Hydroacoustic Monitoring Plan

Alameda Main Street Ferry Terminal Refurbishment Project

SEPTEMBER 2023

Prepared for:

SAN FRANCISCO BAY AREA WATER EMERGENCY TRANSPORTATION AUTHORITY
Pier 9, Suite 111, The Embarcadero
San Francisco, California 94111

Prepared by:

DUDEK
1630 San Pablo Avenue, Suite 300
Oakland, California 94612
Contact: Andrew Hatch

Table of Contents

SECTION **PAGE NO.**

TABLES

FIGURES

APPENDICES

1 Project Overview

1.1 Monitoring Plan Purpose

This Hydroacoustic Monitoring Plan (HMP) has been prepared to be consistent with the relevant requirements of Section 6(e) from the Incidental Harassment Authorization (IHA) for the project and includes information on hydroacoustic monitoring equipment specifications, hydroacoustic testing session occurrences and durations, initial hydrophone locations (distances from pile driving activities and location within the water column), type of piles being installed and the associated pile driver type, and a discussion of the rationale for how the hydroacoustic testing program will capture a representative sample set of readings that are representative of changes in bathymetry and substrate in the waters surrounding the project. The final IHA appears in Appendix A. Deployment locations of the hydroacoustic testing equipment and hydrophones, appropriate to the marine species anticipated in the area, are specified in this HMP to allow for monitoring across the project area, cataloging multiple readings of the sound pressure levels (SPL) and cumulative sound exposure levels (SEL) associated with temporary threshold shifts and permanent threshold shifts the identified within species of concern. The minimum requirements listed in IHA Section 6(e) will also be included:

- Hydrophone equipment and methods: recording device, sampling rate, distance (m) from the pile where recordings were made; depth of water at the pile location and recording device(s);
- Type and size of pile being driven, substrate type, method of driving during recordings (e.g., hammer model and energy), and total pile driving duration;
- For all impact driving, a detailed description of the sound attenuation device used and the duration of its use per pile;
- For impact pile driving (per pile): Number of strikes and strike rate; depth of substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1 µPa): root mean square sound pressure level (SPLrms), cumulative sound exposure level (SELcum), peak sound pressure level (SPLpeak), and single-strike sound exposure level (SELs-s);
- One-third octave band spectrum and power spectral density plots (average per pile type or for each individual pile); and
- Sound measurement data shall be provided to NMFS in tabular spreadsheet format (Microsoft Excel or similar).

1.2 Project Description

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) has proposed the Alameda Main Street (AMS) Ferry Terminal Refurbishment Project (project) to support WETA ferry operations within the Oakland Inner Harbor. Figure 1 illustrates the regional setting of the project; and Figure 2 summarizes the project site features located at 2990 Main Street in Alameda (City), California and includes the existing AMS Ferry Terminal, which consists of a trestle, steel float structure, aluminum gangway, and bridge structure. The site is designated under the General and Maritime Industry land use and zoned as General Industrial (M-2). Much of the project site is within the Oakland Inner Harbor, with a portion of the bridge structure extending onto the landside of the City.

The landside of the project site consists of various bay rocks, rip-rap, and dirt/sand. The project site is accessible by vehicle via Main Street and by ferry within the Oakland Inner Harbor. The project is within a developed area of the City and is bounded by the Oakland Inner Harbor to the north, industrial uses to the east, the San Francisco Bay Trail, AMS Ferry Terminal parking lot, and residential uses to the south, as well as the Main Street Dog Park and undeveloped land uses to the east. Specific project elements include the following:

- **Terminal Bridge and Foundation Replacement**. Project activities would involve demolition of the existing bridge/walkway and bridge foundation and replace them with a new aluminum truss bridge. Onshore and landside support would be installed, consisting of driving a 48-inch monopile and two 24-inch pipe piles with cap beams, respectively (in water).
- **Gangway Replacement**. The project would include removal of the existing sixty-foot-long gangway and replacement with an eighty-foot-long covered aluminum gangway.
- **Float Demolition/Replacement**. The existing terminal float would be removed and replaced-in-kind with a new steel float. Ramps that had been previously installed on the float would be removed, protected in place, and reused once the new float is installed. Float ramps would be shifted to the west to provide additional room for a longer gangway. The four existing thirty-foot guide piles would be removed and replaced with four new 36-inch guide piles. To achieve a more safe, efficient berthing capacity and enable ingress and egress in a timely manner, float demolition/replacement activities would also involve installation of two new 36-inch donut fender piles (in water).
- **Utility Upgrades**. Utility upgrades associated with the project would involve replacement of existing razor equipment, installation of electrical service for new lighting, ramp controls, and outlets, provision of new potable water as well as conduit for future upgrades on bridge, gangway, and float structures. No other utility improvements are planned.

1.3 Pile Removal and Installation

Usage of an impact pile driver to install piles is the primary type of activity that has the potential to elevate underwater noise levels. However, vibratory pile driving technique is expected to be used for the majority of project pile installation with the possibility of using an impact hammer if piles hit refusal prior to the required tip elevation. **Should impact pile driving be required as part of project construction, hydroacoustic monitoring performed per this HMP would be required as per Section 5(f) of the IHA. The IHA does not require hydroacoustic monitoring during vibratory pile driving processes, and thus no hydroacoustic monitoring of pile extraction or installation involving vibratory means is planned .** Pile installation activities for the project include installation of a single 48-inch steel pipe monopile in water for the terminal bridge along with two 24-inch steel pipe piles with concrete cap beams on land. The project also involves removal of four existing 30-inch guide piles, installation of four 36-inch guide piles and two 36-inch donut fender piles in water for the terminal float.

In-water pile driving activity releases sound energy directly into the water due to pile vibration between the surface of the water and the riverbed; and, indirectly as a result of ground-borne vibration at the riverbed. Airborne sound does not make a substantial contribution to underwater sound levels because of the impedance mismatch at the air/water interface. On-land pile driving can generate low-frequency ground-borne vibration that could cause localized sound pressures in the water to be subsequently radiated from the riverbed, but the mechanisms for transmitting this sound into the water are complex and challenging to accurately predict.

Table 1 summarizes the proposed pile-driving activities, the number of piles anticipated per day, and the duration of the pile driving activity for vibratory driving.

Table 1. Summary of Project Pile Locations, Durations, Quantities per Day, and Types

Pile Location (and project feature)	Duration/Estimated Blows per Pile[1]	Piles	Pile Type
In Water - Installation			
• Terminal Bridge and Foundation Replacement	45 minutes (vibrate) 1,105 strikes (impact)	1	48-inch steel pipe
• Float Replacement (Guide Piles and Donut Fender Piles)	45 minutes (vibrate) 1,105 strikes (impact)	6	36-inch steel pipe
On Land - Installation			
• Terminal Bridge and Foundation Replacement	45 minutes (vibrate) 1,105 strikes (impact)	2	24-inch steel pipe
In Water – Removal			
• Guide Piles	45 minutes (vibrate)	4	30-inch steel pipe

Note:
[1] Impact driving if needed, assumes about 20 to 30 minutes of driving with a total of about 1,015 strikes per pile.

2 Regulatory, Guidelines and Requirements

2.1 Established Thresholds

National Oceanic and Atmospheric Administration - Fisheries and National Marine Fisheries Service (NOAA-Fisheries/NMFS) joined with Caltrans, other regulatory agencies, and researchers to form the Fisheries Hydroacoustic Working Group (FHWG) with the intent to provide guidance and establish criteria for the evaluation. The FHWG and NOAA-Fisheries issued interim guidance on hydroacoustic levels resulting from pile driving activities and subsequently agreed upon a dual metric criterion for the onset of physical injury (Level A harassment) of 206 dB re: 1µPa Peak for any single strike and an accumulated sound exposure level (cSEL) of 187 dB re: 1µPa^2-sec for all fish greater than 2 grams in size. The calculation method for cumulative sound exposure level (cSEL) is shown in Appendix B (NOAA 2012a). The agreed upon criteria for fish less than 2 grams maintains the 206 dB Peak single-strike threshold and lowers the accumulated cSEL limit to 183 dB re: 1µPa^2-sec. In addition, NOAA-Fisheries uses a threshold of 150 dB re: 1µPa RMS average sound pressure level as an indication for the onset of behavioral disturbance responses (Level B harassment) for salmonids and green sturgeon is appropriate, until new information indicates otherwise; and 150 dB re: 1µPa^2-sec cSEL or below, resulting from an individual pile strike is considered to be “effective quiet”, or the level at/below which the accumulated energy from multiple strikes would not contribute to injury, regardless of the number of strikes.

In 2016 NOAA-Fisheries issued guidance on underwater thresholds for onset of permanent threshold shifts (PTS) or internal injury for marine mammals, which was updated and incorporated in the “2018 Revision to: Technical

Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0)". These underwater thresholds for marine mammal protection are provided below in Table 2.

Table 2. NOAA-Fisheries Marine Mammal Protection Underwater Level A Thresholds

Hearing Group (Hearing Range/Weighting)	Accumulated SEL (cSEL) Threshold		Peak Threshold
	Impulsive[1]	Non-impulsive[2]	Impulsive[1]
Low-Frequency Cetaceans (LF 7 Hz. to 35 kHz.)	183 dB	199 dB	219 dB
Mid-Frequency Cetaceans (MF 150 Hz. to 160 kHz.)	185 dB	198 dB	230 dB
High-Frequency Cetaceans (HF 275 Hz. to 160 kHz.)	155 dB	173 dB	202 dB
Phocid Pinnipeds (PW 50 Hz. to 86kHz.)	185 dB	201 dB	218 dB
Otariid Pinnipeds (OW 60 Hz. 39 kHz.)	203 dB	219 dB	232 dB

Source: NOAA Fisheries 2018.
Notes: dB = decibel; cSEL = cumulative sound exposure level over a 24-hour period, with a reference value of 1µPa^2-sec; Peak = peak unweighted sound pressure level with reference to 1µPa.
[1] Permanent Threshold Shift (PTS)/injury dual metric threshold for impulsive sources such as impact pile driving, use whichever metric results in the largest isopleth (e.g., seismic air guns, impact pile driving).
[2] Permanent Threshold Shift (PTS)/injury threshold for non-impulsive sources (e.g., vibratory pile driving, drilling).

NOAA-Fisheries indicates that marine mammals are likely to be behaviorally harasses in a manner that would qualify as Level B harassment when exposed to underwater noise levels above received levels of 120 dB 1µPa RMS for continuous sources (e.g., vibratory pile driving, drilling), and above received levels of 160 dB 1µPa RMS for non-explosive, impulsive sources (e.g., seismic air guns, impact pile driving) or intermittent sources (e.g., scientific, non-tactical sonar).

For airborne sound, harbor seals are considered to be behaviorally harassed (Level B harassment) when exposed to received levels equal to, or greater than 90 dB re: 20 µPa RMS, and all other pinnipeds would be considered harassed when exposed to received levels equal to, or greater than 100 dB re: 20 µPa RMS.

2.2 Marine Wildlife Protection Plan and Permit Conditions

The IHA delineates conditions under which incidental harassment of marine mammals is authorized under section 1010(a)(5)(D) of the Marine Mammal Protection Act. Two marine mammals represent the subject of potential incidental take as described in the IHA: harbor seal (*Phoca vitulina richardii);* and the California sea lion (*Zalophus californianus*). All marine mammals are protected under the Marine Mammal Protection Act. California sea lions are not federally-listed under the Endangered Species Act but receive protection under the Marine Mammal Protection Act. They occur from California to Canada. California sea lions are known to occur within the Project area. Harbor seals are not federally-listed under the Endangered Species Act but receive protection under the Marine Mammal Protection Act. They occur from Mexico to Alaska. Harbor seals are known to occur in the Project area.

2.2.1 Mitigation Requirements

To avoid or minimize the potential construction-related effects to target marine mammals (California sea lion and harbor seal) at or near the Project site avoidance/minimization and other mitigation measures will be implemented in accordance with the following from Section 4 of the final IHA (Table 2 reference has been changed to Table 3 in this HMP):

a. Employ protected species observers (PSO) and establish monitoring locations as described in section 5 of the IHA. The Holder must monitor the project area to the maximum extent possible based on the required number of PSOs, required monitoring locations, and environmental conditions.

b. Monitoring must take place from 30 minutes prior to initiation of pile driving activity (i.e., pre-start clearance monitoring) through 30 minutes post-completion of pile driving activity.

c. Pre-start clearance monitoring must be conducted during periods of visibility sufficient for the lead PSO to determine that the shutdown zones indicated in Table 3 are clear of marine mammals. Pile driving may commence following 30 minutes of observation when the determination is made that the shutdown zones are clear of marine mammals.

d. If a marine mammal is observed entering or within the shutdown zones indicated in Table 3, pile driving activity must be delayed or halted. Pile driving must be commenced or resumed as described in condition 4(e) of the IHA.

e. If pile driving is delayed or halted due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily exited and been visually confirmed beyond the shutdown zone indicated in Table 3 or 15 minutes have passed without re-detection of the animal.

f. Use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of three strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced energy strike sets. A soft start must be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer.

g. The Holder must use a bubble curtain during impact pile driving. The bubble curtain must be operated as necessary to achieve optimal performance. At a minimum, the Holder must adhere to the following performance standards:

    i. The bubble curtain must distribute air bubbles around 100 percent of the piling circumference for the full depth of the water column.

    ii. The lowest bubble ring must be in contact with the substrate for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent substrate contact. No parts of the ring or other objects shall prevent full substrate contact.

    iii. Air flow to the bubblers must be balanced around the circumference of the pile.

h. Pile driving activity must be halted (as described in condition 4(d) of the IHA) upon observation of either a species for which incidental take is not authorized or a species for which incidental take has been authorized but the authorized number of takes has been met, entering or within the harassment zone (as shown in Table 3).

i. Construction supervisors and crews, PSOs, and relevant WETA staff must avoid direct physical interaction with marine mammals during construction activity. If a marine mammal comes within 10 meters of such activity, operations must cease and vessels must reduce speed to the minimum level required to maintain steerage and safe working conditions, as necessary to avoid direct physical interaction.

The above-listed measures shall be implemented during all project-related construction activities.

Table 3. Shutdown and Harassment Zones

Method	Pile Type	Pile Size (inches dia.)	Shutdown Zone for Phocids (meters)	Shutdown Zone for Otariids (meters)	Level B Harassment Zone (meters)
Impact, installation	steel	36	830	60	736
Impact, installation	steel	48	140	10	631
Vibratory, extraction*	steel	30	40	10	4,200 (west); 1,700 (east)
Vibratory, installation*	steel	36	40	10	4,200 (west); 1,700 (east)
Vibratory, installation*	steel	48	10	10	4,200 (west); 1,700 (east)

Source: IHA.
Notes: Vibratory driving of 36 inch diameter (dia.) piles used as proxy for vibratory extraction of 30 inch piles.
* Constrained by bends in the Oakland Estuary and relatively shallow bathymetry near the shipping channel: 4,200 m (13,780 ft) west, 1, 700 m (5,577 ft) east.

2.2.2 Monitoring Requirements

Section 5 of the final IHA details the following monitoring requirements:

a. Marine mammal monitoring must be conducted in accordance with the conditions in this section and the IHA.

b. Monitoring must be conducted by qualified, NMFS-approved PSOs, in accordance with the following conditions.

   i. PSO must be independent of the activity contractor (for example, employed by a subcontractor) and have no other assigned tasks during monitoring periods.

   ii. At least one PSO must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

iii. Other PSO may substitute other relevant experience, education (degree in biological science or related field), or training for prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

iv. Where a team of three or more PSOs is required, a lead observer or monitoring coordinator must be designated. The lead observer must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

v. PSOs must be approved by NMFS prior to beginning any activity subject to the IHA.

c. For all pile driving activities, a minimum of one PSO must be assigned to the active pile driving location to monitor the shutdown zones.

d. PSOs must record all observations of marine mammals, regardless of distance from the pile being driven, as well as the additional data indicated in section 6 of the IHA.

e. A PSO will conduct pre-construction monitoring for at least 5 days prior to the start of in-water construction and will cover a period of at least 1 week (with at least 5 days of actual observation over a period of 4 hours each day), which must include 2 hours of monitoring in the morning at the time when construction activities would begin and 2 hours at midday when construction activities would resume.

f. Acoustic monitoring must be conducted in accordance with the Acoustic Monitoring Plan, to be submitted to NMFS no less than 30 days prior to commencement of pile driving activity. Hydroacoustic monitoring must be conducted during all impact pile driving activities.

2.2.3 Reporting Requirements

Section 1.1 of this HMP lists the six minimum requirements, reproduced from IHA Section 6.e, with respect to informational elements contained in a submitted acoustic monitoring report.

3 Monitoring Methodology

If impact pile driving occurs during project construction as a contingency to anticipated vibratory pile driving activities, hydroacoustic monitoring will be conducted. Hydroacoustic monitoring is not required during vibratory pile driving activities and would not be performed during such project construction activity involving vibratory pile driving techniques. Under these conditions, the maximum quantity of piles that will be installed or removed for which hydroacoustic monitoring may need to be performed are shown in Table 4.

Table 4. Summary of Monitoring Requirement for Piles to be Installed or Removed

Pile Location (and project feature)	Duration/Estimated Blows per Pile[1]	Piles	Pile Type
In Water - Installation			
	1,105 strikes (impact)	1	48-inch steel pipe

• Terminal Bridge and Foundation Replacement • Float Replacement (Guide Piles and Donut Fender Piles)	1,105 strikes (impact)	6	36-inch steel pipe

Note:
[1] Impact driving when needed, assumes about 20 to 30 minutes of driving with a total of about 1,015 strikes per pile.

3.1 Contractor Requirements

The acoustical monitoring contractor shall possess a minimum of a bachelor's degree in a related field with demonstratable experience in noise monitoring and analysis. The contractor will submit a detailed description of their qualifications and experience in hydroacoustic measurements and analysis.

3.2 Sound Monitoring Equipment and Monitoring Requirements

The contractors shall provide a list of proposed sound level monitoring equipment, along with specifications and a description of the purpose. The measurement range in terms of amplitude (in dB referenced to one micropascal [re: 1 µPa] for hydroacoustic measurements), sensitivity and frequency range for each transducer and piece of equipment shall be stated. A minimum frequency range of 20 Hz to 20 kHz and a minimum sampling rate of 44,100 Hz will be used when monitoring. Sampling rates higher than 48 kHz are preferred. Table 5 describes the minimum requirements of the equipment to be used. In addition to the equipment selection, quality control/quality assurance procedures should be described (e.g., how will system responses be verified and how will data be managed).

To facilitate further analysis of data full bandwidth, time-series underwater signals shall be recorded as a wave file (.wav) or similar format. Data compression algorithms or technologies (e.g., MP3, compressed .wav, etc.) will not be applied to the recordings.

Table 5. Example Equipment for Underwater Sound Monitoring

Item	Specifications	Minimum Quantity	Usage
Hydrophone	Receiving Sensitivity = -211 dB ± 3dB re. 1Vrms/µPa OR -203 dB ± 3dB re. 1Vrms/µPa	2	Capture underwater sound pressure levels and convert to voltages that can be recorded/analyzed by other equipment.
Signal Conditioning Amplifier	Amplifier Gain- 0.1 mV/pC to 10 V/pC Transducer Sensitivity Range- 10-12 to 103 C/MU	2	Adjust signals from hydrophone to levels compatible with recording equipment.
Calibrator (pistonphone-type) with Hydrophone Coupler/Adaptor	Accuracy- IEC 942 (1988) Class 1	1	Calibration check of hydrophone in the field.

Table 5. Example Equipment for Underwater Sound Monitoring

Item	Specifications	Minimum Quantity	Usage
Digital Signal Analyzer	Sampling Rate- 48kHz or greater	2	Analyzes and transfers digital data to laptop hard drive.
Laptop computer OR Digital Audio Recorder	Compatible with digital signal analyzer		Record digital data on hard drive or digital tape.
If water velocity ~> 1m/s, Flow shield	Open cell foam cover or functional equivalent	2	Eliminate flow noise contamination.
Real Time and Post-analysis software	–		Monitor real-time signal and post-analysis of sound signals.

Note: All measurement systems shall have current National Institute of Standards and Technology (NIST) traceable calibration.

Prior to monitoring, a standard depth sounder or a weighted line will record depth before impact pile driving commences. The hydrophone will be attached to a nylon cord or a steel chain if the current is swift enough to cause strumming of the line. The nylon cord or chain will be attached to an anchor that will keep the line at a set distance from the pile. The nylon cord or chain will be attached to a float or tied to a static line at the surface 10 meters from the pile. The distance will be measured by a tape measure, where possible, or a rangefinder. To the extent practicable there will be a direct line of acoustic transmission (direct line-of-sight) through the water column between the pile and the hydrophones.

The onsite inspector/contractor will inform the acoustics specialist when impact pile driving is about to start to ensure that the monitoring equipment is operational. Underwater sound levels will be continuously monitored during the entire duration of each pile being driven with a minimum one- third octave band frequency resolution. The wideband instantaneous Peak, SEL, and RMS values of each pile should be monitored in real time during construction to ensure that the Project does not exceed its authorized take level. Peak and RMS pressures will be reported in dB re:1 µPa, and SEL will be reported in dB re: 1 μPa^2-sec.

Prior to, and during, the impact pile driving activity, environmental data will be gathered, such as water depth and tidal level, wave height, wind direction and speed and other factors that could contribute to influencing the underwater sound levels (e.g., boats). The start and stop time of each pile driving event will be recorded and the time at which the bubble curtain or functional equivalent is turned on and off will be logged. A functional equivalent must function as well as or better than the attenuation device that was proposed during consultation or required by applicable permits. It must achieve the same or better sound level reductions that were used in the calculations during consultation or the permitting process.

The contractor or agency will provide the following information, in writing, to the acoustical specialist conducting the hydroacoustic monitoring for inclusion in the final monitoring report: a description of the substrate composition, approximate depth of significant substrate layers, hammer model and size, hammer energy settings and any changes to those settings during the piles being monitored, depth pile driven, blows per foot for the piles monitored, and total number of strikes to drive each pile that is monitored.

3.3 Impact Pile Driving Measurements

For underwater measurements, hydrophones will be positioned as outlined below:

- Near Position. A stationary hydrophone will be positioned at a distance of 10 meters from the piles being driven to observe the measurements in real-time. If the water depth at 10 meters is not at least 1.5 meters (5 feet), the closest distance to 10 meters will be used that has a minimum water depth of 1.5 meters. The hydrophone should be placed at approximately mid-depth.

- Middle Position. A second stationary hydrophone recording system will be positioned at approximately 20 to 50 meters from the pile being driven, at a measurement location at a distance equal to three times the water depth at the pile being driven, at a depth of 0.7 to 0.85 times the depth from the surface and at 1 meter above the bottom. This measurement location will be used to measure the extent of fish cSEL thresholds and marine mammal thresholds, and to calculate the site-specific transmission loss. This position will be a continuous recording of the pile being driven and the data will be further analyzed after monitoring completion.

- Distant Position. A third stationary hydrophone recording system will be positioned at approximately 410 meters from the pile being driven to measure the extent of marine mammal thresholds and to calculate the site-specific transmission loss. This position is necessary for the impact driving of 36-inch steel pipe piles and 30-inch steel pipe piles.

For impact pile-driving, the Peak, impulse RMS, and SEL levels of each strike will be monitored in real time using sound-level meters (SLMs). The cSEL will be subsequently computed. The impact pile driving pulse RMS levels will be subsequently measured from recordings.

3.4 Flow-Induced Underwater Noise

When collecting sound measurements in an area with strong currents (such as the Project area), appropriate measures will be taken, when necessary, to ensure that the flow-induced noise at the hydrophone will not interfere with the recording and analysis of the relevant sounds (NMFS, 2012a, b, and c). As a rule, current speeds of 1.5 meters/second or greater are expected to generate significant flow-induced noise, which may interfere with the detection and analysis of low-level sounds such as the sounds from a distant pile driver.

If it becomes necessary to reduce the flow-induced noise at the hydrophone, a flow shield will be described and installed around the hydrophone to provide a barrier between the irregular, turbulent flow and the hydrophone. If no flow shield is used in these situations, the current velocity will be measured and a correlation between the levels of the pile driving sounds and current speed will be made to determine whether the data is valid and can be included in the analysis.

3.5 Calibration

Calibration of measurement systems shall be established prior to use in the field each day. An acoustical piston-phone and hydrophone coupler shall be used along with manufacturer calibration certificates to calibrate the

equipment. The volume correction of the coupler for each hydrophone or microphone shall be known so that the piston phone shall produce a known signal that shall be compared against the measurement system response. The response of the measurement system shall then be noted in the field book and applied to all subsequent measurements. The hydrophones are calibrated to a calibration tone prior to use in the field. The tone is then measured by the hydrophone and the results are recorded onto the beginning of the digital audio recordings. The system calibration status shall be checked by comparing the calibration tone and recorded tones. The recorded calibration tones are used for subsequent detailed analyses of recorded pile strike sounds.

3.6 Sound Attenuation Monitoring

Sound attenuation devices are required for the duration of impact driving for this project. There will be no testing of attenuation effectiveness, and no piles will be impact-driven without properly functioning attenuation devices.

3.7 Signal Processing

3.7.1 Impact Pile Driving

Post-analysis of the underwater pile driving sounds will include:

- Number of pile strikes per pile and per day.
- For each recorded strike (or each strike from a subset), determine the following:
  - The peak pressure, defined as the maximum absolute value of the instantaneous pressure (overpressure or underpressure).
  - The root mean squared sound pressure (RMS).
  - The pulse duration used to compute the RMS.
  - The sound exposure level (SEL) measured across the accumulated sound energy during the pile strike.
  - Maximum, mean, and median of the peak pressure.
  - Maximum, mean, and median of the RMS.
  - Maximum, mean, and median of the SEL.
- Cumulative SEL (cSEL) across all the strikes for each pile.
- One-third octave band spectrum and power spectral density plots between 20 and 20,000 Hz for up to eight successive strikes with similar sound levels.

Broadband back-to-back RMS L_{max} (peak) and L_{eq} (average) 5-minute measurements will be made over the duration of pile driving. L_{max} measurements should be taken with a portable analyzer set for “fast” response (125 msec). For at least one full pile sequence of each pile size and substrate type, frequency spectrum measurements (L_{max} and L_{eq}) using a minimum resolution of one-third octave bands shall be taken to show the spectral content of the impact pile. If measuring background sound levels in the absence of construction is not possible, then report the L_{95} statistic.

3.7.2 Vibratory Pile Driving

Hydroacoustic monitoring is not required during vibratory pile driving processes and will not be conducted during such project construction activities.

4 Analysis

4.1 Impact Pile Driving

Analysis of the data from the San Francisco-Oakland Bay Bridge Pile Installation Demonstration project (PIDP) indicated that 90 percent of the acoustic energy for most pile driving impulses occurred over a 50 to 100 millisecond period with most of the energy concentrated in the first 30 to 50 milliseconds (Illingworth and Rodkin, 2001). The RMS values computed for this project will be computed over the duration between where 5% and 95% of the energy of the pulse occurs. The SEL energy plot will assist in interpretation of the single strike waveform. The single strike SEL associated with the highest absolute peak strike along with the total number of strikes per pile and per day will be used to calculate the cumulative SEL for each pile and each 24-hour period.

4.2 Vibratory Pile Driving

Hydroacoustic monitoring is not required during vibratory pile driving processes and will not be conducted during such project construction activities.

5 Reporting

Preliminary results for the daily monitoring activities, if required, will be submitted/reported to the primary point of contact within 48 hours after monitoring concludes for the day. The NMFS does not require daily reports for this project. In addition, a draft final report including data collected and summarized from all monitoring locations will be submitted within 90 days of the completion of hydroacoustic monitoring. The results will be summarized in graphical form and include summary statistics and time histories of impact sound values for each pile. A final report will be prepared and submitted to the Services within 30 days following receipt of comments on the draft report from the Services. The report shall include:

1. Size and type of piles.
2. A detailed description of the noise attenuation device, including design specifications.
3. The impact hammer energy rating used to drive the piles, make and model of the hammer.
4. A description of the sound monitoring equipment.
5. The distance between hydrophones, microphones and pile.

6. The depth of the hydrophones and depth of water at hydrophone locations.
7. The distance from the pile to the water's edge.
8. The depth of water in which the pile was driven.
9. The depth into the substrate that the pile was driven.
10. The physical characteristics of the bottom substrate into which the piles were driven.
11. The total number of strikes to drive each pile and for all piles driven during a 24-hour period.
12. The results of the hydroacoustic monitoring, as described under Signal Processing. An example table is provided in Appendix C for reporting the results of the monitoring.
13. The distance at which Peak, cSEL, and RMS values exceed the respective threshold values.
14. A description of any observable fish, marine mammal, or bird behavior in the immediate area will and, if possible, correlation to underwater sound levels occurring at that time.
15. The broadband A-weighted and unweighted maximum, minimum, and average L_{max} and L_{eq} levels shall be tabulated for every pile. For each pile size and substrate type frequency spectra (one-third octave minimum frequency resolution) charts will be included to show the frequency content of L_{max} and L_{eq} signatures. Background airborne sound levels or L_{95} surrogate for background sound shall be reported. The frequency content of airborne noise background levels shall also be shown.

6 References

California Department of Transportation (Caltrans). 2020. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Prepared by ICF International and Illingworth & Rodkin, Inc. Report No. CTHWANP-RT-20-365.01.04. October. https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/hydroacoustic-manual.pdf

National Oceanic and Atmospheric Administration - Fisheries (NOAA-Fisheries, see also: NMFS). 2018. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) - Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. April 2018. NOAA Technical Memorandum NMFS-OPR-59. https://media.fisheries.noaa.gov/dam-migration/tech_memo_acoustic_guidance_(20)_(pdf)_508.pdf Accessed March 2023

National Marine Fisheries Service (NMFS). 2012a. Guidance Document: Data Collection Methods to Characterize Underwater Background Sound Relevant to Marine Mammals in Coastal Nearshore Waters and Rivers of Washington and Oregon. January 31, 2012.

National Marine Fisheries Service (NMFS). 2012b. Guidance Document: Sound Propagation Modeling to Characterize Pile Driving Sounds Relevant to Marine Mammals. January 31, 2012.

National Marine Fisheries Service (NMFS). 2012c. Guidance Document: Data Collection Methods to Characterize Impact and Vibratory Pile Driving Source Levels Relevant to Marine Mammals. January 31, 2012.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals 33(4): 411-521

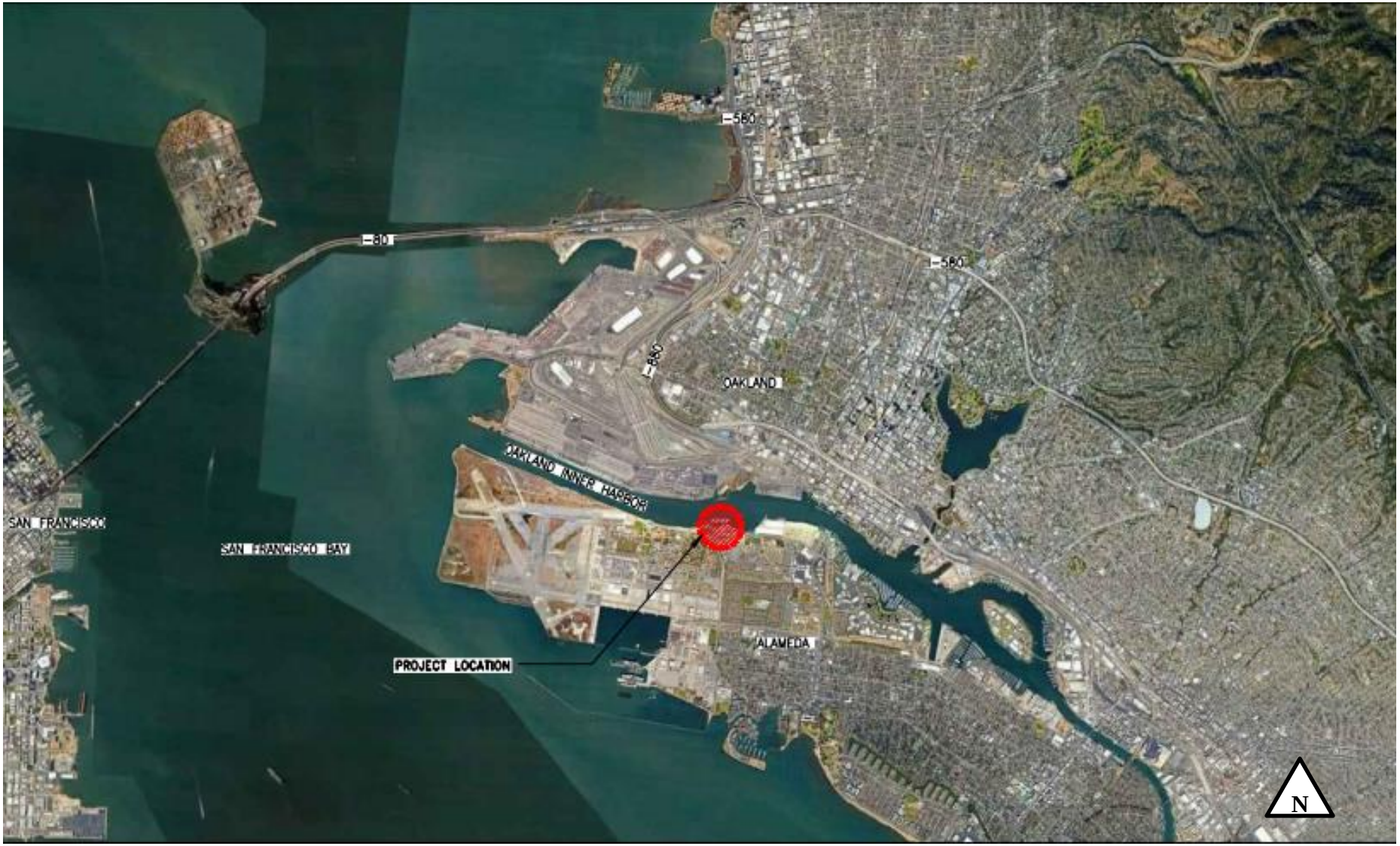

Figure 1 – Regional Setting

INTENTIONALLY LEFT BLANK

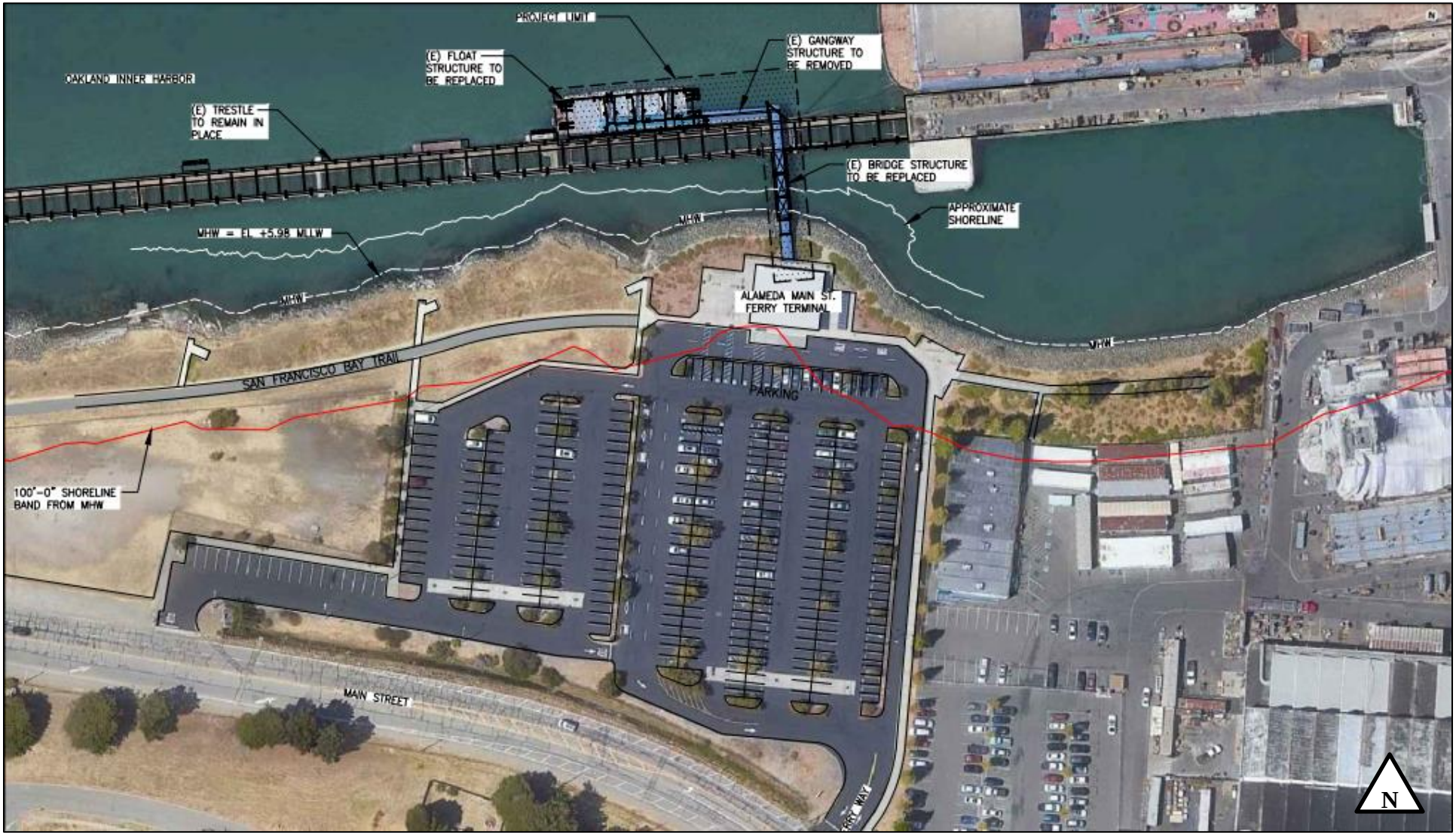

Figure 2 – Project Features

INTENTIONALLY LEFT BLANK

Appendix A

Final Incidental Harassment Authorization

INTENTIONALLY LEFT BLANK

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

INCIDENTAL HARASSMENT AUTHORIZATION

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) and its designees are hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(D)) to incidentally harass marine mammals, under the following conditions:

1. This incidental harassment authorization (IHA) is valid from August 15, 2023, through August 14, 2024.

2. This IHA authorizes take incidental to ferry terminal refurbishment, as specified in WETA's June 12, 2023, IHA application, associated with Alameda Main Street Ferry Terminal Refurbishment in Alameda, California. Hereafter (unless otherwise specified) the term "pile driving" is used to refer to both pile installation and pile removal.

3. General Conditions

   (a) A copy of this IHA must be in the possession of WETA, the Holder of the Authorization (Holder), supervisory construction personnel, lead protected species observers (PSOs), and any other relevant designees of the Holder operating under the authority of this IHA at all times that activities subject to this IHA are being conducted.

   (b) The species and/or stocks authorized for taking are California sea lion (*Zalophus californianus*) and harbor seal (*Phoca vitulina richardii*) (Table 1). Authorized take, by Level A and Level B harassment, is limited to the species and numbers listed in Table 1.

   (c) The taking by serious injury or death of any of the species listed in Table 1 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of this IHA.

   (d) WETA must ensure that construction supervisors and crews, the monitoring team, and relevant WETA staff are trained prior to the start of activities subject to this IHA, so that responsibilities, communication procedures, monitoring protocols, and operational procedures are clearly understood. New personnel joining during the project must be trained prior to commencing work.

4. Mitigation Requirements

(a) The Holder must employ PSOs and establish monitoring locations as described in section 5 of this IHA. The Holder must monitor the project area to the maximum extent possible based on the required number of PSOs, required monitoring locations, and environmental conditions.

(b) Monitoring must take place from 30 minutes prior to initiation of pile driving activity (i.e., pre-start clearance monitoring) through 30 minutes post-completion of pile driving activity.

(c) Pre-start clearance monitoring must be conducted during periods of visibility sufficient for the lead PSO to determine that the shutdown zones indicated in Table 2 are clear of marine mammals. Pile driving may commence following 30 minutes of observation when the determination is made that the shutdown zones are clear of marine mammals.

(d) If a marine mammal is observed entering or within the shutdown zones indicated in Table 2, pile driving activity must be delayed or halted. Pile driving must be commenced or resumed as described in condition 4(e) of this IHA.

(e) If pile driving is delayed or halted due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily exited and been visually confirmed beyond the shutdown zone indicated in Table 2 or 15 minutes have passed without re-detection of the animal.

(f) The Holder must use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of three strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer.

(g) The Holder must use a bubble curtain during impact pile driving. The bubble curtain must be operated as necessary to achieve optimal performance. At a minimum, the Holder must adhere to the following performance standards:

(i) The bubble curtain must distribute air bubbles around 100 percent of the piling circumference for the full depth of the water column.

(ii) The lowest bubble ring must be in contact with the substrate for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent substrate contact. No parts of the ring or other objects shall prevent full substrate contact.

(iii) Air flow to the bubblers must be balanced around the circumference of the pile.

(h) Pile driving activity must be halted (as described in condition 4(d) of this IHA) upon observation of either a species for which incidental take is not authorized or a species for which incidental take has been authorized but the authorized number of takes has been met, entering or within the harassment zone (as shown in Table 2).

(i) The Holder, construction supervisors and crews, PSOs, and relevant WETA staff must avoid direct physical interaction with marine mammals during construction activity. If a marine mammal comes within 10 meters of such activity, operations must cease and vessels must reduce speed to the minimum level required to maintain steerage and safe working conditions, as necessary to avoid direct physical interaction.

5. Monitoring Requirements

(a) Marine mammal monitoring must be conducted in accordance with the conditions in this section and this IHA.

(b) Monitoring must be conducted by qualified, NMFS-approved PSOs, in accordance with the following conditions:

(i) PSOs must be independent of the activity contractor (for example, employed by a subcontractor) and have no other assigned tasks during monitoring periods.

(ii) At least one PSO must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(iii) Other PSOs may substitute other relevant experience, education (degree in biological science or related field), or training for prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(iv) Where a team of three or more PSOs is required, a lead observer or monitoring coordinator must be designated. The lead observer must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(v) PSOs must be approved by NMFS prior to beginning any activity subject to this IHA.

(c) For all pile driving activities, a minimum of one PSO must be assigned to the active pile driving location to monitor the shutdown zones.

(d) PSOs must record all observations of marine mammals, regardless of distance from the pile being driven, as well as the additional data indicated in section 6 of this IHA.

(e) A PSO will conduct pre-construction monitoring for at least 5 days prior to the start of in-water construction and will cover a period of at least 1 week (with at least 5 days of actual observation over a period of 4 hours each day), which must include 2 hours of monitoring in the morning at the time when construction activities would begin and 2 hours at midday when construction activities would resume.

(f) Acoustic monitoring must be conducted in accordance with the Acoustic Monitoring Plan, to be submitted to NMFS no less than 30 days prior to commencement of pile driving activity. Hydroacoustic monitoring must be conducted during all impact pile driving activities.

6. Reporting

(a) The Holder must submit its draft report(s) on all monitoring conducted under this IHA within 90 calendar days of the completion of monitoring or 60 calendar days prior to the requested issuance of any subsequent IHA for construction activity at the same location, whichever comes first. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of receipt of the draft report, the report shall be considered final.

(b) All draft and final monitoring reports must be submitted to *PR.ITP.MonitoringReports@noaa.gov* and *ITP.clevenstine@noaa.gov*.

(c) The marine mammal report must contain, at minimum:

(i) Dates and times (begin and end) of all marine mammal monitoring;

(ii) Construction activities occurring during each daily observation period, including:

A. The number and type of piles that were driven and the method (e.g., impact, vibratory);

B. Total duration of driving time for each pile (vibratory driving) and number of strikes for each pile (impact driving); and

(iii) PSO locations during marine mammal monitoring;

(iv) Environmental conditions during monitoring periods (at beginning and end of PSO shift and whenever conditions change significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon, and estimated observable distance;

(v) Upon observation of a marine mammal, the following information:

A. Name of PSO who sighted the animal(s) and PSO location and activity at time of sighting;

B. Time of sighting;

C. Identification of the animal(s) (e.g., genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species;

D. Distance and location of each observed marine mammal relative to the pile being driven for each sighting;

E. Estimated number of animals (min/max/best estimate);

F. Estimated number of animals by cohort (adults, juveniles, neonates, group composition, etc.);

G. Animal's closest point of approach and estimated time spent within the harassment zone;

H. Description of any marine mammal behavioral observations (e.g., observed behaviors such as feeding or traveling), including an assessment of behavioral responses thought to have resulted from the activity (e.g., no response or changes in behavioral state such as ceasing feeding, changing direction, flushing, or breaching);

(vi) Number of marine mammals detected within the harassment zones, by species; and

(vii) Detailed information about implementation of any mitigation (e.g., shutdowns and delays), a description of specific actions that ensued, and resulting changes in behavior of the animal(s), if any.

(d) The Holder must submit all PSO datasheets and/or raw sighting data with the draft report.

(e) The acoustic monitoring report must contain the informational elements described in the Acoustic Monitoring Plan and, at minimum, must include:

(i) Hydrophone equipment and methods: recording device, sampling rate, distance (m) from the pile where recordings were made; depth of water at the pile location and recording device(s);

(ii) Type and size of pile being driven, substrate type, method of driving during recordings (e.g., hammer model and energy), and total pile driving duration;

(iii) For all impact driving, a detailed description of the sound attenuation device used and the duration of its use per pile;

(iv) For impact pile driving (per pile): Number of strikes and strike rate; depth of substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1 μPa): root mean square sound pressure level (SPL_{rms}), cumulative sound exposure level (SEL_{cum}), peak sound pressure level (SPL_{peak}), and single-strike sound exposure level (SEL_{s-s});

(v) One-third octave band spectrum and power spectral density plots (average per pile type or for each individual pile); and

(vi) Sound measurement data shall be provided to NMFS in tabular spreadsheet format (Microsoft Excel or similar).

(f) Reporting injured or dead marine mammals:

In the event that personnel involved in the construction activities discover an injured or dead marine mammal, the Holder must report the incident to the Office of Protected Resources (OPR), NMFS (*PR.ITP.MonitoringReports@noaa.gov* and *ITP.clevenstine@noaa.gov*) and to the West Coast regional stranding network (866-767-6114) as soon as feasible. If the death or injury was clearly caused by the specified activity, the Holder must immediately cease the activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of this IHA. The Holder must not resume their activities until notified by NMFS.

The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(ii) Species identification (if known) or description of the animal(s) involved;

(iii) Condition of the animal(s) (including carcass condition if the animal is dead);

(iv) Observed behaviors of the animal(s), if alive;

(v) If available, photographs or video footage of the animal(s); and

(vi) General circumstances under which the animal was discovered.

7. This Authorization may be modified, suspended or revoked if the Holder fails to abide by the conditions prescribed herein (including, but not limited to, failure to comply with monitoring or reporting requirements), or if NMFS determines: (1) the authorized taking is likely to have or is having more than a negligible impact on the species or stocks of affected marine mammals, or (2) the prescribed measures are likely not or are not effecting the least practicable adverse impact on the affected species or stocks and their habitat.

8. Renewals

On a case-by-case basis, NMFS may issue a one-time, one-year Renewal IHA following notice to the public providing an additional 15 days for public comments when (1) up to another year of identical, or nearly identical, activities (or a subset of those activities) are planned or (2) the specified activities will not be completed by the time the IHA expires and a Renewal would allow for completion of the activities, provided all of the following conditions are met:

(a) A request for renewal is received no later than 60 days prior to the needed Renewal IHA effective date (note a Renewal IHA expiration date cannot extend beyond one year from expiration of this IHA).

(b) The request for renewal must include the following:

(i) An explanation that the activities to be conducted under the requested Renewal IHA are identical to the activities analyzed for this IHA, are a subset of the activities, or include changes so minor (e.g., reduction in pile size) that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take).

(ii) A preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

(c) Upon review of the request for Renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures will remain the same and appropriate, and the findings made in support of this IHA remain valid.

DAMON RANDALL.KIMBERLY.BETH.1365821093

Digitally signed by DAMON RANDALL.KIMBERLY.BETH.1365821093
Date: 2023.08.14 12:55:29 -04'00'

Kimberly Damon-Randall,
Director, Office of Protected Resources
National Marine Fisheries Service

Table 1. Authorized Incidental Take

Common Name	Scientific Name	Stock	Level A Harassment Take	Level B Harassment Take
California sea lion	*Zalophus californianus*	U.S.	2	25
Harbor seal	*Phoca vitulina richardii*	California	8	50

Table 2. Shutdown and Harassment Zones

Method	Pile Type	Pile Size (in)	Shutdown Zone for Phocids (m)	Shutdown Zone for Otariids (m)	Level B Harassment Zone (m)
Impact, installation	Steel	36	830	60	736
Impact, installation	Steel	48	140	10	631
Vibratory, extraction*	Steel	30	40	10	4,200 W; 1,700 E
Vibratory, installation*	Steel	36	40	10	4,200 W; 1,700 E
Vibratory, installation*	Steel	48	10	10	4,200 W; 1,700 E

Note: Vibratory driving of 36 in piles used as proxy for vibratory extraction of 30 in piles.

* Constrained by bends in the Oakland Estuary and relatively shallow bathymetry near the shipping channel: 4,200 m (13,780 ft) west, 1, 700 m (5,577 ft) east

Appendix B
Calculation of Cumulative SEL

An estimation of individual SEL values can be calculated for each pile strike by calculating the following integral, where T is T90, the period containing 90% of the cumulative energy of the pulse (eq. 1).

$$SEL = 10\log\left(\int_0^T \frac{p^2(t)}{{p_0}^2}\,dt\right) \quad dB \qquad \text{(eq. 1)}$$

Calculating a cumulative SEL from individual SEL values cannot be accomplished simply by adding each SEL decibel level arithmetically. Because these values are logarithms they must first be converted to antilogs and then accumulated. Note, first, that if the single strike SEL is very close to a constant value (within 1 dB), then cumulative SEL = single strike SEL + 10 times log base 10 of the number of strikes N, i.e., 10Log10(N). However, if the single strike SEL varies over the sequence of strikes, then a linear sum of the energies for all the different strikes needs to be computed. This is done as follows: divide each SEL decibel level by 10 and then take the antilog. This will convert the decibels to linear units (or $\mu Pa^2 \bullet sec$). Next compute the sum of the linear units and convert this sum back into dB by taking 10Log10 of the value. This will be the cumulative SEL for all of the pile strikes.

INTENTIONALLY LEFT BLANK

Appendix C

Example Hydroacoustic Monitoring Log

INTENTIONALLY LEFT BLANK

Table C-1. Example table for required information for reporting the results of hydroacoustic monitoring of pile driving.*

Date and Time	Pile ID	Impact Hammer	# Strikes and Strike Rate	Distance to Pile from Hydrophone (meters)	Water Depth (meters)			Peak (dB)			SEL (dB)				RMS (dB)				Notes (e.g., type and depth of substrate to penetrate; sound attenuation device used and duration of its use per pile)
					At Pile	At H-phone	Of H-phone	Max	Min	Mean	Max	Min	Mean	cSEL	Max	Min	Mean	Pulse Duration	

*Data to be furnished in tabular spreadsheet format (Microsoft Excel or comparable). Additional data to be provided includes: 1/3-octave band spectrum and power spectral density plots (average per pile type or for each individual pile).