UNDERWATER ACOUSTIC MONITORING REPORT

YEAR 2: MARCH 1, 2021 – FEBRUARY 28, 2022

DEMOLITION AND REPLACEMENT OF PIER 32

Naval Submarine Base New London
Groton, Connecticut

Prepared for:

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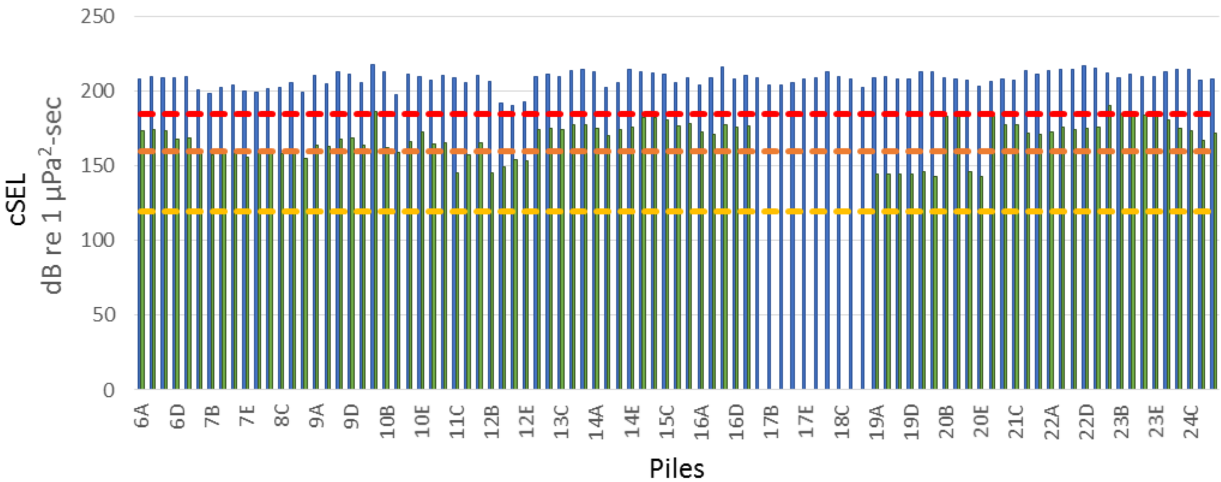
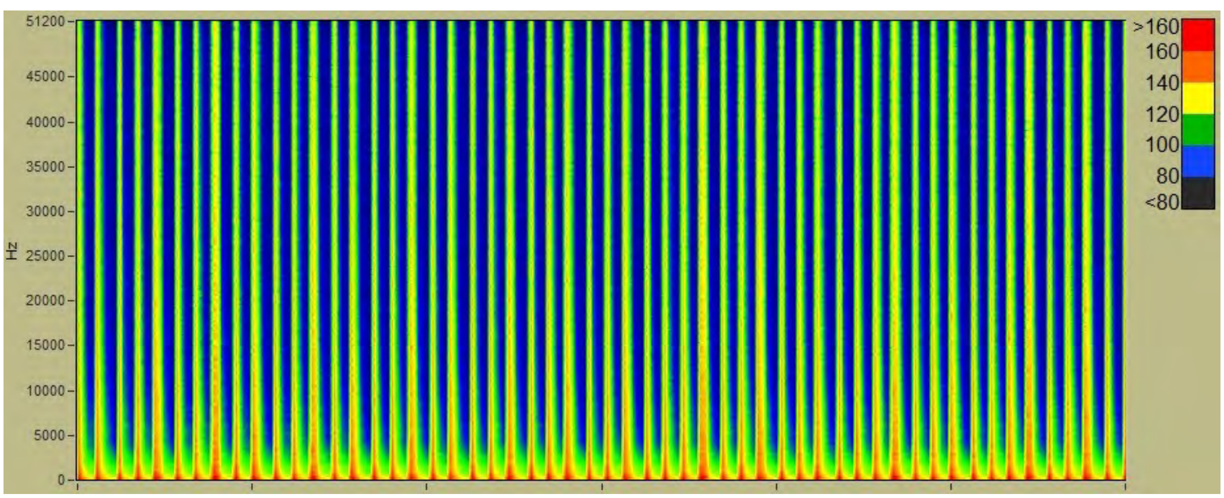
May 2022

Weeks Marine, Inc.
4 Commerce Drive
Cranford, NJ 07016

Underwater Acoustic Monitoring
During the Demolition and Replacement of SSN Berthing Pier
At the Naval Submarine Base, New London, CT

2021 Report on
Monitoring During 36-in Steel Pile Driving for New Pier 32
Between March 1, 2021, and August 02, 2021





March 15, 2022

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Weeks Marine, Inc.
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e4sciences LLC

Underwater Acoustic Monitoring During the Demolition and Replacement of SSN Berthing Pier At the Naval Submarine Base, New London, CT

Monitoring During 36-in Steel Pile Driving for New Pier 32 Between March 1, 2021, and August 02, 2021

Executive Summary

Weeks Marine, Inc. contracted e4sciences, LLC (e4) to monitor acoustic sound levels in the Thames River following the procedures outlined in the *Marine Mammal Observation and Acoustic Monitoring Plan for the Demolition / Replacement of Pier 32 and Demolition of Pier 10 on the Thames River at Naval Submarine Base New London in Groton, CT,* prepared by Naval Facilities Engineering Command Mid-Atlantic (NAVFAC).[1.] Of concern to the National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration are the effects of sound levels generated by the installation of piles on the phocid pinnipeds, the harbor seal (*Phoca vitulina*) and the gray seal (*Halichoerus grypus*) that are native to the Thames River and the Long Island Sound.

The Monitoring Plan (NAVFAC, 2019)[1] and the original Request for Letter of Authorization under the Marine Mammal Protection Act for this project (NAVFAC, 2018)[2] are based on data from similar past construction projects and guidance from the National Marine Fisheries Service (NMFS, 2018a)[3]. Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur permanent injury of some degree (equated to Level A harassment).

The purpose of the acoustic monitoring reported herein was to record in-situ underwater sound levels to empirically verify Level A and Level B harassment zones for the phocid pinnipeds for each specific underwater sound-generating activity. At a range of distances within the planned harassment zones e4sciences recorded sound levels that resulted from impact and vibratory pile driving to calculate actual underwater sound attenuation rates and evaluate the project's Level A and Level B harassment zones.

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[1] NAVFAC, 2019, Marine Mammal Observation and acoustic monitoring plan for the Demolition/Replacement of Pier 32 and Demolition of pier 10 at Naval Submarine base New London, Groton, Connecticut.

[2] NAVFAC, 2018. Request for Letter of Authorization under the Marine Mammal Protection Act for the Demolition/Replacement of Pier 32/Demolition of Pier 10 at Naval Submarine Base New London, Groton, Connecticut. Revised May 2018. In Appendix G, Final Environmental Assessment and Finding of No Significant Impact for Demolition/Replacement of Pier 32/Demolition of Pier 10 Naval Submarine Base New NMFS London Groton, Connecticut, October 2018.

[3] NMFS. 2018a. 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 Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-OPR-59. April 2018.

This report summarizes the first year of passive underwater acoustic monitoring results in the vicinity of Pier 32 from March 1, 2021, to February 28, 2022. All pile driving occurred between March 1, 2021, and August 2, 2021. There were no pile driving activities conducted from August 3, 2021, to February 28, 2022. During this phase of construction both temporary and permanent 36-in steel piles were driven for the installation of the new Pier 32. e4 monitored underwater sound during the installation of 118 permanent 36in x 0.5in steel piles for Bents 1 to 24, and 46 temporary 36in x 0.5in steel piles driven to secure the installation template that aligned the permanent piles (Table ES-1). e4 also monitored during the vibratory drive and removal of three 14-inch H-piles used to probe the depth of bedrock. e4 monitored underwater sound levels during pile vibratory driving with the APE 300-6 head, impact hammer pile driving with the Junttan HHK 16S head, and pile drilling operations. e4 recorded ambient conditions during times when there were no noise-generating construction activities that required monitoring.

In summary, e4 determined the underwater sound source levels and verified harassment level distances.

Underwater sound source levels. The range of sound levels from driving the piles were measured by e4. For vibratory driving of a 36-in steel pile, the measured sound source levels for a 36-in steel pile is lower than the predicted sound level established for the project.. For impact pile driving the measured sound level at 10m is consistent with the predicted sound source levels.

Level-A The measured values show that with respect to vibratory pile driving the cSEL is well below the 201 dB Level A threshold for continuous noise by the time the near-field hydrophone records it. This is consistent with the predictive values. With respect to impact driving, the peak SPL is near the 218 dB Level A threshold for impulsive noise at the near-field hydrophone and well below the threshold at the far-field hydrophone.

Level A distance verification. Level A harassment distances where the cSEL levels drops below 185 dB was determined from linear interpolation. These calculated distances are well within the predicted Level A distance.

Level B distance verification. For Level B verification for impulsive sources this report determined the distance that the SPLrms dropped below the 160 dB Level B threshold that the NAVFAC (2018) used for impact driving. These calculated distances from the filed measurements are well within the predicted Level B distance.

Table ES-1. Summary of monitoring days during installation of 164 36-in piles (118 permanent and 46 temporary) and 3 14-inch H-piles probes**.**

Construction Activities that occurred during monitoring	Number of Piles for each activity (single piles may have multiple activities)	Number of days of activities occurred
None, Monitored ambient conditions	0	18
Total 14-inch H-pile probes vibration	3	5
Total 36in x 0.5in steel piles installed	164	97
Vibration of 36in x 0.5in steel piles	137	42
Impact hammering of 36in x 0.5in steel piles	120	24
Drilling of 36in x 0.5in steel piles	22	17

Note that on some days multiple activities occurred. Additionally, multiple activities may have occurred to individual piles. For example, piles were vibrated before being impact hammered. No other pile types or sizes were installed during the reporting period.

Table of Contents

List of Figures

List of Tables

Weeks Marine, Inc.
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e4sciences LLC

**Underwater Acoustic Monitoring
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At the Naval Submarine Base, New London, CT**

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Between March 1, 2021, and August 02, 2021**

1.0 Introduction

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This report summarizes the first year of passive underwater acoustic monitoring results in the vicinity of Pier 32 from March 1, 2021, to February 28, 2022. For this year, all pile driving occurred between March

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1, 2021, and August 2, 2021. There were no pile driving activities conducted from August 3, 2021, to February 28, 2022. Daily and weekly activity summaries are included in previously submitted weekly reports. After a brief review of the methods this report reviews the results in the following order:

1. Location
2. Ambient conditions
3. Sound Source Verification
4. Per pile and per day data.
5. Cumulative SEL for each pile and each 24-hour period
6. Level A and B harassment zones

During this phase of construction both temporary and permanent 36-in steel piles were driven for the installation of the new Pier 32. e4 monitored underwater sound during the installation of 118 permanent 36in x 0.5in steel piles for Bents 1 to 24, and 46 temporary 36in x 0.5in steel piles driven to secure the installation template that aligned the permanent piles (Table 1). e4 also monitored during the vibratory drive and removal of three 14-inch H-piles used to probe the depth of bedrock. e4 monitored underwater sound levels during pile vibratory driving with the APE 300-6 head, impact hammer pile driving with the Junttan HHK 16S head, and pile drilling operations. e4 recorded ambient conditions during times when there were no noise-generating construction activities that required monitoring.

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2.0. Methods

e4 collected data from two devices suspended in the water in the vicinity of Pier 32. The near-field device was a calibrated Ocean Sonics icListen RB9-ETH-X2 900m rated 10Hz-200 kHz hydrophone with a sampling rate of 50 kHz. The near-field device was suspended from the crane nearest to the pile driving. The near-field hydrophone was placed as close as possible to being 10m from the pile being driven.

The far-field device was a calibrated Ocean Sonics icListen RB9-ETH 900m rated 10Hz-200 kHz hydrophones with a sampling rate of 50 kHz. This second device was deployed from a boat or from Dock E or Pier 33. The distance of the far-field was deployed at varying distances from the pile driving activity. The velocity of river currents exceeded the threshold at which mid-water column monitoring is allowed so the hydrophone was suspended 1 meter from the riverbed.

3.0 Results

Daily and weekly activity summaries are included in weekly reports submitted by e4sciences to Weeks Marine. Weeks Marine submitted daily and weekly summary reports to the MIDLANT Natural Resource Manager for Naval Submarine Base New London on a weekly basis. The summary results for the duration of monitoring comprise Appendix A (Tables A-1 through A-3) and are provided in digital form as spreadsheets. Data are summarized by day and by pile for 36-in piles and 14-inch H-piles pile probes in tables A-1 through A-3. Table A-1 lists the results for vibration of H pile probes. Table A-2 lists the results for vibration of 36in x 0.5in steel piles using the APE 300-6 Head. Table A-3 lists the results for impact hammering of the 36in x 0.5in steel piles using the Junttan Head.

3.1 Locations

The near-field hydrophone was placed as close as possible to the required 10m (33ft) offset from the pile driving. A device, identical to the near-field hydrophone, was occasionally deployed from other cranes on or near Pier 32. The far-field hydrophone was set at different locations including existing Pier 32, Pier 33, Dock E, and sites up and down the river to vary the distance to the source. Figure 1 shows the location of the near-field and a portion of the far-field hydrophones during the extent of the project. Figure 2 shows the overall range of the hydrophone locations deployed during the project.

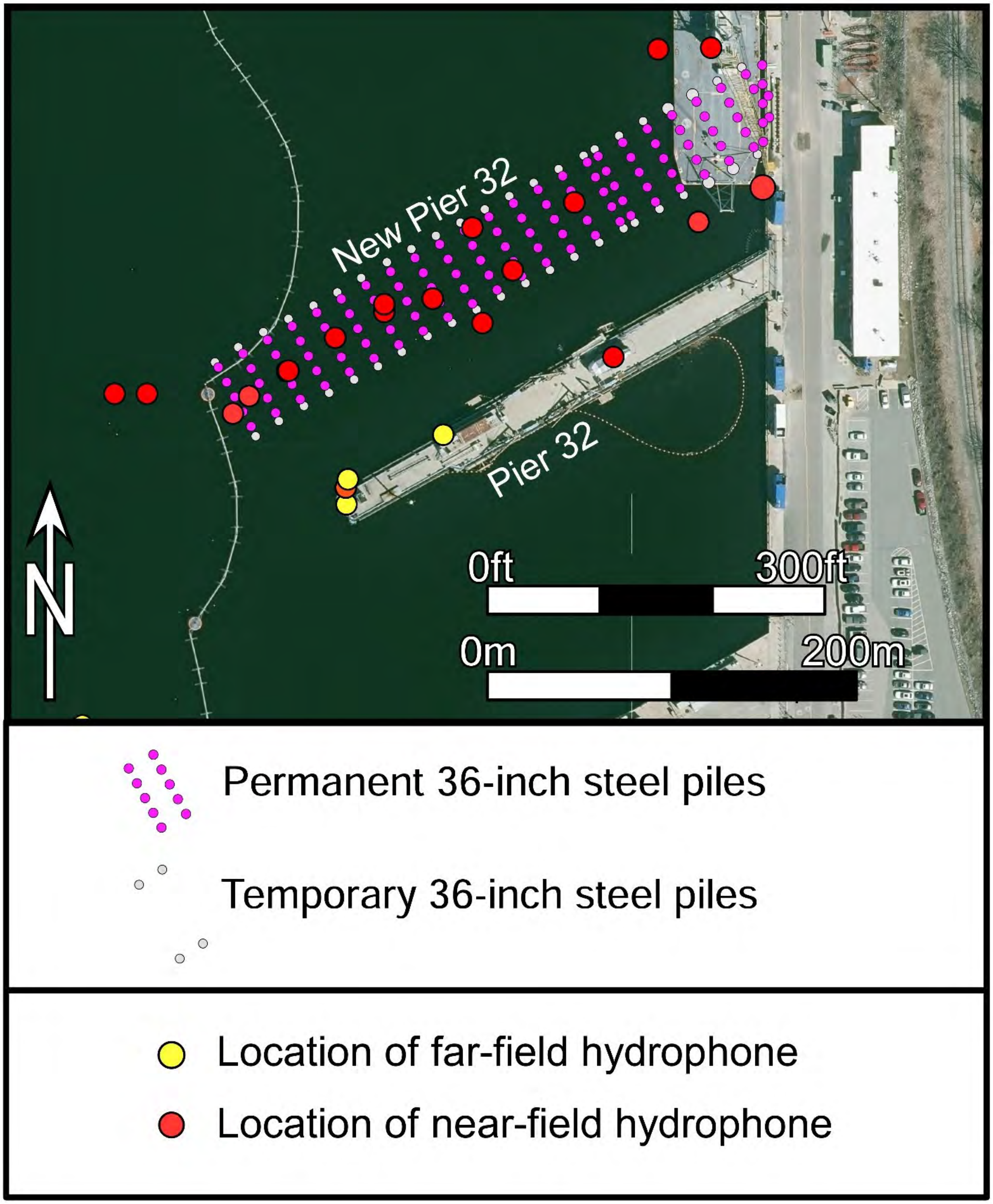


Figure 1. Map showing locations of near-field and a portion of the far-field hydrophones in relationship to the 36-inch steel piles.

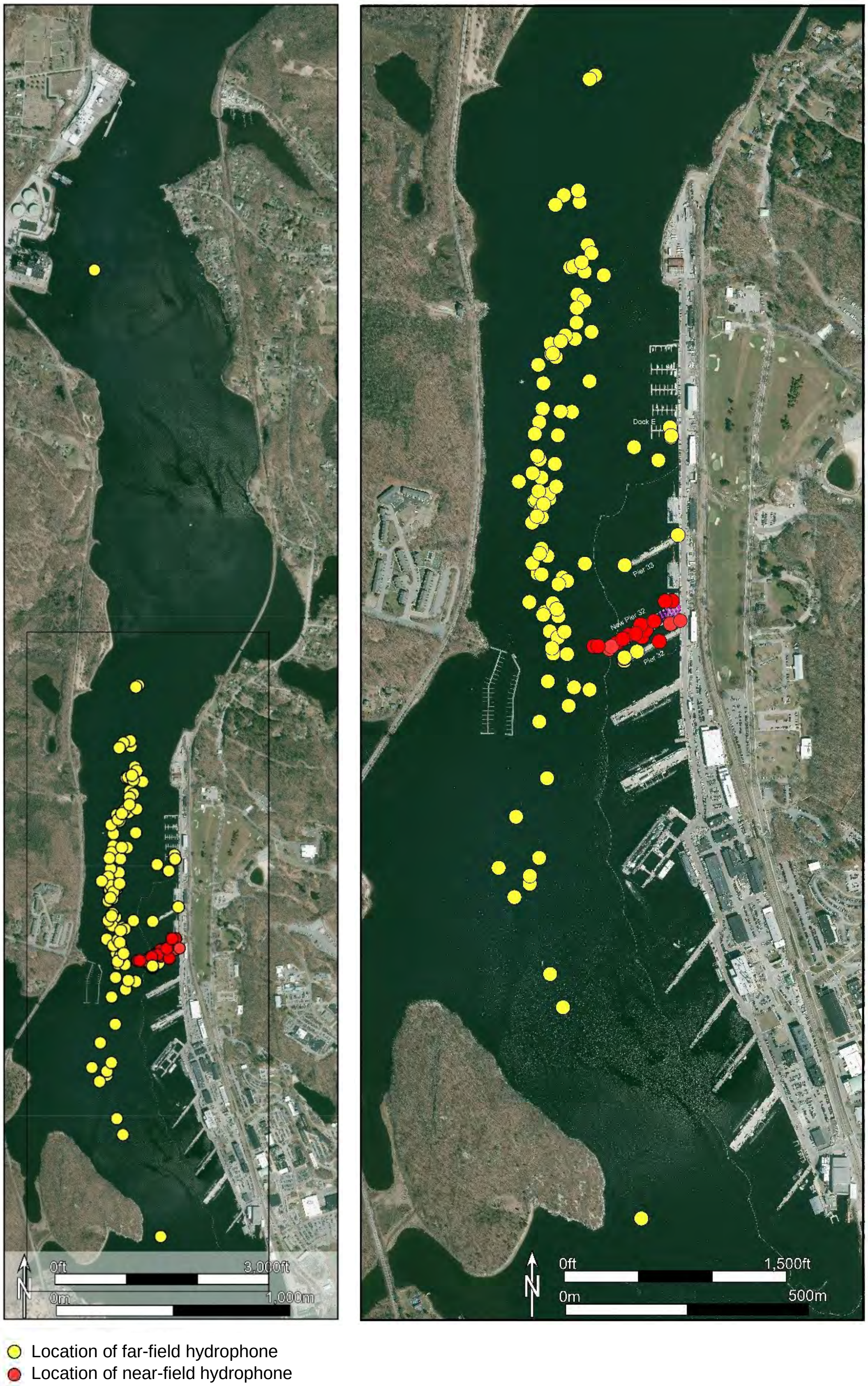


Figure 2. Zoomed out maps showing the overall range of locations of hydrophones during project.

3.2 Ambient conditions – background noise levels

There was no historic ambient or background underwater acoustic data for the Thames River available for the preparation of the Request for Letter of Authorization (NAVFAC, 2018)[2]. NAVFAC, 2018, uses the 120 dB threshold for Level B behavioral harassment from continuous sound for this project. This level was used despite the potential for vessel noise within the river to exceed the 120 dB threshold. The project plan (NAVFAC, 2019)[1] required at least two days of ambient underwater acoustic monitoring.

Background underwater sound levels were measured for 18 days in the absence of construction activities to determine the ambient conditions to understand the range of background sound levels. Data for three of these days are presented below.

Table 2 shows the cumulative sound exposure levels (cSEL) averages for three days during which there was no construction that required underwater acoustic monitoring. These data indicate that the sound levels in the waters in the immediate vicinity of Pier 32 frequently exceeded 120 dB. In the main Thames River channel, the underwater average sound level ranged from less than 120 dB on a quiet day, to averaging slightly more than 121 dB on a loud day.

Table 2. Ambient underwater sound levels measured by e4 for this project.

Monitoring day	Noise Generating Activity	Date	Vicinity of Pier 32	Near-field hydrophone distance to site	Thames River away from Pier 32	Far-field hydrophone distance to site
			cSEL (mean +/- 2 STD)	ft	cSEL (mean +/- 2 STD)	ft
			dB re 1 μPa2-s		dB re 1 μPa2-s	
Relatively quiet day 1	No construction, low vessel activity	2021.03.12	131.2 +/- 10.3	33	112.9 +/- 8.4	834
Relatively loud day 1	No pile driving, high vessel activity	2021.03.11	149.6 +/- 16.6	33	121.2 +/- 15.8	1816
Relatively loud day 2	No pile driving, high vessel activity	2021.04.17	145.8 +/- 5.1	33	121.4 +/- 14.4	1067

Figures 3 through 5 show examples of spectrograms of these ambient data for the 3 days. Each day has a recording near Pier 32 and one from the boat in the Thames River. The figures first show a day that was relatively quiet and then two relatively louder days. Figure 3 shows a relatively quiet background. Figure 4 shows a day with heavy vessel traffic. Figure 5 shows a day that was relatively loud near Pier 32 but not away from it. Vessel traffic produced some of the loudest non-construction noise. Figure 4 shows the acoustic signature of tugboats passing.

Figures 6-8 show Cumulative Distribution Function (CDF) and histogram from the ambient recordings from two hydrophones on the three days. For each hydrophone for each day the full range of frequencies recorded (20 Hz to 51.2 kHz) was used to calculate 30-second Root Mean Square (RMS) values for each 30 second window of each day. These data were used to calculate the CDF and the associated histograms shown in Figures 6-8.

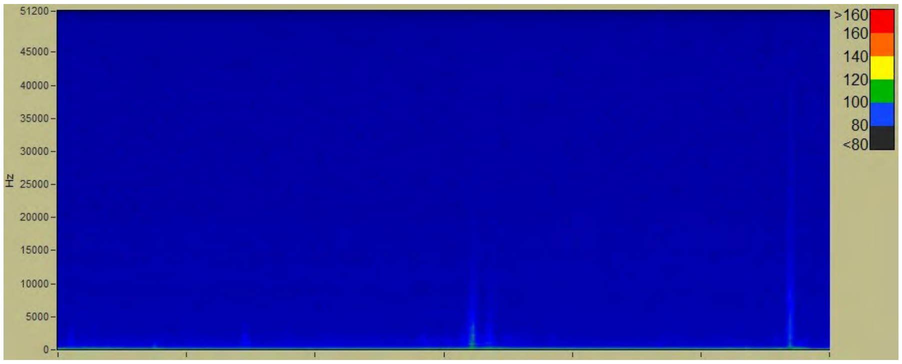


Figure 3A. Example of spectrogram of acoustic ambient data recorded from the Quay wall in the vicinity of Pier 32 area over 5 hours on March 12, 2021. Tick marks are spaced at 41 minutes apart.

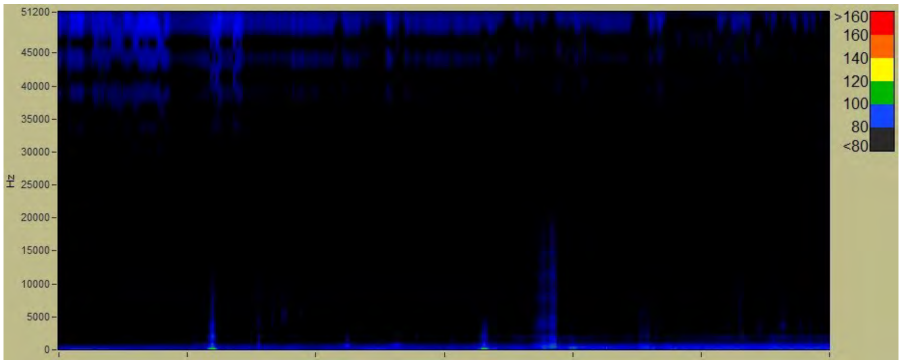


Figure 3B. Example of spectrogram of acoustic ambient data recorded from the end of existing pier 32 area over 4.2 hours on March 12, 2021. Tick marks are spaced at 31 minutes apart.

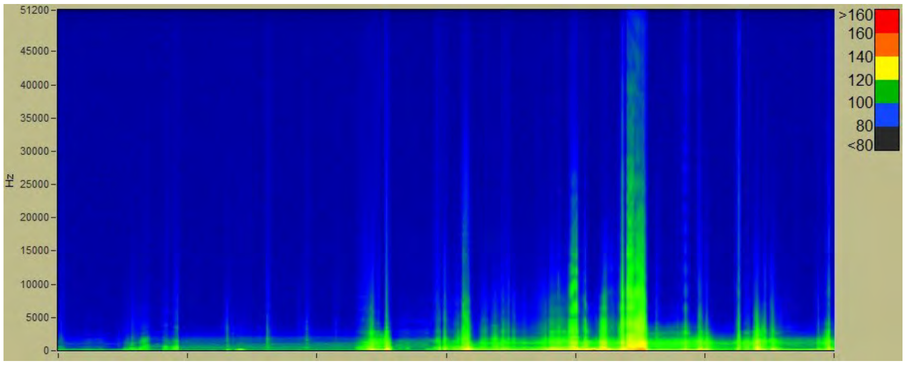


Figure 4A. Example of spectrogram of acoustic ambient data recorded from the pier 32 area on March 11, 2021. Tick marks are spaced at 53 minutes apart.

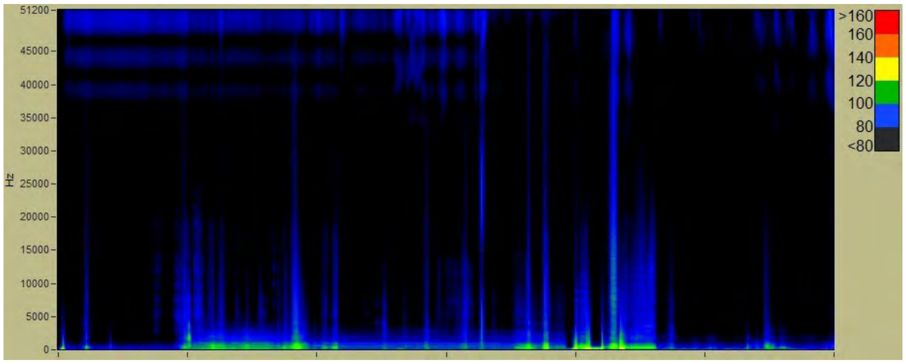


Figure 4B. Example of spectrogram of acoustic ambient data recorded from the boat on March 11, 2021. Tick marks are spaced at 54 minutes apart.

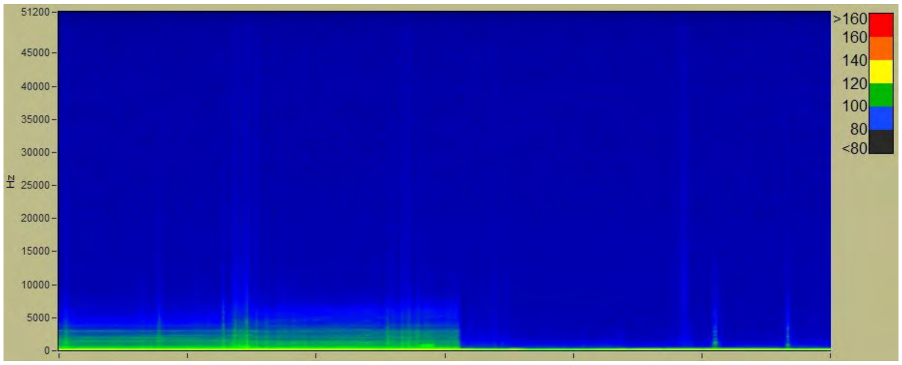


Figure 5A. Example of spectrogram of acoustic ambient data recorded from crane 526 in the area of Pier 32 on April 17, 2021. Tick marks are spaced at 59 minutes apart.

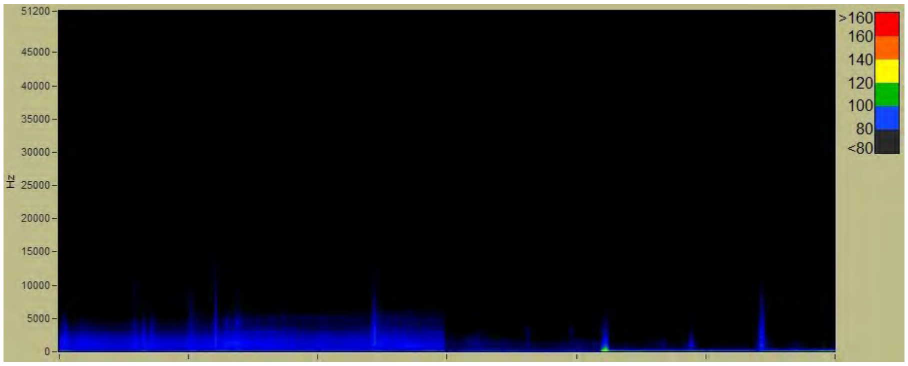


Figure 5B. Example of spectrogram of acoustic data recorded from the boat on April 17, 2021. Tick marks are spaced 61 minutes apart.

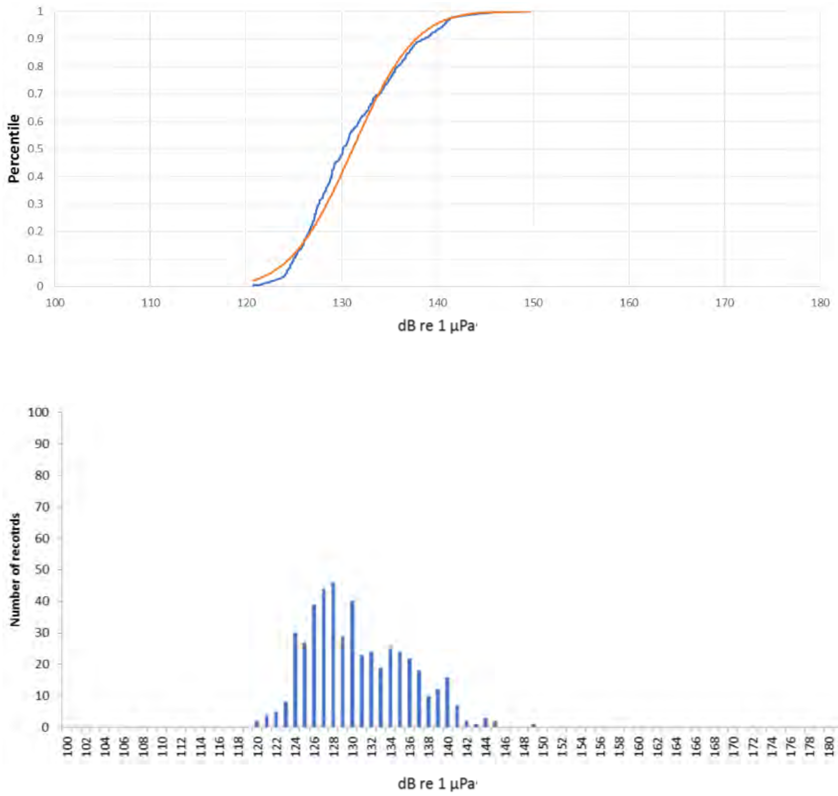


Figure 6A. Relatively quiet ambient conditions recorded near Pier 32 on March 12, 2021. Upper graph plots the cumulative distribution curve of 30-second SPLrms data. The blue line is the raw data, and the orange line is the normalized data curve. Lower graph is the associated histogram.

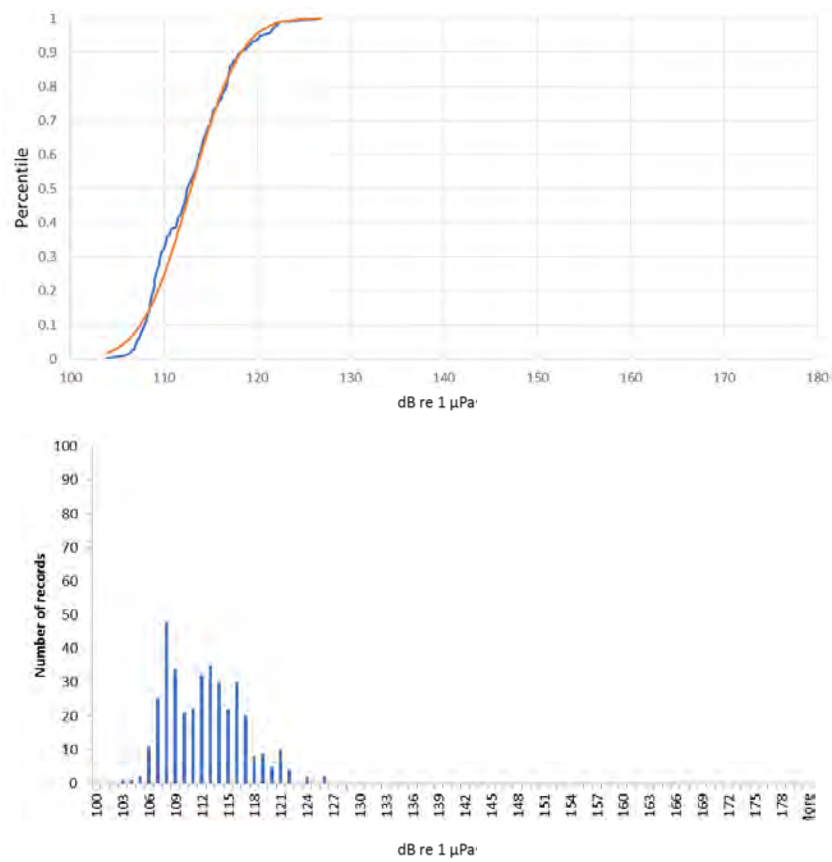


Figure 6B. Relatively quiet ambient conditions recorded from the boat on March 12, 2021. Upper graph plots the cumulative distribution curve of 30-second SPLrms data. The blue line is the raw data, and the orange line is the normalized data curve. Lower graph is the associated histogram.

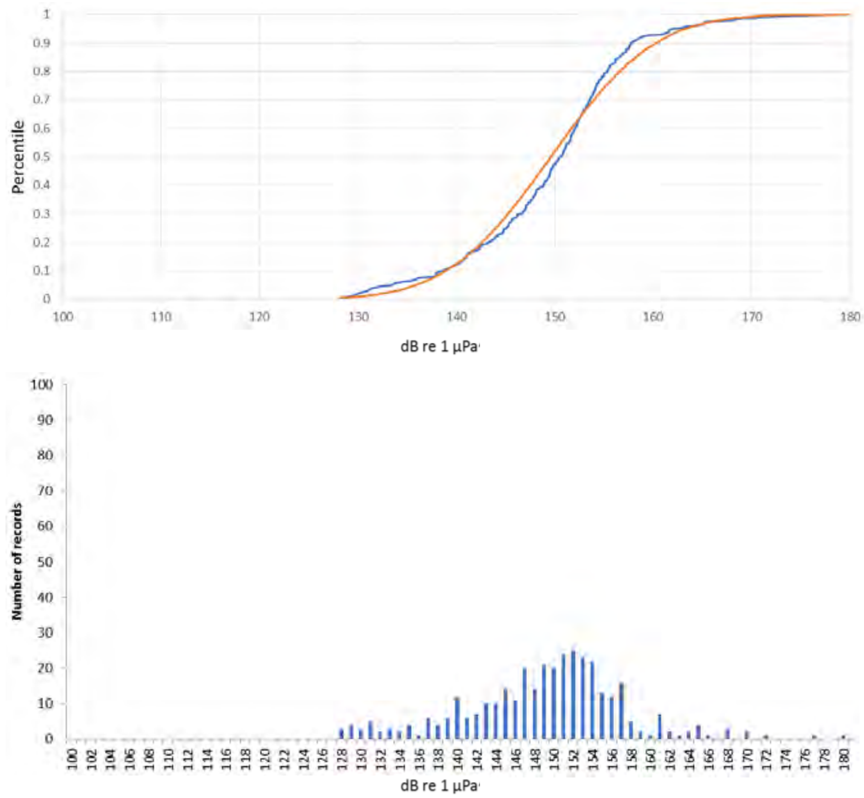


Figure 7A. Relatively loud ambient conditions with high vessel activity recorded near Pier 32 on March 11, 2021. Upper graph plots the cumulative distribution curve of 30-second SPLrms data. The blue line is the raw data, and the orange line is the normalized data curve. Lower graph is the associated histogram.

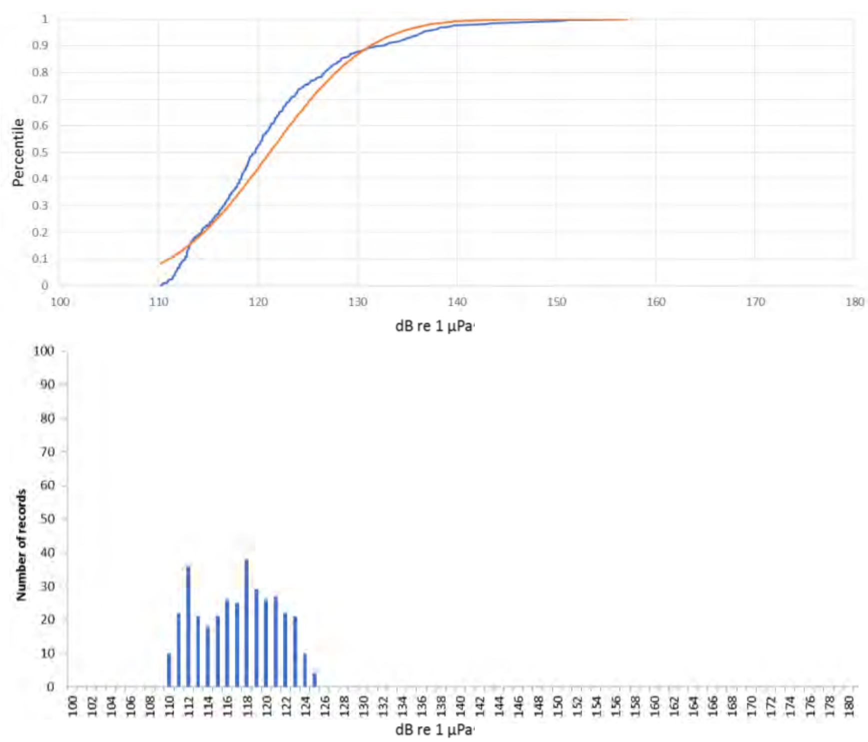


Figure 7B. Relatively loud ambient conditions with high vessel activity recorded from boat on March 11, 2021. Upper graph plots the cumulative distribution curve of 30-second SPLrms data. The blue line is the raw data, and the orange line is the normalized data curve. Lower graph is the associated histogram.

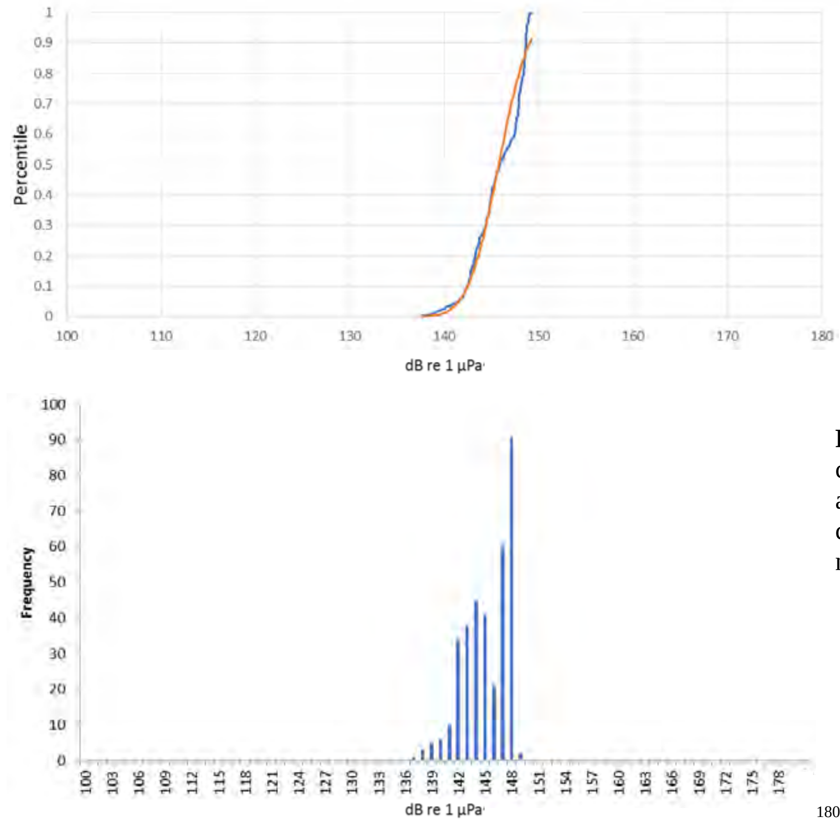


Figure 8A. Cumulative distribution curve of 30-second SPLrms and associated histogram for ambient conditions recorded from crane 526 near Pier 32 on April 17, 2021.

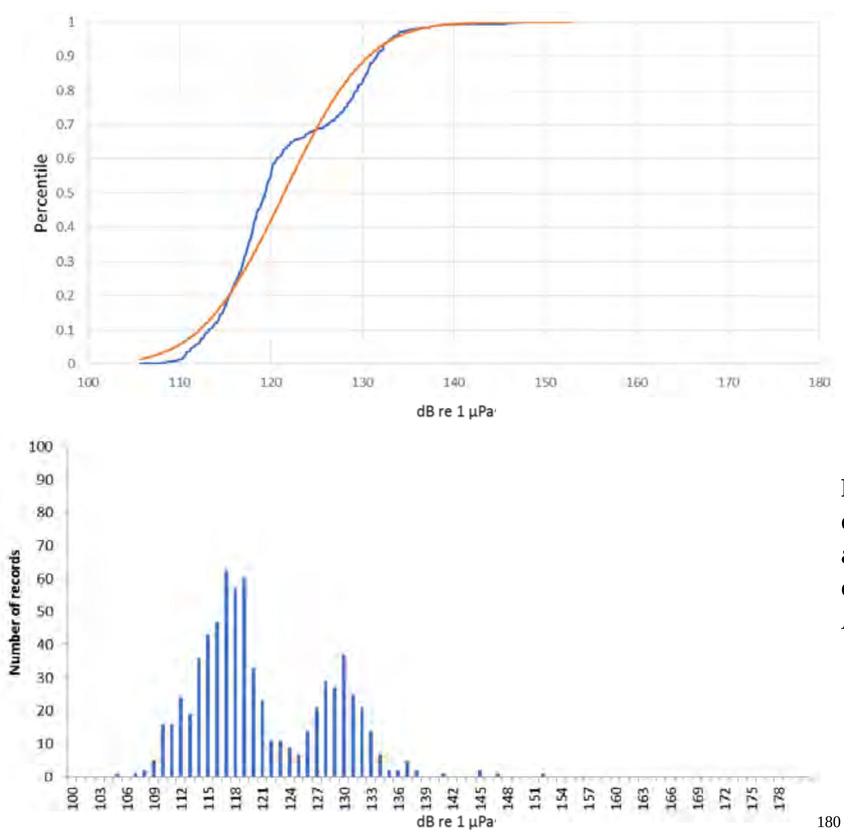


Figure 8B. Cumulative distribution curve of 30-second SPLrms and associated histogram for ambient conditions recorded from the boat on April 17, 2021.

3.3 Underwater Sound Source Verification

Table 3 lists the predicted sound source levels from driving piles for this project as estimated by the Request for Letter of Authorization (NAVFAC, 2018)[2] based on data from historic projects. Table 3 also lists the range of sound levels from driving the piles measured by e4. For vibratory driving of a 36-in steel pile, the measured sound source levels for a 36-in pile are lower than the predicted sound level. For impact pile driving the measured sound level at 10m is consistent with the predicted sound source levels. No other pile types or sizes were installed during the reporting period.

Table 3. Summary of in-water pile driving source levels at 10 m from source (predicted values from Table 4 of NMFS, 2018b[7]).

Method	Pile type	NAVFAC Predicted Source levels @ 10m			2021 Measured Source levels @ 10m		
		SPLpk	SPLrms	SEL	SPLpk mean (range)	SPLrms mean (range)	SEL mean (range)
		dB re 1µPa	dB re 1µPa	dB re 1 µPa^2-sec	dB re 1µPa	dB re 1µPa	dB re 1 µPa^2-sec
Vibratory Driving	36-in steel	n.a.	168	168	n.a.	150.9 (140.4 - 160.4)	147.1 (140.4 - 160.4)
Rock Socket Drilling	36-in steel	n.a.	168	168	n.a.	158.8 (144.1-173.4)	147.3 (132.4-162.1)
Impact Driving	36-in steel	209	198	183	209.6 (202.2-218.9)	196.5 (188.2-204.9)	181.1 (171.1-188.8)

3.3.1 Sound level data. Table 4 shows the underwater sound characteristics during vibration using the APE 300-6 head recorded between 8 and 12 meters from source. Table 5 shows the underwater sound characteristics during impact hammering of the Junttan head recorded between 8 and 12 meters from source.

Table 4. Near-field hydrophone values recorded between 8 to 12 m from the source of vibration of the 36in x 0.5in steel piles using the APE 300-6 Head.

Observed Sound Level	Distance to Hydrophone		cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
	ft	m	dB re 1 µPa^2-sec	dB re 1 µPa	dB re 1 µPa	dB re 1 µPa	dB re 1 µPa^2-sec	dB re 1 µPa^2-sec	dB re 1 µPa^2-sec	dB re 1 µPa	dB re 1 µPa	dB re 1 µPa
Minimum	28.0	8.5	148.2	160.9	186.3	172.4	130.3	152.9	140.4	140.0	166.6	151.9
Maximum	34.6	10.5	183.1	172.7	195.3	185.2	151.2	167.8	160.4	159.8	175.6	168.4
Average*	32.3	9.8	157.5	166.4	182.1	173.6	140.3	155.3	147.1	150.9	167.0	158.4

*Averaged over 18 time periods during which source was between 8 and 12 meters from near-field hydrophone.

Table 5. Near-field hydrophone values recorded between 8m and 12m from the source of impact hammering of the 36in x 0.5in steel piles using the Junttan Head.

Observed Sound Level	Distance to Hydrophone		cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
	ft	m	dB re 1 µPa^2-sec	dB re 1 µPa	dB re 1 µPa	dB re 1 µPa	dB re 1 µPa^2-sec	dB re 1 µPa^2-sec	dB re 1 µPa^2-sec	dB re 1 µPa	dB re 1 µPa	dB re 1 µPa
Minimum	37.3	11.4	189.5	184.9	207.9	202.2	153.8	180.0	174.1	170.2	195.2	188.2
Maximum	37.3	11.4	210.4	216.2	222.5	218.8	187	189.6	188.8	202.7	212.5	204.9
Average*	32.1	9.8	204.9	196.0	214.5	209.6	168.4	184.6	181.1	181.9	205.4	196.5

*Averaged over 30 time periods during which source was between 8 and 12 meters from near-field hydrophone.

[7] NMFS 2018b 50 CFR Part 217 [Docket No. 170908887–8328–01] RIN 0648–BH24 Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to U.S. Navy Pier Construction Activities at Naval Submarine Base New London, in Proposed Rules Federal Register Vol. 83, No. 72, Friday, April 13, 2018, 16027-16043.

3.3.2 Frequency spectrums. Figure 9 shows an example of frequency spectrum recorded during drilling. Figure 10 is the corresponding spectrogram for a one-minute recording.

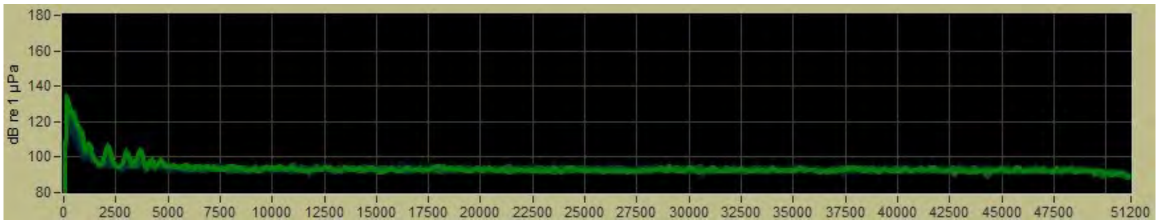


Figure 9. Example frequency spectrum recorded during drilling.

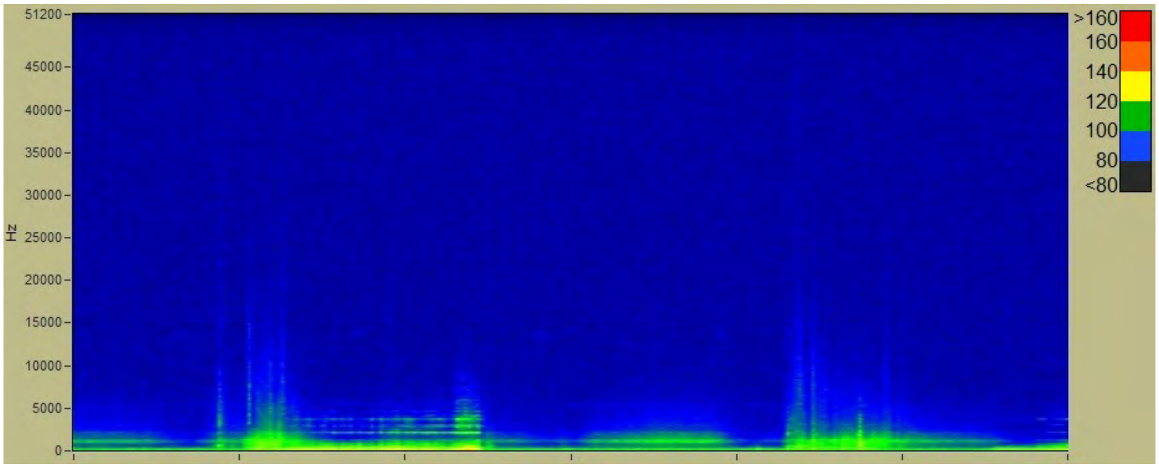


Figure 10. Example spectrogram recorded during drilling. Tick marks are 10 seconds apart.

Figure 11 shows examples of frequency spectrums recorded during pile vibration one near the source and one away from the source. Figure 12 shows the corresponding spectrograms for a one-minute recording.

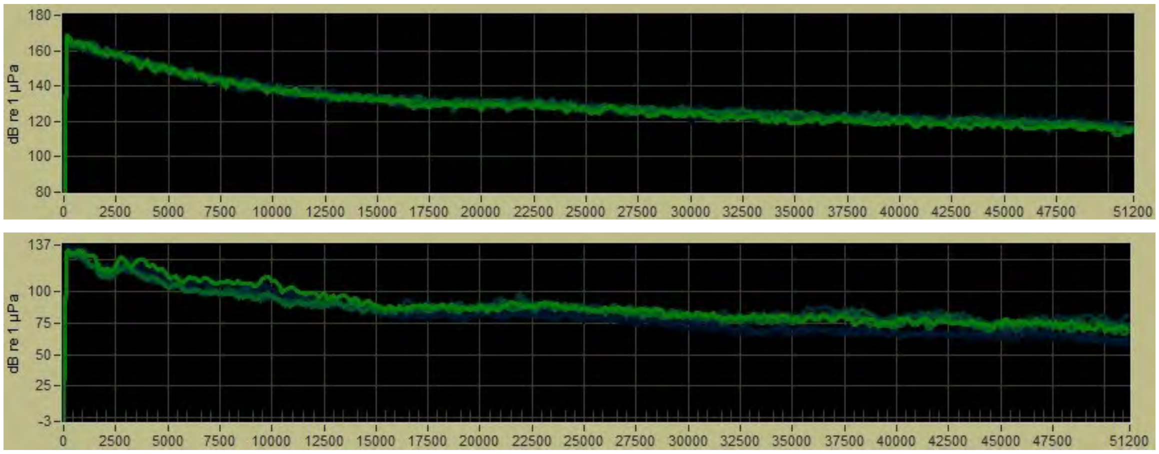


Figure 11. Example frequency spectra recorded during vibration of piles. Top one shows the near-field recording, whereas the bottom one the shows the recorded spectrum at 700ft (213m) from the source.

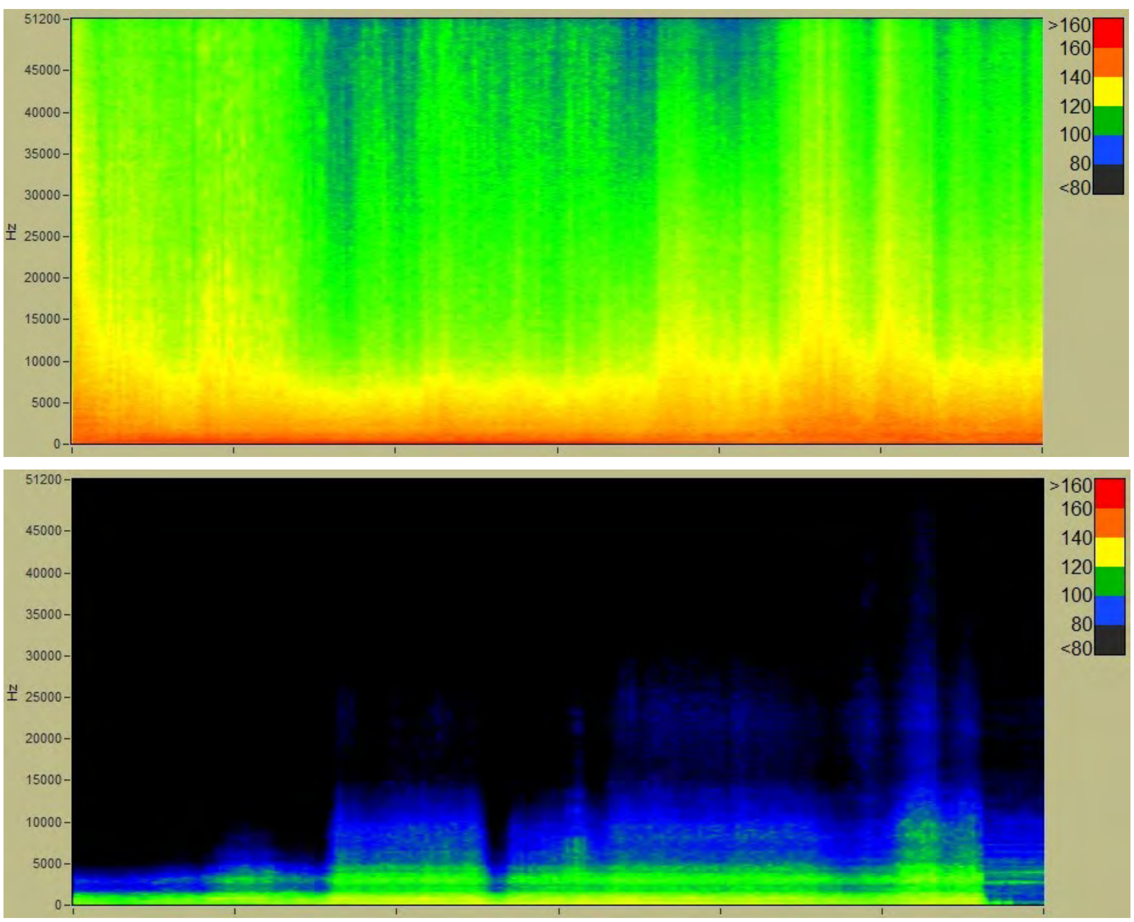


Figure 12. Examples of spectrograms recorded during vibration of piles. The top image shows the near-field record. The bottom image shows the plot recorded at 700ft (213m) from the source. Tick marks are 10 seconds apart.

Figure 13 shows examples of frequency spectrums recorded during pile impact hammering, one near the source and one away from the source. Figure 14 shows the corresponding spectrograms for a one-minute recording.

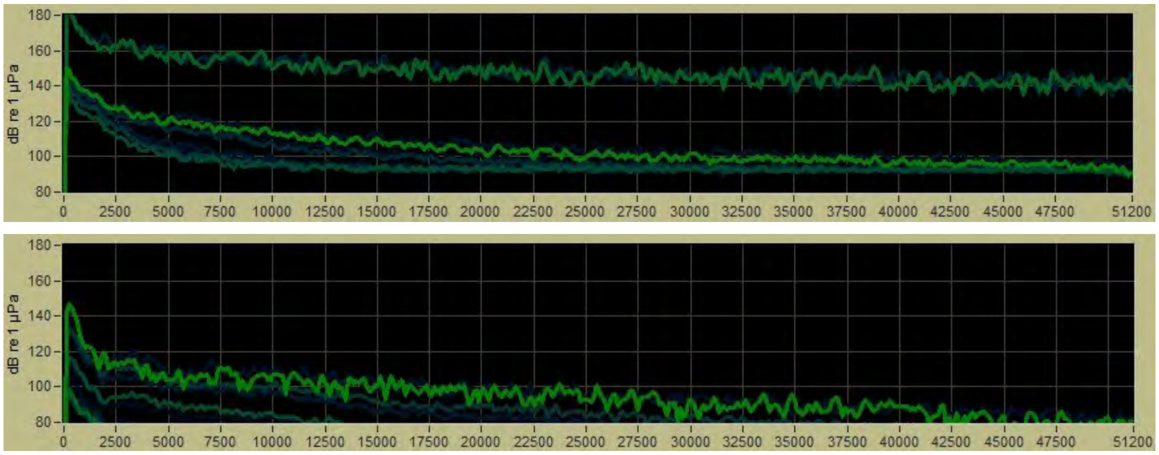


Figure 13. Example spectra recorded during vibration of piles. Top one shows the near-field recording, whereas the bottom one the shows the recorded spectrum at 1,000ft (427 m) from the source.

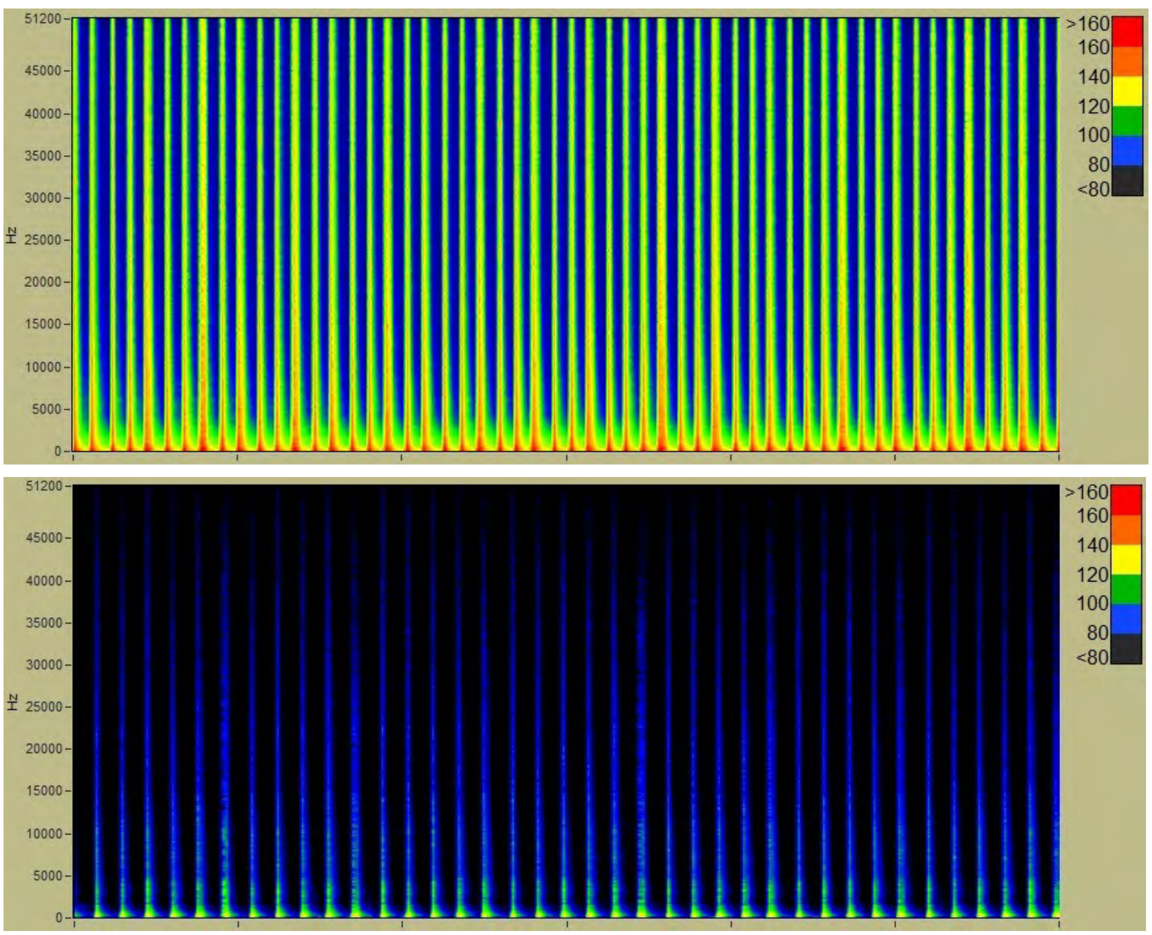


Figure 14. Examples of spectrograms recorded during impact hammering of piles. The top image shows the near-field record. The bottom image shows the plot recorded at 1,000ft (427 m) from the source. Tick marks are 10 seconds apart.

3.4 Per pile and per day data.

3.4.1 Number of pile-strikes per pile and per day. The number of pile strikes were recorded by Weeks and confirmed with the impulse events logged by the hydrophones. Table 6 provides the range in the daily total of pile strikes. Table 7 provides a range in the total number of strikes to install a given pile.

The Wave Equation Analysis for Piles (WEAP) performed by GZA indicated that a typical 190-ft long, 36in x 0.5in Steel Pipe Pile would require 1,551 strikes from the impact hammer to completely drive it to bedrock. This assumed no use of a vibratory hammer. Weeks Marine's means and methods used both vibratory and impact hammers to drive each of the steel pipe piles. This resulted in much fewer strikes from the impact hammer for each pile and each day (Tables 6 and 7).

Table 6. Impact hammer strikes per day using the Junttan Head driving the 36in x 0.5in steel piles.

	Predicted average impact hammer strikes per day	Measured impact hammer strikes per day	Date
Maximum	n.a.	10,734	2021.07.07
Average	6,139	3,439	2021.04.16-2021.08.02
Minimum	n.a.	14	2021.07.01

Table 7. Impact hammer strikes per pile using the Junttan Head driving the 36in x 0.5in steel piles.

	Predicted impact hammer strikes per pile	Measured impact hammer strikes per pile	Piles
Maximum	n.a.	3,266	10A
Average	1,551	629	6A-24E
Minimum	n.a.	103	10C

Far-field observations were made from a range of distances within the Level A and Level B harassment zones. Figure 15 plots all the near- and far-field data for vibratory driving of each 36in x 0.5in pile. Figures 16 and 17 plot all the near- and far-field data for each impact driving of each 36in x 0.5in pile.

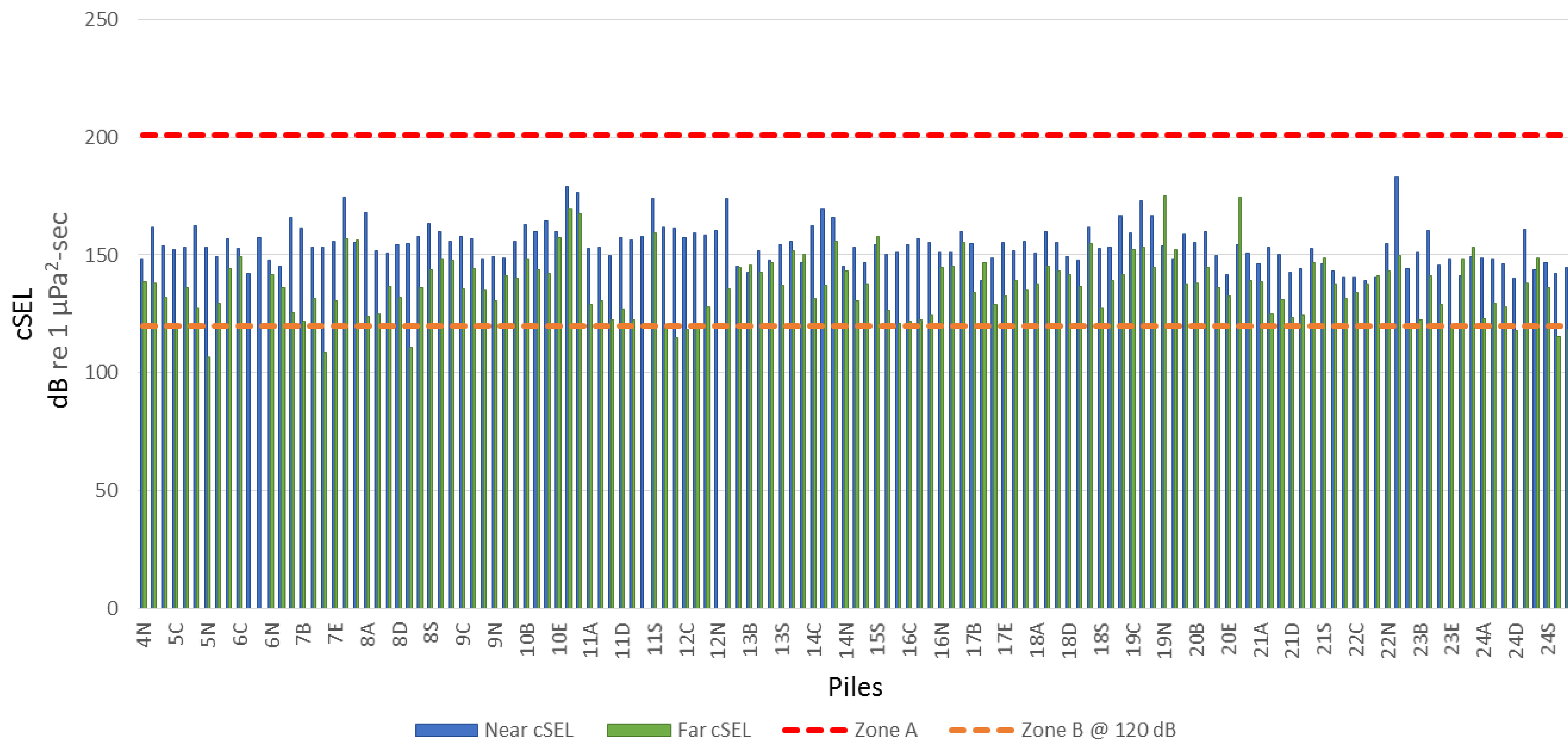


Figure 15. Plot of near-field and far-field cumulative SEL (cSEL) recorded during vibratory driving of each 36in x 0.5in steel pile.

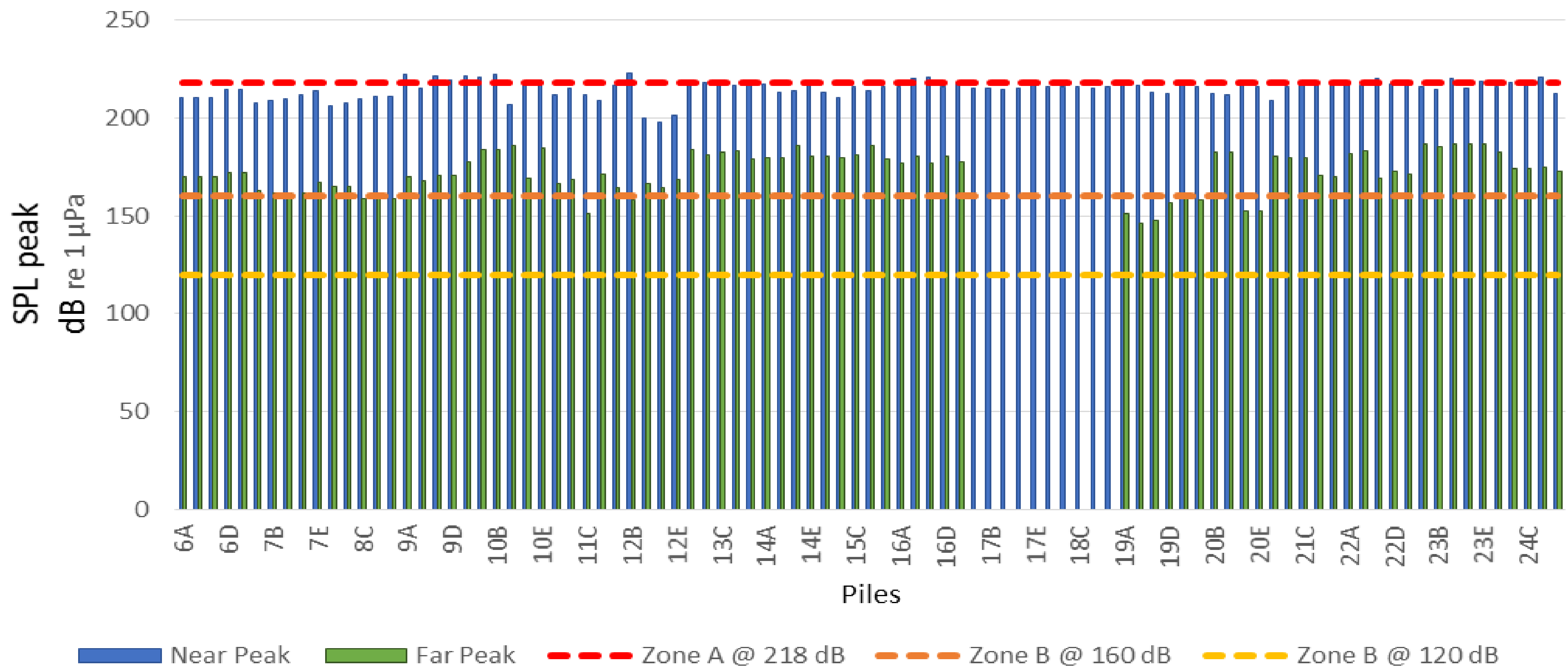


Figure 16. Plot of near-field and far-field Peak impulse (SPLpk) recorded during impact hammer driving of each 36in x 0.5in steel pile.

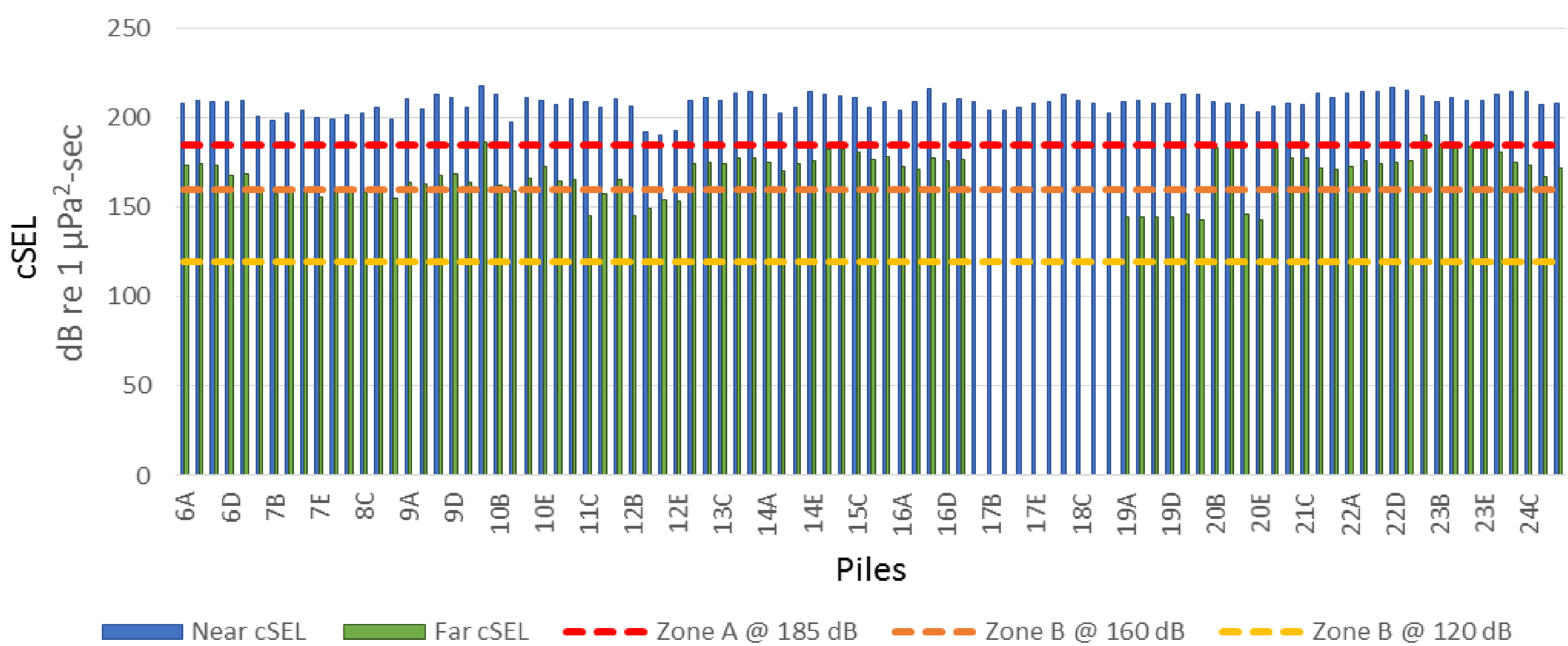


Figure 17. Plot of near-field and far-field cumulative SEL (cSEL) recorded during impact hammer driving of each 36in x 0.5in steel pile.

3.4.2 Values per strike. The sound generated by drilling, vibrating, and impacting was recorded by near-field hydrophones (source without attenuation or transmission loss) and far-field hydrophones (with attenuation and transmission loss). These data include:

A. For each recorded strike (or each strike from a subset), the following:
  i. The peak pressure (SPLpk), defined as the maximum absolute value of the instantaneous pressure (overpressure or underpressure).
  ii. The root mean squared sound pressure across 90% of the strike's energy (SPLrms90%).
  iii. Sound exposure level, measured across 90% of the accumulated sound energy (SEL90%).

B. Maximum, mean, and range of the SPLpk, with, and if applicable, without attenuation.

C. Maximum, mean, range, and Cumulative Distribution Function (CDF) of the SPLrms90%, both with and if applicable, without attenuation where the CDF is used to report the percentage of SPLrms90% values above the thresholds.

D. Maximum, mean, and range of the SEL90%, both with and when applicable, without attenuation.

E. Cumulative SEL (cSEL) across all the pile strikes. If SEL was calculated for all strikes, cSEL is estimated. If SEL was calculated for a subset of strikes, cSEL is estimated as follows: cSEL = SELmean + 10*log (total # strikes).

Table 8 shows the values for the vibrating source for given distances from the source.

Table 9 shows the values for the impact source for given distances from the source.

Examples of per strike impulse events for the piles are summarized in Table 10. Full examples of per strike impulse events are available digitally.

Table 8. Summary for vibratory hammer.

Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
m	dB re 1 μPa^2-sec	dB re 1 μPa			dB re 1 μPa^2-sec			dB re 1 μPa		
All near-field	166.9	149.4	207.5	171.3	121.4	173.6	145.1	134.7	186.3	156.3
200	141.8	137.5	182.3	160.6	108.4	156.6	131.0	118.3	174.7	144.0
300	135.1	131.6	186.3	149.4	94.3	165.3	121.9	106.6	181.1	132.8
400	129.1	125.6	169.1	142.9	91.9	140.7	115.3	101.6	150.0	128.2
500	126.2	125.2	181.6	141.7	92.2	150.8	115.8	100.7	167.4	127.2

Table 9. Summary for impact hammer.

Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
m	dB re 1 μPa^2-sec	dB re 1 μPa			dB re 1 μPa^2-sec			dB re 1 μPa		
All near-field	228.1	166.4	222.6	208.5	141.3	191.3	180.4	152.6	215.7	195.6
400	189.2	141.6	183.5	154.2	108.1	158.1	145.7	120.2	176.1	173.6
600	172.4	138.5	184.3	159.9	111.6	159.5	135.6	123.7	177.2	147.2
800	166.3	147.8	186.2	161.4	119.5	164.9	135.6	130.8	176.3	147.4
1200	153.8	129.2	159.2	145.2	101.7	125.9	118.0	113.0	139.6	128.0

Table 10. Example of the summary of vibration and impact data available in appendix A.

Date	Pile ID	Drive	Location	# of events	SEL		SPLrms		SPLpk		cSEL
					Mean	Max	Mean	Max	Mean	Max	
					dB re 1 µPa²-sec		dB re 1 µPa		dB re 1 µPa		dB re 1 µPa²-sec
2021.06.08	8-B	Vibration	near-field	263	158.4	165.6	169.8	178.2	183.7	197.7	182.6
2021.06.08	8-B	Vibration	far-field	167	132.4	142.1	143.9	154.1	157.2	174.0	154.6
2021.06.08	8-C	Vibration	near-field	175	159.7	167.0	171.4	179.6	185.3	195.7	182.1
2021.06.08	8-C	Vibration	far-field	38	130.7	139.5	142.4	151.4	155.6	167.6	146.5
2021.06.08	8-D	Vibration	near-field	118	161.0	164.4	172.2	176.0	186.1	191.8	181.7
2021.06.08	8-D	Vibration	far-field	91	132.9	136.8	143.9	148.4	157.2	163.8	152.5
2021.04.26	11-A	Impact	near-field	617	186.6	187.6	205.3	212.9	215.2	216.6	214.5
2021.04.26	11-A	Impact	far-field	617	144.4	145.1	157.9	162.4	167.7	168.9	172.3
2021.04.26	11-B	Impact	near-field	1047	183.7	186.2	199.4	211.2	212.6	218.8	213.9
2021.04.26	11-B	Impact	far-field	1040	144.0	146.1	157.9	162.5	167.9	171.3	174.2
2021.04.26	12-A	Impact	near-field	705	186.2	187.3	204.8	214.0	215.6	216.8	214.7
2021.04.26	12-A	Impact	far-field	705	143.4	144.9	155.4	161.4	167.4	170.0	171.9
2021.05.11	16-A	Impact	near-field	405	177.9	186.2	193.6	209.6	206.1	214.6	204.0
2021.05.11	16-A	Impact	far-field	255	146.8	150.8	159.0	167.7	171.7	176.1	170.9
2021.05.11	16-B	Impact	near-field	167	185.8	188.4	200.7	213.1	214.1	216.7	208.0
2021.05.11	16-B	Impact	far-field	156	149.3	153.7	161.6	172.5	174.4	180.1	171.2
2021.05.11	16-E	Impact	near-field	453	182.3	188.9	196.0	211.6	210.0	217.2	208.9
2021.05.11	16-E	Impact	far-field	351	150.5	153.6	163.6	169.5	173.7	177.5	176.0

3.5 Cumulative SEL for each pile and each 24-hour period

The RMS90% values were calculated over the duration between where 5% and 95% of the energy of the pulse occurs. The single strike SEL associated with the highest absolute peak strike along with the total number of strikes per day and per pile was used to calculate the cumulative SEL for each pile and each 24-hour period.

Table 11 shows the single strike SEL associated with the highest absolute peak strike along with the total number of strikes per day, and the cumulative SEL per day calculated from these values. Table 12 shows the single strike SEL associated with the highest absolute peak strike along with the total number of strikes per pile, and the cumulative SEL per pile calculated from these values.

Table 11. The single strike SEL associated with the highest absolute peak strike along with the total number of strikes per day, and the cumulative SEL per day calculated from these values.

Date	Max SEL per day	Strikes per day	cSEL per day
YYYY-MM-DD	dB re 1 µPa²-sec		dB re 1 µPa²-sec
2021.04.16	181.8	1162	212.5
2021.04.19	185.6	1597	217.6
2021.04.20	188.1	1156	218.7
2021.04.21	189.6	3310	224.8
2021.04.26	187.3	3261	222.4
2021.04.27	173.0	1061	203.3
2021.05.04	191.2	2851	225.7
2021.05.05	186.5	312	211.4
2021.05.11	191.3	5680	228.8
2021.05.12	181.1	n.a.[1]	n.a.
2021.05.17	186.7	4231	223.0
2021.05.21	190.1	3801	225.9
2021.05.24	184.3	1811	216.9
2021.05.26	188.2	8083	227.3
2021.06.02	189.6	6303	227.6
2021.06.28	171.8	3094	206.7
2021.07.01	171.1	14	182.6
2021.07.07	186.9	10734	227.2
2021.07.20	183.3	n.a.	n.a.
2021.08.02	186.4	n.a.	n.a.

1. n.a. = data was not provided to e4sciences

Table 12. The single strike SEL associated with the highest absolute peak strike along with the total number of strikes per pile, and the cumulative SEL (cSEL) per pile calculated from these values.

Pile	Max SEL per pile	Strikes per pile	cSEL per pile
	dB re 1 µPa²-sec		dB re 1 µPa²-sec
6A	182.9	1393	214.3
6B	183.9	1703	216.2
6C	184.3	1633	216.4
6D	185.9	n.a.	n.a.
6E	186.9	n.a.	n.a.
7A	178.2	619	206.1
7B	180.1	383	205.9
7C	181.2	598	209.0
7D	184.0	723	212.6
7E	186.5	199	209.5
8A	178.2	495	205.1
8B	178.9	634	206.9
8C	180.0	758	208.8
8D	182.1	971	212.0
8E	181.6	304	206.4
9A	189.6	181	212.2
9B	185.7	173	208.1
9C	189.1	887	218.6
9D	185.6	593	213.3
9E	187.9	263	212.1
10A	189.0	3265	224.1
10B	189.2	426	215.5
10C	178.1	103	198.2
10D	189.2	499	216.2
10E	188.1	835	217.3
11A	185.8	705	211.7
11B	183.8	617	214.6
11C	184.4	1047	210.0
11D	184.3	372	209.2
12A	184.0	331	214.3
12B	187.3	189	210.1
12C	170.1	281	194.6
12D	168.6	424	194.9
12E	173.0	356	198.5
13A	187.0	624	215.0
13B	188.9	611	213.2
13C	189.0	500	214.4
13D	189.7	298	216.0
13E	189.1	260	216.8
14A	191.2	429	214.2
14C	187.8	441	205.3
14D	187.0	405	209.7
14E	190.2	453	217.5
15A	191.0	167	215.9
15B	191.3	559	212.9
15C	186.9	393	215.7
15D	186.9	380	208.5
15E	185.6	196	212.7

Pile	Max SEL per pile	Strikes per pile	cSEL per pile
	dB re 1 µPa²-sec		dB re 1 µPa²-sec
16A	187.4	671	213.1
16B	183.5	868	213.2
16C	184.9	1259	218.8
16D	186.4	215	212.8
16E	184.7	114	216.8
17A	186.3	492	215.7
17B	186.4	282	211.6
17C	186.3	574	212.1
17D	186.3	406	213.4
17E	186.4	244	210.9
18A	186.5	274	213.2
18B	186.3	514	213.9
18C	186.7	346	210.9
18D	186.7	306	212.4
18E	186.7	793	210.3
19A	186.4	745	213.0
19B	186.5	285	213.9
19C	189.2	460	212.4
19D	190.1	448	211.5
19E	184.8	465	216.6
20A	185.8	460	215.1
20B	187.1	483	214.4
20C	186.4	455	213.0
20D	184.3	746	215.8
20E	184.1	1065	211.0
21A	188.2	721	212.7
21B	187.6	739	215.8
21C	186.2	1552	216.0
21D	186.7	1340	215.7
21E	187.6	1107	213.5
22A	187.2	428	216.8
22B	188.0	590	216.3
22C	186.5	898	218.0
22D	184.5	1336	218.0
22E	180.1	1833	218.1
23A	186.3	1053	217.2
23B	189.4	728	212.7
23C	189.6	620	216.1
23D	188.6	131	213.4
23E	183.2	441	213.1
24A	186.0	1331	216.5
24B	186.8	428	218.0
24C	185.8	580	217.5
24D	186.7	871	209.8
24E	183.9	767	209.6

3.6 Harassment Zone Verification

Table 13 lists the sound levels for the onset of injury (Level A harassment thresholds) and for behavioral harassment (Level B harassment thresholds) determined by NMFS[3] for the phocid pinnipeds for each specific underwater sound pile driving activity.

Table 13. Phocid pinnipeds injury and disturbance thresholds for underwater non-explosive sounds (from Table 5-1 of NMFS, 2018a[3], and Table 3 of NMFS, 2018b[4]).

Source type	Level A Harassment PTS Onset Thresholds (received level)		Level B Harassment Behavioral
	peak sound pressure level (unweighted)	sound exposure level, cumulative 24 hour	sound exposure level root mean squared
ISO	Lpk, flat:	LE, PW,24h	Lrms, flat
	SPLpk	cSEL 24h	SPLrms
	dB re 1 µPa	dB re 1 µPa²·s	dB re 1 µPa
Impulsive: Impact Pile Driving	218	185	160
Non-impulsive: Vibratory Pile Driving	n.a.	201	120

Using NMFS guidance, NAVFAC calculated maximum distances for Level A and Level B harassment zones for the phocid pinnipeds for each specific underwater sound-generating activity for this project. Table 14 lists these calculated distances. The harassment zones are calculated with recorded sound source levels, number of pile strikes, and duration of activity; received levels at a range of distances, from which actual rates of transmission loss was determined. The transmission loss equation is shown and plotted in Figure 19.

Table 14. NAVFAC Calculated Harassment Zones Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound for Phocid Pinnipeds (from Table 1-1 of NAVFAC 2019, and Table 6-2 of NAVFAC, 2018).

Method	Pile type	Source Level, dB @10m		Maximum Distance of Harassment Zones							
		SEL	SPLrms	Impulsive Noise				Non-impulsive, continuous noise			
				Level A 185 dB		Level B 160 dB		Level A 201 dB		Level B 120 dB	
		dB re 1 µPa2-sec	dB re 1µPa	meters	feet	meters	feet	meters	feet	meters	feet
Vibratory Driving	36-in steel	n.a.	168	n.a.	n.a.	n.a.	n.a.	<4	13	4,642	15,229
Rock Socket Drilling	36-in steel	n.a.	168	n.a.	n.a.	n.a.	n.a.	<4	13	4,642	15,229
Impact Driving	36-in steel	183	198	984	3,228	3,415	11,201	n.a.	n.a.	n.a.	n.a.

With respect to vibratory pile driving, Figure 15 shows that the cSEL is well below the 201 dB Level A threshold for continuous noise by the time the near-field hydrophone records it. This is consistent with the prediction in Table 14.

With respect to impact driving, Figure 16 shows that the peak SPL is near the 218 dB Level A threshold for impulsive noise at the near-field hydrophone and well below the threshold at the far-field hydrophone. Whereas Figure 17 shows that the cSEL is above the 185 dB Level A threshold at the near-field hydrophones and most far-field hydrophones. Because the cSEL drops below its corresponding threshold at a further distance than the peak SPL the cSEL is used to determine the Level A harassment zone distance.

The project plan (NAVFAC, 2019)[1] required Level B distance verification to use data measured between 10 and 500 m from the source. For verification of both Levels A and B harassment zones for impulsive sound this report uses both 1) the data subset collected between 10 and 500m from the source and 2) all data recorded at all distances. For Level A verification, linear interpolation was used to determine the distance at which the mean cSEL level drops below 185dB. To estimate the maximum distance at which the mean cSEL level drops below 185dB an upper limit line was fitted to the measured data.

Table 15 lists the Level A harassment distances at which the cSEL levels drops below 185 dB as determined from linear interpolation. These distances are well within the predicted Level A distance, of 984m. Figure 18 plots the cSEL versus distance. These distances are plotted on the map in Figure 19.

Table 15. Level A harassment distance at which the mean cSEL level drops below 185dB as determined from linear interpolation.

Pile type	Drive method	Type of fit	Data range	Distance at which Mean cSEL drops below 185		NAVFAC project predicted Level A Harassment Distances for Harbor Seal and Gray Seal during Pile Installation	
				feet	meters	feet	meters
36"x 0.5" steel	Impact hammering	linear	recorded between 10-500m	943	257	3,228	984
		linear	all data	1,001	305		
		upper limit	all data	1,801	549		

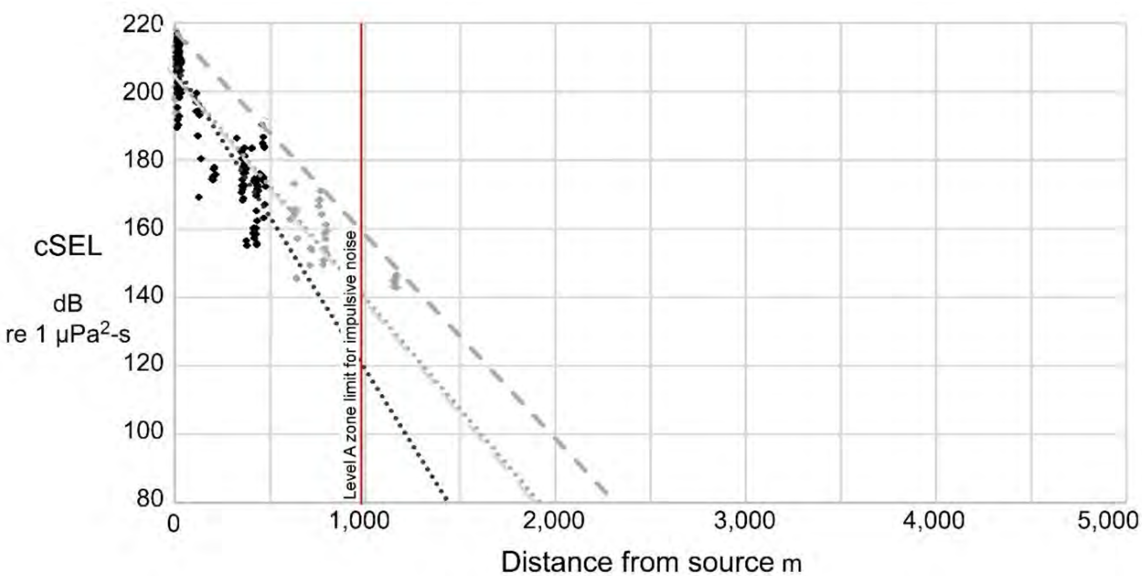


Figure 18. Impact hammer cSEL plotted versus distance from sound source. Black symbols are data recorded between 10 and 500 m from the source. Gray symbols are remaining data recorded less than 10m and greater than 500m from source. The black dotted line is a linear trend line of the data between 10m and 500m. The equation of the trend line is $y = -0.0888x + 207.75$. $R^2 = 0.8012$. The gray dotted line is a linear trend line of all the data. The equation of the trend line is $y = -0.065x + 204.76$. $R^2 = 0.8187$. The dashed gray line is a fitted upper limit line. The equation of the fitted upper limit is $y = -0.0595x + 217.62$. The vertical red line is the NAVFAC predicted Level A Harassment limit for this project.

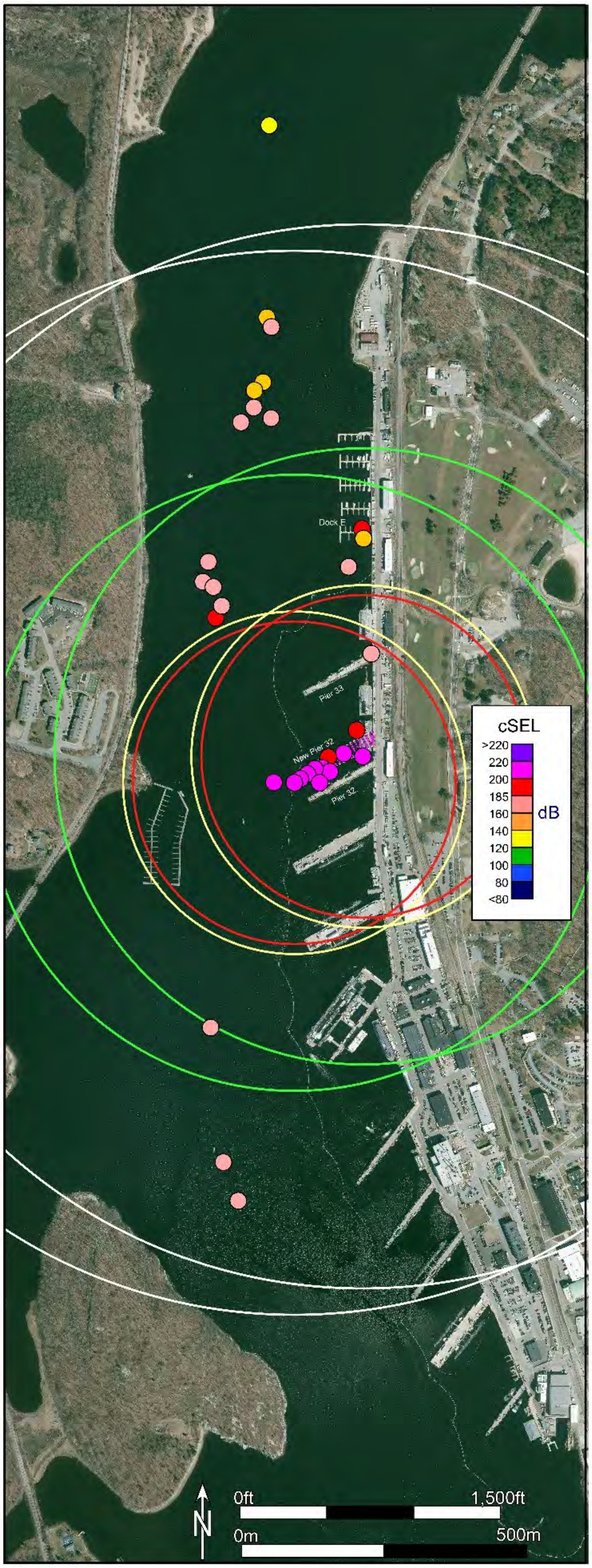


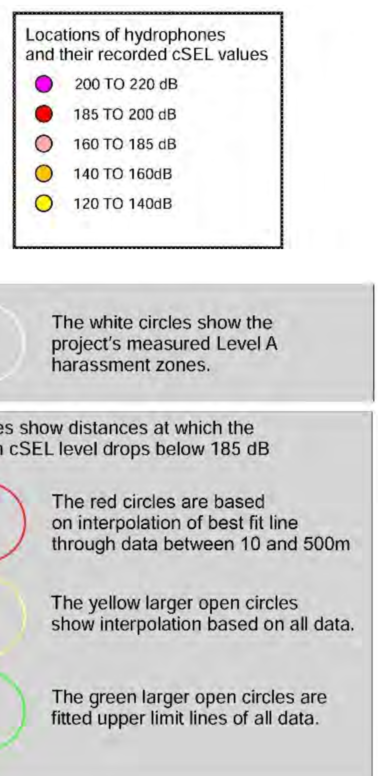
Figure 19. Map showing cumulative SEL values during impact hammering of 36-in steel piles.

Hydrophone locations are dots (small, color-filled circles). The color fill is keyed to the color bar.

The white larger open circles show the project's measured Level A harassment zones. The colored larger open circles show distances at which the mean cSEL level drops below 185 dB (Table 15).

One set of the larger open circles is centered on the westernmost pile. The other set of larger open circles is centered on the easternmost pile.

Key to Symbols



For Level B verification monitoring, the project plan (NAVFAC, 2019; Section 2i and 2ii in the LOA) also required determination of the distance at which the SPLrms drops below 120 dB for both impulsive and non-impulsive sources.

For Level B verification for impulsive sources this report also determined the distance at which the SPLrms dropped below the 160 dB Level B threshold that the NAVFAC (2018) used for impact driving. Linear interpolation was used to determine the distance at which the mean SPLrms level drops below 160dB for impact driving and linear extrapolation was used to determine the distance at which the mean SPLrms level drops below 120dB for both impact pile driving and vibratory pile driving sources.

Level B distance verification for this project followed the project plan (NAVFAC, 2019) requirement to use data measured between 10 and 500 m from the source. This report also uses all data recorded at all distances.

Table 16 lists the Level B harassment zone distances predicted for the project and those determined from the measured data. Figures 20, 21, and 22 plot the measured SPLrms versus distance from sound source for impact hammering of the 36-inch pipe piles. Figures 20 and 21 include the attenuation calculation (transmission loss equation) that NAVFAC used to establish the distances used in this project. These distances are plotted on the map in Figure 23.

Figure 24 plots the SPLrms versus distance from sound source for vibration of the 36-inch pipe piles. Figure 25 plots the SPLrms versus distance from sound source for vibration of the 14-inch H-piles probes. The SPLrms for vibratory pile driving of the 36-inch pipe piles are plotted on the map in Figure 26.

Table 16. Level B harassment zone distance that the mean SPLrms level drops below 160dB and 120 dB as determined from linear interpolation and linear extrapolation, respectively.

Pile type	Drive method	Type of fit	Data range	Distance at which Mean SPLrms drops below 120dB		Distance at which Mean SPLrms drops below 160dB		NAVFAC project Level B Harassment Distances for Harbor Seal and Gray Seal during Pile Installation	
				feet	meters	feet	meters	feet	meters
14-inch H-pile probes	Vibration	linear	recorded between 10-500m	1,492	455	n.a.	n.a.	11,201	3,415
		linear	all data	1,492	455	n.a.	n.a.		
		upper limit	recorded between 10-500m	1,500	457	n.a.	n.a.		
36in x 0.5in steel	Vibration	linear	recorded between 10-500m	2,585	788	n.a.	n.a.	15,226	4,642
		linear	all data	1,897	578	n.a.	n.a.		
		upper limit	all data	2,578	786	n.a.	n.a.		
36in x 0.5in steel	Impact hammering	linear	recorded between 10-500m	2,700	823	1,306	398	11,201	3,415
		linear	all data	3,537	1,078	1,640	500		
		upper limit	all data	4,265	1,300	2,231	680		

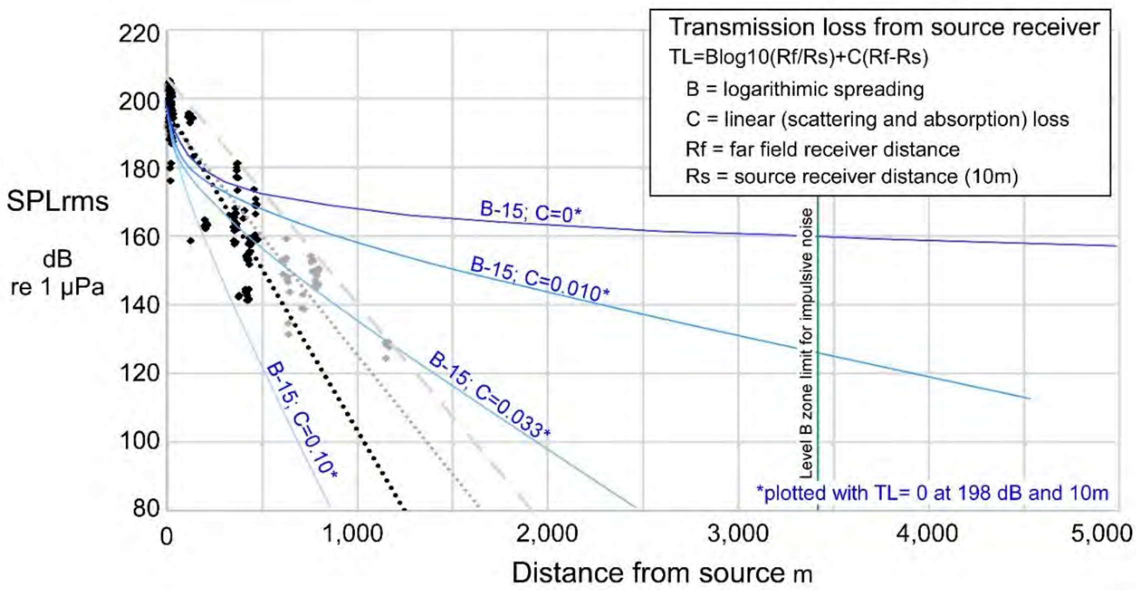


Figure 20. Impact hammer Mean SPLrms plotted versus distance from source. See Figure 22 for details on the measured data. Plotted in blue is transmission loss calculation that NAVFAC used to calculate the harassment zones for this project. The harassment zones were based on the conservative upper line where linear loss (C) was zero and based on a sound source level of 198 dB. The estimated C values for the actual data (assuming that B =15) ranged from 0.01 to 0.1 with the median value at 0.33. These curves are plotted on the graph. The vertical green line is the NAVFAC predicted Level B Harassment limit for this project.

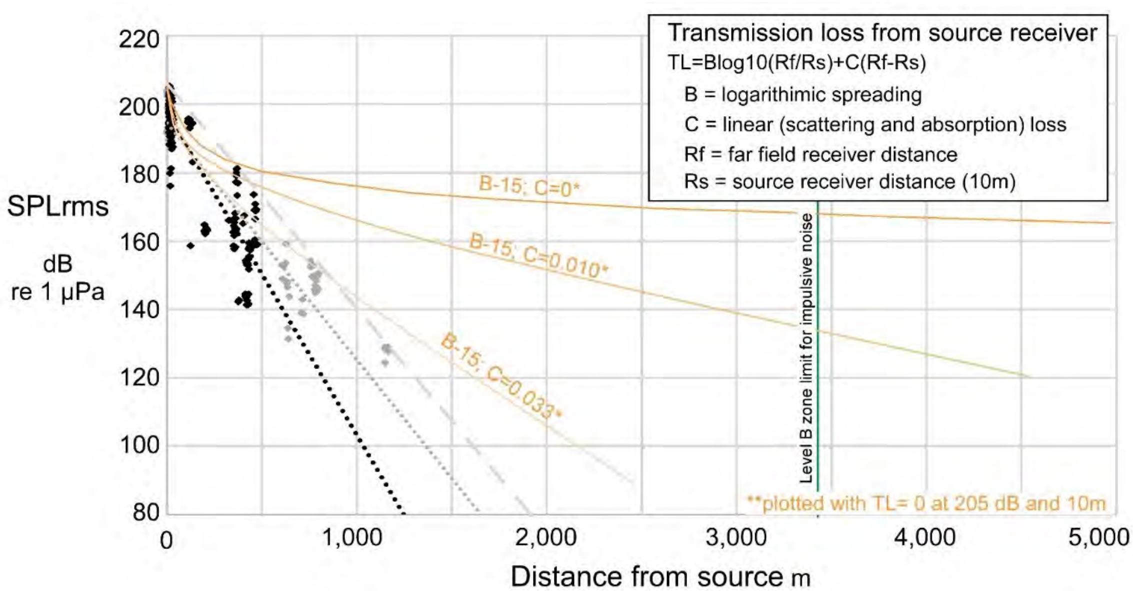


Figure 21. Similar plot to Figure 20 with the exception that the transmission loss calculation is based on the high range of sound source level of 205 dB. Impact hammer Mean SPLrms plotted versus distance from sound source. See Figure 22 for details on the measured data description. Plotted in orange is transmission loss calculation based on a sound source level of 205 dB. The range of C values for the actual data assuming B-15 ranged from 0.01 to 0.1 with the median value at 0.33. The vertical green line is the NAVFAC predicted Level B Harassment limit for this project.

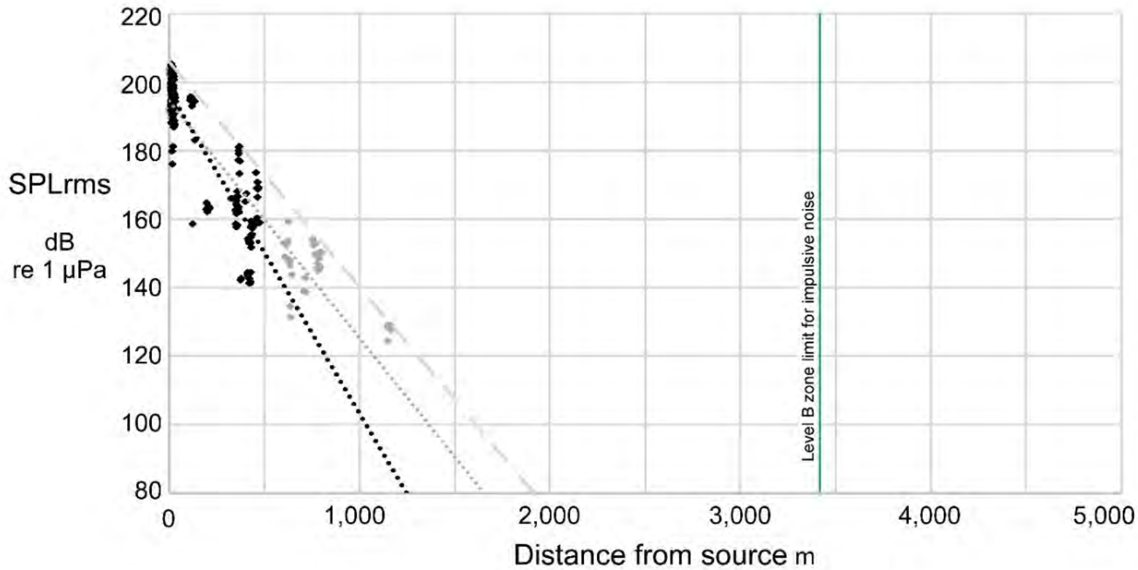


Figure 22. Same plot as in Figures 20 and 21 without the transmission loss calculation. Impact hammer SPLrms plotted versus distance from sound source. Black symbols are data recorded between 10 and 500 m from the source. Gray symbols are remaining data recorded less than 10m and greater than 500m from source. The black dotted line is a linear trend line of the data between 10m and 500m. The equation of the trend line is y = -0.0941x + 197.41. R^2 = 0.7997. The gray dotted line is a linear trend line of all the data. The equation of the trend line is y = -0.0693x + 194.63. R^2 = 0.8273. The dashed gray line is a fitted upper limit line. The vertical green line is the NAVFAC predicted Level B Harassment limit for this project.

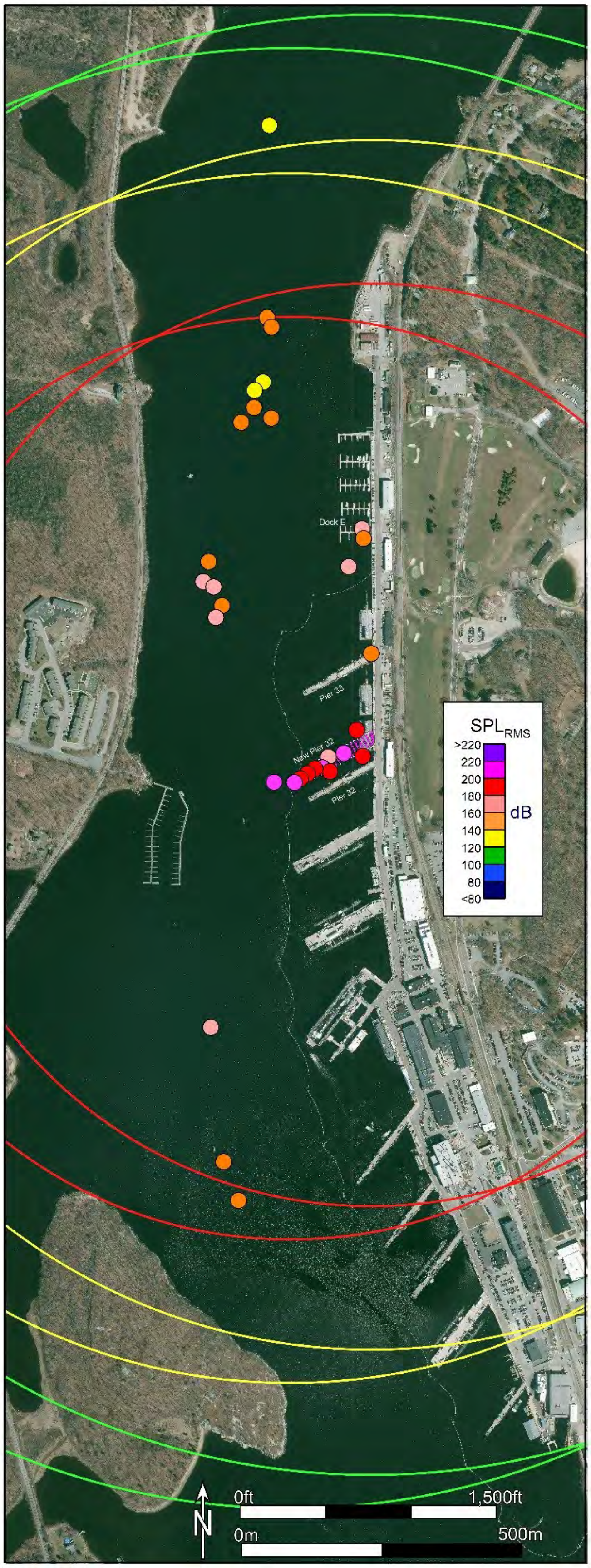
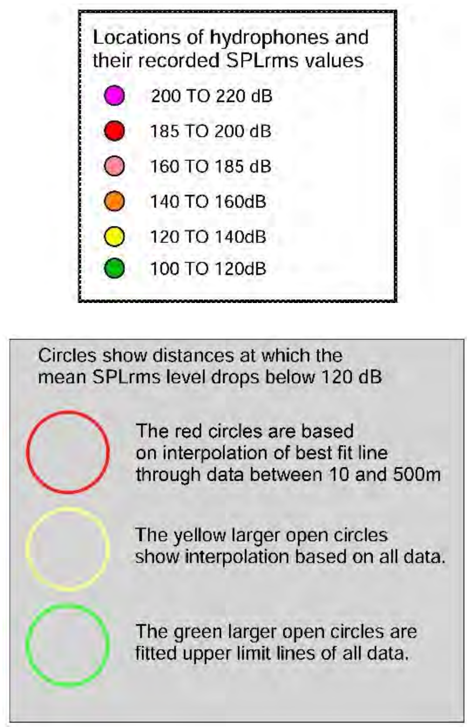


Figure 23. Map showing mean SPL$_{RMS}$ during impact hammering of 36-in steel piles.

Hydrophone locations are dots (small color-filled circles). The color fill is keyed to the color bar.

The larger open circles show distance at which the mean SPLrms level drops below 120 dB (Table 11). One set of the larger open circles is centered the westernmost pile. The other set of the open circles is centered on the eastern most pile.



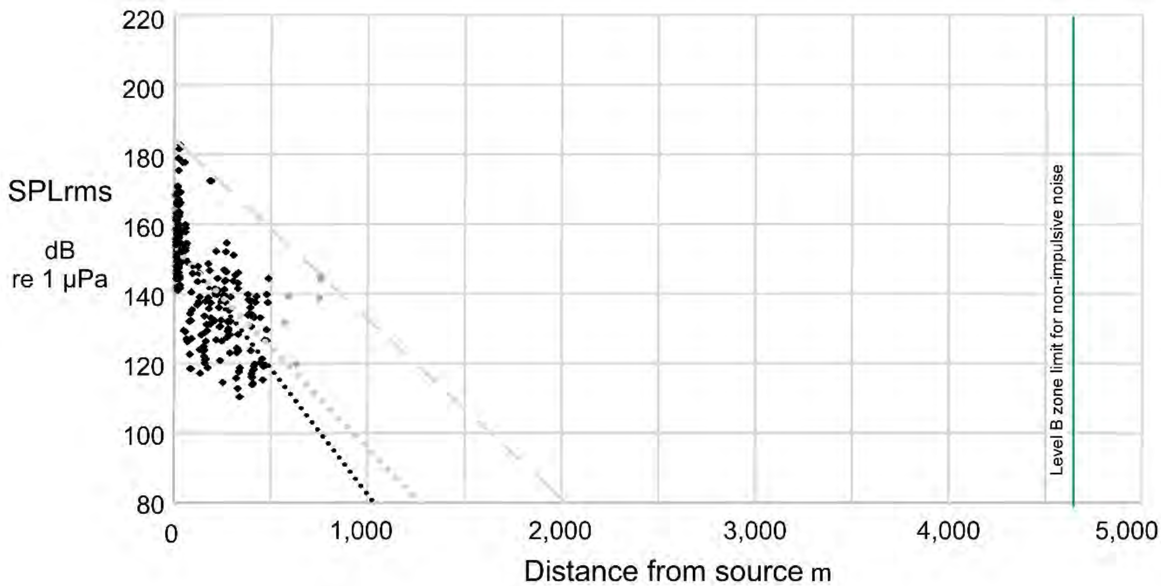


Figure 24. Plot of 36in steel pile vibration Mean SPLrms with distance from source. Black symbols are data recorded between 10 and 500 m from the source. Gray symbols are remaining data recorded less than 10m and greater than 500m from source. Black dotted line is a linear trend line of the data between 10m and 500m. The equation of the black dotted line is $y = -0.0721x + 154.48$. $R^2 = 0.4663$. The gray dotted line is a linear trend line of all data. The equation of the gray dotted line is $y = -0.0575x + 153.18$. $R^2 = 0.3958$. The gray dashed line is an upper limit fitted through high data points.

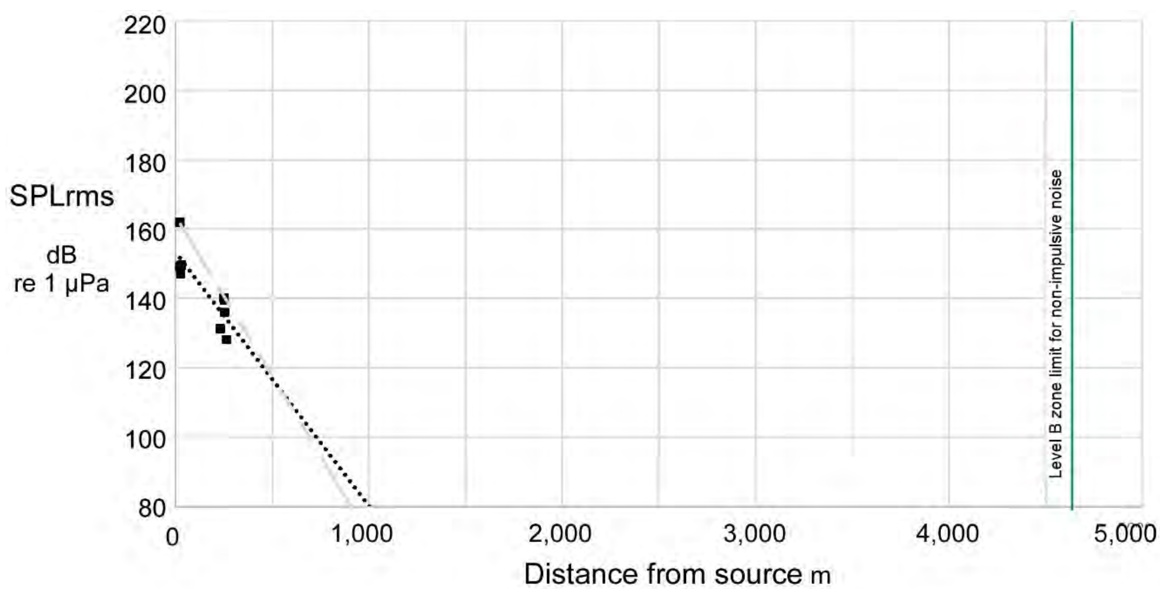


Figure 25. 14-inch H-pile probe vibration Mean SPLrms with distance from source. The black dotted line is a linear trend line of all the data. Note all the data fall between 10m and 500m from the source. The equation of the trend line is $y = -0.0732x + 153.25$. $R^2 = 0.7324$. The gray dashed line is an upper limit fitted through highest data.

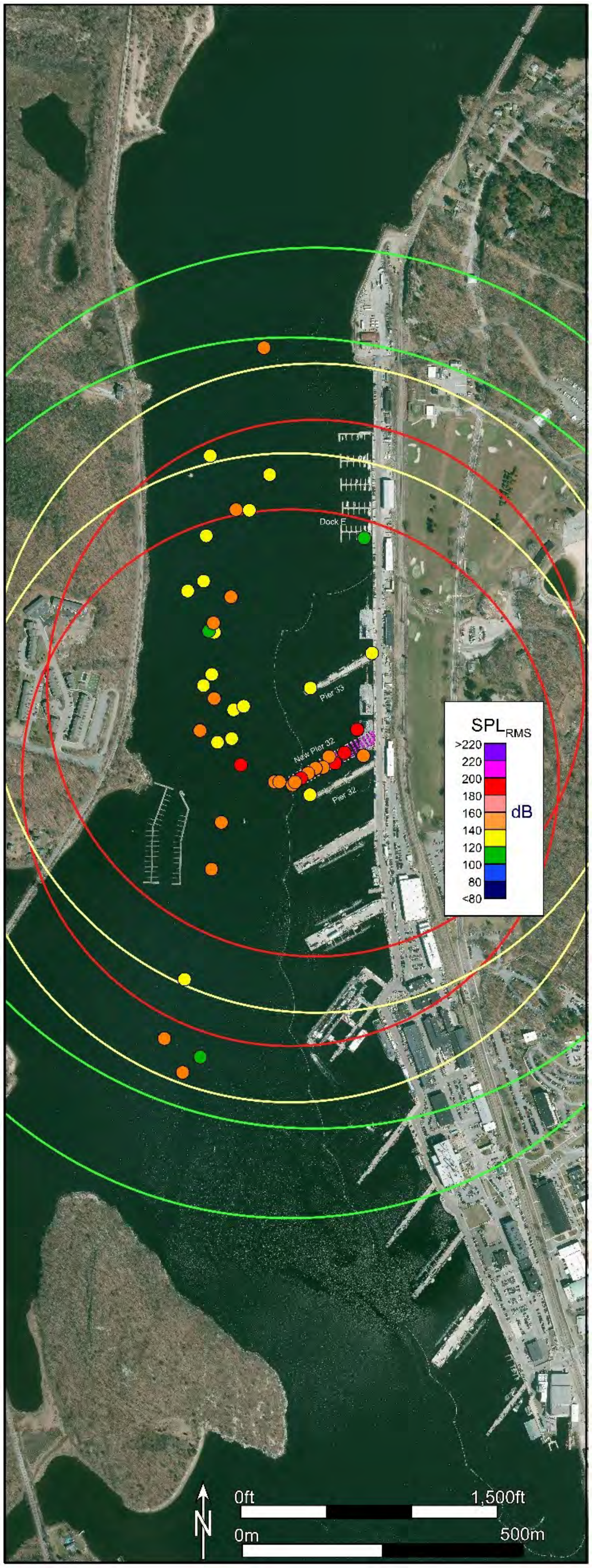
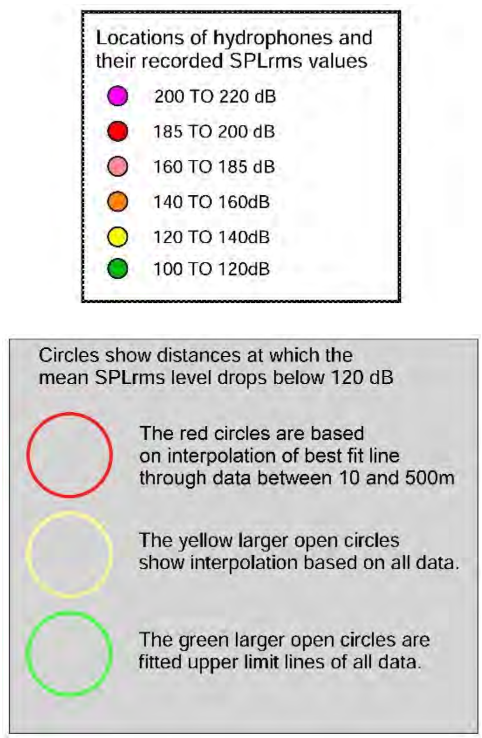


Figure 26. Map showing mean SPLrms values recorded during vibration of 36-in steel piles.

Hydrophone locations are dots (smaller color-filled circles). The color fill is keyed to the color bar.

The larger open circles show distance at which the mean SPLrms level drops below 120 dB (Table 11). One set of open circles are centered the westernmost pile. The other set of open circles is centered on the eastern most pile.

Key to Symbols



Appendix A. Per pile Data

The summary results over the whole time-period are in Tables A-1 through A-3 and are provided in digital form as spreadsheets. In Tables A-1 through A-3 data are summarized by day and by pile. Table A-1 lists the results for vibration of H pile probes. Table A-2 lists the results for vibration of 36in x 0.5in steel piles using the APE 300-6 Head. Table A-3 lists the results for impact hammering of the 36in x 0.5in steel piles using the Junttan Head.

Table A-1. Values for vibration of I-beam probes with the APE 300-6 head. Data listed by date.

					Near Hydrophone											Far Hydrophone										
Date	Start Time	End Time			Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms	Distance to Hydrophone	cSEL	Min SPLpk	e Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 μPa²·sec	dB re 1 μPa			dB re 1 μPa²·sec			dB re 1 μPa			ft	dB re 1 μPa²·sec	dB re 1 μPa			dB re 1 μPa²·sec			dB re 1 μPa		
2021.03.22	17:05	17:05			87	135.8	160	188.9	168.3	128.9	165.5	135.8	142.8	174.5	149.3	758	133.5	155.8	166.1	162.0	110.3	133.5	120.9	123.8	144.9	131.2
2021.03.23	10:34	10:36			87	136.0	162	176.6	168.2	129.3	137.7	133.0	142.0	152.4	147.0	829	136.4	165.5	169.4	167.2	126.2	133.4	129	135.5	143.3	139.5
2021.03.23	11:01	11:03			103	137.9	163.8	181.7	170.1	127.4	147.3	134.9	141.8	161.6	149.5	818	127.3	146.9	146.9	146.9	124.3	124.3	124.3	140.1	140.1	140.1
2021.03.23	11:22	11:32			72	145.3	161.0	178.3	169.3	129.9	142.8	135.3	143.6	154.4	149.1	833	137.3	154.5	154.8	154.7	125.7	127.3	126.5	135.4	136.4	135.9
2021.03.24	15:52	16:46			72	166.0	158.6	188.0	173.3	129.3	166.7	148.7	142.8	177.7	161.9	864	134.5	161.7	161.7	161.7	117.2	117.2	117.2	128.1	128.1	128.1

Table A-2. Values for vibration of the 36in x 0.5in steel piles using the APE 300-6 Head. Data listed by date.

					Near Hydrophone											Far Hydrophone										
Date	Start Time	End Time	Pile ID		Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 μPa²·sec	dB re 1 μPa			dB re 1 μPa²·sec			dB re 1 μPa			ft	dB re 1 μPa²·sec	dB re 1 μPa			dB re 1 μPa²·sec			dB re 1 μPa		
2021.03.26	12:48	13:08	6N		94.5	147.8	159.8	171.5	165.1	132.0	139.9	134.8	140.4	150.7	144.4	952.7	141.4	156.2	166.6	162.6	114.2	128.4	121.6	124.7	139.7	132.1
2021.03.26	15:36	15:54	6S		97.6	145.4	159.3	165.3	162.3	131.9	133.7	132.8	140.1	142.8	141.6	1,459.4	136.0	159.6	164.8	163.4	116.3	123.4	121.1	130.4	135.6	133.2
2021.03.30	11:29	11:42	7N		71.2	174.4	187.9	189.0	188.4	162.8	163.6	163.3	176.9	180.4	178.9	890.9	156.7	164.8	169.2	167.7	138.8	145.6	142.4	151.2	159.3	154.6
2021.03.30	13:05	13:19	8N		50.3	158.0	171.3	179.3	176.4	136.3	153.0	146.5	149.6	162.6	158.1	866.1	136.0	162.7	165.8	164.2	119.5	124.5	122.0	134.9	142.1	137.6
2021.03.30	17:17	17:44	8S		56.7	163.4	177.4	182.8	180.1	146.6	151.6	149.1	154.7	162.1	158.4	881.5	143.5	162.3	168.6	166.8	118.3	129.2	125.8	142.5	157.9	146.3
2021.03.31	11:36	11:50	7S		76.0	155.2	165.1	196.5	172.5	132.1	158.9	143.7	143.2	176.2	156.8	1,087.4	156.4	163.1	170.1	166.2	121.3	144.9	131.1	134.7	161.6	146.0
2021.04.01	13:56	14:14	9N		42.3	149.1	162.1	164.1	163.0	133.5	138.1	136.5	144.4	148.2	146.8	1,871.1	130.6	162.9	162.9	162.9	118.0	118.0	118.0	131.8	131.8	131.8
2021.04.01	14:44	15:01	9S		49.5	148.5	170.0	170.5	170.3	135.0	137.3	136.2	146.5	148.8	147.7	1,944.6	141.0	154.8	154.8	154.8	128.7	128.7	128.7	139.3	139.3	139.3
2021.04.05	12:02	12:31	10N		138.1	179.1	188.5	194.2	190.7	157.5	168.3	164.5	173.7	186.3	177.8	600.6	169.7	178.0	182.3	180.2	155.1	155.1	155.1	171.9	172.9	172.4
2021.04.05	12:58	13:10	10S		179.0	176.7	189.3	193.5	192.0	162.0	169.7	165.9	174.7	183.3	177.8	629.3	167.4	175.4	179.6	177.2	152.4	156.6	154.2	170.5	174.7	172.4
2021.04.08	16:29	16:30	5N		59.0	153.4	171.8	179.7	176.8	147.1	156.6	153.4	155.2	174.5	169.2	2,068.0	106.9	143.4	146.2	144.4	103.2	106.9	105.9	117.5	125.0	119.8
2021.04.09	12:55	12:58	4N		59.0	148.2	159.3	201.4	171.7	132.2	167.5	143.4	143.5	178.6	154.5	1,034.0	138.6	148.9	156.3	151.4	125.8	133.8	128.5	142.6	150.8	145.4
2021.04.10	14:00	14:13	9E		105.0	148.0	162.8	171.3	166.9	134.8	139.8	136.9	147.5	151.3	148.8	463.0	134.9	144.1	150.9	147.7	110.1	123.8	115.8	121.5	136.6	128.2
2021.04.12	15:26	15:39	9A		37.3	156.6	166.7	172.4	168.6	143.3	149.2	145.5	156.4	166.4	161.1	753.8	148.1	139.3	161.5	155.7	112.0	137.0	128.9	122.0	151.4	141.0
2021.04.12	15:43	15:55	9B		29.2	155.9	166.7	170.9	168.2	143.4	147.6	145.1	156.9	164.9	162.1	761.7	147.8	144.3	161.0	153.4	108.6	137.0	125.3	120.3	146.0	136.1
2021.04.12	16:00	16:22	9C		27.7	155.3	161.5	172.7	167.2	136.3	149.5	141.9	145.5	167.9	152.9	769.7	135.6	141.6	145.6	144.3	112.7	122.2	119.8	124.9	133.7	130.5
2021.04.12	16:21	16:29	9D		33.6	156.7	161.2	195.1	173.3	134.4	169.1	147.7	145.0	178.7	158.6	777.9	138.4	138.8	153.2	145.5	108.2	129.4	119.7	118.8	140.3	130.6
2021.04.13	13:47	13:57	10A		25.6	151.8	165.3	169.1	167.2	135.7	146.4	141.8	144.1	163.0	154.1	840.6	140.1	154.1	154.1	154.1	128.7	130.1	129.4	138.7	140.2	139.5
2021.04.13	14:00	14:10	10B		10.7	158.9	168.7	174.8	172.5	142.9	151.8	148.9	152.4	169.2	164.3	849.6	148.2	162.7	162.7	162.7	138.0	138.2	138.1	146.9	146.9	146.9
2021.04.13	14:16	14:24	10C		5.1	159.6	172.4	174.0	173.5	149.2	151.4	150.6	167.0	169.5	168.4	858.7	143.9	159.1	159.9	159.5	134.5	134.9	134.7	142.6	144.6	143.6
2021.04.13	14:30	14:37	10D		19.7	164.3	176.6	194.7	183.3	147.0	166.6	155.8	160.0	175.3	167.9	868.0	142.1	156.9	159.1	158.0	131.6	133.6	132.6	143.5	144.3	143.9
2021.04.13	14:44	14:53	10E		34.6	159.8	169.7	189.9	177.5	144.9	161.8	150.3	156.0	175.3	162.1	877.4	157.2	159.8	180.0	169.9	136.0	147.7	141.9	147.4	156.5	152.0
2021.04.19	8:27	8:38	9A		37.3	160.0	173.3	180.8	177.1	146.7	152.5	149.6	158.0	164.2	161.1	908.8	132.2	144.7	147.5	146.1	120.2	121.8	121.0	128.4	130.0	129.2
2021.04.19	9:32	9:47	9B		29.2	152.4	161.8	175.2	166.6	136.7	147.2	140.6	147.6	158.0	151.3	920.7	133.9	142.6	145.8	144.2	119.1	122.1	120.6	127.5	132.5	130.0
2021.04.19	9:50	10:07	9C		27.7	157.6	171.1	174.8	173.4	143.0	147.3	145.3	154.0	157.6	156.1	932.7	133.7	146.0	146.4	146.2	114.8	121.4	118.1	131.6	138.8	135.2
2021.04.19	10:13	10:28	9D		33.6	155.7	170.7	174.5	172.3	141.6	148.3	143.9	152.3	159.4	155.6	944.7	134.5	141.4	144.2	142.8	116.3	122.7	119.5	126.0	130.6	128.3
2021.04.19	10:33	10:40	9D		44.0	154.0	164.3	179.5	172.7	139.8	151.4	145.5	150.0	161.6	157.3	956.9	144.3	147.0	157.6	152.3	124.0	135.8	129.9	133.2	144.9	139.1
2021.04.19	10:43	10:51	10A		25.6	155.8	166.3	178.3	174.2	141.7	150.2	146.8	152.0	157.9	155.7	893.7	129.2	138.5	146.8	142.7	115.3	120.2	117.8	123.8	131.0	127.4
2021.04.19	10:54	11:10	10B		10.7	162.8	177.1	185.7	180.6	146.6	155.2	150.8	155.2	167.6	161.7	905.8	133.1	146.2	148.4	147.3	120.0	121.1	120.6	128.8	135.2	132.0
2021.04.19	11:12	11:20	10C		51.0	157.8	176.2	183.9	178.9	146.0	151.5	148.8	158.2	165.5	161.2	917.9	130.5	142.3	146.3	144.3	116.7	121.5	119.1	127.1	131.9	129.5

Table A-2 *continued*. Values for vibration of the 36in x 0.5in steel piles using the APE 300-6 Head.

					Near Hydrophone											Far Hydrophone										
Date	Start Time	End Time	Pile ID		Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 µPa²sec	dB re 1 µPa			dB re 1 µPa²sec			dB re 1 µPa			ft	dB re 1 µPa²sec	dB re 1 µPa			dB re 1 µPa²sec			dB re 1 µPa		
2021.04.19	11:25	11:30	10D		19.7	153.5	171.1	172.8	172.2	145.5	147.6	146.5	155.0	156.3	155.7	930.2	128.3	141.9	142.0	142.0	119.7	121.3	120.5	128.1	128.8	128.5
2021.04.19	11:36	11:42	10E		34.6	156.7	173.0	174.5	173.8	147.8	150.0	148.9	161.1	161.5	161.3	942.5	126.6	138.3	141.9	140.1	108.7	118.8	113.8	117.2	128.8	123.0
2021.04.22	14:42	14:51	11N		66.3	157.6	164.1	200.2	174.9	138.9	171.2	148.1	149.4	180.2	159.8											
2021.04.22	15:30	15:34	12N		40.5	160.5	177.9	184.3	181.0	150.0	158.2	154.5	160.5	170.5	166.3											
2021.04.23	9:59	10:06	11S		98.7	174.1	190.5	192.9	191.5	162.8	166.3	165.6	181.9	186.0	182.7	1,567.0	159.3	140.8	181.6	148.1	106.8	150.8	118.6	121.4	167.4	129.7
2021.04.23	10:37	10:45	12S		84.1	173.9	167.9	194.9	191.3	140.8	166.5	164.9	149.1	185.9	181.6	1,570.3	135.6	136.9	152.6	144.0	109.1	126.6	115.9	118.4	136.0	126.6
2021.04.24	14:45	14:55	12A		42.6	161.7	179.6	179.6	179.6	151.7	151.7	151.7	163.2	163.2	163.2	285.5	118.6	145.6	151.6	148.6	105.5	108.6	107.1	117.0	120.0	118.5
2021.04.24	15:00	15:08	12B		44.7	161.2	176.4	176.4	176.4	152.2	152.2	152.2	165.7	165.7	165.7	278.3	114.7	149.0	149.0	149.0	105.7	105.7	105.7	118.5	118.5	118.5
2021.04.24	15:10	15:17	12C		51.4	157.4	174.6	174.6	174.6	148.9	148.9	148.9	162.9	162.9	162.9	271.8	118.2	152.3	152.3	152.3	109.7	109.7	109.7	134.4	134.4	134.4
2021.04.24	15:22	15:32	12D		61.1	159.2	175.0	175.0	175.0	149.2	149.2	149.2	163.1	163.1	163.1	265.9	118.7	152.6	152.6	152.6	108.7	108.7	108.7	122.7	122.7	122.7
2021.04.24	15:40	15:47	12E		72.6	158.4	174.9	174.9	174.9	149.9	149.9	149.9	163.6	163.6	163.6	260.7	128.2	151.3	151.3	151.3	119.7	119.7	119.7	132.1	132.1	132.1
2021.04.24	15:50	15:58	11E		89.6	156.1	174.6	174.6	174.6	147.1	147.1	147.1	163.4	163.4	163.4	284.6	122.3	155.5	155.5	155.5	113.3	113.3	113.3	132.3	132.3	132.3
2021.04.24	15:59	16:08	11D		80.5	157.1	167.4	167.4	167.4	147.6	147.6	147.6	155.0	155.0	155.0	289.3	126.8	148.1	149.8	149.0	115.5	117.3	116.4	139.6	141.3	140.5
2021.04.24	16:12	16:20	11C		73.4	149.6	167.6	167.6	167.6	140.6	140.6	140.6	149.6	149.6	149.6	294.7	122.5	145.5	153.6	149.6	113.3	113.5	113.4	126.3	128.1	127.2
2021.04.24	16:24	16:31	11B		68.9	153.2	166.8	166.8	166.8	144.7	144.7	144.7	154.8	154.8	154.8	300.7	130.3	152.6	153.1	152.9	121.4	121.8	121.6	133.7	137.1	135.4
2021.04.24	16:35	16:40	11A		67.6	152.6	169.1	169.1	169.1	145.6	145.6	145.6	155.8	155.8	155.8	307.4	129.0	153.3	154.1	153.7	121.8	122.0	121.9	144.9	146.7	145.8
2021.04.28	15:07	15:12	13S		83.5	154.5	172.2	178.0	174.6	144.3	152.4	147.5	157.1	167.9	163.1	853.1	137.0	140.8	153.3	146.2	117.6	130.0	123.1	135.7	148.6	141.2
2021.04.28	15:37	15:41	14S		60.7	153.2	171.1	175.7	173.5	145.2	148.9	147.2	160.3	165.9	161.9	843.0	130.4	141.3	147.6	144.8	118.1	124.4	121.7	136.6	142.8	139.7
2021.04.29	9:04	9:10	13N		91.3	147.5	160.7	166.9	165.3	136.6	141.1	139.7	144.5	151.4	148.8	394.3	146.6	140.5	164.4	153.8	112.6	138.8	128.1	122.3	147.0	136.8
2021.04.29	9:45	9:50	14N		70.9	145.4	158.7	162.4	160.9	133.9	141.3	138.4	146.4	150.6	147.7	400.4	143.2	161.1	164.6	162.3	133.4	136.2	134.5	141.8	146.0	143.5
2021.04.29	15:41	15:48	14A		66.5	155.7	157.8	174.3	166.6	136.4	157.3	147.2	146.5	168.6	157.9	407.3	151.9	156.8	165.7	160.2	136.2	143.4	138.7	145.4	152.6	147.9
2021.04.29	15:54	16:00	14B		58.9	146.7	159.8	167.3	162.3	137.0	148.0	138.9	145.7	155.3	147.7	421.7	150.1	150.4	163.1	158.4	129.8	142.3	137.5	138.1	150.2	145.9
2021.04.30	13:41	13:47	14C		54.5	162.6	180.7	188.1	185.3	136.2	161.1	154.8	148.3	177.9	170.6	1,569.8	131.5	144.4	146.5	145.2	121.5	123.7	122.6	136.8	142.4	139.8
2021.04.30	13:54	14:01	14D		54.1	169.7	169.1	196.6	186.2	144.2	171.5	161.2	153.1	179.2	170.8	1,584.6	136.9	146.7	147.4	147.0	127.7	128.4	128.1	137.2	137.8	137.5
2021.04.30	14:08	14:13	14E		57.7	166.0	180.6	184.8	182.9	153.3	161.5	159.0	167.2	175.1	171.0	1,599.4	155.7	146.9	173.6	156.5	118.4	148.7	131.8	130.3	160.7	144.4
2021.05.01	15:29	15:37	13A		88.0	145.3	153.9	171.1	162.1	132.8	141.4	136.3	142.3	150.2	145.2	411.0	144.9	147.6	161.7	153.7	122.8	135.9	127.7	133.1	144.7	137.6
2021.05.01	15:43	15:49	13B		82.0	142.6	153.2	179.7	158.4	130.0	159.3	134.8	138.4	169.1	144.2	425.0	145.9	144.0	164.5	152.2	114.7	138.1	126.0	128.7	147.8	137.4
2021.05.03	14:49	15:23	13C		79.0	151.9	154.4	177.1	158.8	129.4	151.2	136.6	146.6	177.1	158.8	440.0	142.7	146.8	158.3	153.8	115.8	127.4	123.3	130.2	143.6	139.1
2021.05.07	12:29	12:39	15S		216.0	154.4	162.0	193.2	172.9	135.7	160.9	144.4	145.9	174.9	154.5	188.0	158.0	139.6	174.9	153.1	106.3	148.0	117.7	116.6	157.1	129.1
2021.05.07	12:58	13:05	16S		191.0	151.1	168.1	179.1	173.8	138.2	147.7	142.6	148.6	160.7	153.8	165.0	145.1	141.0	166.7	151.9	107.8	136.6	118.7	118.4	145.1	129.5
2021.05.07	16:08	16:15	15N		218.0	146.8	165.4	196.7	173.5	131.2	156.6	138.3	141.2	170.0	149.1	228.0	137.6	142.3	160.4	150.9	106.5	129.1	115.3	116.6	141.5	126.3
2021.05.07	16:45	16:50	16N		193.0	151.4	166.1	187.0	172.6	137.1	157.9	144.1	147.3	166.4	154.5	210.0	144.5	144.6	167.3	154.0	108.6	137.5	115.3	120.2	147.4	127.1
2021.05.08	14:55	15:01	16A		192.0	150.3	157.7	175.7	163.5	137.0	148.0	142.5	146.8	159.1	152.4	1,317.0	126.5	130.2	146.7	135.3	93.3	118.7	101.9	103.9	132.4	117.0
2021.05.08	15:07	15:13	16B		190.0	151.5	165.1	177.5	169.3	140.2	149.8	143.7	149.0	161.0	153.2	1,329.0	121.0	125.9	142.3	135.8	94.8	113.2	100.7	105.0	126.2	116.1
2021.05.08	15:20	15:24	16C		189.0	154.3	165.1	175.5	171.3	140.8	153.4	148.3	152.7	160.9	157.8	1,340.0	121.7	128.1	151.1	135.6	92.9	115.7	100.3	110.0	149.1	118.1
2021.05.08	15:33	15:37	16D		189.0	156.6	165.4	185.2	174.4	141.6	161.6	150.6	151.3	170.3	159.8	1,352.0	122.3	126.0	148.7	138.6	91.9	116.3	104.3	110.7	129.4	119.3
2021.05.08	15:44	15:48	16E		190.0	155.1	166.9	181.1	175.0	139.4	158.3	149.1	148.9	167.2	158.9	1,364.0	124.3	129.3	145.9	137.6	93.7	118.3	105.1	109.5	133.0	119.8
2021.05.10	15:21	15:27	5A		77.6	161.8	158.9	193.9	179.2	135.7	168.6	154.0	147.0	176.9	163.0	1,301.4	138.2	130.4	152.9	141.1	99.6	130.4	112.0	110.3	138.2	123.7
2021.05.10	15:34	15:41	5B		73.4	153.9	158.4	178.1	168.3	136.7	155.4	145.4	144.9	163.5	154.5	1,313.4	131.9	131.7	148.1	137.4	94.7	123.4	103.4	103.8	134.1	116.1
2021.05.10	15:47	15:52	5C		72.2	152.2	162.7	177.2	171.6	137.4	154.6	145.2	145.3	163.8	154.7	1,325.4	116.9	128.6	144.5	133.3	95.6	109.9	102.5	105.0	125.7	113.9
2021.05.10	15:59	16:07	5D		74.0	153.1	163.2	168.6	166.8	141.1	146.0	144.1	149.7	153.6	152.3	1,337.4	136.3	125.6	154.6	133.4	92.8	127.3	102.9	101.9	143.1	114.3
2021.05.10	16:13	16:19	5E		78.7	162.6	167.0	180.4	175.9	142.9	160.8	154.8	152.4	168.3	163.0	1,349.5	127.5	125.9	147.0	134.4	93.1	119.7	106.6	101.6	134.7	118.3
2021.05.12	16:41	17:06	17S		48.2	156.0	161.3	192.8	170.2	132.3	163.9	142.0	140.6	172.5	152.2	503.5	134.9	141.3	148.7	144.2	104.6	120.9	112.9	114.8	130.4	124.9
2021.05.12	17:12	17:33	18S		44.9	152.9	160.2	178.3	167.0	130.2	147.1	139.7	138.5	156.5	149.3	513.2	127.3	139.3	150.6	145.6	103.3	114.1	107.7	115.4	128.3	123.9
2021.05.13	8:37	9:02	17N		41.8	151.6	162.2	180.0	166.6	132.3	152.9	137.6	143.8	162.5	148.0	435.4	139.0	142.0	149.4	144.9	105.2	125.0	111.1	117.1	134.9	124.0
2021.05.13	9:08	9:53	18N		35.7	161.8	159.7	196.9	171.8	133.8	168.5	145.3	142.8	177.8	154.9	446.1	154.6	128.1	164.6	140.9	97.0	138.1	105.0	105.8	147.3	117.2
2021.05.14	16:30	16:35	18A		23.5	150.6	149.4	170.9	162.4	130.8	152.3	143.6	139.7	160.3	152.1	2,457.0	137.6	149.2	157.4	154.0	124.3	130.6	127.4	134.4	143.0	138.7
2021.05.14	16:40	16:49	18B		9.8	160.0	169.9	174.9	172.3	148.5	151.4	150.5	156.7	159.1	158.3	2,470.9	145.1	152.9	160.7	156.9	128.0	135.6	131.6	137.8	151.7	145.3
2021.05.14	16:53	17:01	18C		9.6	155.1	167.7	169.9	169.1	145.3	147.3	146.1	153.7	158.5	155.8	2,484.8	143.4	156.5	160.8	158.0	128.1	134.4	131.4	137.0	150.6	144.1

Table A-2 *continued*. Values for vibration of the 36in x 0.5in steel piles using the APE 300-6 Head.

				Near Hydrophone											Far Hydrophone										
Date	Start Time	End Time	Pile ID	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPL rms	Max SPLrms	Mean SPLrms	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time		ft	dB re 1 μPa²·sec	dB re 1 μPa			dB re 1 μPa²·sec			dB re 1 μPa			ft	dB re 1 μPa²·sec	dB re 1 μPa			dB re 1 μPa²·sec			dB re 1 μPa		
2021.05.14	17:05	17:10	18D	23.2	149.0	152.7	166.5	161.9	130.7	148.5	142.0	140.0	156.6	150.3	2,498.7	141.4	153.2	160.6	157.0	126.9	134.4	130.9	139.0	151.6	144.7
2021.05.15	8:28	8:32	18E	37.9	147.8	164.7	166.3	165.5	139.9	143.6	141.8	153.4	154.3	153.9	619.7	136.7	158.4	164.9	162.1	118.9	130.7	122.8	131.1	156.3	137.4
2021.05.15	15:06	15:11	17A	29.5	159.6	179.2	181.6	180.4	151.6	153.6	152.6	160.1	166.5	163.3	576.6	155.3	152.9	171.1	160.6	126.2	148.3	137.5	140.3	159.7	148.7
2021.05.15	15:17	15:22	17B	20.4	154.9	160.0	175.6	169.8	132.8	155.2	147.9	141.1	166.5	158.6	589.8	133.8	146.9	154.8	151.8	121.6	126.8	124.9	130.1	139.5	135.8
2021.05.15	15:28	15:32	17C	20.3	139.1	157.9	160.1	159.4	132.2	133.9	133.1	140.6	143.7	141.9	603.2	146.7	149.5	165.5	156.4	120.6	140.7	132.2	139.7	155.6	146.7
2021.05.15	15:39	15:42	17D	29.3	148.6	162.7	170.3	166.9	136.8	149.1	143.8	145.2	160.9	154.2	616.6	129.2	159.2	164.1	161.3	120.2	124.4	122.0	129.5	133.8	131.3
2021.05.15	15:50	15:56	17E	41.9	155.2	165.8	170.3	168.7	143.4	150.0	147.4	153.4	161.3	158.6	630.1	132.3	159.6	163.9	161.7	119.2	124.5	122.2	129.2	146.4	133.1
2021.05.18	10:02	10:05	19S	81.0	148.4	160.3	196.9	174.2	128.4	167.0	143.6	139.7	175.2	154.8	1,079.0	152.1	155.0	176.5	161.0	123.0	147.3	130.7	132.9	155.5	141.5
2021.05.18	10:47	10:51	20S	59.4	150.8	174.8	176.7	175.7	143.9	150.9	144.8	154.8	158.6	156.0	1,077.5	139.0	160.7	164.3	162.2	129.8	133.0	131.7	140.2	147.9	143.1
2021.05.18	12:28	12:37	19N	83.4	153.9	159.5	177.1	175.2	136.3	145.6	144.4	144.9	161.6	156.4	1,005.4	174.8	153.1	186.1	161.5	121.2	165.3	131.6	133.6	181.1	143.7
2021.05.18	12:57	13:06	20N	62.6	154.4	160.8	192.0	174.2	130.7	163.4	144.9	143.1	173.2	156.8	1,003.5	174.3	158.5	186.3	170.2	118.6	164.8	139.8	131.1	179.7	151.1
2021.05.19	15:15	15:23	20A	58.3	158.6	173.5	178.7	176.5	146.9	151.5	149.6	157.2	165.8	162.7	1,249.2	137.4	152.1	152.4	152.3	128.2	128.4	128.3	139.3	140.2	139.8
2021.05.19	15:28	15:37	20B	51.4	155.1	169.8	174.9	172.4	142.7	147.4	145.6	153.5	160.9	156.8	1,264.2	137.9	146.2	152.4	150.2	125.4	128.4	127.3	135.8	140.2	138.4
2021.05.19	15:44	16:26	20C	48.4	159.9	167.8	173.3	171.2	140.7	145.6	143.7	151.4	159.4	156.1	1,279.2	144.6	146.2	152.4	149.3	125.4	128.4	126.9	135.8	140.2	138.0
2021.05.19	15:57	16:03	20D	49.9	149.5	165.7	172.5	170.2	137.8	146.0	141.7	146.6	158.6	151.4	1,294.1	136.2	142.3	152.4	147.0	115.1	128.4	123.0	125.3	140.2	133.8
2021.05.19	16:10	16:15	20E	55.5	141.4	159.6	167.8	164.1	129.4	138.6	134.4	138.3	150.0	145.1	1,309.1	132.4	142.3	146.2	144.3	115.1	125.4	120.3	125.3	135.8	130.6
2021.05.20	15:20	15:26	19A	80.2	153.1	161.4	177.9	169.7	137.6	152.9	145.3	147.6	162.2	154.9	690.2	139.0	155.7	155.7	155.7	129.0	131.2	130.1	140.9	141.8	141.4
2021.05.20	15:30	15:38	19B	75.4	166.4	177.9	185.9	181.9	151.1	163.7	157.4	161.3	172.9	167.1	700.9	141.7	154.0	156.9	155.5	131.2	132.7	132.0	139.4	141.0	140.2
2021.05.20	15:43	15:49	19C	73.3	159.1	161.1	187.9	174.5	137.9	164.6	151.3	145.9	174.0	160.0	711.8	152.3	166.5	167.6	167.1	143.6	144.5	144.1	152.0	152.3	152.2
2021.05.20	15:51	15:59	19D	74.3	172.8	190.8	190.8	190.8	162.1	165.4	163.8	174.5	176.2	175.4	722.8	153.3	138.6	166.5	152.6	119.1	144.3	131.7	127.4	151.9	139.7
2021.05.20	16:03	16:11	19E	78.2	166.3	182.5	182.5	182.5	157.3	157.3	157.3	165.6	165.6	165.6	734.0	144.9	158.1	160.8	159.7	133.1	135.9	134.8	142.8	145.4	144.4
2021.05.22	10:04	10:14	21S	41.5	146.4	161.1	168.2	164.1	131.8	142.4	136.4	140.7	151.5	145.8	1,360.0	148.8	141.2	168.5	144.8	106.3	138.8	121.0	119.1	147.7	133.2
2021.05.22	10:33	13:41	22S	34.6	183.1	172.7	195.3	185.2	151.2	167.8	160.4	159.8	175.6	168.4	1,338.1	149.5	142.5	148.5	145.2	118.8	126.8	122.7	128.1	144.1	133.7
2021.05.22	12:21	12:25	21N	46.1	153.0	171.8	178.1	174.7	144.2	150.2	147.0	154.1	161.7	157.4	1,397.7	146.7	143.1	169.1	148.6	120.1	140.7	125.2	134.5	150.0	139.3
2021.05.22	12:44	12:49	22N	39.8	154.6	166.2	182.8	175.8	143.8	152.0	147.6	153.8	162.8	158.4	1,376.4	142.9	141.7	165.5	147.0	119.4	135.9	124.2	129.9	144.2	137.6
2021.05.24	14:15	14:21	22A	72.1	143.4	158.6	159.0	158.8	135.2	135.9	135.6	148.0	148.1	148.1	1,252.8	137.5	149.8	160.3	157.3	114.9	129.7	118.5	129.0	140.7	133.9
2021.05.24	14:27	14:33	22B	64.5	140.4	158.5	162.5	160.5	130.7	134.5	132.6	140.0	144.4	142.2	1,267.7	131.7	142.0	148.7	145.1	113.9	123.9	121.2	128.0	140.5	134.2
2021.05.24	14:40	14:47	22C	59.8	140.4	156.1	161.9	159.0	131.5	132.3	131.9	140.2	141.8	141.0	1,282.7	133.9	138.2	146.0	142.9	119.8	125.4	122.2	130.4	138.6	134.5
2021.05.24	14:54	15:03	22D	58.6	139.3	159.6	164.8	161.8	126.4	133.6	129.8	138.4	145.2	141.7	1,297.7	137.6	142.1	148.9	144.9	118.9	128.1	122.4	132.9	139.7	136.1
2021.05.24	15:10	15:16	22E	61.2	140.6	158.4	161.5	160.3	129.0	136.3	132.8	138.0	144.3	141.4	1,312.7	141.3	141.0	156.5	147.8	117.9	133.5	124.5	132.6	142.1	137.9
2021.05.25	13:43	13:49	21A	72.7	146.2	155.8	173.2	162.9	126.7	150.2	138.4	141.4	164.5	152.6	491.5	138.4	138.3	153.9	147.2	108.3	130.6	113.6	117.4	139.7	123.5
2021.05.25	13:56	14:03	21B	66.7	153.5	153.7	184.5	170.4	124.2	158.8	145.0	140.9	172.1	160.0	503.8	124.8	140.6	155.2	146.8	108.6	116.3	111.9	117.7	127.6	122.1
2021.05.25	14:08	14:15	21C	63.7	150.4	157.6	178.0	165.2	133.5	155.3	141.9	152.4	168.0	158.4	516.3	130.9	139.3	155.1	149.3	107.8	122.4	114.2	121.4	134.4	128.8
2021.05.25	14:19	14:25	21D	64.2	142.5	155.6	161.4	158.0	131.5	138.1	134.7	150.3	156.4	153.2	528.9	123.2	139.3	160.2	147.6	106.6	115.4	110.3	116.7	128.7	121.1
2021.05.25	14:33	14:40	21E	68.0	144.0	155.9	168.5	159.1	131.8	143.5	135.5	150.1	161.4	154.1	541.7	124.6	142.9	159.9	152.5	108.2	116.1	112.0	117.0	126.2	121.3
2021.05.27	10:03	10:10	23S	117.1	149.2	162.1	172.3	167.4	135.7	147.0	140.7	145.1	156.3	149.6	575.1	153.2	144.9	165.6	157.3	111.6	144.7	130.5	121.0	152.8	138.9
2021.05.27	10:35	10:41	24S	96.3	146.7	159.3	171.8	165.0	129.4	148.6	138.9	137.6	160.9	149.1	590.1	136.0	146.4	149.8	148.4	110.3	128.2	121.5	119.6	137.8	131.2
2021.05.27	13:02	13:07	23N	101.8	141.2	160.4	164.4	162.5	131.3	139.2	134.2	140.0	147.8	142.6	516.2	148.0	144.2	168.5	151.8	111.5	141.0	124.3	119.7	153.1	133.6
2021.05.27	13:29	13:34	24N	77.3	143.8	161.3	168.0	165.2	135.2	138.5	136.8	143.8	147.8	146.1	532.7	148.9	149.7	172.4	161.8	111.2	141.9	127.5	122.6	154.3	137.9
2021.05.28	11:17	11:22	24A	37.3	148.9	161.3	168.4	164.9	137.8	145.9	141.9	147.6	153.4	150.5	538.1	123.1	145.4	145.4	145.4	116.1	116.1	116.1	126.4	126.4	126.4
2021.05.28	11:25	11:31	24B	23.5	148.3	161.3	168.4	164.8	137.8	145.9	140.5	145.5	153.4	148.8	549.4	129.6	143.6	143.6	143.6	121.8	121.8	121.8	131.2	131.2	131.2
2021.05.28	11:37	11:43	24C	12.8	146.2	156.4	168.4	163.2	131.4	145.9	138.4	139.8	153.4	146.2	560.8	128.1	143.1	143.1	143.1	120.3	120.3	120.3	129.4	129.4	129.4
2021.05.28	11:51	11:57	24D	15.0	140.2	156.4	158.7	157.2	131.4	134.4	132.4	139.8	142.6	140.7	572.5	117.9	149.6	149.6	149.6	110.1	110.1	110.1	118.8	118.8	118.8
2021.05.28	12:03	12:10	23A	37.9	144.4	158.7	165.1	161.9	134.4	137.7	135.9	142.6	146.4	144.3	521.8	120.2	151.6	151.6	151.6	111.7	111.7	111.7	120.1	120.1	120.1
2021.06.01	11:51	11:58	23B	24.5	151.2	160.8	183.4	169.8	133.4	155.3	142.7	142.9	169.7	153.3	777.8	122.6	132.8	141.4	137.4	106.8	114.1	109.9	116.5	126.5	120.9
2021.06.01	12:03	12:08	23C	14.5	160.2	161.2	197.6	179.9	137.2	166.4	153.2	145.5	176.5	162.3	792.6	141.3	130.0	160.4	151.2	101.1	134.3	121.2	112.9	145.7	132.4
2021.06.01	12:16	12:23	23D	16.5	145.6	158.1	175.1	167.2	129.7	146.9	137.1	139.4	158.3	148.2	807.3	129.0	140.8	149.8	145.9	99.4	120.5	115.0	111.8	131.9	126.4
2021.06.01	12:27	12:33	23E	28.0	148.2	160.9	186.3	172.4	130.3	152.9	140.4	140.0	166.6	151.9	822.1	119.4	131.8	146.0	139.6	98.9	111.6	103.3	111.6	120.2	114.6
2021.06.01	12:46	12:53	24E	27.1	161.0	160.9	190.1	180.9	133.1	161.8	152.5	144.9	169.3	162.4	818.4	138.3	155.0	157.7	156.6	126.4	129.8	128.4	136.0	140.2	138.4

TableA-2 *continued*. Values for vibration of the 36in x 0.5in steel piles using the APE 300-6 Head.

Near Hydrophone

Date	Start Time	End Time	Pile ID	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time		ft	dB re 1 μPa^2·sec	dB re 1 µPa			dB re 1 μPa^2·sec			dB re 1 µPa		
2021.06.03	8:55	8:59	25N	46.7	142.3	160.5	171.3	166.4	132.0	141.8	136.3	142.4	152.7	146.8
2021.06.03	10:19	10:25	25S	75.8	144.9	162.2	174.3	168.2	132.0	144.0	137.1	141.4	155.3	147.3
2021.06.08	15:55	16:02	8A	106.6	167.7	182.1	188.1	185.1	155.0	163.3	159.2	166.4	171.9	169.2
2021.06.08	16:07	16:15	7A	97.4	165.8	182.2	183.3	182.8	156.4	157.2	156.8	165.7	166.7	166.2
2021.06.08	16:22	16:29	7B	83.0	161.5	166.8	188.4	179.0	138.6	161.2	153.0	148.7	170.4	162.3
2021.06.08	16:36	16:43	7C	68.8	153.5	167.4	174.2	170.0	141.7	147.7	145.0	151.4	163.9	157.3
2021.06.08	16:54	17:01	7D	55.1	153.5	167.4	174.2	170.0	141.7	147.7	145.0	151.4	163.9	157.3
2021.06.08	17:05	17:41	7E	42.3	155.7	164.4	173.0	168.2	135.4	146.6	140.1	147.8	155.4	152.7
2021.06.08	17:47	17:55	8E	60.5	154.6	164.5	175.4	170.9	135.5	151.5	145.6	147.5	161.1	156.9
2021.06.08	17:59	18:06	8D	70.0	154.4	166.8	183.6	173.9	139.6	156.7	145.9	150.3	168.5	157.9
2021.06.08	18:12	18:20	8C	81.3	150.9	166.7	167.3	167.1	140.6	143.2	141.9	150.5	154.1	151.8
2021.06.08	18:26	18:35	8B	93.6	151.7	159.6	173.0	168.0	137.6	146.1	142.2	146.3	161.5	154.6
2021.06.10	16:31	16:37	6A	94.2	149.3	162.5	175.9	167.6	134.7	148.5	141.5	144.7	157.5	151.1
2021.06.10	16:43	16:53	6B	79.2	156.6	164.6	173.8	169.2	143.2	149.9	146.6	153.1	159.4	156.3
2021.06.10	17:15	17:21	6C	64.2	152.9	164.9	169.6	166.7	142.5	148.3	145.1	152.4	159.6	155.7
2021.06.10	17:28	17:33	6D	49.2	142.0	160.0	166.4	162.9	130.6	139.7	135.0	141.5	148.9	145.4
2021.06.10	17:39	17:42	6E	34.2	157.1	162.3	207.5	183.7	132.9	173.6	152.3	143.6	182.3	163.0
2021.06.11	9:10	9:14	5A	97.5	152.1	161.7	179.2	171.2	136.5	154.1	146.1	149.4	165.0	157.3
2021.06.11	9:18	9:22	5B	83.0	153.9	158.6	191.4	174.9	129.4	164.3	147.9	140.9	172.6	158.2
2021.06.11	9:28	9:30	5C	68.9	137.1	149.4	179.0	160.2	121.4	156.5	134.1	134.7	164.2	144.6
2021.06.11	9:47	9:50	5E	42.4	139.5	150.4	171.0	159.0	128.1	145.5	134.7	137.1	157.1	145.3
2021.06.11	9:54	10:02	5D	55.2	152.4	155.7	182.8	168.8	132.2	157.1	143.4	141.2	164.9	153.6

Far Hydrophone

Date	Start Time	End Time	Pile ID	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time		ft	dB re 1 μPa^2·sec	dB re 1 µPa			dB re 1 μPa^2·sec			dB re 1 µPa		
2021.06.03	8:55	8:59	25N	1,462.3	115.3	139.3	149.0	142.5	102.1	109.3	104.6	116.1	125.7	120.2
2021.06.03	10:19	10:25	25S	1,515.1	118.1	134.5	141.9	137.7	101.0	110.3	106.6	112.9	125.1	119.2
2021.06.08	15:55	16:02	8A	1,055.1	123.9	137.8	140.5	139.5	96.4	115.4	102.9	110.0	127.2	115.8
2021.06.08	16:07	16:15	7A	1,064.5	125.2	136.4	143.6	139.2	112.4	116.2	114.7	121.4	126.6	124.4
2021.06.08	16:22	16:29	7B	1,078.4	122.1	131.6	145.1	138.1	94.3	113.6	101.5	106.6	123.6	112.8
2021.06.08	16:36	16:43	7C	1,092.2	131.6	136.2	151.4	142.7	98.5	123.1	111.5	112.4	135.5	123.6
2021.06.08	16:54	17:01	7D	1,106.1	108.5	142.3	144.6	143.4	99.1	100.0	99.5	117.5	118.6	117.9
2021.06.08	17:05	17:41	7E	1,120.1	130.6	134.4	136.8	135.6	99.5	115.0	108.9	112.0	123.7	118.8
2021.06.08	17:47	17:55	8E	1,111.1	110.8	140.0	140.3	140.2	96.4	101.8	99.1	107.7	113.3	110.5
2021.06.08	17:59	18:06	8D	1,097.1	132.1	125.0	149.2	137.2	97.2	123.6	107.0	108.1	135.2	117.6
2021.06.08	18:12	18:20	8C	1,083.0	136.5	132.3	149.0	143.0	103.2	127.5	118.5	115.8	135.8	128.4
2021.06.08	18:26	18:35	8B	1,069.1	124.9	132.7	139.5	136.1	111.1	115.4	113.3	120.7	125.5	123.1
2021.06.10	16:31	16:37	6A	686.4	129.4	137.5	144.3	141.4	112.8	121.6	118.5	123.1	137.9	132.3
2021.06.10	16:43	16:53	6B	697.3	144.0	137.7	175.1	155.4	114.7	134.0	122.4	126.2	168.7	141.2
2021.06.10	17:15	17:21	6C	708.5	149.3	149.5	174.3	153.4	108.4	141.5	116.3	118.3	151.8	126.8
2021.06.10	17:28	17:33	6D											
2021.06.10	17:39	17:42	6E											
2021.06.11	9:10	9:14	5A	1,489.8	128.4	125.2	143.8	136.0	92.2	122.4	110.4	100.7	134.2	121.3
2021.06.11	9:18	9:22	5B	1,504.7	127.5	129.9	143.9	135.9	96.8	121.5	105.5	105.3	131.4	115.3
2021.06.11	9:28	9:30	5C	1,519.5	120.0	128.5	139.3	134.3	103.3	117.0	109.8	113.4	127.3	119.6
2021.06.11	9:47	9:50	5E	1,549.3	121.7	127.4	142.7	134.8	103.3	116.9	109.9	114.2	127.2	119.5
2021.06.11	9:54	10:02	5D	1,534.4	124.9	137.2	140.6	139.0	113.9	115.9	115.1	125.5	130.4	126.7

Table A-3. Values for impact hammering of the 36in x 0.5in steel piles using the Junttan Head. Data listed by date.

Near Hydrophone

Date	Start Time	End Time	Pile ID	Strikes	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 μPa^2·sec	dB re 1 µPa			dB re 1 μPa^2·sec			dB re 1 µPa		
2021.04.16	08:19	08:28	9A	35	37.3	189.5	184.9	207.9	202.2	153.8	180.0	174.1	170.2	195.2	188.2
2021.04.16	10:27	10:40	9B	55	29.2	194.2	188.4	209.1	204.6	163.4	180.4	176.8	173.9	202.2	190.9
2021.04.16	10:45	11:04	9C	100	27.7	195.3	187.3	209.5	203.7	161.8	180.7	175.3	176.8	196.0	189.5
2021.04.16	13:15	13:24	9D	179	33.6	201.1	193.8	208.8	206.2	165.0	181.0	178.6	177.8	197.2	193.2
2021.04.16	13:32	13:34	9E	68	44.0	195.4	188.1	209.2	205.3	161.1	180.8	177.1	171.9	198.4	191.7
2021.04.16	13:38	13:39	10A	35	25.6	193.7	192.6	210.4	205.9	166.8	181.8	178.3	180.7	201.5	193.1
2021.04.16	14:11	14:26	10B	146	10.7	198.4	191.0	206.6	204.1	166.1	178.2	176.8	176.2	199.8	191.5
2021.04.16	14:58	15:08	10C	103	5.0	197.6	193.1	206.8	205.2	167.5	178.1	177.5	178.2	195.2	192.2
2021.04.16	15:19	15:26	10D	269	19.7	201.6	188.0	208.1	205.0	165.1	178.1	177.3	175.6	198.4	192.1
2021.04.16	15:30	15:39	10E	172	34.6	199.6	189.7	207.3	204.2	157.2	178.2	177.2	179.2	199.8	191.7
2021.04.19	13:18	13:44	10A	1597	25.6	214.2	191.6	219.6	211.6	163.3	185.6	183.7	173.3	208.6	199.2
2021.04.20	15:01	15:03	9C	298	27.7	207.4	196.5	221.4	211.8	169.9	186.5	182.7	183.7	204.2	199.0
2021.04.20	15:06	15:10	9E	195	44.0	205.7	194.6	221.3	212.0	164.9	187.9	182.8	175.8	205.9	198.7
2021.04.20	15:17	15:19	10E	663	34.6	210.1	192.8	219.1	210.6	163.3	188.1	181.9	177.1	213.9	197.3
2021.04.21	11:32	11:35	9C	489	5.1	213.4	211.4	219.1	216.3	182.0	189.1	186.5	197.5	212.1	203.5
2021.04.21	11:44	12:02	10D	230	19.7	211.4	211.7	218.3	216.5	184.1	189.2	187.8	199.5	209.7	203.9
2021.04.21	12:07	12:16	9D	414	33.6	211.3	213.4	219.5	215.7	184.7	185.6	185.1	200.8	207.7	202.4

Far Hydrophone

Date	Start Time	End Time	Pile ID	Strikes	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 μPa^2·sec	dB re 1 µPa			dB re 1 μPa^2·sec			dB re 1 µPa		
2021.04.16	08:19	08:28	9A	35	2555.1	149.5	150.6	162.8	159.7	125.0	137.2	134.1	136.3	156.0	145.8
2021.04.16	10:27	10:40	9B	55	2569.3	150.7	151.8	160.8	158.8	122.9	135.2	133.3	138.5	152.3	144.8
2021.04.16	10:45	11:04	9C	100	2583.6	154.3	155.7	162.4	159.9	124.8	135.2	134.3	143.1	151.5	145.1
2021.04.16	13:15	13:24	9D	179	2597.8	157.0	147.8	162.8	160.5	119.5	137.1	134.5	130.8	156.2	146.3
2021.04.16	13:32	13:34	9E	68	2612.1	153.1	159.7	162.1	161.0	132.5	135.3	134.8	145.0	152.6	145.9
2021.04.16	13:38	13:39	10A	35	2563.2	150.8	158.3	163.9	161.3	132.9	138.0	135.4	143.2	153.7	147.0
2021.04.16	14:11	14:26	10B	146	2577.4	158.6	161.3	184.2	163.7	129.5	160.9	137.0	145.0	173.6	148.5
2021.04.16	14:58	15:08	10C	103	2591.5	158.8	160.4	186.2	163.8	135.8	164.9	138.7	147.0	176.3	150.3
2021.04.16	15:19	15:26	10D	269	2605.7	161.2	158.7	164.0	162.5	125.9	137.8	136.9	145.6	156.5	149.9
2021.04.16	15:30	15:39	10E	172	2620.0	159.3	161.3	164.0	162.9	135.2	137.7	136.9	147.2	157.4	150.4
2021.04.19	13:18	13:44	10A	1597	1067.2	186.4	172.0	183.6	179.1	128.9	155.9	154.4	139.1	173.0	166.0
2021.04.20	15:01	15:03	9C	298	2025.4	165.4	154.0	170.3	166.2	120.4	144.4	140.7	139.5	160.6	152.7
2021.04.20	15:06	15:10	9E	195	2054.8	164.0	156.0	177.7	166.2	129.8	159.5	141.1	142.7	170.9	153.6
2021.04.20	15:17	15:19	10E	663	2059.7	173.2	159.4	184.3	168.9	133.0	156.7	145.0	147.7	177.2	159.2
2021.04.21	11:32	11:35	9C	489	2489.6	168.2	166.5	169.5	167.6	138.6	143.9	141.3	149.8	160.4	152.4
2021.04.21	11:44	12:02	10D	230	2479.1	166.6	166.3	169.2	167.9	140.9	144.2	143.0	150.8	161.7	154.2
2021.04.21	12:07	12:16	9D	414	2497.1	168.6	163.7	170.8	167.3	133.3	144.5	142.4	148.9	160.1	153.0

Table A-3 *continued*. Values for impact hammering of the 36in x 0.5in steel piles using the Junttan Head.

					Near Hydrophone											Far Hydrophone										
Date	Start Time	End Time	Pile ID	Strikes	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 µPa²·sec	dB re 1 µPa			dB re 1 µPa²·sec			dB re 1 µPa			ft	dB re 1 µPa²·sec	dB re 1 µPa			dB re 1 µPa²·sec			dB re 1 µPa		
2021.04.21	12:25	12:27	10A	1633	25.6	218.1	213.5	220.5	215.0	184.7	189.0	186.0	201.5	207.7	202.8	2510.7	171.1	159.5	167.3	164.0	135.0	141.4	139.0	145.5	155.3	149.7
2021.04.21	12:31	12:40	9A	146	37.3	210.4	216.2	222.5	218.8	187.0	189.6	188.8	202.7	212.5	204.9	2528.5	164.2	166.0	169.6	168.1	140.2	144.4	142.6	150.0	161.5	152.8
2021.04.21	12:44	12:59	10B	280	10.7	212.8	212.7	222.1	217.6	183.7	189.2	188.3	192.9	209.6	204.1	1994.4	162.7	162.1	164.1	162.9	135.9	140.7	138.2	146.9	154.5	148.9
2021.04.21	12:54	13:11	9B	118	29.2	204.8	193.2	215.3	211.8	168.3	185.7	184.1	178.8	206.8	199.3	1987.4	163.0	164.4	167.8	166.3	141.0	143.0	142.3	150.9	157.7	152.8
2021.04.26	10:38	11:46	12A	705	43.0	210.4	195.6	216.5	208.8	170.9	185.8	181.9	181.6	204.4	196.3	2077.0	165.7	142.5	164.1	161.0	117.9	139.6	137.2	129.5	156.8	148.1
2021.04.26	15:28	15:46	11A	617	68.0	207.4	186.5	211.6	205.6	160.0	183.8	179.5	171.0	204.5	193.6	2070.0	164.9	142.6	166.4	159.8	119.3	142.5	137.0	131.9	156.5	147.5
2021.04.26	15:49	16:27	11B	1047	69.0	210.6	192.5	215.6	208.1	166.0	184.4	180.4	177.6	205.3	194.6	2085.0	165.5	138.5	168.2	159.4	111.6	142.8	135.3	125.0	160.6	146.5
2021.04.26	16:33	16:41	11C	372	73.0	208.9	197.7	211.7	210.8	172.3	184.3	183.2	182.6	208.1	198.6	2099.0	145.4	141.4	151.2	145.3	115.7	124.2	119.7	127.0	135.7	131.3
2021.04.26	16:45	17:02	11D	331	81.0	205.9	194.1	209.2	205.9	168.3	184.0	180.7	178.4	202.7	194.7	2114.0	157.2	140.2	171.0	157.0	115.3	142.1	132.0	127.2	159.7	143.7
2021.04.26	17:07	17:19	12B	189	45.0	206.4	194.9	222.6	212.4	167.0	187.3	183.6	179.1	208.7	197.6	2091.0	145.7	139.5	158.3	146.4	112.4	130.5	122.9	123.7	145.9	134.5
2021.04.27	08:23	08:33	12C	281	51.4	191.8	177.9	200.1	196.7	152.1	170.1	167.3	163.4	194.1	179.8	2327.7	149.3	128.7	166.6	152.8	99.5	139.3	129.0	111.5	153.1	139.0
2021.04.27	08:57	09:28	12D	424	61.1	190.3	180.7	198.1	193.8	154.8	168.6	164.0	164.8	190.1	176.1	2343.9	154.4	132.3	164.6	155.8	108.8	139.5	132.5	117.3	155.5	142.9
2021.04.27	10:35	10:50	12E	356	72.6	192.9	174.1	201.3	194.9	146.7	173.0	167.4	160.4	187.9	181.2	2358.2	153.7	121.6	168.6	150.4	97.2	141.9	126.9	108.6	155.8	138.7
2021.05.04	13:39	13:47	13A	312	87.9	209.9	185.0	215.2	211.5	154.7	187.0	185.0	180.2	209.2	200.7	641.0	174.4	156.8	182.1	177.5	129.6	152.8	149.5	143.0	170.8	162.9
2021.05.04	13:58	14:12	13E	611	81.5	214.5	196.2	216.4	213.5	168.7	188.9	186.6	181.5	210.8	201.7	680.6	177.9	163.4	178.8	176.8	131.2	151.4	150.0	147.9	170.4	163.7
2021.05.04	14:17	14:29	13D	500	79.0	213.9	195.2	217.0	214.4	167.8	189.0	186.9	180.0	211.0	200.7	670.4	177.5	149.0	183.2	177.5	124.4	154.0	150.5	140.9	171.2	163.4
2021.05.04	15:10	15:16	13C	298	79.3	209.6	179.8	218.2	212.3	156.9	189.7	184.9	166.2	211.4	199.0	660.4	174.3	165.0	182.6	176.8	136.4	153.8	149.6	149.4	171.4	162.2
2021.05.04	15:21	15:27	13B	260	82.4	211.2	196.7	218.3	215.8	168.8	189.1	187.1	182.2	211.5	202.7	650.6	175.0	169.4	181.1	178.7	142.2	153.1	150.9	157.0	171.1	164.7
2021.05.04	15:46	15:56	14E	429	57.7	215.1	196.5	219.7	216.9	168.2	191.2	188.8	179.2	215.7	204.2	699.0	175.9	152.3	180.1	176.3	129.4	152.0	149.6	139.6	168.3	163.2
2021.05.04	16:09	16:19	14A	441	66.5	213.4	197.9	217.1	216.1	172.8	187.8	187.0	183.9	210.7	203.7	660.5	175.2	152.8	179.6	175.3	115.0	151.6	148.8	132.8	167.4	162.1
2021.05.05	16:18	16:26	13A	312	88.0	202.7	166.4	216.6	205.8	141.3	186.5	177.8	152.6	203.4	192.5	411.0	169.2	140.1	183.7	173.4	101.8	155.7	144.3	114.2	171.2	158.6
2021.05.11	14:47	14:57	16-A	405	55.1	204.5	182.5	216.1	206.7	155.0	187.0	178.4	167.4	209.6	194.0	1152.4	172.5	155.0	177.1	171.3	131.5	151.2	146.4	144.7	168.3	158.6
2021.05.11	15:03	15:14	16-E	453	56.7	210.4	190.8	217.8	211.3	164.8	190.2	183.8	175.2	212.7	197.6	1200.6	177.1	154.2	177.5	173.6	132.3	153.8	150.5	142.1	169.5	163.5
2021.05.11	15:26	15:38	16-B	167	49.1	208.9	195.2	220.1	215.3	170.6	191.0	186.7	180.8	213.1	202.9	1164.4	171.5	157.8	180.1	174.4	137.0	153.7	149.3	147.4	172.5	161.6
2021.05.11	15:42	15:48	16-C	559	47.2	216.1	191.4	220.6	217.0	162.5	191.3	188.6	173.8	215.1	203.5	1176.4	177.8	164.8	176.6	175.0	136.2	152.0	150.3	158.2	169.0	163.8
2021.05.11	15:51	15:56	16-D	393	50.0	208.4	186.8	215.9	209.5	159.3	186.9	182.5	172.1	206.9	195.3	1188.5	176.1	154.4	180.6	173.6	132.2	155.6	150.2	142.0	171.4	162.9
2021.05.11	16:09	16:17	15-E	380	78.7	208.7	186.8	215.9	209.9	159.3	186.9	182.9	172.1	208.8	195.5	1186.2	178.4	172.5	178.8	175.2	149.2	154.5	152.6	164.3	171.0	166.6
2021.05.11	16:21	16:26	15-D	196	74.0	206.2	192.0	214.2	211.5	167.2	185.6	183.3	177.9	209.9	199.2	1173.9	176.9	177.3	186.2	179.7	151.3	165.3	154.0	166.0	174.5	168.1
2021.05.11	16:30	16:45	15-C	671	72.2	211.8	191.3	216.1	210.6	166.3	187.4	183.5	177.5	207.8	198.0	1161.7	180.5	159.1	180.8	175.9	126.6	158.5	152.2	147.5	171.9	165.4
2021.05.11	16:48	17:07	15-B	868	73.4	211.9	191.9	210.2	208.7	167.3	183.5	182.5	177.5	204.5	198.4	1149.5	182.4	156.0	179.6	176.2	128.2	155.9	153.0	145.3	171.9	166.3
2021.05.11	17:11	17:42	15-A	1259	77.6	213.4	187.7	213.5	208.8	160.5	184.9	182.4	170.6	206.2	198.2	1137.4	182.7	163.4	180.1	176.7	132.0	153.9	151.7	159.2	172.4	165.8
2021.05.11	17:46	17:52	14-D	215	98.6	206.1	195.0	214.1	210.0	167.5	186.4	182.8	179.3	206.2	195.6	1159.7	174.3	161.7	186.2	176.3	137.9	160.6	151.0	146.5	177.8	164.5
2021.05.11	17:55	17:57	14-C	114	97.2	202.4	189.5	213.0	208.5	163.0	184.7	181.8	174.1	206.0	196.5	1147.3	170.6	154.9	179.9	174.3	128.9	153.1	150.0	143.7	170.2	162.6
2021.05.12	11:06	11:09				197.2	178.1	213.4	209.4	155.1	181.1	179.1	163.8	201.1	194.1		166.6	160.2	178.2	175.0	134.8	151.4	148.9	148.0	167.5	162.5
2021.05.17	09:55	10:07	18A	492	26.4	208.7	190.2	215.9	211.0	158.4	186.3	181.8	175.8	206.4	198.4	9636.0	-	-	-	-	-	-	-	-	-	-
2021.05.17	10:10	10:19	18C	282	12.6	210.2	200.8	215.9	215.1	174.3	186.4	185.7	183.6	208.8	203.0	9663.5	-	-	-	-	-	-	-	-	-	-
2021.05.17	10:32	10:41	18B	574	12.8	213.2	196.1	215.8	214.9	170.2	186.3	185.6	179.3	208.3	204.1	9649.7	-	-	-	-	-	-	-	-	-	-
2021.05.17	10:45	10:55	18D	406	26.2	208.6	191.8	215.6	211.7	164.2	186.3	182.5	173.9	208.4	199.1	9677.2	-	-	-	-	-	-	-	-	-	-
2021.05.17	10:57	11:05	18E	244	40.9	202.6	197.6	216.1	208.1	168.1	186.4	178.7	181.6	207.1	194.8	9690.9	-	-	-	-	-	-	-	-	-	-
2021.05.17	11:08	11:16	17E	274	44.9	208.0	192.0	216.7	212.4	161.8	186.5	183.6	174.5	211.0	199.5	9680.8	-	-	-	-	-	-	-	-	-	-
2021.05.17	11:19	11:30	17D	514	32.3	205.8	195.6	215.4	207.2	166.7	186.3	178.7	180.4	209.9	193.3	9667.1	-	-	-	-	-	-	-	-	-	-
2021.05.17	11:33	11:43	17C	346	23.3	204.2	195.5	214.9	207.5	167.7	186.7	178.8	182.0	200.4	193.2	9653.3	-	-	-	-	-	-	-	-	-	-
2021.05.17	11:45	11:59	17B	306	23.4	204.2	199.7	215.3	208.1	170.4	186.7	179.3	184.8	209.6	193.3	9639.6	-	-	-	-	-	-	-	-	-	-
2021.05.17	12:01	12:18	17A	793	32.5	209.4	201.5	215.2	209.9	172.0	186.7	180.4	185.2	211.8	194.2	9625.9	-	-	-	-	-	-	-	-	-	-
2021.05.21	13:28	15:52	20A	745	58.3	213.0	190.2	215.9	213.6	158.4	186.4	184.3	173.9	208.8	201.7	3774.9	143.2	136.9	158.2	142.7	109.8	125.9	114.5	121.4	139.6	124.4
2021.05.21	13:42	13:48	20E	285	55.5	203.5	197.6	216.1	208.4	168.1	186.5	179.0	181.6	207.3	195.1	3828.9	142.9	140.7	152.5	146.0	110.1	122.1	118.4	123.6	131.7	127.6
2021.05.21	13:53	14:04	20D	460	49.9	207.5	192.0	219.4	209.8	161.8	189.2	180.9	174.5	211.8	195.3	3815.4	146.5	140.9	152.3	147.4	115.0	122.6	119.9	126.7	131.5	129.0
2021.05.21	14:10	14:18	19E	448	78.2	213.4	198.9	219.1	215.6	173.6	190.1	186.9	183.9	212.5	202.7	3818.3	146.0	139.7	159.2	148.7	114.0	121.9	119.5	125.6	135.0	129.0
2021.05.21	14:23	14:34	19D	465	74.3	207.9	193.6	212.7	208.4	168.6	184.8	181.2	179.5	205.2	194.1	3804.7	144.8	134.3	156.7	143.6	106.6	123.2	118.1	115.5	134.2	128.4

Table A-3 *continued*. Values for impact hammering of the 36in x 0.5in steel piles using the Junttan Head.

					Near Hydrophone											Far Hydrophone										
Date	Start Time	End Time	Pile ID	Strikes	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms	Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 µPa²sec	dB re 1 µPa			dB re 1 µPa²sec			dB re 1 µPa			ft	dB re 1 µPa²sec	dB re 1 µPa			dB re 1 µPa²sec			dB re 1 µPa		
2021.05.21	14:37	14:47	19C	460	73.3	208.3	195.0	213.3	208.6	164.7	185.8	181.7	176.3	202.8	195.7	3791.1	144.3	129.2	147.8	144.0	101.7	119.2	117.7	114.4	133.9	128.5
2021.05.21	15:00	15:11	19B	483	75.4	209.9	191.3	216.6	211.3	166.0	187.1	183.1	177.8	211.2	197.2	3777.6	144.6	141.9	146.5	143.8	111.0	118.4	117.8	127.8	132.7	128.3
2021.05.21	15:15	15:29	19A	455	80.2	209.0	192.9	216.7	211.9	162.8	186.4	182.4	173.7	207.0	196.6	3764.0	144.9	142.0	151.3	145.0	102.8	120.3	118.3	113.0	136.2	128.9
2021.05.24	08:05	08:22	20C	746	109.2	208.6	178.1	212.1	206.3	156.0	184.3	179.9	164.1	203.4	195.5	1332.1	183.5	164.4	182.2	179.3	137.8	158.1	154.8	151.0	172.4	167.4
2021.05.24	08:27	08:59	20B	1065	111.8	209.1	177.9	212.7	206.7	156.4	184.1	178.8	165.3	202.1	194.4	1315.0	183.4	144.1	182.2	177.2	119.0	158.1	153.1	131.1	173.6	165.1
2021.05.26	07:42	07:55	22A	659	52.3	214.2	196.2	217.7	215.4	169.8	188.2	186.0	180.2	214.0	204.6	1414.7	171.6	162.3	170.0	167.4	133.9	144.9	143.4	148.7	161.4	155.4
2021.05.26	08:00	08:14	22B	624	43.6	214.5	195.1	216.6	215.1	167.6	187.6	186.5	180.9	212.9	205.3	1425.7	172.4	158.0	168.9	167.7	127.6	145.1	144.4	147.2	162.4	157.9
2021.05.26	08:17	09:36	22E	1552	45.6	215.7	194.1	218.8	212.7	165.7	186.2	183.8	176.8	211.2	199.5	1459.1	176.1	157.9	171.3	168.1	122.9	146.1	144.2	148.6	162.5	158.0
2021.05.26	10:19	10:39	22C	1340	38.8	215.1	183.8	220.3	213.4	158.5	186.7	183.8	166.5	210.1	200.0	1436.7	174.4	162.2	168.9	166.9	138.2	144.8	143.1	151.6	161.6	157.3
2021.05.26	10:42	11:10	22D	1107	39.6	216.9	193.2	217.1	215.7	165.9	187.6	186.5	179.3	210.3	204.6	1447.9	175.0	150.5	172.6	168.8	118.1	147.1	144.6	143.4	163.3	158.4
2021.05.26	11:41	11:50	21E	428	68.0	211.7	195.6	217.3	214.7	167.2	187.2	185.4	180.1	213.5	202.6	1442.6	171.1	151.6	169.6	167.7	128.3	146.4	144.8	140.7	163.1	159.2
2021.05.26	11:55	12:07	21D	590	64.2	214.3	198.4	218.0	216.1	169.1	188.0	186.6	183.5	215.6	204.5	1431.3	172.1	162.1	170.9	168.2	128.2	146.0	144.4	151.9	164.1	158.4
2021.05.26	12:11	12:21	21C	561	63.7	207.6	181.4	216.5	206.3	152.2	186.5	180.1	162.5	208.1	195.6	1420.0	172.9	162.2	170.6	169.1	129.6	146.4	145.4	153.8	163.4	159.4
2021.05.26	12:24	12:36	21B	551	66.7	207.9	189.1	215.7	208.4	164.1	184.5	180.5	175.2	204.4	195.4	1408.8	169.7	150.3	170.5	166.7	124.2	147.0	142.3	140.3	163.6	154.7
2021.05.26	12:38	12:49	21A	671	72.7	206.6	189.2	209.0	205.2	163.1	180.1	178.3	174.4	201.5	193.0	1397.7	169.7	148.9	169.5	165.5	122.3	145.2	141.4	135.5	161.3	153.4
2021.06.02	07:55	08:02	24A	642	42.9	213.5	196.3	216.2	215.1	169.9	186.3	185.4	181.4	212.8	203.4	1518.8	175.2	165.4	173.2	171.3	136.5	148.8	147.1	156.4	165.8	160.4
2021.06.02	08:04	08:19	24B	728	28.4	214.8	197.8	218.0	215.1	172.1	189.4	186.2	182.2	212.3	204.1	1529.4	174.9	166.6	174.4	170.5	138.0	150.7	146.3	154.4	167.1	159.3
2021.06.02	08:22	08:33	24C	620	14.8	214.4	197.9	219.3	214.9	170.8	189.6	186.5	182.2	212.9	203.9	1540.1	173.8	166.3	174.2	170.1	135.8	149.4	145.9	155.6	166.8	159.0
2021.06.02	08:35	08:41	24D	131	9.0	207.5	196.4	221.0	214.7	161.2	188.6	186.3	178.7	213.4	202.2	1550.8	167.1	149.4	174.7	169.3	125.0	149.1	145.9	138.3	161.9	159.0
2021.06.02	08:45	08:57	24E	441	19.9	208.2	192.1	212.3	210.0	163.6	183.2	181.8	173.6	206.5	199.1	1561.7	172.3	162.3	172.7	170.0	133.8	148.5	145.9	153.6	164.4	159.0
2021.06.02	09:37	09:45	23A	1095	53.8	212.6	193.1	215.9	211.8	165.8	186.0	182.2	175.9	207.3	197.8	1501.2	190.4	171.4	186.6	186.0	146.9	160.9	160.0	158.1	179.5	173.6
2021.06.02	10:16	10:22	23E	428	38.0	210.2	193.0	218.9	214.0	166.8	186.8	183.9	177.1	212.1	201.1	1544.5	183.7	174.6	186.7	185.0	143.1	160.2	157.4	158.8	179.2	169.2
2021.06.02	10:30	10:43	23D	580	33.7	210.1	193.2	215.4	211.7	167.1	185.8	182.5	176.9	208.1	199.4	1533.6	184.1	174.5	186.6	184.1	140.8	160.2	156.5	158.4	177.1	168.7
2021.06.02	10:47	10:56	23C	871	35.6	211.6	190.1	219.9	212.5	162.6	186.7	182.2	174.7	210.7	200.1	1522.7	186.8	172.3	186.6	183.2	145.2	161.4	157.4	157.6	176.7	170.8
2021.06.02	11:10	11:18	23B	767	43.1	209.2	191.0	214.8	210.6	158.5	183.9	180.4	173.8	204.1	198.6	1511.9	184.9	172.1	185.2	181.7	138.5	159.4	156.1	158.7	174.8	169.0
2021.06.28	12:05	12:16	23A	236	421.5	193.2	178.2	197.0	194.7	146.8	171.5	169.5	178.2	197.0	194.7	1201.3	179.0	156.3	182.2	180.0	134.6	157.0	155.3	156.3	182.2	180.0
2021.06.28	12:21	12:37	24A	397	445.9	195.0	177.8	195.6	194.4	155.5	170.0	169.0	177.8	195.6	194.4	1204.2	181.2	150.6	182.7	181.0	128.6	156.9	155.2	150.6	182.7	181.0
2021.06.28	12:41	12:46	22B	115	393.9	187.2	173.7	196.7	193.0	143.0	170.6	166.6	173.7	196.7	193.0	1213.8	176.3	162.7	183.5	181.2	128.3	158.0	155.7	162.7	183.5	181.2
2021.06.28	12:49	12:53	22A	62	397.2	187.1	175.0	198.1	195.5	145.1	171.8	169.2	175.0	198.1	195.5	1198.9	172.6	163.7	182.0	179.1	129.2	157.4	154.7	163.7	182.0	179.1
2021.06.28	12:56	13:27	21A	1162	373.0	199.6	181.1	197.6	195.7	157.4	170.8	168.9	181.1	197.6	195.7	1197.0	183.6	164.6	180.1	177.2	132.3	155.0	152.9	164.6	180.1	177.2
2021.06.28	14:16	14:37	21B	785	369.5	196.9	183.2	196.4	195.1	157.2	169.8	168.0	183.2	196.4	195.1	1212.0	177.6	151.6	179.5	173.3	125.4	155.0	148.7	151.6	179.5	173.3
2021.06.28	14:43	14:53	21C	337	366.5	194.3	189.1	196.7	194.7	164.1	170.5	169.0	189.1	196.7	194.7	1227.0	177.5	165.6	179.5	176.9	135.4	154.6	152.2	165.6	179.5	176.9
2021.07.01	08:42	08:43	24A	14	445.9	180.4	188.3	196.9	194.2	162.7	171.1	168.9	171.8	189.0	183.1	1528.0	163.2	167.5	181.2	177.6	133.4	154.5	151.7	160.0	168.6	166.4
2021.07.07	08:30	08:48	6A	1393	94.2	207.9	185.4	210.3	204.2	158.5	182.9	176.5	169.6	202.7	191.1	1359.1	173.9	153.5	169.7	165.4	129.8	145.7	142.5	140.3	159.4	154.2
2021.07.07	08:55	09:23	6B	1703	79.2	209.5	185.3	210.2	204.2	160.5	183.9	177.2	172.7	204.2	191.7	1373.9	174.6	159.5	169.8	165.8	127.0	145.0	142.3	146.2	159.1	153.6
2021.07.07	09:40	10:15	6C	1633	64.2	209.2	188.3	210.1	203.6	160.5	184.3	177.1	170.8	204.2	191.8	1388.7	173.8	157.9	170.2	166.2	126.8	143.5	141.7	142.8	157.2	153.0
2021.07.07	10:22	10:42	6D	190	49.2	205.7	192.6	214.4	209.3	166.2	185.9	182.9	177.3	203.5	195.0	1403.4	165.2	158.3	169.1	166.1	134.1	144.5	142.4	145.9	157.0	152.9
2021.07.07	11:10	11:30	6E	131	34.2	206.4	197.9	213.0	211.5	169.9	186.9	185.2	182.5	209.7	197.8	1418.2	162.3	155.7	168.1	165.0	130.8	142.5	141.1	141.8	154.6	151.7
2021.07.07	12:10	12:35	7A	619	97.4	200.8	187.0	207.7	202.0	158.0	178.2	172.9	169.8	199.7	187.5	1355.0	160.3	157.4	163.1	159.6	126.0	134.6	132.4	143.3	150.6	144.5
2021.07.07	12:40	13:00	7B	383	83.0	198.3	187.9	208.9	201.7	159.0	180.1	172.5	172.1	201.9	186.9	1369.8	157.3	154.6	161.4	158.6	120.9	133.4	131.5	140.1	151.2	143.6
2021.07.07	13:05	13:30	7C	598	68.8	202.4	188.9	209.7	203.2	161.5	181.2	174.6	174.0	202.2	189.3	1384.6	158.6	150.1	161.3	157.5	119.4	134.7	130.8	135.9	149.2	142.6
2021.07.07	13:35	14:00	7D	723	55.1	204.2	190.5	211.5	204.2	161.7	184.0	175.6	173.5	207.9	190.6	1399.4	158.5	145.4	161.5	156.5	110.8	133.9	129.9	128.6	150.7	141.5
2021.07.07	14:05	14:30	7E	199	42.3	200.6	189.9	214.2	206.2	162.3	186.5	177.6	172.2	209.7	192.9	1414.2	155.8	154.1	167.0	158.8	125.8	142.1	132.8	137.1	155.3	144.5
2021.07.07	15:30	15:55	8A	495	106.6	199.6	183.5	206.4	200.8	157.6	178.2	172.7	168.4	196.8	187.5	1351.3	158.7	154.1	164.8	159.1	119.9	134.0	131.8	138.9	150.3	143.8
2021.07.07	16:00	16:25	8B	634	93.6	202.1	188.4	207.9	202.2	158.8	178.9	174.1	170.4	200.1	188.7	1366.1	159.6	154.6	165.1	158.7	125.5	135.4	131.6	138.2	152.5	143.4
2021.07.07	16:30	16:55	8C	758	81.3	202.5	187.9	209.9	203.1	159.4	180.0	173.7	172.7	203.0	188.5	1381.0	158.3	153.4	158.9	156.3	119.3	130.8	129.5	138.6	149.5	141.3
2021.07.07	17:00	17:25	8D	971	70.0	205.7	185.8	211.1	204.8	159.0	182.1	175.8	169.9	204.4	190.2	1395.8	160.2	151.9	159.7	156.7	123.5	132.9	130.3	134.9	150.1	141.3
2021.07.07	17:47	17:55	8E	304	60.5	199.3	185.9	211.0	203.2	160.5	181.6	174.5	173.9	204.2	190.4	1410.7	155.3	156.1	158.8	157.4	127.5	131.2	130.5	139.0	149.4	141.6
2021.07.20	08:28	08:39	6D		49.2	206.8	190.8	212.2	207.9	163.5	182.6	180.8	174.5	203.4	194.6	1230.5	156.5	142.7	162.2	156.4	108.1	133.6	130.5	120.2	151.5	142.2

Table A-3 *continued*. Values for impact hammering of the 36in x 0.5in steel piles using the Junttan Head.

Date	Start Time	End Time	Pile ID	Strikes	Near Hydrophone: Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	Local Time	Local Time			ft	dB re 1 µPa²·sec	dB re 1 µPa			dB re 1 µPa²·sec			dB re 1 µPa		
2021.07.20	08:44	08:48	6E		34.2	207.4	191.6	211.7	207.8	165.3	183.3	181.4	175.4	203.1	194.6
2021.08.02	08:51	09:23	6D		49.2	209.1	208.5	211.8	209.9	182.0	184.5	183.1	196.0	200.9	198.2
2021.08.02	09:28	10:47	6E		34.2	209.8	210.1	214.5	211.7	181.7	186.4	183.8	198.8	208.6	200.0

Date	Far Hydrophone: Distance to Hydrophone	cSEL	Min SPLpk	Max SPLpk	Mean SPLpk	Min SEL	Max SEL	Mean SEL	Min SPLrms	Max SPLrms	Mean SPLrms
yyyy.mm.dd	ft	dB re 1 µPa²·sec	dB re 1 µPa			dB re 1 µPa²·sec			dB re 1 µPa		
2021.07.20	1243.5	155.1	141.6	163.0	156.1	112.6	134.5	129.1	124.9	147.7	142.7
2021.08.02	1165.3	168.3	167.7	172.1	170.0	137.9	147.0	145.3	155.5	163.8	157.7
2021.08.02	1179.8	168.9	169.2	172.1	170.3	141.9	146.9	145.9	156.7	163.8	158.2