Incidental Harassment Authorization Request

Dumbarton Bridge Seismic Retrofit

Caltrans District 04

Alameda County and San Mateo County
State Route 84
PM ALA 0.0 – 1.2; PM SM 28.5 – 30.15
EA 04-1A5220

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U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration, and
STATE OF CALIFORNIA
Department of Transportation

March 2009

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Abbreviated Terms

µPa	micropascal
BATA	Bay Area Toll Authority
Bay	San Francisco Bay
Caltrans	California Department of Transportation
dB	decibel(s)
EFH	Essential Fish Habitat
Hz	hertz
kHz	kilohertz
MHHW	Mean Higher High Water
NMFS	National Marine Fisheries Service
peak	instantaneous peak sound pressure level
PIDP	pile installation demonstration project
PM	post mile
RMS	root mean square
RSRB	Richmond–San Rafael Bridge
SR 84	State Route 84

1 Detailed Description of the Activity

The Dumbarton Bridge, part of State Route 84 (SR 84), is a major east/west connector between Interstate 880 in Alameda County and U.S. Highway 101 in San Mateo County. The bridge is the southernmost of the toll bridges that span San Francisco Bay (the Bay). Its eastern terminus is in Fremont, and its western terminus is at the border of Menlo Park and East Palo Alto (Figure 1-1). The bridge provides access for approximately 80,000 trips across the Bay between Alameda and San Mateo counties each day.

The bridge has been identified by the Governor's Board of Inquiry as part of the critical transportation system crossing the Bay, and the Board has determined that it is important to maintain the redundancy the bridge provides.

The Dumbarton Bridge is surrounded by important habitats such as open bay, salt ponds, salt marshes, mudflats, and vernal pools. These habitats are home to a variety of important species that are protected by a variety of environmental regulations.

1.1 Project History

The Dumbarton Bridge was designed in the late 1970s based on the design standards that the California Department of Transportation (Caltrans) established in 1971. However, updated standards, particularly Caltrans' Seismic Design Criteria of 1999, prompted further study and identified subsequent improvements necessary to provide adequate seismic resistance. In 2004, the Caltrans Office of Earthquake Engineering conducted a seismic vulnerability study that determined that the Dumbarton Bridge did not meet the current minimum requirements related to seismic resistance. A comprehensive seismic analysis of the bridge was performed based on complete geotechnical soil data, and a set of retrofit strategies was developed. The proposed project, the Dumbarton Seismic Retrofit Project, would provide a seismic upgrade of the Dumbarton Bridge; the upgrade would meet the current requirements.

The proposed project would be funded by the Bay Area Toll Authority (BATA), but Caltrans is doing much of the design and management work and is the point-of-contact for the various environmental planning and permitting requirements.

Figure 1-1. Project Location Map

1.2 Project Description

The existing bridge span is approximately 8,600 feet long and 85 feet wide. The bridge consists of three structural types in five sections. The five sections include a main channel crossing at the center of the bridge, two approach sections (one each on the eastern and western sides), and two trestle structures (one on each end) that anchor the bridge (Figure 1-2, Sheets 1 to 5). Seismic retrofit activities would take place on all five sections of the bridge.

The proposed project is expected to take approximately 3 years. The seismic retrofit activities would take place entirely within the Caltrans right-of-way.

1.2.1 Project Limits

The proposed project would encompass 2.85 miles of SR 84 as it crosses the southern portion of the Bay. The project limits are from post mile (PM) 28.5 to PM 30.15 in San Mateo County and from PM 0.0 at the San Mateo/Alameda County line (near the center of the bridge) to PM 1.2 in Alameda County.

1.2.2 Trestle Sections

The trestle sections are on land and are each 600 feet long. Project activities on these sections would include installing permanent piles adjacent to the existing structure to provide lateral strengthening. The piles would be 4-foot-diameter steel pipe piles driven into the ground with an impact hammer. Installation would be restricted to prescribed work windows to avoid disturbing nesting birds with noise from the on-land pile driving.

A total of 14 piles would be installed on the northern and southern sides of each of the two trestle structures, as follows:

- On the southern side of the western trestle, all 7 piles would be placed on already paved ground.
- On the northern side of the western trestle, all 7 piles would be placed on already paved ground.
- On the southern side of the eastern trestle, all 7 piles would be placed into weedy ruderal vegetation enclosed by parking islands and the trestle itself.
- On the northern side of the eastern trestle, all 7 piles would be placed into a surface water depression wetland.

Figure 1-2. Project Layout
Sheet 1 of 5

Figure 1-2 (Sheet 2 of 5)

Figure 1-2 (Sheet 3 of 5)

Figure 1-2 (Sheet 4 of 5)

Figure 1-2 (Sheet 5 of 5)

The other major activity on the trestle sections would be the addition of a seismic hinge joint to each trestle's connection with its corresponding approach section. These joints extend across the entire roadway bed and may require occasional weekend bridge closures to install the joints.

1.2.3 Approach Sections

The two approach sections are supported by a series of piers (sometimes referred to as "bents" in design documents). The western approach section is 2,850 feet long and extends from Pier 1 to Pier 15, and the eastern approach section is 2,600 feet long and extends from Pier 32 to Pier 44. The retrofit activities in the approach sections involve structural improvements to the abutments, pile caps, bridge columns, and superstructure but would not result in additional permanent structures in the waters of the Bay.

Pile-supported temporary work trestles would be constructed in the Bay to the south of the eastern and western approach structures. The temporary trestles would provide access for project construction activities on the approach sections and part of the main channel crossing. The trestles would extend out to Pier 16 on the western end and to Pier 27 on the eastern end (Figure 1-2). Construction of the temporary trestles is detailed in Section 1.2.5.

1.2.4 Main Channel Crossing

The main channel section of the bridge is 3,000 feet long and extends between Pier 16 and Pier 31 (Figure 1-2, Sheets 3 and 4). All work would be done from the ends of the temporary trestles and from barges in the Bay. Retrofit activities would include upgrades to the bridge columns (above water), pile caps, and hinges, and the addition of isolator bearings at the top of the columns. The seismic upgrade of the main channel section would not require permanent piles.

1.2.5 Temporary Trestle Construction

As described in Section 1.2.3, temporary work trestles would be constructed. The piles supporting the trestles would be 2-foot-maximum-diameter steel pipe piles, placed in rows of 3, spaced at intervals (or spans) of approximately 25 feet. Additional piles (up to 16 per pier) would be placed around each of the piers to support temporary trestles around them, allowing construction access along all four sides of the pier (Figure 1-2, Sheets 2, 3, and 4). All temporary trestles would be less than 25 feet wide.

Collectively, approximately 1,000 temporary piles would be placed into the Bay. To reduce noise-related impacts on nesting birds, temporary piles within 800 feet of shore that are installed during the nesting season would be installed with vibratory hammers instead of impact hammers. Impact hammers would be necessary for verification of load capacity. Caltrans anticipates that approximately 10 to 20 percent of the piles installed by vibratory method would be “tapped” with an impact hammer to verify the load capacity. Beyond 800 feet from shore, the piles would be driven with an impact hammer using a bubble curtain system to reduce underwater noise levels.

On completion of the project, the temporary work trestles would be removed and the supporting piles would be pulled out of the bay floor or cut off below the mud line.

Two public fishing piers lie just south of the Dumbarton Bridge. The western pier, referred to as the Ravenswood Pier, is closed to the public because of safety issues. The eastern pier, referred to as the Dumbarton Pier, is inside the Don Edwards San Francisco Bay National Wildlife Refuge. This pier is currently open to the public.

The Ravenswood Pier would be removed as part of the western temporary trestle construction described above. Starting at the shoreline, construction crews would remove a short section of the Ravenswood Pier and then either pull the existing reinforced-concrete piles or cut them off 3 feet below the mudline. Construction crews would then drive temporary piles, construct a section of temporary trestle, and repeat the process farther east. When work is completed, the temporary trestle would be removed from the easternmost end, working back toward the western shore of the Bay. The Ravenswood Pier would not be replaced.

The eastern temporary trestle would be built between the Dumbarton Pier and the bridge, and access to this fishing pier would be preserved. Sectional pile driving and trestle construction would proceed as on the western end, except that the existing fishing pier would not be disturbed. When the retrofit activities are completed, the trestle and piles would be removed starting with the outermost portion and working back toward the shoreline.

While the temporary trestles are in place, retrofit work would be conducted on the superstructure and substructure of the various bridge sections, including retrofit of the bridge hinges in the superstructure; strengthening of the columns above the pile caps, bent caps just below the superstructure, pedestals on top of the pile caps, and pile caps; and other actions that would not affect habitat or generate large amounts of noise.

1.2.6 Temporary Cofferdams

Reinforcing the connection between the columns, pedestals, and pile caps would involve adding a reinforced concrete collar. The reinforcement would increase the size of the pedestals as they sit atop the pile caps. This work would be performed at most of the piers, including those without adjacent temporary trestles.

Adding the concrete collars would require placing a cofferdam around each pier, dewatering the enclosure, and removing any mud deposits from the tops of the pile caps. Caltrans anticipates that the cofferdams would be constructed of sheet piles driven 15 feet into the bay floor with a vibratory hammer and placed a maximum of 6 inches to 1 to 2 feet from the edges of the existing pile caps. Dewatering would then lower the water level to expose the top and several feet of the sides of each pile cap. Up to 50,000 gallons of water would be removed from each cofferdam, resulting in a total of 1,000,000 gallons of initial dewatering. However, the total volume would be moved over many months because not all cofferdams would be in place at once. If the initial dewatering occurs at low tide, the volume would be as noted, but each day a cofferdam is in place, it would need to be pumped down again because of underseepage. The actual volume of dewatering over the project duration would be larger.

Project design plans and field surveys indicate that a maximum total of 1,800 cubic yards of mud could sit atop the pile caps of the shallow water piers, including Piers 1 and 44, which are on land and would be excavated. The mud and dirt would be disposed of offsite in an upland location. The total footprint area of concrete added to the Bay as fill from these activities would be 25,000 square feet with a volume of 700 cubic yards.

1.2.7 Construction Staging and Access

No construction staging would occur in the project area. Contractors would be required to procure environmentally cleared staging areas away from the immediate project vicinity. Use of currently graded and disturbed areas at each end of the bridge for short-term material laydown and vehicle access would be permitted. The parking areas on both sides would be reconfigured as needed to provide parking for construction workers as well as to maintain some public parking for the Dumbarton Pier.

On the western end of the Dumbarton Bridge, all access roads are within Caltrans right-of-way. On the eastern end, access into the project area is via Marshlands Road, which is reachable from the Thornton Avenue–South exit from SR 84. Marshlands Road originates more than 2 miles east of the project area, enters the Don Edwards San Francisco Bay National Wildlife Refuge, and provides vehicle access to the Dumbarton Pier parking lot where construction personnel parking and material laydown would occur.

1.2.8 Temporary Barrier and Drainage System

The proposed project would include construction of a barrier to keep high-tide water from Moseley Tract from encroaching onto the northern frontage road on the western end of the bridge and project work area. At present, the highest tides in the Bay flow unchecked out of the Moseley Tract to the immediate north of the project area and onto the roadway. The barrier would be installed completely within Caltrans right-of-way on the edge of the paved shoulder. The temporary barrier would reduce the flooding from tides and keep the access road open. The barrier would be left in place post-construction until Caltrans determined it should be removed.

The barrier would be approximately 2,000 feet long and between 39 and 56 inches above the existing road. In addition, metal sheet pile would be installed up to 20 feet into the ground within the existing shoulder to reduce the underseepage that would otherwise occur. The sheet pile would be driven outside the nesting season for listed birds if practicable; however, a vibratory hammer would be used to drive it if such seasonal avoidance is not feasible. The sheet pile would run the entire length of the barrier and would rise approximately 3 feet above ground.

The proposed barrier would create an enclosed space that would require a water collection system, including drains, pipes, and a pump, that together would collect local rain water and runoff from the frontage road and return it to the Bay. The main pipe would run underground parallel to the barrier throughout its length. A number of drains would allow gravity-driven flow of rainwater and runoff from the frontage road and parking lots to collect in the pipe. The water would flow to a pumphouse at the eastern end of the barrier, adjacent to the western shore of the bay. Currently, rainwater runoff enters the Bay in a manner and volume similar to what are expected after project completion. No changes to local hydrology are expected.

The pumphouse would be up to 10 feet tall, have a maximum footprint of 12 feet by 15 feet, and be completely buried underground in a space excavated for it. The volume of excavated material could reach 2,000 cubic yards and would be supported on 4 steel piles, no greater than 2 feet in diameter. The pumps would push water through a 12- to

18-inch-diameter outflow pipe upwards and through the existing levee. At the end of the outflow pipe, a strip of riprap would be placed to disperse the outflow and reduce erosion. The strip would have a maximum area of 500 square feet and a maximum volume of 1,500 cubic feet. Installation of the barrier and associated drain and pumping system would be the first project activities to take place.

2 Dates, Duration, and Region of Activity

Construction activities would take place on and adjacent to the Dumbarton Bridge main channel crossing and approach spans. The Dumbarton Bridge, which is part of SR 84, is the southernmost bridge across San Francisco Bay and connects the cities of Fremont and Palo Alto (Figure 2-1). Both the eastern and western approaches of the bridge abut sections of the Don Edwards San Francisco Bay National Wildlife Refuge. This refuge includes several sloughs, notably Mowry and Newark sloughs, along which Pacific harbor seals (*Phoca vitulina richardsi*) (seals) are known to haul out. Mowry Slough hosts the largest harbor seal haul-out in San Francisco Bay. Newark Slough, which is closer to the bridge, has a regularly used but smaller haul-out approximately 2.7 miles from the project site. The main channel beneath the bridge is bounded by extensive mudflats on both the eastern and western ends of the bridge (Figure 2-1).

The proposed seismic retrofit is expected to begin in the summer of 2010 and continue for approximately 3 years. Pile-driving activities for construction of the temporary trestles would begin in July 2010 and is estimated to be completed within 1 year. Pile driving on land for the 48-inch piles along the bridge trestle structure would occur over a matter of several weeks and would be timed to avoid impacts to nesting special-status bird species. No permanent piles would be placed in the water.

Boating activities are not expected near seal haul-outs, and given the distance of the nearest haul-out to the project site, project-related noise is not expected to disturb resting seals. For these reasons, no seasonal restrictions on project activities to protect pupping or molting seals are included.

Figure 2-1. Project Vicinity Map

3 Species and Numbers of Marine Mammals in Area

Although at least 35 species of marine mammals can be found off the coast of California, very few species venture into San Francisco Bay, and only Pacific harbor seals and California sea lions (*Zalophus californicus)* make the Bay a permanent home. Gray whales (*Eschrichtius robustus*) are regularly sighted in the Bay during their yearly migration, though most sightings tend to occur in the Central Bay.

A number of studies have estimated marine mammal numbers in the Bay. A recent study that Caltrans conducted before and during seismic retrofit work on the Richmond–San Rafael Bridge (RSRB) in northern San Francisco Bay included extensive monitoring of marine mammals at points throughout the Bay, including the Central and South Bay areas. Although the study focused on seals, all other observed marine mammals were recorded. Monitoring took place from May 1998 to September 2005.

The RSRB study concluded that at least 500 seals populate San Francisco Bay. This estimate agrees closely with previous seal counts in the Bay, which ranged from 524 to 641 seals from 1987 to 1999 (Goals Project 2000).

RSRB monitors sighted at least 90 California sea lions in the North Bay and at least 57 in the Central Bay. Sea lions are year-round residents of the Bay, though their total numbers fluctuate seasonally. Sea lions haul out primarily at Pier 39, near Fisherman's Wharf in San Francisco. An estimated 1,105 animals were observed in September 2001 at Pier 39 (Parsons Brinckerhoff 2001), and winter numbers are generally over 500 animals (Goals Project 2000).

RSRB monitors also recorded 12 living and 2 dead gray whales, all in either the Central or North Bay, and all but two sightings occurred during the months of April and May. One gray whale was sighted in June and one in October (the specific years were unreported). The Oceanic Society has tracked gray whale sightings since they began returning to the Bay regularly in the late 1990s. 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 two to six whales enter the Bay in any given year.

RSRB monitors noted a single sea otter (*Enhydra lutris)* in the Central Bay in March 2001, and at least one harbor porpoise (*Phocoena phocoena)* was seen near the same location in May 2000. Sea otters and harbor porpoises rarely occur in the Bay, and neither is considered likely to occur within the project vicinity.

Humpback whales (*Megaptera noveangliae*) are rare, though well-publicized, visitors to San Francisco Bay. 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 just over 2 weeks in San Francisco Bay and the Sacramento River before finding their way back out to sea. Although it is possible that a humpback whale will enter the Bay and find its way toward the Dumbarton Bridge during construction activities, this occurrence is unlikely, and measures taken to minimize and mitigate for effects to gray whales would adequately protect a stray humpback whale if it does enter the project vicinity.

The marine mammal species most likely to be affected by the project are harbor seals, California sea lions, and gray whales.

4 Status and Distribution of the Affected Species

Marine mammals are protected under the Marine Mammal Protection Act of 1972, as amended. None of the species likely to occur in southern San Francisco Bay are listed under the Endangered Species Act of 1972. Gray whales, previously listed as endangered, were delisted in 1994.

4.1 Pacific Harbor Seals

The Pacific harbor seal is one of five subspecies of *Phoca vitulina*, or the common harbor seal. They are a true seal, with a rounded head and visible ear canal, as 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 reach over 6 feet and 300 pounds. They have the broadest range of any pinniped (Burns 2002), 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.

Harbor seals generally do not migrate annually. They display year-round site fidelity, though they have been known to swim several hundred miles to find food or suitable habitat. Seals within the Bay engage in limited seasonal movements associated with foraging and breeding activities (Kopec and Harvey 1995), and seals in the South Bay may make daily northward foraging migrations.

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).

Although generally solitary in the water, harbor seals come ashore at communal sites known as “haul-outs,” which 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). Bay harbor seals haul out in groups ranging in size from a few individuals to several hundred seals. Bay haul-out sites that support some of the largest concentrations of seals include Mowry Slough south of Dumbarton Bridge (approximately 4 miles south of the project site), Corte Madera Marsh, Castro Rocks, and Yerba Buena Island in the Central Bay (all approximately 25 to 35 miles north of the project site). Harbor seal haul-outs in the Bay are shown in Figure 4-1.

The seal haul-out site closest to the Project is at Newark Slough, approximately 2.7 miles south of the project site, near the junction of Newark Slough and Plummer Creek. Although the Newark Slough haul-out is a known pupping site, relatively few harbor seals use the site. Both Newark and Mowry sloughs are used by seals continuously year-round but have significantly higher numbers of seals during pupping and molting seasons (spring and summer). Other South Bay haul-outs include Coyote Point, Seal Slough, Belmont Slough, Bair Island, Corkscrew Slough, Greco Island, Ravenswood Point, Hayward Slough, Dumbarton Point, Calaveras Point, Drawbridge, and Guadalupe Slough (Goals Project 2000).

4.2 California Sea Lions in the Bay

The California Sea Lion belongs to the family Otariidae or “eared seals,” for the external ear flaps not shared by other pinnipeds. Seal lions are sexually dimorphic: males can reach up to 8 feet long and weigh 700 pounds, whereas females are smaller, at approximately 6 feet long and 200 pounds. California sea lions are endemic to the Northern Pacific Ocean, breeding in Southern California and along the Channel Islands during the spring. After the breeding season, males migrate up the Pacific Coast and enter the Bay. They are extremely intelligent and social. Group hunting is common, and they may cooperate with other species such as dolphins when hunting large schools of fish. In the Bay, they feed primarily on pacific herring, northern anchovy, and sardines (*sardinops asgax caerlrus*).

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. 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 South Bay area to forage.

4.3 Gray Whales in the Bay

Gray whales are large baleen whales. They grow to 49 feet in length and weigh up to 40 tons. They are one of the most frequently seen whales, easily recognized by their

Figure 4-1. Marine Mammal Haul-out Sites

mottled gray color and lack of dorsal fin. Adult whales carry heavy loads of attached barnacles, which add to the mottled appearance.

Although once found in three populations across the globe, the Atlantic population is believed extinct, and gray whales are limited to the Pacific Ocean, where they are divided into eastern and western stocks. Eastern gray whales migrate each year along the west coast of North America, feeding in northern waters primarily off Alaska during the summer before heading to breeding and calving grounds off Mexico over the winter. Their migrations take them past the coast of San Francisco from December through February, heading south, and again from mid-February through July, heading north. During the migration, gray whales will occasionally enter rivers and bays (such as San Francisco Bay) along the coast. Individual whales may use the shallow Bay waters for foraging, or they may simply be off course.

Small numbers of gray whales have been observed foraging along the coast from California to British Columbia during summer instead of migrating to Alaska (Sumich 1985). The population has recently reached a level thought to be near carrying capacity (approximately 26,000 animals), which may explain this new trend. Reports from The Sea Training Institute, The Oceanic Society, the RSRB monitors, and local news reports indicate that since 1999, gray whale sightings in the Bay have become more common, with at least two to six whales entering the Bay annually.

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.

5 Type of Incidental Take Authorization Requested

Caltrans requests an authorization from the National Marine Fisheries Service (NMFS) for incidental take by harassment (Level B as defined by Title 50 Code of Federal Regulations Part 216.3) of small numbers of marine mammals, specifically harbor seals, California sea lions, and gray whales during construction work related to the seismic retrofit of the Dumbarton Bridge in San Francisco Bay. The operations outlined in Sections 1 and 2 have the potential to result in takes of marine mammals by underwater and airborne noise disturbance during construction, including pile driving and work on the bridge columns and superstructure from land, barges, or temporary work trestles.

The effects will depend on the species and the distance and received level of the sound; however, temporary disturbance reactions are most likely to occur. Because of the mitigation measures outlined in Section 11, no serious injury (Level A) is anticipated. No intentional or lethal takes are expected.

6 Number of Marine Mammals That May Be Affected

Incidental harassment may occur as a result of noise produced by the pile driving and general work activities associated with the project and may potentially affect individual harbor seals and sea lions in the area, particularly during daily migrations between South Bay haul-outs and North Bay foraging areas. Potential harassment would occur when piles are being driven, which would include approximately 30 to 60 minutes per day over the first 8 to 10 months of the construction period.

6.1 Pacific Harbor Seals

As many as 300 seals may pass under the Dumbarton Bridge daily (some traveling north and some south) as they move between resting haul-outs and foraging areas (Bell 2008; Kopec 2008). These seals may be affected by construction activities on the bridge. In general, any harbor seal using the South Bay haul-outs may be affected, as these seals frequently leave the South Bay to forage under the bridge and in the Central and North Bay areas. The number of seals affected by this project would vary seasonally. During the pupping and molting season, mothers and pups or molting adults spend 10 to 12 hours a day onshore, compared to an average of 7 hours onshore for nonreproductive, nonmolting adults. In the Bay, pupping occurs from March to May and molting in June and July. These activities correspond to the greatest number of harbor seals at major haul-out sites in the Bay (Kopec and Harvey 1995) and therefore the greatest number of seals expected in the South Bay. In the spring and summer, as many as 300 to 400 seals per day may haul out in the South Bay, most of which pass under the Dumbarton Bridge during daily foraging activities. These numbers may also vary annually: in the breeding season of 2008 both Newark and Mowry sloughs experienced lower than average numbers of seals. Only 5 to 10 seals consistently hauled out at a time at Newark Slough, though the site has a historical average of 30 to 40 seals during pupping season, and Mowry Slough had only 200 to 220 seals hauling out compared to historical averages of 300 seals (Bell 2008).

6.2 California Sea Lions

Although less common in the South Bay than harbor seals, sea lions have been reported in the vicinity of the Dumbarton Bridge over the last decade (Bell 2008; Knoerle 2005). In 1994, a male sea lion was rescued after he climbed onto SR 84 and approached the toll booth for the Dumbarton Bridge. Shortly thereafter, a female sea lion forced the closure of all lanes of the Bayfront Expressway on the east side of the Bridge for several hours until she also was captured and transported to rescue facilities. No sea lion haul-outs have been reported for the South Bay, and the number of sea lions foraging near the Dumbarton Bridge is expected to be low.

6.3 Gray Whales

Gray whales have been observed regularly in San Francisco Bay during their migration period. Reports from The Sea Training Institute, The Oceanic Society, the RSRB monitors, and local news reports indicate that since 1999 gray whale sightings have become more common in the Bay, with at least two to six whales entering the Bay annually. As reported in Section 4, the gray whale population has reached a level thought to be near carrying capacity (approximately 26,000 animals), which may explain this trend. The Oceanic Society made an attempt to observe and record reported gray whales in the Bay during spring 2000. They observed gray whales apparently feeding in a number of areas around the Bay; however, most the whales were seen near the mouth of the Bay.

Assuming two to six gray whales enter the Bay per year (an assumption based on sightings of gray whales in the Bay), it is estimated that at most up to two whales will venture far enough south to be affected by pile-driving activities at the Dumbarton Bridge.

7 Anticipated Impact of the Activity on the Species or Stock

Project activities may result in behavioral changes in marine mammals, primarily from underwater noise levels generated during 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 mammals.

7.1 Fundamentals of Noise

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 hertz (Hz); intensity describes the loudness of a sound and is measured in decibels (dB). Decibels are measured using a logarithmic scale.

The method commonly used to quantify airborne sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects that 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 (dBA). Sounds levels measured underwater are not weighted and include the entire frequency range of interest.

Frequency is the rate at which sound waves oscillate or vibrate and is measured in cycles per second, or hertz (Hz). A marine mammal’s sensitivity to sound varies with frequency. Marine mammals are responsive only to sounds within a particular range of frequencies. A hearing threshold is the minimum received sound pressure that a marine mammal can detect at a specified frequency. Hearing thresholds are generally low within the range of frequencies that the animal detects best. As frequencies rise above or fall below this “best” range, thresholds increase; therefore, sound pressure levels must be higher to be detected. Seals and sea lions detect sound in both air and water.

When a pile-driving hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, ground, and air. The sound pressure pulse as a function of time is referred to as the waveform. The instantaneous peak sound pressure level (peak) 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. 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). The RMS term is referred to as $RMS_{90\%}$. $RMS_{90\%}$ is approximated in the field for pile-driving sounds by measuring the signal with a precision sound level meter set to the "impulse" RMS setting ($RMS_{impulse}$). Table 7-1 contains definitions of these terms. In this report, decibels are referenced to 1 micropascal (µPa).

Table 7-1: Definitions of Underwater Acoustical Terms

Term	Definition
Peak sound pressure, unweighted (dB)	Peak sound pressure level based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a decibel (referenced to a pressure of 1 µPa) but can also be expressed in units of pressure, such as µPa or PSI.
RMS sound pressure level, (NMFS criterion) dB re 1 µPa	The average of the squared pressures over the time that constitutes that portion of the waveform containing 90 percent of the sound energy for one pile-driving impulse.[1]

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

µPa = micropascal
dB = decibel
NMFS = National Marine Fisheries Service
PSI = pound(s) per square inch
RMS = root mean square

7.2 Applicable Noise Criteria

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

Since 1997, NMFS has been using generic sound exposure thresholds to determine when an activity in the ocean produces sound that may result in impacts to marine mammals such that take by harassment might occur (70 Federal Register 1871). NMFS is developing new science-based criteria to improve and replace the current criteria, but the new criteria have not yet been finalized (Southall et al. 2007). Figure 7-1 shows the current Level A (injury) and Level B (disturbance) threshold levels for cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions). There are separate Level B criteria for impulse noise (e.g., impact pile-driving) and continuous noise (e.g., vibratory pile-driving).

7.3 Estimation of Pile-Driving Noise

The primary and most significant source of underwater noise during construction would be pile driving for temporary work trestles in water and permanent support piles on land. The majority of the temporary trestle piles would be driven in the Bay in water less than 10 feet deep, and at low tides pile driving would take place entirely out of the water. The permanent piles at the bridge trestle structures (see Figure 1-2, Sheets 2 and 4) would be driven on land, but close enough to shore to potentially generate noise in the Bay. To estimate underwater sound pressure levels for the proposed project, measurements from a number of underwater pile-driving projects conducted under similar circumstances were compiled. The expected underwater sound levels from the pile-driving activities are described below. The underwater sound levels were estimated by Illingworth & Rodkin, Inc., based on field measurements (provided in Appendix A).

7.3.1 Temporary Trestle Piles

As described in Section 1, temporary construction access trestles would be built simultaneously on the eastern and western ends of the bridge. The trestles would be supported by 24-inch-diameter steel pipe piles. Many of the trestle piles would be driven using an impact hammer; however, in order to meet certain avoidance and minimization measures for terrestrial wildlife, temporary trestle piles within 800 feet from the shore would be driven using a vibratory hammer to the maximum extent practicable. Because of tidal fluctuations, many of the nearshore temporary piles would be driven at low tide and directly into the mud rather than through the water column. Farther from shore and in deeper water, an impact hammer would be used to drive the piles. Caltrans would install bubble curtains around the temporary piles when they are driven in water with a depth greater than 2 feet. The use of bubble curtains has been shown to be effective in decreasing the noise levels generated during pile driving. The use of an air bubble curtain on the installation of the trestle piles in the water is expected to reduce the source levels by approximately 10 dB.

Figure 7-1. Pinniped and Cetacean Harassment Levels

7.3.1.1 Noise Levels from Impact-Driven 24-inch-diameter Temporary Trestle Piles

Using an impact hammer, 3 to 6 piles, representing 1 to 2 bents, could be driven on most days of the 6- to 8-month construction period with occasional days when 9 piles could be driven. The project in total would require placing approximately 1,000 temporary piles into the Bay. Placement of each pile is expected to take 10 to 15 minutes, for a total driving time of up to 2 hours per day on each side, although the simultaneous trestle construction prevents exact calculations of daily noise durations. The 30 to 120 minutes of underwater noise generated per day would be discontinuous because the construction of the trestle deck sections would occur at each row of piles before the next row of piles could be installed. As the tide ebbed and flowed, these piles would either be driven in direct contact with water or out of the water on tidal mud.

A review of four projects was conducted to develop representative source levels. The projects are the Rodeo Dock repair in San Francisco Bay (Illingworth & Rodkin, Inc. 2004), the Stockton Wastewater Treatment Plant in the San Joaquin River (Illingworth & Rodkin, Inc. 2006a), the Klamath River Bridge repair (Illingworth and Rodkin 2006b), and the Amorco Wharf construction, near Benicia (Illingworth & Rodkin, Inc. 2005). Review of these reports showed that driving 24-inch steel piles in water without the use of attenuation such as bubble curtains typically produces maximum underwater sound levels of about 208 dB peak, and 194 dB RMS at a distance of 33 feet. The measured drop-off rate close to these types of piles was little more than 15 dB for each 10-fold increase in distance.[1]

More extensive measurements were conducted for the Richmond–San Rafael Bridge project, which involved construction of a temporary trestle with 30-inch-diameter piles (Caltrans 2003). These piles were driven in relatively shallow waters at depths of 10 to 20 feet. Measurements were taken at approximately 35 to 200 feet from the piles.

Source levels for these 30-inch-diameter piles were similar to slightly higher than the levels reported for 24-inch-diameter piles. Peak levels dropped 10 dB from 35 feet to 200 feet. The attenuation rate applies only to water depths of greater than about 3 feet. Very shallow water does not support the propagation of low-frequency sounds and in waters less than 3-feet deep, even high-frequency sounds attenuate rapidly. Therefore, pile driving sounds attenuate at a much greater rate at lower tides when the water is

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[1]For example, if the sound was 180 dB at 10 feet, it would be expected to drop to somewhat less than

shallow. Overall attenuation rates for long distances are estimated to be 17 dB per tenfold increase in distance.

Given a source level of 194 dB RMS at 33 feet and using bubble curtains in water greater than 2 feet deep, levels above 190 dB RMS would extend in a radius of about 15 feet from the pile being driven. Levels exceeding 180 dB RMS could extend in a radius of 60 feet. The calculated distance for sounds above 160 dB RMS would be approximately 3,330 feet, assuming that the rate of attenuation would increase somewhat, from the generally shallow nature of this part of the Bay.

7.3.1.2 Noise Levels from Vibratory-Driven 24-inch Diameter Trestle Piles

When piles are driven with a vibratory hammer, less intense noise energy is produced than with the impact hammer. Up to 6 of these piles could be driven in one day. It is estimated that each pile would be driven in approximately 10 minutes. There would be about 60 minutes of vibratory driving per day (during the 6- to 8-month trestle construction period) when the 6 piles are driven.

Under this method (driving piles with a vibratory hammer), installation of a 24-inch pile is expected to generate a sound level of 166 dB RMS at 35 feet. Noise levels above 190 dB would not be reached, and levels exceeding 180 dB could extend 10 feet from the pile.

7.3.2 Forty-eight-inch Steel Pipe Piles on Land at Bridge Trestle Structures

Retrofit of the bridge trestle sections[2] would include seven 48-inch-diameter steel pipe piles, driven along both the northern and southern sides of both ends for a total of 28 permanent piles. The piles would be a minimum of 50 feet from water during high tide. At lower tides, they would be more than 1,000 feet from shallow waters. The expected underwater sound levels would be attenuated considerably by the substrates at low tide. In addition, the closest waters would be very shallow and would therefore propagate sound energy poorly.

The Russian River bridge replacement in Geyserville, California, included driving 48-inch steel-shell piles on land near the river. Measurements from that project are

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165 dB at 100 feet.

[2] The bridge trestle structures are not to be confused with the temporary work trestles. The bridge trestle structures are part of the existing bridge and are at the far eastern and western ends of the bridge (see Figure 1-2, Sheets 2 and 4).

used here as approximate source levels (Illingworth & Rodkin 2006c) because piles are materially similar to the steel pipe piles that would be used here. The piles driven adjacent to the river produced sound levels of 190 to 199 dB peak and 182 to 187 dB RMS at 65 feet. Sound levels at the proposed project would likely be lower because these sounds would propagate mostly through the mud substrate. As a result, levels are not expected to exceed 190 dB RMS in water. It is possible that levels could exceed 180 dB RMS 100 feet from the shore at high tide. Noise with an intensity of 160 dB RMS may occur within 1,475 feet of the pile at high tide.

7.3.3 Twenty-four-inch-diameter Steel Pipe Piles on Land at Bridge Trestle

These piles would be a minimum of 20 feet from water during high tide. At lower tides, they would be more than 1,000 feet from shallow waters. The expected sound levels would be attenuated considerably by the substrates. In addition, the closest waters would be very shallow and would not support the propagation of sounds through the substrates, particularly attenuated sounds that are made up primarily of very low frequency sound. Data collected during the replacements of the Russian River Bridge in Geyserville included the measurements of 24-inch piles driven on land near the water. The most relevant data from these measurements are the piles driven about 65 feet from the edge of the river, where measurements were made in the river 35 feet from shore. Maximum levels in the deep-water channel averaged 172 dB RMS, although much lower throughout much of the driving. If a 20- dB decrease for every 10-fold increase in distance is assumed, the sound levels would drop off below 160 dB RMS at about 500 feet. Levels of 180 dB or 190 dB RMS would not occur in the water with these piles.

All 4 of the piles could be driven in 1 day. It is estimated that each pile would be driven in 10 minutes.

7.3.4 Vibratory-Driven Sheet Piles

Sheet piles would be driven in two places within the project area: around the pier footings to form a cofferdam to allow dewatering, and on the northwestern side of the floodwall along the frontage road. Driving the sheet piles would produce different effects because they would be in different places.

7.3.4.1 Noise Levels for Vibratory-Driven Cofferdam Sheet Piles in Water

Driving the sheet piles may be concurrent with continued construction of temporary trestles. The sheet piles would be driven with a vibratory hammer approximately 10 feet into the substrate. Each pile would be driven in about 4 minutes. An analysis by Illingworth & Rodkin (2008) indicates that the noise levels from this activity are expected to be 174 dB at a distance of 10 feet. Sound levels would not exceed 190 dB and would drop below 180 dB at 5 feet from the sheet. A maximum of 30 sheets would be driven per day.

7.3.4.2 Noise Levels for Vibratory-Driven Sheet Piles on Land

The sheet piles placed on the northwestern side of the temporary barrier wall along the frontage road would be installed approximately 30 to 40 feet from the water's edge when a moderate tide is in. The piles would be driven approximately 10 feet into the ground and take about 4 minutes each. Sheet pile driving was measured in a similar situation as part of the Ten Mile River Bridge Replacement project north of Fort Bragg, California. Peak sound pressure levels ranged from 128 dB to 155 dB with an average of 135 dB. The RMS ranged from 118 dB to 131 dB with an average of 122 dB. Sound levels during installation of sheet piles in the proposed project would not exceed 180 dB and would exceed the Level B harassment criterion (120 dB for continuous noise) only within about 150 feet from shore during a high tide.

7.3.5 Summary of Affected Area

Expected in-water pile-driving noise based on measured results for similar projects, as described above, is summarized in Figure 7-2. During high tide, when unmitigated temporary trestle piles are driven in water with an impact hammer, peak sounds would extend to a maximum of about 50 feet from the point of impact, and the sound would attenuate outside that range. At 60 feet from the point of impact, sound is expected to attenuate to 190 dB RMS, at 230 feet, sound is expected to attenuate to 180 dB RMS, and at 3,300 feet, sound is expected to attenuate to 160 dB RMS, or below harassment levels. Between 230 feet and 3,280 feet from pile-driving activities, Level B harassment of any marine mammal is expected if piles are impact-driven without the use of a bubble curtain.

The project will use bubble curtains for impact driving in water greater than 2 feet in depth, and because of this, affected area is significantly reduced. Sound is expected to attenuate to 190 dB RMS at 15 feet. At 60 feet, sound is expected to attenuate to 18 dB, and at 850 feet, sound is expected to attenuate to 160 dB RMS. Level B

Figure 7-2. Distance to Marine Mammal Sound Level Criteria

harassment of marine mammals is therefore expected between 60 feet and 850 feet from impact pile-driving activities.

Vibratory driving of the steel piles from the shoreline out to 800 feet would not result in sound levels above 190 dB. Levels of 180 db would be exceeded at 10 feet or less from the pile. However, the area of Level B harassment (120 dB for continuous noise) would be much greater than the area of Level B harassment for impact driving.

Installation of the barrier wall sheet piles would have little noticeable underwater-noise-related impacts on marine mammals. Sound levels from installation of the cofferdam sheet piles would decrease to 180 dB within 5 feet of the sheet.

Sound levels from driving the 48-inch steel piles at the bridge trestle sections would not exceed 190 dB. At high tide, sound levels in water could reach 180 dB within 100 feet of the shore and 160 dB within 1,470 feet of the shore. The criteria would not be exceeded at during low tides.

Figure 7-3 shows example locations of the area where unattenuated sound levels reach 180 dB or higher at high tide both near the shore and near the channel. As noted above, both the eastern and western trestles would be constructed simultaneously, so at any given time, similar areas would be affected on each side of the channel.

To ensure that no marine mammal is subjected to Level A harassment, a safety zone corresponding to the 180 dB contour around pile-driving activity would be enforced. No pile driving would occur within this zone until it was clear of marine mammals for at least 15 minutes before the commencement of pile-driving activity. This conservative safety zone would ensure the protection of any cetacean that may enter the project vicinity, and the zone is more than the distance necessary to ensure that seals (the most likely marine mammal to be encountered) and sea lions are not subject to Level A harassment.

7.4 Impact of Noise on Area Marine Mammals

7.4.1 General Effects of Noise on Marine Mammals

Marine mammals use hearing and sound transmission to perform vital life functions. The introduction of sound into their environment could be disrupting to those behaviors. Sound (hearing and vocalization/echolocation) serves four primary functions for odontocetes, including (1) providing information about the environment

Figure 7-3. 180 dB (RMS) Underwater Noise Contour at Example Temporary Trestle Pile Locations (Impact-Driven Steel Piles with a Bubble Curtain)

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(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).

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The effects of sounds from pile driving on marine mammals may include one or more of the following: masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995). In assessing the potential effects of noise, Richardson et al. (1995) have suggested four criteria for defining zones of influence. These zones are discussed in Sections 7.4.1.1 thru 7.4.1.4, from greatest influence to least influence.

7.4.1.1 Zone of Hearing Loss, Discomfort, or Injury

The zone of hearing loss, discomfort, or injury is the area in which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. The possible effects of a damaging sound level are a temporary threshold shift, a temporary loss in hearing, a permanent threshold shift, 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 sound 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 noise level criteria for this type of harassment are 180 dB for cetaceans and 190 dB for pinnipeds.

7.4.1.2 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 criteria for the zone where this effect occurs are 160 dB for impact noise and 120 dB for continuous noise.

7.4.1.3 Zone of Responsiveness

The zone of responsiveness is the area in which animals react behaviorally or physiologically. The behavioral responses of marine mammals to sound depend on a number of factors, including (1) the acoustic characteristics 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 sound (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 sound 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 criteria for the zone where these effects occur are 160 dB for impact noise and 120 dB for continuous noise.

7.4.1.4 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 kilohertz (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 (such as the beluga and killer whales), and pinnipeds (such as the harbor seal). The hearing capabilities of the species discussed in this document are described below. No criteria 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 sound range of a take as defined by NMFS.

7.4.2 Sound Sensitivity in Water

In water, harbor seals are typically sensitive to sounds ranging from about 1 kHz to 60 kHz with thresholds between 60 and 85 dB. Sensitivity above 60 kHz is typically poor, and the threshold increases to above 120 dB for maximum frequencies of 180 kHz (Richardson et al. 1995).

California sea lions have a narrower sensitivity range at high frequencies but are more sensitive than harbor seals to underwater noise at low frequencies—they are typically sensitive to sounds from approximately 1 to 30 kHz with a threshold of 80 dB. Outside these limits, the threshold increases to 115 dB for frequencies as low as 300 Hz and to 145 dB for frequencies as high as 70 kHz (Richardson et al. 1995).

No acoustical measurements of gray whale hearing have been published. However, gray whales have been shown to hear sounds in the 50 to 500 Hz range, and baleen whale sounds, though mostly below 1 kHz, are common up to 8 kHz. However, the low and high end limits of hearing for gray whales are unknown (Richardson et al. 1995).

7.4.3 Sound Sensitivity in Air

In air, harbor seals are most sensitive to sounds ranging from about 2 kHz to 20 kHz with thresholds between 40 and 50 dB (Richardson et al. 1995).

California sea lions have a slightly greater sensitivity and higher frequency cut-off than harbor seals: sea lions are typically sensitive to sounds from approximately 1 to 20 kHz with a threshold of 30 to 50 dB (Richardson et al. 1995).

7.4.4 Response to Pile Driving in the Bay

Before the start of the seismic retrofit work on the East Span of the Bay Bridge, Caltrans conducted a pile installation demonstration project (PIDP) to evaluate the noise from driving large piles in the Bay, including marine mammal responses to pile-driving activities (Parsons Brinckerhoff 2001). During the PIDP period, harbor seals were not visibly disturbed by the pile driving. Up to 85 seals per monitoring period hauled out at Yerba Buena Island. The typical response of hauled-out seals to pile driving was a head alert (during initial pile-driving activity only) or watching the activity, and in water they calmly swam in and out of the established 500-meter safety zone with no sign of an avoidance response. Responses to other disturbances, such as helicopter noise, boat traffic, and kayaks included head alerts and flushing.

During the same PIDP period, sea lions responded to pile driving by swimming rapidly out of the area, regardless of the size of the pile-driving hammer or the presence or absence of sound attenuation devices.

7.4.5 Impacts on Foraging Activity

Disturbances to harbor seals in the vicinity of Dumbarton Bridge may temporarily affect the daily migration of seals under the bridge or temporarily inhibit them from foraging near the bridge. However, limiting pile driving to 30 to 60 minutes per day would allow for minimal disruption of foraging or dispersal habitat under or near the bridge.

No impacts to foraging or haul-out for sea lions are anticipated because very few sea lions use the South Bay for foraging and no known sea lion haul-outs exist in the South Bay. The Dumbarton Bridge area is not a regular or commonly used foraging area for gray whales, and project construction activities are not expected to affect foraging habitat for whales within the Bay.

7.4.6 Impacts to Marine Mammals at Haul-Out Areas

During both the pupping and molting seasons, hauled-out seals are especially vulnerable to stresses caused by human disturbance. During this time, they react negatively to humans coming within 300 to 570 feet (Green et al. 2006) and may abandon their haul-outs or experience reduced reproductive success (Calambokidis et al. 1979). Therefore, the protection of their remaining haul-outs is an important measure for the preservation of this species.

Construction-related impacts to seals in the form of alert and flush disturbances were recorded during RSRB monitoring (Green et al. 2006). Seals hauled out at Castro Rocks, located 82 to 280 feet from the RSRB, were disturbed by various construction-related activities, including noise and boating activity. However, during the PIDP project for the seismic retrofit of the East Span of the Bay Bridge, seals at the Yerba Buena Island haul-out initially alerted during PIDP pile driving at a distance of approximately 0.94 miles, but quickly became acclimatized (Parsons Brinckerhoff 2001).

Hauled-out seals at Newark Slough or other South Bay haul-outs are not expected to be affected by project-related activities. Boating activities would be primarily north of or adjacent to the Dumbarton Bridge, and noise-generating activities would occur at or adjacent to the Dumbarton Bridge. These activities would be at least 2.72 miles from the nearest seal haul-out, more than twice the distance of the Yerba Buena Island seals from the PIDP project.

Sea lions do not haul out in the South Bay; therefore, sea lion haul-outs would not be affected by this project.

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.

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

No permanent impacts to habitat are proposed for or would occur as a result of this project. Therefore, no restoration of the habitat would be necessary. A temporary, small-scale loss of foraging habitat may occur for marine mammals under the Dumbarton Bridge during pile-driving activities. Temporary impacts to seafloor foraging habitat for gray whales will occur as a result of placing temporary piles within the Bay. This habitat disturbance is not expected to impact the ability of gray whales to forage within the Bay. Noise energy released during pile driving would have the potential to disturb, injure, or kill fish within the vicinity of the pile driving. As a result, the affected area could lose foraging value to marine mammals. The frequency and decibel ranges that have been shown to negatively impact fish (FHWG 2008) and an analysis of potential sound output of the proposed project indicate that the distance from underwater pile driving at which noise has the potential to cause temporary hearing loss in fish is 788 feet, or an area of approximately 45 acres.

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. Therefore, up to 45 acres of pinniped foraging habitat may have decreased foraging value as each pile is driven. The duration of fish avoidance of this area after pile driving stops is unknown. However, the affected area represents far less than 1 percent of the total area of San Francisco Bay within 5 miles on either side of the Dumbarton Bridge, and even long-term behavioral avoidance of the disturbed area would still leave large areas of pinniped foraging habitat. Also, any concentration of fish outside of this impact zone may provide increased pinniped foraging opportunities that would balance out the decrease in foraging within the impact zone, as long as fish populations or habitat are not significantly decreased by the project.

The southern portion of the 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 EFHs. The southern portion of the Bay (south of the San Mateo Bridge) is classified as an EFH for 14 species of commercially important fish and sharks. In addition to EFH designations, the Bay is designated as a Habitat Area of Particular Concern for various fish species within the Pacific Groundfish and Coastal Pelagic Fisheries management plans, as this estuarine system serves as breeding and rearing grounds important to these fish stocks.

Given the short daily duration of high noise associated with the project, the relatively small areas being affected, and the impact avoidance and minimization measures, the proposed project is not likely to have a permanent, adverse effect on the EFH, and therefore the project is not likely to have a permanent, adverse effect on pinniped foraging habitat.

10 Anticipated Impact of the Loss or Modification of Habitat

Foraging and dispersal habitat for marine mammals will be temporarily modified by the placement of temporary trestles in the Bay as part of the project. This modification is expected to have no impact on the ability of marine mammals to disperse or forage. No permanent modification of habitat is planned.

11 Impact Minimization Methods

Proposed avoidance measures for the project would include the following:

- Work would occur only during daylight hours (0700 to 1900 hours).
- A marine mammal monitoring program would be developed in consultation with NMFS before the construction (see also Section 13). A work plan that describes the elements of the monitoring program will be prepared. The monitoring program will include marine mammal safety zones that will be strictly enforced. As part of this program, a marine mammal monitor or monitors would survey the area either from a survey boat, the Dumbarton Bridge, or land-based locations with excellent views of the safety zones before the startup of pile-driving equipment. Pile driving would not begin until no marine mammals (pinnipeds or cetaceans) have been sighted within a designated safety zone for at least 15 minutes before the initiation of pile driving. Section 7 describes the proposed safety zones for each type of pile. These proposed safety zone distances would ensure that no marine mammal would be subject to Level A harassment.
- Pile driving would begin with a soft start to allow any marine mammals to leave the area before commencement of pile-driving activities.
- Boating exclusion zones would be maintained 800 feet outside of all known marine mammal haul-outs. This distance is calculated based on the largest average distance (718 feet) at which watercraft elicited alarm responses, including head alerts and flushes, during the RSRB marine mammal monitoring project (Green et al. 2006).
- Personnel on project-related watercraft would be required to receive marine mammal education, which would include information on regulations regarding distances that must be maintained between watercraft and marine mammals, behavior relative to marine mammals, including steering watercraft so as not to approach marine mammals head-on, and reporting of marine mammal sightings.

12 Arctic Subsistence Uses, Plan of Cooperation

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

13 Monitoring and Reporting

Caltrans would develop a monitoring plan that would collect data for each distinct marine mammal species observed in the project area during the construction period. Marine mammal behavior, the overall numbers of individuals observed, the frequency of observation, and the time corresponding to the daily tidal cycle would be included in the plan. Monitoring would occur at higher tide levels when piles are being driven in water.

The following information provides details for the proposed monitoring plan:

- Hydroacoustic monitoring would be conducted by a qualified monitor during pile-driving activities when piles are being driven in water greater than 3 feet in depth. Details would be developed during work plan preparation, but might include monitoring one pile in every set of 3 piles during installation of the temporary trestles. A reference location would be established at the estimated 180 dB contour (distance of 230 feet from the pile driving). Sound measurements would be taken at the reference location and at locations every 20 feet until the 180 dB level is found. Measurements would be taken at two depths: one in mid water column and one near the bottom but at least 3 feet above the bottom, unless obstructions such as land force a variation in depth or number of measurements. Marine mammal safety zones would be adjusted to maintain a safety zone outside of 180 dB, according to the results of this monitoring. Additional acoustical monitoring details will be developed in conjunction with NMFS prior to the start of construction.
- Biological monitoring would be conducted by qualified biologists approved by NMFS.
- Biological monitoring would occur before the first day of the survey to establish baseline data.
- Specific details of the biological monitoring will be developed in conjunction with NMFS during work plan preparation, but will likely include monitoring when piles are being driven (when the water depths are greater than 3 feet). 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 (e.g., Zeiss, 10 × 42 power).
- Data collection will consist of a count of all pinnipeds and cetaceans by species, a description of behavior (based on the Richmond Bridge Harbor Seal Survey classification system), sex and age class, if possible, location, direction of

movement, type of construction that is occurring, time that pile driving begins and ends, any acoustic or visual disturbance, and time of the observation. Environmental conditions such as wind speed, wind direction, visibility, temperature, tide level, current, and sea state (described using the standard Beaufort sea scale) would also be recorded.

- Biological monitoring would occur from appropriate monitoring locations, including the Dumbarton Bridge, the shore, or watercraft, so as to maintain an excellent view of the safety zone and adjacent areas during the survey period. Monitors would be equipped with radios or cell phones for maintaining contact with other researchers or work crews, Global Positioning System units for determining observation locations, and range finders to determine distance to marine mammals, boats, buoys, and construction equipment.
- Any marine mammal carcass found in the area would be tagged, and the species, and if possible, age, sex, and cause of death would be recorded and reported to Caltrans who would report it to NMFS.
- Weekly monitoring reports that summarize the monitoring results, construction activities, and environmental conditions would be submitted to Caltrans for transmittal to NMFS.
- A final report would be submitted to NMFS 90 days after completion of the proposed project.

Additional biological monitoring details may be considered during preparation of the monitoring plan.

14 Coordinating Research to Reduce and Evaluate Incidental Take

Marine mammal and hydroacoustical monitoring reports would provide useful information that would allow design of future projects to further reduce incidental take of marine mammals. Monitoring results and reports would be made publicly available on request.

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APPENDIX A

NOISE ESTIMATES

(Illingworth and Rodkin)