Murray Street Bridge (# 36C-0108)
Seismic Retrofit Project

Incidental Harassment Authorization Application

Murray Street Bridge
Santa Cruz Small Craft Harbor
City of Santa Cruz
Santa Cruz County, CA
Federal Project Number STPLX-5025 (048)

January 2015

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Caltrans

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Incidental Harassment Authorization Application

MURRAY STREET BRIDGE SEISMIC RETROFIT PROJECT (#36C-0108)
CITY OF SANTA CRUZ, SANTA CRUZ COUNTY, CALIFORNIA

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1. Description of the Activity

Location and Setting

The proposed project is located at the eastern edge of the City of Santa Cruz in the county of Santa Cruz (see Figure 1). The project area includes the Murray Street Bridge which spans the Santa Cruz Small Craft Harbor, portions of lands within the Santa Cruz Port District harbor area, portions of the harbor waters, and the area along the Murray Street road right-of-way, west of Lake Avenue (see Figure 2). The GPS coordinates (from Caltrans SI&A sheet) are:

- Latitude: N 36 degrees, 58 minutes 4 seconds
- Longitude: W 122 degrees, 00 minutes 10 seconds

Three marine mammals are known to occur within the Santa Cruz Small Craft Harbor: southern sea otter (*Enhydra lutris nereis*), harbor seal (*Phoca vitulina richardii);* and the California sea lion (*Zalophus californianus*). All marine mammals are protected under the Marine Mammal Protection Act. The docks and other features within the study area are haul-out sites for harbor seal and California sea lion. The open water of the study area provides habitat for the southern sea otter, the harbor seal, and the California sea lion.

Project Overview and Purpose

The proposed project consists of a seismic retrofit of the existing Murray Street Bridge, which spans the Santa Cruz Small Craft Harbor and additional minor modifications to replace deficient bridge barriers (widening shoulders to standard widths and replacement and improvement of sidewalks and railings). The seismic retrofit project will provide the bridge with additional vertical support and resistance to lateral seismic forces by installing additional pilings and supplemental structural elements. In order to provide sufficient area for construction operations, some boats, Harbor facilities, and commercial businesses will require temporary relocation.

The nine-span bridge is supported by two abutments (identified as Abutments 1 and 10, located at the western and eastern ends of the bridge, respectively) and 8 "bents" (identified as Bents 2 through 9, located at 60-foot intervals between the abutments). The seismic retrofit project consists of the following basic elements:

(1) Installation of concrete infill walls at Bents 2, 3, 4, and 9 to span the voids between the existing concrete support columns. The infill walls will also span the void between the existing and new columns at Bent 9.

(2) Installation of shear keys and seat extenders at Abutments 1 and 10 and Bents 2 through 9.

(3) Retrofit of foundations with 16-inch diameter CISS (cast-in-steel-shell) piles at Bent 9 and Abutments 1 and 10. These piles will extend to depths of approximately –55 feet to –90 feet at Bent 9 and to depths of approximately –30 feet to –55 feet at Abutment 10.

(4) Retrofit abutment with two 96-inch CIDH piles (cast-in-drilled-hole) piles behind Abutment 10 to a depth of -50 feet.

(5) Retrofit of both outriggers and bents with 30-inch diameter CISS piles at Bents 6, 7, and 8 and 30-inch diameter CIDH piles at Bents 2, 3, 4, and 5. These piles will extend to depths of approximately -55 feet to -85 feet at Bent 5 and at approximately –85 feet to –120 feet at Bents 6-8.

(6) Installation of fenders to protect boats passing by the pier foundations, new pile caps at Bents, 5, 6, 7, and 8, and replacement of existing fender.

Figure 3 provides a cross section showing the abutment and bents and proposed improvements. The bridge seismic retrofit will include removal and installation of piles as summarized below.

	Location	Number	Pile Type
In Water			
▪ Removal-Bridge	Bridge Bent 6	4	14-inch P/C Concrete
Total In-Water Removal		**4**	
▪ Install New Permanent Bridge Piles	Bridge Bent 5 Bridge Bent 6-8 Bent 9	4 12 8	30-inch CIDH 30-inch CISS 16-inch CISS
Total In-Water Bridge Pile Installation		**24**	
On Land			
▪ Install New Permanent Bridge Piles	Bridge Bent 2-4 Abutments 1 & 10 Abutment 10	6 10 2	30-inch CIDH 16-inch CISS 96-inch CIDH
Total On-Land Bridge Pile Installation		**18**	

In addition, 35 14-inch concrete piles would be removed at Docks FF and T to accommodate project construction with reinstallation upon completion of construction. If a temporary trestle is constructed to facilitate installation of the permanent bridge piles, it is estimated that 120 12-inch steel piles or 72 20-inch steel piles would be installed and removed upon completion of construction.

Description of Activity Construction

In-water and on-land construction activities that result in noise and vibration may result in incidental take (harassment) of marine mammals present in the area at the time of construction. Construction will occur within harbor waters and on lands adjacent to the harbor. The construction phasing and approximate schedule is presented on Table 1.

In-Water Construction Activities. The construction schedule includes 10 months of potential in-water construction activity over 2 years – 5 months during the first year and 5 months during the

second year. Activities include: removal of docks to accommodate construction access; potential installation of piles for a construction trestle from the bridge; pile driving; transport of materials; and replacement of harbor docks upon completion of the bridge seismic retrofit project. In-water activities would be intermittent throughout the 5-month periods, but it is conservatively assumed that some activity could occur daily throughout these periods.

- Installation of Bridge Piles: The most intense activity would be the installation of new bridge support piles, which will also involve the demolition of the existing piles at Bent 6. CISS piles at Bents 5 through 8 will be installed within the waterway by driving 30-inch steel casings either to refusal at rock or into a shaft drilled within rock (depending on the location). The installation of new piles at Bents 5 through 8 will include two piles on each side for a total of 16 piles in the water (and 10 additional piles at Bents 4 and 9 that are partially in the water). The work activity will be focused within the area of the bridge. Overall the installation of piles is expected to take a total of approximately 1 day for each 30-inch pile and 4 days for 8 16-inch piles for a total of 30 days. The installation of these piles requires the use of a crane(s), a drilling rig, a pile driver, excavation and earthmoving equipment, concrete trucks and pumps, concrete vibrators, supply trucks, welding equipment, and other machinery. Based on the geotechnical site characteristics, permanent bridge piles will be partially or entirely vibrated into the Harbor substrate rather than driving them entirely by means of "hammering". A vibratory hammer would be used to start driving all sheet piles, but an impact hammer may be required to complete driving depending on the density of subsurface materials.
- Installation of In-Water Barge or Temporary Bridge Trestle: Installation of an in-water barge or temporary bridge trestle is planned to accommodate equipment for pile installation. Work within the waterway will require either the use of barges or construction of trestles to provide work platforms. If barges are utilized, prefabricated modular units may be brought to the site and locked together. This type of platform can be installed, reconfigured, and removed relatively quickly, but the system is not suitable for areas that are too narrow to accommodate the modules. For example, footings from the Union Pacific Railroad Bridge to the north and footings from the Murray Street Bridge appear too close together to allow use of a modular barge between footings. In these areas, a trestle likely will need to be constructed.
- Removal and Replacement of Boat Berths: The temporary use of portions of the eastern harbor boat yard and the western parking lot for contractor staging, in combination with provision of construction access to the bridge from the waterway, will result in temporary disruptions of harbor activities including temporary removal of existing boat berths and replacement upon completion of the project. To accommodate construction staging and in-water construction, the project calls for the temporary relocation of berths at Dock FF and Dock BY (Boat Yard on east side) to existing visitor berths with reconstruction of Dock FF and Dock BY upon completion of the bridge seismic retrofit construction. Dock FF accommodates University of California Santa Cruz (UCSC) boats that are used for university classes. A walking dock (gangway) would be constructed to connect the existing parking lot area to the portion of Dock FF that will remain during construction. Six temporary berths may be constructed adjacent to the gangway to minimize relocation of some of the existing boats. Upon completion of construction, no additional new boat berths

will be constructed as was originally proposed. Although design plans have not yet been completed for the reinstalled berths, it is expected that the berth docks would be plastic, wood or concrete over polyethylene floats and would be anchored with pilings. Piles would be driven into the harbor floor by mechanical hammer. There would be no dredging or placement of fill in harbor waters with reinstallation of docks and both berths.

Land Construction Activities. The proposed project includes the other construction activities that are located on land as follows:

- Demolition: Demolition activities include the removal of pilings at Bent 6, temporary removal of the gangway under Bent 4, the removal of existing sidewalks and railings along the entire length of the bridge, and the removal of pavement at both ends of the bridge. Equipment for demolition activities includes cranes, excavators, front-end loaders, dump trucks, concrete saws, and jackhammers.
- Pile and Anchor Installation Outside Waterway: The CISS piles at Abutment 1, Bent 9 and Abutment 10 will be installed by driving 16-inch steel casing to depths of approximately –30 to –90 feet and filling them with concrete. The 96-inch diameter anchor pile for Abutment 10 will require excavation and installation of a temporary steel casing, which will be filled with concrete. The 30-inch CIDH piles at Bents 2-4 will be installed by first driving 30-inch steel casing to depths of approximately -70 to -90 feet and filling them with concrete. The anchor pile excavation will be dewatered by pumping, if necessary. The installation of these piles will require the use of excavation equipment, soil tamper equipment, and the other construction equipment described above for installing piles within the waterway.
- Bridge Construction: The project includes installation of new girders on the southern edge of the bridge, the installation of a cantilevered extension along the northern edge of the bridge, and the construction of barrier railings as well as the installation and construction of various project features below the bridge road surface and above the piles. Equipment required for this part of the project would include a crane, concrete trucks and pumps, supply trucks, welding equipment, and other machinery.
- Roadway Approach Construction: Excavation of existing road approaches up to 200 feet from each end of the bridge will be performed. Gravel base and asphalt concrete will be placed to match the new widened bridge deck. Equipment used will be typical paving equipment including graders, loaders, bulldozers, rollers, dump trucks, and a paving machine. Metal beam guard railings will be placed at each corner of the bridge.
- Construction of Temporary Trestle: Construction of a trestle could vary depending on materials available to contractors. One possible trestle configuration would be 60-foot long steel girders over the Harbor navigation channel. The spans would be supported on falsework bents, perhaps constructed of steel piles which are a fairly common falsework material. Piles would be driven in the water by a crane sitting over the land. Preliminary estimates by the project engineer indicate that up to 120 12-inch steel beams would be required for a trestle spanning the bridge; vibratory drivers would be used. Approximately 6-8 of these small size piles could be installed per day. All piles would be removed at the end of construction. The trestle could be made of "Bailey Bridge" panels that can be used to

provide bents or towers. The deck might be made of heavy timbers or open-grid panels with a safety railing to keep people and materials on the deck.

- Contractor Staging: Contractor staging activities for Phases 1 and 2 of the project will take place in an approximately 8,000 square-foot portion of an existing boat yard near the eastern edge of the bridge. Contractor staging activities for Phases 3, 4, and 5 of the project will take place in the northern portion (approximately 11,000 square feet) of a parking lot situated at the western edge of the bridge. This staging area will be used through the end of Stage 5, when original facilities will be restored.
- Temporary Harbor Facility Relocation: The temporary use of portions of the eastern harbor boat yard and the western parking lot for contractor staging as described above, in combination with provision of construction access to the bridge from the waterway, will result in temporary removal, relocation and replacement of some Harbor facilities, including temporary relocation of boats in the on-land boat yard on the east side of the Harbor that will be temporarily relocated to boat storage for approximately four months. On the west side, 60 rowing boats stored under the existing Murray Street bridge will be temporarily relocated to an on-land dry boat storage facility near docks A and B, and an additional 200± square feet of storage area will be constructed to accommodate the temporary row boat storage. Row boats stored under Span 2 and UCSC Rowing Facility boats under Span 1 will be temporarily relocated to the US Coast Guard parking lot and fenced.

  Uses at existing offices, bathroom facilities, and storage areas located north of the western staging area (and within the City's right-of-way) will be displaced during Phases 3, 4, and 5 of the project. The buildings will be protected during construction, and a temporary 600 square foot facility (modular) will be installed on the US Coast Guard parking area for a period of approximately six months, which will temporarily house these businesses.

2. Dates, Duration and Geographic Region

The Murray Street Bridge Retrofit project is currently planned to commence in the spring of 2016. The project area includes waters within the Santa Cruz Small Craft Harbor and adjacent lands managed by the Santa Cruz Port District (see Figure 2). The study area consists of the open waters, docks, and other potential haul-out features of the Harbor from the Harbor Launch Ramp area (including the fuel dock and Vessel Assist dock) to 500 feet upstream of the boundary of the Area of Impact (see Figure 2).

The Murray Street Bridge Retrofit project is tentatively proposed for construction in five partially overlapping interchangeable phases. Generally, work will begin on the eastern side of the Harbor and progress to the western side. The timing of each phase and a brief description of work to be performed during each phase is provided in Table 1.

Overall, the seismic retrofit work will be executed over a period of approximately 18 months within four construction phases as described in Table 1. The additional bridge improvements will be constructed over a period of approximately 6 months as part of Phase 5 of the construction.

In-water activity will occur in Phases 2 and 4 over an approximate total 10-month period over two years with 5 months during the first year and 5 months during the second year. However, the phases may overlap. Work tasks will vary throughout the phase. The in-water pile driving for the bridge piles would occur over a total of 30 days within this period.

Due to in-water work timing restrictions to protect federally-listed salmonids, all in-water construction activities including pile removal/installation would occur between the period from July 1 to mid-November unless otherwise permitted by the National Marine Fisheries Service (NMFS).

3. Species and Numbers of Marine Mammals

Three marine mammals are known to occur within the Santa Cruz Small Craft Harbor:

- Southern sea otter (*Enhydra lutris nereis*), federally listed as threatened and listed by the California Department of Fish and Game as "Fully Protected";
- Harbor seal (*Phoca vitulina richardsi);* and
- California sea lion (*Zalophus californianus*).

The open water of the study area provides habitat for the southern sea otter, the harbor seal, and the California sea lion. Southern sea otters appear to be incidental visitors to the Harbor, using the site for foraging. Harbor seals use the harbor for foraging and use Docks F and FF as haul-out areas. California sea lions use the harbor only occasionally for hauling out and are incidental visitors to the Harbor, using the waters for foraging and the docks and other features within the study area as occasional haul-out sites. California sea lions are present when fish runs occur within the harbor. (Weather, currents, seasonal upwelling conditions, and other oceanographic factors periodically bring anchovies, sardines, and other prey species into the Harbor, in turn drawing great numbers of birds and marine mammals.) The following table summarizes the status, local occurrence and total range/population for these species.

Common Name	Scientific Name	Status [1]	Occurrence in Santa Cruz Harbor		Total Range and Population [1]	
			Numbers	Seasonality	Range	Abundance
California Sea Lion	*Zalophus californianus*	Not Listed [2]	1-15	Occasional, especially when prey species are present	California to Canada	296,750
Harbor Seal (Eastern Pacific subspecies)	*Phoca vitulina richardii*	Not Listed [2]	1-11	Summer, Fall, Winter-outside breeding seasons	Mexico to Alaska	30,196 in California
Southern Sea Otter	*Enhydra lutris nereis*	Threatened	1-2	Incidental Visitor	California, Santa Barbara to San Mateo County	2,723

[1] From "U.S. Pacific Marine Mammal Stock Assessments, 2013." August 2014. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center

[2] Not listed as "endangered" or "threatened" under the Endangered Species Act nor as :"depleted" under the Marine Mammal Protection Act.

4. Affected Species and Distribution

Survey Methods

Nineteen marine mammal surveys were conducted between December 2006 and October 2009 by EcoSystems West Consulting Group to estimate the numbers of each of three species (California sea lion, harbor seal, and southern sea otter) using the area surrounding the Murray Street Bridge (Bridge) and to determine the type of use, especially during the period of time when in-water construction activities are proposed for the project. A total of 40 survey hours were conducted, including early morning, midday, evening and nighttime surveys with an emphasis on early morning and midday surveys. In an effort to determine the diurnal and nocturnal movement patterns of the harbor seals, initially 3-4 site visits/day were conducted, 2 times per week.

Once a general understanding of the harbor seals' use of the area was gained, the surveys were focused on estimating the number of individuals present in the study area in the morning (when pile driving or other in water activities might be expected to begin for the day) and around midday (when pile driving and other in water activities might resume after a lunch break). An effort was made to determine the maximum number of individuals using haul-outs within the study area by arriving pre-dawn, when animals were still at rest and had not been flushed into the water by Harbor activities.

For each survey, the following were recorded: the time of the survey, the temperature, visibility, wind speed, tide, and moon phase. During surveys, one or two biologists walked and sat at key observations points, or rowed a small boat, throughout the study area, using binoculars, and examined the site for presence of marine mammals. A general census of the area was taken on each site visit, counting the numbers of each species present, noting the activity of the animals, as well as their location, with reference to an aerial map of the Area of Influence and vicinity. Notations were made on the aerial map of the site, when necessary, to clarify locations of observed animals. When feasible, observed animals were photographed, and the sex of California sea lions was noted.

It was not possible to determine with certainty whether or not an individual had already been counted (unless all animals remain hauled-out for the duration of the survey); however, an effort was made to avoid duplicating counts by taking into account the time and location of the observation with reference to previous observations. Where we were unable to determine if counts were redundant, we noted this on data tables.

Ecosystems West biologists also made note of fish activity, when we observed evidence such as jumping fish or congregations of feeding birds and mammals. EcoSystems West biologists also noted relevant personal communications with Port District employees, Harbor business employees, and marine mammal experts regarding marine mammal presence. Further, EcoSystems West biologists noted incidental observations of other wildlife species, such as bats or bird species, and recorded all observations on a standard data sheet designed for the Project's marine mammal surveys.

Distribution of Marine Mammals

Table 2 presents the estimates of marine mammals present in the survey area during 2009 surveys. Table 3 presents the number of animals observed hauled-out and the haul-out locations during 2009 surveys. Figure 4 shows the spatial distribution of observed marine mammals throughout the survey area. Figure 2 provides an aerial view of the study area and shows the location of the docks referenced on the x-axis of the spatial distribution figure.

California Sea Lion. During December 2006 surveys, one California sea lion was observed swimming under the western section of the Murray Street Bridge. During September/October 2009 surveys, California sea lions were observed foraging and hauling-out within the Harbor on 18 of 19 survey visits (the exception was a nighttime survey where visibility was limited). Numbers of California sea lions varied widely throughout the survey period, from 1 animal to 13-15 animals/survey. The larger numbers of animals were observed when "rafts" of sea lions were present foraging throughout the survey area and fish presence was evident (September 30 – October 2).

California sea lions use the harbor only occasionally for hauling out and the specific haul-out location varied during initial site visits, throughout the marine mammal survey period, as well as during prior and subsequent incidental observations of the harbor. The closest regular haul-out location for large numbers of California sea lions is the Municipal Wharf. Individuals and occasionally pairs of sea lions were observed hauled-out on docks throughout the survey area, on the fuel dock, and more commonly, on the Vessel Assist dock, and the docks on the western side of the Harbor, from AA to FF (see Table 3). One individual was observed hauled-out on the rubber Kayak docks under the Bridge. Figure 2 provides an aerial view of the survey area, with docks and other haul-out features identified. Some of the animals that were observed hauled-out appeared to be lethargic, remaining on the same or proximate dock for two or more days in a row, sometimes with a cough, or swimming without vigor in the adjacent waters. One juvenile was observed hauled-out on the cement wall on the western border of the Harbor between E and F Docks (see Figure 5). Observations of sea lions were distributed throughout the Survey Area, with a spike of observations in the area near the launch ramp, fuel dock, and Vessel Assist dock (see Figure 4).

California sea lions appear to be incidental visitors to the Harbor, appearing in the greatest numbers when schools of fish are abundant within the Harbor, as evidenced by jumping fish and large congregations of feeding birds and "rafts" of sea lions. Sick and weakened sea lions also appear to use the Harbor as a haul-out refuge. Young of the year sea lions faced an 85% mortality in 2009 due to starvation. This is likely caused by an El Nino-like response in prey resources (G. Oliver, personal communication, 2009). While juvenile rock fish were abundant, anchovies were essentially absent, and while sardines were abundant, juvenile sardines were scarce (G. Oliver, personal communication, 2009; K. Carney, personal communication, 2009). Rock fish and adult sardines provide an adequate prey base for healthy adult sea lions, but may be too fast for juveniles or weakened adults to catch. In addition, more varied and scarce prey resources may require greater traveling distances and deeper diving for successful hunting, placing too great a

metabolic demand on young of the year or weakened sea lions (M. Weise, personal communication, 2009; G. Oliver, personal communication, 2009). Spring and fall algal blooms causing damoic acid poisoning in sea lions may have also been a factor in the presence of hauled-out sea lions in the Harbor (N. Crane, personal communication, 2009). Similar influences will affect the presence of sea lions in the Harbor in subsequent years, but numbers will likely vary. The Harbor does not provide mating or breeding habitat or other habitat of a similar ecological significance for the California sea lion.

Harbor Seal. During December 2006 surveys, six harbor seals were observed hauled-out on dock FF at night. During Fall 2009 surveys, harbor seals were observed foraging and telescoping on 18 out of 19 surveys. Numbers of observed harbor seals varied widely from 1 to 11 animals. Harbor Seals were only observed hauled-out on F and FF Docks, only during early morning surveys, and when biologists arrived prior to the onset of nearby early morning Harbor activities, such as the arrival of kayakers at FF Dock and "Velocity" Crew at F Dock. (Velocity is a private sports fishing and whale watching charter boat.) With any proximate activity, such as boat and human activities occurring in the harbor area, harbor seals may be flushed from their haul-out locations into the water.

Observations of harbor seals were concentrated in two locations: to a lesser degree in the area around the launch ramp, fuel dock and Vessel Assist dock; and primarily in the area around Docks F and FF and Dock S, the Live Bait dock, where harbor seals were frequently observed telescoping just off Dock S. The Live Bait dock clerk, Kevin Carney, and well as Port District staff report that five or six of the harbor seals appear to be residential, hauling-out, foraging, and telescoping in the area of Docks FF through S throughout the year (K. Carney, personal communication, 2009; B. Foss, personal communication, 2009).

On only one survey date did we survey the entire Upper Harbor, upstream (north) of the Bridge. This survey was conducted in an effort to assess potential use of the Upper Harbor during midday. Six harbor seals were observed foraging in the Upper Harbor.

Harbor seals are residential within the Harbor, using Docks F and FF as a primary haul-out and the surrounding area as foraging habitat. The Harbor does not provide breeding or molting habitat. Nearby known breeding and molting locations include Point Lobos, Elkhorn Slough (NOAA 2007), and Lover's Point State Marine Reserve (SIMON 2008). The numbers of harbor seals occupying the Harbor are likely to be highest during late summer, fall and winter, outside of breeding (March - May) and molting (June - July) seasons. Individuals that are not sexually reproductive may remain at the Harbor later into the spring, until molting season.

The harbor seals only use Docks F and FF as haul-out sites at night, when disturbances in the Harbor are at a minimum. The animals flush with any disturbance in the early morning. The total number of hours of haul-out time/day for harbor seals outside of breeding and molting season averages seven hours. It is unknown if the harbor seals occupying the Harbor use the site exclusively as their haul-out during the fall and winter or if they use other nearby haul-outs in conjunction with the Harbor. Use of multiple haul-out sites by harbor seals varies, as does distance travelled between multiple haul-out sites and for foraging.

In one study in Humboldt and Del Norte Counties, approximately half of the harbor seals tagged used one to two haul-out sites, and half used three or more, traveling an average distance of 28 km between sites. Males travelled further and sub-adult females travelled slightly further than sexually reproductive females (Pecharich, A.G. and P.D. Goley 2003). In a monitoring study of harbor seals for the Richmond San Rafael Bridge, 65% used more than one haul-out site, and when seals used Castle Rock as their primary haul-out, mean in-water distances from the haul-out site for most seals ≤ 5 km (i.e. foraging areas were located close to the primary haul-out site) (Green, D. et al. 2006).

In an unpublished study of harbor seal prey base, harbor seals using the San Lorenzo River in Santa Cruz were found to use the river as their haul-out exclusively, foraging in the ocean and returning during the night when disturbances were at a minimum (Weise, M. personal communication, 2009). Nearby known haul-outs for the eastern Pacific harbor seal include Pleasure Point in Live Oak; the Cement Boat at Seacliff State Beach in Aptos; Table Rock, off Wilder State Park; as well as numerous other sites along the north coast from Wilder State Park to Ano Nuevo State Park (NOAA 2007).

Southern Sea Otter. The southern sea otter is regularly sighted in the Harbor waters. During the December 2006 field surveys, one sea otter was observed swimming in the open water of the main Harbor channel, north (upstream) of the Murray Street bridge. During September/October 2009 surveys, southern sea otters were observed foraging in the Harbor during five of the nineteen surveys conducted, with observations concentrated during one week of the four-week-long survey period, between September 17 and 23 (Table 2) . On four of these visits, only one sea otter was observed. On one visit, a mother and juvenile were observed and heard calling and responding until the pair reunited.

Southern sea otters appear to be incidental visitors to the Harbor. Otters occur in the kelp forests just off the coast, where separate groupings of females and young, territorial males, and non-territorial males breed, forage, and groom, in close proximity to the Harbor. Availability of food resources based both on seasonal variation and seasonal and El Nino-influenced ocean currents, as well as Spring and Fall algal blooms of a diatomic species of *Pseudo-nitzschia*, causing damoic acid poisoning may have been factors influencing the presence of otters in the Harbor during Fall 2009 surveys. Similar factors are likely to exist in subsequent years, but numbers will likely vary. The Harbor does not provide mating or breeding habitat or other habitat of a similar ecological significance for the southern sea otter.

5. Type of Incidental Take Authorization Requested

The incidental harassment authorization request is for Level B incidental take (behavioral harassment) of the marine mammals (California sea lions, harbor seals, and southern sea otters) for incidental harassment of any marine mammal that might enter the 120 dB Zone of Influence (ZOI) during active pile driving activity. Noise, vibrations, and other physical disturbances can harass marine mammals. The range of effects potentially includes behavioral changes, physiological stress, physical injury (including hearing loss), and mortality.

The method of take is incidental harassment from disturbance associated with construction activities, personnel and equipment, and noise, deterring regular foraging and haul-out activities as well as from temporary removal of primary haul-out sites (Dock FF) for harbors seals. In addition, animals present in the Upper Harbor may be temporarily restricted (until the end of daily construction activities) from moving through the Work Area under the bridge to access the Harbor exit and other areas for foraging or hauling out.

Construction activities that may impact marine mammals primarily include pile removal (concrete and steel), augering, and pile installation (concrete dock pile, steel trestle pile and steel bridge pile). Other construction activities and noise sources include trucks delivering materials and other construction on-land construction activities on the bridge, abutments and roadway. The construction activities will be limited to the area around the bridge. Both in-water and in-air noise is expected during the course of construction, and potential impacts are discussed below in subsection 7. In-water activities principally consist of pile driving.

All noise-generating construction activities will take place during daylight hours, and would begin each day after harbor seals have already flushed from their haulouts, and during which time harbor seals might normally be congregating and foraging around Dock S and throughout the harbor. California sea lions may be foraging throughout the Harbor, particularly if prey fish species are abundant, and southern sea otters might be occasional visitors, foraging or seeking refuge in the Harbor. California sea lions may also use the docks within the Harbor for day-time haul-outs and be flushed by in-air noise. Behavioral effects, as further described below in subsection 7, would be similar for all three noise-generating activities, with the main differences being the duration, frequency, and total hours associated with each activity (see Table 4).

6. Take Estimates Marine Mammals

Incidental harassment of marine mammals during the Murray Street Bridge Retrofit Project may occur to all three marine mammal species (southern sea otter, California sea lion, and harbor seal) present in the Area of Impact and vicinity. Avoidance and minimization measures will be implemented to reduce the potential for harassment to the maximum extent possible, as detailed in the subsection 11 below.

Incidental take is estimated for each species by estimating the maximum number of marine mammal being present within a ZOI during active pile driving based on estimates of numbers of animals identified during the marine mammal surveys. Numbers of residential harbor seals are expected to be at a maximum during the season in which surveys were conducted (outside of breeding and molting seasons).

Pile driving (in-water and on-land) estimates are based on the maximum number of days that pile driving could potentially occur (installation of 42 permanent bridge; installation and removal of 120 temporary piles to support a construction trestle, if used; removal and re-installation 35 boat berth piles, and removal of 4 existing bridge piles. In total, up to 49 days of pile driving and 15.5 days of pile removal are anticipated.

For the exposure estimate, it is conservatively assumed that the highest count of sea lions, harbor seals, and sea otters observed will be foraging within the ZOI and be exposed multiple times during the Project. The calculation for marine mammal exposures is estimated by:

Exposure estimate = N * ("X" days of pile driving activity + "X" days of pile removal), where:

N = # of animals

Exposure estimate = N animals * "X" days

Enumeration of the anticipated incidental takes is shown on Table 4 based on the estimated number of piles and days of pile installation/removal, which is summarized below. In addition, a one-time harassment is predicted for harbor seals when Dock FF is temporarily removed.

	Maximum # of Animals/Day	Total Days	Total Incidental Take During Construction
Southern sea otter	2	64.5	129
California sea lion	15	64.5	968
Harbor seal	11	64.5	710

Therefore, Caltrans and the City of Santa Cruz is requesting authorization for Level B acoustical harassment of up to 129 sea otters, 968 California sea lions, and 710 harbor seals due to pile driving. It is assumed that this number will include multiple harassments of the same individuals.

7. Anticipated Impact of the Activity

The waters and haul-out features within the Harbor do not provide rookery, mating, breeding, molting, or other habitat of a similar ecological significance for sea otters, California sea lions or harbor seals. However, construction activities may impact marine mammals using the Harbor for foraging and haul-out activities. Construction activities that may impact marine mammals include pile removal (concrete and steel), augering, and pile installation (concrete dock pile, steel trestle pile and steel bridge pile). These activities will be limited to the area around the bridge. Both in-water and in-air noise is expected throughout the duration of construction, with the most noise generated during pile installation operations, as pile removal and installation radiates sound into the water, the substrate, as well as the air. Other noise events would include trucks delivering materials, bridge removal equipment, concrete pumps, etc., none of which should generate as much noise as pile installation.

Current NMFS practice regarding exposure of marine mammals to high-level underwater sounds is that cetaceans and pinnipeds exposed to impulsive sounds of at or above 180 and 190 dB (RMS[1]), respectively, have the potential to be injured (Level A harassment). NMFS considers the

[1] RMS refers to the sound pressure level that is 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 (ICF Jones and Stokes, July 2010).

potential for behavioral (Level B) harassment to occur when marine mammals are exposed to sounds below injury thresholds at or above the 160 dB (RMS) threshold for impulse sounds (e.g., impact pile-driving) and the 120 dB (RMS) threshold for continuous noise (e.g., vibratory pile-driving).

Currently, no data are available describing baseline levels of underwater sound in Santa Cruz Harbor waters. Normal ambient noise levels in the harbor include vessel motors, heavy vehicular traffic on the bridge, construction noise from the dry dock repair facility, commercial charters, kayakers, and significant water traffic, to which marine mammals in the harbor are habituated. Underwater noise levels are estimated to fall between 100 dB and 140 dB based on review of underwater sound levels in other areas (ICF Jones and Stokes, 2010).

The existing noise environment in the project area is dominated by motor vehicle movement on Murray Street/Eaton, Lake Avenue, Seventh Avenue and other nearby arterial streets. Trains utilizing the tracks adjacent to the site, the operation of commercial and private boats in the harbor, and operation of boat yards engaged in repair activities also contribute sporadic noise incidents. Ambient noise levels were monitored as part of the preparation of the CEQA (California Environmental Quality Act) environmental review documents at the Lake Avenue entrance to the Santa Cruz Harbor on Lake Avenue. Noise levels were measured and are reported using percentile noise descriptors: L_{90} (the background noise level exceeded 90 % of the time), L_{50} (the median noise level exceeded 50% of the time), L_1 (the peak level exceeded 1% of the time), and L_{eq} (the average energy-equivalent noise level). Monitored noise levels are shown in Table 5.

Construction Impacts

Steel pile driving construction activities associated with the bridge seismic retrofit project could result in behavioral responses by marine mammals and rise to the level of harassment. However, construction-generated underwater noise would not rise to the level associated with injury based on the results of a hydroacoustic analysis prepared by ICF International for the City of Santa Cruz, which is included in ATTACHMENT C. The analysis calculated the distances to the 120 dB, 160 dB, 180 dB, and 190 dB-RMS contours for the largest of each type of pile to be driven, which correspond to the following thresholds:

- 190 dB-RMS – Pinniped injury (Level A harassment)
- 180 dB-RMS – Cetacean injury (Level A harassment)
- 160 dB-RMS – Cetacean and Pinneped disturbance under impact pile driving (Level B harassment)
- 120 dB-RMS – Cetacean and Pinneped disturbance under vibratory pile driving (Level B harassment)

Pile Driving Construction Impacts. The most intense in-water activity would be the installation of new bridge support piles. CISS (cast-in-steel-shell) piles at Bents 5 through 8 will be installed within the waterway by driving 30-inch diameter steel casing either to refusal at rock or into a

shaft drilled within rock (depending on the location). The installation of new piles at Bents 5-8 will include two piles on each side for a total of 16 piles in the water (and 10 additional piles at Bents 4 and 9 that are partially in the water). Table 4 summarizes the length of time estimated for installation of each pile. The installation of these piles requires the use of cranes, a drilling rig, a pile driver, exaction and earthmoving equipment, and other equipment.

The results of the hydroacoustic analysis are presented on Table 1 in ATTACHMENT C, and are summarized below. The calculations are based on source levels for similar piles driven for similar projects, based on information provided in Caltrans' *Compendium of Pile Driving Sound*[2]. In accordance with NMFS guidance[2], an attenuation rate of 4.5 dB per doubling of distance was assumed. The results of the analysis indicate the following:

1. The distance, within which the pinniped injury threshold of 190 dB-RMS is predicted to be exceeded, is 10 meters or less.
2. The distance, within which the cetacean injury threshold of 180 dB-RMS is predicted to be exceeded, is less than 50 meters.
3. The distance, within which the impact driving disturbance threshold of 160 dB-RMS is predicted to be exceeded, is 1,000 meters or less.
4. The distance, within which the vibratory driving disturbance threshold of 120 dB-RMS is predicted to be exceeded, is as high a 46,400 meters.

These predicted distances are based on an open water attenuation rate of 4.5 dB per doubling of distance, but do not consider additional attenuation effects that will likely occur at the breakwater into Monterey Bay. Because no empirical data is available on the extent of these additional attenuation effects, a specific prediction assuming this additional attenuation is not factored into the above. However, if an additional attenuation of 15 dB were to occur (as an example), the 46,400 meter distance would be reduced to approximately 4,600 meters, which is still a very large and impractical distance within which to monitor (ICF International, November 2014).

The 120 dB disturbance threshold associated with vibratory pile driving is extremely low. The disturbance threshold for impact pile driving is 40 dB higher (i.e. less restrictive) than the threshold for vibratory driving. The difference between impact driving and vibratory driving source levels for the same pile is typically in the range of about 15 to 25 dB. Accordingly, the disturbance effect distances for impact driving are typically far less than the distances for vibratory driving. Because it is impractical to monitor within several thousand kilometers of the pile driving, it is proposed that the assumption for the maximum distance for Level B harassment is 1,000 meters. Under this assumption, the contractor will be allowed to use vibratory driving if the contractor can demonstrate, by underwater monitoring conducted during actual pile driving, that the 120 dB vibratory threshold will not be exceeded within 1,000 meters of pile driving. If this cannot be achieved, the contractor will be then required to use impact driving only and limit measured sound levels to 160 dB or less at 1,000 meters (ICF International, November 2014).

[2] Caltrans 2012. Compendium of Pile Driving Sound Data, Sacramento, CA.

The distance from the bridge to the breakwater is about 780 meters. Therefore, the impact distance will extend about 120 meters into Monterey Bay as shown on Figure 6.

Pile-driving activities within harbor waters may deter otters from regular foraging in the project area and temporarily disrupt movement within the harbor waters, and may deter sea lions from foraging or hauling-out in the project area. Pile-driving activities will affect harbor seals congregating and foraging around Dock S, immediately downstream of the Work Area, as well as harbor seals using the nighttime haul-outs (Dock F and FF) immediately adjacent to the Bridge. Dock FF is slated to be removed temporarily for the duration of construction and will be constructed at the southern end of the current FF dock immediately adjacent to the work area.
No alterations to sea lion habitat are anticipated as a result of the project. No other direct or indirect impacts are anticipated.

Other Onland Construction Activities. In-air noise will be generated primarily during pile installation operations; other noise sources include trucks delivering materials, bridge removal equipment, concrete pumps, and other typical construction equipment, none of which should generate as much noise as the pile installation. Construction-related noise levels would vary throughout the day, depending on the type of equipment in use at any one time and the distance to the receptors. Anticipated equipment includes, but is not limited to equipment that would be used for excavation, installation of bridge piles, and surface improvements, such as cranes, excavators, concrete saws and jackhammers, pile driver or vibrator, and concrete trucks and pumps. Table 6 shows typical noise levels associated with different types of construction equipment. Conventional construction activities (such as demolition, construction of bridge superstructure elements, and construction of new road approaches to the bridge) are expected to generate noise levels in the range of approximately 80 to 90 dBA at a distance of 50 feet. A typical value for impact hammers would be 100 dBA at 50 feet.

Sea otters were observed in the Harbor only incidentally (a maximum of 2 or less otters/day) and all observations were made in the lower Harbor; therefore, it is unlikely that sea otters would be exposed to elevated in-air sound levels. In the event that an otter was observed within the monitoring buffer, this detection would initially be made near the launch ramp, far from the work area, where in-air noise levels would not exceed normal ambient levels for the harbor. Work would be stopped until the animal departed. No incidental harassment of otters as a result of in-air noise is predicted. Because of the range of normal ambient noise-generating activities in the Harbor and ongoing occurrence of animals in the Harbor, it can be assumed that the marine mammals are habituated to human-generated noises.

In addition, animals foraging in the Upper Harbor may be impacted by construction activities. During EcoSystems West Fall 2009 surveys harbor seals were observed regularly in the Upper Harbor, while greater numbers of California sea lions were observed sporadically, largely depending on available prey resources. No southern sea otters were observed in the Upper Harbor, although an individual was observed immediately under the Murray Street Bridge. Marine mammals may travel into the Upper Harbor in the morning before construction begins for the day or during a lunch break, but one navigable channel will always be open for boats and

passage of animals. In addition, these animals may be likely to approach the work area and noise levels that may cause harassment or injury.

Species Impacts

The harbor seal population in California is approximately 30,196 individuals (U.S. NOAA-NMFS, August 2014). This application requests incidental taking by Level B acoustical harassment of up to 710 harbor seals. Although the estimate assumes multiple take of a few individuals (not single takes of 710 individuals), the requested number of takes represents 2.4 % of the California stock.

The Pacific stock California sea lion population is approximately 296,750 individuals (U.S. NOAA-NMFS, August 2014). This application requests incidental taking by Level B acoustical harassment of up to 968 California sea lions. Although the estimate assumes multiple take of a few individuals (not single takes of 968 individuals), the requested number of takes represents 0.3 % of the Pacific stock.

The California southern sea otter population is approximately 2,723 individuals (U.S. NOAA-NMFS, August 2014). This application requests incidental taking by Level B acoustical harassment of up to 129 southern sea otters. Although the estimate assumes multiple take of a few individuals (not single takes of 129 individuals), the requested number of takes represents 0.4.7 % of the California stock.

If incidental takes occurs it is only expected to result in short-term changes in behavior and potential temporary hearing threshold shift. These takes would be unlikely to have any impact on stock recruitment or survival and therefore, would have a negligible impact on the U.S. stock. No cetacean species occur within the Harbor.

With implementation of avoidance and minimization efforts, potential effects will be minimized; however, temporary harassment may occur. With implementation of the proposed work restrictions, monitoring and other mitigation measures specified in the following subsection 11, disturbance from project-related construction activities is expected to have only a short-term impact. No long-term avoidance or permanent abandonment of sites or nearby areas is expected.

8. Anticipated Impacts on Subsistence Uses

Not applicable. There are no known subsistence uses of sea otters, sea lions or harbor seals in the project area.

9. Anticipated Impacts on Habitat

The proposed activities are not expected to have any long-term detrimental impact on the habitat of harbor seals, California sea lions or sea otters. Construction-related effects will be temporary and minimized with implementation of the proposed avoidance/minimization and mitigation measures. No permanent removal of habitat will occur. The project includes installation of

temporary boat docks during construction and replacement of boat docks temporarily removed for construction upon completion of the bridge retrofit.

10. Anticipated Effects of Habitat Impacts on Marine Mammals

There is no anticipated impact of habitat loss or modification of harbor seal, California sea lion or southern sea otter populations as a result of the Murray Street Bridge Seismic Retrofit Project.

11. Mitigation Measures

Avoidance/minimization and other mitigation measures will be implemented to avoid or minimize the potential construction-related effects to marine mammals at or near the Murray Street Bridge Seismic Retrofit site. These measures generally include:

- Limitation on timing of pile driving;
- Pre-construction monitoring and hydroacoustic monitoring during construction; and
- Establishment of a buffer and monitoring of noise levels.

The following mitigation measures will be implemented to avoid or minimize potential project-related effects to southern sea otters, harbor seals, and California sea lions. Caltrans will initiate consultation with the U.S. Fish and Wildlife Service (USFWS) regarding potential harassment of southern sea otters during in-water construction activities to determine the need for additional project conditions. The separate "Marine Mammal Monitoring Plan" sets forth additional details of mitigation monitoring and reporting.

1. Timing of Pile Driving. In-water pile-driving activities in Harbor waters will be limited to the period of July 1 to mid-November, unless otherwise permitted by the National Marine Fisheries Service (NMFS).

2. Pre-Construction Monitoring. Prior to initiation of in-water construction, a qualified biological monitor, approved by the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service, will conduct monitoring of marine mammals to update existing information on the animals' occurrence in and near the project area, their movement patterns, and their use of any haul-out sites. This preconstruction monitoring will take place at least five days prior to the start of in-water construction and will cover a period of at least one week (with at least 5 days of actual observation over a period of 4 hours each day), 2 hours in the morning at the time that construction activities would begin and 2 hours at midday, when construction activities would resume after a lunch break.

3. Pre-Construction Removal of Haul-out Sites. All known and potential haul-out sites that occur in the construction work area shall be removed, preferably to a near-by location outside of the work area prior to construction. These sites could include floating docks (i.e. Dock FF) rubber docks, or boats, such as those used by UCSC.

4. Pre-Construction Workers Training. Prior to in-water construction, the approved monitor will conduct a workers training to instruct construction crews regarding the status and sensitivity of the target species in the area and the actions to be taken to avoid or minimize impacts in the event of a target species entering the in-water work area.

5. In-Water Construction Biological Monitoring. The qualified biological monitor will be present during in-water construction activities to search for target marine mammal species and halt project activities that could result in injury or mortality to these species [an estimated 8 hour/day (or for the duration of in-water construction activities each day) during the estimated 10 months of in-water activities plus an additional 16 days of on-land pile driving]. Each day, before pile driving (or other loud in-water construction activity) begins, the monitor will survey the buffer zone for marine mammals. The monitor will also scan for target species throughout the project vicinity, i.e., the areas adjacent to the project site and buffer zone.

6. Establish Buffer Area. The commencement of pile driving activities will be delayed if marine mammals are present within a 500-foot radius[3] of the work area. This 500-foot radius is based on pile-driving activities for similar projects (Sandholdt Bridge) and on the feasibility of monitoring the area for animals entering the Harbor from the open waters of the Monterey Bay. The buffer radius may be reduced or increased based on a measurement of the distance the 160 db pressure travels in the underwater harbor waters and/or through the air. This radius will be visibly flagged on the banks of the harbor during these activities. Each day prior to the start of pile-driving, the approved monitor will survey the buffer zone for marine mammals. If a marine mammal is detected, pile driving will be delayed until the marine mammal(s) has moved beyond the buffer zone, verified by visual confirmation or lack of visual sighting within the next 15 minutes of the last sighting, to assume that the animal has moved beyond the buffer zone. If the animal should move back into the buffer zone after the commencement of pile-driving, no further work stoppage will be necessary, unless the animal comes within an unsafe distance of the work area that may result in injury to the animal. At this point, work will cease to avoid physical injury to the animal. This distance will be determined by USFWS and/or NMFS. The monitor will record the species, numbers and behaviors of any animal(s) entering the buffer zone after commencement of work and notify Caltrans, NMFS (regarding harbor seals or California sea lions) or USFWS (regarding sea otters) via telephone and in writing within 48 hours. The monitor will also submit a written description of the event to Caltrans (and in turn NMFS or USFWS, as applicable) within 7 days.

7. Buffer Changes – Acoustical Monitoring. The buffer radius may be reduced or increased based on a measurement of the distance the 160 db pressure travels in the underwater harbor waters

[3] The 500 ft radius is intended to be an initial buffer, prior to tests that determine the actual distance at which pile driving noise is recorded to be 160 dBs. This initial buffer was selected based on estimates that underwater noise levels can be conservatively predicted to fall below 160 dB outside of a radius of between 33 and 300 feet for driving steel piles as large as 30-inch diameter (ICF Jones and Stokes 2010); 500 ft is safely outside of this radius. In addition, an initial 500 foot buffer was used for a project of a similar scale, the Sandholdt Road Bridge Replacement Project (LSA Associates, Inc. 2004), the project that Caltrans initially recommended that EcoSystems West Consulting Group use as a comparative standard.

and/or through the air. This would be determined using approved in-water and in-air acoustic monitoring devices. The City of Santa Cruz shall notify Caltrans in writing of the proposed change in buffer zone area, who in turn will notify NMFS and USFWS. An approved biological monitor will operate the monitoring devices during pile driving and any other loud construction activities, such as bridge demolition or use of hydraulic tools. The devices, placed at the determined buffer, will produce acoustic data for the duration of noise-producing activities. An alarm would alert the monitor to sound levels approaching 160 db.

8. Underwater Acoustical Monitoring-Use of Vibratory Pile Driving Equipment. the contractor will be allowed to use vibratory driving if the contractor can demonstrate, by underwater monitoring conducted during actual pile driving, that the 120 dB vibratory threshold will not be exceeded within 1,000 meters of pile driving. If this cannot be achieved, the contractor will be then required to use impact driving only and limit measured sound levels to 160 dB or less at 1,000 meters. The distance from the bridge to the breakwater is about 780 meters. This means that the impact distance will extend about 120 meters into Monterey Bay.

9. Disturbance Prohibition. No disturbance or noise will be used to encourage the movement of the target species from the work area. The City will contact USFWS and NMFS to determine the best approach for exclusion of the target species from the in-water work area.

10. Disturbance Prohibition. No intentional hazing will be used on eastern Pacific harbor seals, California sea lions, southern sea otters, or other state- or federally-listed threatened or endangered species. The City will contact the Caltrans, USFWS and CDFW if sea otters begin to occur in the vicinity of the bridge work, to determine whether any changes to this mitigation plan may be required.

11. Non-Pile Driving Construction Buffer. Other in-water construction activities, such as the use of heavy equipment to construct bridge abutments (i.e., activities not involving loud, impulsive hammering sounds) will generate noise levels equivalent to that of a diesel truck. For these activities, a 50-foot radius buffer zone will be established. This buffer zone will be clearly marked by highly visible stakes securely placed into the banks. Each day, before construction begins, the monitor will search the 50-foot radius for marine mammals. If a marine mammal is sighted within the buffer zone, the monitor will require the contractor to delay in-water construction activities until the monitor determines that no marine mammals are present within the buffer area.

12. Construction Monitoring Records. The biological monitor will keep a record of all observations of the target species. The information on each observation will include: a) species identification and approximate number of animals observed; b) age and sex class of each animal (if possible); c) activity and direction of movement; d) ongoing project activities at the time of observation; e) responses of target species to project activities; f) any unusual behavior or circumstances observed (project- or non-project related); and g) location, date and time of each observation. Summary monitoring reports will be submitted to Caltrans, who will forward reports to NMFS and USFWS by December 31 of each year that in-water construction activities take place.

13. Notification of Injury. In the event that the monitor determines that a marine mammal has been injured by project activities, all work shall cease and Caltrans shall be notified. Caltrans will

consult with NMFS and/or USFWS to determine if additional measures are necessary. Work may resume upon notification by Caltrans.

14. Post-Construction Replacement of Haul-out Areas. All known and potential haul-out sites that were removed from the work area prior to construction will be returned to their approximate location.

15. Post-Construction Monitoring. Post-construction monitoring will be conducted to determine if harbor seals resume their use of Dock F and FF as primary haul-out sites. NMFS may require additional project conditions, to be applied depending on the outcome of post-construction monitoring.

12. Arctic Plan of Cooperation

Not applicable; the project location is not within the Arctic region.

13. Monitoring and Reporting

To assess the level of project-specific impacts(s), the City will implement monitoring and reporting measures as a component of the Marine Mammal Mitigation Plan as summarized below:

- Pre-construction monitoring (#2) and worker training (#4)
- Monitoring during construction (#5) and prior to daily pile driving activities (#16)
- Acoustical monitoring and Equipment Requirements (#7 and 8)
- Maintenance of monitoring record/observations (#12)
- Reporting (#13)
- Post-construction monitoring (#15)

The City of Santa Cruz shall submit, annually, a post-construction compliance report prepared by the on-site biologist to Caltrans, NMFS and USFWS offices within 90 calendar days after the IHA expires. This report shall detail the following:

1. Dates that construction occurred.
2. Pertinent information concerning the success of the Project in meeting the avoidance and minimization measures.
3. An explanation of failure to meet such measures, if any.
4. Known Project effects on marine mammals, if any.
5. Marine mammal sightings:
    a. number of animals sighted within exclusion and harassment zones and actions taken,
    b. animal behavior and behavior change,
    c. animals' age (pup, juvenile, adult),

d. environmental condition such as weather, visibility, sea state, etc.

6. Occurrences of incidental harassment, if any.
7. Documentation of employee environmental education.
8. Any other pertinent information.

14. Suggested Means of Coordination

All marine mammal monitoring data collected during the pre-construction and in-construction phases of the project will be submitted to Caltrans for submittal to NMFS and USFWS. This information will also be made by the City available to the Santa Cruz Port District, other marine mammal researchers (i.e., at UCSC, Moss Landing Marine Lab), other interested agencies and the general public.

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16. Glossary

Abutments: The mass of concrete supporting the beams at each end of the bridge.

Bents: Also known as piers, the vertical concrete elements supporting the ends of beams (but not at the ends of the bridge-those are abutments)

CIDH (cast-in-drilled-hole) Piles: To support bents and piers, holes are drilled into the ground and steel reinforcement and concrete are then placed into the holes to form the piles.

CISS (cast-in-steel-shell) Piles: Hollow steel pipes that are driven into the ground to support bents and piers. Concrete is then placed into the pipe for added support.

Diatomic: Any of various microscopic one-celled or colonial algae of the class Bacillariophyceae, having cell walls of silica.

Domoic Acid Poisoning: Nerve toxin caused by naturally occurring algal blooms consumed by sardines, anchovies, and shellfish, and that, in turn, accumulates in birds and marine mammals. Exposure to the biotoxin affects the brain, causing animals to become lethargic, disoriented, and have seizures that sometimes result in death. In sea lions exposed to domoic acid during pregnancy, domoic acid is concentrated and retained in the mother's amniotic fluid, thus subjecting the fetus to repeated direct absorption, resulting in abnormal development of brain neurons which affects the animal in later life stages, through seizures and abnormal behavioral changes.

Harassment: Under the 1994 Amendments to the MMPA, harassment is statutorily defined as, any act of pursuit, torment, or annoyance which--

- *(Level A Harassment)* has the potential to injure a marine mammal or marine mammal stock in the wild; or,
- *(Level B Harassment)* 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 but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

Haul-out Sites: the location where animals, such as pinnipeds, crawl or pull themselves out of the water and onto land, ice, or other object, such as a buoy or dock.

Incidental take: an unintentional, but not unexpected, taking, where take is defined--

- *Under the MMPA* as "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect."

- *Under the ESA* as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

Outriggers: Portions of bents or piers that extend outside the limits of the bridge, usually because of obstructions on the ground preventing the piers from being placed at the location bents or piers would ideally be placed.

Rafts of sea lions: a mass of sea lions or other pinnipeds on the surface or the water in very close proximity.

Seasonal upwelling: Cold, nutrient rich water coming to the surface from depths of over 50 meters. Along the central California coast, during the summer, wind blows from the north to the south, pulling the surface water with it. As the surface water leaves an area, the 'hole' left behind is filled in by water 'upwelling' from below. Subsurface water that rises to the surface as a result of upwelling is typically biologically productive; therefore, good fishing grounds typically are found where upwelling is common.

Shear Keys: Masses of concrete on an abutment, bent, or pier that prevent beams from sliding off their supports

ATTACHMENT A
Figures

1. Project Location
2. Area of Potential Impact
3. Bridge Cross Section
4. Distribution of Observed Marine Mammals
5. Photographs of Marine Mammals
6. 1,000 Meter Limit From Construction Area

FIGURE 1: PROJECT LOCATION

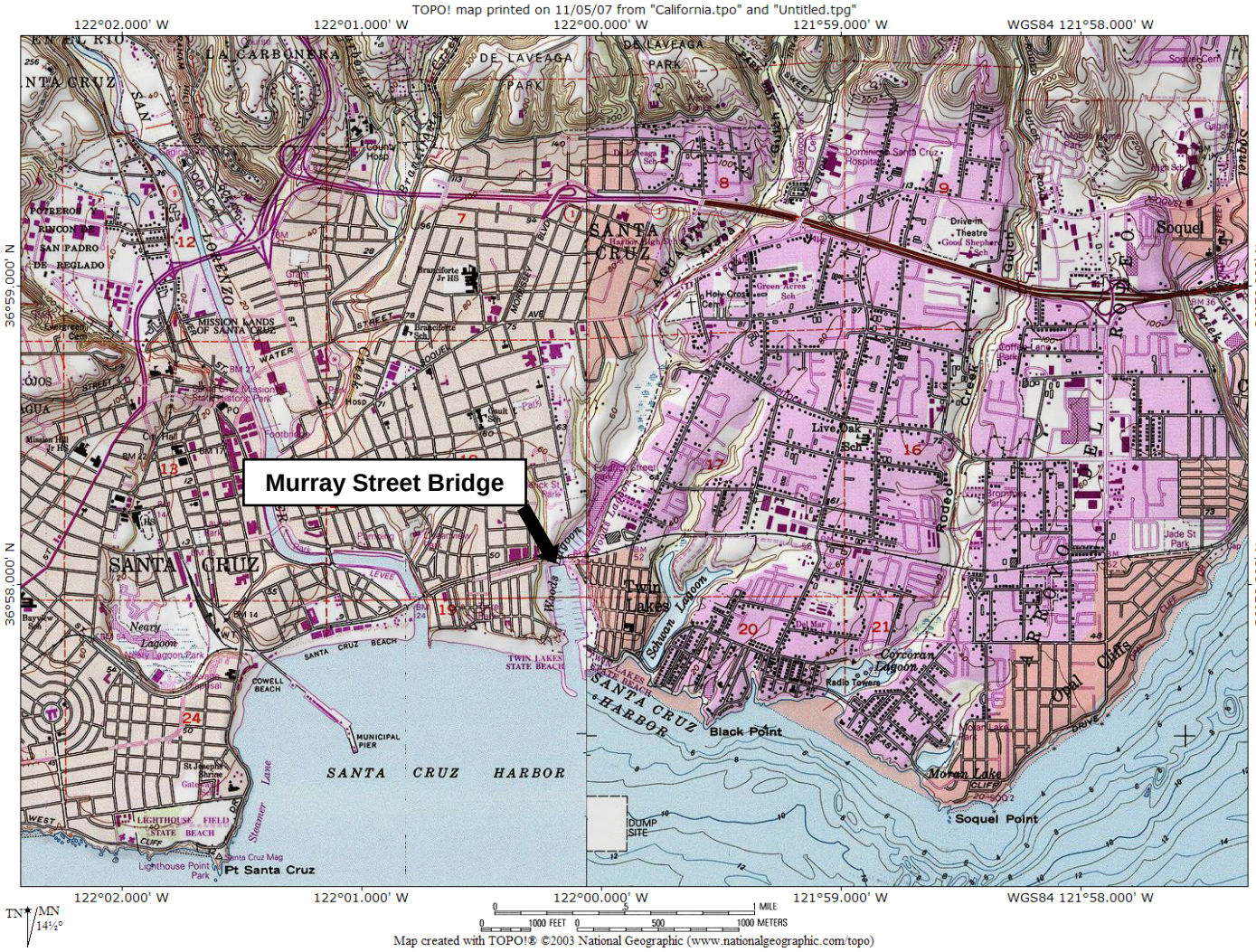


FIGURE 2: AREA OF POTENTIAL IMPACT

FIGURE 3: BRIDGE CROSS SECTION

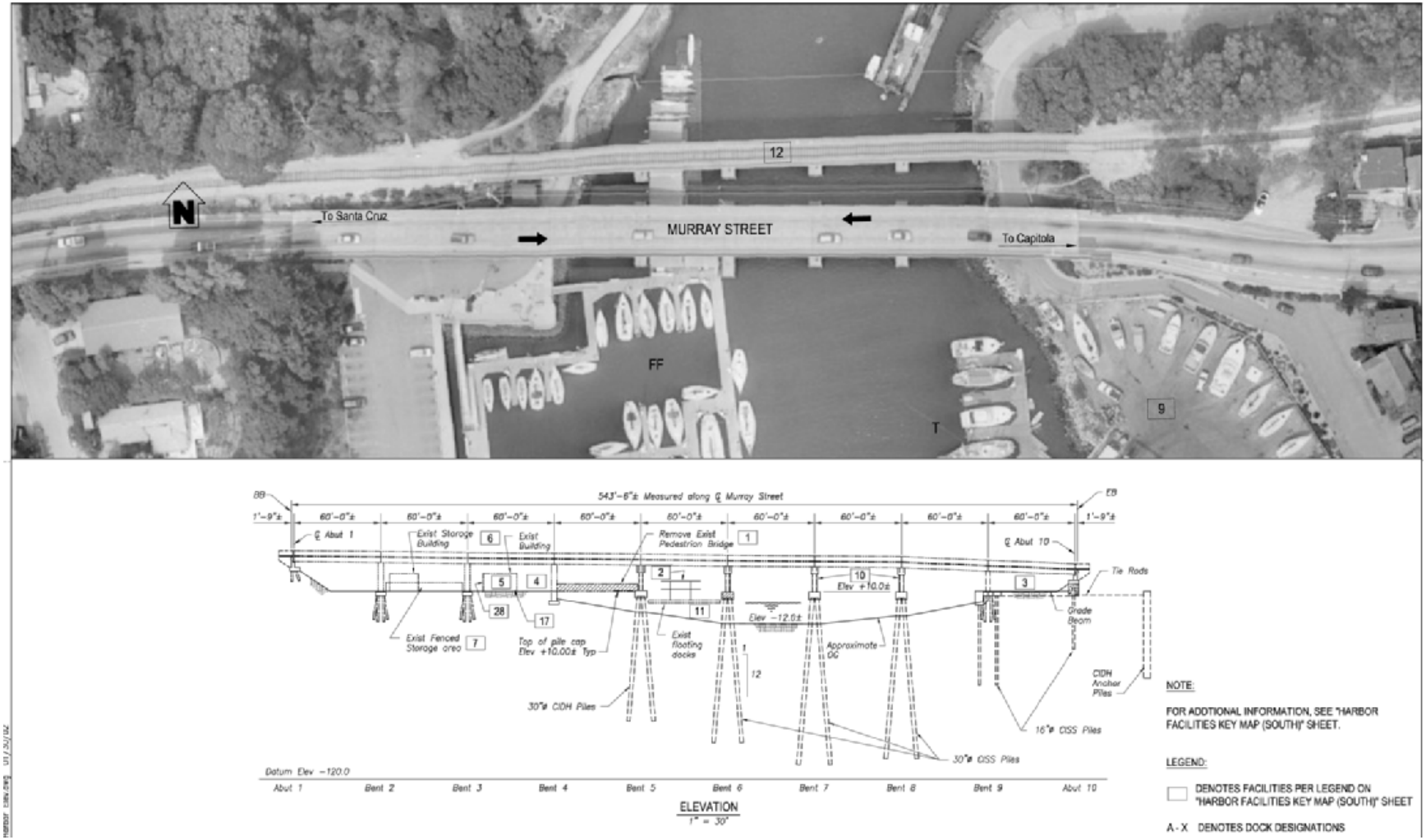


FIGURE 4: DISTRIBUTION OF OBSERVED MARINE MAMMALS

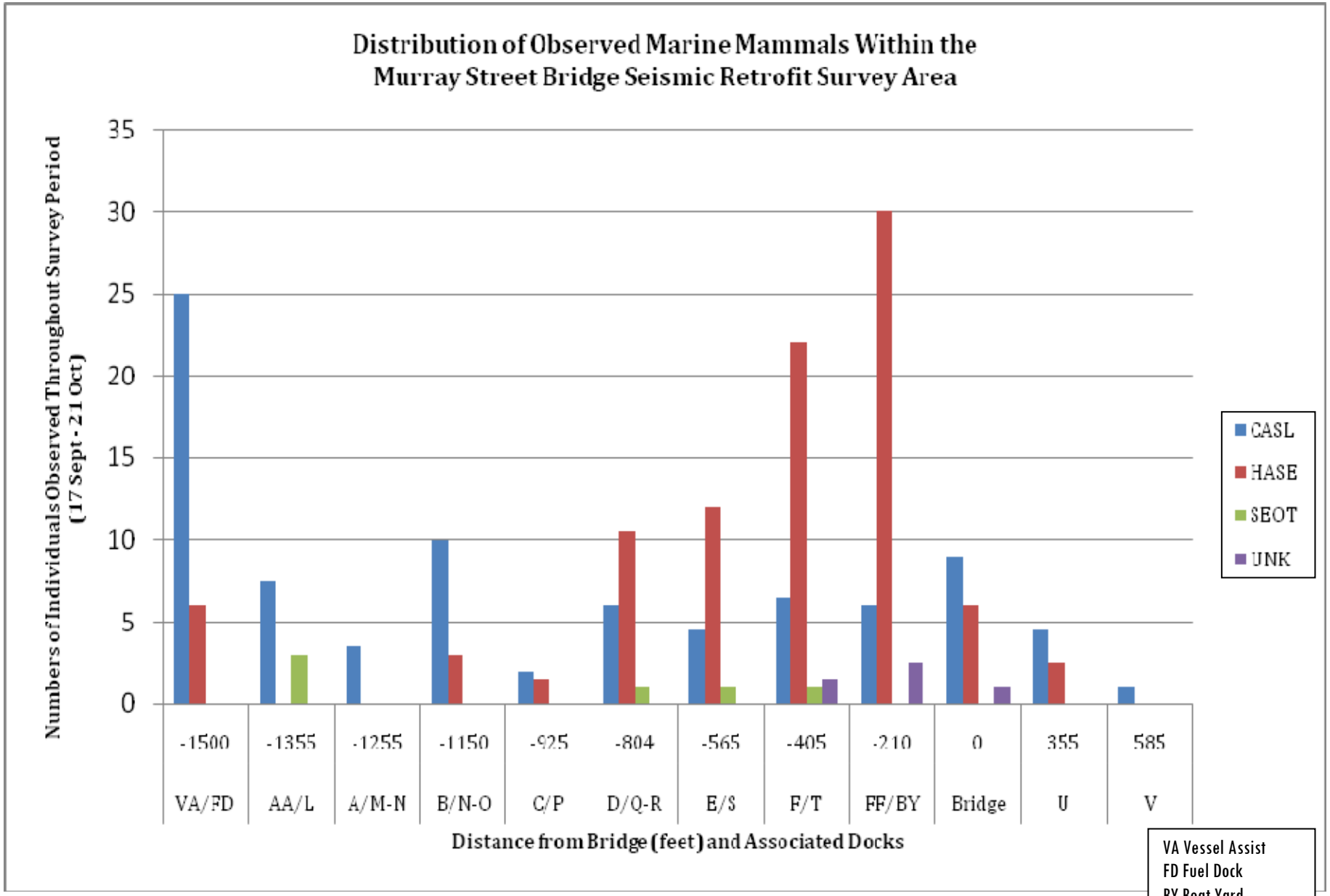


FIGURE 5: PHOTOGRAPHS OF HAULED-OUT MARINE MAMMALS DURING FALL 2009 SURVEYS

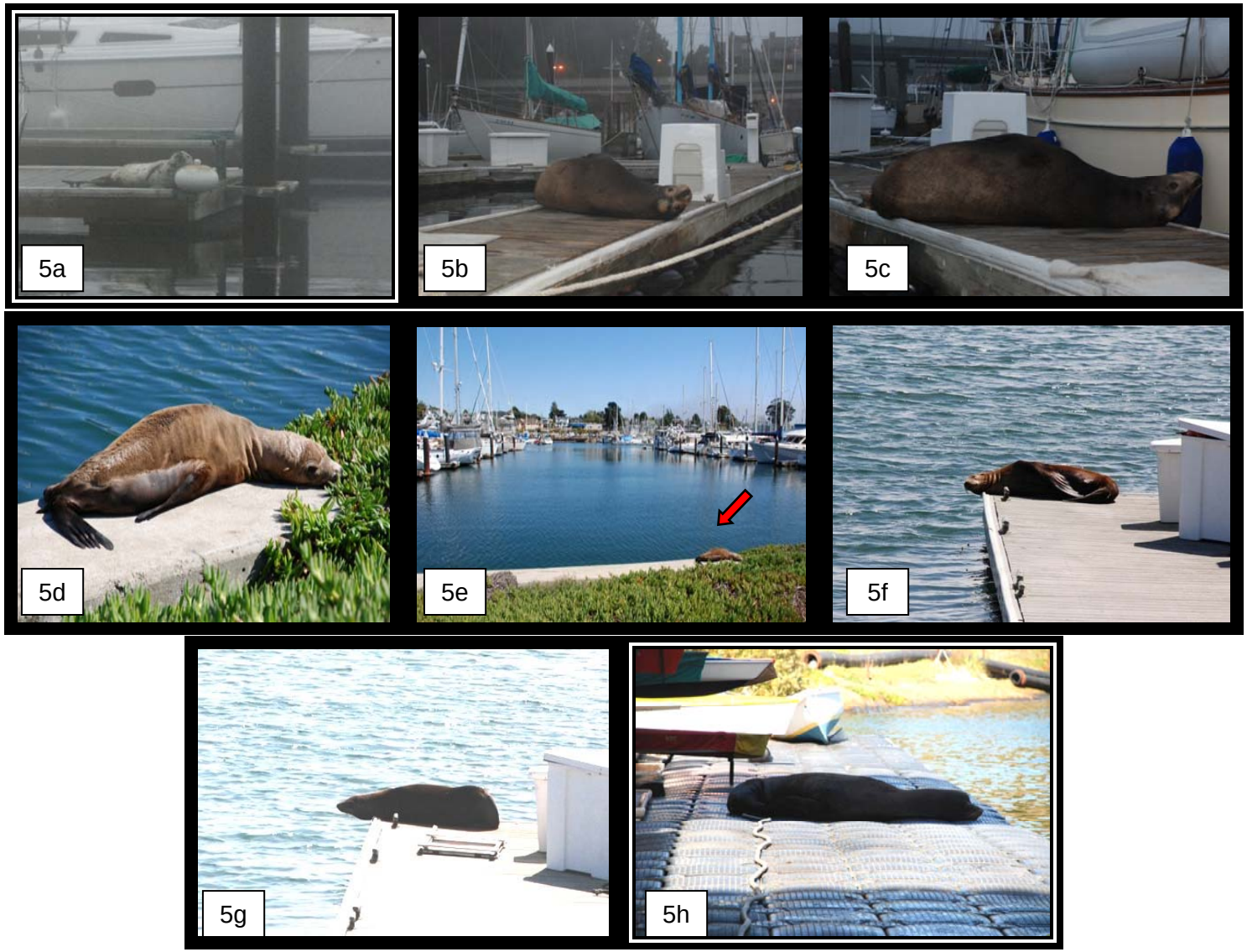
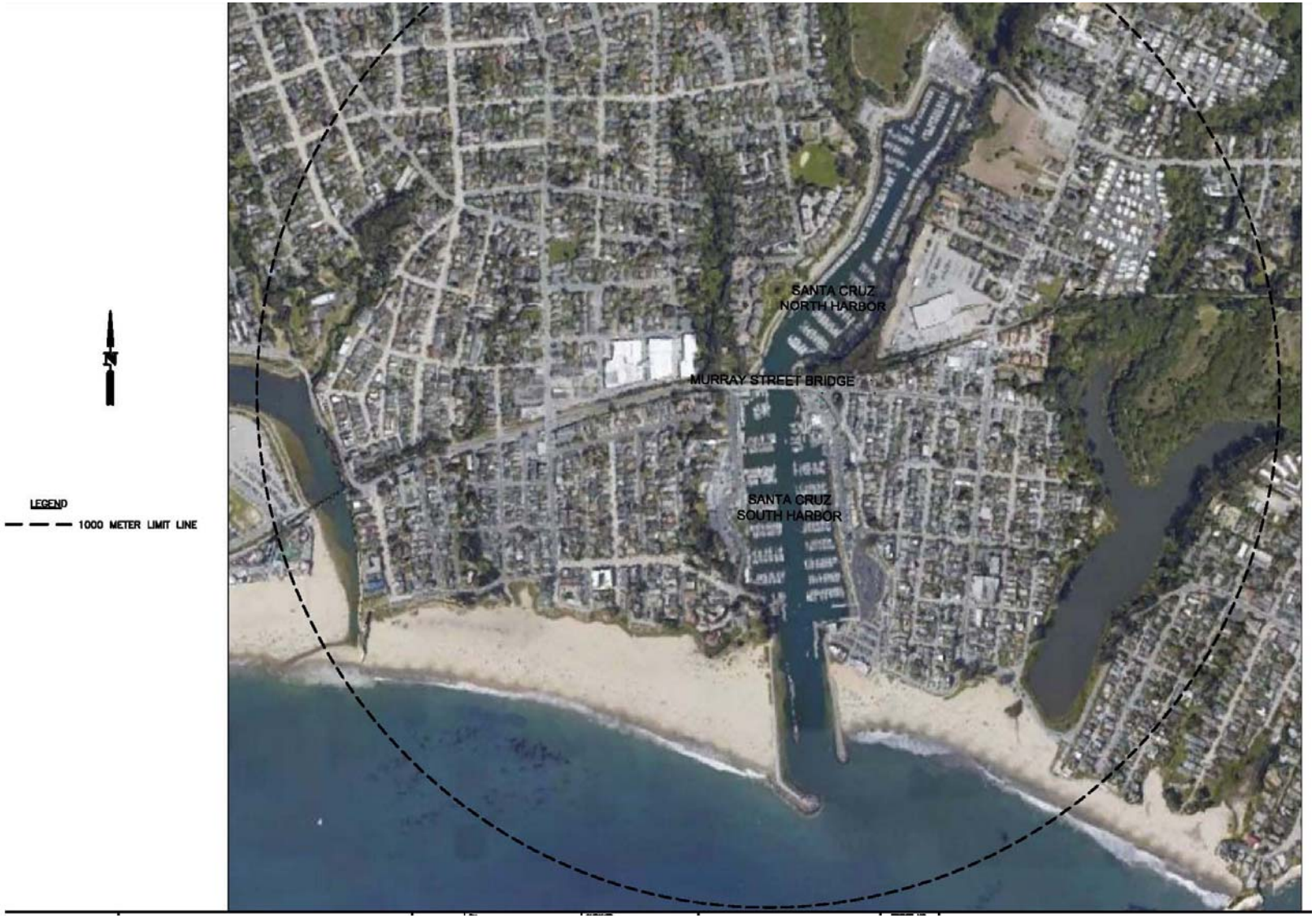


FIGURE 6: 1,000 METER LIMIT FROM CONSTRUCTION AREA



ATTACHMENT B
Tables

1. Construction Phasing and Schedule
2. Estimated Numbers of Marine Mammals in Survey Area
3. Numbers of Animals Hauled Out & Haul-out Locations
4. Estimated Potential Harassment of Marine Mammals
5. Existing Noise Levels
6. Noise Levels of Construction Equipment Noise

TABLE 1. Murray Street Bridge Retrofit Project: Construction Phasing & Approximate Schedule

Work Tasks	Effects on Harbor and Road Operations
Phase 1: Construction in East Zone - 2 months (May-July)[1]	
• Temporarily relocate overhead utilities north of bridge • Prepare construction staging area (8,000 sq.ft.) at harbor boat yard • Construct temporary sewer bypass on north side of bridge • Retrofit Bent 9 & Abutment 10; install anchor piles • Erect Girder Span 9 • Construct temporary sheet pile wall	* Install traffic control system with alternating 1-way traffic * Close Murray for 7 days for driving anchor piles * Temporary relocation (dry storage) of 9 dry-docked boats from boat yard * Traffic controls along Lake Avenue during construction staging area setup * Close east walkway under bridge
Phase 2: Construction in Eastern Waterway – 5 months (July-December)	
• Remove berths (12) at docks FF and north of dock T • Construct work platform(s) (trestle or barge) for Stage 2 work [2] • Retrofit Bents 7 & 8 (includes installing anchor piles at Bents 7 & 8) • Erect Girder Spans 7 & 8 and construct Deck Spans 7, 8, & 9 • Restore boat yard; reopen pedestrian path • Remove east work platform • Replace berths (2) north of Dock T upon construction in the eastern waterway And only between July and mid-November	* Temporary relocation of 2 boats from north of Dock T to AA * Temporary closure of East Drive & part of harbor boat yard * Availability of only one boat channel under the bridge for 6 non-consecutive half-days
Phase 3: Construction in West Zone - 6 months (December-May)	
• Install row boat storage at docks A/B & USCG area • Install temporary building at USCG area • Temporarily relocate existing offices and row boats to above [2] • Close portion of western parking lot [2] • Construct temporary access ramp to Dock FF • Retrofit Abutment 1 and Bents 2, 3, & 4 • Erect Girder Spans 1, 2, & 3 [and construct Deck Spans 1, 2, & 3]	* Closure of West Path, western concrete stairway and access ramp to Dock FF * Temporary relocation of affected facilities (offices, storage, restrooms, etc.)

[CONTINUED ON NEXT PAGE]

Phase 4: Construction in Western Waterway - 5 months (May-October)

- Construct modifications to Dock FF; move 7 boats to new Dock FF
- Construct work platform(s) (trestle or barge) for Stage 4 work
- Retrofit Bents 5 & 6 (including installation of anchor piles)
- Erect Girder Spans 4, 5, & 6 [and construct Deck Spans 4, 5, & 6]
- Construct south rails after south side construction completed [3]
- Remove work platform(s)
- Construct new water line
- Relocate PG&E electrical, gas lines

* Closure of West Path, western concrete stairway and access ramp to Dock FF
* Temporary relocation of affected facilities (offices, storage, restrooms, etc.)
* Temporary relocation of 8 boats from Dock FF
* Availability of only one boat channel under the bridge for 6 non-consecutive half-days

Phase 5: Construction of Superstructure and Barrier Rails – 6 months [no timing provided]

- Remove sidewalks & temporary barrier rails
- Construct new barrier rails
- Restore Dock FF, parking lot, existing offices and related facilities
- Restore all remaining facilities to original condition
- Repair deck

FOOTNOTES:

1 Note that construction phases overlap; the sum of the construction periods specified is therefore greater than the total period indicated by start and finish dates.

2 These tasks could be initiated and/or completed during the prior stage.

3 These tasks could be completed either in Phase 2 or 4.

4 Temporary closure of Murray Street bridge roadway to all traffic is possible during any phase for a short duration. The alternating one-way traffic with signal control will occur during the construction, but not during the full duration of construction activities.

TABLE 2. Estimated Numbers of Marine Mammals in the Murray Street Bridge Seismic Retrofit Survey Area[1] during 2009 Surveys

		Work Area[2]				Upper Harbor[3]				Lower Harbor[4]				Total in Survey Area			
Date	Time	CASL	HASE	SEOT	Unk[5]	CASL	HASE	SEOT	Unk[5]	CASL	HASE	SEOT	Unk[5]	CASL	HASE	SEOT	Unk[5]
17-Sep	Morning		3							1				1	3		
17-Sep	Midday						1			1	1			1	2		
17-Sep	Evening									1	1	1		1	1	1	
17-Sep	Night											2				2	
20-Sep	Evening									1				1			
20-Sep	Night	1								3	3			4	3		
21-Sep	Morning				1					1	4	1		1	4	1	1
21-Sep	Midday		1							2	1			2	2		
22-Sep	Night		1							2	2			2	3		
23-Sep	Morning		2							4		1		4	2	1	
23-Sep	Midday		1							2		1		2	1	1	
29-Sep	Night	1	2		2				1					1	2		3
30-Sep	Midday	6	8							9*	6*			9 to 15	8 to 11		
1-Oct	Morning		6 to 9							10	4*			10	6 to 11		
2-Oct	Morning	8	2							13*	4*			13 to 15[6]	4 to 6		
6-Oct	Midday	1	2				1			3	1			4	3		
7-Oct	Morning	1	3			4	1*			2	6			7	9 to 10		
17-Oct	Midday		3				6			1	1 to 2			1	10 to 11		
21-Oct	Midday	1	2				1							1	3		

Notes: CASL – California Sea Lion; HASE – Eastern Pacific Harbor Seal; SEOT – Southern Sea Otter

1. Survey Area = Harbor Launch Area to 500 ft north of the Area of Impact ; 17-Oct midday survey included entire Upper Harbor ≈ 2300 ft north of the Murray St Bridge

2. Work Area = Immediate Area around Murray St Bridge

3. Upper Harbor = Work Area to 500 north of Work Area

4. Lower Harbor = Work Area to Harbor Launch

5. Unknown Marine Mammal due to Darkness

6. "Raft" of 7 CASL foraging throughout the survey area

* Some individuals may have already been counted in other locations

TABLE 3. Numbers of Animals Hauled Out & Haul-Out Locations within Murray Street Bridge Surveys

		CASL		HASE	
Date	**Time**	**# of animals-dock**	**Notes**	**# of animals-dock**	**Notes**
17-Sep	Morning			3-FF	2 flushed into water when I came within ≈ 30 ft[1]
17-Sep	Midday				
17-Sep	Evening				
17-Sep	Night				
20-Sep	Evening	1-AA			
20-Sep	Night	1-AA, 1-F	same CASL as evening survey still present on AA Dock, large bull CASL with white topknot on D Dock, coughing[2]		
21-Sep	Morning	1-F	large bull CASL with white topknot from 20-Sept still present		
21-Sep	Midday	1-AA, 1-E/F	Sub-adult male or female on end of AA Dock[3]; juvenile on cement wall along harbor[4]		
22-Sep	Night	1-D	large bull CASL with white topknot		
23-Sep	Morning	1-FD, 1-D	CASL on Fuel Dock, flushed when approached by fishermen; large bull CASL with white topknot on D Dock	1-FF, 1-F	HASE on F Dock flushed with arrival of "Velocity" charter boat crew
23-Sep	Midday				
29-Sep	Night				
30-Sep	Midday				
1-Oct	Morning	1-AA	sub-adult male or female CASL on end of AA Dock	2-FF	2 HASE on F Dock, growling at HASE in water
2-Oct	Morning	1-AA	sub-adult male or female CASL on end of AA Dock	2-FF, 1-F	HASEs on FF flushed when I approached
6-Oct	Midday	1-AA	sub-adult male or female CASL on end of AA Dock[6]		
7-Oct	Morning			3-FF, 6-F	2 of 3 HASE on FF Dock flushed with arrival of kayakers
17-Oct	Midday				
21-Oct	Midday	1-FF	large bull CASL on rubber docks by UCSC Kayaks[7]		

Notes: CASL – California Sea Lion; HASE – Eastern Pacific Harbor Seal; *Survey Area = Harbor Launch Ramp Area (including Fuel Dock and Vessel Assist Dock) to 500 ft upstream of the Area of Impact

1. See Figure 5a
2. See Figure 5b
3. See Figure 5c
4. See Figure 5d, e
5. See Figure 5f
6. See Figure 5g
7. See Figure 5h

TABLE 4. Estimated Potential Harassment of Marine Mammals During Murray Street Bridge Seismic Retrofit Construction Activities

Variable	Bridge Pile Driving			Boat Berths		Temporary Construction Trestle	
	16- CISS/CIDH Pile Installation	30-inch CISS/CIDH Pile Installation	96-inch CIDH Pile Installation	Concrete Pile Removal	14-inchConcrete Dock Pile Installation	20-inch Steel Trestle Pile Installation	Steel Pile Removal
Number of Piles	18	22	2	39 [1]	35	72	72
Sound Duration (Hours/Activity)	4	8	8	0.5	1	1	0.25
Activity Frequency Per Day	2	1	1	6	5	8	8
Number of Days	**9**	**22**	**2**	**6.5**	**7**	**9**	**9**
Total Hours Exposure	72	176	16	19.5	35	72	18
Total Harassment – Maximum Animals Per Day	**Total Days for Specified Pile Size**						
Southern sea otters – 2 otters per day	18	44	4	13	14	18	18
California sea lions – 15 sea lions per day	135	330	30	98	105	135	135
Harbor seals – 11 seals per day	99	242	22	72	77	99	99
SUMMARY – Total (64.5 days) • Southern Sea Otter: 129 • California Sea Lion: 968 • Harbor Seal: 710							

[1] Includes removal of four 14-inch concrete piles at Bridge Bent 6 and 35 14-inch concrete piles at Docks FF and T

TABLE 5: Existing Noise Levels – Murray Bridge area (dBA)

Location	L_{90}	L_{50}	L_{eq}	L_1
Harbor entrance – 20 feet from Lake Avenue	51	60	62	69

TABLE 6: Noise Levels of Construction Equipment Noise (in dBA)

Equipment	Typical Noise Level (dBA) 50 ft from Source
Air Compressor	81
Backhoe	80
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile-driver (Impact)	101
Pile-driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rock Drill	98
Roller	74
Saw	76
Scraper	89
Truck	88

SOURCE: Transit Noise And Vibration Impact Assessment, May 2006, Federal Transit Administration, FTA-VA-90-1003-06 as cited in the City of Santa Cruz General Plan 2030 Draft EIR (September 2011).

ATTACHMENT C

Hydroacoustic Analysis

Memorandum

Date:	November 20, 2014
To:	Christophe Schneiter, City of Santa Cruz Department of Public Works, and Mark Imbriani, TRC
From:	Kate Giberson
Subject:	**Santa Cruz Murray Street Bridge (36C-0108) Seismic Retrofit Project – Hydroacoustic Analysis and Marine Mammal Evaluation**

Introduction

The City of Santa Cruz (City) and TRC requested that ICF International (ICF) review the hydroacoustic analysis and marine mammal evaluation completed for the Murray Street Bridge (36C-0108) Seismic Retrofit Project (Project). The purpose is to assist the City and TRC in addressing questions/comments and provide more information for the Incidental Harassment Authorization (IHA) permit application, as conveyed in the January 2, 2014, emails from Tom Edell with Caltrans and Guan Shane with NOAA National Marine Fisheries Institute (NMFS).

ICF acoustical analyst David Buehler and ICF wildlife biologist Kailash Mozumder reviewed the existing documentation and information provided by the City and TRC, including: noise calculation spreadsheets, Natural Environment Study (NES), Biological Assessment (BA), and Marine Mammal Mitigation Plan (MMMP). Based on the information reviewed and our understanding of the project, Mr. Buehler conducted a supplemental hydroacoustic analysis, and Mr. Mozumder re-evaluated the impact on marine mammals based on the new calculations. The results of this effort are included in this memorandum, following our understanding of the project.

Project Understanding

The Project consists of the seismic retrofit of the existing Murray Street Bridge, which spans the Santa Cruz Small Craft Harbor, and additional minor modifications to replace deficient bridge barriers. The Project will provide the bridge with additional vertical support and resistance to lateral seismic forces by installing additional pilings and supplemental structural elements.

In-water activities include: removal of docks to accommodate construction access; potential installation of piles for a construction trestle from the bridge, pile driving; transport of materials; and replacement of harbor docks upon completion of the bridge seismic retrofit project. The construction schedule includes 10 months of potential in-water activity over 2 years (5 months during the first year and 5 months during the second year). Although in-water activities would be

intermittent throughout the 5-month period, it is conservatively assumed that some activity could occur daily throughout these periods.

The most intense in-water activity would be the installation of new bridge support piles, which is the subject of this hydroacoustic analysis. CISS (cast-in-steel-shell) piles at Bents 5 through 8 will be installed within the waterway by driving 30-inch diameter steel casing either to refusal at rock or into a shaft drilled within rock (depending on the location). The installation of new piles at Bents 5-8 will include two piles on each side for a total of 16 piles in the water (and 8 additional on-land piles at Bent 9 and Abutment 10). Overall the installation of piles is expected to take a total of approximately 2 days for each pile for a total of 32 days. The installation of these piles requires the use of cranes, a drilling rig, a pile driver, exaction and earthmoving equipment, and other equipment. Based on the geotechnical site characteristics, permanent bridge piles will be partially or entirely vibrated into the Harbor substrate rather than driving them entirely by means of hammering.

Hydroacoustic Analysis

ICF calculated the distances to the 120 dB, 160 dB, 180 dB, and 190 dB-RMS contours for the largest of each type of pile to be driven (**Table 1**). These sound levels correspond to the following thresholds:

190 dB-RMS – Pinniped injury (Level A harassment)

180 dB-RMS – Cetacean injury (Level A harassment)

160 dB-RMS – Cetacean and Pinneped disturbance under impact pile driving (Level B harassment)

120 dB-RMS – Cetacean and Pinneped disturbance under vibratory pile driving (Level B harassment)

The calculations are based on source levels for similar piles driven for similar projects, based on information provided in Caltrans' *Compendium of Pile Driving Sound*[1].

In accordance with NMFS guidance[2], an attenuation rate of 4.5 dB per doubling of distance was assumed. The results of the analysis indicate the following:

1. The distance, within which the pinniped injury threshold of 190 dB-RMS is predicted to be exceeded, is 10 meters or less.
2. The distance, within which the cetacean injury threshold of 180 dB-RMS is predicted to be exceeded, is less than 50 meters.
3. The distance, within which the impact driving disturbance threshold of 160 dB-RMS is predicted to be exceeded, is 1,000 meters or less.

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[1] Caltrans 2012. Compendium of Pile Driving Sound Data, Sacramento, CA.

[2] NMFS guidance is in a published spreadsheet (http://www.dot.ca.gov/hq/env/bio/fisheries_bioacoustics.htm), which states: A22 is the Transmission Loss Constant. Default is 15 unless site-specific transmission loss information is available.

4. The distance, within which the vibratory driving disturbance threshold of 120 dB-RMS is predicted to be exceeded, is as high a 46,400 meters.

These predicted distances are based on an open water attenuation rate of 4.5 dB per doubling of distance. These predicted distances do not consider additional attenuation effects that will likely occur at the breakwater into Monterey Bay. Because no empirical data is available on the extent of these additional attenuation effects, a specific prediction assuming this additional attenuation is not included in Table 1. However, if an additional attenuation of 15 dB were to occur (as an example), the 46,400 meter distance would be reduced to approximately 4,600 meters, which is still a very large and impractical distance within which to monitor.

The challenge in this situation is that that 120 dB disturbance threshold associated with vibratory pile driving is extremely low. The disturbance threshold for impact pile driving is 40 dB higher (i.e. less restrictive) than the threshold for vibratory driving. The difference between impact driving and vibratory driving source levels for the same pile is typically in the range of about 15 to 25 dB. Accordingly, the disturbance effect distances for impact driving are typically far less than the distances for vibratory driving.

Because it is impractical to monitor within several thousand kilometers of the pile driving, the engineering team is proposing to assume that the maximum distance for Level B harassment is 1,000 meters. Under this assumption, the contractor will be allowed to use vibratory driving if the contractor can demonstrate, by underwater monitoring conducted during actual pile driving, that the 120 dB vibratory threshold will not be exceeded within 1,000 meters of pile driving. If this cannot be achieved, the contractor will be then required to use impact driving only and limit measured sound levels to 160 dB or less at 1,000 meters. The distance from the bridge to the breakwater is about 780 meters. This means that the impact distance will extend about 120 meters into Monterey Bay.

Marine Mammal Evaluation

ICF re-evaluated the impact on marine mammals, including southern sea otter, Eastern Pacific harbor seal, and California sea lion. Based on review of the existing MMMP, other relevant IHAs referenced in the MMMP, communication with Shane Guan at NMFS, and the new calculations described above, we recommend the following updates to the July 2010 "Murray Street Bridge (#36C-0108) Seismic Retrofit Project Marine Mammal Mitigation Plan".

1. Repackage the existing single document into two stand-alone documents.

   - The first document will serve as the IHA application. This document will be created by changing the existing document title from "Murray Street Bridge (#36C-0108) Seismic Retrofit Project Marine Mammal Mitigation Plan" to "Incidental Harassment Authorization Application for the Murray Street Bridge Seismic Retrofit Project".

   - The second document will serve as the Marine Mammal Monitoring Plan (MMMP) that is required by NMFS. The majority of the information needed for this document can be found in the existing document. To create the project specific MMMP, we recommend that the text found on page 29 (under the heading "Marine Mammal Mitigation Measures") be extracted and repackaged as a second stand-alone document. This second document should be titled "Murray Street Bridge Seismic Retrofit Project Marine Mammal Monitoring Plan". This

project specific MMMP should explicitly identify the zones of influence (ZOI's), the proposed monitoring measures, and the qualifications for the biological monitor which is often referenced by NMFS as the Protected Species Observers (PSO). ICF can provide an example marine mammal monitoring plan if needed.

2. Address the comment from NMFS regarding the conservative estimate of take (question #6).

   - Remove the following sentence on page 20: "The number of potential takes was estimated by assuming that 10% of the average number of marine mammals observed in the survey area might be present…"

   - Use the more simple calculation shown below, based on NMFS' recommendation and consistent with our experience with NMFS. The numbers used for the take estimates should be the maximum number observed, shown on the table on page 21. Adjusting these numbers will demonstrate to NMFS that your calculations for take are conservative. These adjusted numbers should be reflected both in the text for question #7 and in Table 4 (page 22) of the current document.

     The calculation for marine mammal exposures is estimated by:

     Exposure estimate = N * ("X" days of pile driving activity + "X" days of pile removal), where:

     N = # of animals

     Exposure estimate = N animals * "X" days

     Therefore, _____ is requesting authorization for Level B acoustical harassment of up to X harbor seals and X California sea lions due to pile driving. It is assumed that this number will include multiple harassments of the same individuals.

If you have any questions, please contact me (Kate Giberson) at 408-216-2835 (office) or 831-419-6800 (cell).

Table 1. Summary of Pile Driving Sound Impact Calculations for Marine Mammals - Murray Street Bridge

Location	Pile Type/Size	Driving Type	Data Source	Assumed Source Levels (dB) at 10 meters			Attenuation K Factor	Distance to Criterion Level (meters)			
								Pinniped Injury	Cetacean Injury	Cetacean and Pinneped Disturbance (Impact)	Cetacean and Pinneped Disturbance (Vibratory)
				Peak	SEL	RMS		190 dB-RMS	180 dB-RMS	160 dB-RMS	120 dB-RMS
in water	sheet pile	Impact	Caltrans 2012. Table I.2-3. 24-inch AZ steel sheet pile driven at Port of Oakland	205	179	189	15	<10m	40	858	NA
in water	sheet pile	vibratory	Caltrans 2012. Table I.2-3. 24-inch AZ steel sheet pile driven at Port of Oakland	177	162	163	15	<10m	<10m	NA	7,356
in water	30-in CISS	impact	Caltrans 2012. Table I.2-3. 30-inch steel pipe driven at Richmont/San Rafael Bridge	205	NA	190	15	10	46	1,000	NA
in water	30-in CISS	vibratory	Caltrans 2012. Table I.2-2. 36-inch steel pipe driven at Richmont/San Rafael Bridge	185	175	175	15	<10m	<10m	NA	46,416
on land	30-in CISS	impact	Caltrans 2012. Table I.2-3. 48-in steel pipe at Russian River	198	NA	185	15	<10m	22	464	NA
on land	30-in CISS	vibratory	Estimated from impact level using difference between impact and vibratory for 30-inch in water.	178	NA	170	15	<10m	<10m	NA	21,544
in water	12-in steel H	impact	Caltrans 2012. Table I.2-3. 10-inch steel H pile San Rafael Canal.	190	NA	175	15	<10m	<10m	100	NA
in water	12-in steel H	vibratory	Caltrans 2012. Table I.2-3. 10-inch steel H pile San Rafael Canal.	161	NA	147	15	<10m	<10m	NA	631

The reliability of predictions beyond 1,000 meters is limited. Caltrans recommends limiting prediction distances to 1,000 meters. (Caltrans 2009).

Attenuation calculated using the practical spreading model with K factor of 15. This equates to 4.5 dB per doubling of distance.

Analyst: David Buehler, ICF International

Date: 10-20-14