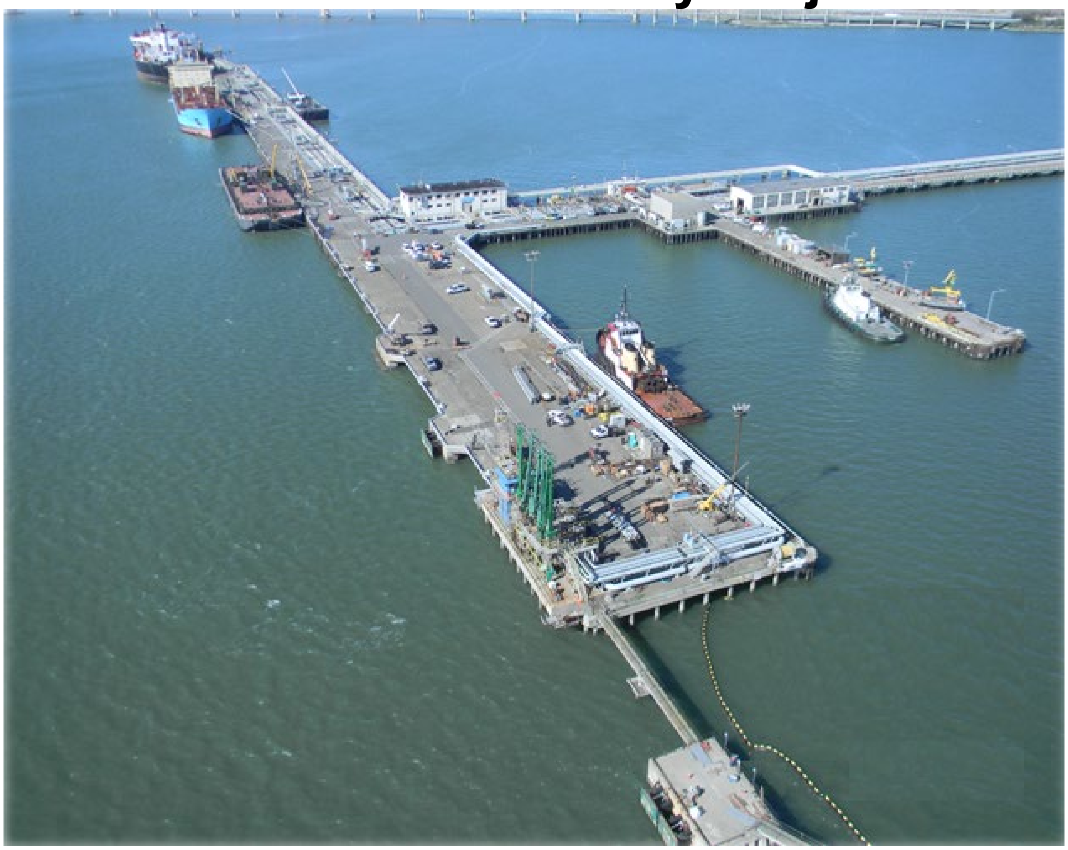
Request for Incidental Harassment Authorization

Chevron Richmond Refinery Long Wharf Maintenance and Efficiency Project



Chevron Richmond Refinery – Capital Projects

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REVISED March 2021

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Acronyms

Caltrans	California Department of Transportation
CASL	California sea lion
cSEL	cumulative sound exposure level
CSLC	California State Lands Commission
dB	decibel(s)
DPS	distinct population segment
EFH	Essential Fish Habitat
EOSC	Estuary and Ocean Science Center
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FHWG	Fisheries Hydroacoustic Working Group
FMP	fisheries management plan
GGCR	Golden Gate Cetacean Research
HAPO	Pacific harbor porpoise
HASE	Pacific harbor seal
Hz	hertz
IHA	Incidental Harassment Authorization
IWC	International Whaling Commission
L_{max}	unweighted maximum noise level
LWMEP	Long Wharf Maintenance and Efficiency Project
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MOTEMS	Marine Oil Terminal Engineering and Maintenance Standards
µPa	microPascal
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
psi	pounds per square inch
PSO	Protected Species Observer
PTS	permanent threshold shift
RMS	root mean square
RSRB	Richmond-San Rafael Bridge
SEL	sound exposure level
SFOBB	San Francisco-Oakland Bay Bridge
SPL_{peak}	instantaneous peak sound pressure level
TMMC	The Marine Mammal Center
UME	Unusual Mortality Event

1 Detailed Description of the Activity

1.1 Project History

The Long Wharf has existed in its current location since early 1900s. Its operations are regulated primarily by the California State Lands Commission (CSLC) through a State Lands lease, Article 5 of CSLC regulations, and Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) (California Building Code Chapter 31F).

The Berth 2 fender system (timber pile and whaler) was designed and installed in 1940. Marine loading arms, gangways, and fender systems at Berths 1, 3, and 4 were installed in 1972. The marine loading arms were recently replaced between 2016 and 2018. The Berth 4 fender panels were replaced in 2011 and the Berth 1 fender panels were replaced in 2012. The existing configuration of these systems have limitations to accepting more modern, fuel efficient vessels with shorter parallel mid-body hulls and in some cases do not meet current MOTEMS requirements. The Long Wharf Maintenance and Efficiency Project (LWMEP, Project) was designed to upgrade the Wharf to bring it to current codes.

Construction of the Project began in 2018 and was to be completed in 2 to 3 years. Since 2018, a number of items have been completed under previous Incidental Harassment Authorizations (IHAs), including installation of fendering systems and a seismic retrofit of Berth 4. The need for unanticipated and unscheduled dredging in 2019 prior to installing piles for the Berth 4 seismic retrofit caused a one-year delay in the Project The 2020 COVID-19 pandemic, and associated work restrictions, have caused further schedule delays, pushing the completion date to 2021. This IHA Request covers the elements that could not be completed under the 2020 IHA renewal. In addition, this application covers the removal of temporary piles not included last year. In the 2018 IHA application, 14-inch H-piles were noted as temporary piles. Although originally listed as temporary, Chevron was in the process of determining the permitting requirements to leave these fender piles in place. The 2019 IHA application had included 20-inch and 36-inch piles as temporary and listed the activities as installation and removal. The piles were installed in 2019, and the 20-inch piles were removed in October of that year, but the 36-inch piles were not. Chevron had been considering leaving the 36-inch piles in place, and they were not removed in 2020. Chevron has since reconsidered leaving any of the temporary piles in place and has decided to remove the 14-inch H-piles at Berth 2, and 36-inch piles at Berth 4. Therefore, removal of these piles is included in this 2021 application.

Section 1.4 describes the uncompleted portions of the Project to be completed in 2021.

1.2 Project Location

The Refinery Long Wharf is located in central San Francisco Bay (the Bay) just south of the eastern terminus of the Richmond-San Rafael Bridge (RSRB) in Contra Costa County. Figure 1-1 illustrates the Project vicinity and specific location.

1.3 Project Purpose

The purpose of the Project is to comply with current MOTEMS requirements and to improve safety and efficiency at the Long Wharf. To meet MOTEMS requirements, the fendering system at Berth 2 is being updated and the Berth 4 loading platform is being seismically retrofitted to stiffen the structure and reduce movement of the Long Wharf in the event of a level 1 or 2 earthquake.

1.4 Description of Proposed 2021 Construction

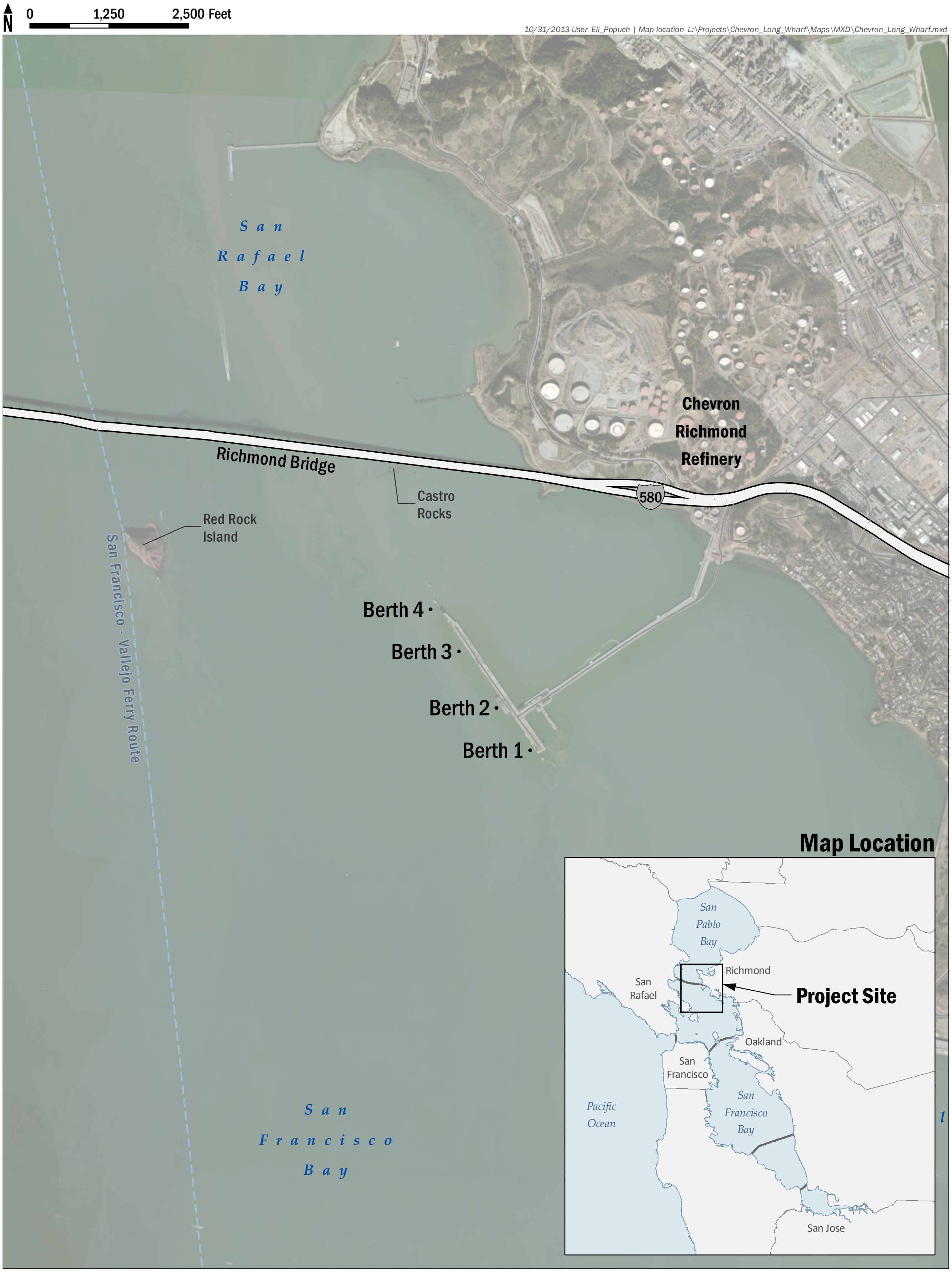
The remaining modifications in 2021 involve ongoing modifications at Berths 2 and 4 (Figure 1-1). Modifications at these berths include adding new standoff fenders, a mooring hook and adding protective barrier piles for the Berth 4 seismic retrofit. In addition, temporary piles and existing timber piles would be removed. The work to be done at Berths 2 and 4 is summarized below.

Berth 2 Modifications

The remaining modifications at Berth 2 include the following:

- Replace one bollard with a new hook.
- Install four new standoff fenders in Berth 2.
- Remove up to 106 existing timber fender piles (approximately 16 inches in diameter) and 36 temporary 14-inch steel H piles using vibratory methods.

Nine 24-inch square concrete piles will be installed with an impact driver to support the standoff fenders. A bubble curtain attenuation system will be used for this impact driving. These modifications are shown on Figure 1-2.



Chevron
Chevron Long Wharf
MAINTENANCE AND EFFICIENCY PROGRAM

FIGURE 1-1
Chevron Long Wharf - Project Location

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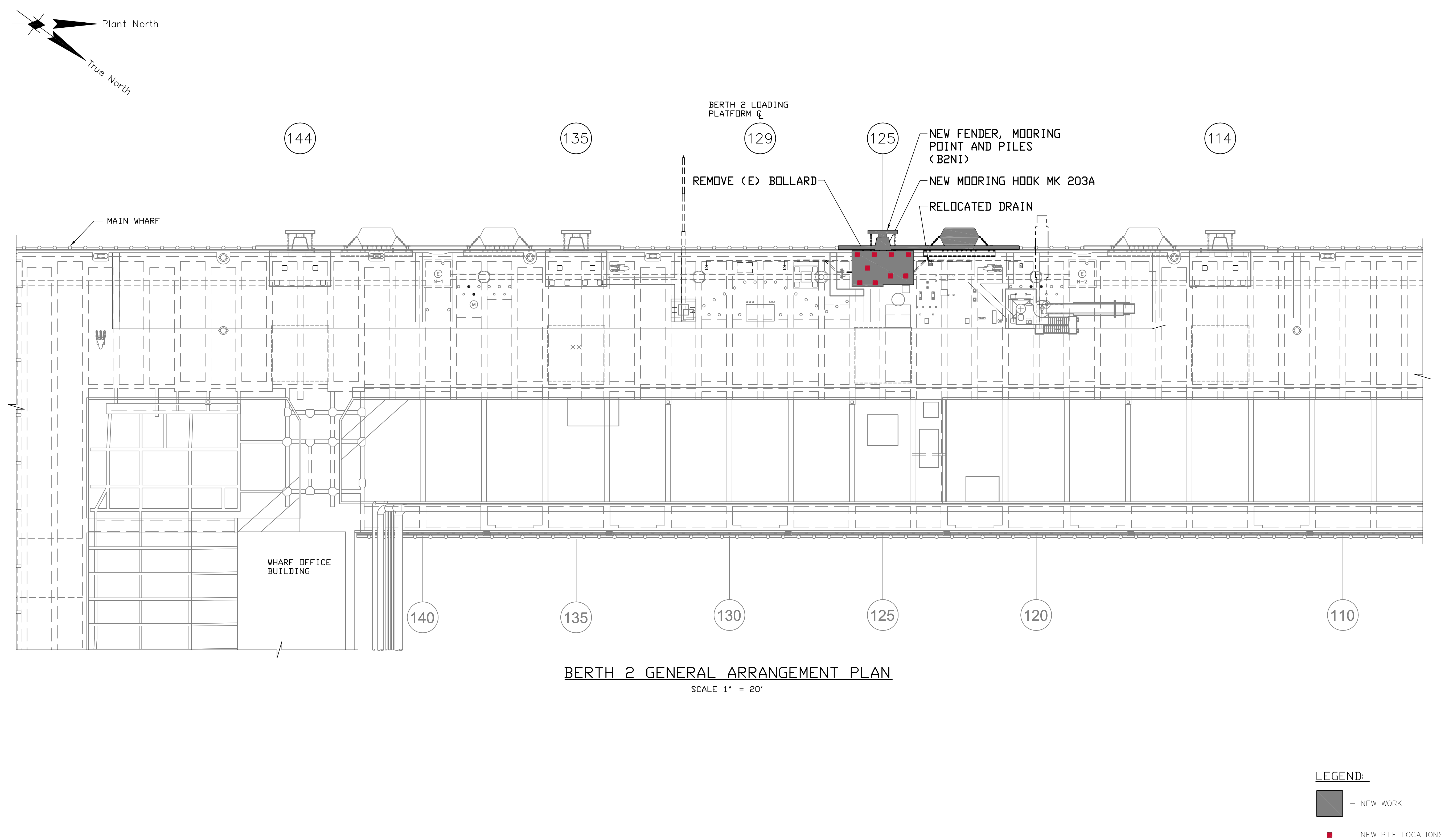

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FIGURE 1-2

Berth 2 Features

Source: Moffat & Nichol Engineers, 2015

Berth 4 Modifications

The remaining modifications at Berth 4 include the following:

- The Project will add 4 clusters of 13 composite piles 14 inches[1] in diameter (52 total composite piles) as markers and protection for the new 60-inch seismic retrofit batter piles on the east side of Berth 4 that were installed in 2020. Features are shown on Figure 1-3.

The composite piles will be installed with a vibratory driver. Up to eight 36-inch steel piles that were used to support temporary templates for the Berth 4 seismic retrofit will be removed using vibratory methods.

[1] In prior authorizations for this project, these same piles were identified as being 12 inches in diameter. The piles have a taper from 12 to 14 inches in diameter. This application is consistently referring to these piles by referencing their largest diameter.

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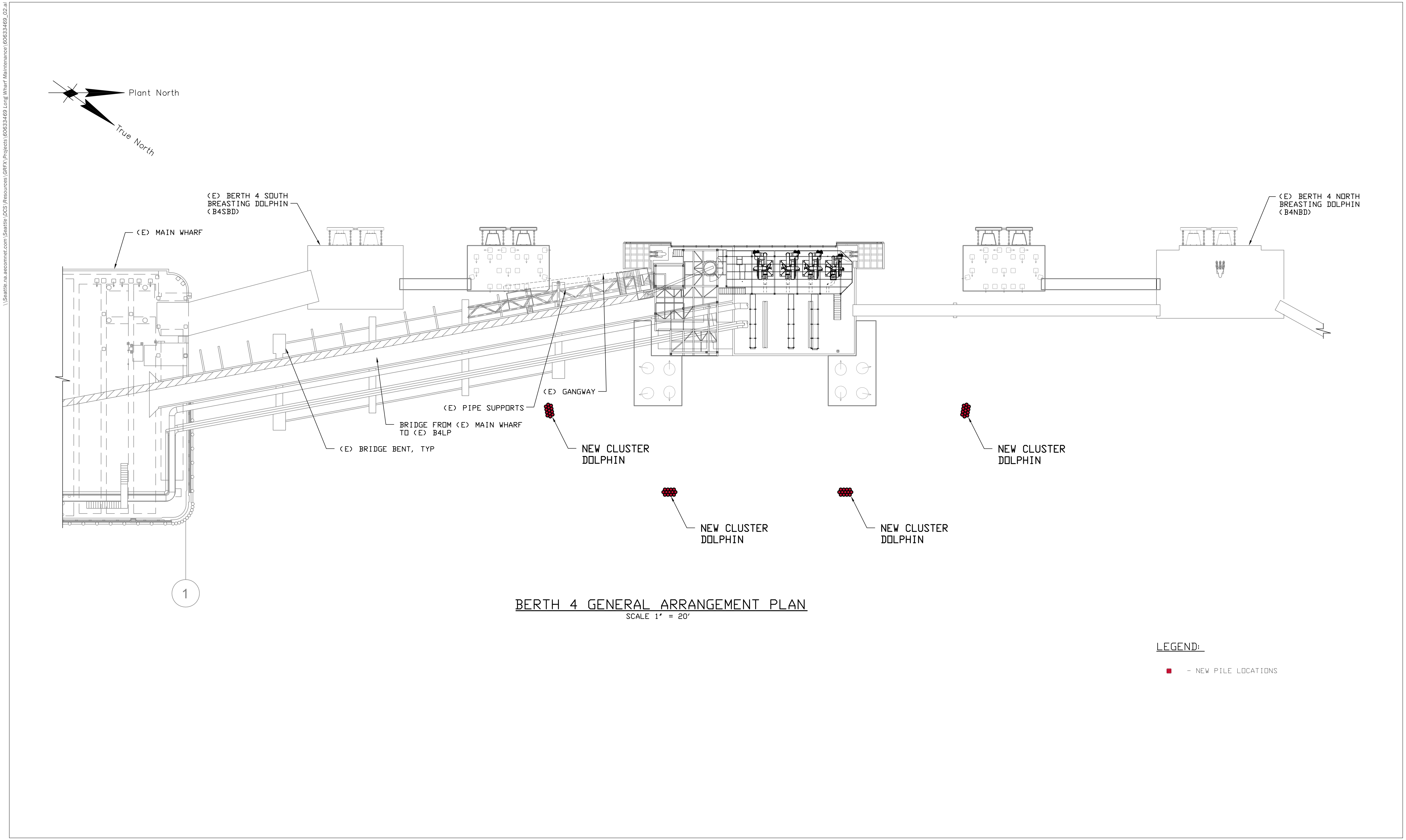

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FIGURE 1-3

Berth 4 Features

Source: Moffat & Nichol Engineers, 2015

2 Dates, Duration, and Region of Activity

2.1 Dates and Duration of Construction

Construction would be scheduled such that the Long Wharf remains operational during construction. Pile driving activities would occur within the standard National Marine Fisheries Service (NMFS) work windows for listed fish species (June 1 through November 30). Only one type of pile driving or extraction activity would be occurring on any one work day, and work at Berths 2 and Berths 4 would not be occurring simultaneously. Only one pile would be driven or extracted at a time. This application is requesting take for the remaining pile driving and extraction, planned to occur during the 2021 work season, as provided in Table 2-1.

Table 2-1: Pile Driving Summary for 2021 Work Season

Pile Type	Driver Type	Number of Piles	Number of Driving Days
Pile Driving:			
24-inch square concrete piles*	Impact	9	8
14-inch composite piles	Vibratory	52	11
Pile Extraction:			
16-inch timber piles	Vibratory	106	9
14-inch steel H pile	Vibratory	36	6
36-inch steel pipe piles	Vibratory	8	2

*A bubble curtain attenuation system will be used for all impact driving.

2.2 Project Location

As described in Section 1, the Long Wharf is located in the San Francisco Bay at Richmond, California (Figure 1-1).

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3 Species and Numbers of Marine Mammals

Although at least 35 species of marine mammals can be found off the coast of California, very few species venture into San Francisco Bay. Only Pacific harbor seals, California sea lions, and possibly harbor porpoises are considered resident species within the Bay's estuarine waters. Small numbers of gray whales are regularly sighted in the Bay during their annual migration, though most sightings tend to occur in the Central Bay near the Golden Gate. Four other species that may occur occasionally within San Francisco Bay are also considered in this application: Northern elephant seal, Northern fur seal, Steller sea lion and Common bottlenose dolphin.

3.1 Pacific Harbor Seal

The Pacific harbor seal (*Phoca vitulina richardii*) is one of five subspecies of *P. vitulina*, or the common harbor seal. They are a true seal, with a rounded head and visible ear canal, distinct from the eared seals, or sea lions, which have a pointed head and an external ear. Males and females are similar in size and can exceed 2 meters (6 feet) and 136 kilograms (300 pounds). The harbor seal diet generally consists of fish, though they also consume shrimp and shellfish. In San Francisco Bay, harbor seals forage in shallow, intertidal waters on a variety of fish, crustaceans, and a few cephalopods (e.g., octopus). The most numerous prey items identified in harbor seal fecal samples from haul-out sites in the Bay include yellowfin goby (*Acanthogobius flavimanus*), northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea harengus pallasi*), staghorn sculpin (*Leptocottus armatus*), plainfin midshipman (*Porichthys notatus*), and white croaker (*Genyonemus lineatas*) (Harvey and Torok 1994).

Harbor seals generally do not migrate annually. They display year-round site fidelity, though they have been known to swim several hundred kilometers to find food or suitable breeding habitat. The number of harbor seals in the San Francisco Bay increases in the winter foraging period compared to the spring breeding season. This pattern differs from remote coastal sites nearby where the higher abundance of seals occurs in the breeding season (Codde and Allen 2013).

The California Department of Transportation (Caltrans) conducted marine mammal surveys before and during seismic retrofit work on the RSRB in northern San Francisco Bay from May 1998 to February 2002. The surveys included extensive monitoring of marine mammals at points throughout the Bay. Although the study focused on harbor seals hauled out at Castro Rocks and Red Rock Island near the RSRB, all other observed marine mammals were recorded. Caltrans surveys determined that at least 500 harbor seals populate San Francisco Bay (Green et al. 2002). This estimate agrees with more recent seal counts in San Francisco Bay, indicating a relatively stable population size (Lowry et al. 2008, Codde and Allen 2020).

Although generally solitary in the water, harbor seals come ashore at "haul-outs"—shoreline areas where pinnipeds congregate to rest, socialize, breed, and molt—that are used for resting, thermoregulation, birthing, and nursing pups. Haul-out sites are relatively consistent from year to year (Kopec and Harvey 1995), and females have been recorded returning to their own natal haul-out when breeding (Green et al. 2006). The haul-out sites at Mowry Slough, in the south Bay, Corte Madera Marsh and Castro Rocks, in the north Bay, and Yerba Buena Island, in the central Bay, support the largest concentrations of harbor seals within the San Francisco Bay. The main pupping areas in the San Francisco Bay are at Mowry Slough and Castro Rocks (Caltrans 2012). Pups have also been observed at Corte Madera Marsh and Yerba Buena Island, although births of harbor seals have not been observed at those sites. The nearest haul-out site to the Project is Castro Rocks, approximately 650 meters (0.4 mile) north of the northernmost point on the Long Wharf.

Seals haul out year-round on Castro Rocks during medium to low tides; few alternative low tide sites are available in San Francisco Bay. Usage of Castro Rocks by harbor seals is highest during the summer molting period of June and July (Codde and Allen 2020). The seals at Castro Rocks are habituated to a degree to some sources of human disturbance such as large tanker traffic and the noise from vehicle traffic on the bridge, but often flush into the water when small boats maneuver close by or when people work on the bridge (Kopec and Harvey 1995). During the 2020 working season of the Project, protected species observers (PSO) recorded observations from the Long Wharf during construction activities. The number of seals hauled out at Castro Rocks during monitored activities varied greatly in 2020, from 0 to 50 individuals depending on tide level (AECOM 2020 - Appendix C).

During the pile driving that occurred in the 2018 construction season, 25 harbor seals were observed by PSOs in the water in proximity to the Long Wharf (AECOM 2018). In 2019, 48 harbor seals were observed in the water during construction monitoring, and in 2020, 83 harbor seals were observed (AECOM 2019, 2020). The Project PSOs recorded harbor seal behavioral changes during vibratory and impact pile driving in 2020, which included looking in the direction of the work area, and going under the surface of the water (a change from swimming or resting at the surface) when pile driving began (AECOM 2020 - Appendix C).

Due to the close proximity of the active haul-out site, it is likely that harbor seals would be incidentally harassed during construction.

3.2 California Sea Lion

The California sea lion (*Zalophus californianus*) belongs to the family Otariidae or "eared seals," referring to the external ear flaps not shared by other pinniped families. California sea lions are

sexually dimorphic: males can reach up to 2.4 meters (8 feet) long and weigh 320 kilograms (700 pounds), whereas females are smaller, at approximately 2 meters (6 feet) long and 90 kilograms (200 pounds). Sexual maturity occurs within 4 to 5 years. They are extremely intelligent and social, which has led to interactions with small-craft vessels and even bites in human swimmers in the Bay’s urban waters (Kornblith et al. 2019, Sahagún 2020).

Sea lions breed mainly on offshore islands, ranging from Southern California's Channel Islands to Mexico, although a few pups have been born on Año Nuevo and the Farallon Islands approximately 30 miles offshore from San Francisco Bay (TMMC 2020). Over the monitoring period for the RSRB, monitors sighted at least 90 California sea lions in the North Bay and at least 57 in the Central Bay. No pupping activity was at any locations within the San Francisco Bay (Caltrans 2012).

Although California sea lions forage and conduct many activities within the water, they also use haul-outs. In the Bay, sea lions haul out primarily on floating docks at Pier 39 in the Fisherman’s Wharf area of the San Francisco Marina, approximately 12.5 kilometers (7.8 miles) southwest. This species used the Bay in greater numbers during El Niño conditions. Based on counts done in 1997 and 1998, the number of California sea lions that haul out at Pier 39 fluctuates with the highest occurrences in August and the lowest in June. Of the California sea lions observed, approximately 85 percent were males. An estimated 1,105 animals were observed in September 2001 at Pier 39 (Parsons Brinckerhoff 2001), and winter numbers are generally more than 500 animals (Goals Project 2000). The California sea lions usually arrive at Pier 39 in August after returning from the Channel Islands (Caltrans 2013). In addition to the Pier 39 haul-out, California sea lions haul out on buoys and similar structures throughout the Bay. They are seen swimming off mainly the San Francisco and Marin shorelines within the Bay but may occasionally enter the Project area to forage.

California sea lions feed on seasonally abundant schooling fish, rockfish, and squid. Seasonal and annual dietary shifts vary with environmental conditions that affect prey populations. In central California sea lion populations, short-term seasonal diet changes correspond to prey movement and life history patterns, whereas long-term annual changes correspond large-scale ocean climate shifts and foraging competition with commercial fisheries (Weise and Harvey 2008, McClatchie et al. 2016, De Long et al. 2017). The California sea lions that use the Pier 39 haul-out site may be feeding on Pacific herring (*Clupea harengus*), northern anchovy (*Engraulis mordax*), and other prey within the waters of the Bay (Caltrans 2013). They have also been observed foraging on a regular basis in the shipping channel south of Yerba Buena Island. The relatively deep shipping channel west and north of the Long Wharf also provides foraging areas for California sea lions.

LWMEP PSOs documented a California sea lion foraging on a small shark along the west side of the Long Wharf during construction monitoring in 2019, and a total of eight sea lions were observed during monitoring periods in 2020 (AECOM 2019, 2020). Most of the sea lion observations occurred west of the Long Wharf in 2020. The Project PSOs recorded California sea lion behavioral changes during vibratory and impact pile driving in 2020, which included looking in the direction of the work area, and going under the surface of the water (a change from swimming or resting at the surface) when pile driving began (AECOM 2020 - Appendix C).

Because California sea lions forage over a wide range in San Francisco Bay, it is likely that some individuals would be incidentally harassed during construction.

3.3 Steller Sea Lion

Steller sea lions (*Eumetopias jubatus*) have been reported at Año Nuevo Island between Santa Cruz and Half Moon Bay and at the Farallon Islands about 48 kilometers (30 miles) off the coast of San Francisco (Fuller 2012). Two studies of Steller sea lion distribution did not detect individuals in San Francisco Bay. The SF Bay Subtidal Habitat Goals Report, Appendix 2-1 contains one reference to Steller sea lions in the San Francisco Bay, stating that since 1989, several hundred California Sea Lions have congregated in the winter on docks at Pier 39, which are on rare occasions joined by a few Steller sea lions (Cohen 2010). No Stellar sea lion sightings have occurred during monitoring periods of the LWMEP from 2018 through 2020.

This species is a rare visitor to San Francisco Bay and is not expected to occur in the Project area during construction. As a result, this species is not considered further.

3.4 Northern Elephant Seal

Northern elephant seals (*Mirounga angustirostris*) are common on California coastal mainland and island sites where they pup, breed, rest, and molt. The largest rookeries are on San Nicolas and San Miguel islands in the Northern Channel Islands. In the vicinity of San Francisco Bay, elephant seals breed, molt, and haul out at Año Nuevo Island, the Farallon Islands, and Point Reyes National Seashore (Lowry et al. 2014). Adults reside in offshore pelagic waters when not breeding or molting. Northern elephant seals haul out to give birth and breed from December through March, and pups remain onshore or in adjacent shallow water through May, when they may occasionally make brief stops in San Francisco Bay (Caltrans 2015). When pups of the year return in the late summer and fall to haul out at rookery sites, they may also occasionally make brief stops in San Francisco Bay. Elephant seal pups are regular seasonal patients at The Marine Mammal Center (TMMC) in Sausalito, California, and a healthy juvenile male was observed basking at Aquatic Park, in San Francisco, in the Spring of 2019 (Hernández 2020). No Northern

elephant seal sightings have occurred during monitoring periods of the LWMEP from 2018 through 2020.

Incidental take of this species is being requested in the rare event a few individuals are present in San Francisco Bay during pile driving.

3.5 Northern Fur Seal

The range of the northern fur seal (*Callorhinus ursinus*) extends from southern California, north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (NMFS 2015e). During the breeding season, the majority of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean. On the coast of California, small breeding colonies are present at San Miguel Island off southern California, and the Farallon Islands off central California (NMFS 2015e). Northern fur seal are a pelagic species and are rarely seen near the shore away from breeding areas. The species shows high site fidelity to breeding and rookery haul-out locations, making long-distance swims to find prey if necessary. Fur seals feed on small schooling fish, such as walleye pollock, herring, hake, anchovy and squid. Similar to sea lions, dietary shifts and long-term population trends may vary with environmental conditions that affect prey populations. Juveniles of this species occasionally strand in San Francisco Bay, particularly during El Niño events (TMMC 2016). No Northern fur seal sightings occurred during monitoring periods of the LWMEP from 2018 through 2020.

Incidental take of this species is being requested in the rare event a few individuals are present in San Francisco Bay during pile driving.

3.6 Harbor Porpoise

The harbor porpoise (*Phocoena phocoena*) is a member of the Phocoenidae family. They generally occur in groups of two to five individuals, and are considered to be shy, relatively nonsocial animals. The harbor porpoise has a small body, with a short beak and medium-sized dorsal fin. They can grow to approximately 1.5 meters (5 feet) and 80 kilograms (176 pounds). Females are slightly larger than the males, and reach sexually maturity at 3 to 4 years. They are typically found in waters less than 75 meters (246 feet) deep within coastal waters, bays, estuaries, and harbors. A systematic ship survey of depth strata out to 90 meters depth in northern California showed that porpoise abundance declined significantly in waters deeper than 60 meters (Carretta et al. 2001). Their prey base consists of demersal and benthic species, such as schooling fish and cephalopods (NOAA 2012b).

In prior years, harbor porpoises were observed primarily outside of San Francisco Bay. The few harbor porpoises that entered did not venture far into Bay. No harbor porpoises were observed during marine mammal monitoring conducted before and during seismic retrofit work on the

RSRB, which is just north of the Long Wharf (Figure 1-1). However, in recent years there have been increasingly common observations of harbor porpoises within San Francisco Bay. According to observations by Golden Gate Cetacean Research (GGCR) (housed under TMMC in Sausalito, California), as part of their multi-year assessment, approximately 225 harbor porpoises have been observed in the San Francisco Bay (Caltrans 2012). During 6 days of marine mammal monitoring in 2017 for the San Francisco – Oakland Bay Bridge dismantling (monitoring was conducted for an average of 2 hours and 45 minutes per day), a total of 32 harbor porpoises were observed (Caltrans 2018). During the LWMEP 2019 monitoring period from June to November 2019, one harbor porpoise was observed in the Project vicinity; and in 2020, PSOs observed four total harbor porpoises from June to October (AECOM 2019, 2020b).

Harbor porpoise sightings are generally concentrated in the vicinity of the Golden Gate (approximately 12 kilometers [7.5 miles] southwest of the Project site) and Angel Island (6 kilometers [3.7 miles] southwest of the Project site), with lesser numbers sighted in the vicinity of Alcatraz and around Treasure Island (Keener 2011). Sightings also occasionally occur from the shoreline of Tiburon, directly across the Bay from the Long Wharf (EOSC 2020). The sightings in the LWMEP vicinity were observed close to Red Rocks and the nearby shipping channel, west and northwest of the Long Wharf (AECOM 2020 - Appendix C).

Because this species is more frequently venturing into the Bay east of Angel Island, there is a chance that a small number of individuals could be incidentally harassed.

3.7 Bottlenose Dolphins

The common bottlenose dolphin (*Tursiops truncatus truncatus*) is part of the Delphinidae family. The species is found is all oceans across the globe, and is one of the most commonly observed marine mammal species found along coastal waters and in estuaries. Bottlenose dolphins are large a solid gray in color, weighing up to 1,400 pounds and can reach lengths of about 13 feet. Sexual maturity occurs between 5 to 14 years of age. Calves stay with the mother for approximately 2 to 4 years. They are extremely social and intelligent and have complex social structures. They are usually observed in groups of at least five to 10 individuals. They eat a variety of fish species, squid, and crustaceans.

The range of the California Coastal stock of bottlenose dolphin has expanded northward along the Pacific Coast since the 1982-1983 El Niño (Carretta et al. 2013, Wells and Baldridge 1990). They now occur as far north as the San Francisco Bay region and have been observed along the coast in Half Moon Bay, San Mateo, Ocean Beach in San Francisco, and Rodeo Beach in Marin County. The species shows little site fidelity to any portion of the California coastal distribution (Weller et al. 2016). Observations indicate that bottlenose dolphin occasionally enter San

Francisco Bay, sometimes foraging for fish in Fort Point Cove, just east of the Golden Gate Bridge (GGCR 2014). Transient individuals of this species occasionally enter San Francisco Bay, observations indicate that they remain in proximity to the Golden Gate near the mouth of the Bay and would not be within the Project area during construction. No bottlenose dolphin sightings have occurred during monitoring periods of the LWMEP from 2018 through 2020.

Incidental take of this species is being requested in the rare event a few individuals are present in San Francisco Bay during pile driving.

3.8 Whales

3.8.1 Gray Whale

Gray whales (*Eschrichtius robustus*) are large baleen whales. They grow to approximately 15 meters (49 feet) in length and weigh up to 36 metric tons (40 short tons). 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. 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 (NOAA 2012c). They feed in northern waters primarily off the Bering, Chukchi, and western Beaufort seas during the summer, before heading south to the breeding and calving grounds off Mexico over the winter. Between December and January, late-stage pregnant females, adult males, and immature females and males migrate southward. The northward migration occurs between February and March. During this time, recently pregnant females, adult males, immature females, and females with calves move north to the feeding grounds (NOAA 2003). Gray whales commonly feed in nearshore waters just outside of San Francisco Bay, and a few individuals enter into the San Francisco Bay during their northward migration.

RSRB project monitors recorded 12 living and two dead gray whales, all in either the Central or North Bay, and all but two sightings occurred during the months of April and May (Winning 2008). One (1) gray whale was sighted in June and one in October (the specific years were unreported). In the Spring of 2019, nine dead gray whales washed up on the shoreline of the Bay and on Ocean Beach on the west side of San Francisco. Ship strikes and malnutrition were the cause of deaths for all but one, which was unknown (Katz 2019). According to TMMC records, between one to three gray whales strand in or near the Bay annually during the migration season (Katz 2019). No gray whale sightings have occurred during monitoring periods of the LWMEP from 2018 through 2020.

The Oceanic Society has tracked gray whale sightings since they began returning to the Bay regularly in the late 1990s. A study conducted by the Oceanic Society in 2001 found that of a

total of 98 whales that entered the Golden Gate, most ventured only a mile or two into the Bay, but some ventured past San Pablo Bay (Self 2012). The Oceanic Society data show that all age classes of gray whales are entering the Bay and that they enter as singles or in groups of up to five individuals. However, the data do not distinguish between sightings of gray whales and number of individual whales (Winning 2008).

It is likely that gray whales enter the Bay in any given year, typically from March to May, outside of the June to November window when pile driving would occur.

3.8.2 Humpback Whale

Humpback whales (*Megaptera noveangliae*) are rare, though well-publicized, visitors to the interior of San Francisco Bay. They are more commonly observed in offshore waters. Climate variables highly influence humpback whale diet and annual changes in feeding areas along the California coast (Fleming et al., 2015). The Gulf of the Farallones, approximately 30 miles offshore from San Francisco Bay, is a distinct and managed important feeding ground for the species (Calambokidis et al. 2014, NMFS 2020a).

A humpback whale nicknamed "Humphrey" journeyed through the Bay and up the Sacramento River in 1985 and re-entered the Bay in the fall of 1990, stranding on mudflats near Candlestick Park (Fimrite 2005). In May 2007, a humpback whale mother and calf spent slightly more than 2 weeks in San Francisco Bay and the Sacramento River before finding their way back out to sea. No humpback whale sightings have occurred during monitoring periods of the LWMEP from 2018 through 2020.

Although it is possible that a humpback whale will enter the Bay and find its way into the Project area during construction activities, their occurrence is very unlikely and no take for this species is being sought. As a result, this species is not considered further.

4 Status and Distribution of the Affected Species

4.1 Pacific Harbor Seal

The Pacific Harbor Seal is protected under the Marine Mammal Protection Act (MMPA), but not threatened or endangered under the Endangered Species Act (ESA). Pacific harbor seals have the broadest range of any pinniped, inhabiting both the Atlantic and Pacific oceans. In the Pacific, they are found in near-shore coastal and estuarine habitats from Baja California to Alaska, and from Russia to Japan. Pacific harbor seals generally do not migrate annually.

Of the three recognized populations of Pacific harbor seals along the west coast of the continental United States, the California stock occurs within California coastal waters. Although the different populations are genetically distinct, 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. There are approximately 400 to 600 harbor seal haul-out sites in California, distributed widely along the mainland and offshore islands. The estimated population of the California stock is 30,968 (Table 4-1). This record is consistent with the Final Marine Mammal Stock Assessments, released in 2017 and the Draft 2020 Pacific Marine Mammal Stock Assessments (NOAA 2017, NMFS 2020a). The population assessments are extrapolated from observations of the number of Pacific harbor seals ashore during the peak haul-out period (May to July) during the 2012 surveys. The number of pacific harbor seals observed was multiplied by a correction that is equal to the "inverse of the estimated fraction of seals on land" (NOAA 2017). Pacific harbor seals are precocial, with the pups entering the water right after birth. As a result, it was not possible to count the number of pups.

Between 1981 and 2004, the Pacific harbor seal population increased, followed by a steady decrease between 2005 and 2010. The maximum statewide count from 1981 to 2009 also showed the California stock had been on a sharp decline in 2009 and in 2012 after surveys were conducted. The breeding population of harbor seals on the Farallon Islands was below the ten-year average in 2018; however the pupping rate remained consistent (Duncan 2020). Generally, the California stock has increased since the MMPA in 1972, but seal counts in San Francisco Bay have remained comparatively small (Sedlak and Greig 2012). It is hypothesized that the California stock is stabilizing at what may be its carrying capacity, but may see annual declines due to fisheries mortalities (Duncan 2020). Other conservation concerns near the Bay include vessel strikes, disturbance, entanglements in fishing gear, and habitat loss.

Table 4-1: Stock Assessment of Marine Mammal Stocks Present in San Francisco Bay

Species	Stock Name	Stock Abundance	Relative Occurrence in San Francisco Bay	Season(s) of Occurrence
Pacific harbor seal *(Phoca vituline)*	California stock	30,968	Common	Year-round
California sea lion *(Zalophus californianus)*	Eastern U.S. stock	257,606	Common	Year-round
Harbor porpoise *(Phocoena phoceona)*	San Francisco-Russian River Stock	7,524	Common in the vicinity of the Golden Gate and Richardson's Bay, occasional elsewhere	Year-round
Gray Whale *(Eschrichtius robustus)*	Eastern North Pacific stock	26,960	Occasional in the vicinity of the Golden Gate. Rare elsewhere.	Spring
Humpback whale (*Megaptera novaeangliae*)	California/Oregon/ Washington stock	2,900	Occasional in the vicinity of the Golden Gate. Rare elsewhere.	Summer and Fall
Bottlenose dolphin *(Tursiops truncates)*	California Coastal stock	453	Common in the vicinity of the Golden Gate and Richardson's Bay. Rare elsewhere.	Year-round
Northern elephant seal (*Mirounga angustirostris*)	California Breeding Stock	179,000	Rare	Spring and Fall
Northern fur seal (*Callorhinus ursinus*)	California stock	14,050	Rare; stranding may occur in San Francisco Bay during El Niño years.	Year-round

Source:
NOAA 2017, NOAA 2019, NMFS 2020a

Castro Rocks and other haul-outs in San Francisco Bay are part of the regional survey area for long-term National Park Service (NPS) monitoring studies of harbor seal colonies within the Golden Gate National Recreation Area that have been conducted since 1976 (NPS 2014). In 2019, the numbers at Castro Rocks averaged 291 individuals (adults and pups) during breeding season, and 237 during the molting season (Codde 2020). Survey data indicates that harbor seal usage of Castro Rocks has steadily increased in recent years, with the largest observations at Castro Rocks in 17 years of monitoring occurring in 2019 (Codde 2020). However, regional counts in 2017, 2018, and 2019 during breeding and molting seasons show the regional population of harbor seals is in-line with a 17-year average (Codde and Allen 2020).

4.2 California Sea Lion

The California sea lion is protected under the MMPA, but not threatened or endangered under the ESA. Under the Endangered Salmon Predation Prevention Act that amended the MMPA in 2018, National Oceanic and Atmospheric Administration (NOAA) Fisheries Authorizes states and tribes to remove sea lions to conserve protected fish populations Preying on Protected Fish

in the Columbia River Basin (NOAA 2020). 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 the Northern Gulf of California. Members of the Pacific Temperate population, which range between Canada and Baja California, occur within the Project area. According to the most recent Stock Assessment report, last updated March 18, 2019, the Pacific Temperate population is estimated to be 257,606 animals, which corresponds with a pup count of 47,691 animals along the U.S. west coast (Laake et al. 2018) (Table 4-1). This record is consistent with the Draft 2020 Pacific Marine Mammal Stock Assessments, and updated from the 2014 stock assessment report as well as the Final Pacific Marine Mammal Stock Assessments released in 2017, that estimated 296,750 animals (NMFS 2015c).

California sea lions different age and sex classes are not all ashore at any given time, so previous population assessments were based on an estimate of the number of births and number of pups in relation to the known population. The previous population estimate was derived from visual surveys. The updated population estimate instead is derived from visual surveys, mark-recapture surveys of different age and sex classes, along with bycatch and other mortality estimates (NMFS 2019b). Estimates of the total population size based on the more recent pup counts made in 2011, which show the highest record to date, are currently being developed.

Statistical analysis of the pup counts between 1975 and 2014 determined an annual increase of the California stock. However, there are substantial mortality events and the population decreased 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. According to NOAA, pup and juvenile mortality in turn affects future age and sex classes. Additionally, because there are fewer females present in the population after such events, pup production is further limited. The decline in pup production observed during 2000 and 2003 can be attributed in part to previous El Niño events, which affected the number of reproductive females within the population (NOAA 2017). Other conservation concerns are vessel strikes, competition for forage with commercial fisheries, domoic acid poisoning, hookworms, and climate change. DeLong et al. 2017 estimates that for each 1 degree C increase in SST, the estimated odds of survival decline by 50 percent for pups and yearlings, based on the same NOAA population survey trends presented in the 2019 stock assessment report.

An Unusual Mortality Event (UME) of California sea lions also occurred in 2013, which was not an El Niño year. This UME was classified due to unusually high numbers of stranded juvenile “young of the year” sea lions that exhibited symptoms of dehydration, emaciation, and low weight for their age (NOAA 2017). This event was generally limited to California Counties

south of and including Santa Barbara County. The cause of this UME is still under investigation, but two likely contributors were a change in the availability of sea lion prey, especially sardines, which are a high value food source for mothers when nursing pups, and unknown disease agents during that time period (NOAA 2017). Although current data show changes in availability of sea lion prey in Southern California waters and unknown disease agents were likely contributors to the UME, the exact mechanism is still under investigation (NOAA 2017).

Sea lion counts at Pier 39 vary by season and annually. There were two major drop-offs in 2009 and in 2014, but those records are not tied to population trends – rather, it is thought that the animals simply choose other haul-outs, for unknown reasons (Alexander 2014). The maximum count on the Farallon Islands in recent 2018 and 2019 seasons indicate the Islands are becoming an increasingly important breeding ground as a result of an expanding population near San Francisco Bay. The maximum counts at this location have steadily increased since 1970. Pups were first observed in 1983, and have had the highest counts in the last decade (Duncan 2020).

4.3 Harbor Porpoise

Harbor are protected under the MMPA, but are not considered endangered or threatened under the ESA. Harbor porpoise have a broad range in both the Atlantic and Pacific Oceans. In the Pacific, they are found from Point Conception, California to the Alaska; and from Kamchatka and Japan. The harbor porpoise population along the Pacific coastline consists of nine distinct stocks (the Morro Bay, 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 San Francisco-Russian River stock is the population that could occur within the Project area.

The San Francisco-Russian River stock consists of 7,524 individuals (Table 4-1) (NMFS 2020a). This record is consistent with the Draft 2020 Pacific Marine Mammal Stock Assessments, and updated from the 2014 stock assessment report as well as the Final Pacific Marine Mammal Stock Assessments released in 2017, that estimated 9,886 animals. Previous estimates were based on aerial surveys that were conducted between 2007 and 2011, within to 50-fathom isobath range. More recent surveys have been conducted in deeper waters (up to 200 meters) to provide a more accurate estimate of those animals that may travel between the Bay and the Gulf of the Farallones, as well as those that may be missed by aerial observers.

Over the last 5 years, there have been no reported fishery-related deaths or injury of harbor porpoises within the range of the San Francisco-Russian River stock (NOAA 2017). The population size peaked in 2005 at about 14,500 porpoises, and then dropped to about 7,000 to 8,000 porpoises during 2010 through 2017 (NMFS 2020b). The reason for the decline is

hypothesized to be a shift in habitat use from where surveys have been conducted historically in offshore waters, into the Bay (Stern et al. 2017, Forney et al. 2019).

4.4 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 distinct population segment (DPS). Gray whales are protected by the MMPA throughout their range. The Western North Pacific DPS is additionally listed as Endangered under the ESA, and considered depleted under the MMPA. The Eastern North Pacific DPS is not listed as strategic or depleted under the MMPA, nor is it listed as threatened or endangered under the ESA. Studies have documented approximately 30 gray whales observed in both the Western and Eastern North Pacific; however there are still significant genetic differences between the two stocks (NMFS 2019c). The Eastern DPS is the stock that is observed in San Francisco Bay.

Animals that spend the summer and autumn feeding in coastal waters of the Pacific coast of North America from California to southeast Alaska are additionally recognized as the "Pacific Coast Feeding Group" but are not yet managed as a distinct stock (IWC 2012, NMFS 2019c). Animals in the Pacific Coast Feeding Group typically migrate past San Francisco Bay from February to May, and are sighted in far northern California, Oregon, and Alaska from June 1 to November 30 (Gosho et al. 2011, Calambokidis et al. 2017 as cited in NMFS 2019c). Eastern North Pacific gray whales migrate each year along the west coast of North America. Shore-based observations in central California have been recorded since 1967. Based on shore observations in 2015 and 2016 and according to the most recent Stock Assessment report last revised May 15, 2019, the population is estimated to consist of 26,960 individuals (Table 4-1) (NMFS 2019c). This record is consistent with the Draft 2020 Pacific Marine Mammal Stock Assessments, and updated from the Final Pacific Marine Mammal Stock Assessments released in 2017, that estimated 20,990 animals (NOAA 2017).

The population of the Eastern North Pacific gray whale stock has increased over the last 20 years (NMFS 2019c). Excluded from this trend are two UMEs, one in 1999/2000 and one in 2019/2021. In the 1999/2000 UME, gray whales were observed in unusually high numbers along the entire west coast of the North America; 651 gray whales stranded. As of February 4, 2021, a total of 391 gray whales have stranded in the 2019/2021 UME (NMFS 2019d, 2021). A total of 34 gray whales were recorded stranded along California coasts in 2019, and 18 gray whales in 2020, compared to the 18 year average from 2001 to 2018 of less than 10 gray whales (NMFS 2021). The cause of death in most of the gray whales was emaciation, in others, ship strikes and fishery gear entanglements – all common conservation concerns throughout gray whales' range

and near the Bay. NOAA Fisheries is still investigating data from both UMEs linked to greater ocean environmental conditions (NMFS 2019d, 2020c). Gray whales migrate extremely long distances each year and rely on regions of reliable high productivity. Although gray whale populations are considered stable, California's shifting ocean climate and a warming Alaska is likely putting pressure on the species that is highly susceptible to climate change.

4.5 Northern Elephant Seal

The Northern elephant seal is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA, nor is it listed as endangered or threatened under the ESA (NMFS 2015d). Northern elephant seal population size is estimated by approximation from the number of pups produced because all age classes are not ashore simultaneously. Based on the NOAA Fisheries stock assessment last updated July 31, 2015, Lowry et al. (2014) reported that 40,684 pups were born at U.S. rookeries in 2010 with 23 percent pup survival. From this, a total population estimate of approximately 179,000 elephant seals has been made (Lowry et al. 2014), of which 81,368 are the California Breeding stock (Table 4-1) (NMFS 2015d). This record is consistent with the Final Marine Mammal Stock Assessments, released in 2017 and the Draft 2020 Pacific Marine Mammal Stock Assessments (NMFS 2017a, 2020a).

According to the NPS, the number of Northern elephant seals that use Point Reyes shores for breeding have increased every year since 1980; and in 2018, the NPS at Drake's Beach recorded the largest number of elephants seals ever recorded at that location, and high pup survival (Robertson 2018). During the 2019 breeding season on the South Farallon Islands, 90 cows had a 78 percent pupping rate, down significantly when compared to the 2017 and 2018 seasons (Duncan 2020). However, pup survival and weaning success were both up compared to the 2018 season. The long term average since 2009 shows 74 percent pup survival, 67 percent weaning success on the Islands. Northern elephant seals haul out to give birth and breed from December through March. Pups remain onshore or in adjacent shallow water through May. Both sexes make two foraging migrations each year: one after breeding and the second after molting (Stewart and DeLong, 1995). Pup mortality is high when they make the first trip to sea in May, and this period correlates with the time of most strandings.

Pups of the year return in the late summer and fall to haul out at rookery sites, but may occasionally make brief stops in San Francisco Bay. Approximately 100 juvenile northern elephant seals of the California Breeding stock strand in San Francisco Bay each year, including individual strandings at Yerba Buena Island and Treasure Island (fewer than 10 strandings per year) (Caltrans 2015). The juvenile male that was observed basking at Aquatic Park in April, 2019 was estimated to be 1 to 2 years old, and appeared healthy (Hernández 2020).

4.6 Northern Fur Seal

The Northern fur seal is separated into two stocks: the California and the Eastern Pacific stock. Both are protected under the MMPA. The Eastern Pacific stock is listed as strategic and depleted under the MMPA, but not threatened or endangered under the ESA. The California stock is not listed as strategic or depleted under the MMPA, nor is it listed as threatened or endangered under the ESA (NMFS 2015d). The Eastern Pacific stock uses the Pribilof and Bogoslof Islands off of Alaska for breeding; the California stock breeds on the Farallons and San Miguel Island (NMFS 2015d). The most recent Stock Assessment Report, revised December 31, 2015, estimates the California stock is 14,050 seals (NMFS 2015e). This record is consistent with the Final Marine Mammal Stock Assessments, released in 2017 and the Draft 2020 Pacific Marine Mammal Stock Assessments (NMFS 2017a, 2020a).

Population estimates are based on surveys from San Miguel Island and the Farallon Islands from 2008 to 2013. The Eastern Pacific stock is estimated at 626,734 seals (NMFS 2015d). Both the Eastern Pacific and California stocks forage in offshore waters outside San Francisco Bay. Northern fur seal populations experience significant declines as a result of El Niño events, which reduced food availability for the species (NMFS 2015e). In normal years, TMMC in Sausalito admits about five northern fur seals that stranded on the Central California Coast (TMMC 2016). During El Niño years, this number dramatically increases; for example, during the 2006 El Niño event, 33 fur seals were admitted (TMMC 2016). There were also an unusually high number for strandings along the California coast in 2014 and 2015 (Lauer et al. 2019). Some of these stranded animals in TMMC records were collected from shorelines in San Francisco Bay.

The breeding population on the Farallon Islands only accounts for 0.3 percent of the population, but is used as an abundance index because it incorporates pups, juveniles, and adults (NMFS 2015d). The population estimate of northern fur seals at the Farallon Islands was 666 in 2013 and increased to 1,019 in 2014 (NMFS 2015d). The highest pup count on the Farallon Islands occurred in 2018 (Duncan 2020).

The overall trend of the California stock is increasing; however, the species is impacted greatly by changes in oceanic conditions that likely impact prey distribution. Events that cause changes in marine communities, alter sea-surface temperature, currents, and upwelling impact foraging habitat for the species. When individuals have to travel farther to find food, it means they have to migrate greater distances from breeding and rookery sites. The 1982-1983 El Niño event, for example, resulted in a 60 percent decline in the northern fur seal population at San Miguel Island (NMFS 2015e).

4.7 Bottlenose Dolphin

The Common bottlenose dolphin is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA, nor is it listed as endangered or threatened under the ESA (NMFS 2017a). The California Coastal Stock is genetically distinct from offshore populations. According to the most recent Stock Assessment repot, last revised February 9, 2017, the California Coastal stock is estimated at 453 animals. This record is consistent with the Draft 2020 Pacific Marine Mammal Stock Assessments and Final Pacific Marine Mammal Stock Assessments released in 2017 (NOAA 2017, 2020). The population estimated is based on mark-recapture surveys from 2009 to 2011 (Weller et al. 2016). This record is The mark-recapture surveys can only account for those individuals with distinct identifiable marks, and does not include approximately 40 percent of observed but undistinguishable animals (NMFS 2017a). Despite a relatively small population size, they are frequently seen because they spend the majority of time in nearshore waters (NMFS 2017a).

Bottlenose dolphin are most often seen just within the Golden Gate or just east of the bridge when they are present in San Francisco Bay, and their presence may depend on the tides (GGCR 2018). As of 2012, GGCR has photo-documented 41 individuals that travel mostly between San Francisco Bay and Monterey Bay (SeaGrant 2013). Other coastal studies estimate that about 10 percent of the southern California population has migrated north to the Bay area (Carter 2019). Beginning in the summer of 2015, as many as two bottlenose dolphins have been observed frequently swimming in the Oyster Point area of South San Francisco (GGCR 2018; Perlman 2017). Despite recent occurrence, this stock is highly transitory in nature, and is not expected to spend extended periods of time in San Francisco Bay; however, the number of sightings in the Central Bay has increased, which may indicate they are becoming more of a resident species.

5 Type of Incidental Take Authorization Requested

5.1 Take Authorization Request

Under Section 101 (a)(5)(D) of the MMPA, Chevron requests an authorization from NMFS for incidental take (as defined by Title 50 Code of Federal Regulations, Part 216.3) of small numbers of marine mammals, specifically Pacific harbor seals, California sea lions, harbor porpoise, Northern elephant seal, Northern fur seal, bottlenose dolphin, and gray whales during pile driving activities associated with the Richmond Refinery LWMEP in San Francisco Bay. With implementation of the measures outlined in Section 11, no serious injury is anticipated, and the potential for take through non-serious injury (Level A Harassment) will be avoided. Chevron requests an IHA for incidental take of marine mammals described in this application. It is anticipated that Chevron would request an annual reissuance of an IHA because the Project is unlikely to be completed within the year that the IHA is issued.

The noise exposure assessment methodology used in this IHA request attempts to quantify potential exposures to marine mammals resulting from underwater and airborne noise generated during pile extraction and pile driving. Section 6 presents a detailed description of the acoustic exposure assessment methodology. Results from this approach tend to provide an overestimation of exposures because all animals are assumed to be available to be exposed 100 percent of the time. The effects will depend on the species, received level of sound, duration of exposure, and distance from the work area; however, temporary behavioral reactions are most likely to occur. The analysis for the Project evaluates potential exposures (see Section 6 for estimates of exposures by species) over the course of the construction that could be classified as Level A or Level B Harassment, as defined under MMPA.

5.2 Method of Take

The Project, as outlined in Sections 1 and 2, has the potential to result in incidental take of marine mammals by underwater and airborne noise disturbance during the removal of existing piles and driving of new piles. These activities have the potential to disturb or displace marine mammals, or have effects on hearing capacity. Specifically, the proposed activities may result in “take” in the form of Level B Harassment (behavioral disturbance only) from airborne or underwater noise generated from pile extraction and driving. Section 11 contains additional details on impact reduction and mitigation measures that are proposed for this Project.

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6 Number of Marine Mammals that May Be Affected

Project activities may result in temporary behavioral changes in marine mammals due to underwater and airborne noise levels generated during extraction and pile driving activities. This section describes the noise levels that are expected to be generated by the Project activities, and the potential impacts of the noise levels on marine mammal species that could be found in the Project area.

6.1 Fundamentals of Sound

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the pitch of a sound, and is measured in the number of cycles per second, or hertz (Hz). Intensity describes the pressure per unit of area, (i.e., loudness) of a sound, and is measured in decibels (dB). A 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 microPascal (µPa) is commonly used to describe sounds in terms of decibels, and is expressed as "dB re 1 µPa." Therefore, 0 dB on the decibel scale would be a measure of sound pressure of 1 µPa. Sound levels in dB are calculated on a logarithmic basis. An increase of 10 dB represents a tenfold increase in acoustic energy, although 20 dB is 100 times more intense, 30 dB is 1,000 times more intense, etc. For airborne sound pressure, the reference amplitude is usually 20 µPa, and is expressed as "dB re 20 µPa."

The method commonly used to quantify airborne sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects that of human hearing. This method is less sensitive at low frequencies and extremely high frequencies than at the mid-range frequencies. The method is called "A" weighting, and the dB level that is measured using this method is called the A weighted sound level. Sounds levels measured underwater are not weighted, and include the entire frequency range of interest.

When a pile driving hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, substrate, and air. The sound pressure pulse is a function of time, and is referred to as the waveform. The instantaneous peak sound pressure level is the highest absolute value of pressure over the measured waveform, and can be a negative or positive pressure peak. Sound is frequently described as a root mean square (RMS) level, which is a statistical average of the sound wave amplitude. The RMS level is determined by analyzing the waveform and computing the average of the squared pressures over the time that constitutes the portion of the waveform containing 90 percent of the sound energy (Richardson et al., 1995). Sound levels are also described in relation to cumulative sound exposure levels (cSEL) where the

A-weighted instantaneous sound pressures are squared and summed[2] throughout the duration of an event, referenced to 1 µPa. Table 6-1 contains definitions of these terms. In this document, dB for underwater sound is referenced to 1 µPa, and dB for airborne noise is references to 20 µPa.

Table 6-1: Definitions of Underwater Acoustical Terms

Term	Definition
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 µPa and 1 µPa for underwater.
SPL_{peak} Sound Pressure Level (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 µPa) but can also be expressed in units of pressure, such as µPa or psi.
cSEL (dB)	cSEL is calculated by summing the cumulative pressure squared over the measurement duration, integrating over time, and normalizing to 1 second, referenced to 1 microPascal^{2}-second (1 µPa^{2}-sec).
RMS 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.

Notes:

cSEL = Cumulative Sound Exposure Level
dB = decibel
µPa = microPascal
psi = pounds per square inch
RMS = root mean square
SPL_{peak} = instantaneous peak sound pressure level

In common use, noise refers to any unwanted sound. This meaning of noise will be used in the following discussion in reference to marine mammals; that is—pile driving noise may harass marine mammals.

6.2 Applicable Noise Thresholds

In 2010, NMFS established interim thresholds regarding the exposure of marine mammals to high-intensity noise that may be considered take under the MMPA. Updated NOAA guidance on assessing the effects of underwater noise on marine mammals for agency impact analysis was adopted in 2016 and updated in 2018 (NMFS 2018b). The 2016 guidance includes sound thresholds for slight injury to an animal's hearing, or permanent threshold shift (PTS) (Level A Harassment). The underwater sound pressure threshold for slight injury or PTS (Level A Harassment) is a dual metric criterion for impulse noise (e.g., impact pile-driving), including both a peak pressure and cSEL threshold, which is specific to the species hearing group (i.e., high-frequency cetaceans [i.e., harbor porpoise], mid-frequency cetaceans [i.e., bottlenose dolphin], low-frequency cetacean [i.e., gray whale], phocids [i.e., Pacific harbor seal and

[2] SEL values are logarithms and must first be converted to antilogs for summation. Because the single strike SEL varies over the sequence of strikes, a linear sum of the energies for all the different strikes needs is computed. This is done as follows: divide each SEL decibel level by 10 and then take the antilog to convert the decibels to linear units (or uPa^{2}-s). Then the linear units can be summed and converted back into dB by taking 10Log10 of the value. This will be the cumulative SEL for all of the pile strikes.

northern elephant seal], and otariids [i.e., California sea lion and northern fur seal]). For continuous noise (e.g., vibratory pile extraction or driving), the PTS threshold is based on cSEL for each species hearing group.

The 2010 thresholds for Level B Harassment levels are still applicable: 160 dB RMS for impulse sounds and 120 dB for nonimpulsive or continuous sounds. Level B Harassment is considered to have occurred when marine mammals are exposed to noise of 160 dB RMS or greater for impulse noise and 120 dB RMS for continuous noise. In some instances, ambient noise levels may be used in place of the 120 dB RMS threshold for continuous noise. For continuous noise, RMS levels are based on a time constant of 10 seconds, and those RMS levels are averaged across the entire event. For impact pile-driving, the overall RMS level are characterized by integrating sound energy for each acoustic pulse across 90 percent of the acoustic energy in each pulse, and averaging all the RMS levels for all pulses. Harassment thresholds for the various types of airborne and underwater noise are shown in Table 6-2.

Table 6-2: Injury and Behavioral Disruption Thresholds for Airborne and Underwater Noise

Hearing Group and species considered	Airborne Threshold (Impact and Vibratory Pile-Driving)	Underwater Continuous Noise Thresholds (e.g., Vibratory Pile-Driving)		Underwater Impulse Noise Thresholds (e.g., Impact Pile-Driving)		
	Level B RMS Threshold[1]	Level A cSEL Threshold	Level B RMS Threshold	Level A Peak Threshold[2]	Level A cSEL Threshold[2]	Level B RMS Threshold
Phocids (Pacific harbor seals, northern elephant seals)	90 dB (unweighted)	201 dB	120 dB	218 dB	185 dB	160 dB
Otariids (California sea lions, northern fur seals)	100 dB (unweighted)	219 dB	120 dB	232 dB	203 dB	160 dB
Low-Frequency Cetaceans (gray whales)	N/A	199 dB	120 dB	219 dB	183 dB	160 dB
Mid-Frequency Cetaceans (bottlenose dolphins)	N/A	198 dB	120 dB	230 dB	185 dB	160 dB
High-Frequency Cetaceans (harbor porpoises)	N/A	173 dB	120 dB	202 dB	155 dB	160 dB

Notes:

1 The airborne disturbance guideline applies to hauled-out pinnipeds.

2 Level A threshold for impulse noise is a duel criterion based on peak pressure and cSEL. Thresholds are based on the NMFS 2016a Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing.

cSEL = cumulative sound exposure level
dB = decibel
N/A = Not applicable, no thresholds exist
RMS = root mean square

Underwater peak and RMS are re: 1 μPa; cSEL is re: 1 μPa^{2}-sec; Airborne RMS is re: 20 μPa.

The application of the standard 120 dB RMS threshold for underwater continuous noise can sometimes be problematic, because this threshold level can be either at or below the ambient noise level of certain locations, and not all species may respond to noise at that level. Exposure thresholds for continuous noise have been developed based on the best available scientific

information on the response of gray whales to underwater noise. To date, there is very little research or data supporting a response by pinnipeds or odontocetes to continuous noise from vibratory pile extraction and driving as low as the 120 dB threshold. Southall et al. (2007) summarized numerous behavioral observations made of low-frequency cetaceans to a range of nonimpulse noise sources, such as vibratory pile-driving. Generally, the data suggest no or limited responses to received levels of 90 to 120 dB RMS, and an increasing probability of behavioral effects in the 120 to 160 dB RMS range. There is limited data available on the behavioral effects of continuous noise on pinnipeds while underwater; however, field and captive studies to date collectively suggest that pinnipeds do not react strongly to exposures between 90 and 140 dB re 1 μPa RMS (Southall et al. 2007). Additionally, ambient underwater noise levels in urbanized estuaries often far exceeds 120 dB RMS, as a result of the nearly continuous noise from recreational and commercial boat traffic.

6.3 Estimation of Pile Extraction and Driving Noise

A review of underwater sound measurements for similar projects was undertaken to estimate the near-source sound levels for vibratory pile extraction and driving and impact pile driving. Pile driving sound from similar type and sized piles have been measured from other projects and can be used to estimate the noise levels that the Project would generate. This analysis uses the practical spreading loss model the use of which NMFS and the United States Fish and Wildlife Service have accepted to estimate transmission loss of sound through water.

The primary sources of underwater noise produced during construction would be pile driving and pile extraction. This includes the installation of 24-inch square concrete piles and 14-inch composite barrier piles, removal of previously driven temporary 14-inch steel H piles and 36-inch hollow steel pipe piles, and removal of existing timber piles as described in Section 2. The concrete pile will be driven with an impact hammer. Installation of the composite piles will use a vibratory hammer. All pile removal will be completed using vibratory equipment or by cutting them at the mud line as in the case of timber piles that may break during extraction.

All pile installation and extraction would occur in water depths ranging from approximately 4.6 to 15 meters (15 to 49 feet) mean lower low water (MLLW), depending on location. Water depths in the vicinity average about 3 meters (10 feet) MLLW to the east of the Long Wharf and about 12 meters (39 feet) MLLW to the west of the Long Wharf. The substrate at the pile driving locations is primarily Bay mud, although other substrate types such as sand or gravel may be encountered as the pile penetrates deeper. To estimate underwater noise levels for the LWMEP, measurements from a number of underwater pile driving projects conducted under similar circumstances (similar water depths in areas of soft substrate) were reviewed for use as source level data.

For pile driving that does not have project specific hydroacoustic data available (in this case, the installation of 14-inch composite piles and extraction of timber piles), the NMFS standard transmission loss factor of 15 (4.5 dB per doubling of distance) is used. Project-specific transmission loss values have been measured for the impact driving of 24-inch concrete piles, and vibratory driving of the 36-inch steel pipe piles as well as the 14-inch steel H piles. For the 24-inch concrete pile driving, a transmission loss factor ranging from 14 to 20 (~4.4 to ~8 dB per doubling of distance) has been calculated from hydroacoustic monitoring of attenuated impact driving of concrete piles conducted at the Long Wharf in 2018 and 2019 (AECOM 2018, AECOM 2019). Due to the wide range of this measured transmission loss, the standard value of 15 will also be applied for the impact driving of concrete piles. For vibratory driving of the 36-inch steel pipe piles, hydroacoustic monitoring determined that the transmission loss ranged from 20.8 to 25.0. A similar transmission loss of 20 or greater was measured during vibratory driving of the 14-inch steel H piles. Using these ranges, a transmission loss of 20 is conservatively applied for vibratory removal of the 36-inch and steel pipe piles as well as the 14-inch steel H piles. Copies of the NMFS PTS calculation sheets used to develop PTS isopleths for Level A Harassment are provided in Appendix A. Table 6-3 and 6-4 provides a summary of the underwater noise impact analysis that is presented in the following paragraphs.

Table 6-3: Expected Underwater Pile Driving Noise Levels and Distances of Threshold Exceedance with Impact and Vibratory Driver

Pile Type	Source Levels (dB) / Source distance (meters)		Distance to Threshold 160/120 dB RMS (Level B)* meters (feet)
	Peak	RMS	
Impact Driving			
24-inch square concrete (1 to 2 per day)	191 / 10	173 / 10	74 (241)
Vibratory Driving/Extraction			
14-Inch Composite Barrier Piles (5 per day)	178 / 10	168 / 10	15,849 (51,984)
36-inch steel pipe pile extraction (4 per day)	196 / 10	167 / 15	3,358 (11,015)
14-inch steel H pile extraction (4 per day)	165 / 10	150 / 10	316 (1,037)
Timber pile extraction (12 per day)	No Data Available	152 / 10	1,359 (4,459)

Notes:

* For underwater noise, the Level B Harassment threshold is 160 dB for impulsive noise and 120 dB for continuous noise.

dB = decibels
RMS = root mean square

Table 6-4: Expected Pile-Driving Noise Levels and Distances of Level A Threshold Exceedance with Impact and Vibratory Driver

Project Element Requiring Pile Installation	Source Levels (dB) / Source Distance (meters)		Distance to Level A Threshold[1] meters (feet)				
	Peak[2]	RMS / SEL	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
Impact Driving							
24-inch square concrete (1 to 2 per day)	191 / 10	161 SEL / 10	31 (102)	1 (3)	37 (121)	17 (56)	1 (3)
Vibratory Driving/Extraction							
14-Inch Composite Barrier Piles (5 per day)	178 / 10	168 RMS / 10	18 (59)	2 (7)	26 (85)	11 (36)	1 (3)
36-inch steel pipe pile (4 per day)	196 / 10	167 RMS / 15	13 (43)	2 (7)	17 (56)	9 (30)	1 (3)
14-inch steel H pile extraction (4 per day)	165/ 10	150 RMS / 10	2 (7)	<1 (1)	2 (7)	1 (3)	<1 (1)
Timber pile extraction (12 per day)	No Data	152 RMS / 10	2 (7)	<1 (<1)	3 (10)	1 (3)	<1 (<1)

Notes:

For calculation worksheets used to develop these numbers is provided in Appendix A.

1 Level A thresholds are based on the NMFS 2016a Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing; cSEL threshold distances are shown. See footnote 3 below.

2 All distances to the peak Level A thresholds are less than 33 feet (10 meters).

Distances are rounded to the nearest foot or to "<1.0 (0)" for values less than 1 foot.

Peak and cSEL are re: 1 µPa and 1 µPa^{2}-sec, respectively.

cSEL = cumulative sound exposure level
dB = decibels
SEL = sound exposure level
RMS=Root Mean Square

The area of effect of a particular noise in the natural environment is also dependent on the background noise levels. Ambient underwater noise in the vicinity of the Long Wharf is generated by shipping activity at the facility, including the arrival, departure, loading, and offloading of vessels that occurs daily, the presence of a nearby high speed ferry route, and the potential sound generated by the Richmond Bridge piers in the water to the north of the Long Wharf. Underwater noise measurements were made near the Wharf from July 20 to July 22, 2015 found that ambient noise at both berth locations was greater than 120 dB RMS. Noise levels at Berth 1 were consistently higher than noise levels at Berth 4. This is likely due to a combination of factors, including greater vessel activity at the Berth 1, proximity to the main shipping channel used by ferries, large ships, and other vessels, and current induced vibration of the piles supporting the Long Wharf. Other vessel traffic in the area that is unrelated to activities at the Long Wharf also likely contribute to underwater noise in the Project area. For example, the San Francisco Bay commuter ferries that pass near the Long Wharf and between Red Rock Island and Castro Rocks produce underwater noise levels of 152 to 177 dB peak (EIP Associates

2006). Because ambient noise levels at the Long Wharf will vary due to the presence of location and presence of vessels during construction, the default Level B threshold value of 120 dB is used in this analysis, even though ambient noise levels may often exceed this value during pile driving.

6.3.1 Underwater Noise from Impact Pile Driving

24-inch square concrete piles

Modifications at the four berths require the placement of new 24-inch diameter square concrete piles. Approximately one to two of these piles would be installed in one work day, using impact driving methods along with a bubble curtain attenuation system. Based on measured blow counts for 24-inch concrete piles driven at the Long Wharf Berth 4 in 2011, installation for each pile could require up to approximately 440 blows from a DelMag D62 22 or similar diesel hammer, producing approximately 165,000 foot pounds maximum energy (may not need full energy) and 1.5 second per blow average over a duration of approximately 20 minutes per pile, with 40 minutes of pile driving time per day if two piles are installed.

To estimate the noise effects of the 24-inch square concrete piles, the underwater noise measurements recorded for this pile type, with bubble curtain attenuation, at the Long Wharf during the 2018 construction season are used. These measured values were: 191 dB peak, 161 dB sound exposure level (SEL) (single strike), and 173 dB RMS (AECOM 2018). Based on these measured levels, installation of the 24-inch concrete piles is expected to produce underwater sound exceeding the Level B 160 dB RMS threshold over the distances summarized in Table 6-3 and areas shown on Figure 6-1. Cumulative noise from impact driving of these piles could produce noise levels above the Level A threshold over the relatively short distances provided in Table 6-4.

6.3.2 Underwater Noise from Vibratory Pile Extraction and Driving

14-inch Composite Barrier Piles[3]

As part of the Berth 4 Loading Platform seismic retrofit, four clusters of 13 composite piles (52 piles total) will be installed to provide protection to the infrastructure. These piles would be installed with a vibratory pile driver (APE 400B King Kong or similar vibratory driver), with a drive time of approximately 10 minutes per pile. Up to five of these piles could be installed in any single work day.

[3] The barrier piles are 14 inches in diameter above the mud line and 12.25 inches in diameter below the mud line. For purposes of this IHA request we have used the 14-inch diameter to describe the piles and calculate underwater noise effects.

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FIGURE 6-1
Underwater Impact Driving Noise (Area Exceeding 160 dB Level B Threshold)

Projects conducted under similar circumstances with similar piles were reviewed to approximate the noise effects of the 14-inch composite piles. The best match for estimated noise levels is from the Anacortes Ferry Terminal in Washington State, where 13-inch composite piles were installed with a vibratory hammer. RMS noise levels produced during this installation varied from 138 to 158 dB RMS at 43 meters (141 feet) from the pile (Laughlin 2012). From these measurements, a peak noise value of 178 dB and an average RMS value of 168 dB normalized to a 10 meter (33 feet) distance was used to estimate the extent of underwater noise from installation of the 14-inch composite piles. Cumulative noise from vibratory driving of these piles could produce noise levels above the Level A PTS threshold over the relatively short distances provided in Table 6-4. During installation of the 14-inch composite barrier piles for the proposed Project, up to 50 minutes of vibratory driving could occur per day; during this time, the Level B threshold would be exceeded over the distances shown in Table 6-3.

36-inch Temporary Steel Pipe Piles

For the Berth 4 Loading Platform seismic retrofit, eight 36-inch diameter temporary steel piles were installed in 2020. In 2021, these temporary piles will be removed using a vibratory pile driver (APE 400B King Kong or similar vibratory driver). Each 36-inch temporary pile may require approximately 5 minutes of vibratory driving for removal. Up to four of these piles could be removed in a single work day.

Installation of this pile type was hydracoustically monitored in 2019. The sound levels during vibratory extraction are expected to be equal to or less than the maximum sound levels recorded during installation. For the 36-inch piles, the maximum measured peak sound value was 196 dB measured at 10 meters, and the highest median RMS value recorded was 167 dB measured at 15 meters (AECOM 2020 - Appendix D). Based on these sources values, the cumulative noise from vibratory extraction of the 36-inch template support piles could produce noise levels above the Level A PTS threshold over the relatively short distances provided in Table 6-4, and could have the potential to produce RMS values above the Level B threshold at distances summarized in Table 6-3. During extraction of the 36-inch steel pipe piles, the Level B Threshold is expected to be exceeded for a duration of about 20 minutes per day within the areas shown in Figure 6-2.

14-inch Temporary Steel H Piles

To keep Berth 2 operational during construction, temporary fenders were installed in 2018, which are supported by 36 14-inch steel H piles. In 2021, these temporary piles will be removed using a vibratory pile driver (APE 400B King Kong or similar vibratory driver). Each 14-inch temporary H pile may require approximately 5 minutes of vibratory driving for removal. Up to six of these piles could be removed in a single work day.

Installation of this pile type was hydracoustically monitored in 2018. The sound levels during vibratory extraction are expected to be equal to or less than the maximum sound levels recorded

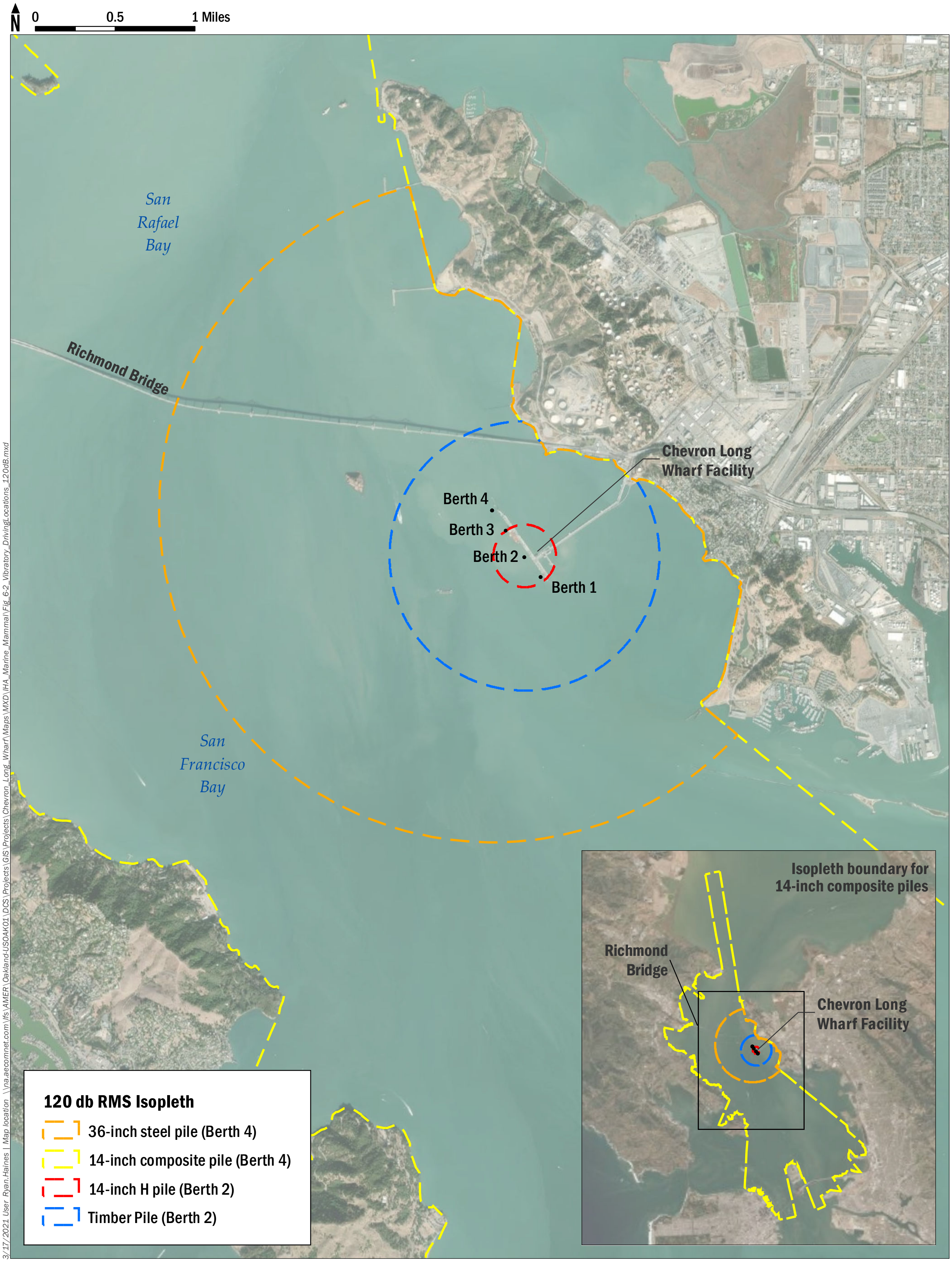

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FIGURE 6-2

Underwater Vibratory Driving Noise
(Area Exceeding 120 dB Level B Threshold)

during installation. For the 14-inch H piles, the maximum measured peak sound value was 165 dB measured at 10 meters, and the highest median RMS value recorded was 150 dB measured at 10 meters (AECOM 2018). Based on these sources values, the cumulative noise from vibratory extraction of the 14-inch steel H piles could produce noise levels above the Level A PTS threshold over the relatively short distances provided in Table 6-4, and could have the potential to produce RMS values above the Level B threshold at distances summarized in Table 6-3. During extraction of the 14-inch steel H piles, the Level B Threshold is expected to be exceeded for a duration of about 30 minutes per day within the areas shown in Figure 6-2.

Extraction of Timber Piles

The Project includes the removal of 106 16-inch timber piles using a vibratory pile driver. With the vibratory hammer activated, an upward force would be applied to the pile to remove it from the sediment. Up to 12 of these piles could be extracted in one work day. Extraction time needed for each pile may vary greatly, but could require approximately 400 seconds (approximately 7 minutes) from an APE 400B King Kong or similar driver.

The most applicable noise values for timber pile removal from which to base estimates for the LWMEP are derived from measurements taken at the Pier 62/63 pile removal in Seattle, Washington. During vibratory pile extraction associated with this Project, which occurred under similar circumstances, the RMS was approximately 152 dB (WSDOT 2011).

Cumulative noise from vibratory driving of these piles would produce noise levels above the Level A PTS threshold over the relatively short distances provided in Table 6-4. The area over which the Level B threshold could be exceeded is shown on Figure 6-2.

6.3.3 Airborne Noise

Pile driving generates airborne noise that could potentially result in behavioral disturbance to pinnipeds (e.g., sea lions and harbor seals) which are hauled-out or at the water's surface. As with the underwater noise, the practical spreading model is used to determine the extent over which sound levels may result in Level B Harassment of marine mammals. A 20 $\log_{10}$ attenuation rate was used to calculate the distances to the NMFS thresholds for pinnipeds presented in Table 6-2. The marine environment around the Project site is mostly water and would be considered a "hard" site, and no excess ground attenuation or atmospheric absorption is assumed. The 20 $\log_{10}$ attenuation rate of sound is based on spherical spreading loss and equates to a 6-dB reduction in sound per doubling distance (Richardson et al. 1995).

Source levels for impact driving of the 24-inch concrete piles re based on measurements taken during installation of hollow 36-inch concrete piles for the Mukilteo Ferry Terminal in Washington (Laughlin 2007). During impact driving of the 36-inch concrete piles, the greatest unweighted maximum noise level (L_{max}) value was 98 dB, the unweighted average noise level

was not reported, but would be less than the L_{max}. To conservatively estimate the distances to the specified in the airborne noise thresholds for pinnipeds, the L_{max} will be used.

Measured airborne noise levels from vibratory driving used in this analysis are based on measurements made during the Navy Test Pile Project in Bangor Washington (NAVFAC 2012). For vibratory driving of 36-inch steel pipe piles, the greatest L_{max} value measured was 105 dB, and the average L_{max} was 97 dB (standardized to 15 meters [49 feet]). Table 6-5 provides distances using the average L_{max} levels, which should conservatively estimate the distance to the NMFS threshold. Airborne noise levels from the vibratory installation of the 14-inch composite barrier piles and vibratory extraction of timber piles is expected to be similar to or less than the noise levels produced by installation of the steel piles.

Table 6-5: Modeled Extent of Sound Pressure Levels for Airborne Noise

Pile Driving Activity	Distance to Level B Thresholds	
	100 dB RMS (California Sea Lions)	90 dB RMS (Pacific Harbor Seals)
Impact Driving –24-Inch Concrete Piles	12 meters (39 feet)	38 meters (124 feet)
Vibratory Driving and Extraction – All Pile types	11 meters (35 feet)	34 meters (110 feet)

Notes:
dB = decibels
RMS=Root Mean Square

Although airborne pile-driving RMS noise levels above the NMFS airborne noise thresholds will not extend to the Castro Rocks haul-out site, peak noise levels will be higher and may be audible over greater distances. It is expected that some pile-driving noise would be audible to harbor seals hauled out at Castro Rocks. However, the Castro Rocks haul out is subject to high levels of background noise from the Richmond Bridge, ongoing vessel activity at the Long Wharf, ferry traffic, and other general boat traffic. As a result, pile driving noise is not expected to regularly incite a reaction from hauled out harbor seals at Castro Rocks and would not cause incidental harassment.

Airborne noise from other construction activities associated with the Project, such as jack hammering of Wharf structures during removal, was not specifically modeled, but is expected to produce noise levels similar to or less than the pile driving described above (FHWA 2006). Although other construction noise may be occasionally audible to harbor seals hauled out at Castro Rock, it is not expected to regularly incite a reaction and would not result in incidental harassment.

Any pinnipeds that surface in the area over which the airborne noise thresholds may be exceeded would have already been exposed to underwater noise levels above the applicable thresholds and thus would not result in an additional incidental take.

6.4 Description and Estimation of Take

For this analysis, the potential numbers of marine mammals that may be exposed to take as defined in the MMPA is determined by comparing the calculated areas over which the Level B Harassment threshold may be exceeded, as described in Section 6.3, with the expected distribution of marine mammal species within the vicinity of the proposed Project, as described in Section 3. Limited at-sea densities for marine mammal species are available for San Francisco Bay and some of the estimates here are determined using data taken during marine mammal monitoring associated with the RSRB retrofit project, the San Francisco-Oakland Bay Bridge (SFOBB) replacement project, and other marine mammal observations for San Francisco Bay. For Pacific harbor seal, take estimates were developed from recent annual surveys of haul outs in the Bay conducted by the NPS (Codde and Allen 2013, 2015, 2017, 2020; Codde 2020).

The mechanisms of take requested are expected to be limited to temporary effects on individual animals and no significant effect on the populations of these species.

6.4.1 Pacific Harbor Seal

To estimate the number of harbor seals potentially exposed to Level B Harassment, the Castro Rocks haulout occupancy is used due to its proximity to the Project location. In terms of the number of animals that use the site, Castro Rocks is the largest harbor seal haul out site in the northern part of San Francisco Bay and is the second largest pupping site in the Bay (Green et al. 2002). The pupping season is from March to June in San Francisco Bay. During the molting season (typically June-July and coincides with the period when piles will be driven) as many as approximately 300 harbor seals have been observed using Castro Rocks as a haul out (Codde and Allen 2020). Harbor seals are more likely to be hauled out in the late afternoon and evening, and are more likely to be in the water during the morning and early afternoon (Green et al. 2002). However, during the molting season, harbor seals spend more time hauled out and tend to enter the water later in the evening. During molting, harbor seals can stay onshore resting for an average of 12 hours per day during the molt compared to around 7 hours per day outside of the pupping/molting seasons (NPS 2014).

Tidal stage is a major controlling factor of haul out usage at Castro Rocks with more seals present during low tides than high tide periods (Green et al. 2002). Additionally, the number of seals hauled out at Castro Rocks also varies with the time of day, with proportionally more animals hauled out during the nighttime hours (Green et al. 2002). Therefore, the number of harbor seals in the water around Castro Rocks will vary throughout the work period.

Pile driving would occur intermittently during the day with average active driving times typically of a few hours per day, so varying sets of animals may be hauled out or in the water. However, there are no systematic counts available for accurately estimating the number of seals that may be in the water near the Long Wharf at any given time. To provide a conservative assessment,

the take estimates are based on the highest mean value of harbor seals observed at Castro Rocks during recent annual surveys conducted by the NPS during the molting season (Codde and Allen 2013, 2015, 2017, 2020; Codde 2020), a value of 237 seals observed in 2019. Furthermore, the analysis assumes that all 237 seals would swim into the Level B zone each day that pile driving or extraction is occurring.

A summary of the estimated take for harbor seal is provided in Table 6-6. Level A take is not requested for the impact driving or vibratory driving/extraction occurring in 2021, due to the small predicted sizes of the Level A zones.

Table 6-6: Level B Harassment Estimate for Pacific Harbor Seal (Per Day)

Pile Type	Level B Zone (square kilometers)	Estimated Level B Take per Day (based on largest mean haul-out at Castro Rocks – 237 animals)
Vibratory Driving/Extraction		
14-inch composite pile	165.62	237
36-inch steel pipe pile	25.27	237
14-inch steel H pile	0.31	237
Timber Pile Removal	5.63	237
Impact Driving		
24-inch concrete pile	0.02	237

Note:
Total take by Level B harassment by pile type for the 2021 construction season is summarized in Section 6.5.

Total take by Level B Harassment by pile type for the 2021 construction season is summarized in Section 6.5. Due to the small size of the Level A zone for phocid pinnipeds, Level A take of this species is not requested.

6.4.2 California Sea Lion

Relatively few California Sea Lions are expected to be present in the Project area during periods of pile driving, as there are no haul-outs used by this species in the vicinity. However, LWMEP PSOs documented a total of 8 sea lion sightings during 2020 monitoring (AECOM 2019, 2020b). Most of these sea lion observations occurred west of the Long Wharf. During monitoring for the SFOBB Project in the central Bay, 83 California sea lions were observed in the vicinity of the bridge over a 17-year period from 2000 to 2017, and from these observations, an estimated at-sea density of 0.16 animals per square kilometer is derived (NMFS 2018a). Using this in-water density and the areas of potential Level B Harassment, take is estimated for California sea lion as provided in Table 6-7. Due to the small size of the Level A zone for otariid pinnipeds, Level A take of this species is not requested.

6.4.3 Harbor Porpoise

As described in Section 3.3, a small but growing population of harbor porpoises uses San Francisco Bay. Harbor porpoises are typically spotted in the vicinity of Angel Island and the Golden Gate (6 and 12 kilometers [3.7 and 7.5 miles] southwest respectively) (Keener 2011) and the vicinity of treasure island (Caltrans 2018), but may use other areas in the Central Bay in low numbers, including the Project area. Based on monitoring conducted for the SFOBB project in 2017, an in-water density of 0.17 animals per square kilometer has been estimated by Caltrans for this species (NMFS 2018a). Using this in-water density and the areas of potential Level B Harassment, take is estimated for California harbor porpoise as provided in Table 6-8. Level A take is not requested for impact or vibratory driving/extraction in 2021 due to the small sizes of the predicted Level A zones.

Table 6-7: Level B Harassment Estimate for California Sea Lion (Per Day)

Pile Type	Level B Zone (square kilometers)	Level B Take Estimate (based on Central Bay density of 0.16 animals per square kilometer)
Vibratory Driving/Extraction		
14-inch composite pile	165.62	26.50
36-inch steel pipe pile	25.27	4.04
14-inch steel H pile	0.31	0.05
Timber Pile Removal	5.63	0.90
Impact Driving		
24-inch concrete pile	0.02	0.01

Note:
Total take by Level B harassment by pile type for the 2021 construction season is summarized in Section 6.5.

Table 6-8: Level B Harassment Estimate for Pacific Harbor Porpoise (Per Day)

Pile Type	Level B Zone (square kilometers)	Level B Estimate Central Bay In-Water – 0.17 per square kilometer
Vibratory Driving/Extraction		
14-inch composite pile	165.62	28.16
36-inch steel pipe pile removal	25.27	4.30
14-inch steel H pile	0.31	0.05
Timber/pile removal	5.63	0.96
Impact Driving		
24-inch concrete pile	0.02	0.01

Note:
Total take by Level B harassment by pile type for the 2021 construction season is summarized in Section 6.5.

Total take by Level B Harassment by pile type for the 2021 construction season is summarized in Section 6.5.

6.4.4 Northern Elephant Seal

As described in Section 4.5, small numbers of this may species haul out or strand on coastline within the Central Bay. Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced an estimated at-sea density for northern elephant seal of 0.16 animal per square mile (0.06 animal per square kilometer) (Caltrans 2015). Most sightings of northern elephant seal in San Francisco Bay occur in spring or early summer, and are less likely to occur during the periods of in-water work for this project. As a result, densities during pile driving for the proposed action would be much lower. Additionally, this species was not observed by the PSOs in the vicinity of the Long Wharf during 2018, 2019, or 2020 pile driving monitoring. However, it is possible that a lone northern elephant seal may enter

the Level B Harassment area (Table 6-3) once per every 3 days during pile driving, for a total of 12 takes. Level A Harassment of this species is not expected to occur.

6.4.5 Northern Fur Seal

The incidence of northern fur seal in San Francisco Bay depends largely on oceanic conditions, with animals more likely to strand during El Niño events. Equatorial sea surface temperatures of the Pacific Ocean are below average across most of the Pacific Ocean, and La Niña conditions are likely to remain into the summer, it is unlikely that El Niño conditions will develop in 2021 (NOAA 2021). Additionally, this species was not observed by the PSOs in the vicinity of the Long Wharf during 2018, 2019, or 2020 pile driving monitoring. Using guidance provided by NMFS provided for other recent projects, it is anticipated that at most 10 animals would be in San Francisco Bay and enter the area of Level B Harassment (Table 6-3) during construction (NMFS 2016b). Level A Harassment of this species is not expected.

6.4.6 Bottlenose Dolphin

When this species is present in San Francisco Bay, it is more typically found close to the Golden Gate. Recently, beginning in 2015, two individuals have been observed frequently in the vicinity of Oyster Point (GGCR 2016; GGCR 2017; Perlman 2017). The average reported group size for bottlenose dolphins is five. Reports show that a group normally comes into San Francisco Bay, is near Yerba Buena Island once per week for approximately a 2-week stint and then leaves (NMFS 2017b). Assuming the dolphins come into San Francisco Bay approximately three times per year, 30 takes of up to five individuals would be anticipated, if the group enters the areas over which the Level B Harassment thresholds may be exceeded (Table 6-3).

Although a small Level A zone for mid-frequency cetaceans is estimated during impact driving, marine mammal monitoring of the shutdown zone, as outlined in Section 14, would ensure that driving does not occur if bottlenose dolphins are within the area of Level A Harassment for their hearing group, so Level A Harassment of this species is not expect to occur.

6.4.7 Whales

The only whale species that travels far into San Francisco Bay with any regularity is the gray whale. As described in Section 3.4.1, gray whales occasionally enter the Bay during their northward migration period, and are most often sighted in the Bay between February and May. Most venture only about 2 to 3 kilometers (about 1 to 2 miles) past the Golden Gate, but gray whales have occasionally been sighted as far north as San Pablo Bay. Pile driving is not expected to occur during this time, and gray whales are not likely to be present at other times of year. If pile driving does occur during the northward migration period, and in the very unlikely event that a gray whale or pair of gray whales makes its way close to the Long Wharf, we are requesting take by Level B Harassment of up to two gray whales per year (Table 6-3).

Although a small Level A zone for marine mammals resulting from cumulative noise is estimated during pile driving (Table 6-4), marine mammal monitoring, as outlined in Section 13 would detect the presence of a whale and stop the driving activity so that driving does not occur if gray whales are within this shutdown zone.[4]

6.5 Summary and Schedule of Estimated Take for 2021

Pile driving associated with the proposed Project is expected to be completed in 2021. Take that would occur through Level B Harassment would occur during short periods of pile driving during the construction season described in Section 2. Table 6-9 summarizes the estimate of Level B Harassment for each species by pile driving activity. The Level B Harassment estimates are based on the number of individuals assumed to be exposed per day, the number of piles driven per day and the number of days of pile driving expected based on an average installation rate. It is also assumed that an individual animal can only be taken once per method of installation during a 24-hour period.

Table 6-9: Summary of Estimated Level B Harassment by Species for 2021 Work Season

Pile Type	Pile Driver Type	# of Piles	# of Driving Days	Species						
				Harbor Seal	CA Sea Lion	Harbor Porpoise	Gray Whale*	N. Elephant Seal	N. Fur Seal*	Bottlenose Dolphin*
36-inch steel pipe pile removal	Vibratory	8	2	474	8.09	8.59	NA	0.66	NA	NA
14-inch steel H pile removal	Vibratory	36	6	1422	0.30	0.32	NA	2	NA	NA
24-inch concrete pile installation	Impact	9	8	1896	0.02	0.02	NA	2.66	NA	NA
14-inch composite pile installation	Vibratory	52	11	2607	291.50	309.72	NA	3.66	NA	NA
Timber pile removal	Vibratory	106	9	2133	8.10	8.61	NA	3	NA	NA
Total Level B Harassment (2019)				**8,532**	**308**	**327**	**2**	**12**	**10**	**30**

Note:
*Take is not calculated by activity type for these species, only a total estimate is given.

[4] As with the pinniped species, PTS areas for pile driving associated with this project have been calculated using the new NMFS approved calculation workbook, which is provided in Appendix A.

7 Anticipated Impact of the Activity on the Species or Stock

7.1 Effects of Underwater Noise on Marine Mammals

Marine mammals use hearing and sound transmission to perform vital life functions. The introduction of noise into their environment could disrupt those behaviors. Sound (hearing and vocalization/echolocation) serves four primary functions: (1) providing information about the environment; (2) communication; (3) prey detection; and (4) predator detection. The distances to which the construction noise associated with the Project are audible depend on source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and the sensitivity of the receptor (Richardson et al., 1995).

The effects of noise from pile driving on marine mammals can be physiological or behavioral, and may include one or more of the following depending on frequency and intensity: 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) have suggested criteria for defining four zones of effect. These zones are discussed in Sections 7.1.1 through 7.1.4, from greatest effect to least.

7.1.1 Zone of Hearing Loss, Discomfort, or Injury

The zone of hearing loss, discomfort, or injury is the area in which the received sound energy is potentially high enough to cause discomfort or tissue damage to auditory or other systems. The possible effects of damaging sound energy are a temporary hearing threshold shift,[5] a temporary loss in hearing, PTS, and a loss in hearing at specific frequencies or deafness. Non-auditory physiological effects or injuries that can theoretically occur in marine mammals exposed to strong underwater noise are stress, neurological effects, bubble formation, resonance effects and other types of organ or tissue damage. These effects would be considered Level A Harassment; applicable NMFS acoustic thresholds for this type of harassment based by cumulative SEL and vary by hearing group, as discussed in Section 6.2.

Vibratory pile extraction and driving does not generate high-peak sound pressure levels commonly associated with physiological damage. Impact driving can produce noise levels in excess of the Level A thresholds; however, Chevron will implement measures (Section 11) that

[5] On exposure to noise, the hearing sensitivity may decrease as a measure of protection. This process is referred to as a shift in the threshold of hearing, meaning that only sounds louder than a certain level will be heard. The shift may be temporary or permanent.

will limit the numbers of marine mammals may be exposed to sound pressure levels that could cause physical harm. During impact pile driving, a noise attenuation system (i.e., bubble curtains) would be used to reduce sound pressure levels. PSOs will monitor the shutdown zones for the presence of marine mammals (Section 11 provides a detailed discussion of mitigation measures). They will alert work crews to the presence of pinnipeds or cetaceans in or near the shutdown zone, and advise when to begin or stop work to reduce the potential for acoustic harassment. With implementation of these measures, no Level A take of marine mammals is expected.

7.1.2 Zone of Masking

The zone of masking is the area in which noise may interfere with the detection of other sounds, including communication calls, prey sounds, and other environmental sounds. This effect would be considered Level B Harassment; the applicable threshold for the zone where this effect occurs are 160 dB for impact noise and 120 dB or ambient noise levels for continuous noise.

7.1.3 Zone of Responsiveness

The zone of responsiveness is the area in which animals react behaviorally. The behavioral responses of marine mammals to noise depend on a number of factors, including (1) the acoustic characteristics of the noise source of interest; (2) the physical and behavioral state of the animals at the time of exposure; (3) the ambient acoustic and ecological characteristics of the environment; and (4) the context of the noise (e.g., does it sound like a predator?) (Richardson et al., 1995; Southall et al., 2007). However, temporary behavioral effects are often simply evidence that an animal has heard a noise and may not indicate lasting consequence for exposed individuals (Southall et al., 2007). These types of effects would be considered Level B Harassment; the applicable threshold for the zone where these effects occur are 160 dB for impact noise and 120 dB or ambient noise levels for continuous noise.

7.1.4 Zone of Audibility

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 Hz to 180 kHz, with best thresholds near 40 dB (Southall et al., 2007). Study data show reasonably consistent patterns of hearing sensitivity in three groups: small odontocetes (such as the harbor porpoise), medium-sized odontocetes (toothed whales such as killer whales), and pinnipeds (such as the California sea lion). No thresholds apply to this zone because it is difficult to determine the audibility of a particular noise for a particular species. This zone does not fall within the noise range of a take as defined by NMFS. The zone of audibility is also limited by background noise levels which may mask the particular noise in question. Background noise is produced both by natural (waves, rain, and other organisms) and anthropogenic sources (watercraft, bridges, etc.).

7.1.5 Expected Responses to Pile Extraction and Driving

With both vibratory extraction and vibratory and impact pile driving, it is likely that the onset of activities could result in temporary, short-term changes in typical behavior and/or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or may swim away from the noise source and avoid the area. Other potential behavioral changes could include increased swimming speed, increased surfacing time, and decreased foraging in the affected area. Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance. Because pile installation or removal work would occur for a just few hours a day, and only on intermittent days throughout the construction schedule, it is unlikely to result in permanent displacement of animals. Based on the best available science, exposures to marine mammal species and stocks from pile driving activities is anticipated to result in only short-term effects on individuals exposed, will likely not affect annual rates of recruitment or survival, and employed mitigation measures will prevent injury or mortality.

Monitoring conducted during the seismic retrofit of the Richmond Bridge, which is considerably closer to the harbor seal haul out, Castro Rocks (20 to 100 meters (66 to 328 feet) versus 560 meters (1,837 feet) to the closest point on the Long Wharf), did not show a decline in the use of the haul-out site (Green et al. 2006). Any pupping that may occur at Castro Rocks would largely occur outside the work window for pile driving.

The expected responses to pile replacement work noise depend partly on the average ambient background noise of the site. San Francisco Bay in the area surrounding the Long Wharf experiences frequent boat traffic, foot traffic on accessible portions of the wharf, and noise from the tankers and tugs accessing the wharf. For marine mammals that use San Francisco Bay regularly, or harbor seals which are part of a resident population, responses to noise may be lessened due to habituation.

During the 2018 construction season of the Project, a total of 24 harbor seals were observed in the water in the vicinity (~300 meters or closer) of the Long Warf during active pile driving (AECOM 2018). None of the seals observed demonstrated behavioral changes or signs of distress as a result of pile-driving activities (AECOM 2018). During the 2019 construction season, a total of 48 harbor seals, one sea lion, and one harbor porpoise were observed within 400 meters of the work area. None of the animals observed demonstrated behavioral changes or signs of distress. The observed sea lion hauled out onto one of the project tug boats and was allowed to leave on its own (AECOM 2019). A total of 83 harbor season, eight sea lions, and two harbor porpoises were observed during monitoring periods in 2020 (AECOM 2020 - Appendix C). The harbor porpoises were observed approximately 75 meters from the work area, not during active pile driving, and did not display any behavioral changes or signs of distress.

The Project monitors recorded harbor seal and sea lion behavioral changes during active vibratory and impact pile driving in 2020, which included looking in the direction of the work area, and going under the surface of the water (a change from swimming or resting at the surface) (AECOM 2020 - Appendix C).

From the 2018 LWMEP monitored construction season through the 2020 construction season, the number of marine mammals observed in the water in the vicinity of the work area has appeared to have increased (Table 7-1) (AECOM 2018, 2019, 2020b). To account for variation in monitoring effort between years, the total hours of monitoring effort for each season was divided by the total number of each marine mammal species sightings. The standardized frequency value, defined as the number of sightings per hours of monitoring effort, may be used to compare each year's data (Table 7-1).

Table 7-1. Number of Marine Mammal Sightings per Monitoring Effort

Year	Total HASE Sighting Frequency*	Total CASL Sighting Frequency*	Total HAPO Sighting Frequency*
2018	0.58	0	0
2019	0.93	0.17	0.01
2020	1.40	0.13	0.03

Notes:
*Total number of sightings per total hours of monitoring effort.
HASE = Pacific harbor seal
CASL = California sea lion
HAPO = Pacific harbor porpoise

7.2 Effects of Airborne Noise on Marine Mammals

Marine mammals could be exposed to airborne noise levels at sound pressure levels that would constitute Level B Harassment during impact or vibratory pile driving and extraction (see Section 6 for results). Injury or Level A Harassment is not expected to occur from airborne noise.

Marine mammals that occur in the Project area would be exposed to airborne noise associated with pile driving that has the potential to cause harassment, depending on their distance from pile extraction and driving activities. Pacific harbor seals and California sea lions may be exposed to airborne noise if they surface in proximity to pile driving work. Airborne noise from the project would not exceed Level B thresholds at the Castro Rocks haul-out site, but would likely cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, the noise generated could cause pinnipeds to exhibit changes in their normal behavior, such as causing them to move farther from the noise source.

During the 2020 LWMEP monitoring periods, a monitor was always stationed on the Berth 4 mooring dolphin catwalk to provide an unobstructed view of Castro Rocks. Harbor seals were the only species of marine mammal observed at the haul out. The number of harbor seals observed during monitoring periods varied from 0 to 50 animals, depending on tide levels. There were two instances during the 2020 LWMEP that monitors observed behavioral changes in harbor seals hauled out at Castro Rocks. In one instance, there was one seal hauled out and it moved into the water when impact piling driving began. In the second instance, two out of seven seals hauled out on Castro Rocks raised their heads and looked in the direction of the work area when impact pile driving began. No behavioral changes were observed in seals hauled out at Castro Rocks during vibratory pile driving in 2020. In addition, California sea lions were observed in 2019 and 2020 hauled out on a channel buoys, located approximately 500 meters southwest and west of the pile driving location. No behavioral changes were observed.

As with underwater noise, because of the relatively short duration of the work and the limited amount of time per day when pile replacement work would occur, exposure to airborne noise would not result in population level impacts or affect the long-term fitness of these species.

7.3 Effects of Human Disturbance on Marine Mammals

The activities of workers in the Project area may also cause behavioral reactions such flushing from the haul-out, head alerts, or moving farther from the disturbance to forage.

The seals at Castro Rocks have habituated to a degree to some sources of human disturbance such as large tanker traffic and the noise from vehicle traffic on the bridge, but often flush into the water when small boats maneuver close by or when people work on the bridge (Kopec and Harvey 1995). During monitoring conducted for the RSRB project, construction activities caused a 5.4-fold increase in disturbance when compared to pre-construction monitoring. The majority of the construction related disturbance (72 percent) was due to construction related boats moving in the vicinity of Castro Rocks. The average distance at which construction boats caused flushing was 120 meters (394 feet) with a standard error of 7 meters (23 feet). The average distance at which other construction activities caused flushing is similar – 121 meters (397 feet) with a standard error of 15 meters (49 feet).

During the prior years of marine mammal monitoring for the Project, some behavioral changes were observed during construction. In the 2019 construction season, a California sea lion hauled out on the stern of an active tugboat during construction activities. There was no interaction with the sea lion, and it left the tug on its own (AECOM 2019). In 2020, a group of harbor seals were observed swimming together at the surface along the west side of the Long Wharf, and all dove

suddenly when a sailing vessel approached the group. The animals were not observed again (AECOM 2020 - Appendix C).

There were two instances during the project's 2019 construction activities that work was halted due to a marine mammal entering the shutdown zone, including the sea lion hauled out on the tug boat and one harbor seal in the water (AECOM 2019). In 2020, there were two instances that work was halted due to marine mammals (one harbor seal and one sea lion) entering the shutdown zones in the water (AECOM 2020 - Appendix C). In all cases, the animals left on their own and pile driving did not begin again until at least 15 minutes after the last confirmed sighting of the animal outside of the shutdown zones.

Construction activities associated with the proposed Project will involve minimal additional boat traffic and would occur at distances much greater than the average distances to activity that caused flushing during RSRB project activities.

8 Anticipated Impact on Subsistence Uses

No subsistence uses of marine mammals occur within San Francisco Bay. No impacts are expected to the availability of the species stock as a result of the proposed Project.

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9 Anticipated Impact of the Activity on the Habitat or the Marine Mammal Populations, and the Likelihood of Restoration of the Affected Habitat

The proposed Project would result in small net increase in bay fill of approximately 0.01 acre of benthic habitat due to the placement of piles. The piles would be generally be placed within the existing footprint of the Long Wharf. This would not have a measurable influence on habitat for marine mammals in the Bay. A temporary, small-scale loss of foraging habitat may occur for marine mammals if marine mammals leave the area during pile extraction and driving activities.

Acoustic energy created during pile replacement work would have the potential to disturb fish within the vicinity of the pile replacement work. As a result, the affected area could have a temporarily decreased foraging value to marine mammals. During pile driving, high noise levels may exclude fish from the vicinity of pile driving; Hastings and Popper (2005) identified several studies that suggest fish will relocate to avoid areas of damaging noise energy. An analysis of potential noise output of the proposed Project indicates that the distance from underwater pile driving at which noise has the potential to cause temporary hearing loss in fish ranges from approximately 10 to 158 meters (33 feet to 518 feet) from pile driving activity, depending on the type of pile[6]. Therefore, if fish leave the area of disturbance, pinniped foraging habitat may have temporarily decreased foraging value when piles are driven.

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.

San Francisco Bay is classified as Essential Fish Habitat (EFH) under the Magnuson-Stevens Fisheries Conservation and Management Act, as amended by the Sustainable Fisheries Act. The EFH provisions of the Sustainable Fisheries Act are designed to protect fisheries habitat from being lost due to disturbance and degradation. The act requires implementation of measures to conserve and enhance EFH.

San Francisco Bay, including the area of the Project, is classified as EFH for 20 species of commercially important fish and sharks that are federally managed under three fisheries

[6] Distance where underwater noise exceeded the Fisheries Hydroacoustic Working Group (FHWG 2008) threshold of 187 dB SEL for adult fish during vibratory extraction of concrete and timber piles (10 meters, 32 feet) and 60-inch steel piles (158 meters, 520 feet). Other distances include 23 meters (75 feet) during vibratory driving of the composite barrier piles, and 11 meters (37 feet) during impact driving of concrete piles. Noise levels during pile driving would not exceed peak levels (206 dB) that would cause mortality to fish.

management plans (FMPs): Coastal Pelagic, Pacific Groundfish, and Pacific Coast Salmon (Table 9-1). The Pacific Coast Salmon FMP includes Chinook salmon.

Table 9-1: EFH Managed Species in Central San Francisco Bay

Fisheries Management Plan	Species, Common Name	Species, Scientific Name
Coastal Pelagic	Northern anchovy	*Engraulis mordax*
	jack mackerel	*Trachurus symmetricus*
	Pacific sardine	*Sardinops sagax*
Pacific Groundfish	english sole	*Parophrys vetulus*
	sand sole	*Psettichthys melanostictus*
	curlfin sole	*Pleuronichthys decurrens*
	Pacific sanddab	*Citharichthys sordidus*
	starry flounder	*Platichthys stellatus*
	lingcod	*Ophiodon elongatus*
	brown rockfish	*Sebastes auriculatus*
	Pacific whiting (hake)	*Merluccius productus*
	kelp greenling	*Hexagrammos decagrammus*
	leopard shark	*Triakis semifasciata*
	spiny dogfish	*Squalus acanthias*
	skates	*Raja* ssp.
	soupfin shark	*Galeorhinus galeus*
	Bocaccio	*Sebastes paucispinis*
	Cabezon	*Scorpaenichthys marmoratus*
Pacific Coast Salmon	Chinook salmon	*Oncorhynchus tshawytscha*
	Coho salmon	*Oncorhynchus kisutch*

Note:
EFH = Essential Fish Habitat

In addition to EFH designations, San Francisco Bay is designated as a Habitat Area of Particular Concern for various fish species within the Pacific Groundfish and Coastal Pelagic FMPs, as this estuarine system serves as breeding and rearing grounds important to these fish stocks. A number of these fish species are prey species for pinnipeds.

Given the short daily duration of increased underwater noise levels associated with the Project and the impact avoidance and minimization measures (Section 11), the proposed Project is not likely to have a permanent, adverse effect on EFH. Therefore, the Project is not likely to have a permanent, adverse effect on marine mammal foraging habitat.

10 Anticipated Impact of the Loss or Modification of Habitat

The Project'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. 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. Although the proposed Project would result in a small net increase in Bay fill of approximately 0.01 acre of benthic foraging habitat, this would not have a measurable influence on habitat for marine mammals in the Bay.

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11 Impact Reduction Methods

Section 6 describes the potential number of marine mammals—by species—that may be exposed to acoustic sources that would be considered Level B Harassment by NMFS. Level A Harassment will be avoided through the use of bubble curtains and marine mammal monitoring within a shutdown zone as described in this Section. The following mitigation measures are proposed by Chevron to reduce the number of marine mammals potentially affected by this Project.

11.1 Mitigation for Pile Extraction and Driving Activities

As described in Section 6, cumulative noise from pile driving could produce noise levels above the Level A threshold over the distances provided in Table 6-4. The results of this modeling guided the establishment of a shutdown zone around each pile to prevent Level A Harassment to marine mammals. The following measures will be implemented to reduce the area of potential effects where harassment of marine mammals could occur:

1. Noise Attenuation

Noise attenuation systems (i.e., bubble curtains) will be used during all impact pile driving to interrupt the acoustic pressure and reduce the impact on marine mammals. The use of bubble curtains generally reduce underwater pile driving noise levels by approximately 5 dB or more (Caltrans 2020), which decreases the area over which the Level A and Level B Harassment may be exceeded. By reducing underwater sound pressure levels at the source, bubble curtains would also reduce the area over which Level B Harassment would occur, thereby potentially reducing the numbers of marine mammals affected.

2. Shutdown Zones

The shutdown zones established for each pile type will include all of the area where underwater sound pressure levels are expected to reach or exceed the cumulative SEL thresholds for Level A Harassment as provided in Table 6-4. Specifically, the radii of the shutdown zones will be to next largest 10 meter interval from the values provided in Table 6-4, with minimum shutdown zone of 10 meters.

Shutdown zones for the various pile types will be established in the marine mammal monitoring plan that will be developed for the 2021 construction season. To prevent Level A take, shutdown zones larger than the modeled cumulative noise Level A zone will be established during initial pile driving, while hydroacoustic measurements are made to establish actual field conditions.

These shutdown zones may be adjusted, in consultation with NMFS, once field conditions have been established through hydroacoustic monitoring, which is described in Section 13.

3. Visual Monitoring

The shutdown zones will be monitored for 30 minutes prior to any pile extraction and driving activities to obtain visual confirmation that the area is clear of any marine mammals. Visual monitoring will occur from clear vantage points along the Long Wharf. Pile extraction or driving will not commence until cetaceans have not been sighted within the shutdown zone for a 30 minute period.

If a marine mammal enters the shutdown zone during pile driving, work will stop until the animal leaves the shutdown zone, and will not resume until no marine mammals are observed in the shutdown zone for 30 minutes. If a marine mammal is seen above water and then dives below, a 15 minute wait period will begin; and if the animal is not re-detected in that time, it will be assumed that the animal has moved beyond the shutdown zone. Further description of the proposed marine mammal monitoring is described in Section 13.

Monitoring will be conducted by qualified observers familiar with marine mammal species and their behavior. Up to two PSOs will be stationed to observe the shutdown zone and ensure that pile driving does not occur when cetaceans are present within the shutdown zone. These observers will also record information regarding the presence and behavior of marine mammals within the shutdown zones and Level B Harassment zones. The observer will monitor the shutdown zone from the most practicable vantage point possible (the Long Wharf itself, or a boat) to determine whether marine mammals enter the shutdown zone. Details of visual monitoring protocols will be provided in the marine mammal monitoring plan, and that plan will be approved by NMFS prior to the start of construction.

4. Acoustic Monitoring

Hydroacoustic monitoring will be conducted during a portion of the vibratory pile driving to verify and refine the limits of the shutdown zone. This monitoring is described further in Section 13.

5. Daylight Construction Period

Pile driving would occur only during daylight hours when visual marine mammal monitoring can be conducted.

6. Soft Start

A "soft-start" technique is intended to allow marine mammals to vacate the area before the pile driver reaches full power. For impact driving, an initial set of three strikes would be made by the hammer at reduced energy, followed by a 1-minute waiting period, then two subsequent three-strike sets before initiating continuous driving. For vibratory hammers, the contractor will initiate the driving for 15 seconds at reduced energy, followed by a 1-minute waiting period when there has been downtime of 30 minutes or more. This procedure shall be repeated two additional times before continuous driving is started. This procedure would also apply to vibratory pile extraction.

Should any serious injury or mortality result during the course of the proposed activities, Chevron will suspend operations and will immediately contact NMFS.

11.2 Mitigation Effectiveness

Level A Harassment will be avoided through the use of bubble curtains and implementation of shutdown zones. Visual observation of marine mammals depends on several factors, including the behavior of the animal (e.g., underwater swimming), the observer's ability to detect the animal, environmental conditions and monitoring platforms.

PSOs will be biologists with experience in the detection and behavior of marine mammals so that the observers are able to adequately detect marine mammals in the shutdown zone; and to determine their behavior and whether they appear to be harassed by the pile extraction and driving activities. Prior to the start of work, all PSOs will submit CVs to NMFS for approval.

Observers will be positioned in locations that provide the best vantage points for monitoring, but conditions such as fog or choppy waters may hinder observations. Pile driving work would be stopped whenever the PSOs are unable to observe the entirety of the shutdown zones. Observers are likely to be on the Long Wharf decking or structures adjacent to the work area.

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12 Arctic Subsistence Uses, Plan of Cooperation

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

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13 Monitoring and Reporting

Chevron would develop a detailed monitoring plans for conducting acoustic measurements and documenting marine mammal observations. The acoustic monitoring plan will outline the methods for underwater noise measurements to provide data on actual noise levels during construction, and provide data such that the marine mammal shutdown zone can be properly enforced during pile extraction and driving activities. The marine mammal monitoring plan will provide details on data collection for each distinct marine mammal species observed in the Project area during the construction period. Monitoring will include the following: marine mammal behavior observations, count of the individuals observed, and the frequency of the observations. Both plans would be submitted to NMFS for review and approval prior to the start of construction. The monitoring plans are described in more detail below.

13.1 Acoustic Monitoring

Hydroacoustic monitoring would be conducted by a qualified monitor during pile extraction and driving activities. Details would be developed during work plan preparation, but will include monitoring at least two piles of each type. A reference location would be established at the estimated cumulative SEL contour for that pile type. Measurements would be taken at two depths: one in mid-water column, and one near the bottom (but at least 1 meter [3 feet] above the bottom). Additional details of the acoustical monitoring plan will be developed in conjunction with NMFS prior to the start of construction, but will likely include acoustic monitoring during installation of two composite piles. Monitoring of the concrete pile installation and the installation of the 36-inch steel pipe piles occurred during prior years of the project, and sufficient hydroacoustic data has been collected for those pile types.

13.2 Marine Mammal Monitoring

Specific details of the biological monitoring will be developed in conjunction with NMFS during finalization of the IHA, and any updates will be incorporated into the project Marine Mammal Monitoring Plan. Chevron will collect sighting data and observations on behavioral responses to construction for marine mammal species observed in the region of activity during the period of construction. All observers will be trained in marine mammal identification and behaviors, and would conduct the following general monitoring and reporting tasks:

- Biological monitoring would occur within 1 week before the Project's start date, to establish baseline observations.

- Observation periods will encompass different tide levels and hours of the day. Monitoring of marine mammals around the construction site 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 and cetaceans by species, a description of behavior (if possible), location, direction of movement, type of construction that is occurring, time that pile replacement work begins and ends, any acoustic or visual disturbance, and time of the observation. Environmental conditions such as weather, visibility, temperature, tide level, current and sea state would also be recorded.

- Biological monitoring would occur from appropriate monitoring locations on the Long Wharf to maintain a clear view of the shutdown zone and adjacent areas during the survey period. Monitors would be equipped with radios or cell phones for maintaining contact with work crews.

- During pile extraction and driving, the underwater shutdown zone will be monitored for 30 minutes prior to commencing work. If marine mammals are within the shutdown zone, the start of extraction or driving will be delayed until no animals are sighted within the zone for 30 minutes.

- A final report would be submitted to NMFS within 90 days after completion of the proposed Project (or annual pile driving work).

14 Coordinating Research to Reduce and Evaluate Incidental Take

To reduce the likelihood that impacts will occur to the species, stocks, and subsistence use of marine mammals, construction activities will be conducted in accordance with federal, state and local regulations and the minimization measures proposed in Section 11 to protect marine mammals. Chevron will coordinate all activities as needed with relevant federal and state agencies. These include, but are not limited to: NMFS, United States Army Corps of Engineers, and the California Department of Fish and Wildlife.

Marine mammal and acoustic monitoring reports would provide useful information that would allow design of future projects to reduce incidental take of marine mammals. Chevron 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 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.

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Appendix A PTS Calculation Spreadsheets

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24-inch Square Concrete Pile - Impact Driven

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Chevron Long Wharf Maintenance and Efficiency Project (LWMEP) 2021 IHA
PROJECT/SOURCE INFORMATION	LWMEP pile driving monitoring on 6/6 2018 with bubble curtain attenuation found a 15 log transmission loss or greater, a peak of 191 dB, mean RMS of 173 and a mean SEL of 161.

Please include any assumptions

PROJECT CONTACT	Bill Martin - bill.h.martin@aecom.com

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	Default

[¥] Broadband: 95% frequency contour percentile (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 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based source levels are

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**190.4**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	161
Number of strikes per pile	440
Number of piles per day	2
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	191
Distance of $L_{p,0\text{-}pk}$ measurement (meters)[+]	10
$L_{p,0\text{-}pk}$ Source level	206.0

RESULTANT ISOPLETHS*

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

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**31.3**	**1.1**	**37.3**	**16.8**	**1.2**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.8**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

14-inch Composite Pile - Vibratory Installation

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Chevron Long Wharf Maintenance and Efficiency Project (LWMEP) 2021 IHA
PROJECT/SOURCE INFORMATION	Anacortes Ferry Terminal in Washington State - RMS noise levels produced during this installation varied from 138 to 158 dB RMS at 43 meters (141 feet) from the pile (Laughlin 2012).

Please include any assumptions

PROJECT CONTACT	Bill Martin - bill.h.martin@aecom.com

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 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	168
Number of piles within 24-h period	5
Duration to drive a single pile (minutes)	10
Duration of Sound Production within 24-h period (seconds)	3000
10 Log (duration of sound production)	34.77
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

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)	**17.7**	**1.6**	**26.2**	**10.8**	**0.8**

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)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to
they need to make sure t
to ensure the built-in cal

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

14-inch steel H Pile - Vibratory Extraction

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Chevron Long Wharf Maintenance and Efficiency Project (LWMEP) 2021 IHA
PROJECT/SOURCE INFORMATION	2019 LWMEP hydroacoustic monitoring

Please include any assumptions

PROJECT CONTACT	Bill Martin - bill.h.martin@aecom.com

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 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	150
Number of piles within 24-h period	6
Duration to drive a single pile (minutes)	5
Duration of Sound Production within 24-h period (seconds)	1800
10 Log (duration of sound production)	32.55
Transmission loss coefficient	20
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

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)	**1.5**	**0.2**	**2.0**	**1.0**	**0.1**

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**

NOTE: If user decided to they need to make sure t to ensure the built-in cal

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

16-inch Timber Pile - Vibratory Extraction

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Chevron Long Wharf Maintenance and Efficiency Project (LWMEP) 2021 IHA
PROJECT/SOURCE INFORMATION	RMS 152 Provided by NMFS, cited Seattle Pier 62/63.

Please include any assumptions

PROJECT CONTACT	Bill Martin - bill.h.martin@aecom.com

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 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	152
Number of piles within 24-h period	12
Duration to drive a single pile (minutes)	6.666
Duration of Sound Production within 24-h period (seconds)	4799.52
10 Log (duration of sound production)	36.81
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

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)	2.1	0.2	3.1	1.3	0.1

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

NOTE: If user decided to
they need to make sure t
to ensure the built-in cal

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

36-inch Steel Pipe Pile - Vibratory Extraction

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Chevron Long Wharf Maintenance and Efficiency Project (LWMEP) 2021 IHA
PROJECT/SOURCE INFORMATION	2019 LWMEP hydroacoustic monitoring

Please include any assumptions

PROJECT CONTACT	Bill Martin - bill.h.martin@aecom.com

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 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	167
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	5
Duration of Sound Production within 24-h period (seconds)	1200
10 Log (duration of sound production)	30.79
Transmission loss coefficient	20
Distance of sound pressure level (L_{rms}) measurement (meters)	15

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

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)	**13.0**	**2.1**	**17.4**	**8.9**	**1.2**

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**

NOTE: If user decided to
they need to make sure t
to ensure the built-in cal

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