ACOUSTIC and MARINE PROTECTED SPECIES INTERIM MONITORING REPORT FOR THE NAVY'S PIER 6 REPLACEMENT PROJECT

AT

NAVAL BASE SAN DIEGO, CALIFORNIA

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Naval Facilities Engineering Systems Command Southwest

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Prepared for:

Naval Facilities Engineering Command Southwest
NAVFAC SW – EV Core

750 Pacific Highway, Floor 12

San Diego, CA 92132-0058
Point of Contact: Mr. Todd McConchie, Natural Resources Specialist

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Prepared by:

Tierra Data Inc.
10110 W. Lilac Road
Escondido, California 92026

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1.0 Introduction

This interim report summarizes the protected species monitoring efforts that the U.S. Navy (Navy) was required to undertake during the construction of the Pier 6 Replacement Project (Project) at Naval Base San Diego (NBSD), California (Figure 1-1). Marine mammal and acoustic monitoring efforts were conducted in accordance with the Marine Mammal Protection Act (MMPA) Incidental Harassment Authorization (IHA) issued by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) for the incidental take of California sea lions (*Zalophus californianus*). The current IHA covers all available working days from October 1, 2021 through September 30, 2022. This report summarizes results from both the protected species and acoustic monitoring efforts between October 14, 2021 and June 22, 2022. During this timeframe, Project activities covered under the IHA included the removal of all old Pier 6 structural and fender piles, as well as the installation of structural piles for the new Pier 6. This report fulfills the IHA requirement to, in the event that in-water work will not be completed by the end of the IHA time period, submit a preliminary monitoring report 60 days prior to the end of the IHA time period and request a one-year renewal of the current IHA.

Incidental take was expected as a result of the Project. Table 1-1 presents the total authorized take for California sea lions, as well as the documented take for the Project thus far. At the time that the IHA was issued, no other marine mammal species were expected to occur in the Project area with any regularity.

Table 1-1. Authorized and Observed Amount of Taking by Level A/B Harassment, by Species and Stock.

Species & Stock	Authorized Take 01 Oct 2022 - 30 Sep 2022		Documented Take 14 Oct 2021 - 22 Jun 2022	
	Level A	Level B	Level A	Level B
California sea lion (*Zalophus californianus*) U.S. Stock	0	1000	0	14

Protected Species Observers (PSOs) observed additional MMPA species as part of the monitoring effort, including harbor seals (*Phoca vitulina*), coastal bottlenose dolphins (*Tursiops truncatus*), as well as Endangered Species Act (ESA)-listed green sea turtles (*Chelonia mydas*). In coordination with NOAA, the Navy adopted a zero-take approach for marine mammal species by observing the following protocols: in the event that these species were observed to be potentially entering the established zone of influence (ZOI) for an IHA-covered underwater construction activity, noise-generating in-water activities were delayed from starting, or shut down, until the animal(s) was observed leaving the applicable Level B ZOI, or on hour had passed since the last observation. The Navy and NMFS have a current ESA Programmatic Agreement that outlines monitoring protocols for green sea turtles and these were followed for all turtle observations.

As of June 22, 2022, all in-water demolition of the old Pier 6 and pile installation of structural piles for the new Pier 6 was completed. Fender-pile driving is scheduled to occur over 54 days starting in late November or early December 2022 and continue until February 2023. Further

monitoring will be necessary to complete this work and will require the renewal of the existing IHA.

1.1 Project Description

1.1.1 Project Location

The Project includes replacement of Pier 6 at NBSD in San Diego Bay (Figure 1-1). Constructed by the Navy in 1945, original Pier 6 was functionally obsolete and operationally constrained given its inadequate utilities capacity, load restrictions, and inadequate deck size to support current and projected ship berthing operations. A floating security fence surrounds the various piers at NBSD (Figure 1-1).

1.1.2 Project Activities

The proposed demolition and construction activities at Pier 6 locations are summarized in Table 1-2. These proposals were the activities that were covered under the IHA Monitoring Plan for Pier 6 (Naval Facilities Engineering Command [NAVFAC] 2020).

Table 1-2. Proposed Activity Summary for Pile Driving and Demolition Activities.

Method	Pile Type	Number of Piles	Piles/ Day	Total Estimated Days
Demolition Activities				
Vibratory Extraction High-pressure Water Jetting Hydraulic Pile Clipper Hydraulic Chainsaw	20-in Square Concrete Piles 24-in Square Concrete Piles	1,833	**8**	**250**
	12-in Composite (Timber-Plastic) Piles	149		
Vibratory Extraction	16-in I-shaped Steel Piles	16		
	Total	**1,998**		
Construction Activities				
Impact Pile Driving	24-in Octagonal Concrete Test Piles	15	**7**	**138**
	24-in Octagonal Concrete Structural Piles	513		
	24-in Square Concrete Fender Test Piles	4		
	24-in Square Concrete Fender Piles (Primary)	204		
	20-in Square Concrete piles (Load-out Ramp Cradle)	4		
	16-in Fiberglass Fender Piles (Secondary & Corner)	226		
High-pressure Water Jetting	20- and 24-inch Concrete Piles	Within Above Counts		
	Total	**966**		

Note: High-pressure water jetting may be used to assist pile installation/extraction and a hydraulic cutter may be used to clip piles at the mudline.

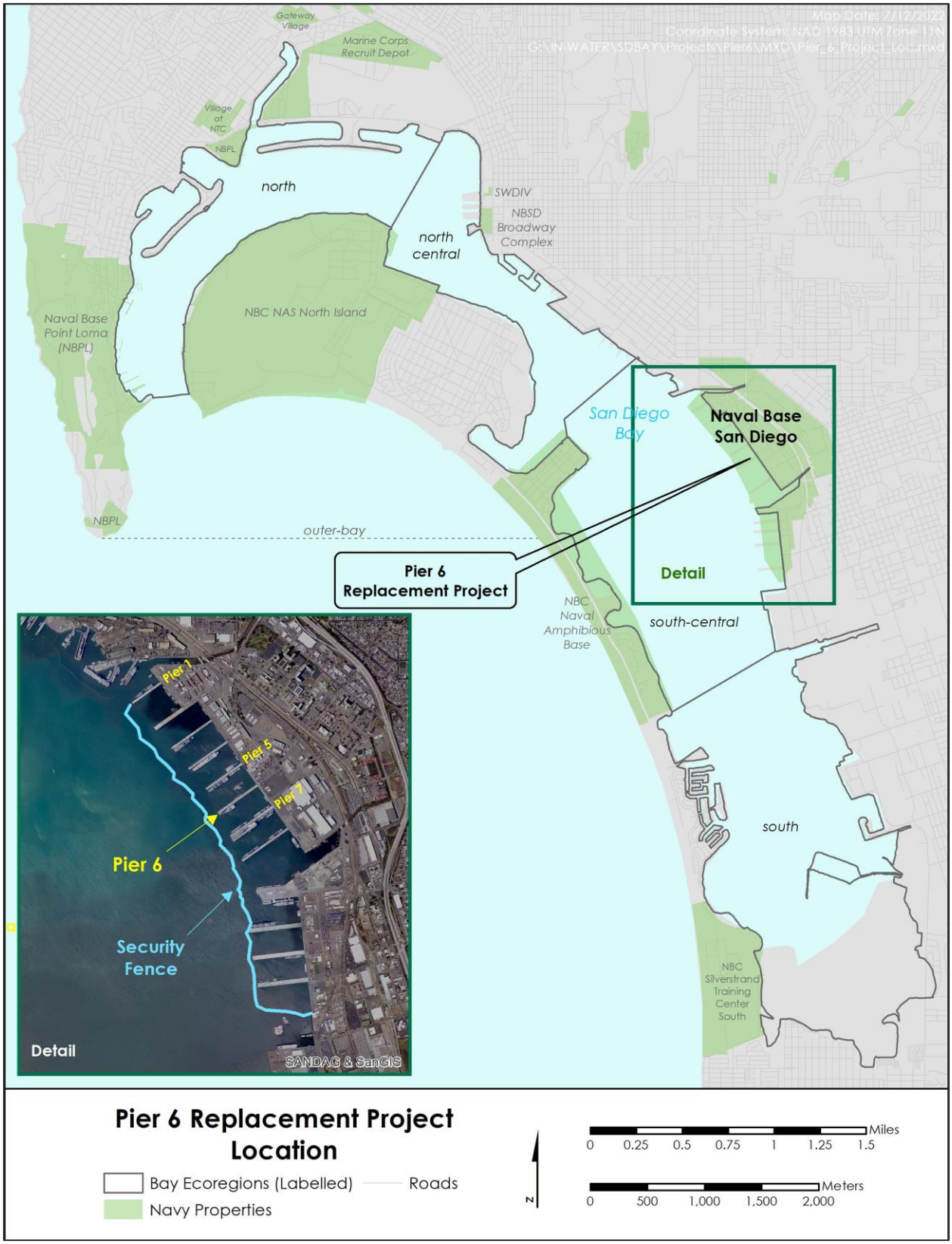

Figure 1-1. Regional Location of the Fuel Pier Replacement Project.

Table 1-3 presents construction and demolition activities that have occurred to date.

Table 1-3. Completed Activity Summary for Pile Driving and Demolition Activities.

Method	Pile Type	Number of Piles	Avg. Piles/ Day	Total Days
Demolition Activities				
Vibratory Extraction High-pressure Water Jetting Hydraulic Pile Clipper	24-in Square Concrete Fender Piles	160	**26**	**70**
	20-in Square Concrete Fender Piles (Quay Wall)	6		
	20-in Octagonal Concrete Fender Piles (Quay Wall)	6		
	24-in Octagonal Concrete Test Piles	9		
	20-in Square Concrete Structural Piles	1,654		
	Total	**1,835**[1]		
Construction Activities				
Impact Pile Driving	24-in Octagonal Concrete Test Piles	9	**8**	**62**
	24-in Octagonal Concrete Structural Piles	517		
High-pressure Water Jetting	24-in Octagonal Concrete Piles	Within Above Counts		
	Total	**526**		

Note:

[1] Note that the total observed piles removed (1,835 piles) exceeds by 2 the proposed number of 20-in and 24-in piles identified in Table 1-2 (1,833 piles). This is likely due to command PSOs double counting piles as a result of difficulties encountered when viewing/tracking the large number piles removed during the course of demolition activities at Pier 6.

2.0 Monitoring Methods

2.1 Marine Species Monitoring

As per the IHA monitoring plan (NAVFAC 2020), PSOs monitored the buffered shutdown zone and ZOIs for each relevant activity during all days of in-water construction that has the potential to result in Level A or Level B harassment.

2.1.1 Level A and Level B Harassment Monitoring and Shutdown Zones

Maximum potential distances to Level A and Level B acoustic harassment associated with the actual pile driving and removal activities at Pier 6 are provided in Table 2-1 and shown on Figure 2-1. All Level A ZOIs were less than 10 (33 ft) based on calculations associated with either a site-specific model or calculations from the NMFS Level A spreadsheet (Table 2-1; NMFS 2018). Although Figure 2-1 depicts the 10 m (33 ft) "Physical Interaction Shutdown ZOI," the Navy applied a 20-m (66-ft) buffered shutdown area to account for the swimming speed of marine mammals and be consistent with other shutdown zones to be implemented for the Project (i.e., 20 m [66 ft] green sea turtle shutdown zone).

Table 2-1. Calculated Distance to Underwater Acoustic Thresholds and ZOIs within the Thresholds from Pile Driving and Removal.

Activity Description/ Source Sound Levels at 10 m (33 ft)	Minor Injury (PTS Onset) Level A[1]		Behavioral Disturbance Level B[2,3]	
	Radial Distance (m)	ZOI Area (km^2)	Maximum Length x Width or Radial Distance (m)	Total ZOI Area (km^2) (Open Water / Around Piers)
Demolition Activities				
Vibratory pile extraction 20-inch and 24-inch concrete[4], 160 RMS	<10	<0.001	6,990 x 1,173	5.35 (4.06 / 1.29)
Hydraulic pile clipper, concrete[5], 161 RMS	<10	<0.001	2,154	7.7 (6.5 / 1.2)
Installation Activities				
Impact driving 20- and 24-inch concrete[4,6], 188 PEAK, 176 RMS, 166 SEL	<10	<0.001	192	0.10 (0.10 / NA)

Notes:

[1] Assumes 600 strikes per pile, 10-minute duration for all non-impulsive sounds except for high-pressure water jetting (20-minute), and seven piles installed and eight piles removed per day

[2] Level B ZOIs were calculated to the average ambient underwater noise value of 126 dB re 1 µPa within the project area (Dahl and Dall'Osto 2019).

[3] Level B ZOI areas were calculated separately for open water versus areas around piers where the structure's influence on sound propagation is uncertain; slight variations between these estimated values and those presented in other documentation result from rounding at the hundredths level.

[4] Distances to Level A and B thresholds were calculated for impact and vibratory pile driving or extraction using acoustic models developed for South-Central San Diego Bay (Dall'Osto and Dahl 2019) and source data from Caltrans (2015). The distances to the Level A SEL_{cum} threshold are adjusted for the representative frequency range of Otariid functional hearing group. The Level B ZOIs for impact pile installation and vibratory pile extraction are based on the 160 dB threshold and distance to ambient levels (126 dB), respectively.

[5] For pile installation/extraction activities using other equipment (water jetting, pile clippers, chain saw), the 2020 NMFS User Spreadsheet was used to calculate distances to the Level A SEL_{cum} threshold and practical spreading loss model was used to calculate distances to Level B thresholds. Weighting Factor Adjustments of 2 kHz for impact pile driving and 2.5 kHz for non-impulsive sounds, and the representative frequency range for Otariid functional hearing group were used (NMFS 2012).

[6] Impact driving values as reported in Dall'Osto and Dahl 2019.

Abbreviations:

dB re 1 µPa = decibels referenced to a pressure of 1 microPascal; km^2 = square kilometers, m = meters; N/A = not applicable because the ZOI is contained within the shutdown zone (less than 10 m [33 ft] from source); PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level; ZOI = Zone of Influence (area encompassed within acoustic threshold boundary).

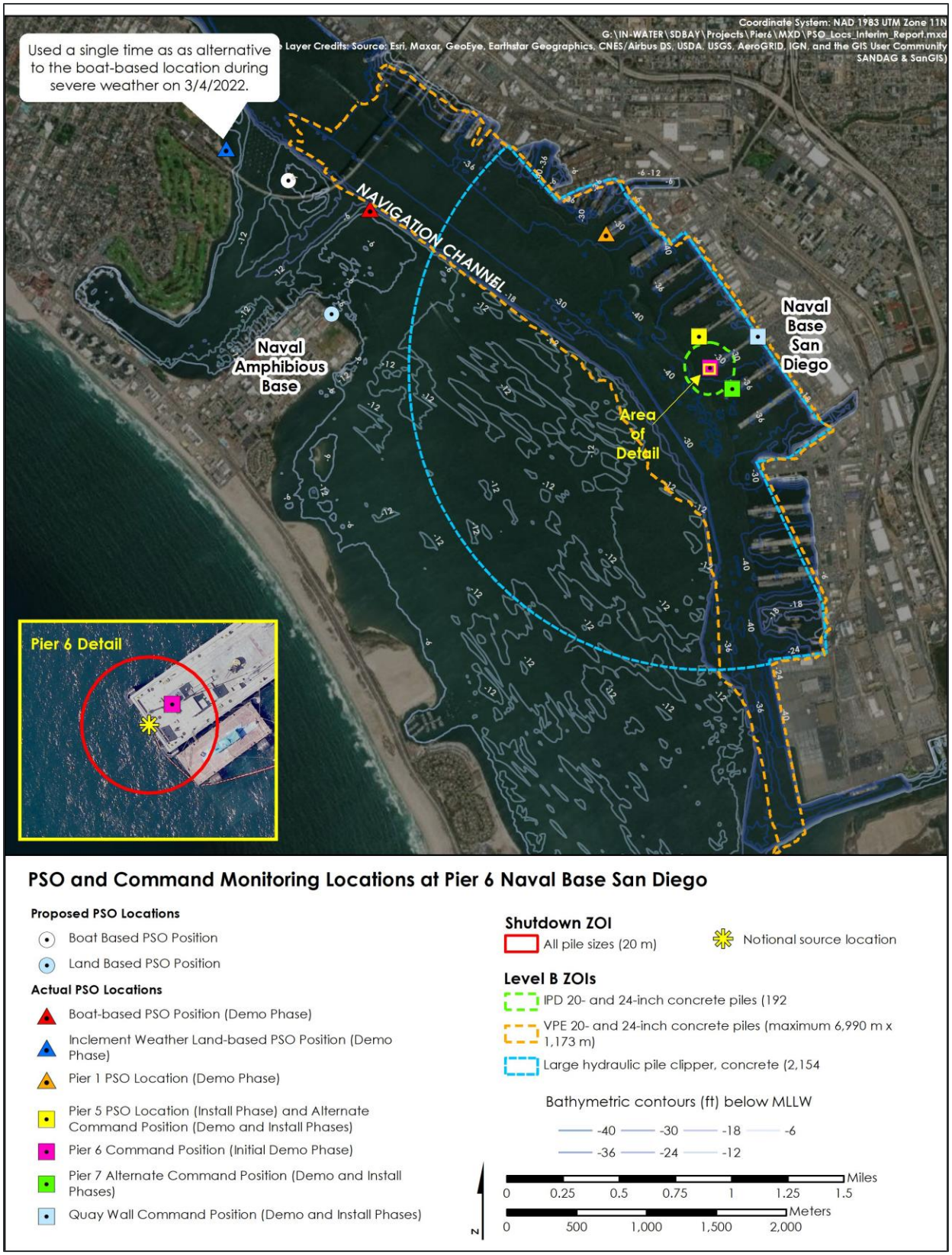

Figure 2-1. PSO/Command Positions and Monitored ZOIs.

2.1.2 Monitoring Periods

PSOs conducted pre-activity monitoring hereinafter referred as "Pre-Con" for at least 30 minutes prior to the commencement of in-water construction activities. PSOs conducted during activity monitoring of both active pile extraction and pile installation, as well as in-between active construction monitoring, herein referred to as "Pre-/Post-." Once construction was complete for the day, PSOs conducted post-activity monitoring referred to herein as "Post-Con" for a total of 30 minutes.

2.1.3 Monitoring Zones and PSO Locations

Figure 2-1 presents the ZOIs and the PSO locations for demolitions and construction activities monitored thus far. These ZOIs were set forth in the Pier 6 IHA monitoring plan (NAVFAC 2020). The ZOI for clipping piles was determined using NMFS Technical Guidance (NMFS 2018), including the NMFS User Spreadsheet and practical spreading loss model (NAVFAC 2020). The ZOIs for impact and vibratory pile driving/extraction were created using acoustic models developed for the South-Central region of San Diego Bay (Dall'Osto and Dahl 2019). The models consider local environmental conditions (bathymetry, sediment type, seasonal water temperatures) and the physiography of the bay.

The Pier 6 monitoring plan (NAVFAC 2020) provided "representative" PSO locations. The PSO locations presented in Figure 2-1 differ somewhat from the monitoring plan in the following ways:

- The location for the boat-based PSO monitoring vibratory pile extraction was moved south of the Coronado Bridge to provide a more sheltered anchorable vantage point. This location provided a more complete view to the clipping ZOI's northern extent (see Figure 2-1) allowing PSOs to monitor animals as they transited south (into) or north (out of) this liminal zone.
- A second land-based PSO was originally slated to monitor from Naval Amphibious Base (NAB). Since the boat-based PSO had been moved south, closer to NAB, it obviated the need for a NAB land-based position. Alternatively, this PSO position was moved east, across the channel to Pier 1. The Pier 1 location not only offered more a distinct viewshed, but also allowed the PSO to monitor from an elevated position, greatly enhancing the distance to which animals could be located and tracked. This position was able to not only easily observe hauled out pinnipeds on the NBSD security fence and navigation buoys, but also track small pods of coastal bottlenose dolphins well into the South Bay. This positioning, which provided overlapping viewsheds allowed PSOs to competently pass animals between monitors without fear of losing them.
- Due to safety concerns with being on the pier or the construction barges during pile extraction/installation, the Command position would sometimes move to adjacent piers or the quay wall (depending on where the in-water work was taking place) to observe the shutdown zones. However, they were in contact with the barge via radio at all times. In the event that there were two concurrent activities, two Command PSOs were placed at the best location to observe the specific shutdown zones.

2.1.4 Project Staffing

Staff included the Project manager (PM), on-site field supervisor (FS), database administrator (DA), PSOs, acoustic technicians (ATs), and boat drivers (BDs) (Table 2-2). PSOs were experienced in

marine species identification and were approved by the Navy as well as NMFS. Furthermore, prior to beginning their observations, all PSOs received training on identifying the marine species likely to be present in San Diego Bay, the specifics of the ZOIs, and the Project activities likely to occur. Prior to all Project-related activities, ATs were trained on how to use the acoustic data logging equipment as well as how to run analyses on the data collected.

Table 2-2. Project Staff.

Company/Organization	Name	Role(s)
Tierra Data, Inc.	Karen Green	PM
	Robert Wolf	APM, DA, CC
	Jenna Walls	Primary FS, PSO, AT, DA, CC
	Jim Kellogg	PSO, BD, AT
	Daniel Conley	PSO, BD, AT, FS
	Madison Delgado	PSO
	Danielle Hankins	PSO, FS
	Joseph Kean	PSO
	Beth Sabiston	PSO, FS
	Scott Snover	PSO
	Rachel Tuck-Mayoras	PSO
	Sienna Santiago	PSO
	Harry Smead	BD
	Calley Roter	BD
Marine Taxonomic Services	Hannah Tannenbaum	PSO, BD, FS
	Erik Mahan	PSO, BD
	Grace Teller	PSO, BD
	Matthew Forest	PSO
	Raelynn Heinitz	PSO
University of Washington	Peter Dahl	Acoustics Consultant

PM = Project Manager; APM = Assistant Project Manager; PSO = Protected Species Observer; FS = Field Supervisor; AT = Acoustic Technician; BD = Boat Driver; DA = Database Administrator; CC = Company Contact.

2.1.5 Shutdown and Delay Procedures

If a California sea lion entered the buffered shutdown zone during pile driving or extraction operations, pile demolition or installation was to be either: 1) halted if in demolition or installation was in progress, or 2) delayed if demolition or installation was not currently active, but imminent. A shutdown or delay was in place until either the animal had voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes had passed without a re-detection of the animal(s) from the last observation time.

If a marine mammal species not covered in the IHA entered the Level B harassment zone, all pile driving or removal activities were to be halted until the animal(s) had been either observed to have left the Level B ZOI, or was not observed for at least one hour.

2.2 Acoustic Monitoring

2.2.1 Hydroacoustic Monitoring Equipment

Three separate hydroacoustic measurement systems were available to collect underwater acoustic data during demolition and installation activities (Table 2-3). The two Applied Physics Laboratory-University of Washington (APL-UW) Underwater Sound Level Meters (USLM) each used a High Tech, Inc. (HTI) 96-min hydrophone, one with 180 dB re: 1V/µPa sensitivity and the other with 200.9 dB re: 1V/µPa sensitivity. They were used initially as the primary acoustic measurement devices to collect real-time acoustic data at source and far-field locations. When it was determined that one of the Hydro dB USLMs developed technical issues, a Larson Davis (LD) 831 USLM fitted with a RESON TC-4033 hydrophone was employed to record acoustic data as a second unit, if needed.

Table 2-3. Hydroacoustic Data Collection Equipment.

Make	Model	Hydrophone
APL-UW USLM	Custom (SN#002 & SN#006)[1]	HTI 96-min
Larson Davis	831	RESON TC-4033
ETMC Technologies (Pistonphone)	42AC	N/A

Note:
[1] Two separate units were employed using the same parameters.

2.2.2 Instrument Calibration

Individual HTI and RESON hydrophones were calibrated at least once per week. Calibrations were made using an ETMC 42AC pistonphone equipped with a custom coupler designed for a 96-min hydrophone. The pistonphone generates a consistent 100 Pascal signal and calibrations were made at 163.9 dB re 1 µPa at 250 Hz for each hydrophone.

2.2.3 Hydroacoustic Data Collection

Underwater Sound Pressure Levels (SPLs) were recorded at, or as safely and practically close to, 10 m (33 ft) for demolition and installation activities (i.e., source measurements), as well as at various distances from the source of the noise (far-field measurements). All data were collected from a vessel at anchor, piers, or the quay wall near the Project area. Vessels were used when collecting data from a pier- or quay wall-based position was impractical due to safety concerns, or the distances required to collect relevant data. In all cases, regardless of hydrophone location, the measurements were recorded at a depth equal to half of the water depth, and the GPS positions logged for each individual sound recording file. During all vessel-based acoustic recordings, the vessel's engine was turned off and the hydrophones were deployed so that minimal influence from the deployment process would interfere with the data collection. Two ATs collected data concurrently, to the greatest extent possible, with the first co-located most often with the pier-based "Command" position and the second using a vessel to collect far-field data. On one occasion two vessels were used at far-field but with one nearer to source than the other.

When using the APL-UW USLM, the hydroacoustic measurements were recorded using either the "impact" setting (i.e., during impact pile driving) or "vibratory" setting (i.e., vibratory pile driving, or other non-impulsive noise sources).

The LD 831 provides LZ metrics, which are unweighted SPLs. The only metric analyzed during monitoring was LZF_{max}, which represents the maximum root mean square recorded for any 125-millisecond time frame during each individual recording and is considered equivalent to the dB RMS values attained post processing from the APL-UW USLM.

2.2.4 Acoustic Data Management

Acoustic information was documented on hardcopy forms and then transferred to a Microsoft (MS) Excel database. Information collected included: AT name, observation date/time, station, general morning/afternoon weather information (wind, waves, and air temperature), pile number, hydrophone latitude/longitude, hydrophone depth, water depth, start/end time of activity, and type of activity. Data records were double-checked during data entry and printed copies for each day were archived with the original field data forms. Blow counts for impact pile driving were provided by the construction contractor and were also added to the database, if appropriate. All APL-UW USLM raw acoustic files were saved as *.BIN files and converted to *.TXT files, which were imported into MS Excel where mean and median values were calculated for acoustic metrics and maximum values were identified. The raw wave files from the LD 831 were processed using the LD Utility software (v. G4) and imported into MS Excel and similarly evaluated.

Mean, median and maximum metrics were reported for impact pile driving (RMS_{90}, peak, and SEL_{90}) and for vibratory pile driving and other non-impulsive sounds (RMS). SEL_{cum} was computed for individual pile driving events based on single strike SEL_{90} and number of hammer strikes, as defined by the mean single strike SEL + 10*log10 (# hammer strikes) in dB re µPa2-sec. For non-impulsive sounds (i.e., clipping and vibratory extraction) SEL_{cum} was computed for individual extraction events based on the dB RMS and total activity time for the day, as defined by dB RMS + 10*log10 ((sec/pile)*(piles/day)) in dB re μPa^2-sec.

3.0 Monitoring Results

The results of the marine species and acoustic monitoring efforts associated with this Project are presented in Sections 3.1 and 3.2 and detail the data collected during the October through June monitoring period. Appendix A provides the distance and bearing to animals that were considered as Level B Take during active pile removal or installation.

3.1 Monitoring Effort

Over the course of 132 days, the construction contractor completed the pile removal, structural pile installation, and test pile phases of the Project (Table 3-1). A total of 1,823 structural and fender piles were removed though various means and methods over 75 days and a total of 526 piles were installed over 67 days. The Test pile program, which included the installation and then removal of nine piles, occurred over a total of eight days (Table 3-1).

Table 3-1. Pier 6 Construction Activities by Pile Type.

Pile Size/Type	Activity	Method(s)	Total Piles	Date Ranges	Days of Activity[1]
24-in Square Concrete Fender Piles	Demolition	Clip	160	10/14/2021 - 11/4/2021	14
24-in Octagonal Concrete Test Piles (Installation)	Install	IPD	9	10/20/2021 - 10/27/2021	3
20-in Square Concrete Fender Piles (Quay Wall)	Demolition	Clip	6	10/26/2021, 11/4/2021	2
24-in Octagonal Concrete Test Piles (Removal)	Demolition	Clip	9	10/28/2021 - 11/3/2021	5
20-in Octagonal Concrete Fender Piles (Quay Wall)	Demolition	Clip	6	11/4/2021, 3/1/2022	2
20-in Square Concrete Structural Piles	Demolition	Clip/VPE	1,654	1/3/2022 - 3/16/2022	53
24-in Octagonal Concrete Structural Piles	Install	IPD	517	3/22/2022 - 6/22/2022	64

IPD = Impact Pile Driving; VPE = Vibratory Pile Extraction

Note:

[1] Various test-pile, fender-pile, and pile-demolition days overlapped.

3.2 Marine Species Monitoring

Marine species data were collected on 132 days and over 2,400 hours of observer effort (Table 3-2). The level of monitoring effort varied over time as dictated by the construction schedule. Apart from being the months with the greatest number of workdays, January through March represented the busiest period for construction monitoring as days grew longer, and a boat PSO was required on nearly all days during this period (Table 3-2). Moreover, between February 28 and March 3, 2022 two commands were required as both clipping and vibratory pile extraction occurred simultaneously for five days. Beginning on March 22, 2022, construction switched to impact pile driving, which necessitated only a command and a single pier-based PSO as the ZOI shrank significantly (see Figure 2-1).

Table 3-2. Summarized PSO Observation Time by Month and Activity.

Month	Number of Observers per Day[1]	Pre-Con[2]	Pile Extraction[2]	Pile Installation[2,3]	Pre-/Post[2]	Delay[2]	Post-Con[2]	Total Monthly Hours[2]
October	3-4	68:25:53	22:54:30	02:54:23	111:18:43	00:00:00	29:49:41	**235:23:10**
November	3	41:15:00	09:19:09	00:00:00	51:06:27	00:00:00	18:39:27	**120:20:03**
January	3	118:23:33	29:28:54	00:00:00	370:57:03	04:13:12	43:26:39	**566:29:21**
February	3	80:56:27	43:29:36	00:00:00	386:42:18	01:30:06	36:32:03	**549:10:30**
March	3-4	87:07:01	18:00:45	11:46:24	329:01:10	04:39:54	26:31:36	**477:06:50**
April	2	31:35:06	00:00:00	20:58:06	93:33:54	00:00:00	09:30:00	**155:37:06**
May	2	37:44:36	00:00:00	33:24:10	96:12:20	00:00:00	10:00:00	**177:21:06**
June	2	26:06:33	00:00:00	28:52:13	59:25:17	00:00:00	08:00:00	**122:24:03**
TOTAL	**-**	**491:34:09**	**123:12:54**	**97:55:16**	**1498:17:12**	**10:23:12**	**182:29:26**	**2403:52:09**

Notes:
[1] On days when two simultaneous construction activities were taking place, an additional command PSO was required.
[2] All time in hh:mm:ss.
[3] Includes both impact pile driving and impact soft start.
[4] Times presented are the product of the number of observers and elapsed time for each activity of the course of a month

The following sections summarize the protected species that were observed during the monitoring effort from to October 14, 2021 to June 22, 2022. Table 3-3 presents the number of animals observed during the construction activities. Figure 3-1 and Figure 3-2 depict the locations of animals observed as well as the construction activity that coincided with the observation. In all, there were 252 observations of 336 protected animals, excluding resights.

Table 3-3. Species Observed by Construction Activity.

Species	Pile Demolition Monitoring [Individuals (Sightings)]			Pile Driving Monitoring [Individuals (Sightings)]		Non-Construction Monitoring [Individuals (Sightings)]		
	Clipping	VPE	Delay	IPD	Delay	Pre-Con	Pre-/Post-	Post-Con
California sea lion	9 (9)	4 (4)	2 (2)	2 (2)	1 (1)	89 (84)	114 (107)	9 (8)
Coastal bottlenose dolphin	0 (0)	0 (0)	7 (3)	0 (0)	0 (0)	41 (10)	40 (10)	9 (3)
Harbor seal	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)
Green sea turtle	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (4)	2 (2)	0 (0)
TOTAL	**9 (9)**	**4 (4)**	**9 (5)**	**2 (2)**	**1 (1)**	**134 (98)**	**158 (122)**	**18 (11)**

VPE = Vibratory pile extraction; IPD = Impact pile driving; Pre-Con = Pre-construction monitoring; Pre-/Post- = Pre-/Post-construction monitoring; Post-Con = Post-construction monitoring

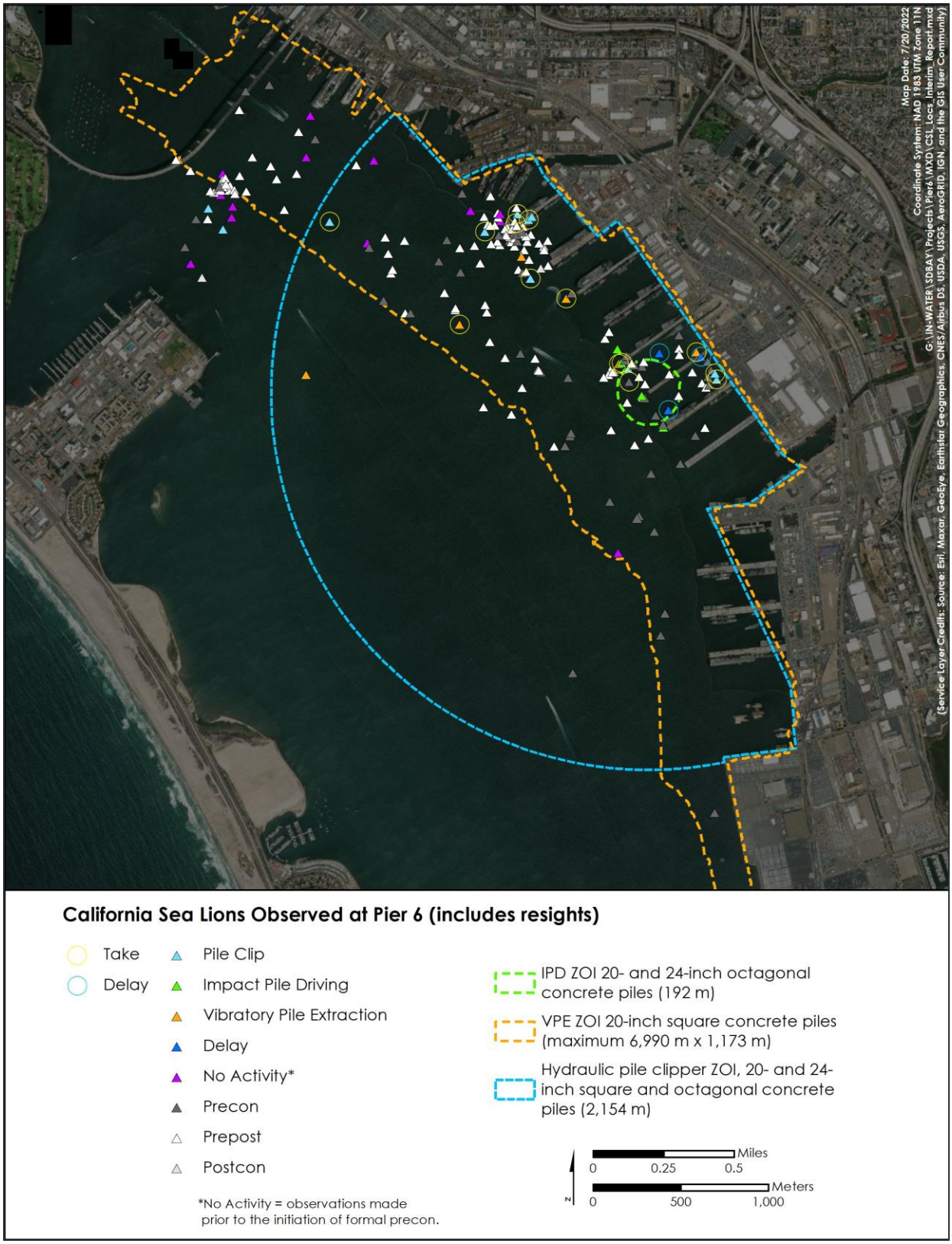

Figure 3-1. All California Sea Lion Observations Recorded During Monitoring.

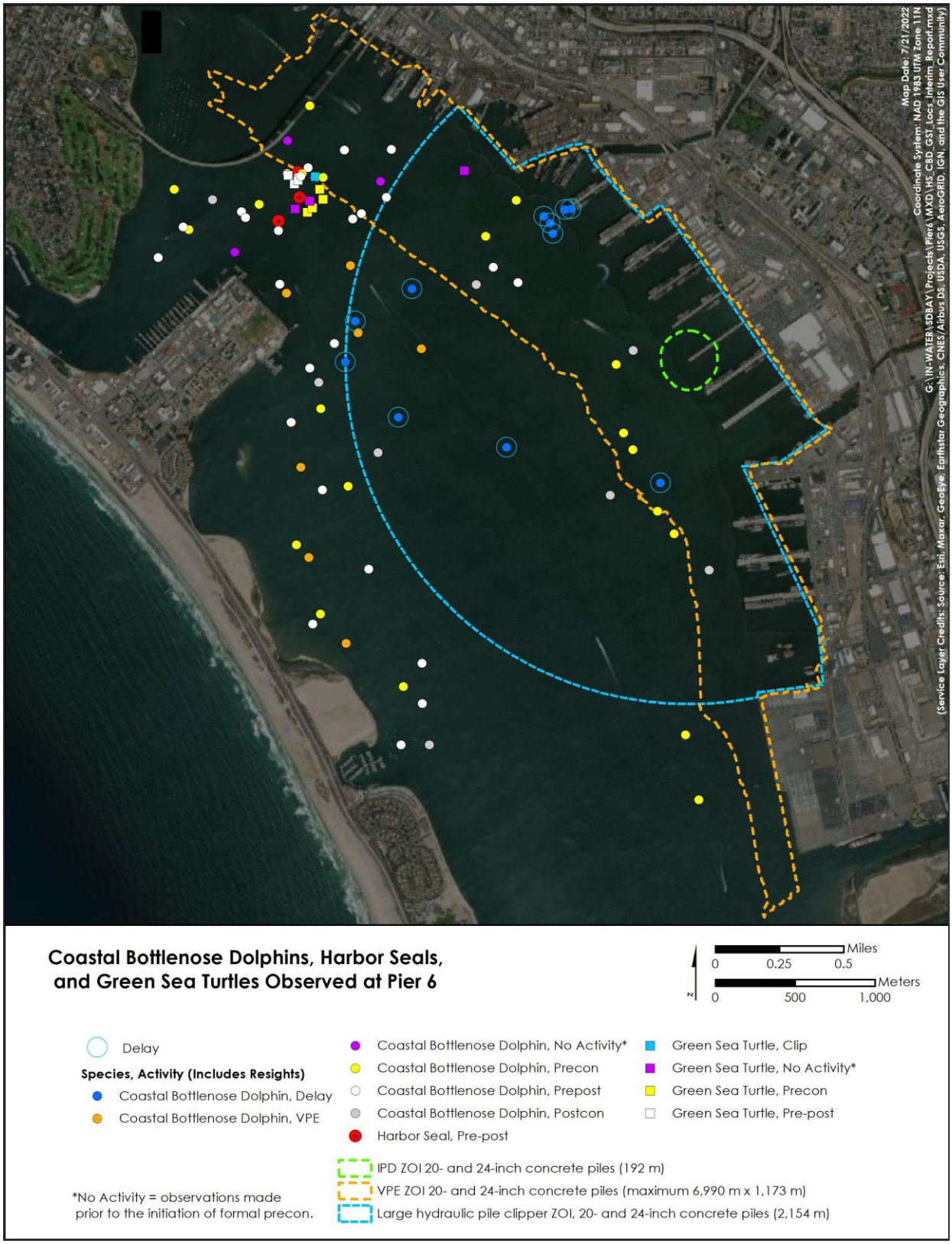

Figure 3-2. All Coastal Bottlenose Dolphin, Harbor Seal, and Green Sea Turtle Observations Recorded During Monitoring.

3.2.1 California Sea Lion

California sea lions were the most frequently observed marine mammal species. Individual or groups were often seen swimming or hauled out on the security fence or navigation buoys. As with all other protected species, except for coastal bottlenose dolphins, this species tended to be observed as single individuals. January, February, and March exhibited the highest numbers of observations, even when normalizing for observer hours. This is likely because of the near daily employment of the boat-based PSO for these months, as well as the pier-based PSO at Pier 1. Table 3-4 presents California sea lion observations.

Table 3-4. California Sea Lion Observations.

Month	Days Monitored	Indiv. Observed	Obs.	Group Size			Avg. Indiv./ Day	Observer Hrs.	Obs./ Observer Hrs.
				Mean	Min	Max			
October	13	11	11	1.00	1	1	0.85	235:23:10	1.122
November	4	1	1	1.00	1	1	0.25	120:20:03	0.199
January	21	97	87	1.11	1	2	4.62	566:29:21	4.110
February	20	64	61	1.05	1	2	3.20	549:10:30	2.797
March	20	42	42	1.00	1	1	2.10	477:06:50	2.113
April	19	6	6	1.00	1	1	0.32	155:37:06	0.925
May	20	6	6	1.00	1	1	0.30	177:21:06	0.812
June	15	3	3	1.00	1	1	0.20	122:24:03	0.588
TOTAL	**132**	**230**	**217**	**-**	**-**	**-**	**1.74**	**2403:52:09**	**2.296**

Indiv. = Individuals; Obs. = Observations; Avg. = Average; Hrs. = Hours

3.2.2 Coastal Bottlenose Dolphin

Coastal bottlenose dolphins were not anticipated in the IHA application for the Pier 6 Project. Once the PSOs started seeing dolphins on a regular basis during demolition activities, the Navy contacted the acoustics consultant Dr. Peter Dahl (University of Washington) to understand the potential for harassment of this species, as well as harbor seals. Dr. Dahl reasoned that the threshold ZOIs for these unanticipated species (High-Frequency Cetaceans) would be smaller than what had been developed for California sea lions (Otariids) in Dall'Osto and Dahl (2019). Therefore, the Navy adopted a conservative approach and decided to continue using the ZOI developed for the California sea lion and apply that for use with coastal bottlenose dolphins and harbor seals. This approach was simple to employ immediately and allowed PSOs to easily enact a zero-take protocol by shutting down or delaying work as the dolphins approached the ZOI developed for California sea lions. Coastal bottlenose dolphins were easy to track from Pier 1, and their presence resulted in PSOs calling delays in late January, early February, and early March. Table 3-5 presents coastal bottlenose dolphin observations.

Table 3-5. Coastal Bottlenose Dolphin Observations.

Month	Days Monitored	Indiv. Observed	Obs.	Group Size			Avg. Indiv./ Day	Observer Hrs.	Obs./ Observer Hrs.
				Mean	Min	Max			
October	13	2	1	2.00	-	2	0.15	235:23:10	0.204
November	4	6	1	6.00	-	6	1.50	120:20:03	1.197
January	21	45	10	4.50	2	6	2.14	566:29:21	1.906
February	20	30	9	3.33	1	6	1.50	549:10:30	1.311
March	20	14	5	2.80	1	5	0.70	477:06:50	0.704
April	19	0	0	-	0	0	0.00	155:37:06	0.000
May	20	0	0	-	0	0	0.00	177:21:06	0.000
June	15	0	0	-	0	0	0.00	122:24:03	0.000
TOTAL	**132**	**97**	**26**	**-**	**-**	**-**	**0.73**	**2403:52:09**	**0.968**

Indiv. = Individuals; Obs. = Observations; Avg. = Average; Hrs. = Hours

3.2.3 Harbor Seal

During monitoring efforts on January 17 and January 18 one harbor seal was observed each day. Both of these observations were made during a Pre-/Post- period, outside of the clipping ZOI. Refer to the coastal bottlenose dolphin section above regarding the approach the Navy took to enacting a zero-take approach to harbor seals. Table 3-6 presents harbor seal observations.

Table 3-6. Harbor Seal Observations.

Month	Days Monitored	Indiv. Observed	Obs.	Group Size			Avg. Indiv./ Day	Observer Hrs.	Obs./ Observer Hrs.
				Mean	Min	Max			
October	13	0	0	-	-	-	0.00	235:23:10	0.000
November	4	0	0	-	-	-	0.00	120:20:03	0.000
January	21	2	2	1.00	1	1	0.10	566:29:21	0.085
February	20	0	0	-	-	-	0.00	549:10:30	0.000
March	20	0	0	-	-	-	0.00	477:06:50	0.000
April	19	0	0	-	-	-	0.00	155:37:06	0.000
May	20	0	0	-	-	-	0.00	177:21:06	0.000
June	15	0	0	-	-	-	0.00	122:24:03	0.000
TOTAL	**132**	**2**	**2**	**-**	**-**	**-**	**0.02**	**2403:52:09**	**0.020**

Indiv. = Individuals; Obs. = Observations; Avg. = Average; Hrs. = Hours

3.2.4 Green Sea Turtle

Green sea turtles are known to inhabit the south-bay ecoregion. All green sea turtles that were observed by the boat-based PSO, outside of the clipping ZOI, and/or prior to, or during the pre-construction survey, or during Pre-/Post- periods. These animals were predominantly observed in mid-October (five individuals) and then only once more in February (one individual). Table 3-7 presents green sea turtle observations.

Table 3-7. Green Sea Turtle Observations.

Month	Days Monitored	Indiv. Observed	Obs.	Group Size			Avg. Indiv./ Day	Observer Hrs.	Obs./ Observer Hrs.
				Mean	Min	Max			
October	13	5	5	1.00	-	1	0.38	235:23:10	0.510
November	4	0	0	-	-	-	0.00	120:20:03	0.000
January	21	0	0	-	-	-	0.00	566:29:21	0.000
February	20	1	1	1.00	-	1	0.05	549:10:30	0.044
March	20	0	0	-	-	-	0.00	477:06:50	0.000
April	19	0	0	-	-	-	0.00	155:37:06	0.000
May	20	0	0	-	-	-	0.00	177:21:06	0.000
June	15	0	0	-	-	-	0.00	122:24:03	0.000
TOTAL	**132**	**6**	**6**	**-**	**-**	**-**	**0.05**	**2403:52:09**	**0.060**

Indiv. = Individuals; Obs. = Observations; Avg. = Average; Hrs. = Hours

3.2.5 Delays During Monitoring Efforts

A total of ten delays and zero shutdowns occurred during the monitoring efforts (Table 3-8, see Figure 3-1 and Figure 3-2). The total time of all delays was just over 3 hours 55 minutes, and the delays averaged 23 minutes 30 seconds across all delays. The occurrence of California bottlenose dolphins prompted a majority of the shutdowns (80%). This species was not observed on the Project after the delay on March 11, 2022.

3.2.6 Distance and Bearing

The distances and bearings of each marine mammal observed during pile driving or removal is provided in Appendix A.

Table 3-8. Delays in Project Activities Due to Protected Species Observed Within the Shutdown Zone at Pier 6.

Date	Species	Number of Individuals	Start	Stop	Duration	Delayed Activity	Description
1/25/2022	CSL	2	10:55:37	11:10:37	00:15:00	Demo (Clip)	2 CSL approached 20 m shutdown at 1055 during a Pre-/Post- and prompted a delay. CSL were not seen leaving so 15 minute delay was imposed. Delay ended at 1110. Crew resumed clipping at 1115.
1/31/2022	CBD	3	07:45:36	08:55:00	01:09:24	Demo (Clip)	Near the end of the morning's Pre-Con, PSOs called for a delay when 3 CBD entered ZOI for large clipper at 0745. CBD were last seen still inside the ZOI at 0755. The delay was extended for an hour given the CBD were not seen leaving the ZOI. The shutdown ended 0855 and pile clipping commenced 0857.
2/8/2022	CBD	3	08:34:36	08:55:24	00:20:48	Demo (Clip)	Contractor was in a Pre-/Post- at 0834 when 3 CBD were seen entering the clipping ZOI resulting in a delay until 0855 when CBD was observed leaving ZOI.
2/11/2022	CBD	3	07:23:21	07:32:35	00:09:14	Demo (Clip)	Contractor had clipper in the water preparing to clip first pile when delay was called at 0723 as 3 CBD entered the ZOI. CBD seen leaving ZOI at 0732, clipping began 0735.
3/7/2022	CBD	9	08:05:00	08:08:09	00:03:09	Demo (VPE)	CBD observed in ZOI around 0730 during Pre-Con. At 0805, demo crew requested to start vibratory extraction. Command called for a delay while dolphins left the ZOI. Dolphins confirmed leaving at 0808 and demo crew were given green light. Vibratory extraction began 0810.
3/9/2022	CBD	5	09:25:01	10:18:31	00:53:30	Demo (Clip)	Delay called during a Pre-/Post- at 0925 as 4 CBD entered ZOI. Delay in place until 1018 when CBD seen leaving ZOI. Contractor recommenced clipping at 1035.
3/10/2022	CBD	4	08:42:01	09:01:00	00:18:59	Demo (Clip)	Delay called at 0842 during Pre-/Post- as CBD entered ZOI. Delay in place until 0901 when CBD seen leaving ZOI.
3/11/2022	CBD	1	09:11:00	09:22:00	00:11:00	Demo (Clip)	Delay called at 0911 during a Pre-/Post- as CBD entered ZOI. Delay in place until 0922 when CBD seen leaving ZOI.
3/11/2022	CBD	1	09:32:00	09:46:00	00:14:00	Demo (Clip)	CBD re-entered ZOI at 0932 when crew was on break during a Pre-/Post-. CBD were seen leaving ZOI at 0946. Green light given to demo crew at 0946. Clipping recommenced clipping at 1007.
3/28/2022	CSL	1	10:45:12	11:05:12	00:20:00	Install (Impact)	CSL surfaced and dove again in 20 m ZOI at 1045 during Pre-/Post- while pile and hammer were being placed in the water. Command asked crew to delay construction activity. CSL resighted heading due north under Pier 5. Command had Pier 5 PSO search for animal to ensure it had not turned back towards ZOI. Gave okay to start construction again at 1105.

CSL = California Sea Lion; CBD = Coastal Bottlenose Dolphin; VPE = Vibratory Pile Extraction; ZOI = Zone of Influence; PSO = Protected Species Observer; m = Meters

3.2.7 Environmental Data

Six-minute tide data was accessed from NOAA's U.S. Tsunami Program Coastal Water Level Data Inventory (NOAA 2022) and matched to each animal observation. Table 3-9 presents the numbers of individuals observed during ebb and flood tides observed for each species.

Table 3-9. Individuals Observed by Tidal Cycle.

Species	Indiv. Observed (Ebb)		Indiv. Observed (Flood)		Indiv. Observed
California Sea Lion	150	65%	80	35%	230
Coastal Bottlenose Dolphin	45	46%	52	54%	97
Harbor Seal	2	100%	0	0%	2
Green Sea Turtle	2	33%	4	67%	6
Grand Total	**199**		**136**		**335**

Indiv. = Individuals

For each observation, PSOs collected Beaufort sea state (Table 3-10), visibility (Table 3-11), and sky cover (Table 3-12). The tables below summarize the information for these environmental variables.

Table 3-10. Individuals Observed by Beaufort Sea State.

Beaufort Sea State	0	1	2	3	4	Total Indiv. Observed
California Sea Lion	25	140	40	22	3	230
Coastal Bottlenose Dolphin	14	64	19	-	-	97
Harbor Seal	1	1	-	-	-	2
Green Sea Turtle	-	6	-	-	-	6
Grand Total	**40**	**211**	**59**	**22**	**3**	**335**
Percentage of Total	**12%**	**63%**	**18%**	**7%**	**1%**	**100%**

Indiv. = Individuals

Table 3-11. Individuals Observed by Visibility.

Beaufort Sea State	Excellent (>20 km)	Good (10 - 20 km)	Moderate (5 - 10 km)	Poor (0.5 - 5 km)	Bad (<0.5 km)	Total Indiv. Observed
California Sea Lion	110	102	15	1	2	230
Coastal Bottlenose Dolphin	64	24	9	-	-	97
Harbor Seal	-	2	-	-	-	2
Green Sea Turtle	5	1	-	-	-	6
Grand Total	**179**	**129**	**24**	**1**	**2**	**335**
Percentage of Total	**53%**	**39%**	**7%**	**0%**	**1%**	**100%**

Indiv. = Individuals; km = Kilometer(s)

Table 3-12. Individuals Observed by Sky Cover.

Sky Cover	Clear	Partly Cloudy	Cloudy	Overcast	Hazy	Fog	Total Indiv. Observed
California Sea Lion	115	58	31	14	7	5	230
Coastal Bottlenose Dolphin	60	12	18	7	-	-	97
Harbor Seal	-	1	1	-	-	-	2
Green Sea Turtle	3	-	-	-	3	-	6
Grand Total	**178**	**71**	**50**	**21**	**10**	**5**	**335**
Percentage of Total	**53%**	**21%**	**15%**	**6%**	**3%**	**1%**	**100%**

Indiv. = Individuals

3.3 Acoustic Monitoring

Acoustic data was collected on 15 days and included collection of data for 20-in square concrete piles, 24-in octagonal concrete piles for the following activities: pile clipping, vibratory pile extraction, and impact pile driving (fuel setting two and three).

3.3.1 Demolition Activities

24-inch Square Concrete Fender Pile (Pile Clipper)

Between October 14, 2021 and November 4, 2021, the construction contractor removed the 24-inch square concrete fender piles using a pile clipper. The fender piles were all plumb (vertical) piles. Hydroacoustic data were collected on November 1 and 2, 2021 using both APL-UW USLMs. Average duration of pile clipping was 3 minutes 29 seconds, with a maximum of 7 minutes 7 seconds, and a minimum of 39 seconds. Data collected at source (10 m [33 ft]) and to 141 m (461 ft) were collected from Pier 6 prior to the deck removal, while data collected at 536 m (1,757 ft) and beyond were from a vessel near the piers or outside of the NBSD security exclusion fencing. At source (10 m [33 ft]) the mean SPL was 153.0 dB RMS, and the maximum SPL was 165.8 dB RMS (Table 3-13). From distances 11 to 19 m [36 to 63 ft] there was not a significant difference in the SPLs compared to source (10 m [33 ft]), as a result these distances are considered near source. For near source (11 to 19 m [36 to 63 ft]) the mean SPLs ranged from 145.9 to 160.6 dB RMS and maximum SPLs ranged from 160.8 to 166.9 dB RMS. For recordings from 35 to 81 m (115 to 265 ft) the mean SPLs ranged from 136.2 to 150.7 dB RMS and the maximum SPLs ranged from 144.3 to 157.3 dB RMS. For recordings from 138 to 141 m (452 to 461 ft) the mean SPLs ranged from 133.2 to 136.6 dB RMS, and the maximum SPLs ranged from 135.8 to 140.1 dB RMS. For distances from 536 to 792 m (1,757 to 2,599 ft) the mean SPLs ranged from 138.9 to 142.9 dB RMS, and the maximum SPLs ranged from 141.8 to 150.9 dB RMS. For recordings at 1,271 and 1,272 m (4,170 and 4,173 ft) the mean SPLs ranged from 130.6 to 131.0 dB RMS and maximum SPLs ranged from 135.3 to 138.1 dB RMS.

Table 3-13. Hydroacoustic Metrics for Removal of 24-inch Square Concrete Fender Piles (via Pile Clipper) at Source (10 to 13 m [33 to 42 ft]) and Graduated Distances.

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB RMS (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
1-Nov-21	SFS03G	4.0 (13.1)	10 (33)	00:06:26	153.0	157.4	165.8	190.9
1-Nov-21	SFS03H	4.5 (14.8)	11 (36)	00:05:29	159.7	160.3	166.9	196.9
2-Nov-21	SFS05H	4.8 (15.7)	13 (42)	00:04:03	145.9	139.1	166.8	178.8
2-Nov-21	SFS05G	4.8 (15.7)	14 (45)	00:05:30	158.0	158.4	164.4	192.3
2-Nov-21	SFS05F	4.8 (15.7)	15 (48)	00:07:07	154.8	155.0	164.4	190.1
2-Nov-21	SFS05E	4.8 (15.7)	15 (51)	00:01:00	160.6	160.6	165.5	187.4
2-Nov-21	SFS05D	4.8 (15.7)	16 (54)	00:02:12	152.4	152.4	162.7	182.6
2-Nov-21	SFS05C	4.8 (15.7)	17 (57)	00:05:19	155.3	154.6	165.5	189.4
2-Nov-21	SFS05B	4.8 (15.7)	18 (60)	00:00:38	153.2	157.0	160.8	178.1
2-Nov-21	SFS05A	4.5 (14.8)	19 (63)	00:01:24	156.7	156.6	161.1	185.0
1-Nov-21	SFS03A	4.0 (13.1)	35 (115)	00:01:38	150.7	150.2	157.3	182.7
1-Nov-21	SFS03B	4.0 (13.1)	36 (118)	00:01:11	147.1	147.3	155.4	177.6
2-Nov-21	SFS05G	4.8 (15.7)	80 (262)	00:05:30	138.8	138.9	144.4	173.0
2-Nov-21	SFS05F	4.8 (15.7)	81 (265)	00:07:07	136.2	136.1	144.3	171.5
2-Nov-21	SFS05H	4.8 (15.7)	81 (265)	00:04:03	140.0	139.7	146.0	172.9
2-Nov-21	SFS05D	4.5 (14.8)	138 (452)	00:02:12	133.7	133.4	138.7	164.0
2-Nov-21	SFS05C	4.5 (14.8)	139 (455)	00:05:19	133.2	132.7	140.1	167.3
2-Nov-21	SFS05E	4.5 (14.8)	139 (456)	00:01:00	136.6	137.0	139.3	163.4
2-Nov-21	SFS05B	4.3 (14.1)	140 (458)	00:00:38	134.4	134.8	135.8	159.3
2-Nov-21	SFS05A	4.3 (14.1)	141 (461)	00:01:24	134.7	134.6	137.9	163.0
1-Nov-21	SFS03A	6.0 (19.7)	536 (1,757)	00:01:38	138.9	138.8	141.8	170.8
1-Nov-21	SFS03B	6.0 (19.7)	536 (1,760)	00:01:11	139.4	140.1	143.2	169.9
1-Nov-21	SFS03D[1]	3.5 (11.5)	747 (2,450)	00:03:15	142.9	141.6	150.9	177.8
1-Nov-21	SFS03F[1]	3.5 (11.5)	748 (2,456)	00:01:54	139.5	138.1	148.1	172.1
1-Nov-21	SFS03E[1]	3.5 (11.5)	792 (2,599)	00:05:00	142.8	141.7	150.3	179.6
1-Nov-21	SFS03G	2.5 (8.2)	1,271 (4,170)	00:06:26	130.6	130.1	135.3	168.5
1-Nov-21	SFS03H	2.5 (8.2)	1,272 (4,173)	00:05:29	131.0	130.7	138.1	168.2

Notes:
[1] SPLs values appear incongruent with other data and further analysis shall be provided in the final report.

24-inch Octagonal Concrete Structural Test Pile (Pile Clipper)

Between October 28, 2021, and November 3, 2021, the construction contractor removed the 24-inch octagonal concrete structural test piles using a pile clipper. The test piles were all plumb piles. Hydroacoustic monitoring of these activities occurred between November 1, 2021, and November 3, 2021, using the APL-UW USLM. Only nine total test piles were installed and subsequently removed, with data being collected on five of them (Table 3-14). Average duration of pile clipping was 1 minute 18 seconds, with a maximum of 2 minutes, and a minimum of 32 seconds. Data

collected from 10 to 148 m (33 to 486 ft) from Pier 6 prior to the deck removal while data at 730 m (2,395 ft) were collected from a vessel. At source (10 m [33 ft]) the mean SPLs ranged from 144.9 to 146.5 dB RMS and maximum SPLs ranged from 164.8 to 165.5 dB RMS (Table 3-14). Data from other distances are presented in (Table 3-14).

Table 3-14. Hydroacoustic Metrics for Removal of 24-inch Octagonal Concrete Structural Test Piles (via Pile Clipper) at Source (10 m [33 ft]) and Graduated Distances.

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB rms (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
2-Nov-21	TP4	4.0 (13.1)	10 (33)	00:02:00	146.5	147.2	165.5	170.3
3-Nov-21	TP3	5.0 (16.4)	10 (33)	00:01:32	144.9	142.0	164.8	169.3
3-Nov-21	TP2	4.0 (13.1)	58 (190)	00:01:23	136.1	137.1	143.4	160.0
2-Nov-21	TP5	4.8 (15.7)	148 (486)	00:01:04	132.5	131.3	136.0	153.6
1-Nov-21	TP7	3.5 (11.5)	730 (2,395)	00:00:32	142.1	142.2	145.3	160.2

20-inch Square Concrete Structural Pile (Vibratory Extraction)

Removal of 20-inch square concrete structural piles using the vibratory hammer/extractor started January 10, 2022 and was completed on March 8, 2022. In January, February, and March 2022, hydroacoustic monitoring was conducted across six days during that period using the APL-UW USLM and LD 831. Batter (angled) piles made up the majority of those removed by vibratory extraction except for a few plumb piles. Average duration of pile clipping was 3 minutes 45 seconds, with a maximum of 12 minutes 2 seconds, and a minimum of 1 minute 53 seconds. During the data collection, the pier-deck had been removed and the ATs could not collect source data from pier-based locations, and getting closer to the piles to collect source data from a vessel was unsafe. Therefore, the nearest recording to source was made at 49 m [161 ft] from a vessel (Table 3-15). Clustering recordings from 49 to 79 m (161 to 259 ft) the mean SPLs ranged from 134.3 to 149.5 dB RMS, and the maximum SPLs ranged from 142.6 to 155.6 dB RMS. For distances from 216 to 246 m (708 to 806 ft) the mean SPLs ranged from 127.6 to 144.4 dB RMS, and the maximum SPLs ranged from 132.1 to 152.8 dB RMS. For distances from 396 to 839 m (1,298 to 2,751 ft) the mean SPLs ranged from 128.1 to 139.4 dB RMS, and the maximum SPLs ranged from 131.2 to 141.1 dB RMS. For recordings from 1,089 to 1,638 m (3,574 to 5,375 ft) the mean SPLs ranged from 126.4 to 130.2 dB RMS, and the maximum SPLs ranged from 128.1 to 133.9 dB RMS. The maximum distance for which data were successfully collected and evaluated was 1,638 m [5,375 ft]. During the course of data collection, attempts were made to collect data at greater distances; however, influence of other anthropogenic sources were identified as polluting the data. As a result, the data from these distances were discarded.

Table 3-15. Hydroacoustic Metrics for Removal of 20-inch Square Concrete Structural Piles (via Vibratory Extractor) at Graduated Distances.

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB RMS (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
2-Mar-22	55MB	5.0 (16.4)	49 (161)	00:02:14	140.0	138.4	151.6	175.1
2-Mar-22	53MB	5.0 (16.4)	54 (178)	00:03:36	138.5	138.2	144.2	175.7
28-Jan-22	6CB	5.0 (16.4)	62 (203)	00:12:02	146.4	145.6	153.0	182.0
28-Jan-22	7CB	4.0 (13.1)	62 (205)	00:02:10	148.2	148.6	153.2	176.4
28-Jan-22	9CB	4.5 (14.8)	65 (213)	00:02:07	135.4	134.5	148.0	163.4
28-Jan-22	7AB[1]	5.0 (16.4)	65 (214)	00:06:47	143.0	141.7	150.4	176.0
28-Jan-22	7AB[1]	4.5 (14.8)	65 (214)	00:06:14	149.5	150.3	155.6	182.2
2-Mar-22	56MB	5.0 (16.4)	67 (221)	00:04:54	138.7	138.7	145.3	177.2
28-Jan-22	9AB	4.5 (14.8)	69 (225)	00:04:01	143.7	142.6	149.7	174.6
27-Jan-22	12CB	4.0 (13.1)	71 (232)	00:03:36	142.3	145.2	149.5	172.6
27-Jan-22	13CB	4.5 (14.8)	72 (237)	00:05:25	142.7	142.7	149.9	174.9
27-Jan-22	12AB	4.0 (13.1)	74 (241)	00:03:10	147.2	147.5	151.9	177.0
27-Jan-22	13AB	4.0 (13.1)	75 (247)	00:04:44	134.3	132.7	142.6	165.8
14-Feb-22	15AB	4.5 (14.8)	79 (259)	00:03:12	139.6	137.9	150.8	165.4
2-Mar-22	60AB[2]	6.0 (19.7)	216 (708)	00:06:15	132.4	132.3	139.1	172.0
2-Mar-22	62AB[2]	6.0 (19.7)	218 (715)	00:02:40	132.0	132.1	137.9	167.9
2-Mar-22	64AD[2,3]	6.0 (19.7)	223 (730)	00:02:54	132.3	132.7	140.3	168.5
2-Mar-22	47MB[2]	5.0 (16.4)	225 (737)	00:02:19	132.5	132.4	145.1	167.8
2-Mar-22	64AI[2,3]	6.0 (19.7)	229 (752)	00:03:04	129.6	129.4	140.3	166.1
11-Jan-22	90AB	4.0 (13.1)	232 (760)	00:04:46	144.0	145.2	150.4	179.7
11-Jan-22	91AB	4.0 (13.1)	232 (760)	00:02:45	138.5	138.0	147.2	171.8
11-Jan-22	92AB	4.0 (13.1)	232 (762)	00:01:56	129.2	129.0	132.1	160.9
11-Jan-22	93AB	4.0 (13.1)	233 (763)	00:04:30	127.6	127.5	134.1	163.1
1-Mar-22	62MB[2]	5.0 (16.4)	235 (773)	00:02:23	129.8	129.2	141.9	165.0
1-Mar-22	64AMB[2]	5.0 (16.4)	236 (775)	00:03:38	128.4	127.9	139.9	165.4
1-Mar-22	63MB[2]	5.0 (16.4)	236 (776)	00:02:08	130.3	129.3	144.6	165.0
1-Mar-22	73AB[2]	6.0 (19.7)	237 (776)	00:05:43	144.4	144.8	152.8	183.3
1-Mar-22	64AM[2,3]	5.0 (16.4)	237 (778)	00:02:30	133.4	133.3	139.5	168.8
1-Mar-22	65MB[2]	5.0 (16.4)	239 (783)	00:02:39	128.8	128.0	140.3	164.4
1-Mar-22	66MB[2]	5.0 (16.4)	240 (788)	00:05:13	129.1	128.5	148.9	167.6
1-Mar-22	67MB[2]	5.0 (16.4)	242 (792)	00:02:12	129.6	129.3	141.1	164.4
1-Mar-22	68MB[2]	5.5 (18.0)	243 (797)	00:01:53	133.4	132.4	139.5	167.5
1-Mar-22	70MB[2]	6.0 (19.7)	246 (806)	00:02:31	132.1	131.2	140.9	167.5
1-Mar-22	74AB	4.5 (14.8)	396 (1,298)	00:02:18	128.1	127.9	132.3	163.1
2-Mar-22	64AI[3]	6.5 (21.3)	454 (1,488)	00:03:04	133.8	132.9	140.7	170.3
2-Mar-22	64AJ[3]	6.5 (21.3)	454 (1,491)	00:03:37	136.6	137.9	139.1	173.8
1-Mar-22	65MB	6.0 (19.7)	510 (1,674)	00:02:39	139.4	139.6	141.1	175.0

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB RMS (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
1-Mar-22	63MB	6.0 (19.7)	518 (1,701)	00:02:08	139.2	139.1	140.5	173.9
2-Mar-22	60AB	6.5 (21.3)	564 (1,849)	00:06:15	131.5	131.5	133.1	171.0
1-Mar-22	66MB	4.5 (14.8)	772 (2,533)	00:05:13	133.3	133.1	135.9	171.9
1-Mar-22	64AMB	2.2 (7.2)	783 (2,567)	00:03:38	129.1	129.1	131.2	166.1
1-Mar-22	73AB	4.5 (14.8)	839 (2,751)	00:05:43	138.7	138.7	142.5	177.7
2-Mar-22	47MB	5.5 (18.0)	1089 (3,574)	00:02:19	130.2	130.2	133.9	165.4
2-Mar-22	64AD[3]	2.5 (8.2)	1,183 (3,881)	00:02:54	126.4	126.1	128.3	162.6
2-Mar-22	62AB	2.8 (9.2)	1,638 (5,375)	00:02:40	126.9	127.0	128.1	162.8

Notes:
[1] Two recording were made on pile 7AB as two separate extraction attempts were made on the pile with more than one hour elapsing between attempts.
[2] Data collected using LD 831, all other data were collected using the APL-UW USLM.
[3] Plumb piles, all others were batter piles.

20-inch Square Concrete Structural Pile (Pile Clipper)

Removal of 20-inch square concrete structural piles using a pile clipper began January 3, 2022, and was completed on March 16, 2022. Hydroacoustic monitoring was conducted across six days within that period using the APL-UW USLM and LD 831. Acoustic data were collected on both batter and plumb piles, but a majority of the recordings were for plumb piles (Table 3-16). Average duration of pile clipping was 19 seconds, with a maximum of 53 seconds, and a minimum of 14 seconds. During the data collection, the pier-deck had been removed and the ATs could not collect source data from pier-based locations and getting closer to the piles to collect source data from a vessel was unsafe. Mean SPLs near source (12 and 13 m [41 and 43 ft]) ranged from 152.4 to 155.5 dB RMS and maximum SPLs near source ranged from 154.4 to 161.8 dB RMS (Table 3-16). For recordings from 22 to 39 m (72 to 129 ft) the mean SPLs ranged from 140.3 to 157.3 dB RMS, and the maximum SPLs ranged from 141.2 to 159.8 dB RMS. For distances from 56 to 77 m (184 to 252 ft) the mean SPLs ranged from 129.7 to 148.5 dB RMS. For recordings from 110 to 155 m (362 to 509 ft) the mean SPLs ranged from 129.1 to 140.7 dB RMS, and the maximum SPLs ranged from 129.4 to 142.6 dB RMS. For distances from 261 to 638 m (856 to 2,093 ft) the mean SPLs ranged from 128.5 to 141.5 dB RMS, and the maximum SPLs ranged from 129.9 to 148.6 dB RMS. For recordings from 1,052 to 1,533 m (3,452 to 5,031 ft) the mean SPLs ranged from 126.7 to 134.3 dB RMS and maximum SPLs ranged from 127.5 to 138.4 dB RMS.

Table 3-16. Hydroacoustic Metrics for Removal of 20-inch Square Concrete Structural Piles (via Pile Clipper) at Near Source (12 to 13 m [41 to 43 ft]) and Graduated Distances.

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB RMS (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
9-Feb-22	27B	5.0 (16.4)	12 (41)	00:00:20	155.5	156.2	158.8	183.5
9-Feb-22	27C	5.0 (16.4)	13 (41)	00:00:18	153.9	157.5	161.8	181.5

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB RMS (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
9-Feb-22	27D	5.0 (16.4)	13 (43)	00:00:26	152.4	152.7	154.4	181.6
10-Feb-22	31MB	5.5 (18.0)	22 (72)	00:00:14	157.3	158.8	159.8	186.2
10-Feb-22	31K	5.5 (18.0)	26 (85)	00:00:16	150.2	150.5	153.8	179.6
10-Feb-22	31I	5.5 (18.0)	29 (95)	00:00:16	147.9	148.2	150.0	177.4
10-Feb-22	31L	5.5 (18.0)	31 (103)	00:00:23	146.1	148.8	151.8	177.1
10-Feb-22	30H	5.5 (18.0)	31 (103)	00:00:16	147.6	148.7	151.3	177.0
10-Feb-22	31M	5.5 (18.0)	32 (107)	00:00:17	154.5	154.6	156.0	184.2
10-Feb-22	30J	5.5 (18.0)	33 (108)	00:00:17	145.2	145.0	153.1	174.9
28-Jan-22	13KB	4.3 (14.1)	36 (118)	00:00:18	143.7	145.0	149.1	170.7
28-Jan-22	13J	4.3 (14.1)	36 (120)	00:00:19	148.5	149.3	153.3	175.8
10-Feb-22	30D	5.5 (18.0)	39 (129)	00:00:18	140.3	140.4	141.2	170.3
27-Jan-22	10MB	4.3 (14.1)	56 (184)	00:00:17	147.1	147.5	152.0	174.8
27-Jan-22	10M	4.3 (14.1)	57 (187)	00:00:17	146.2	146.5	148.8	173.9
27-Jan-22	10L	4.3 (14.1)	58 (190)	00:00:17	148.5	148.9	150.8	176.2
27-Jan-22	10K	4.3 (14.1)	59 (193)	00:00:20	146.6	147.6	150.5	175.0
27-Jan-22	10J	4.3 (14.1)	60 (196)	00:00:19	144.9	146.7	150.1	173.2
28-Jan-22	6E	4.5 (14.8)	61 (199)	00:00:16	129.7	126.0	146.4	156.2
27-Jan-22	10I	4.5 (14.8)	61 (200)	00:00:17	147.2	149.0	153.0	175.0
28-Jan-22	7E	4.5 (14.8)	61 (201)	00:00:17	142.7	142.8	147.4	169.5
27-Jan-22	10H	4.5 (14.8)	62 (202)	00:00:16	143.6	144.3	148.9	171.0
28-Jan-22	6D	4.5 (14.8)	62 (203)	00:00:19	137.9	138.5	143.4	165.1
28-Jan-22	7D	4.5 (14.8)	62 (205)	00:00:19	138.9	139.3	141.7	166.2
27-Jan-22	10G	4.5 (14.8)	64 (209)	00:00:18	145.6	146.7	147.7	173.6
28-Jan-22	9E	4.5 (14.8)	64 (209)	00:00:21	137.2	136.7	138.9	164.9
10-Feb-22	31E	5.0 (16.4)	64 (209)	00:00:18	144.6	145.5	148.7	174.5
28-Jan-22	9D	4.5 (14.8)	65 (212)	00:00:21	135.3	133.8	140.7	163.0
27-Jan-22	10E	4.5 (14.8)	65 (214)	00:00:18	137.2	138.3	141.1	165.2
27-Jan-22	10F	4.5 (14.8)	65 (214)	00:00:20	140.0	140.1	142.6	168.4
28-Jan-22	9C	4.5 (14.8)	66 (216)	00:00:19	133.6	134.0	135.9	160.8
27-Jan-22	10D	4.5 (14.8)	66 (217)	00:00:23	138.9	142.2	146.4	168.0
28-Jan-22	7AB[1]	4.5 (14.8)	66 (218)	00:00:19	138.3	137.4	140.1	165.5
27-Jan-22	10C	4.5 (14.8)	67 (221)	00:00:16	136.6	136.8	139.3	164.1
27-Jan-22	10B	4.5 (14.8)	68 (224)	00:00:17	138.4	139.0	143.2	166.1
10-Feb-22	31H	5.0 (16.4)	70 (229)	00:00:22	140.3	140.6	142.5	171.2
28-Jan-22	13D	4.0 (13.1)	72 (236)	00:00:18	133.7	134.3	136.7	160.7
28-Jan-22	13B	4.0 (13.1)	74 (242)	00:00:18	135.1	135.2	136.7	162.1
28-Jan-22	13A	4.0 (13.1)	75 (245)	00:00:15	139.4	139.8	142.2	165.7
28-Jan-22	14B	4.0 (13.1)	76 (249)	00:00:18	135.2	135.5	137.5	162.2
28-Jan-22	14A	4.0 (13.1)	77 (252)	00:00:18	134.1	134.7	138.5	161.1

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Continuous Noise Duration (hh:mm:ss)	Unweighted dB RMS (dB re 1 µPa)			SEL_{cum} (dB re 1 µPa²-sec)
					Mean	Median	Max	Mean
28-Jan-22	15B	5.5 (18.0)	110 (362)	00:00:19	135.1	135.8	137.8	162.4
28-Jan-22	15A	5.5 (18.0)	111 (365)	00:00:19	136.4	136.7	138.9	163.7
10-Feb-22	32I	5.0 (16.4)	115 (376)	00:00:17	134.0	134.0	136.8	163.7
10-Feb-22	32H	5.0 (16.4)	115 (377)	00:00:15	137.3	138.1	140.4	166.5
10-Feb-22	32AB[1]	5.0 (16.4)	115 (377)	00:00:17	129.4	129.6	130.7	159.1
10-Feb-22	32E	5.0 (16.4)	116 (382)	00:00:18	131.6	131.8	132.6	161.6
10-Feb-22	32D	5.0 (16.4)	118 (386)	00:00:16	132.8	134.3	134.4	162.2
10-Feb-22	32C	5.0 (16.4)	118 (387)	00:00:19	132.2	132.4	134.0	162.3
10-Feb-22	32CB[1]	5.0 (16.4)	120 (393)	00:00:17	129.1	129.3	129.4	158.8
9-Feb-22	27L	5.3 (17.4)	154 (506)	00:00:18	140.5	140.9	142.3	168.1
9-Feb-22	27J	5.3 (17.4)	155 (508)	00:00:53	135.9	139.0	141.7	168.2
9-Feb-22	27I	5.3 (17.4)	155 (509)	00:00:20	140.7	141.6	142.6	168.8
9-Feb-22	27MB[1]	5.5 (18.0)	261 (856)	00:00:23	134.9	133.5	137.8	163.6
9-Feb-22	27H	5.5 (18.0)	263 (864)	00:00:20	135.7	136.1	137.6	163.8
9-Feb-22	27G	5.5 (18.0)	264 (865)	00:00:24	132.8	132.9	134.8	161.7
2-Mar-22	97C[2]	6.0 (19.7)	291 (956)	00:00:18	132.6	131.4	143.1	161.5
2-Mar-22	101C[2]	6.0 (19.7)	303 (994)	00:00:16	137.7	138.7	148.6	166.1
2-Mar-22	101D[2]	6.0 (19.7)	303 (995)	00:00:17	137.7	138.7	148.4	166.4
2-Mar-22	103B	6.5 (21.3)	330 (1,084)	00:00:18	137.8	138.0	141.0	166.6
2-Mar-22	103C	6.5 (21.3)	331 (1,087)	00:00:21	141.1	140.7	142.2	170.7
2-Mar-22	102E	6.5 (21.3)	335 (1,099)	00:00:16	141.5	141.7	143.1	169.9
2-Mar-22	102F	6.5 (21.3)	336 (1,102)	00:00:16	138.7	138.7	139.2	167.0
28-Feb-22	52D	6.5 (21.3)	365 (1,197)	00:00:24	128.5	128.0	129.9	159.3
2-Mar-22	100E	6.5 (21.3)	401 (1,316)	00:00:17	136.7	137.3	139.0	165.3
2-Mar-22	98C	5.5 (18.0)	411 (1,347)	00:00:14	130.7	130.7	131.2	158.5
2-Mar-22	98A	5.5 (18.0)	412 (1,353)	00:00:16	131.2	131.5	133.7	159.6
2-Mar-22	100D	2.9 (9.5)	638 (2,093)	00:00:18	136.8	136.8	137.2	165.7
2-Mar-22	97E	5.5 (18.0)	1,052 (3,452)	00:00:15	129.5	130.0	130.9	157.6
2-Mar-22	97D	5.5 (18.0)	1,053 (3,456)	00:00:15	131.6	131.4	133.8	159.6
2-Mar-22	97C	5.5 (18.0)	1,054 (3,459)	00:00:18	130.2	130.0	133.9	159.0
2-Mar-22	101F	2.5 (8.2)	1,080 (3,544)	00:00:17	132.2	131.9	133.4	160.8
2-Mar-22	101C	2.8 (9.2)	1,533 (5,028)	00:00:16	134.3	135.7	138.4	162.7
2-Mar-22	101D	2.8 (9.2)	1,533 (5,013)	00:00:17	126.7	127.0	127.5	155.4

Notes:

[1] Batter piles, all others were plumb piles.

[2] Data collected using LD 831, all other data were collected using the APL-UW USLM.

3.3.2 Installation Activities

24-inch Octagonal Concrete Structural Pile (Impact Driving)

Structural impact pile driving occurred between March 22, 2022, and June 22, 2022. Hydroacoustic monitoring was conducted over three days in March and May 2022 during the installation of 24-inch octagonal concrete structural piles using the impact hammer. Data were collected using the APL-UW USLM from the quay wall, the construction contractor's temporary floating dock, and from a vessel. When driving each pile, the impact hammer was used in conjunction with a high-pressure water hose attached to the pile to send a high-pressure water jet down the pile during driving. The water jet was cut off with approximately 3 m (10 ft) left to drive. During the combined use with the high-pressure water jet, the impact hammer was always set on fuel setting two. However, during the installation of piles further away from the shore, a high-pressure water jet was not used and the impact hammer was set to fuel setting three. Throughout pile installation, some piles were driven and allowed to set before the impact hammer was used to "re-tap" the piles to assess vertical resistance. During the "re-tap" process, the water jet was not used and the hammer was used on fuel setting two. The ATs were unable to collect data at source (10 m [33 ft]) because they could not record from a location close enough to the piles due to safety concerns.

For piles driven on fuel setting two, the nearest recordings to source were made at 39 to 49 m (129 to 160 ft) from the quay wall where the maximum RMS_{90} values ranged from 160.9 to 167.2 dB, maximum single strike SEL_{90} values ranged from 149.3 to 152.8 dB and maximum PEAK values ranged from 177.2 to 180.5 dB (Table 3-17). For recordings from 67 to 74 m (218 to 244 ft) the maximum RMS_{90} values ranged from 165.4 to 167.7 dB, maximum single strike SEL_{90} values ranged from 152.7 to 155.0 dB and maximum PEAK values ranged from 174.6 to 177.9 dB. For distances from 102 to 211 m (334 to 693 ft) the maximum RMS_{90} values ranged from 147.5 to 175.7 dB, maximum single strike SEL_{90} values ranged from 140.0 to 161.7 dB and maximum PEAK values ranged from 163.9 to 183.8 dB. For recordings from 417 to 551 m (1,369 to 1,808 ft) the maximum RMS_{90} values ranged from 142.9 to 157.1 dB, maximum single strike SEL_{90} values ranged from 136.4 to 145.9 dB and maximum PEAK values ranged from 162.7 to 169.7 dB.

Distances from which data collected for piles driven on fuel setting three ranged from 51 to 378 m (168 to 1,242 ft) (Table 3-17). The maximum RMS_{90} values ranged from 153.0 to 179.0 dB, maximum single strike SEL_{90} values ranged from 142.6 to 164.1 dB and maximum PEAK values ranged from 171.2 to 188.1 dB.

Table 3-17. Hydroacoustic Metrics for Installation of 24-inch Octagonal Concrete Structural Piles (Impact Driving at Fuel Setting Two and Three) at Graduated Distances.

Date	Pile No.	Hydrophone Depth (m [ft])	Distance (m [ft])	Strikes		RMS_{90} (dB re 1 µPa)			SEL_{90}[1] (dB re 1 µPa²-sec)			PEAK (dB re 1 µPa)			$SEL90_{cum}$ (dB re 1 µPa²-sec)
				No. of Strikes	Mean Strike Duration (sec)[2]	Mean	Median	Max	Mean	Median	Max	Mean	Median	Max	Mean
Piles Driven at Fuel Setting 2															
23-Mar-22	2E	4.0 (13.1)	39 (129)	656	0.054	163.2	163.6	167.2	150.5	150.5	152.8	174.7	174.6	177.2	178.7
23-Mar-22	2F	4.0 (13.1)	44 (144)	737	0.085	157.9	158.1	163.6	147.2	147.5	150.7	170.7	171.1	178.6	175.9
23-Mar-22	2G	4.0 (13.1)	49 (160)	855	0.120	153.3	153.9	160.9	144.1	144.8	149.3	166.5	166.8	180.5	173.4
25-Mar-22	4G	4.5 (14.8)	67 (218)	530	0.061	163.7	164.5	167.7	151.6	152.2	155.0	174.0	174.7	177.9	178.8
25-Mar-22	4H	4.5 (14.8)	71 (233)	447	0.080	161.9	163.4	165.9	150.9	152.4	154.8	172.3	173.0	176.2	177.4
25-Mar-22	4J	4.5 (14.8)	74 (244)	328	0.069	161.3	162.2	165.4	149.7	150.2	152.7	171.8	172.2	174.6	174.8
25-Mar-22	4F	5.0 (16.4)	102 (334)	588	0.077	160.3	161.0	164.2	149.1	149.4	150.8	172.6	172.8	175.6	176.8
23-Mar-22	2B[3]	5.0 (16.4)	102 (335)	703	0.056	168.7	168.6	175.7	156.2	156.1	161.7	177.4	177.3	183.8	184.7
25-Mar-22	4E	5.0 (16.4)	110 (361)	558	0.191	148.4	148.5	150.8	141.2	141.2	142.7	162.3	162.3	166.1	168.7
25-Mar-22	4D	4.8 (15.7)	127 (418)	664	0.159	149.7	150.3	155.2	141.7	142.4	145.4	163.7	164.6	171.7	169.9
25-Mar-22	4C	4.5 (14.8)	141 (464)	731	0.133	153.8	153.9	160.2	145.0	145.1	148.8	169.7	169.9	174.9	173.7
25-Mar-22	4B	4.5 (14.8)	170 (556)	535	0.241	138.6	139.1	149.3	132.4	132.9	142.5	156.1	155.1	175.8	159.7
23-Mar-22	2C	5.5 (18.0)	202 (664)	957	0.158	149.0	149.0	152.9	141.0	141.0	143.8	164.5	164.5	169.9	170.8
23-Mar-22	1A Re-tap	5.3 (17.4)	208 (682)	12	0.158	151.1	153.0	153.7	143.1	144.9	145.5	169.7	172.0	173.1	153.8
23-Mar-22	1B Re-tap	5.3 (17.4)	209 (685)	12	0.170	148.6	150.6	152.0	140.9	142.8	143.8	166.9	168.9	171.3	151.7
23-Mar-22	1D Re-tap	5.3 (17.4)	211 (693)	12	0.217	136.2	136.4	147.5	129.6	129.8	140.0	153.5	154.0	163.9	140.4
23-Mar-22	2A[3]	5.5 (18.0)	417 (1,369)	612	0.123	150.9	150.6	157.1	141.8	141.8	144.7	165.8	165.6	169.7	169.7
23-Mar-22	2D	5.8 (19.0)	422 (1,385)	853	0.235	141.3	140.5	153.7	135.0	134.3	145.9	155.3	154.9	163.4	164.3
23-Mar-22	2A	5.5 (18.0)	551 (1,808)	612	0.240	142.0	141.9	142.9	135.8	135.9	136.4	161.3	161.9	162.7	163.7
Piles Driven at Fuel Setting 3															
12-May-22	34H	5.0 (16.4)	51 (168)	620	0.051	171.6	171.5	179.0	158.7	158.7	164.1	182.0	181.7	188.1	186.7
12-May-22	34J	5.0 (16.4)	77 (252)	365	0.052	169.1	168.7	174.3	156.3	155.9	160.7	178.7	178.3	182.4	181.9
12-May-22	33A	5.3 (17.4)	128 (422)	286	0.091	158.5	159.7	165.8	148.1	149.1	152.7	170.8	171.7	176.0	172.7
12-May-22	33B	6.3 (20.7)	194 (637)	396	0.153	154.0	154.3	159.2	145.9	146.0	147.6	167.8	167.7	171.2	171.9
12-May-22	33C	6.5 (21.3)	378 (1,241)	487	0.176	145.6	147.8	153.0	138.1	140.0	142.6	159.5	160.4	171.2	165.0

Notes:
[1] All SEL_{90} values are for a single strike.
[2] Mean strike duration was computed for individual pile driving events based on mean RMS_{90} and mean single strike SEL_{90}, as defined by 10 ^ ((SEL_{90} - RMS_{90})/10).
[3] SPLs values appear incongruent with other data and further analysis shall be provided in the final report.

3.4 Summary of Observed Level B Take (October 14, 2021 to June 22, 2022)

Take at Pier 6 has been much less than was authorized under the IHA thus far. To date the total take number is 14, or 1.4% of the total authorized take (Table 3-18). The 14 individuals that have been incidentally harassed account for roughly 8.5% of the total in-water individuals observed thus far. While monitoring zones are potentially large, we feel that the monitoring protocols allowed us to either observe the whole of monitoring zone (i.e., during impact pile driving), or capture animals as they entered the monitoring zones (i.e., during demolition activities). As such, we have not generated an estimate of Level B Take based on areas that the PSOs were not able to observe.

Table 3-18. Total Observed Level B Take.

Species	Total Number of Animals Observed in the Water		Authorized Level B "Take" Total	Observed Level B "Take" Total
	Indiv.	Sightings		
California sea lion	164	172	1,000	14

Indiv. = Individuals

Table 3-19 presents the total number of takes by construction activity. Most of the takes occurred during pile clipping. This is not surprising given that pile clipping at Pier 6 exhibits a large ZOI (7.7 square kilometers [km^2]) compared to impact pile driving (0.1 km^2). Moreover, while pile clipping has a similar sized ZOI to vibratory pile extraction (5.35 km^2), pile clipping totaled approximately 27.5 hours of monitoring, while vibratory pile extraction totaled only 13.6 hours.

Table 3-19. Number of Takes by Construction Activity.

Construction Activity	Pile Clipper	Vibratory Pile Extraction	Impact Pile Driving
Number of Takes	8	4	2
Percentage of Total Take	57.14%	28.57%	14.29%

4.0 Future In-Water Project Activities

The remaining in-water pile installation will consist of the fender piles, including 204 24-inch square concrete piles and 226 16-inch round plastic piles. The pile installation is expected to occur on approximately 54 days starting in November or early December, 2022 and continue through February, 2023. Pile installation will use the same monitoring protocols used for the pile installation of the 24-inch octagonal concrete structural piles. Because these activities will occur after the current IHA time-period (October 1, 2021 to September 30, 2022), the Navy will be requesting a one-year renewal of the current IHA, per provisions outlined in the current IHA permit. This would extend the IHA until September 30, 2023.

5.0 References

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Appendix A: Distances and Bearings to Animals Observed During Active Construction

Species	Pile No.	Activity	Distance (m)	Bearing (Deg)
Green sea turtle	4A	Clip	2,835	109
Coastal bottlenose dolphin	79AB	VPE	2,276	104
Coastal bottlenose dolphin	79AB	VPE	1,764	91
California sea lion	57AB	VPE	2,112	90
Coastal bottlenose dolphin	UVWB	VPE	2,698	97
Coastal bottlenose dolphin	UVWB	VPE	2,231	92
Coastal bottlenose dolphin	UVWB	VPE	2,703	73
Coastal bottlenose dolphin	UVWC	VPE	2,871	62
Coastal bottlenose dolphin	UVWC	VPE	2,977	51
California sea lion	88B	Clip	1,327	132
California sea lion	88A	Clip	2,642	110
California sea lion	2B	Clip	1,345	126
California sea lion	9KB	VPE	1,400	97
California sea lion	11KB	VPE	35	104
California sea lion	16MB	VPE	825	113
California sea lion	23E	Clip	2,235	111
California sea lion	11L	Clip	2,936	106
California sea lion	31J	Clip	179	304
California sea lion	26AB	VPE	1,155	121
California sea lion	36ABB	Clip	1,031	119
California sea lion	43KB	Clip	1,220	134
California sea lion	43MB	Clip	1,215	135
California sea lion	49I	Clip	201	276
California sea lion	43CB	VPE	1270	131
California sea lion	10E	IPD	471	84
California sea lion	10E	IPD	423	56
California sea lion	10E	IPD	475	29
California sea lion	10E	IPD	438	79
California sea lion	4J	IPD	475	91
California sea lion	50H	IPD	296	77

VPE = Vibratory pile extraction; IPD = Impact pile driving

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