# DANA POINT HARBOR REVITALIZATION

# SC 8 ACOUSTIC MONITORING PLAN

## INTRODUCTION

The purpose of this Acoustic Monitoring Plan is to describe the methodology proposed for measuring underwater sound levels during the installation of steel pipe piles for the development of the Dana Point Harbor Revitalization Project. This monitoring plan addresses the underwater sound monitoring required to assess the project's potential effect on marine mammals. The project consists of demolishing existing docks and piles and replacing them within Dana Point Harbor. Construction activities are anticipated to commence in 2021 and will include demolition activities and pile installation by pile driving hammer. Pile installation is planned to be completed during the course of a five year in-water construction schedule. Table 1 shows a summary of the piles being installed.

**Table 1**
**Summary of Pile Installation**

| Project Element | Pile Diameter | Pile Type | Method | Number of Piles/Schedule |
|---|---|---|---|---|
| Inner Basin | 12.75 inches | Steel with HDPE Sleeve | Impact Driver or Waterjet/Pre-drilling | Up to 8 piles per day |
| Inner Basin | 14 inches | Steel with HDPE Sleeve | Impact Driver or Waterjet/Pre-drilling | Up to 8 piles per day |
| Outer Basin | 18 inches | Steel with HDPE Sleeve | Impact Driver or Waterjet/Pre-drilling | Up to 8 piles per day |

## PILE INSTALLATION

The pile driving will consist of the piles being installed primarily using an impact hammer, but prioritizing a vibratory hammer where feasible. Hydroacoustic monitoring will be conducted for a minimum of ten percent of all impact pile driving within the first phase of dock construction.

The monitoring will be done in accordance with the methodology outlined in this Hydroacoustic Monitoring Plan. The monitoring will be conducted to achieve the following:

- Establish the limits of the exclusion zone, which will be the distance between the active pile driving site and the locations where the maximum recorded peak sound pressure level (SPL) or cumulative sound exposure level (SEL) falls below the temporary and permanent threshold shift levels for pinnipeds (TTS and PTS respectively);

- The maximum SPL or SEL thresholds for Phocid and Otariid Pinnipeds where temporary or permanent hearing damage may result will be based on NOAA's most

up-to-date technical guidance, currently National Marine Fisheries Service. 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p.;

- Describe the methods necessary to assess underwater noise including details on the number, location, distance and depth of hydrophones, and associated monitoring equipment; and

- Provide provisions to provide all monitoring data to the Executive Director of the California Coastal Commission within 30 days of completion of the required testing activity.

Two hydrophone systems are proposed to record the sound levels at multiple locations and determine the extent that sound levels decrease spatially, but at a minimum at the far oceanside corners of the harbor dock infrastructure on both the East and West sides to determine the maximum exclusion zones appropriate during the pile driving activities taking place anywhere within the harbor. The chosen sites will capture a representative amount of readings necessary to identify changes in bathymetry and substrate.

During the testing phase a preliminary exclusion zone 500 feet from the harbor terminus shall be used and adjusted if, during testing, the SPL or SEL threshold is exceeded beyond the 500-foot exclusion zone and/or if the marine mammal monitor observes dead or injured fish within the vicinity of pile driving operations. The testing area shall be created at the furthest location from typical pinniped haul-out within the harbor. One hydrophone will be located 10 meters (33 feet) from the pile being driven and the second hydrophone will be located 124 meters (408 feet) from the pile being driven as well as representative areas to determine hydroacoustic changes relative to changes in bathymetry and substrate. The second hydrophone will be used to determine if the cumulative SEL is in compliance with the levels necessary to establish the exclusion zone and may be moved either further out or closer in depending on the levels measured.

**CHARACTERISTICS OF UNDERWATER SOUND**

Several descriptors are used to evaluate underwater noise impacts. Two common descriptors are the maximum recorded peak sound pressure level (SPL) and the cumulative sound exposure (SEL). The peak pressure is the instantaneous maximum or minimum overpressure observed during each pulse and can be presented in Pascals (Pa) or decibels (dB) referenced to a pressure of 1 microPascal (µPa). Since water and air are two distinctly different media, a different sound pressure level reference pressure is used for each. In water, the most commonly used reference pressure is 1 µPa, whereas the reference pressure for air is 20 µPa. For comparison, an underwater sound level of equal perceived loudness would be 62 dB higher to a comparable sound level in air.

The cumulative sound exposure level (SEL) for non-impulsive sounds has a reference value of $1\mu Pa^2s$. SEL, frequently used for human noise exposures, is now used as a metric to quantify impacts to marine mammals. SEL is calculated by summing the cumulative pressure squared ($p^2$) over the measurement duration, integrating over time, and normalizing to 1 second. This metric accounts for both negative and positive pressures because $p^2$ is positive for both negative and positive pressure and thus both are treated equally in the cumulative sum of $p^2$. The units for SEL are dB re: 1 microPascal$^2$-sec. ($1\,\mu Pa^2$-sec).

**METHODOLOGY**

One hydrophone will be placed at mid water depth at the nearest distance, at approximately 10 meters (33 feet) depending on site conditions, from each pile being monitored. An additional hydrophone will be placed at mid water depth at a distance of 124 meters (408 feet) from the pile, to provide two sound level readings during ambient and pile driving recording. The 10-meter (33-foot) and the 124-meter (408-foot) locations will be monitored live to determine compliance with permit conditions. A weighted tape measure will be used to determine the depth of the water. The hydrophones will be attached to a nylon cord or a steel chain if the current is swift enough to cause strumming of the line. One end of the nylon cord or chain will be attached to an anchor that will keep the hydrophone at the specified distance from the pile. The opposite end of the nylon cord or chain will be attached to a float or tied to a static line at the surface at the specified recording distance from the pile. The distance will be measured by a tape measure, where possible, or a range finder. To the extent practicable, there will be an unobstructed path between the pile and the hydrophones.

Ambient underwater sound levels will be measured for at one full 24-hour cycle in the absence of construction activities, to determine background sound levels.

Underwater sound levels will be continuously monitored during the entire duration of each pile being driven. Peak levels of each strike will be monitored in real time. Sound levels will be measured in decibels.

Prior to and during the pile driving activity, environmental data will be gathered including, but not limited to, wind speed and direction, air temperature, water depth, wave height, weather conditions, and a description of any observable fish and marine mammal behavior that took place during the hydroacoustic testing activities. Start and stop time of each pile driving event will be recorded as well.

Table 2 details the equipment that will be used to monitor underwater sound pressure levels.

The project manager will supply the hydroacoustics specialist with the substrate composition, hammer model, and size; depth the pile is driven and blows per foot for the piles monitored. Hammer energy settings will also be recorded by the project manager, as well as any changes made to those settings during the pile monitoring period.

**Table 2**
**Equipment for Underwater Sound Monitoring**

| Item | Specifications | Quantity | Usage |
|---|---|---|---|
| Hydrophone | Minimum Sensitivity – 211 dB ± 3 dB re 1 V/µPa | 2 | Capture underwater sound pressures and convert to voltages that can be recorded/analyzed by other |
| Signal Conditioning Amplifier | Amplifier Gain – 0.1 mV/pC to 10 V/pC Transducer Sensitivity Range – $10^{-12}$ to $10^{3}$ C/MU | 2 | Adjust signals from hydrophone to levels compatible with recording equipment. |
| Calibrator (pistonphone- | Accuracy – IEC 942 (1988) Class 1 | 1 | Calibration check of hydrophone in the field. |
| SLM and Solid State Recorder | Sampling Rate – 48K Hz or greater | 2 | Measures and Records data. |
| Laptop computer | Compatible with digital analyzer | 1 | Store digital data on hard drive. |
| Post-analysis | Real time Analyzer – | 1 | Monitor real-time signal and post-analysis of sound signals. |

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

**EQUIPMENT**

Measurements will be made using hydrophones that have a flat frequency response and are omni-directional over a frequency range of at least 10 to 20,000 Hertz (Hz). For example, a G.R.A.S. CT-10 hydrophone with PCB in-line charge amplifiers (Model 422E13) and PCB Multi-Gain Signal Conditioners (Model 480M122) or equivalent systems could be used to measure sound pressures that pile driving could generate. The signals will be fed into Larson Davis Model 831 Integrating Sound Level Meters (SLM). Quality recordings using a digital audio recorder would be made during attended measurements.

The SLM will be used to establish the cumulative SEL zone and to approximate the exclusion zones in the field.

The SPL and SEL will be measured using an SLM. The SLM has the ability to measure the Z-weighted peak sound pressure levels over the relative short periods (e.g., time constant of 35 milliseconds). The SLM can closely approximate the unweighted SEL of each pile strike by measuring the 1-second equivalent sound energy level ($L_{eq\ (1\text{-}sec)}$) using the linear integration setting. The SLM also approximates the unweighted $RMS_{90\%}$ (where the time period containing 90% of the energy is used in the integration) of each pile strike by measuring the maximum (using the $L_{max}$ setting) with the SLM detector set to Z-weighted "impulse." Note that underwater pile strike acoustic events have durations typically between 50 and 100 milliseconds, so use of the "impulse" setting to approximate sound pressure levels for impact

pile strikes would likely provide a higher level.

All measurement equipment used would be required to have a frequency response of ±1 dB from 10 Hz to 20,000 Hz over the anticipated measurement range of 170 to 220 dB linear peak re: 1 µPa. Hydrophones of different sensitivities may be required depending on the acoustic environment.

**CALIBRATION**

Calibration of measurement systems shall be established prior to use. An acoustical piston phone and hydrophone coupler would be used along with manufacturer calibration certificates. Calibration of measurement systems would be established as follows:

- Use an acoustically certified piston phone and hydrophone coupler that fits the hydrophone and that directly calibrates the measurement system**.** The volume correction of the hydrophone coupler using the hydrophone is known so that the piston phone produces a known signal that can be compared against the measurement system response**.** The response of the measurement system is noted in the field book and applied to all measurements.

The SLMs are calibrated to the calibration tone prior to use in the field. The tone is then measured by the SLM and is recorded on to the beginning of the digital audio recordings that will be used. The system calibration status would be checked by measuring the calibration tone and recording the tones. The recorded calibration tones are used for subsequent detailed analyses of recorded pile strike sounds.

All field notes would be recorded in water-resistant field notebooks. Such notebook entries would include operator's name, date, time, calibration notes, measurement positions, pile-driving information, system gain setting, and equipment used to make each measurement.

The equipment will be calibrated and set to properly measure sounds in the proper range; that is, pile-driving sounds will not overload the instrumentation and the noise floor of the instrumentation is not set too high that pile-driving sounds above 170 dB peak cannot be properly measured.

**REPORTING**

The hydroacoustic data consisting of SPL and SEL levels will be submitted to the Executive Director of the California Coastal Commission within 30-days after completion of the hydroacoustic testing activities for their review and shall include:

- A description of all pile driving activities;
- A description of the acoustic monitoring equipment and protocols that were used during the pile driving activities;
- The results of the hydroacoustic monitoring;

- Based on the foregoing, a determination of the necessary marine mammal exclusion zone(s) to be implemented during future pile driving activities; and
- A description of any observable fish and marine mammal behavior that took place during the hydroacoustic testing activities.