 216.3, would result from implementation of the proposed project. Detailed information on take estimates and anticipated impacts are provided in Sections 6 and 7, respectively.

Levels of harassment for marine mammals are defined in the Marine Mammal Protection Act (MMPA) of 1972. Level A harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding, or sheltering."

In addition to incidental take resulting from noise during pile driving and/or extraction, intentional take to encourage animals to leave the work zone may be allowed under Section 109(h)(1) of the MMPA. This section permits federal, state, and local officials to take marine mammals in the course of official duties (e.g., the protection or welfare of a marine mammal, protection of public health and welfare, and non-lethal removal of nuisance animals). Because this take is intentional in nature, authorization is not requested in this incidental harassment application package.

Sound attenuation measures including implementation of a bubble curtain and cushion pads during impact pile driving would be used. Pile extraction and driving equipment would be located on a barge and no staging would be located on the existing wharf. The extensive use of the breakwater and wharf by seabirds and California sea lions poses a challenge for conducting the waterfront repairs because they have become accustomed to a noisy waterfront and are not easily deterred. However, the USCG has successfully completed other construction activities at the project site, including installation of the Hawksbill floating dock in 2004, replacement of an Aid to Navigation device in 2008, and conducting repairs to the small boat and patrol boat floating docks between November 2008 and February 2009. Monitoring of seabirds and marine mammals at the project site was conducted by the USCG during these construction projects and behavioral disturbance of seabirds and marine mammals was determined to be minor and did not cause long-term or permanent changes in behavior (Phillips and Harvey 2004; Hoover and Harvey 2008; Harvey and Hoover 2009).

A full list of mitigation measures has been developed to avoid Level A (injury) harassment and reduce the potential effects from Level B (disturbance) harassment to marine mammals during pile-extraction and pile-driving activities and is included in Section 10.

IHA

Regional Location
USCG Station Monterey

FIGURE 1-1

No warranty is made by the USCG as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

IHA

Project Site

FIGURE 1-2

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SECTION 2
DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

The proposed pile extraction and driving activities will occur between June 15 and October 15, 2018. No work will begin until all necessary permits and approvals are acquired and an approved monitoring plan is in place.

Under the Proposed Action, the repairs will require a maximum of 60 work days for completion, with up to 8 days of pile driving and/or extraction activities. Pile driving and extraction is estimated to take 240 minutes per day (4 hours), and approximately 8.5 hours over the course of project construction.

2.1 SPECIES AND NUMBERS OF MARINE MAMMALS

There are 9 marine mammal species that may occur or move through the waters near or within the project area. These include the California sea lion, Pacific harbor seal, harbor porpoise, Risso's dolphin, bottlenose dolphin, southern sea otter, and—in rare instances—gray whales, humpback whales, and killer whales (West Coast transient, eastern North Pacific offshore, or southern resident stocks). With the exception of the southern sea otter, which is under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS), these marine mammals are managed under the jurisdiction of the NMFS, a division of the National Oceanic and Atmospheric Administration (NOAA).

2.1.1 California Sea Lion

The California sea lion (*Zalophus californianus*) belongs to the "eared seal" family, Otariidae, referring to the external ear flaps not shared by other pinniped families. California sea lions are sexually dimorphic: males reach average lengths of 7.5 feet long and weigh approximately 700 pounds, whereas females are smaller, at approximately 6 feet long and 240 pounds. They have broad foreflippers and a long, narrow snout. Males have a robust body, broad forehead, and dark brown coats, while females and juveniles have a more slender body with a slightly lighter coat. Sexual maturity occurs within 4 to 5 years, and their lifespan is 20 to 30 years. California sea lions are social animals and can be observed in groups of several hundred individuals onshore. They are fast, agile swimmers and are able to dive to depths of up to 1,760 feet deep. They feed mainly in upwelling areas on a variety of prey such as squid, anchovies, mackerel, rockfish, and sardines, as well as taking fish from commercial fishing gear, sport-fishing lines, and at fish passage facilities (NOAA 2015a). Although California sea lions forage and conduct many activities in the water, they also use "haul-outs"—shoreline areas where pinnipeds congregate to rest, socialize, breed, and molt. California sea lions breed in Southern California and along the Channel Islands during the spring. After the breeding season, males migrate northward up the Pacific Coast and enter Monterey Bay, where they primarily haul-out at Año Nuevo State Park (in San Mateo County) and the Monterey Breakwater. Immature and/or nonbreeding males are year-round residents at the Monterey Breakwater. California sea lions are the most abundant marine mammal in the project area and regularly use the Monterey Breakwater and portions of the pier as a haul-out site.

2.1.2 Pacific Harbor Seal

The Pacific harbor seal is 1 of 5 subspecies of *Phoca vitulina*, or the common harbor seal. They are part of the "true seal" family, Phocidae, with a rounded head, visible ear canal, short, concave, dog-like snouts, and short forelimbs, which limit locomotion on land. Males are slightly larger than females, weighing up to 245 pounds and reaching approximately 6 feet in length. Their coloring is generally blue-gray on the back with light and dark speckling. Although generally solitary in the water, harbor seals tend to come ashore at haul-outs (usually rocks, reefs, or beach), which are used for rest, thermoregulation, social interaction, birthing, nursing pups, and to avoid predators. Their prey consists mainly of fish, shellfish, and crustaceans, and Pacific harbor seals are capable of both shallow and deep dives during hunting depending on prey availability. Mating occurs at sea, and females give birth during the spring and summer. Pups are ready to swim minutes after being born, and are nursed for 24 days on average (NOAA 2015b). They display year-round site fidelity, though they do travel approximately 185 to 310 miles to find food or suitable breeding areas. In California, there are approximately 400 to 600 haul-out sites located on a mixture of rock shores, intertidal sand bars, and beaches associated with the mainland and offshore islands (NOAA 2015c). Pacific harbor seals are not known to regularly use the Monterey Breakwater as a haul-out site, but may use beaches or other relatively low-gradient areas to haul-out in the project area, and in areas nearby such as beaches along Cannery Row in the City of Monterey.

2.1.3 Harbor Porpoise

The harbor porpoise (*Phocoena phocoena*) is a member of the Phocoenidae family. They generally occur in groups of 2 to 5 individuals and are considered to be shy, nonsocial animals. The harbor porpoise has a small, robust body with a short, blunt beak and medium-sized triangular dorsal fin. They can grow to approximately 5 to 5.5 feet in length and weigh approximately 135 to 170 pounds. Females are slightly larger than the males, reach sexually maturity at 3 to 4 years, and may give birth every year for several years in a row. Gestation lasts for 10 to 11 months, and calves are nursed for 8 to 12 months. They are typically found in waters less than 250 feet deep within bays, estuaries, and harbors. Their prey base consists of demersal and benthic species, mainly schooling fish and cephalopods (NOAA 2014a). The harbor porpoise is a resident species of Monterey Bay and could occur within the project area.

2.1.4 Risso's Dolphin

Risso's dolphin (*Grampus griseus*), sometimes called the "gray dolphin," is a member of the Delphinidae family. They can reach lengths of approximately 8.5 to 13 feet and weigh from 660 to 1,100 pounds, with males and females usually approximately the same size. Their head is bulbous with a vertical crease and indistinguishable beak. Their dorsal fin is curved or sickle-shaped and is located mid-way down the back. Calves are black, dark gray, or brown with a dark cape and saddle with little or no scarring on the body. As they age, their coloration lightens to pale gray or almost white, with bodies displaying heavy scarring. Risso's dolphins generally occur in groups of 5 to 50 individuals, but typically average from 10 to 30 individuals. The majority of their diet consists of squid, but they also feed on fish, krill, and other cephalopods mainly at night when their prey is closer to the surface. Not much is known about reproduction, but individuals become sexually mature when they reach a length of approximately 8.5 to 9 feet. Breeding and calving may occur year-round with a gestation period of 13 to 14 months and most births occurring from fall to winter in California waters. The estimated lifespan of a Risso's dolphin is at least 35 years. They are found in waters generally greater than 3,300 feet and seaward of the continental shelf and slopes. The California/Oregon/Washington stock is estimated to be between 13,000 and 16,000 individuals (NOAA 2012). They have a low potential to occur within the project area.

2.1.5 Bottlenose Dolphin

The bottlenose dolphin (*Tursiops truncatus*) is a member of the Delphinidae family. The bottlenose dolphin has a robust body and a short, thick beak, with coloration ranging from light gray to black with lighter coloration on the belly. Inshore animals are smaller and lighter in color, and offshore animals are larger, darker in color, and have smaller flippers. Bottlenose dolphins range in length from 6 to 12.5 feet and in weight from 300 to 1,400 pounds, with males slightly larger than females. Females reach sexual maturity at 5 to 13 years, and males at 9 to 14 years, with sexual maturity varying by population. Calving occurs every 3 to 6 years on average, after a 12-month gestation period, and are weaned at 18 to 20 months of age. The lifespan for males is 40 to 45 years, and is more than 50 years for females. They generally occur in groups of 2 to 15 individuals, with offshore herds sometimes including several hundred individuals (NOAA 2015d). California coastal bottlenose dolphins are typically found within approximately 0.6 miles of shore (NOAA 2008). They are generalists in their feeding habits and prey on a variety of organisms endemic to their habitat, foraging both individually and cooperatively. Coastal bottlenose dolphins prey on benthic invertebrates and fish and use high frequency echolocation to locate and capture prey. They use multiple feeding strategies, including "fish whacking," in which they strike a fish with their flukes and knock it out of the water (NOAA 2015d). The California coastal bottlenose dolphin has been consistently sighted in and around Monterey Bay and could occur within the project area (NOAA 2008).

2.1.6 Southern Sea Otter

One species of the Mustelidae family is known to occur within the central California coast: the southern sea otter (*Enhydra lutris nereis*). The southern sea otter was listed as threatened under the Endangered Species Act (ESA) on January 14, 1977. The southern sea otter is the largest member of the Mustelidae and the smallest species of marine mammal in North America. Southern sea otters have evolved to inhabit a narrow ecological zone, adapting to the nearshore ecosystem and preferring rocky shoreline with kelp beds. Adult sea otters average approximately 65 pounds for males and 45 pounds for females; average lengths are approximately 4.5 feet and 4 feet for males and females, respectively. The forepaws of southern sea otters are clawed and used for feeding and grooming, while the hind limbs are posteriorly oriented and flipper-like for swimming. The tail is less than one-third the body length, and of uniform thickness from base to tip. The southern sea otter feeds on a variety of benthic invertebrates (e.g., sea urchins, abalone, octopus, crabs) and are usually found in areas where the water depth is less than 60 feet. Adult female sea otters typically give birth to one pup each year, with births peaking in the spring and fall. Male sea otters aggregate at the northern and southern limits of their range in winter and early spring. Southern sea otters may live for 15 to 20 years in the wild. Kelp beds provide important foraging and shelter habitat for this species (USFWS 2003). The southern sea otter is a resident species of Monterey Bay and is regularly observed within the Monterey Harbor. They have a high potential to occur within the project area.

2.1.7 Whales

Whales would typically travel offshore within coastal waters; however, in rare instances, whales could occur within or near Monterey Harbor. The 3 species most likely to occur would be gray, killer, and humpback whales.

Gray Whale. Gray whales (*Eschrichtius robustus*) are large baleen whales and the only species in the Eschrichtiidae family. They grow to approximately 50 feet in length and weigh approximately 80,000 pounds, with females slightly larger than males. They are one of the most frequently seen whales along the California coast, easily recognized by their mottled gray color and lack of dorsal fin; instead, they have a "dorsal hump" and a series of 8 to 14 small bumps, known as "knuckles." Adult whales carry heavy loads of attached barnacles, which add to the mottled appearance. Gray whales are the only baleen whales known to feed on the sea floor, where they scoop up bottom sediments to filter out benthic crustaceans, mollusks, and worms. They are found mainly in shallow coastal waters in the North Pacific Ocean and make one of the longest annual migrations of any mammal, migrating in the fall from their summer feeding grounds in the northern Bering and Chukchi seas and the northern Pacific coast, south along the coast of

North America to spend winter in their breeding and calving areas off the coast of Baja California, Mexico. From mid-February to May, the Eastern North Pacific stock of gray whales can be seen migrating northward with their calves along the West Coast (NOAA 2013a). Although gray whales are not resident species within the project area, during their annual migration they can occur within approximately 2 miles of the coast of Monterey Bay (Monterey Bay National Marine Sanctuary [MBNMS] 2014).

Killer Whale. The killer whale (*Orcinus orca*) is a member of the Delphinidae family and is characterized by its distinct black and white color pattern. It is black on top, with white undersides and white patches near its eyes, and has a variable gray or white saddle behind its dorsal fin. They exhibit sexual dimorphism; the males reach up to 32 feet and 22,000 pounds, while the females reach up to 28 feet and 16,500 pounds. Males live for approximately 30 years, but can live as long as 50 to 60 years, while females usually live for approximately 50 years, but can live as long as 100 years. Female killer whales become sexually mature after reaching approximately 15 to 18 feet and carry their calves for close to a year and a half. They live within matriarchal societies and are highly social animals, relying on underwater sound for orientation, feeding, and communication. Their diet, which often depends on location or specific stock, consists of fish, sharks, sea birds, and other marine mammals. Three distinct forms of killer whales are recognized: resident, transient (Bigg's), and offshore. *Resident whales* have a rounded dorsal fin that is curved and tapering, primarily eat fish, and occur in large "pods" of social groups. *Transient whales* have a straighter dorsal fin and only have two patterns of saddle patch pigmentation, feed almost exclusively on other marine mammals, and are found in social units of less than 10 whales. *Offshore whales* are similar to resident whales, but have multiple nicks on the edge of their dorsal fin, smaller overall size, and males and females tend to be more similar in size. They often occur 9 miles or more offshore, in groups of 20 to 75 individuals, and feed primarily on fish and occasionally sharks (NOAA 2016a). Transient killer whales prey on gray whales and California sea lions within the Monterey Bay National Marine Sanctuary (MBNMS), and have the potential to occur in the project area (MBNMS 2014).

Humpback Whale. The humpback whale (*Megaptera novaeangliae*) is known for its long pectoral fins, which can reach up to 15 feet long and give them increased maneuverability. They frequently perform aerial displays such as breaching or slapping the surface of the water with their pectoral fins, tails, or heads. Like all baleen whales, adult females are larger than adult males, reaching up to 60 feet in length and weighing from 25 to 40 tons. Their body coloration is mostly dark gray with a variable amount of white on their pectoral fins and belly. This variation is so distinctive between individuals that the pigmentation pattern on the undersides of their flukes is used to identify individual whales. Humpbacks in the Pacific Ocean can be found in high latitude feeding grounds such as the Gulf of Alaska during the summer, and migrate to calving grounds in subtropical or tropical waters such as the Hawaiian Islands during the winter; it is the farthest migration of any mammal. Humpbacks spend the majority of their time in the summer feeding and building up fat stores to live off of during the winter. They filter feed on tiny crustaceans (mostly krill), plankton, and small fish, and can consume up to 3,000 pounds of food per day. They use air bubbles, including a unique variant called "bubble netting," to herd, corral, or disorient fish. Mating occurs in their wintering grounds, during which males sing complex songs that can last up to 20 minutes and be heard 20 miles away. Gestation lasts approximately 11 months, and newborns are 13 to 16 feet long and weigh approximately 1 ton (NOAA 2016b). Humpback whales are one of the more commonly observed large baleen whales in the MBNMS, mostly seen during summer and fall as they are feeding (NOAA 2014b). Both the Mexico Distinct Population Segment (DPS) and the Central America DPS can occur in the vicinity of the project area.

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SECTION 3
AFFECTED SPECIES STATUS AND DISTRIBUTION

3.1 INTRODUCTION

There are 9 marine mammal species that may occur or transit the waters near the project area. Three of these species are listed under the federal ESA: Southern sea otters, which are expected to regularly occur in Monterey Harbor; the southern resident killer whale and the humpback whale Central America DPS, both of which are considered rare in Monterey Bay. Table 3-1 presents a stock assessment and relative occurrence of marine mammal species that may occur in the project area.

Table 3-1. Stock Assessment of Marine Mammals Present in the Vicinity of the Monterey Breakwater

Species	Stock(s)	Stock(s) Abundance	Relative Occurrence in Monterey Breakwater Vicinity	Season(s) of Occurrence
California sea lion *Zalophus californianus*	United States (U.S.) stock (Pacific temperate)	296,750	Common	Year-round
Pacific harbor seal *Phoca vitulina*	California stock	30,968	Common	Year-round
Harbor porpoise *Phocoena*	Monterey Bay stock	3,715	Rare to occasional	Year-round
Risso's dolphin *Grampus griseus*	California/Oregon/ Washington stock	6,272	Rare to occasional	Year-round
Bottlenose dolphin *Tursiops truncatus*	California coastal stock	323	Rare to occasional	Year-round
Southern sea otter *Enhydra lutris nereis*	Mainland and San Nicolas Island stock	2,941	Common	Year-round
Gray Whale *Eschrichtius robustus*	Eastern North Pacific stock	20,990	Rare to occasional	Year-round
Killer whale *Orcinus orca*	West Coast transient stock	240	Rare to occasional	Year-round
	Eastern North Pacific offshore stock	243	Rare to occasional	Year-round
	Southern resident stock	78	Rare to occasional	During winter months
Humpback whale *Megaptera novaeangliae*	California/Oregon/ Washington stock	1,918	Rare to occasional	Year-round

Sources: (NOAA 2008, 2011a, 2011b, 2013b, 2014c, 2014d, 2015c, 2015e, 2015f, 2015g; USFWS 2014).

3.2 CALIFORNIA SEA LION

Based on genetic variations in the mitochondrial DNA, there are five genetically distinct populations of California sea lions: Pacific temperate, Pacific subtropical, Southern Gulf of California, Central Gulf of California, and Northern Gulf of California. Members of the Pacific temperate population, which range between Canada and Baja California, occur within the project area. Because all age and sex classes are not all ashore at the same time, instead of counting the entire population of sea lions, population assessment is based on pup counts during the breeding season. Population size is then estimated from the number of births and proportion of pups in the population. Based on pup counts for rookeries in Southern California in 2008, the population estimate is 296,750 individuals. More recent pup counts made in 2011 totaled 61,943 individuals, the highest recorded to date. Estimates of population size based on these counts are currently being developed, along with new estimates of the fraction of newborns in the population. Statistical analysis of the pup counts from 1975 through 2011 determined an approximate 5.4 percent annual growth rate between 1975 and 2008. However, this does not take into account decreases associated with El Niño years observed in 1983, 1984, 1992, 1993, and 2003. During these periods, pup counts decreased by between 20 and 64 percent. As a result of the large numbers of sea lion strandings in 2013, NOAA declared an unusual mortality event (UME). The exact causes of this UME are still unknown, but hypotheses include nutritional stress of pups resulting from lack of forage fish available to lactating mothers, and unknown disease agents. The U.S. stock is not listed as *endangered* or *threatened* under the ESA or as depleted under the MMPA (NOAA 2015e).

3.3 PACIFIC HARBOR SEAL

Widely distributed in both the North Atlantic and North Pacific, Pacific harbor seals have the broadest range of any pinniped. In the eastern North Pacific, they are found in near-shore coastal and estuarine habitats from Mexico to Alaska. Of the 3 recognized populations of Pacific harbor seals along the West Coast, the California stock occurs within California coastal waters. Although the different populations are genetically distinct, like the California sea lion, the geographical boundary between the Oregon/Washington Coastal stock (Oregon and Washington Outer Coast and Inland Waters of Washington) and the California stock is determined by the boundary between Oregon and California. Similar to the California sea lion, population assessments are extrapolated by observations of the number of Pacific harbor seals ashore at a given time. However, unlike other pinnipeds, a complete pup count is not possible due to the fact that harbor seal pups enter the water almost immediately after birth. The estimated population of the California stock is 30,968, based on the most recent harbor seal counts performed during May-July 2012. Between 1981 and 2004, population counts increased, followed by a decrease in population in subsequent surveys conducted in 2009 and 2012. A partial reason for this decrease could be mortalities associated with shootings, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, entrainment in power plants, and vessel and vehicle strikes (NOAA 2015c).

3.4 Harbor Porpoise

Harbor porpoises have a broad range in both the Atlantic and Pacific oceans. In the Pacific, they are found from Point Conception, California to Alaska and across to Kamchatka and Japan. The harbor porpoise population along the Pacific coastline consists of 8 distinct stocks (the Monterey Bay, San Francisco-Russian River, northern California/southern Oregon, northern Oregon/Washington coast, Inland Washington, Southeast Alaska, Gulf of Alaska, and Bering Sea stocks). The Monterey Bay stock, consisting of 3,715 individuals, is the population that could occur within the project area. These estimates are based on aerial surveys conducted in 2011 along the coast out to either the 200-meter depth contour or 15 nautical miles (NM) from shore. The latest population abundance estimate is significantly greater than previous estimates dating to 1988, but further analyses is required to estimate current population trends. The Harbor porpoise in California is listed neither as *threatened* or *endangered* under the ESA nor as *depleted* under the MMPA (NOAA 2014c).

3.5 Risso's Dolphin

The California/Oregon/Washington stock of Risso's dolphin is commonly observed on the shelf in the Southern California Bight and in slope and offshore waters of California, Oregon, and Washington. Dolphins found off California during winter months are thought to shift northward into Oregon and

Washington as water temperatures increase in late spring and summer. Current population estimates are taken from 2 shipboard surveys within 300 NM of the coasts of California, Oregon, and Washington in the summer and autumn of 2005 and 2008. The 2005-2008 geometric mean abundance estimate for the California/Oregon/Washington stock based on the 2 most recent ship surveys is 6,272 individuals. This multi-year average abundance estimate is the most appropriate for management within U.S. waters since as oceanographic conditions vary, Risso's dolphins may spend time outside the U.S. Exclusive Economic Zone. Abundance estimates range from approximately 4,000 to 11,000 individuals in California waters for 5 separate surveys conducted between 1991 and 2008, with no apparent trend in abundance, likely due to inter-annual variability in the distribution of animals within the ship survey area. There are no known habitat issues of concern for this species, and they are not listed as *threatened* or *endangered* under the ESA or as *depleted* under the MMPA (NOAA 2011a).

3.6 Bottlenose Dolphin

The California coastal bottlenose dolphin population ranges primarily from Point Conception south into Mexican waters, but have been consistently sighted in central California as far north as San Francisco since the 1982-83 El Niño, which resulted in increased water temperatures off California. California coastal bottlenose dolphins move in and out of areas along the coast; over 80 percent of the dolphins identified in Santa Barbara, Monterey, and Ensenada (Baja California) have also been identified off San Diego. The most recent estimate of the California coastal stock is 323 individuals, based on photographic mark-recapture surveys conducted along the San Diego coast in 2004 and 2005. However, this estimate does not reflect that approximately 35 percent of dolphins encountered lack identifiable dorsal fin marks; which could make the true population size closer to 450 to 500 individuals. The population size has been stable for approximately 20 years, based on a comparison of mark-recapture abundance estimates for the periods 1987-89, 1996-98, and 2004-05. The California coastal stock is listed neither as *threatened* or *endangered* under the ESA nor as *depleted* under the MMPA (NOAA 2008).

3.7 SOUTHERN SEA OTTER

Southern sea otters currently range from San Mateo County in the north to Santa Barbara County in the south. Historically, southern sea otters ranged along the coast of Oregon, California, and as far south as Punta Abreojos, Baja California, before hunting of southern sea otters for pelts in the 1700s and 1800s extirpated the species throughout most of its range, except for a small population near Bixby Creek in Monterey County. They have gradually expanded northward and southward along the central California coast since receiving protection under the International Fur Seal Treaty in 1911. The official population count in 2013 was 2,941 individuals, which included the 3-year running average for the mainland population (2,882) and the previous year's high count at San Nicolas Island (59). The 2011 mainland spring census was not completed due to weather conditions; so this 3-year average is calculated from the 2012 and 2013 raw counts. The overall growth trend for the past five years has been generally flat, although there is considerable regional variation within their range. The southern sea otter is listed as a federally *threatened* species under the ESA, is designated as a fully protected mammal under California state law, and is considered to be a *strategic stock* and *depleted* under the MMPA (USFWS 2014). The Southern sea otter is expected to be present in the project area during construction.

3.8 WHALES

Although all whales are infrequent visitors within the Level A and Level B zones, the USCG will stop construction activities if any of these individuals enter either of these zones.

Gray Whale. Although gray whales were once found in three populations across the globe, the Atlantic population is believed extinct, and the species is now limited to the Pacific Ocean, where they are divided into eastern and western stocks. Eastern North Pacific gray whales migrate each year along the West Coast of North America. Most whales in the Eastern North Pacific stock feed in the Chukchi, Beaufort, and northwestern Bering seas, except for a group of approximately 200 whales referred to as the "Pacific Coast Feeding Group" (PCFG) that summer and feed along the Pacific coast between Kodiak Island, Alaska, and northern California. The most recent abundance estimate for the

Eastern North Pacific population is from the 2010/2011 southbound survey count and is 20,990 individuals. The 2012 abundance estimate for the range of the PCFG is 209. The population size of this stock has increased over several decades despite an UME in 1999 and 2000, and has remained stable since the mid-1990s. This stock of gray whales was removed from the List of Endangered and Threatened Wildlife in 1994 (NOAA 2015f).

Killer Whale. Killer whales are found in all parts of the oceans, with the most abundant populations occurring in cooler waters off the coast of Antarctica, Norway, and Alaska. There are 8 killer whales stocks occurring within the North Pacific Ocean that are further classified as being either *resident*, *transient*, or *offshore* populations. These populations differ according to genetics, morphology, behavior, and ecology. Three stocks have potential to occur in the project vicinity: the West Coast transient, eastern North Pacific offshore, and the southern resident populations.

The West Coast transient killer whale stock includes killer whales occurring from California to southeastern Alaska. From 1975 to 2012, 521 individual whales have been identified, with 217 part of the "outer coast" subpopulation and 304 belonging to the more well-known "inner coast" population. Based on a 2006 mark-recapture study, the entire West Coast transient population is currently estimated at 243 individuals, although this estimate does not include the "outer coast" subpopulation or whales from California. The difference in these numbers can be attributed to differing sampling methods, geographic range of individual pods, or newly identified individuals. Between the mid-1970s and mid-1990s, the West Coast transient stock increased due to higher birth and survival rates, coupled with an increase of individuals immigrating into the area. This growth overlapped with a decrease in their primary prey, the Pacific harbor seal. Since the mid-1900s, growth of the West Coast transient stock has slowed. This stock is not designated as *depleted* under the MMPA or listed as *threatened* or *endangered* under the ESA (NOAA 2013b). This population has potential to occur in Monterey Bay during the work period.

The eastern North Pacific offshore killer whale stock occurs between California and Alaska. The current population estimate, based on shipboard line-transect surveys conducted between 2005 and 2008, is 240 individuals, with a minimum population of 162 individuals. However, this is a conservative estimate, due to the lower frequency in observations of offshore stock. According to NOAA's *Killer Whale: Eastern North Pacific Offshore Stock Assessment*, there are no data available on the current population trend for the eastern North Pacific offshore stock. They are listed neither as *threatened* or *endangered* under the ESA nor as *depleted* under the MMPA (NOAA 2011b). This population of killer whale has potential to occur in Monterey Bay during the work period.

Resident killer whales that may occur off the coast of California belong to the eastern North Pacific southern resident killer whale population (J, K, and L pods). Although this killer whale population's spring, summer, and fall range typically includes the Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait, they have been sighted as far south as Monterey Bay and central California during winter months. The most recent population count taken in 2014 is 78 whales, an estimate which serves as both a best estimate of abundance and a minimum estimate of abundance. Since the first complete census of this stock in 1974 (71 animals counted), the population number has fluctuated annually. Since the peak census count of 99 individuals in 1995, the population has declined. They were listed as *endangered* under the ESA in 2005, and the stock is considered as a *strategic stock* under the MMPA (NOAA 2015g). This population has a low potential to be present in Monterey Bay or Harbor during the work period.

Humpback Whale. The California/Oregon/Washington stock of humpback whales includes animals that appear to be part of two separate feeding groups, one group in California and Oregon and the other in northern Washington and southern British Columbia. The best estimate of population size for the California and Oregon group is taken as the 2008-2011 Darroch estimate of 1,729 individuals. The best population estimate for the Washington and British Columbia group is 189 individuals, taken from a range of photographic mark-recapture abundance estimates taken in 2005. Combining these abundance estimates gives an estimate of 1,918 whales for the California/Oregon/Washington stock. The current population trend for this stock is a 6 to 7 percent growth rate. The Mexico DPS was listed as threatened and the Central America DPS was listed as endangered in December 2016. The Central America DPS is known to feed along the west coast of the US and has the potential to occur in the vicinity of the project area.

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SECTION 4
TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

4.1 TAKE AUTHORIZATION REQUEST

The USCG requests an authorization from the NMFS and USFWS, Under Section 101 (a)(5)(D) of the MMPA, for incidental take by Level B harassment (as defined by Title 50 Code of Federal Regulations, Part 216.3) of small numbers of marine mammals, specifically California sea lions, Pacific harbor seals, harbor porpoise, Risso's dolphin, bottlenose dolphin, Southern sea otter, gray whales, killer whales, and humpback whales during performance of repairs to the pier at USCG Station Monterey in Monterey Bay. With implementation of the measures outlined in Section 10 of this request, no injury to marine mammals (i.e., Level A harassment) is anticipated. The USCG requests an Incidental Harassment Authorization (IHA) for the incidental take of marine mammals as described in this application. The USCG may request an annual renewal of the IHA if the project is not completed within the authorized year. The USCG is not requesting a multi-year Letter of Authorization (LOA) at this time because the activities described herein are not expected to rise to the level of injury or death, which would require an LOA.

A detailed description of the acoustic exposure assessment methodology used to quantify potential exposures to marine mammals resulting from underwater and airborne noise generated during pile extraction and pile driving can be found in Section 6 of this request. The methodology used generates conservative take estimates because all animals are assumed to be exposed 100 percent of the time. Temporary behavioral responses are expected to occur as a result of the Proposed Action; however, the extent of the response would depend on the species, received level of sound, and distance from the work area.

4.2 METHOD OF TAKE

The Proposed Action has the potential to result in Level B incidental take of marine mammals resulting from underwater and airborne noise disturbance during the removal of existing piles and driving of new piles. Our evaluation assumes underwater noise will encompass all takes and therefore airborne takes are not separated out to avoid double counting species. With implementation of mitigation measures described in Section 10, Level A harassment is not anticipated.

SECTION 5
TAKE ESTIMATES FOR MARINE MAMMALS

This section describes potential impacts and take estimates resulting from noise levels expected to be generated during pile driving and extraction activities.

5.1 APPLICABLE NOISE CRITERIA

In 2010, NMFS established interim thresholds regarding the exposure of marine mammals to high-intensity noise that may be considered take under the MMPA. *Level A harassment* is defined as "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." *Level B harassment* is defined as "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering."

Updated NOAA guidance on assessing the effects of underwater noise on marine mammals for agency impact analysis was finalized in August 2016 (NOAA 2016d). This guidance is primarily related to Level A harassment. Changes from the 2010 interim guidance to the final 2016 guidance include expanding the thresholds to account for factors such as distance, duration, and source. Note that this project had an approved IHA in 2015 using a detailed sound assessment and independent model for both Level A and B effects. We have revised species stock information and associated Level B take using the 2010 interim thresholds and have revised the Level A (exclusion zone) using the updated 2016 noise guidance as shown in Table 5-1.

There are no official thresholds for airborne noise; however, guideline thresholds have been established based on pinniped haul-out behavioral disturbance from airborne construction noise (Washington State Department of Transportation [DOT] 2016). Acoustic criteria for marine mammals are shown in Table 5-1.

Table 5-1. Injury and Behavioral Disruption Thresholds for Airborne and Underwater Noise

Functional Hearing Group	Airborne Marine Construction Criteria (Impact and Vibratory Pile Driving)	Underwater Continuous Noise Criteria (e.g., vibratory pile driving)		Underwater Pulsed Noise Criteria (e.g., impact pile driving)		
	Level B Threshold[1]	Level A Threshold (PTS)	Level B Threshold	Level A Threshold		Level B Threshold
	dB Threshold	dB SEL_{cum}	dB RMS	Peak SPL	dB SEL_{cum}	dB RMS
Low-Frequency Cetaceans (Gray whale, Humpback whale)	N/A	199	120	219	183	160
Mid-Frequency Cetaceans (Risso's dolphin, bottle nose dolphin, killer whale)	N/A	198	120	230	185	160
High-Frequency Cetaceans (Harbor porpoise)	N/A	173	120	202	155	160
Phocid Pinnipeds (Pacific harbor seals)	90	201	120	218	185	160
Otariid Pinnipeds (California sea lions)	100	219	120	232	203	160
Mustelids (Southern sea otter[2])	100	180	120		180	160

[1] The airborne disturbance guideline applies to hauled-out pinnipeds or surfaced southern sea otters.
[2] NMFS does not have specific criteria for Southern sea otters.
Notes:
dB = decibel
μPa = microPascal
RMS = root mean square
PTS = Permanent Threshold Shift PTS

Because species in the vicinity are counted in the take estimates for underwater noise, we are not including "take" as it relates to airborne noise per personal communication with Stephanie Egger (NOAA NMFS May 30, 2017). Based on the proposed construction methods and mitigation measures (e.g. shutting down when individuals enter the exclusion zone), no Level A harassment is anticipated as a result of implementation of the Proposed Action.

5.2 Estimation of Pile Extraction and Driving Sound

Pile installation methods to be used in implementing the Proposed Action have not been confirmed at this time; however, either an impact (i.e., diesel or hydraulic) hammer or vibratory hammer will be used. If a vibratory hammer is used, an impact hammer would still be used to proof load bearing piles. Because installation and extraction methods have not been confirmed, an analysis of both pile driving methods was conducted; however, because take would only be counted once we have used the method of vibratory pile driving as it provides the more conservative method of take.

The following section summarizes the distances to the various sound thresholds that are used in the Area of Influence (AOI) and resulting estimate of potential take of marine mammals.

5.2.1 Underwater Noise from Vibratory Pile Extraction and Driving

Level B analysis:

The NMFS and USFWS typically use the practical spreading model to estimate transmission loss of sound through water. Applying the practical spreading model, the distance to the 120 dB RMS (Level B threshold for marine mammals) would extend miles beyond the source. However, that model does not take into consideration underwater sound barriers that would stop or diffuse sound, such as the Monterey Breakwater, for the proposed project.

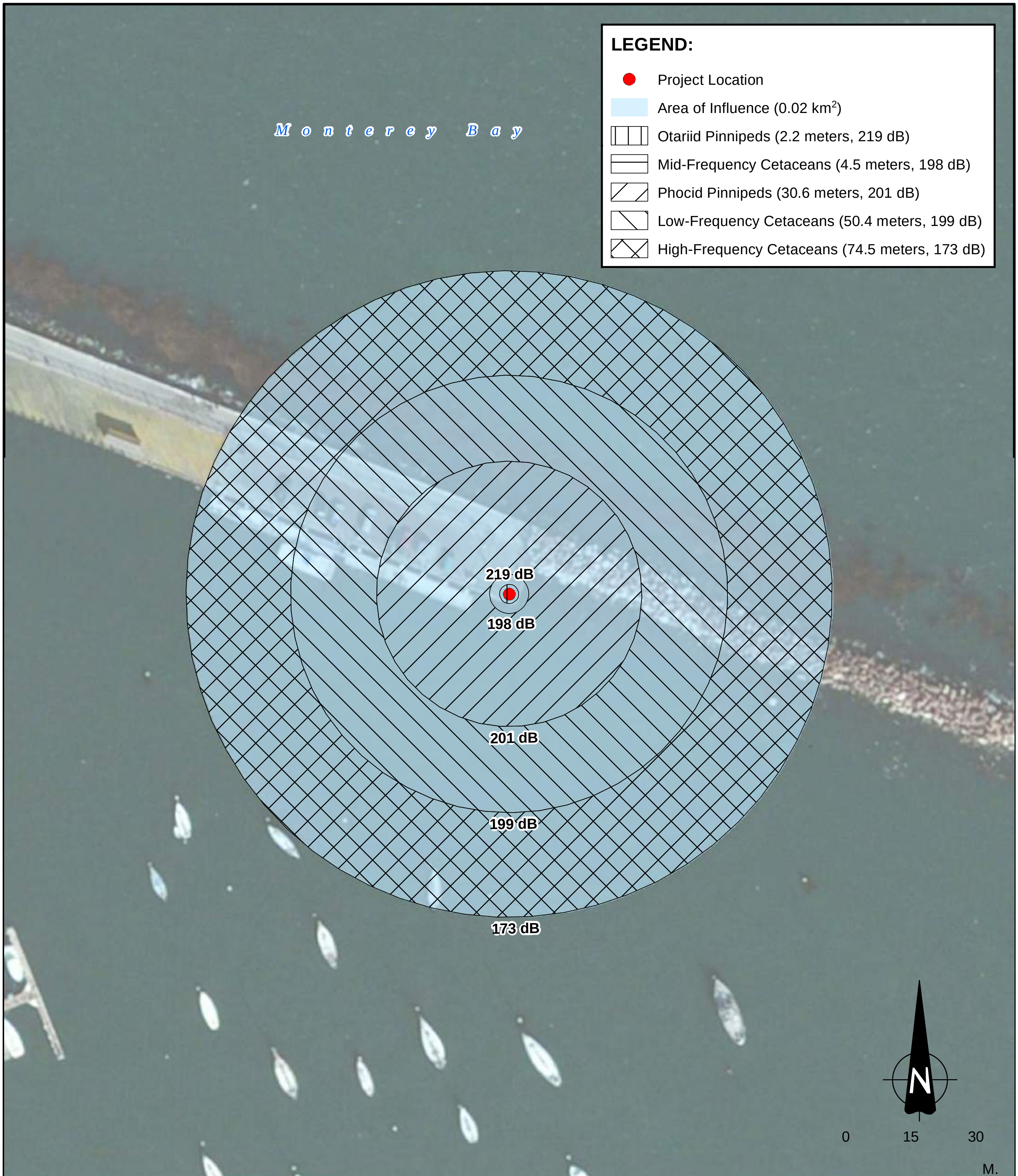
To more accurately estimate the extent of underwater noise, the software package *SoundPlan* was used to simulate the effect of the Monterey Breakwater in reducing underwater sound transmission from the proposed project (Illingworth and Rodkin, Inc. 2012). Table 5-2 shows the results of the modeled underwater noise analysis for where 120 dB RMS (Level B threshold) levels would stop, and Figure 5-1 shows the pattern of sound expected from vibratory pile extraction and pile installation, taking into account shielding from the Monterey Breakwater. From these data, an AOI of approximately 7.3 square kilometers (km^2) was established. The modeled distances shown in the table below are likely an overestimate of the

IHA

Unattenuated Underwater RMS Levels During Vibratory Pile Extraction and Driving

FIGURE 5-1

No warranty is made by the USCG as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.



UNITED STATES COAST GUARD		USCG BASE ALAMEDA MONTEREY, CALIFORNIA	DATE JUNE 2017
			SCALE 1 " = 30 meters
Amec Foster Wheeler Environment & Infrastructure, Inc. 104 West Anapamu Street, Suite 204A Santa Barbara, CA 93101	amec foster wheeler	LEVEL A ISOPLETHS VIBRATORY PILE DRIVING	PROJECT NO. 336010017
			FIGURE 5-2

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Table 5-2. Modeled Extent of Underwater Sound Pressure Levels (SPLs) from Vibratory Pile Extraction and Driving

Modeling Scenario	Distance to 120 dB RMS (Level B Threshold)
Modeled north	2,000 meters
Modeled northeast shoreline	2,400 meters
Modeled east to shoreline	1,800 meters
Modeled south to shoreline	550 meters
Area of Influence	**7.3 km^2**

Notes:
dB = decibel
RMS = root mean square

extent of underwater noise, because the NMFS practical spreading loss assumptions of 15 $\log_{10}$ sound propagation were assumed, and that Monterey Breakwater would reduce noise considerably faster than assumed.

Per the sound assessment completed for the project and included in Appendix A the following assumptions and parameters were used for the analysis: *For vibratory pile installation, it is estimated that it would take approximately 20 minutes (1200 seconds) to vibrate in each pile and between one to two minutes of impact driving of each pile with the impact hammer to proof them. It is also estimated that the pile driving crew could vibrate several piles in one day and complete the impact driving the following day. Approximately 100 blows were assumed for proofing of piles with an impact hammer.*

RMS levels are based on a time-constant of 10 seconds; near-source level of 168 dB RMS at 33 feet (10 meters) level was used to characterize the sound that would be produced from vibratory pile installation. All references to underwater sound are noted as unweighted.

A copy of the completed sound assessment is included as Appendix A.

Level A analysis:

To calculate Level A isopleths, we used the NOAA NMFS 2016 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NOAA 2016d). Specifically, we used the "alternative methodology" presented in Appendix D of the 2016 guidance. The alternative methodology allows for the application of updated acoustic thresholds, using a set of alternative tools including a "user spreadsheet", to assist with incorporation of weighting factor adjustments (WFA) to determine the isopleths for PTS onset. Source level and distance information was referenced using the same soundplan data that was used to determine level B guidance. The sound level (RMS SPL) input used for the calculations was 168, activity duration used was 4 hours, and the distance to source was 10 meters (as indicated in the sound assessment provided in Appendix A). The extent of anticipated Level A injury during vibratory pile extraction and driving is presented in Table 5-3 below. In addition, copies of the spreadsheet and related input factors are included in Appendix B.

Table 5-3. Extent of Anticipated Level A Injury During Vibratory Pile Extraction and Driving

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**50.4**	**4.5**	**74.5**	**30.6**	**2.2**

5.2.2 Underwater Noise from Impact Pile Driving

Level B analysis:

The extent of underwater noise from impact pile driving was predicted using the *SoundPlan* software package as described above for vibratory pile driving. Table 5-4 shows the extent of noise levels for the NMFS marine mammal and fish criteria, assuming the use of noise attenuation (bubble curtain). Figure 5-3 shows the extent of attenuated (use of a bubble curtain) noise levels for impact pile driving out to the NMFS behavioral criterion of 160 dB RMS. The area encompassed by the 160 dB criterion is approximately 0.27 km^2.

Per the sound assessment completed for the project and included in Appendix A the following assumptions and parameters were used for the analysis: *For the scenario that requires mostly impact pile driving, pile installation are estimated to require up to 20 minutes of pile driving. However, there is no reliable estimate of the pile driving time.*

UNITED STATES COAST GUARD	amec foster wheeler	USCG BASE ALAMEDA MONTEREY, CALIFORNIA	DATE JUNE 2017 SCALE 1 " = 120 meters
Amec Foster Wheeler Environment & Infrastructure, Inc. 104 West Anapamu Street, Suite 204A Santa Barbara, CA 93101		ATTENUATED UNDERWATER RMS LEVELS DURING IMPACT PILE DRIVING	PROJECT NO. 336010017 FIGURE 5-3

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K:\USCG - Coast Guard\336010017 Monterey\dwg\Figure 5-3 - Attenuated Underwater RMS Levels.mxd - stephane.descombes - 6/14/2017 - 10:50:06 AM

Table 5-4. Modeled Extent of Underwater SPLs from Impact Pile Driving

Modeling Scenario	Distance to Marine Mammal Criteria RMS (dB re: 1µPa) 160 (Level B Threshold)
Modeled attenuated noise transmission north and northeast (through breakwater)	76 meters
Modeled attenuated noise transmission in all directions (except north and northeast)	465 meters

Notes:
Assumes 10 dB of underwater noise attenuation by using a bubble curtain during pile driving
Distances and method of calculation are presented in Appendix A.
— = Criteria would not be exceeded over any distance
dB = decibel
µPa = microPascal
RMS = root mean square

Assuming a hammer is used that moves the pile at about 30 to 40 blows per minute, up to 20 minutes of impact pile driving would be required for each pile. A full pile driving event was assumed to require 685 pile strikes. The project would install up to 3 piles in one day.

"unattenuated near-*source impact pile driving levels applicable to this project are 208 dB peak, 195 RMS and 175 dB SEL. Note, a substantially higher RMS level of 195 dB was assumed….. Typically, there is an approximately 10 to 15 dB difference in peak and RMS sound pressure levels. Assuming the higher peak pressure of 208 dB, an RMS level of 195 dB would typically occur. To provide a conservative estimate, the higher RMS sound pressure level was assumed for this assessment.*

Level A analysis:

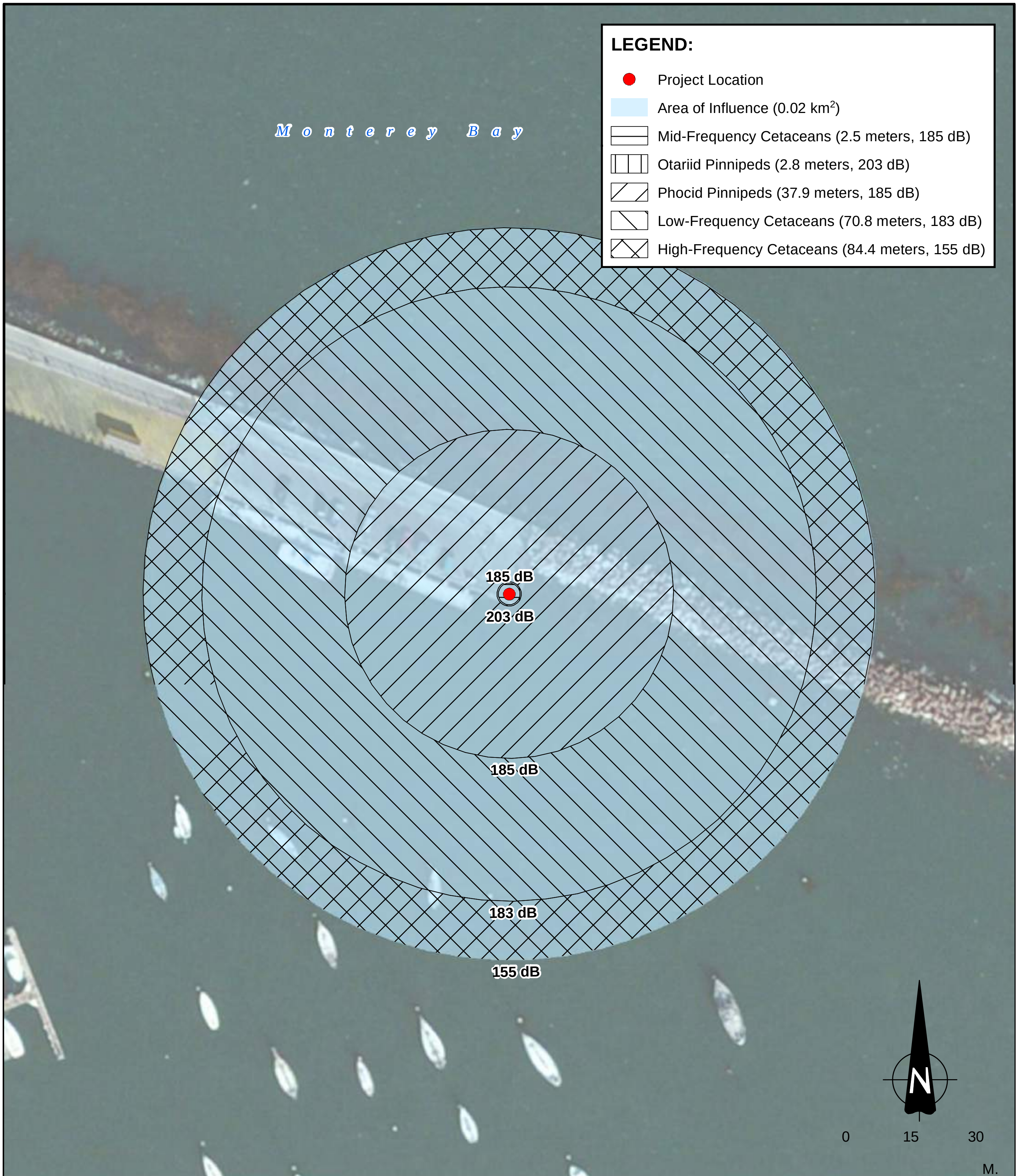
To calculate Level A isopleths for injury, we used the alternative methodology presented in Appendix D of the updated guidance (NOAA 2016d). Specifically, our analysis depends on the "user spreadsheet" to assist with incorporation of WFAs to determine the isopleths for PTS onset. Source level and distance information was referenced using data provided for similar piles and substrate identified in the California Department of Transportation Compendium of Pile Driving Sound Data Report (Caltrans 2007). Referenced data includes a source level (in SEL) of 174 at a distance of 10 meters, an average strike per pile of 30, with a maximum piles driver per day of 5. The potential area within the thresholds for estimated underwater Level A injury from impact pile extraction and driving is presented in Table 5-5.

Table 5-5. Extent of Underwater Level A Injury from Impact Pile Extraction and Driving.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**70.8**	**2.5**	**84.4**	**37.9**	**2.8**

To prevent Level A take, marine mammal observers will be monitoring the exclusion zone for marine mammals. Note that the Level A exclusion zone is slightly larger than the Level B zone; however, to be conservative we have shown Level A and Level B isopleths both at 84.4 meters as we will be shutting down for high frequency cetaceans within that zone. They will alert work crews to the presence of marine mammals in or near the exclusion zones (i.e., area where SELs can exceed the adapted Level A criteria), and advise when to begin or stop work to avoid Level A harassment.

Conservation measures including bubble curtains and cushion pads will be used during construction to reduce noise from impact pile driving. Attenuated noise values shown in Table 5-4 assume that underwater noise could be reduced 10 dB with the use of a properly designed and deployed air bubble curtain attenuation system. Special care will be taken to form a tight seal with the bottom in the uneven substrate characteristic of the project site, to achieve the noise reduction of 10 dB assumed for this analysis. As a result of these measures, as well as others described in Section 10, there will be no Level A take.



UNITED STATES COAST GUARD	amec foster wheeler	USCG BASE ALAMEDA MONTEREY, CALIFORNIA	DATE JUNE 2017
			SCALE 1 " = 30 meters
Amec Foster Wheeler Environment & Infrastructure, Inc. 104 West Anapamu Street, Suite 204A Santa Barbara, CA 93101		LEVEL A ISOPLETHS IMPACT PILE DRIVING	PROJECT NO. 336010017
			FIGURE 5-4

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5.2.3 Airborne Noise

Pile driving generates airborne noise that could potentially result in behavioral disturbance to pinnipeds and sea otters that are either hauled-out or at the water's surface. The practical spreading model was used to determine the extent over which sound levels may result in harassment of marine mammals. A 20 $\log_{10}$ attenuation rate was used to calculate the distances to the various NMFS thresholds.

Airborne noise levels from vibratory and impact driving used in this analysis are based on measurements made during the Navy Test Pile Project in Bangor, Washington (Navy 2012). For vibratory driving, the greatest unweighted maximum noise level (L_{max}) measured was 102 dB, and the average L_{max} was 97 dB at 50 feet or 15 meters. For impact driving, the greatest L_{max} was 112 dB, and the average L_{max} was 103 dB at 50 feet or 15 meters.

Table 5-6 provides distances using L_{max} levels, which should conservatively estimate the distance to the NMFS criterion. Figures 5-5 and 5-6 show the areal extent of these noise levels.

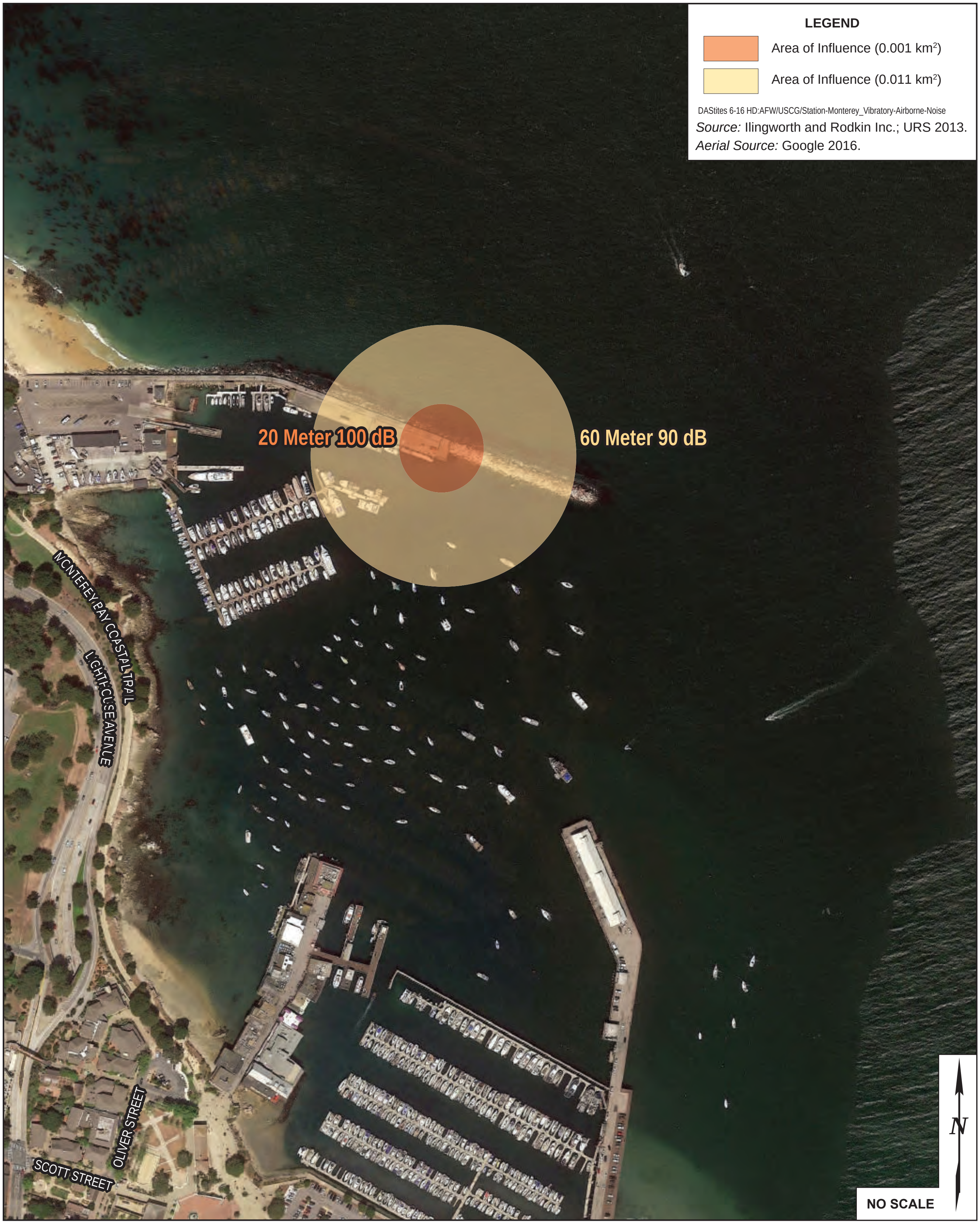
Table 5-6. Modeled Extent of SPLs for Airborne Noise

Threshold	Distance		Area	
	100 dB	90 dB	100 dB	90 dB
Vibratory Extraction and Driving	20 meters	60 meters	0.001 km2	0.011 km2
Impact Driving	60 meters	190 meters	0.011 km2	0.113 km2

Note:
dB = decibel

5.3 DESCRIPTION AND ESTIMATION OF TAKE

The USCG is seeking authorization to expose marine mammals to Level B harassment that may result from pile replacement work associated with the repairs to the USCG pier. The take is expected to have no more than a behavioral effect on individual animals and no effect on the populations of these species. Any effects experienced by individual marine mammals are anticipated to be limited to short-term disturbance of normal behavior, or temporary displacement of animals near the source of the noise.



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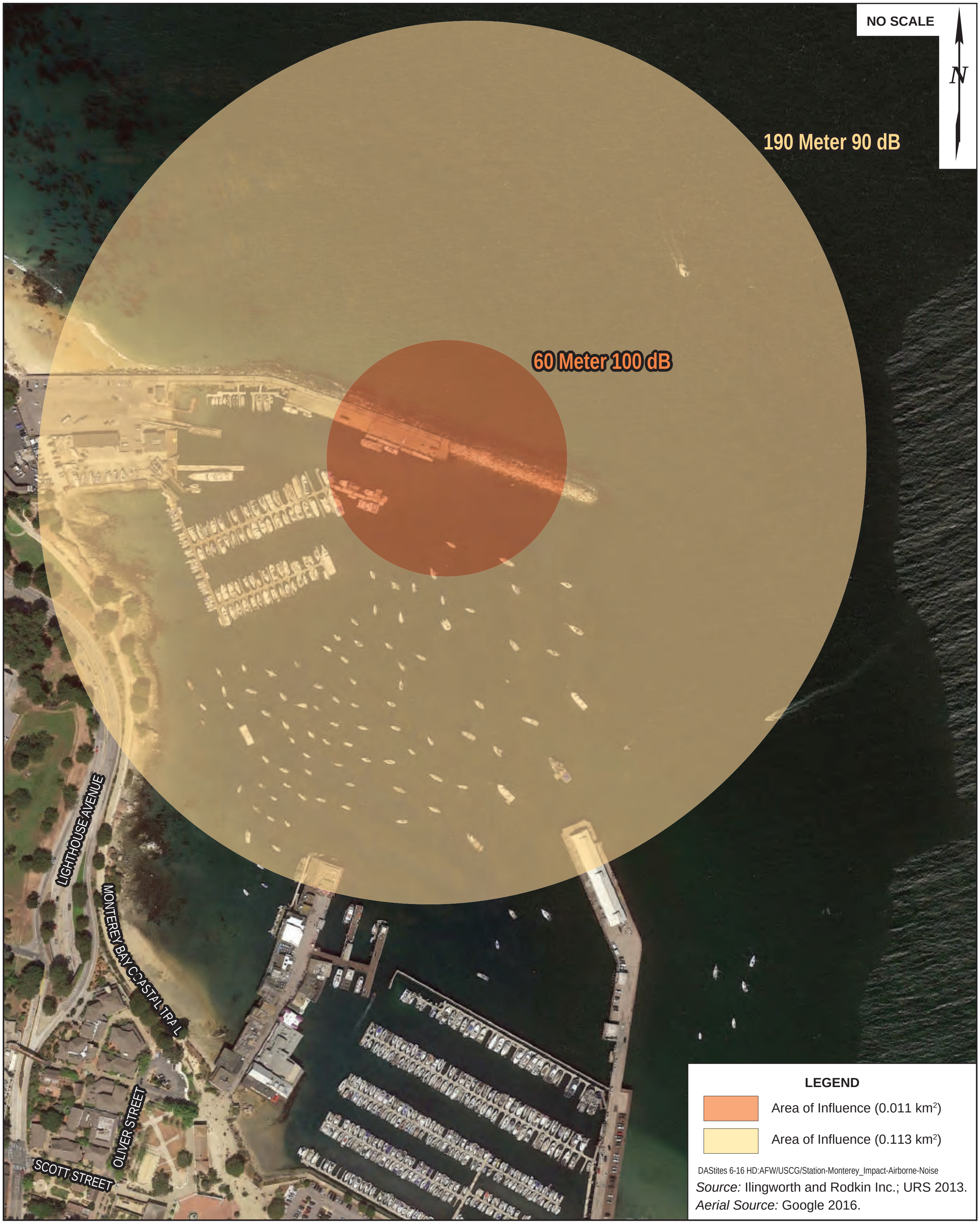
Airborne Noise Exposure Areas During Vibratory Pile Extraction and Driving

FIGURE 5-5

No warranty is made by the USCG as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.



IHA

Airborne Noise Exposure Areas During Impact Pile Driving

FIGURE 5-6

No warranty is made by the USCG as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

Marine mammal monitoring will ensure that no cetaceans or pinnipeds are present in their respective Level A harassment zones during pile driving.

The take analysis presented here relies on the best data currently available for marine mammal populations at the Monterey Breakwater and in the nearby waters of Monterey Bay. The population data used are discussed in each species take calculation subsection below.

Estimated take of each marine mammal species was calculated using the following equation:

Take Estimate = (n * AOI) * 8 days of activity

Where:

n (number of animals per unit area) = The density estimate used for each species. For southern sea otter, the unit of area is linear km of coastline. For all other species, the unit of area is km^2.

Multiplying n * AOI produces an estimate of the abundance of animals that could be present in the area of exposure per day. The final take estimate is rounded up to the next whole number.

Application of the equation above assumes the following:

- All piles to be installed would have a noise disturbance distance equal to the pile that causes the greatest noise disturbance (i.e., the piling furthest from shore, in this case the farthest east pile along Monterey Breakwater);
- An average of 2 or 3 piles will be installed and removed per day; We have assumed 3 piles for our calculations.
- Pile driving would occur over a period of up to 8 days;
- A noise attenuation system such as a bubble curtain and cushion pad would be used during impact pile driving;
- An individual animal can only be taken once per method of installation during a 24-hour period.

The exposure assessment methodology estimates the number of individuals that would potentially be exposed to Type B harassment during pile extraction and driving activities due to noise levels that exceed established NMFS thresholds. Results of the acoustic impact exposure assessments should be regarded as conservative estimates that are strongly influenced by limited biological data, and therefore exposure of harassment to marine mammals presented below is over estimated. Furthermore, the short duration and limited extent of the repairs would limit actual exposures.

5.3.1 California Sea Lion Take

NMFS conducts annual surveys of pinnipeds using aerial photography. Counts of California sea lions hauled-out at the Monterey Breakwater and harbor area were obtained from Mr. Mark Lowry of NMFS (Lowry 2016). Data were available for 18 surveys conducted annually from 1998 to 2013, with the exception of the years 2000 and 2010. The surveys are generally conducted each year in July, though the data included one survey each from June, September, and December 1998, when additional funds were available for surveys.

The numbers of individuals identified each year varied over the course of the surveys, ranging from 1 (1999 and 2013) to 1,124 (December 1998) individuals. The highest number of individuals was recorded during the December 1998 survey, an El Niño year with warmer ocean temperatures in the winter. The December 1998 count was not typical, because many individuals stay north during years with warmer winter ocean temperatures, rather than traveling south to the typically warmer waters of the Channel Islands, where most breeding and pupping occurs (Lowry 2012). In recent years (2012 and 2013) counts have been lower, with 101 individuals identified in 2012 and only one individual identified in 2013. The overall average number of California sea lions identified per survey, for all of the surveys of the Monterey Breakwater combined, was 250 individuals per survey year.

The exposure calculation for take of individual California sea lions at sea is limited to exposure to underwater noise. The calculations below assume an average density of 8.62 individuals/km^2.

The exposure calculation provided below for breakwater animals accounts for the average density of individuals hauled out on the breakwater (250 individuals) as well as animals presumed to be underwater and not counted on any given survey. Per NOAA NMFS we have assumed all individuals will be hauled out over the 9 days and therefore represent a total of 2,000 individuals.

To estimate the densities of California sea lions exposed to airborne harassment, the average annual counts of out-of-water animals was used (i.e., 250 individuals), distributed over the area encompassed by the pier and the exposed rock portion of the Monterey Breakwater. Using the take estimate equation described previously, Table 5-7 presents the number of acoustic harassments that are estimated from vibratory pile driving for underwater noise.

Table 5-7. Number of Potential Exposures of California Sea Lions within the Acoustic Threshold Zone During Vibratory Pile Driving

California Sea Lions	Calculated exposure for underwater noise	
	Level A Threshold (219 dB)	Level B Threshold (120 dB)
Area of Influence	n/a	7.3 km²
Estimated Take	0	504
Estimated take of California sea lions at breakwater haul-out (assumes 250 animals at haulout)	–	2,000

Notes:
dB = decibel
km^2 = square kilometer

5.3.2 Pacific Harbor Seal Take

Pacific harbor seals are much less abundant in the project area than California sea lions, and only two annual surveys conducted since 1998 identified any individuals. The 2004 annual Pinniped survey conducted by NMFS counted 28 Pacific harbor seals in Monterey Harbor in 2004, and 1 in 2005 (Lowry 2012). Pacific harbor seals hauled-out along Cannery Row, north of the Monterey Breakwater, ranged from 1 to 24 in 2002, 2004, and 2009. During repairs on the Pier in 2009, Pacific harbor seals were occasionally observed in the nearby waters, but were never observed to haul-out on the breakwater (Harvey and Hoover 2009).

For purposes of this take estimate, 28 individuals (the most observed during any single survey) were assumed to be in the water at any given time. To conservatively estimate the density of Pacific harbor seals in the AOI, we assumed all 28 individuals are within 5 kilometers (km) of the breakwater (area 78.5 km^2). The calculated density is therefore 0.36/km^2.

Based on the limited available data, it appears that it is rare for Pacific harbor seals to haul-out on the Monterey Breakwater in the immediate vicinity of the project. Therefore, it is assumed that the population of Pacific harbor seals that could potentially be exposed to airborne noise are the same individuals for the in-water calculations, and therefore the same population density and exposure estimates are the same for underwater noise.

Table 5-6 shows the number of acoustic harassments that are estimated from vibratory pile driving for underwater noise.

Table 5-8. Number of Potential Exposures of Pacific Harbor Seals within Acoustic Threshold Zones During Vibratory Pile Driving

Pacific Harbor Seals (assume density of 0.36/km^2)	Calculated exposure for underwater noise	
	Level A Threshold (201 dB)	Level B Threshold (120 dB)
Area of Influence	n/a	7.3 km^2
Estimated take	0	21

Notes:
dB = decibel
km^2 = square kilometer

5.3.3 Harbor Porpoise Take

A conservative estimate of the density of harbor porpoise in the southern portion of Monterey Bay nearshore is approximately 2.321 per km^2 (Forney et al. 2014). Exposures were calculated using the equation presented above. Table 5-9 shows the number of acoustic harassments that are estimated from underwater noise generated by vibratory pile driving during construction.

Table 5-9. Number of Potential Exposures of Harbor Porpoise within Acoustic Threshold Zones During Vibratory Pile Driving

Harbor Porpoise (estimated density 2.32 per km^2)	Calculated exposure for underwater noise	
	Level A Threshold (173 dB)	Level B Threshold (120 dB)
Area of Influence	n/a	7.3 km^2
Estimated Take	0	3

Note:
dB = decibel
km^2 = square kilometer

In order to minimize the number of potential exposures, marine mammal observers will be monitoring the exclusion zone for cetaceans. They will alert work crews to the presence harbor porpoise and other marine mammals in or near the exclusion zones (i.e., area where SPLs can exceed the adapted Level A criteria), and advise when to begin or stop work to avoid Level A harassment. These impact minimization measures will reduce potential takes by behavioral disturbance (Level B harassment) to the extent that the take would have a negligible short-term effect on individual harbor porpoises, and would not result in population-level impacts.

5.3.4 Risso's Dolphin Take

According to the MBNMS, Risso's dolphins are relatively common off California, and typically occur in pods of 10-30 individuals. The most recent publicly available stock assessment of Risso's dolphin was published in 2010 (NOAA 2011a). The stock assessment estimated that for the period of 2005-2008, the geometric mean of the population for California, Oregon, and Washington waters was 6,272. Assuming that the length of shoreline extending throughout the Washington, Oregon, and California coast is 2,080 km, and the surveys extended 556 km from shore, the average density of Risso's dolphins is approximately 0.005 per km^2. This low density would provide a vanishingly small take estimate of Risso's dolphin. As stated above, Risso's dolphins typically occur in pods of 10-30 animals, and therefore are not likely to be observed or "taken" as individual animals. As a result, the take estimate for Risso's dolphin for the purpose of this document is a single occurrence of a small pod of 10 individuals.

Disturbances from underwater noise on Risso's dolphin are not expected to be significant. Marine mammal monitors will alert work crews to the presence of marine mammals in or near the exclusion zones. Level B harassment would have a negligible short-term effect on individual Risso's dolphins and would not result in population-level impacts.

5.3.5 Bottlenose Dolphin Take

Bottlenose dolphins are relatively common residents in Monterey Bay, frequently spotted within 1 km of shore along sandy beaches, travelling just outside of the breakers (MBNMS 2016). Abundance and densities of cetaceans in the California Current ecosystem were conducted from 1991 to 2005 (Barlow, Forney 2007). The results of the surveys indicate that bottlenose dolphin population density throughout the entire west coast shoreline is 1.78 individuals per 100 km^2. During the same survey, the mean group size for bottlenose dolphins observed in Central California was four individuals. Other, more recent data suggest that densities may be up to 0.04 per km^2 (Weller 2016).

Even using the higher density estimate, using a density-based approach for estimating take results in very low numbers (<1 over the entire period of construction). Rather than using density calculations to estimate take, the estimate of take for the purpose of this document would be a small pod of 10 bottlenose dolphins. Again, the level of take associated with Level B harassment would have a negligible short-term effect on individual bottlenose dolphins and would not result in population-level impacts.

5.3.6 Killer Whale Take

Killer whales (both West Coast transients and Eastern North Pacific offshore stocks) visit the MBNMS on an intermittent and unpredictable basis. Killer whales have been seen attacking other marine mammals such as gray whales and California sea lions which are their primary prey in the sanctuary. Killer whales have been observed by local kayakers in recent years, but it is unknown from which stock they belong.

Due to the low frequency and unpredictability of killer whales entering the AOI, the application of a density equation is not reasonable for predicting take. It is not unusual for killer whales to enter Monterey Bay, typically in groups of 3 to 8 at a time (Guzman 2016). To be conservative, the take estimate for this assessment is based on the largest of the typical group size, 8 animals.

As with other species described above, potential takes by behavioral disturbance (Level B harassment) would have a negligible short-term effect on individual whales, and would not result in population-level impacts.

5.3.7 Gray Whale Take

As described above, the occurrence of gray whales would be extremely rare near shore in the project area. The NOAA National Center for Coastal Ocean Science (NCCOS) reported densities of gray whales at 0.1 to 0.5 per km^2 (NCCOS 2007); however, it is unclear how applicable these data are for the very near-shore environment of the project area. Gray whales would be more likely to encroach on the project area during the spring migration north, when they tend to stay closer to shore than during the winter southern migration. It is highly unlikely that take of gray whales would occur by impact driving because there are no reported sightings of gray whales actually entering the Monterey Harbor area. During vibratory driving, the 120 dB contour (criteria for continuous noise) extends farther offshore to the north of the Monterey Breakwater. If there is take of whales by harassment, it is more likely to be during vibratory driving activities.

As with other species described above, potential takes by behavioral disturbance (Level B harassment) would have a negligible short-term effect on individual whales, and would not result in population-level impacts.

5.3.8 Humpback Whale Take

Humpback whales are typically found further offshore than gray whales, and therefore would not be affected by a nearshore pile driving, but since 2014 higher numbers of humpback whales have been observed in and near Monterey Bay by whale-watching vessels. Because conservation measures include a complete shutdown if any humpback whale is observed, we anticipate no take of humpback whales.

As with other species described above, potential takes by behavioral disturbance (Level B harassment) would have a negligible short-term effect on individual whales, and would not result in population-level impacts.

5.3.9 Southern Sea Otter Take

Southern sea otter Census data for 2012 indicate that there are approximately eight southern sea otters per kilometer of coast line within Monterey Harbor and nearby shoreline areas (U.S. Geological Survey [USGS] 2015). At this density, we expect approximately 8 southern sea otters within Monterey Harbor and approximately 40 to 48 throughout the entire AOI for vibratory pile driving.

Table 5-10 depicts the estimated take for Southern sea otters as a result of underwater noise generated by vibratory pile driving during construction.

Table 5-10. Number of Potential Exposures of Southern Sea Otter within Various Acoustic Threshold Zones

Density of Southern Sea Otter	Underwater			Airborne	
	Impact Level A Threshold	Impact Level B Threshold (160 dB)	Vibratory Level B Threshold (120 dB)	Impact Level B Threshold (100 dB)	Vibratory Level B Threshold (100 dB)
At-sea underwater: 8 per km of coastline	0	36	384	–	–
At-sea above water: 8 per km of coastline	–	–	–	8	4

Notes:
– = Not Applicable
dB = decibel
km = linear kilometer

Southern sea otters that are taken could exhibit behavioral reactions. Marine mammal observers will alert work crews to the presence of southern sea otters in or near the exclusion zone (i.e., area where SPLs can exceed the adapted Level A criteria for pinnipeds), and advise when to begin or stop work to reduce the potential for acoustic harassment. Outside of the exclusion zone, southern sea otters maybe exposed to underwater noise that result in behavioral effects, such as startling or the cessation of feeding (Level B harassment). Based on the exposure analysis, southern sea otters are anticipated to experience airborne SPLs that would qualify as harassment, and individuals that are rafting or at the surface may exhibit behavioral reactions to the airborne noise. This harassment would have a negligible short-term effect on individual southern sea otters, and would not result in population-level impacts.

5.3.10 Summary

Based on the modeling results presented above, the total number of takes that the USCG is requesting for the 6 marine mammal species that may occur in the project area during construction is presented below in Table 5-11. These estimates are conservative to reflect the presence of a substantial haul-out site within the work area.

Table 5-11. Summary of Potential Take for All Species

Species	Vibratory Driving	
	Level B Underwater	Total Estimated Take
California sea lion	1,504	1,504
Pacific harbor seal	21	21
Harbor porpoise	3	3
Risso's dolphin	10	10
Bottlenose dolphin	10	10
Gray whale	4	4
Humpback whale	6	6
Killer whale	8	8
Southern sea otter	384	388

Marine mammal observers will be monitoring an exclusion zone for the presence of marine mammals. They will alert work crews to the presence of marine mammals in or near the exclusion zone (i.e., area where noise pressure levels can exceed Level A criteria) and advise when to begin or stop work to reduce the potential for acoustic harassment.

Based on the exposure analysis, the marine mammal species described above are anticipated to experience underwater noise pressure levels that would qualify as Level B harassment, and individuals that are hauled-out may exhibit behavioral reactions to the airborne noise. Potential take from behavioral disturbance (Level B harassment) would have a negligible short-term effect on individuals, and would not result in population-level impacts.

SECTION 6
ANTICIPATED IMPACT OF THE ACTIVITY

6.1 EFFECTS OF UNDERWATER NOISE ON MARINE MAMMALS

Pile driving may result in either physiological or behavioral effects on marine mammals including masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment, or nonauditory physical effects such as damage to other organs (Richardson et al. 1995). In assessing the potential effects of noise, Richardson et al. (1995) has suggested criteria for evaluating different zones of these effects. These zones are summarized as follows:

- **The zone of hearing loss, discomfort, or injury**: Direct effects that result in discomfort or tissue damage to auditory or other systems including a temporary threshold shift, a temporary loss in hearing, a permanent threshold shift and a loss in hearing at specific frequencies or deafness.
- **The zone of masking:** Where noise may interfere with the detection of other sounds, including communication calls and prey sounds. T he applicable criteria for the zone where this effect occurs are 160 dB for impact noise and 120 dB for continuous noise.
- **The zone of responsiveness**: The area within which marine mammals change their behavior. Temporary behavioral effects may not indicate long lasting consequence for exposed individuals are typically considered Level B harassment (160 dB for impact noise and 120 dB for continuous noise) (Richardson et al. 1995; Southall et al. 2007).
- **The zone of audibility** is the area in which the marine mammal may hear the noise. Marine mammals as a group have functional hearing ranges of 10 hertz (Hz) to 180 kilohertz (kHz), with best thresholds near 40 dB (Southall et al. 2007).

No physiological damages are expected from pile driving operations occurring during the pier repairs. Impact and vibratory pile driving can produce noise levels in excess of the Level A criteria; however, USCG will implement measures (Section 10) that will greatly reduce the chance that a marine mammal may be exposed to sound pressure levels that could cause physical harm. As described previously and detailed in Section 10, when impact pile driving equipment is employed, a noise attenuation system (i.e., bubble curtains and cushion pads) would be used to reduce sound pressure levels and a marine mammal monitoring program would be implemented.

6.2 Expected Responses to Pile Extraction and Driving

The response of marine mammals to pile replacement depends largely on the change between ambient background noise and the construction-related noise. The background noise at Monterey Harbor is relatively high due to boat traffic, foot traffic, noise from Station Monterey, and other boats. Therefore, marine mammals that frequent the area (pinnipeds in particular) are habituated to the background noise, and may be less affected by construction-related noise.

With any of the pile driving options, the greatest potential for disturbance to non-resident marine mammals is at the onset of activities, resulting in temporary, short-term changes in typical behavior and/or avoidance of the affected area. Potential behavioral changes may include noticeable startle response, avoidance of the area, increased swimming speed, and increased surface time. Pinnipeds may increase their time hauled out on land to avoid in-water disturbance. Because pile replacement work would occur for a few hours a day over a relatively short period of time, it is unlikely to result in permanent displacement of animals.

6.3 Effects of Airborne Noise on Marine Mammals

Marine mammals that occur in the project area would be exposed to airborne noise associated with pile replacement work that has the potential to cause harassment, depending on their distance from pile extraction and driving activities. Airborne noise is most likely to affect marine mammals hauled out on the adjacent jetty (California sea lions) and Southern sea otters that are at the surface during pile driving. Airborne noise would likely cause behavioral responses similar to those discussed above in relation to underwater noise. For example, the noise generated could cause hauled-out pinnipeds to exhibit changes in their normal behavior, such as causing them to temporarily abandon their habitat and move farther from the noise source.

However, due to the high levels of background noise in Monterey Harbor, increased sound levels that might flush Pinnipeds in areas of low disturbance may not elicit a response in Monterey Harbor. In 2004, construction activities on the pier generated noise from drilling and coring equipment. Disturbance to hauled-out California sea lions was minimal and included small behavioral responses such as barking and head turning. Construction noise did not cause any animals to flush (Phillips and Harvey 2004).

6.4 EFFECTS OF HUMAN DISTURBANCE ON MARINE MAMMALS

As described previously, the breakwater experiences moderate to heavy foot traffic from fishermen and tourists, and therefore, the California sea lions which use the breakwater are habituated to human activity. To avoid potential injury to both workers and/or California sea lions, there may be times when it becomes necessary to deter hauled-out animals to safely gain access to the work site. Because the animals who routinely use the jetty as a haul out site are habituated to human disturbance and noise associated with marina activities, use of a noise deterrent is not recommended. Instead, the use of non-lethal, physical deterrence are suggested, such as marine hose or sprayer aimed at the rump or chest of animals that must be deterred. Such an action would be allowable under Section 109 of the MMPA, which permits federal, state, and local officials to take marine mammals in the course of official duties.

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SECTION 7
ANTICIPATED IMPACTS ON SUBSISTENCE USES

There are no relevant subsistence uses of marine mammals implicated by this action. No subsistence uses of marine mammals occur within Monterey Bay.

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SECTION 8
ANTICIPATED IMPACTS ON HABITAT

No permanent long-term effects on marine habitat are proposed or are anticipated to result from project implementation. Specifically, implementation of the Proposed Action would not increase the pier's existing footprint and no new structures would be installed that would result in the loss of additional habitat.

Short-term changes to the marine environment and marine mammal habitat may occur during construction. Construction may result in a short-term loss of foraging habitat. Just as marine mammals may be disturbed by underwater noise as described throughout this document, acoustic energy created during pile replacement work would have the potential to disturb forage fish within the vicinity of the pile replacement work. As a result, the affected area could temporarily lose foraging value to marine mammals. Hastings and Popper (2005) identified several studies that suggest fish will relocate to avoid areas of damaging noise energy. Therefore, if fish leave the area of disturbance, pinniped foraging habitat may have temporarily decreased foraging value when piles are driven using impact hammering. The duration of fish avoidance of this area after pile driving stops is unknown. However, the affected area represents an extremely small portion of the total area within foraging range of marine mammals that may be present in the project area.

Monterey Bay is classified as Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act. Monterey Bay is classified as an EFH for 118 species of commercially important fish, 30 of which have potential to occur within the project area. In addition to EFH designations, portions of the Monterey Bay are designated as a Habitat Area of Particular Concern (HAPC) for various fish species within the Pacific Groundfish, Pacific Coast Salmon, Highly Migratory Species, and Coastal Pelagic Fisheries management plans. These HAPC areas include kelp forest and rocky reef habitats, both of which occur in and adjacent to the Project Area. Given the short daily duration of increased underwater and airborne noise levels associated with the project, the relatively small areas being affected, and the impact avoidance and minimization measures (Section 10), the proposed project is not likely to have a permanent, adverse effect on EFH.

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SECTION 9
ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

The Proposed Action's activities are not expected to result in any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or populations. Foraging and dispersal habitat for marine mammals will be temporarily modified by disturbance from increased airborne and underwater noise levels during pile extraction and driving. As described in Section 9, this modification is expected to have no impact on the ability of marine mammals to disperse and forage in undisturbed areas within their foraging range. There would be no increase in permanent habitat loss as a result of the project.

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SECTION 10
MITIGATION MEASURES

Mitigation measures to avoid Level A (injury) harassment and reduce the potential effects from Level B (disturbance) harassment to marine mammals during pile-extraction and pile-driving activities include:

1. Noise Attenuation

- Noise attenuation systems (i.e., bubble curtains and cushion pads) will be used during all impact pile driving to interrupt the acoustic pressure and reduce the impact on marine mammals. By reducing underwater sound pressure levels at the source, bubble curtains would reduce the area over which both Level A and B harassment would occur, thereby potentially reducing the numbers of marine mammals affected.
- Pre-drilling would be performed and would be discontinued when the pile tip is approximately 5 feet above the required pile tip elevation. Pre-drilling is a method that starts the "hole" for the new pile; the pile is inserted after the hole has been pre-drilled which creates less friction and overall noise and turbidity during installation. Pre-drilling also is beneficial for overall pile stability as it reduces the stress and therefore chance of breakage or damage to the pile during installation.
- Because the existing conditions include sloped topography and riprap, care would be taken when placing the bubble curtain to ensure a good seal is formed.

2. Exclusion Zone

- As discussed in Section 6, various AOIs were identified that would experience noise levels in excess of the Level A criteria for marine mammals. Because of this, the establishment of exclusion zones around each pile will be implemented to prevent Level A harassment to individual species. The exclusion zone includes all areas where underwater sound pressure levels are expected to reach or exceed the Level A harassment criteria for marine mammals. To be conservative we have used the isopleths for impact pile driving which extend the farthest out. These correspond to the following distances:

  - 2.5 meters for the Risso's dolphin, bottlenose dolphin, and killer whale (203 dB)
  - 2.8 meters for the California sea lion (185 dB)
  - 37.9 meters for the harbors seal (185 dB)
  - 70.8 meters for the gray whale and humpback whale (183 dB)
  - 84.4 meters for the harbor porpoise (155 dB)
- To provide a margin of safety, a provisional, conservative exclusion zone will be established during initial pile extraction and driving efforts, while hydroacoustic measurements are made to establish actual field conditions. These exclusion zones will be adjusted once field conditions have been established through hydroacoustic monitoring.

3. Visual Monitoring for Marine Mammals

- The exclusion zone will be monitored for 30 minutes prior to any pile extraction and driving activities to ensure that the area is clear of any marine mammals. If an individual is observed, pile extraction or driving will not commence until the individual has left the exclusion zone for a minimum of a 15-minute period (pinnipeds and small cetaceans) or a 30-minute period (large cetaceans).
- If a marine mammal enters the exclusion zone during pile replacement work, activity will stop until the individual leaves the exclusion zone. Work would not commence for a period of 15-minutes (pinnipeds and small cetaceans) or a 30-minutes period (large cetaceans) after they have left the exclusion zone.
- Monitoring will be conducted by qualified observers familiar with marine mammal species and their behavior. The observer will monitor the exclusion zone from the most practicable vantage point possible (i.e., the pier itself, the breakwater, adjacent boat docks in the harbor, or a boat) to determine whether marine mammals enter the exclusion zone.
- If a species is observed within the level A or B zones, that has not been included in this IHA request, work would immediately cease and delay procedures including a 30-minute wait period would be implemented.
- If a humpback whale is observed within the Level A or Level B zones, work will cease until they leave these zones. Work would not commence until 30-minutes after the last sighting within these zones.

4. Acoustic Monitoring

   - Hydroacoustic monitoring will be conducted during pile driving using the 2012 guidance.

5. Daylight Construction Period

   - Work would occur only during daylight hours.

6. Soft Start (for impact pile driving only)

   - A "soft-start" technique is intended to allow marine mammals to vacate the area before the pile driver reaches full power. An initial set of three strikes would be made by the hammer at 40-percent energy, followed by a 1-minute waiting period, then two subsequent three-strike sets before initiating continuous driving.

7. Safe Access to Work Zone

   - Should any serious injury or mortality to marine mammals result during the course of the proposed activity, the USCG will suspend operations and will immediately contact NMFS. If sea otters are injured during implementation of the project, the USCG will suspend operations and immediately contact the Monterey Bay Aquarium's sea otter 24-hour emergency line.

10.1 MITIGATION EFFECTIVENESS

With implementation of the above mitigation measures, marine mammals will be protected from Level A harassment and potential behavioral effects classified as Level B harassment will be reduced; however, if mitigation is not conducted properly the potential for effect increases. Measures such as visual observations and hydroacoustic monitoring are being implemented to ensure that mitigation measures are effective. Biologists and hydroacoustic monitors will have the required qualifications to conduct respective monitoring. Monitors will be required to check in frequently to ensure mitigation measures are working. For example, visual monitors will monitor the exclusion zone for marine mammals and will stop work if marine mammals enter exclusion zone. Additionally, monitors will ensure the appropriate exclusion zone is placed for protection of

Level A harassment. If hydroacoustic monitoring indicates that mitigation measures are not reducing sound to appropriate levels, monitors will work with the construction crew to adjust measures and/or they will expand the exclusion zone as needed for the protection of marine mammals.

SECTION 11
ARCTIC PLAN OF COOPERATION

Not applicable. The proposed activity would take place in Monterey Bay and no activities would occur in or near a traditional Arctic subsistence hunting area.

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SECTION 12
MONITORING AND REPORTING

The USCG prepared two monitoring plans – an Acoustic Monitoring Plan and a Marine Mammal Monitoring Plan – that will be implemented prior to and during pile replacement activities. Both plans will provide means and methods for ensuring no lethal take, that behavioral take is kept to a minimum, and that activities are documented.

The Acoustic Monitoring Plan was developed in conjunction with NMFS and USFWS. Key elements of the plan include:

- Using a qualified hydroacoustic monitor during pile extraction and driving
- Monitoring timing requirements
- Reference point locations for monitoring
- Details regarding acoustic thresholds for marine mammal exclusion zones
- Plans to adjust exclusion zones based on in situ acoustic monitoring to maintain a safe zone for marine mammals during pile replacement activities

The USCG has prepared a Marine Mammal Monitoring Plan for the proposed project that will be revised in coordination with NMFS and USFWS during the permitting process, as needed. Key elements of the marine mammal monitoring plan include:

- Biological monitoring will be performed by a trained observer in marine mammal identification and behaviors
- Biological monitoring would occur a minimum of 1 day during the week before the Proposed Action's start date, to establish baseline observations
- Observation would be conducted for 30 minutes prior to, continuously during, and for 30 minutes after pile driving and extraction activities. Observations will be conducted using high-quality binoculars as necessary (e.g., Zeiss, 10 x 42 power)
- Data collection will consist of a count of all pinnipeds, mustelidae, and cetaceans by species, a description of behavior (if possible), location, direction of movement, time that pile replacement work begins and ends, any observed behavior changes, and time of the observation.

Environmental conditions such as weather, visibility, temperature, tide level, current and sea state would also be recorded on a daily observation sheet

- Biological monitoring would occur from monitoring locations that allow full observation of the AOI, including USCG pier and Monterey Breakwater, adjacent docks within the harbor or watercraft, to maintain an excellent view of the exclusion zone and adjacent areas during the survey period. Monitors would be equipped with radios or cellular telephones for maintaining contact with work crews
- During pile extraction and driving, the underwater exclusion zone will be monitored for 30 minutes prior to commencing work. If marine mammals are within the exclusion zone, the start of extraction or driving will be delayed until no animals are sighted within the zone for a minimum of 15-minutes (pinnipeds and small cetaceans) or 30-minutes (large cetaceans)
- Daily observation sheets will be compiled on a weekly basis and submitted with a weekly monitoring report that summarize the monitoring results, construction activities, and environmental conditions would be submitted to NMFS and USFWS
- A final report would be submitted to NMFS and USFWS within 90 days after completion of the proposed project.

SECTION 13
SUGGESTED MEANS OF COORDINATION

Construction activities will be conducted in accordance with federal, state and local regulations and the minimization measures proposed in Section 10 to protect marine mammals. In addition, the USCG will coordinate all activities with the relevant federal and state agencies including, but are not limited to: NMFS, USFWS, United States Army Corps of Engineers, and California Department of Fish and Wildlife.

Further marine mammal and acoustic monitoring reports will be developed in coordination with USFWS and NMFS. The USCG will share field data and behavioral observations on marine mammals that occur in the project area. Results of each monitoring effort will be provided to NMFS and USFWS in a summary report at the conclusion of monitoring. This information could be made available to Federal, State and local resource agencies, scientists and other interested parties upon written request to NMFS or USFWS.

In addition, NOAA research scientists have expressed interest in collecting data to further characterize the behavioral response of harbor porpoises during pile driving activities. The proposed USCG pier repair project offers a unique opportunity to conduct a study of the effect of pile-driving on harbor porpoises off the U.S. coast. This would fill an important knowledge gap, as most previous studies of this type have been conducted on harbor porpoises in Europe. Harbor porpoises are particularly sensitive to acoustic disturbance, and harm can result either from exposure to sound or from secondary effects of displacement (e.g., reduced foraging success, stress, exposure to other threats). The location of this project along the coast of Monterey Bay would allow a small-scale study to monitor porpoise distribution and abundance before, during, and after the pile-driving activities, using a network of passive acoustic instruments located at varying distances, ideally combined with periodic aerial surveys. The acoustic moorings would be deployed a few months before construction begins to provide a baseline of porpoise distribution and abundance. Moorings would remain in place throughout the construction phase and for a few months after project completion, to examine potential changes in porpoise distribution and habitat use through time. The aerial surveys would provide additional spatial snapshots of porpoise distribution at key time periods. NMFS Southwest Fisheries Science Center has relevant expertise and some of the needed equipment to perform such a study if funding is made available. The USCG will provide notification to allow NOAA research scientists the opportunity to collect data during construction.

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Appendix A

Final Analysis of Underwater and Airborne Sound Levels for Waterfront Repairs at United States Coast Guard Station Monterey, Monterey, California

Final Analysis of Underwater and Airborne Sound Levels for Waterfront Repairs at United States Coast Guard Station Monterey Monterey, California

November 8, 2012

Prepared for

United States Coast Guard
Civil Engineering Unit Oakland
Oakland, California

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Project No: 12-113

INTRODUCTION

This study is an assessment of potential sound levels generated by planned pile driving activities involved with the waterfront repairs at the United States Coast Guard (USCG) Station Monterey, in Monterey, California. The USCG proposes to remove and replace the 17 piles supporting the pier; replace the existing potable water line; and improve associated structures to maintain the structural integrity of the pier and potable water line. The purpose of the project is to provide repairs and maintenance of these structures to support the operational requirements of Station Monterey, as well as a National Oceanic and Atmospheric Administration (NOAA) boat, which also uses these facilities.

The proposed project would involve removing the existing timber deck, timber stringers, steel pile caps, steel support beams, and hardware to access the 17 timber piles. The timber piles would then be removed through use of a vibratory extractor. Each timber pile would be replaced with a minimum 14-inch-diameter (up to a maximum of 18-inch-diameter) steel-pipe pile that would be positioned and installed in the footprint of the extracted timber pile. The majority of the pile driving would be conducted with a vibratory hammer, and an impact hammer would be used for proofing the piles. The new steel-pipe piles would not be filled with concrete. Other material and hardware removed to conduct the pile replacement would be replaced with in-kind materials. This project is proposed for construction in the 2013 fiscal year.

This report includes the prediction of underwater and airborne sound levels calculated based on the results of measurements for similar projects. Predicted underwater sound levels are compared against interim thresholds that have been accepted by the Federal Highway Administration (FHWA), Caltrans, and NOAA National Marine Fisheries Service (NMFS). These thresholds are discussed in this report.

Pile driving will produce underwater and airborne noise in and around Monterey Bay. Most of the pile driving activities will be in water about 30 feet deep or less that is adjacent to the jetty.

There is no way to accurately predict underwater sound levels from these activities, other than to rely on acoustic data measured from previous projects. Available underwater sound data for projects involving the installation of similar piles were reviewed. The sound levels for proposed pile driving activities were estimated using these data combined with an understanding of how and where these activities would occur. These predictions are essentially a best estimate based on empirical data and engineering judgment, but by their very nature contain a degree of uncertainty. The duration of driving for each pile installation and number of piles strikes was also estimated as part of the noise prediction process, based on available data from similar projects and engineering estimates. The availability of data for this type of environment (i.e. fairly deep open water) is limited.

Pile driving also causes elevated airborne sound levels, which usually cause annoyance to humans nearby. There is concern that these sound levels may affect marine mammals in the area. This study also reports airborne sounds associated with pile driving, based on measurements of similar pile driving activities.

UNDERWATER SOUNDS FROM PILE DRIVING

Fundamentals of Underwater Noise

Sound is typically described by the *pitch* and loudness. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. *Loudness* is intensity of sound waves combined with the reception characteristics of the auditory system. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe sound. *A decibel (dB)* is a unit of measurement describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. For underwater sounds, a reference pressure of 1 micro pascal (μPa) is commonly used to describe sounds in terms of decibels. Therefore, 0 dB on the decibel scale would be a measure of sound pressure of 1 μPa. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc.

When a pile driving hammer strikes a pile a pulse is created that propagates through the pile and radiates sound into the water, the ground substrate, and the air. Sound pressure pulse as a function of time is referred to as the waveform. In terms of acoustics, these sounds are described by the peak pressure, the root-mean-square pressure (RMS), and the sound exposure level (SEL). The peak pressure is the highest absolute value of the measured waveform, and can be a negative or positive pressure peak. For pile driving pulses, RMS level is determined by analyzing the waveform and computing the average of the squared pressures over the time that comprise that portion of the waveform containing the vast majority of the sound energy.[1] The pulse RMS has been approximated in the field for pile driving sounds by measuring the signal with a precision sound level meter set to the "impulse" RMS setting and is typically used to assess impacts to marine mammals. Another measure of the pressure waveform that can be used to describe the pulse is the sound energy itself. The total sound energy in the pulse is referred to in many ways, such as the "total energy flux,"[2] The "total energy flux" is equivalent to the un-weighted SEL for a plane wave propagating in a free field, a common unit of sound energy used in airborne acoustics to describe short-duration events referred to as dB re 1μPa^2-sec. Peak pressures and RMS sound pressure levels are expressed in dB re 1 μPa. The total sound energy in an impulse accumulates over the duration of that pulse. Figure 1 illustrates the descriptors used to describe the acoustical characteristics of an underwater pile driving pulse. Table 1 includes the definitions of terms commonly used to describe underwater sounds.

The variation of instantaneous pressure over the duration of a sound event is referred to as the waveform. Studying the waveforms can provide an indication of rise time; however, rise time differences are not clearly apparent for pile driving sounds due to the numerous rapid fluctuations that are characteristic to this type of impulse. A plot showing the accumulation of sound energy over the duration of the pulse (or at least the portion where much of the energy accumulates)

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[1] Richardson, Greene, Malone & Thomson, *Marine Mammals and Noise,* Academic Press, 1995 and Greene, personal communication.

[2] Finerran, et. al., *Temporary Shift in Masked Hearing Thresholds in Odontocetes after Exposure to Single Underwater Impulses from a Seismic Watergun*, Journal of the Acoustical Society of America, June 2002.

illustrates the differences in source strength and rise time. An example of the characteristics of a typical pile driving pulse is shown in Figure 1.

Table 1 - Definitions of Underwater Acoustical Terms

Term	Definitio
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro pascals (µPa)and 1 µPa for underwater.
Equivalent Noise Level, L_{eq}	The average noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The sound levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Peak Sound Pressure, unweighted (dB)	Peak sound pressure level based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a decibel (referenced to a pressure of 1
RMS Sound Pressure Level, (NMFS Criterion)	The average of the squared pressures over the time that comprise that portion of the waveform containing 90 percent of the sound energy for one pile driving impulse.[3]
Sound Exposure Level (SEL), dB re 1 μPa^2 sec	Proportionally equivalent to the time integral of the pressure squared and is described in this report in terms of dB re 1 μPa^2 sec over the duration of the impulse. Similar to the unweighted Sound Exposure Level (SEL) standardized in airborne acoustics to study noise from single events.
Cumulative SEL	Measure of the total energy received through a pile-driving event (for this project defined as pile driving over one day or maximum of 3 piles)
Waveforms, µPa over time	A graphical plot illustrating the time history of positive and negative sound pressure of individual pile strikes shown as a plot of µPa over time (i.e., seconds)
Frequency Spectra, dB over frequency range	A graphical plot illustrating the distribution of sound pressure vs. frequency for a waveform, dimension in rms pressure and defined frequency bandwidth

SEL is an acoustic metric that provides an indication of the amount of acoustical energy contained in a sound event. For pile driving, the typical event can be one pile driving pulse or many pulses such as pile driving for one pile or for one day of driving multiple piles. Typically, SEL is measured for a single strike and a cumulative condition. The cumulative SEL associated with the driving of a pile can be estimated using the single strike SEL value and the number of pile strikes through the following equation:

$$SEL_{CUMULATIVE} = SEL_{SINGLE\ STRIKE} + 10 \log (\#\ of\ pile\ strikes)$$

For example, if a single strike SEL for a pile is 165 dB and it takes 1,000 strikes to drive the pile, the cumulative SEL is 195 dBA (165 dB + 30 dB = 195 dB), where 10 * $\log_{10}(1000) = 30$.

[3] The underwater sound measurement results obtained during the Pile Installation Demonstration Project indicated that most pile driving impulses occurred over a 50 to 100 millisecond (msec) period. Most of the energy was contained in the first 30 to 50 msec. Analysis of that underwater acoustic data for various pile strikes at various distances demonstrated that the acoustic signal measured using the standard "impulse exponential-time-weighting" (35-msec rise time) correlated to the RMS (impulse) level measured over the duration of the impulse.

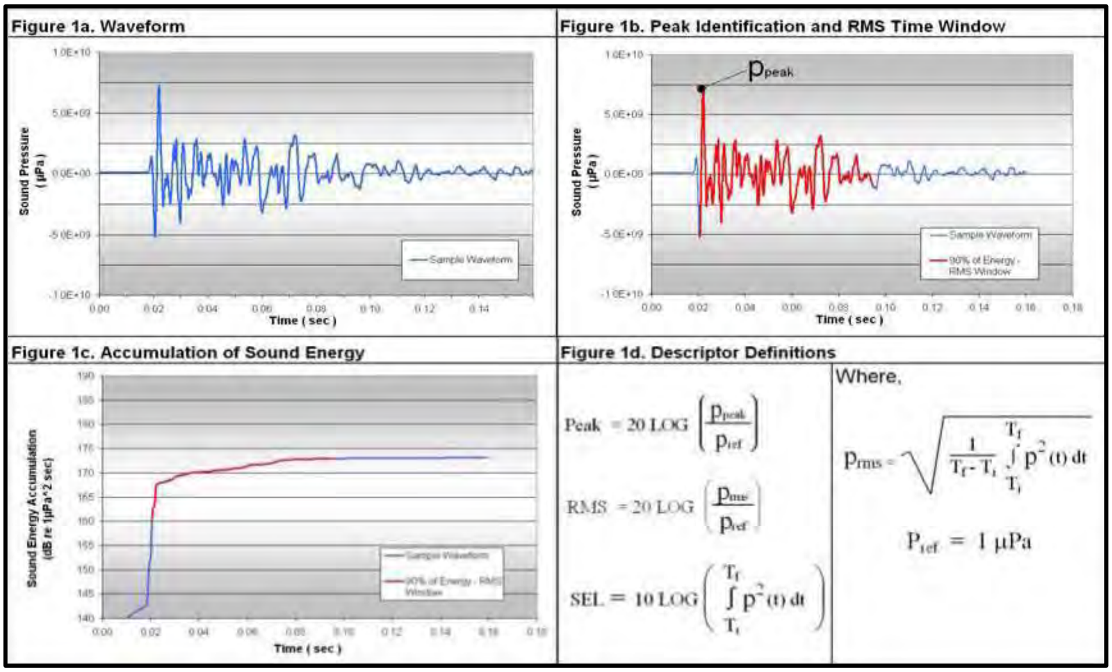

Figure 1. Characteristics of a Pile Driving Pulse

Underwater Sound Thresholds

Underwater sound affects to fish and marine mammals are discussed below. In this report, peak pressures and RMS sound pressure levels are expressed in decibels re 1 µPa. Sound exposure levels are expressed as dB re 1μPa^2-sec.

Fish

A Fisheries Hydroacoustic Workgroup (FHWG) that consisted of transportation officials, resources agencies, the marine construction industry (including Ports), and experts was formed in 2003 to address the underwater sound issues associated with marine construction. The first order of business was to document all that was clearly known about the effects of sound on fish, which was reported in *The* "Effects of Sound on Fish."[4] This report provided recommended preliminary guidance to protect fish. A graph showing the relationship between the SEL from a single pile strike and injurious effects to fish based on size (i.e., mass) was presented. Fish with a mass of about 0.03 grams were expected to have no injury for a received SEL of a pile strike below 194 dB and suffer 50% mortality at about 197 dB. The report also described possible effects to the auditory system (i.e., auditory tissue damage and hearing loss), based on a received dose of sound. The recommendations were frequency dependent, based on the hearing thresholds of fish or most sensitive auditory bandwidths. For salmonids, hearing effects would be expected at or near the thresholds for injury based on the single strike SEL. Further investigations into the effects of pile driving sounds on fish was also recommended.

Caltrans commissioned a subsequent report to provide additional explanation of, and a practical means to apply, injury criteria recommended in The Effects of Sound on Fish. This report is entitled "Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper",

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[4] Hastings, M and A. Popper. 2005. The Effects of Sound on Fish. Prepared for the California Department of Transportation. January 28 (revised August 23).

(*White Paper*).[5] The White Paper recommended a dual criterion for evaluating the potential for injury to fish from pile driving operations. The dual approach considered that a single pile strike with high enough amplitude, as measured by zero to peak (either negative or positive pressure) could cause injury. A peak pressure threshold for a single strike was recommended at 208 dB. In 2007, Carlson et al provided an update to the White Paper in a memo titled "Update on Recommendation for Revised Interim Sound Exposure Criteria for Fish during Pile Driving Activities."[6] In this memo, they propose criteria for each of three different effects on fish; 1) hearing loss due to temporary threshold shift, 2) damage to auditory tissues, and 3) damage to non-auditory tissues. These criteria vary due to the mass of the fish and if the fish is a hearing specialist or hearing generalist. In preparing this update, Dr. Mardi Hastings summarized information from some current studies in a report titled "Calculation of SEL for Govoni et al. (2003, 2007) and Popper et al. (2007) Studies."

On June 12, 2008, NMFS; U.S. Fish and Wildlife Service; California, Oregon, and Washington Departments of Transportation; California Department of Fish and Game; and the U.S. Federal Highway Administration generally agreed in principal to interim criteria to protect fish from pile driving activities, as shown in Table 2. Note that the peak pressure criteria of 206 dB was adopted (rather than 208 dB), as well as accumulated SEL criteria for fish smaller than 2 grams. NMFS interpretation of the interim criteria is described by Woodbury and Stadler (2009)[7].

Table 2 - Adopted Impact Pile Driving Acoustic Criteria for Fish

Interim Criteria for Injury	Agreement in Principle
Peak	206 dB for all size of fish
Cumulative SEL	187 dB for fish size of two grams or greater. 183 dB for fish size of less than two grams.
Behavior effects threshold 150 dB RMS	

The primary difference between the adopted criteria and previous recommendations is that the single strike SEL was replaced with a cumulative SEL over a day of pile driving. NMFS does not consider sound that produces an SEL per strike of less than 150 dB to accumulate and cause injury. The adopted criteria listed in Table 2 are for pulse-type sounds (e.g., pile driving) and do not address sound from vibratory driving of piles; there are no acoustic thresholds that apply to the lower amplitude noise produced by vibratory pile driving. In fact, the acoustic thresholds developed for fish only apply to impact pile driving.

The Bureau of Ocean Energy Management, (BOEM -formerly Minerals Management Service), Caltrans, and National Cooperation of Highway Research Programs (NCHRP 25–

[5] Popper, A., Carlson, T., Hawkins, A., Southall, B. and Gentry, R. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper. May 14.

[6] Carlson, T, Hastings, M and Poper, A. 2007. Memo to Suzanne Theiss, California Department of Transportation, Subject: Update on Recommendations for Revised Interim Sound Exposure Criteria for Fish during Pile Driving Activities. December 21.

[7] Stadler, J. and Woodbury, D. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. Proceedings of inter-noise 2009, Ottawa, Canada. August 23-26.

28)/Transportation Research Board (TRB) have funded studies to identify the onset of injury to fish from impact pile driving. One of the goals of these studies was to provide quantitative data to define the levels of impulsive sound that could result in the onset of barotrauma injury to fish.[8] Laboratory simulation of pulse-type pile driving sounds enabled careful study of the barotrauma effects to Chinook Salmon. The neutrally buoyant juvenile fish were exposed to impulsive sounds and subsequently evaluated for barotrauma injuries. Significant barotrauma injuries were not observed in fish exposed to 960 pulses at 180 dB SEL per pulse or 1,920 pulses at 177 dB per pulse. In both exposures, the resulting accumulated SEL was 210 dB SEL. Results of these studies are under review. At this time, the criteria in Table 2 are used by NMFS to assess impacts to fish. Potential behavior impacts that might occur above 150 dB RMS are not used to restrict pile driving.

Marine Mammals

Under the Marine Mammal Protection Act, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering."

Current NMFS practice regarding exposure of marine mammals to high level sounds is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB RMS or greater, respectively, are considered to have been taken by Level A (i.e., injurious) harassment. Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds 160dB RMS or greater for impulse sounds (e.g., impact pile driving) and 120 dB RMS for continuous noise (e.g., vibratory pile driving). The application of the 120 dB RMS threshold can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. For continuous sounds, NMFS Northwest Region has provided guidance for reporting RMS sound pressure levels. RMS levels are based on a time-constant of 10 seconds; RMS levels should be averaged across the entire event. For impact pile driving, the overall RMS level should be characterized by integrating sound for each acoustic pulse across 90 percent of the acoustic energy in each pulse and averaging all the RMS for all pulses.

NMFS Northwest Region has defined the estimated auditory bandwidth for marine mammals[9]. For this project location, the functional hearing groups are low-frequency cetaceans (humpback and gray whales), high-frequency cetaceans (harbor porpoises) and pinnipeds (Stellar and California sea lions, harbor and northern elephant seals). For pile driving, the majority of the acoustic energy is confined to frequencies below 2 kHz and there is very little energy above 20 kHz. The underwater acoustic criteria for marine mammals are shown in Table 3.

[8] Halvorsen MB, Casper BM, Woodley CM, Carlson TJ, Popper AN (2012) Threshold for Onset of Injury in Chinook Salmon from Exposure to Impulsive Pile Driving Sounds. PLoS ONE 7(6): e38968. oi:10.1371/journal.pone.0038968

[9] Note that NMFS Southwest Region has not provided guidance for measuring sound levels from pile driving, so guidance from the Northwest Region is used in this assessment.

Table 3 - Adopted Underwater Acoustic Criteria for Marine Mammals[10]

Species	Underwater Noise Thresholds (dB re: 1µPa)			
	Vibratory Pile Driving Disturbance Threshold	Impact Pile Driving Disturbance Threshold	Injury Threshold	Frequency Rang
Cetaceans	120 dB RMS	160 dB RMS	180 dB RMS	7 Hz to 20 kHz (Low) 150 Hz to 20 kHz (Mid) 200 Hz to 20 kHz (High)
Pinnipeds	120 dB RMS	160 dB RMS	190 dB RMS	75 Hz to 20 kHz

Underwater Sound Generating Activities

For the proposed project, the primary sources of underwater sound would be from the driving of round steel piles to support the pier. The options for installing these piles range from driving the piles the full length with an impact hammer (either diesel or hydraulic) to vibrating in the piles with limited impact driving to proof the pile bearing. At this time it is not known what method will be used, so an analysis of the different methods is provided. The pile sizes will be between 14-inch and 18-inch-diameter. This analysis conservatively assumes that larger 18-inch size for the noise projections. Impact pile driving produces pulsed-type sounds, while vibratory pile driving produce continuous-type sounds. The distinction between these two general sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing.

Pulsed sounds, such as impact pile driving, explosions, or seismic air guns are brief, distinct acoustic events that occur either as an isolated event (e.g., explosion) or repeated in some succession (e.g., impact pile driving). Pulsed sounds are all characterized by discrete acoustic events that include a relatively rapid rise in pressure from ambient conditions to a maximum pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures. Pulsed sounds are typically high amplitude events that have the potential to cause hearing injury. Continuous or non-pulsed sounds can be tonal or broadband. These sounds include vessels, aircraft, machinery operations such as vibratory pile driving or drilling, and active sonar systems. This project may involve both pulsed and continuous type sounds from pile installation.

Given the dense substrate at the project, it is possible that much of the pile installation would involve impact pile driving. However, this analysis assumes two methods:

1. Vibratory installation and proofing of piles with an impact hammer
2. Impact pile driving only

Preliminary indications are that MGF RBH 200 vibration hammer and/or Delmag D30/32 diesel impact hammer or equivalent hammer would be required to vibrate and impact-drive these relatively small diameter piles. The driving periods are not likely to be continuous. The piles require a minimum of 35 feet of embedment into the ground.

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[10] Based on NOAA 77 FR 43049, July 23, 2012. Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Pile Replacement Project.

For vibratory pile installation, it is estimated that it would take approximately 20 minutes (1200 seconds) to vibrate in each pile and between one to two minutes of impact driving of each pile with the impact hammer to proof them. It is also estimated that the pile driving crew could vibrate several piles in one day and complete the impact driving the following day. Approximately 100 blows were assumed for proofing of piles with an impact hammer. In terms of underwater sound effects on fish, the highest cumulative sound levels would occur under a scenario where numerous piles are impact driven in one day.

For the scenario that requires mostly impact pile driving, pile installation are estimated to require up to 20 minutes of pile driving. However, there is no reliable estimate of the pile driving time. Assuming a hammer is used that moves the pile at about 30 to 40 blows per minute, up to 20 minutes of impact pile driving would be required for each pile. A full pile driving event was assumed to require 685 pile strikes. The project would install up to 3 piles in one day. In terms of underwater sound effects on fish, the highest cumulative sound levels would occur under a scenario where three piles are impact driven in one day.

Discussion of Underwater Sound Generation from Pile Driving

A review of underwater sound measurements for similar projects was undertaken to estimate the near-source sound levels for vibratory and impact pile driving. Sounds from similar-sized steel shell piles have been measured in water for several projects.

Vibratory Pile Installation Sound Generation

A review of available acoustic data for pile driving indicates that recent Test Pile Program at Naval Base Kitsap at Bangor, Washington provides the most extensive set of data. The project involved the installation of test piles of 24-, 36- and 48-inches in diameter using a vibratory driver. Most of the installed piles were 36 inches in diameter and only one pile was 24-inch diameter. This Test Pile Program provided the average sound level based on the RMS levels using a 10-second time constant. Most other data reported are based on maximum RMS values using a 1- to 10-second time constant (e.g., Caltrans Fish Guidance Manual 2009).

For 36-inch diameter piles driven by the Navy, the average RMS level for all pile driving events was 159 dB RMS at 33 feet or 10 meters. There was a considerable range in the RMS levels measured across a pile driving event, where the highest average RMS level was 169 dB RMS.

The range of vibratory sound levels at 33 feet or 10 meters reported by Caltrans is 155 dB for 12-inch diameter piles to 175 dB RMS for 36-inch diameter piles (based on maximum 1-second RMS levels). All of these piles were driven in relatively shallow water.

Noting that the piles to be used for this project will be smaller than those driven by the Navy for their Test Pile Program at Bangor, Washington, a near-source level of 168 dB RMS at 33 feet (10 meters) level was used to characterize the sound that would be produced from vibratory pile installation.

Impact Pile Driving Sound Generation

A review of existing data indicates that measurements conducted for the USCG Tongue Point Pier Repairs in the Columbia River are most representative. This project was located on the Columbia

River near Astoria, Oregon. The purpose of the project was to repair the existing Tongue Point pier. The project included installation of 24-inch-diameter steel pipe piles to replace existing wood-piles, along with reconstruction of a concrete deck. Figures 2a and 2b show the installation of these piles.

Figure 2a. Pile layout on Pier. Piles have been vibrated in and are ready to be driven with the impact hammer

Figure 2b. Preparing to impact drive a 24- inch steel trestle pile with bubble rings to attenuate under water noise.

Data measured at the Tongue Point Pier Repair included similar types of pile driving on an existing pier in deep water. Although the length of the installed piles are similar to those proposed for this project, the diameters were larger than proposed for this project. The difference in pile size should not result in much, if any, difference in the expected noise levels from pile driving.

Average sound levels measured at Tongue Point include peak pressures of 189 to 207 dB, RMS sound pressure levels of 178 to 189 dB, and SEL levels of 160 to 175 dB per strike at 33 feet (10 meters). Sound levels associated with vibratory installation of the piles were not measured on this project. The ambient levels measured in between pile driving ranged from a RMS level of 115 to 125 dB. Due to the difference in pile sizes, use of the Tongue Point data would likely overestimate sound levels expected at the proposed USCG Station Monterey project. Based on the Tongue Point sound measurements, unattenuated near-source impact pile driving levels applicable to this project are 208 dB peak, 195 RMS and 175 dB SEL. Note, a substantially higher RMS level of 195 dB was assumed rather than 189 dB that was measured for Tongue Point. Typically, there is an approximately 10 to 15 dB difference in peak and RMS sound pressure levels. Assuming the higher peak pressure of 208 dB, an RMS level of 195 dB would typically occur. To provide a conservative estimate, the higher RMS sound pressure level was assumed for this assessment.

PREDICTION OF UNDERWATER SOUND FROM PROJECT PILE DRIVING

Estimated noise impacts are discussed specifically for each type of pile driving. For vibratory driving, which would provide a continuous sound, a source level of 168 dB RMS was applied. Impact driving, which produces higher amplitude pulse-type sounds would have a near-source level of 208 dB peak, 195 dB RMS and a single strike SEL of 175 dB. These levels represent unattenuated conditions (i.e., no air bubble curtain or other means of reducing underwater sounds).

Sound from pile installation (i.e., impact or vibratory pile driving) would transmit or propagate from the construction area. Transmission loss (TL) is the decrease in acoustic pressure as the sound pressure wave propagates away from the source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. NMFS has developed an underwater acoustic calculator that uses practical spreading (a 15 $\log_{10}$ function) to predict sound levels at various distances from the source. This equates to a 4.5 dB decrease in sound level for every doubling of distance away from the source. The formula for transmission loss is $TL = 15 \log_{10} (R)$, where R is the distance from the source divided by the distance to where a near-source level was measured (i.e., 33 feet or 10 meters for this application). This TL model, based on the default practical spreading loss assumption, was used to predict underwater sound levels generated by pile installation from this project. Measurements conducted during project pile driving could further refine the rate of sound propagation or TL.

Pile installation would be adjacent to a rock jetty that would provide substantial underwater shielding of sound transmission to areas north (or through the jetty). Figure 3 depicts this rock jetty.

Figure 3. Aerial view of the project site showing the rock jetty that extends along the north side of the project piers

Vibratory Pile Installation

The peak noise level threshold will not be exceeded with the vibratory installation of the piles. The peak levels are expected to be less than 190 dB at 10 meters. There are no cumulative SEL criteria for vibratory pile installation; therefore, an analysis was not conducted to determine SEL levels for the vibratory driving. The criteria for harassment of marine mammals from vibratory pile driving are based on the average RMS levels. Table 4 shows the distance to the different harassment criteria. Note that these distances are based on a standard 15 $\log_{10}$ propagation rate. The actual distances would be less than the projected distances as a result of shielding from the rock jetty and the topography of the bottom of the bay.

Vibratory sound from pile driving was modeled using SoundPlan to simulate the effect of the rock jetty in reducing sound. Unlike impact pile driving, vibratory sound is radiated only from the pile and tends to have a higher frequency sound content. Therefore, there is little or no ground borne sound that could transmit through underwater barriers such as the rock jetty. SoundPlan was used to develop the pattern of sound transmission; however, NMFS practical spreading loss assumptions of 15 $\log_{10}$ sound propagation (as described above) were assumed. Figure 4 shows the pattern of sound expected from vibratory pile installation, taking into account shielding from the rock jetty. The distances to the 120 dB RMS contour are limited by interaction with the rock jetty and shoreline. Table 4 reports the theoretical and modeled distances to where 120 dB RMS sound levels would extend. It is likely that the rock jetty would reduce sound considerably more than predicted, so that the distance north from the jetty to the extent of the 120 dB RMS sound level would be less than reported in Table 4.

Table 4 - Modeled Extent of 120 dB RMS Sound Pressure Levels from Vibratory Pile Installation

Modeling Scenario	Distance to 120 dB RMS
Theoretical	10 miles or 16 kilometers
Modeled North	6,650 feet or 2,000 meters
Modeled Northeast Shoreline	8,000 feet or 2,400 meters
Modeled East to Shoreline	6,000 feet or 1,800 meters
Modeled South to Shoreline	1,800 feet or 550 meters

Impact Pile Driving

Peak sound pressure, average RMS sound pressure levels, and SELs from impact driving were predicted using the near source levels for impact pile driving and the practical loss sound propagation assumptions described above. As with vibratory driving, the rock jetty was considered in the modeling. Table 5 shows the extent of sound levels for the NMFS marine mammal and fish criteria. Figure 5 shows the extent of unattenuated RMS sound pressure levels for impact pile driving out to the NMFS behavioral criterion of 160 dB RMS.

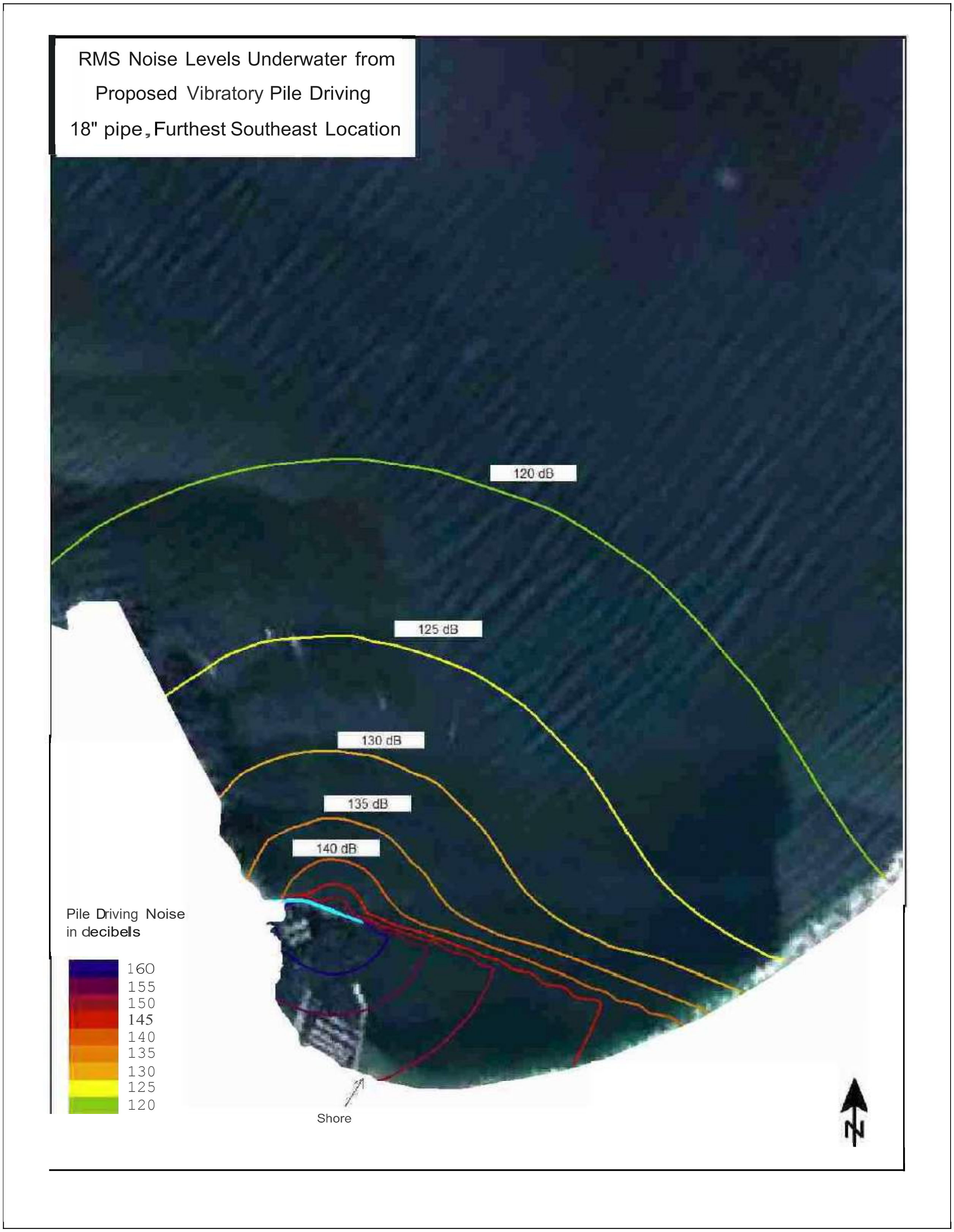


Figure 4. Extent of RMS Sound Pressures from Vibratory Pile Installation

Reducing sounds from impact pile driving using air bubble curtains is common. Caltrans reports a large range in sound reduction from almost no reduction to 30 dB as a result of use of these curtains. During the Tongue Point project (i.e., the source of impact pile driving levels for this assessment) the reduction from an air bubble curtain was between 8 and 14 dB. Therefore, this assessment assumes that underwater sounds could be reduced at least 10 dB with the use of a properly designed and deployed air bubble curtain attenuation system. Based on the topography (on a slope with large rocks- rip rap) it will be difficult to obtain a good seal between the bottom surface of the causeway and the bubble ring. Special care will be required to obtain the minimum sound reduction of 10 dB.

Table 5 - Modeled Extent of Sound Pressure Levels from Unattenuated and Attenuated Impact Pile Driving

	Distance to Marine Mammal Criteria			**Distance to Fish Criteria**		
	RMS (dB re: 1µPa)			**Peak (dB re: 1µPa)**	**Cumulative SEL* (dB re: 1µP - 2**	
Modeling Scenario	**160**	**180**	**190**	**206 dB**	**187**	**18**
Modeled Unattenuated	7,050 ft. 2,150 m	330 ft 100 m	75 ft 22 m	<70 ft <20 m	400ft 123 m	750 ft 228 m
Modeled North and Northeast (through jetty)	250 ft 76 m	--	--	<33 ft <10 m	<33 ft <10 m	<33 ft <10 m
Modeled East to Shoreline	6,070 ft 1,850m	330 ft 100 m	75 ft 22 m	<70 ft <20 m	400ft 123 m	750 ft 228 m
Modeled South to Shoreline	1,800 ft 550 m	330 ft 100 m	75 ft 22 m	<70 ft <20 m	400ft 123 m	750 ft 228 m
Modeled Attenuated in all directions (except North)	1,525 ft 465 m	75 ft 22 m	<33 ft <10 m	<33 ft <10 m	90 ft 27 m	160 ft 49 m

* Based on the driving of one pile. SEL criteria apply to impact pile driving events that occur during one day. See Tables 6 through 8 for predicted accumulated SEL for various daily pile driving scenarios.

Accumulated SEL levels associated with impact pile driving will vary daily, depending on the amount of pile driving. Two impact pile driving scenarios were considered:

- Full Drive: Assumes the pile would be driven 35 feet into the ground and require 685 pile strikes

- Proofing: Assumes about 2 to 3 minutes of pile driving, requiring up to 100 pile strikes.

Tables 6 and 7 predict the accumulated SEL for the driving or proofing of up to 10 piles. Table 6 reports the accumulated SEL levels based on unattenuated pile driving, while Table 7 assumes a 10-dB reduction in the SEL level when using a properly deployed air bubble curtain system. Table 8 reports the estimated distances to the accumulated 183 and 187 dB SEL level, depending on the number of piles driven or proofed in one day. Note that the calculated distances for the cumulative SEL shown in Table 8 reflect that there is no increase in the cumulative SEL when the single strike SEL is below 150 dB. For example the distance to the 150 dB single strike SEL is 100 meters for impact driving; therefore the cumulative SEL does not change for distances beyond 100 meters.

Figure 5. Extent of RMS Sound Pressures from Impact Pile Driving

Not To Scale

Table 6 -Cumulative SEL levels for Unattenuated Pile Driving at 33 ft (10 m)

Pile Type	Pile size	Blows	Single Strike SEL	Number of Piles Driven in a Day		
				1	2	3
Full Drive	18- inch	685	175	203	206	208
Proofing	18-inch	100	170	190	193	195

Table 7 - Cumulative SEL for Attenuated Pile Driving at 33 ft (10 m)

Pile Type	Pile size	Blows	Single Strike SEL	Number of Piles Driven in a Day		
				1	2	3
Full Drive	18- inch	685	165	193	196	198
Proofing	18-inch	100	160	185	188	190

Table 8 - Distances to the Cumulative SEL Criteria for Attenuated Pile Driving in Meters

Location	Pile size	Blows	Hammer type	RMS	Peak Sound Pressure	Single Strike SEL	Distance to the 187 dB Cumulative SEL - Meters									
							1	2	3	4	5	6	7	8	9	10
Full Drive	18-inch	685	D30/36	185	198	165	27	42	55	67	78	88	97	100	100	100
Proofing	18-inch	100	D30/36	185	198	165	<10	12	15	19	22	24	27	29	32	34

Location	Pile size	Blows	Hammer type	RMS	Peak Sound Pressure	Single Strike SEL	Distance to the 183 dB Cumulative SEL - Meters									
							1	2	3	4	5	6	7	8	9	10
Full Drive	18-inch	685	D30/36	185	198	165	49	78	100	100	100	100	100	100	100	100
Proofing	18-inch	100	D30/36	185	198	165	14	22	28	34	40	45	50	54	59	63

AIRBORNE SOUNDS FROM PILE DRIVING

Pile driving generates airborne sound that could potentially result in disturbance to marine mammals (i.e., pinnipeds) which are hauled out or at the water's surface. The NMFS has adopted thresholds for harassment and injury to marine mammals, as shown in Table 9. The appropriate airborne noise thresholds for behavioral disturbance for all pinnipeds, except harbor seals, is 100 dB re 20 µPa RMS and for harbor seals is 90 dB re 20 µPa RMS. Similar to underwater sounds, these sounds are considered over the frequency range of 75Hz to 20,000 Hz and are assumed to be similar to C-weighted sound levels, which are broadband sound levels that are weighted at very low frequencies below 100 Hz.[11] The thresholds are interpreted to apply to average RMS sound levels during a driving event.

[11] C-weighting is based on a curve defined by IEC 61672:2003 relating to the measurement of sound pressure level. The weighting is employed by arithmetically adding a table of values for one third-octave bands, to the measured levels. There is generally no weighting applied to sounds between about 80 and 8,000 Hz.

Table 9 - Adopted Airborne Criteria for Marine Mammals[12]

Species	Disturbance Airborne Noise Thresholds for Impact & Vibratory Pile Driving (dB re: 20 µPa)
Cetaceans	None
Pinnipeds	90 dB RMS (un-weighted) for harbor seals 100 dB RMS (un-weighted) for sea lions and all other pinnipeds

Fundamentals of Airborne Noise

Sound from a single source (i.e., a "point" source) radiates uniformly outward in a spherical pattern as it travels away from the source. The sound level attenuates (or drops off) at a rate of 6 dBA for each doubling of distance. Usually the noise path between the source and the observer is very close to the ground. Noise attenuation from ground absorption and reflective wave canceling adds to the rate of attenuation. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is done for simplification only; for distances of less than 300 feet, prediction results based on this scheme are sufficiently accurate. For acoustically "hard" sites (i.e., sites with a reflective surface, such as a smooth body of water, between the source and the receiver), no excess ground attenuation is assumed.

Sounds generated from construction activities are considered point sources, rather than a line source such as a freeway or roadway. The marine environment around the project site is mostly water and would be considered a "hard" site. The TL drop off rate of sound is based on spherical spreading loss (a 20 $\log_{10}$ function). This equates to a 6-dB reduction in sound per doubling distance. The formula for calculating the drop off is the source level plus $20*\text{Log}_{10}(D_1/D_2)$, where D_1 is the reference position and D_2 is the receiver position. For example, if an impact pile driver has a reference level of 110 dB at 50 feet the noise level at 500 feet would be calculated as follows for conditions where excess attenuation is not anticipated:

Received level = 110dBA +20Log$_{10}$*(50/500) dBA*

Received level =110+(-20) dBA

Received level = 90 dBA

There are relatively few data regarding the un-weighted sound levels for impact or vibratory pile driving. Table 10 shows the Lmax and Leq levels[13] measured while driving relatively small diameter steel shell piles (24- to 36-inch diameter) at the Navy Test Pile Program project in Bangor, Washington.

[12] Based on NOAA 77 FR 43049, July 23, 2012. Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Pile Replacement Project.

[13] L_{max} level is the typical maximum RMS sound level measured with a Sound Level Meter set to the "fast" response (or 1/8th second response time). The Leq is the energy average sound level measured over a driving event.

Table 10 – Underwater Sound Levels from Driving of Steel Piles Measured at 50 ft (15m)

Sound Descriptor	Sound Level in dB	
	Vibratory Hammer	Impact Hamme
Lmax	102	112
Leq	97	103

Airborne Impacts from Vibratory Pile Driving

Measured sound levels from vibratory pile driving used in this analysis are based on measurements made during the Navy Test Pile Project, as shown in Table 10. The maximum measured unweighted Lmax was 102 dB and the average Lmax was 97 dB at 50 feet or 15 meters. The $20\log_{10}$ attenuation rate was used to calculate the distances to the various NMFS thresholds that are presented in Table 11. The distances shown are based on the Lmax levels. We believe that as NMFS criterion are based on average levels, these distances likely overestimates impacts. Figure 6 shows the extent of these sound levels.

Table 11 – Distance to Thresholds with Vibratory driving

Threshold	Distance (meters)	
	100 dB	90 dB
Lmax	65 ft 20 m	200 ft 60 m
Leq	35 ft 10 m	110 ft 35 m

Airborne Impacts from Impact Pile Driving

Measured sound levels from impact pile driving used in this analysis are also based on measurements made during the Navy Test Pile Project. The maximum measured unweighted Lmax was 112 dB and the average Lmax was 103 dB at 50 feet (15 meters). The $20\log_{10}$ attenuation rate was used to calculate the distances to the various NMFS thresholds that are presented in Table 12. The levels shown are the Lmax levels. Again, these distances likely overestimate impact areas, since they are based on the maximum levels. Figure 7 shows the extent of these sound levels.

Table 12 – Distance to Thresholds for Impact Driving

Threshold	Distance	
	100 dB	90 dB
Based on Lmax	200 ft 60 m	630 ft 190 m
Based on Leq	70 ft 20 m	225 ft 70 m

Figure 6. Extent of Airborne L_{max} Sound Levels from Vibratory Pile Driving

Figure 7. Extent of Airborne L_{max} Sound Levels from Impact Pile Driving

AMBIENT SURVEY

Baseline sound levels, both underwater and in air, were measured in the project area during August 12 through 14, 2012. The results of the baseline acoustic field program are presented in this section and are used to assess potential for adverse noise impacts on marine mammals and fish habitat during the proposed improvements at USCG Station Monterey. Measurements included a continuous two-day measurement at the project site and spot measurements both inside and outside the harbor.

Equipment

Underwater sound measurements were made using Reson TC4033 hydrophones with PCB in- line charge amplifiers (Model 422E13) and PCB Multi Gain Signal Conditioners (Model 80M122). The signals were fed into Larson Davis Model 831 Integrating Sound Level Meter (SLM) (Type 1) and digital recorders. The multi gain signal conditioner provides the ability to lower or raise the signal strength so that measurements are made within the dynamic range of the instruments used to analyze the signals.

Continuous airborne measurements were conducted using a Larson Davis Model 820 Integrating Sound Level Meter (SLM) (Type 1) fitted with precision microphones and windscreens. The sound level measuring assemblies were calibrated before and after the noise monitoring survey, and the response of the systems were always found to be within 0.5 dB of the calibrated level. No calibration adjustments were made to the measured noise levels. In addition, digital recordings with calibration tones were made for backup purposes.

Field Activities

Ambient sound levels were measured at two fixed positions and one vessel based position. All underwater sound measurements were made in decibels referenced to 1 µPa and airborne measurements were in decibels referenced to 20 µPa. At the two fixed positions the hydrophones were placed at mid depth of the water column. The first position was based on the existing USCG Station Monterey Pier and was set up to measure a 24-hour period; this allowed an analysis of the day night differences in the noise levels. The second fixed position was placed on the dock across from the USCG Station Monterey pier. Due to security concerns this system was placed in the morning and picked up at the end of the day. The hydrophone was set at mid water depth. Figures 8 through 11 are photographs of the monitoring positions. Time and date stamped time histories for all relevant datasets were compiled in 1-second Leq intervals. These data are presented in Appendix A.

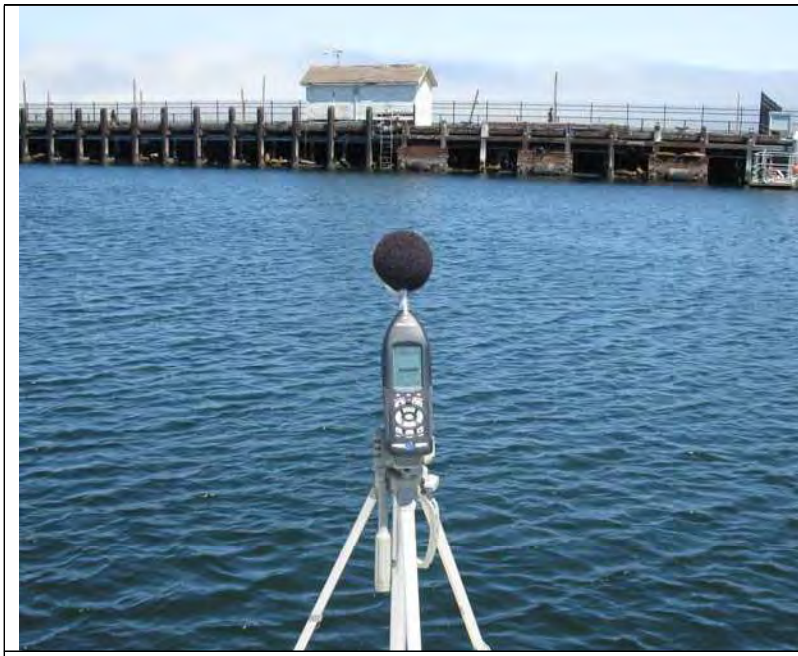


Figure 8. Photo of project site taken at dock monitoring position looking at the monitoring position at the USCG pier.

Figure 9. Photo of airborne and underwater monitoring location at the USCG wharf.

Figure 10. Airborne and underwater acoustic monitoring at new dock across from USCG pier.

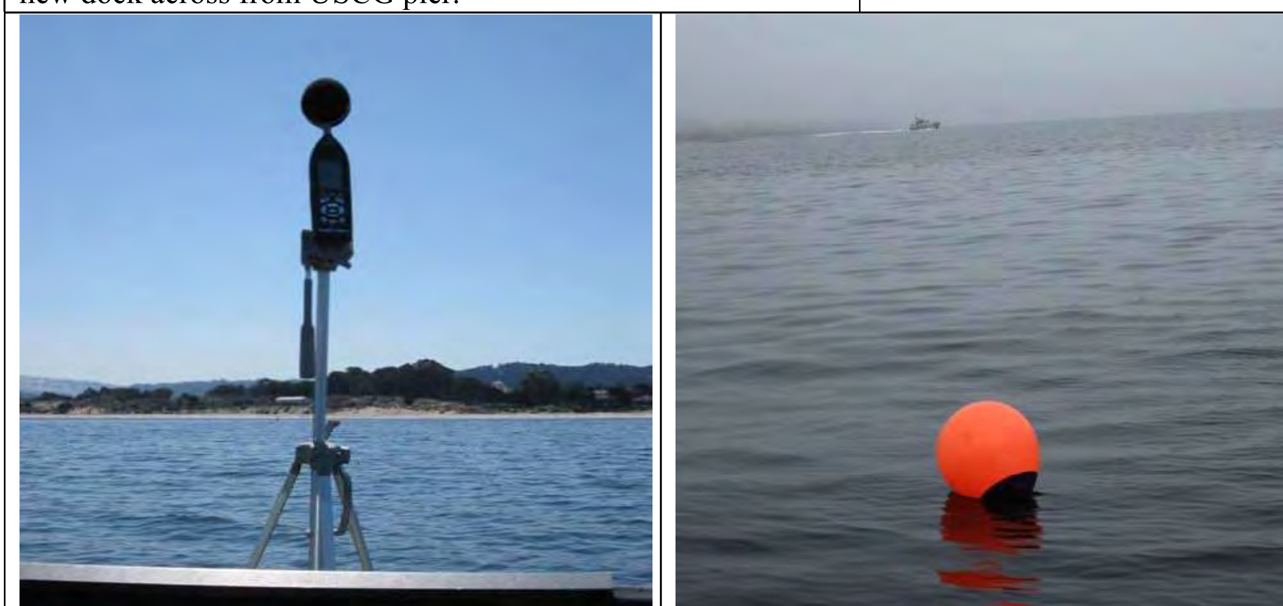


Figure 11. Airborne and underwater sound measurement position from floating boat about 1 km east of the project site.

Table 13 summarizes the data collected at the project site and the nearby dock. These data are summarized by day and night periods. The data are presented statistically, where the L_{10} level is the level exceeded 10 percent of the time, the L_{50} is the median level and the L_{90} is the level exceeded 90 percent of the time. Measurements at nighttime were only conducted from the pier.

Table 13 - Summary Results: Underwater Broadband Sound Pressure Levels (80 to 20,000 Hz), in dB reference 1 μPa

Sound Descripto	USCG Pier			Dock
	Overall	**Day**	**Night**	**Da**
Maximum	143	143	134	142
L_{10}	123	124	117	--
L_{50}	114	116	113	112
L_{90}	112	112	112	--

Table 14 summarizes the median and range of underwater sound levels measured at the pier site and Table 15 provides similar data for the dock site. In the vicinity of the project site, the median broadband ambient underwater sound levels (between 80 Hz and 20 kHz) were measured at 114 dB. Maximum levels were typically around 125 dB, as indicated by the L_{10} level. The maximum sounds were likely from boats. There were a considerable number of harbor seals and California sea lions near the hydrophones that may have resulted in elevated localized sounds. While ambient sounds are in the 110 to 120 dB range, acoustic events, such as boat traffic, typically result in sound levels that exceed 120 dB.

Table 14 - Summary of Underwater Measurement Levels at the USCG Pier in dB reference 1 μPa

Partial day 8/12	
Max	136
Min	112
Median	113

Night 8/1 - /14	
Max	132
Min	110
Median	113

Night 8/1 - /13	
Max	136
Min	110
Median	113

Day 8/1	
Max	135
Min	111
Median	116

Day 8/13	
Max	143
Min	110
Median	116

For all data	
Max	143
Min	110
Median	114

The ambient sound levels were similar at all locations and were found to be marginally affected by sea state conditions and tidal currents. Light winds and relatively calm seas occurred during the measurement survey. Sources of anthropogenic noise included early morning fishing boats leaving the boat launch and boat traffic throughout the day. There was also a constant cracking or popping sound present at all locations measured. This was attributed to the presence of what is commonly called the Snapping Shrimp. These species have an oversized claw that is used to communicate and hunt, and for defense. The resulting sounds from these shrimp sound like static.

Sound pressure levels recorded at the two measurement locations were consistent; however, periodic deviations on the order of 20 dB were seen for brief periods.

Table 15 - Summary of Underwater Measurement Levels at the Dock Across from USCG Pier in dB reference 1 µPa

Day 8/13	
Max	142
Min	105
Median	112

Summary All data	
Max	142
Min	105
Median	112

Day 8/14	
Max	139
Min	106
Median	114

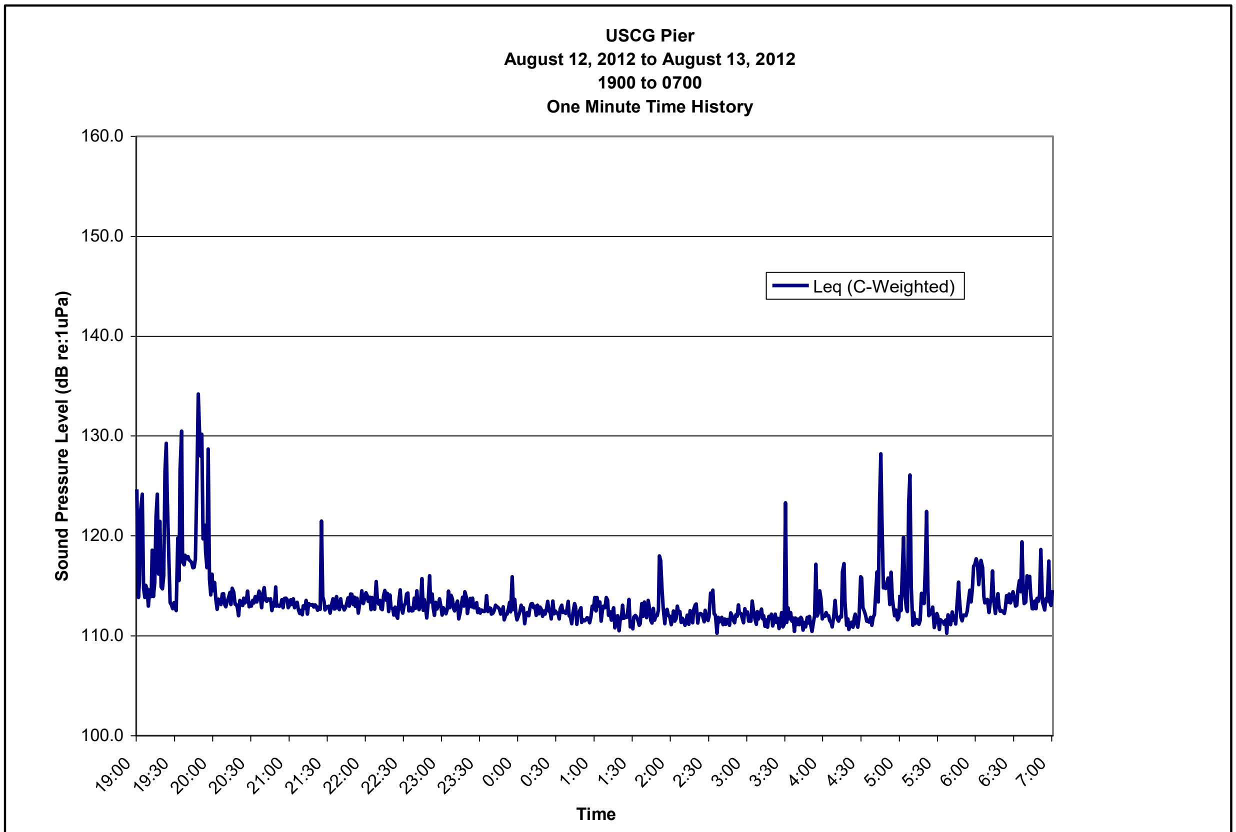
Airborne sound levels were measured in decibels referenced to 20 µPa. Airborne noise levels at the project site vary. The median daytime sound level ranged 62 to 68 dB (C weighted). Ambient sounds included barking seals, boat traffic, birds, distant traffic, and occasional aircraft. Barking seals and seagulls were observed to produce the highest noise levels.

Table 16 - Summary of Airborne Measurement Levels at the USCG Pier in dB reference 20 µPa

Sound Descriptor	Total		8/12 Night		8/13 Day		8/13 Night		8/14 Day	
	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lma
L_{10}	77	85	81	88	74	86	70	79	66	76
L_{50}	65	72	74	81	68	78	60	67	62	67
L_{90}	57	62	65	71	63	71	53	56	60	63

Airborne sounds were measured from a boat floating approximately 1 kilometer east of the project site in Monterey Bay. However, wind waves interacting with the boat caused elevated low frequency noise that raised the overall unweighted sound pressure levels. These were measured at 65 to 75 dB during the daytime (about 0900 to 0930). These levels were typical of sounds measured in the project area (i.e., inside the harbor).

Appendix A Acoustic Data


USCG Pier
August 12, 2012 to August 13, 2012
1900 to 0700
One Minute Time History
Leq (C-Weighted)
Sound Pressure Level (dB re:1uPa)
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150.0
140.0
130.0
120.0
110.0
100.0
19:00
19:30
20:00
20:30
21:00
21:30
22:00
22:30
23:00
23:30
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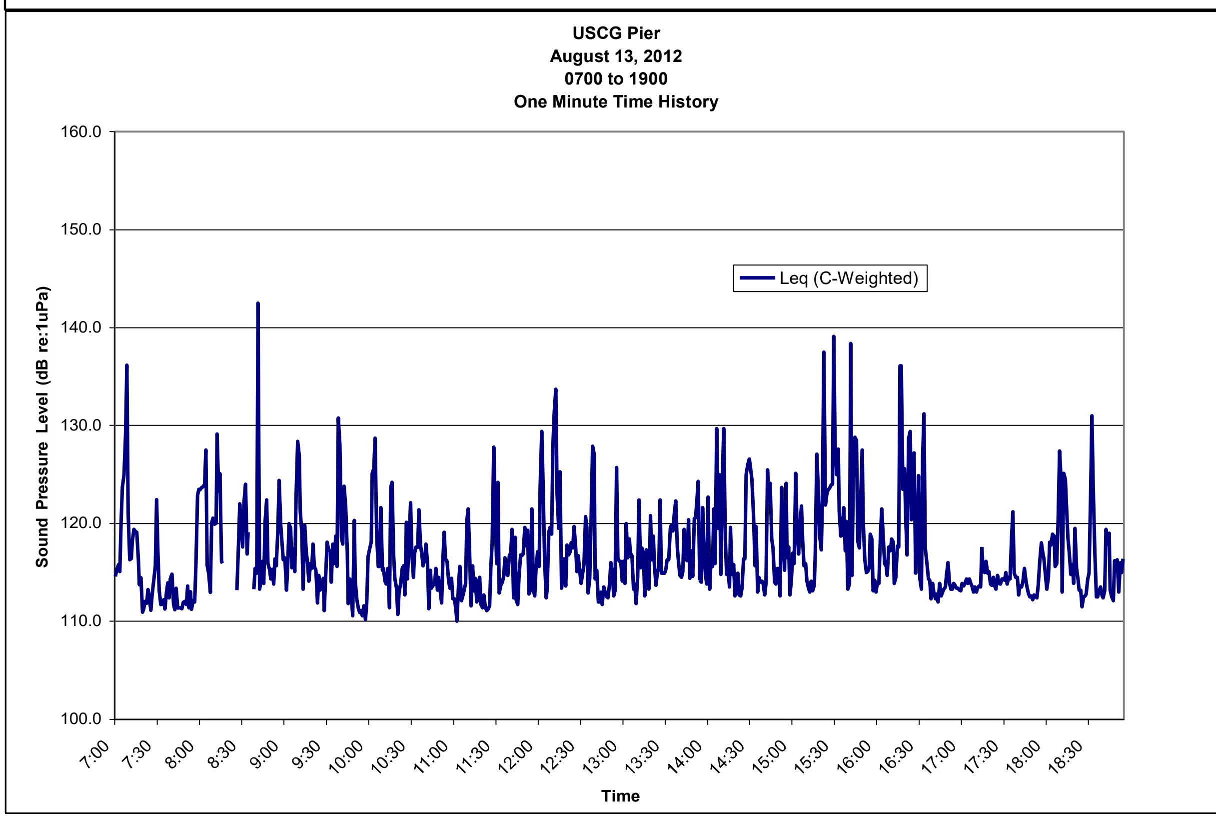
6:30
7:00
Time


USCG Pier
August 13, 2012
0700 to 1900
One Minute Time History
Leq (C-Weighted)
Sound Pressure Level (dB re:1uPa)
160.0
150.0
140.0
130.0
120.0
110.0
100.0
7:00
7:30
8:00
8:30
9:00
9:30
10:00
10:30
11:00
11:30
12:00
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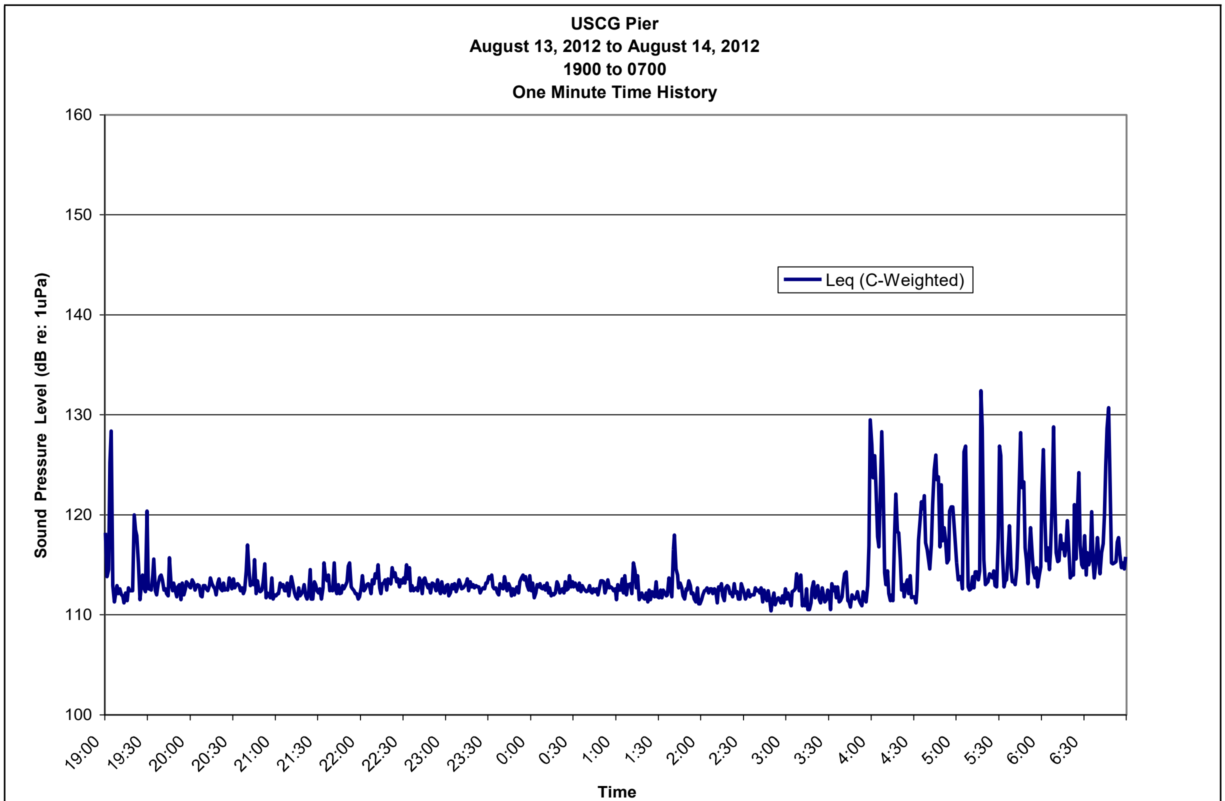
18:00
18:30
Time


USCG Pier
August 13, 2012 to August 14, 2012
1900 to 0700
One Minute Time History
Sound Pressure Level (dB re: 1uPa)
160
150
140
130
120
110
100
Leq (C-Weighted)
19:00
19:30
20:00
20:30
21:00
21:30
22:00
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23:30
0:00
0:30
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6:00
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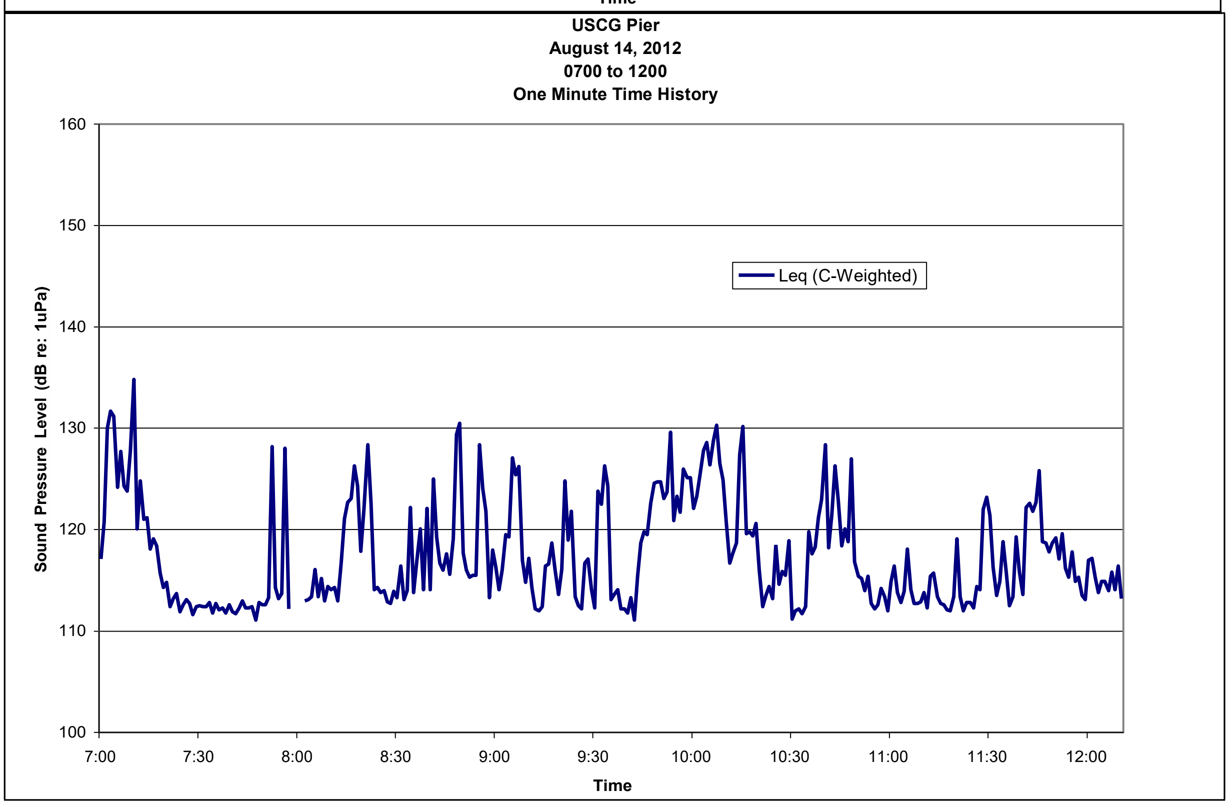
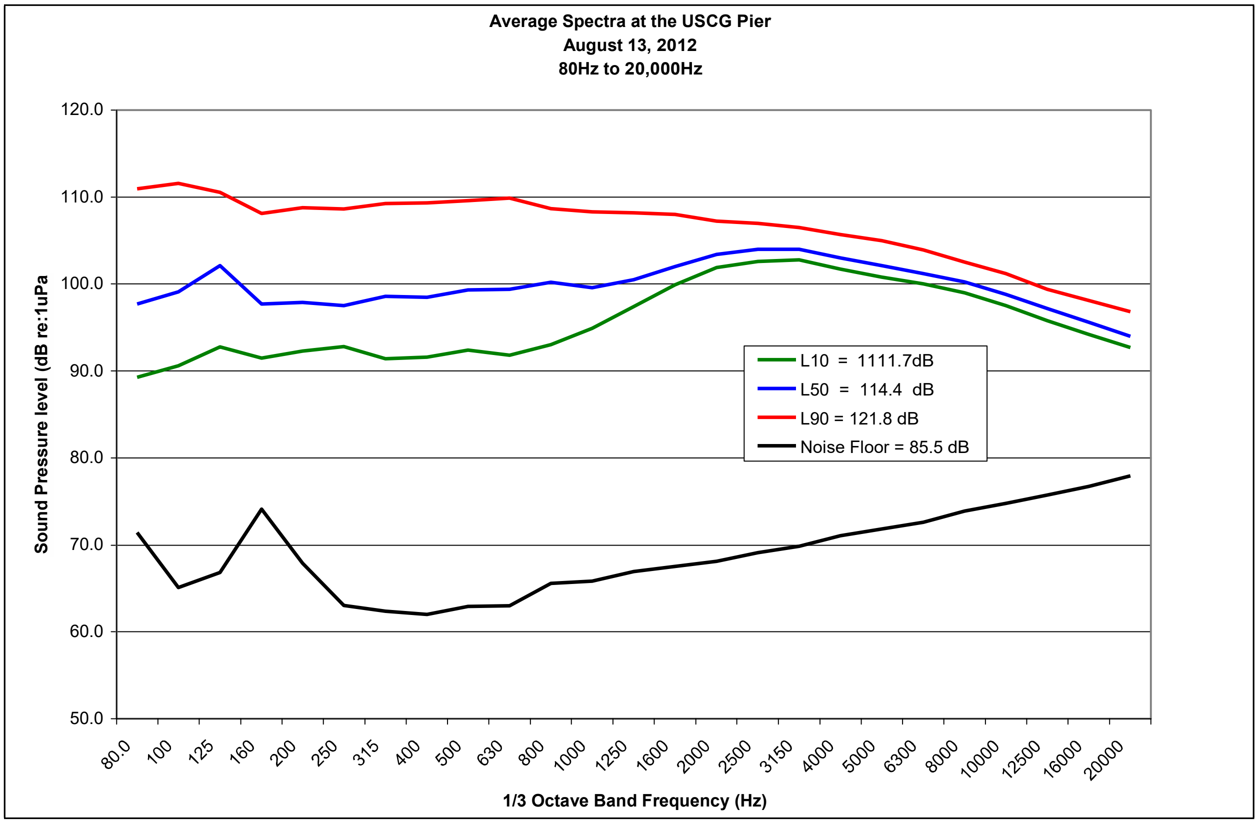
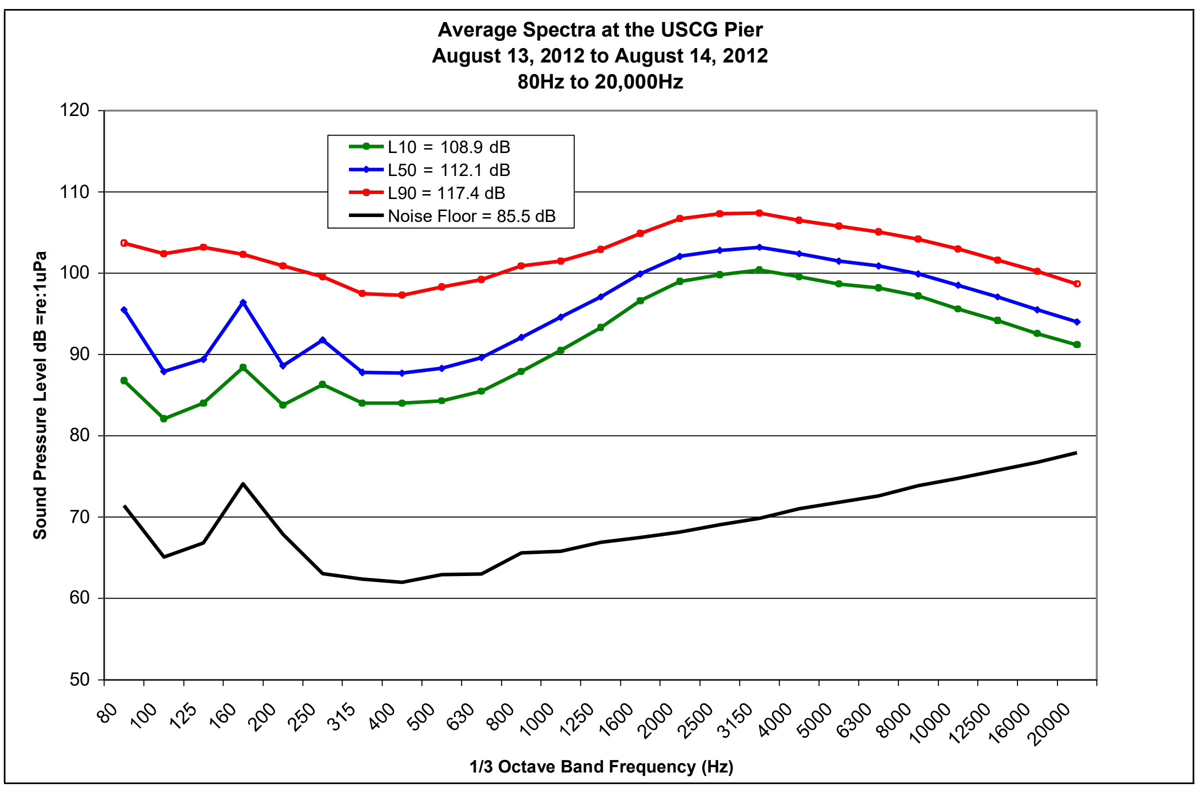
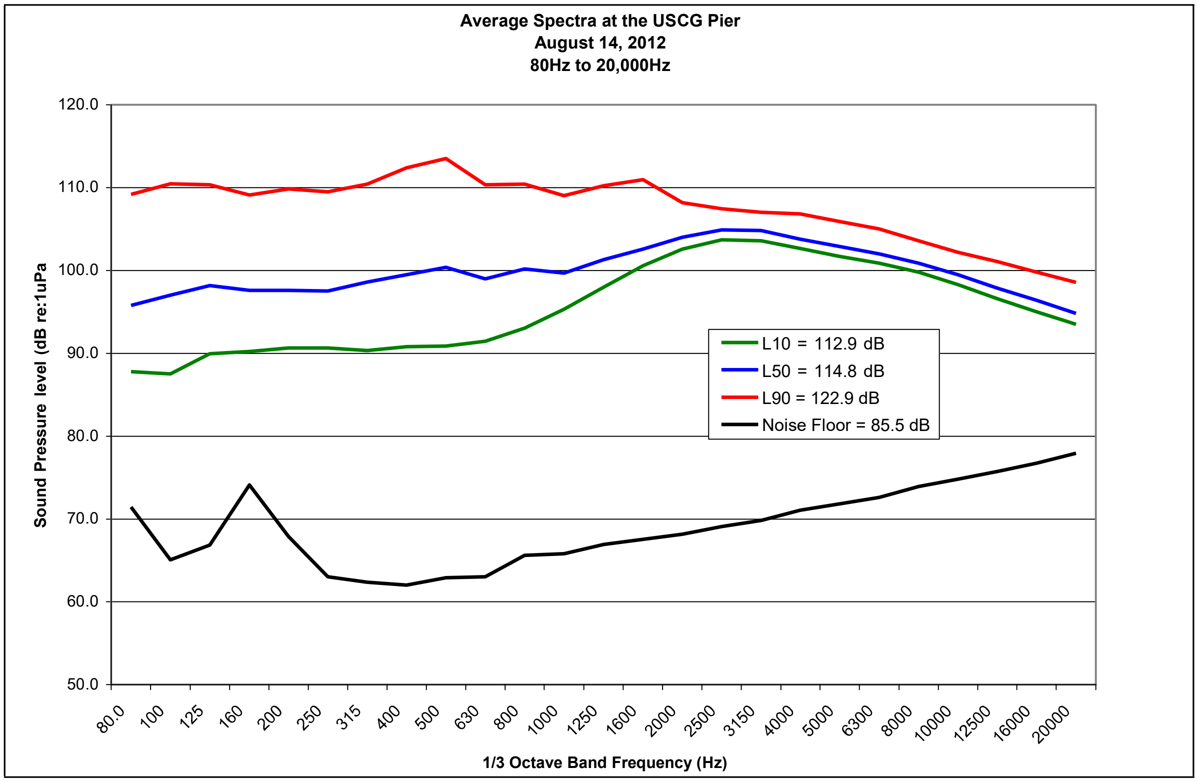
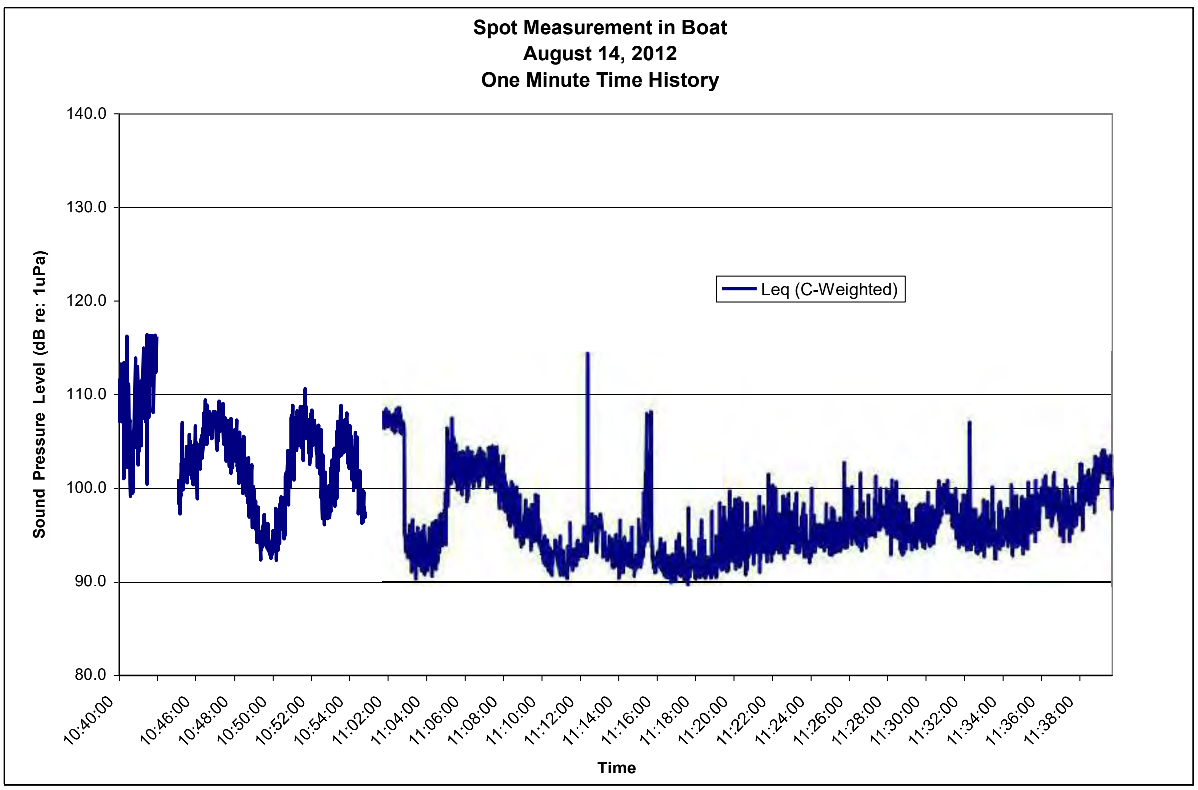
Time

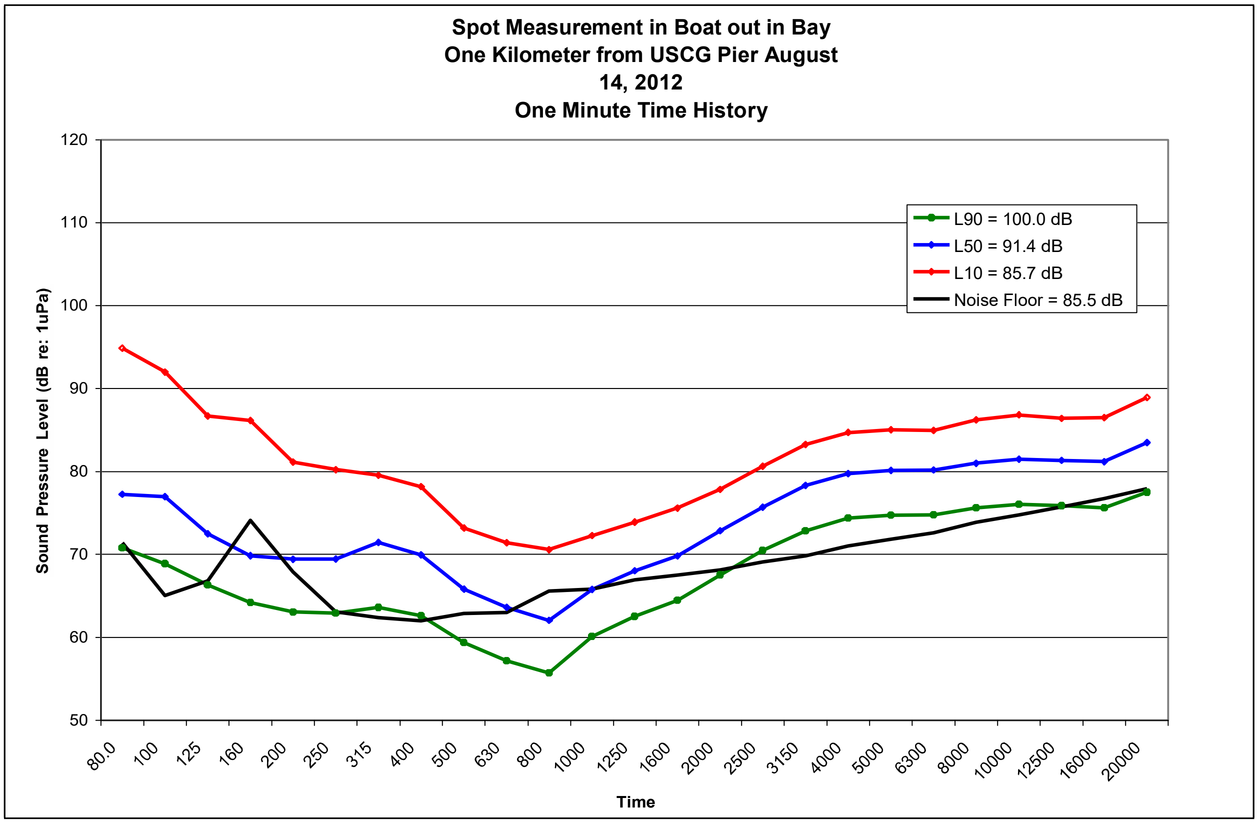

USCG Pier
August 14, 2012
0700 to 1200
One Minute Time History
Sound Pressure Level (dB re: 1uPa)
160
150
140
130
120
110
100
Leq (C-Weighted)
7:00
7:30
8:00
8:30
9:00
9:30
10:00
10:30
11:00
11:30
12:00
Time

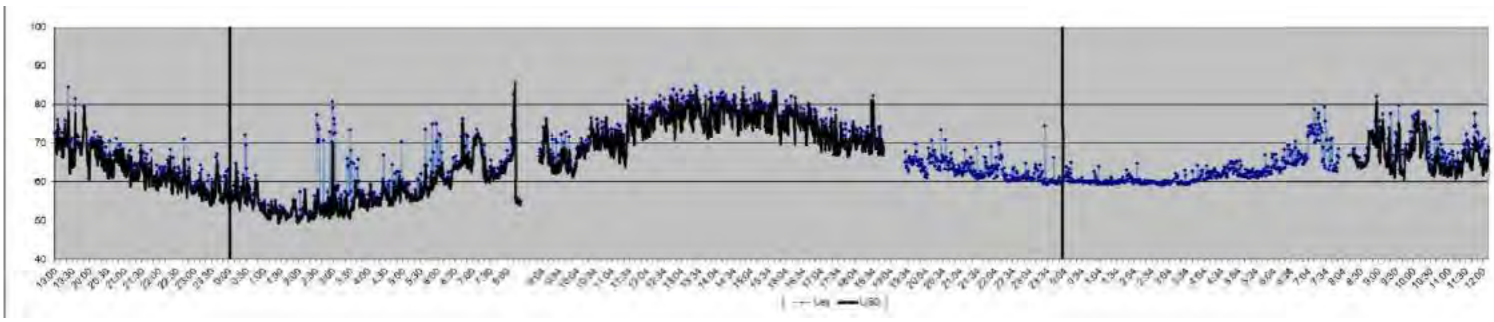

Average Spectra at the USCG Pier
August 13, 2012
80Hz to 20,000Hz
Sound Pressure level (dB re:1uPa
1/3 Octave Band Frequency (Hz)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
L10 = 1111.7dB
L50 = 114.4 dB
L90 = 121.8 dB
Noise Floor = 85.5 dB


Average Spectra at the USCG Pier
August 13, 2012 to August 14, 2012
80Hz to 20,000Hz
Sound Pressure Level dB =re:1uPa
1/3 Octave Band Frequency (Hz)
120
110
100
90
80
70
60
50
80
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
L10 = 108.9 dB
L50 = 112.1 dB
L90 = 117.4 dB
Noise Floor = 85.5 dB

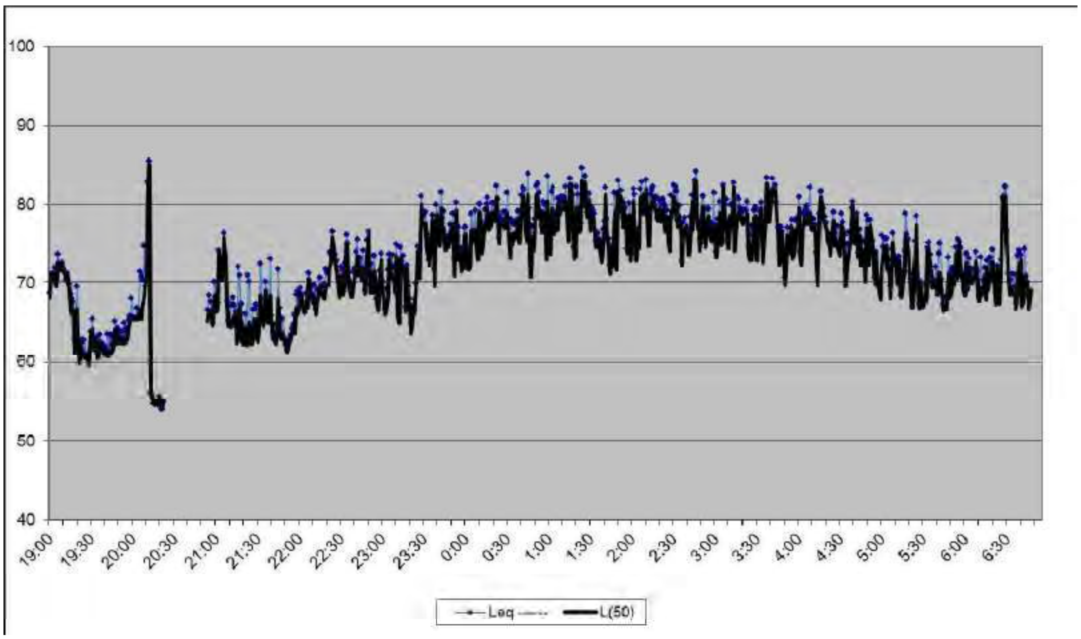

Average Spectra at the USCG Pier
August 14, 2012
80Hz to 20,000Hz
Sound Pressure level (dB re:1uPa)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
1/3 Octave Band Frequency (Hz)
L10 = 112.9 dB
L50 = 114.8 dB
L90 = 122.9 dB
Noise Floor = 85.5 dB

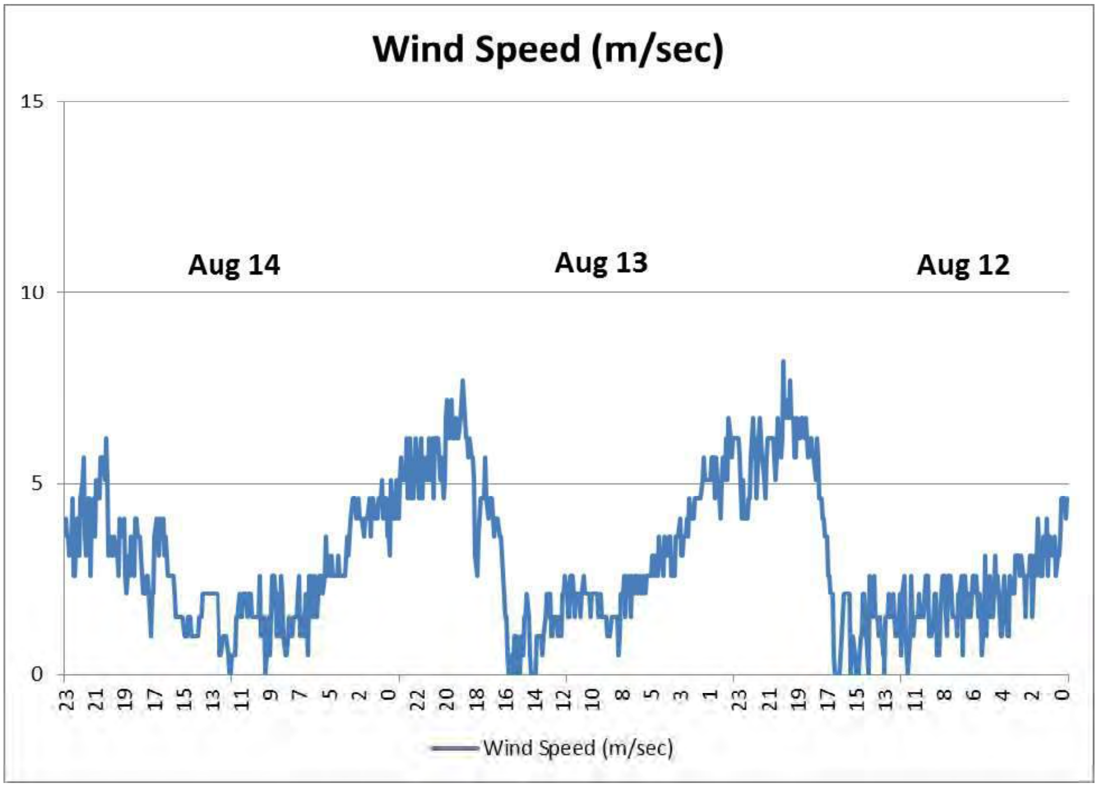

Spot Measurement in Boat
August 14, 2012
One Minute Time History
Sound Pressure Level (dB re: 1uPa)
140.0
130.0
120.0
110.0
100.0
90.0
80.0
Leq (C-Weighted)
10:40:00
10:46:00
10:48:00
10:50:00
10:52:00
10:54:00
11:02:00
11:04:00
11:06:00
11:08:00
11:10:00
11:12:00
11:14:00
11:16:00
11:18:00
11:20:00
11:22:00
11:24:00
11:26:00
11:28:00
11:30:00
11:32:00
11:34:00
11:36:00
11:38:00
Time

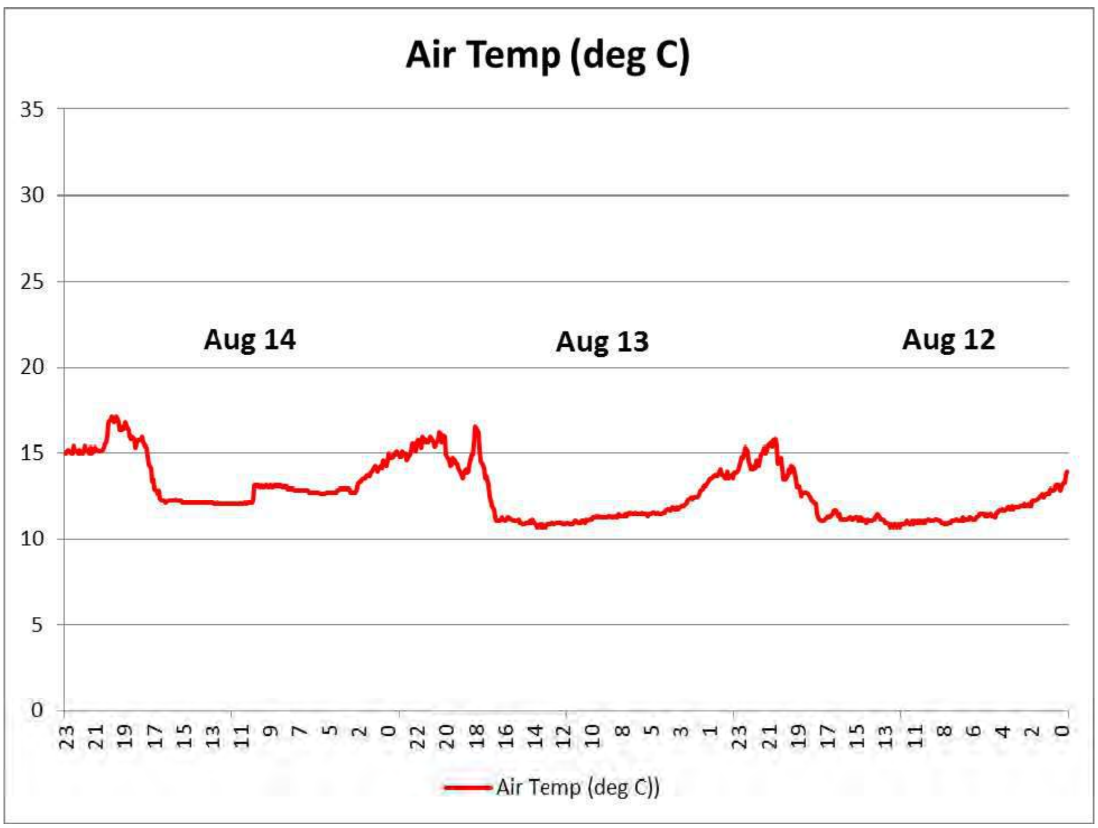

Spot Measurement in Boat out in Bay
One Kilometer from USCG Pier August
14, 2012
One Minute Time History
Sound Pressure Level (dB re: 1uPa)
120
110
100
90
80
70
60
50
L90 = 100.0 dB
L50 = 91.4 dB
L10 = 85.7 dB
Noise Floor = 85.5 dB
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
Time



Airborne Sound Levels Measured at the USCG Pier dB re 20 µPa, -







Meteorological Data Measured by NOAA in Monterey Bay

Station MTYC1 - 9413450 - Monterey, CA

Owned and maintained by NOAA's National Ocean Service

Water Level Observation Network

36.605 N 121.888 W (36°36'18" N 121°53'18" W)

Appendix B

NOAA NMFS User Spreadsheets for Calculating Level A Noise Isopleths

A: STATIONARY SOURCE: Non-Impulsive, Continuous

VERSION: 1.1 (Aug-16)

KEY

(green)	Action Proponent Provided Information
(pink)	NMFS Provided Information (Acoustic Guidance)
(blue)	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	USCG Station Monterey
PROJECT/SOURCE INFORMATION (Please include any assumptions)	Vibratory Pile Driving
PROJECT CONTACT	Will Robinson

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	2.5	default

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 43), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (RMS SPL)	168
Activity Duration (hours) within 24-h period	4
Activity Duration (seconds)	14400
10 Log (duration)	41.58
Propagation (xLogR)	15
Distance of source level measurement (meters)[+]	10

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

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

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**50.4**	**4.5**	**74.5**	**30.6**	**2.2**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION: 1.1 (Aug-16)

KEY	
(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Acoustic Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	USCG Base Alameda Waterfront Repairs
PROJECT/SOURCE INFORMATION Please include any assumptions	Impact Pile Driving
PROJECT CONTACT	Will Robinson

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	2	defaul value

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 64), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either E1-1 OR E.1-2 method to calculate isopleths (not required to fill in sage boxes for both)

E.1 1: METHOD USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	
Activity Duration (h) within 24-h period OR Number of piles per day	
Pulse Duration[Δ] (seconds)	
Number of strikes in 1 h OR Number of strikes per pile	
Activity Duration (seconds)	0
10 Log (duration)	#NUM!
Propagation (xLogR)	
Distance of source level measurement (meters)*	

[Δ]Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

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

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

RESULTANT ISOPLETHS*

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

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

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

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**195.8**

Source Level (Single Strike/shot SEL)	174
Number of strikes in 1 h OR Number of strikes per pile	30
Activity Duration (h) within 24-h period OR Number of piles per day	5
Propagation (xLogR)	15
Distance of single strike SEL measurement (meters)*	10

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

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

RESULTANT ISOPLETHS*

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

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	70.8	2.5	84.4	37.9	2.8

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-0.01	-19.74	-26.87	-2.08	-1.15

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$