Submittal #01 57 19-10R5

Hydroacoustic Monitoring Plan

Multi-Mission Expansion of Dry Dock 1

P-381

Year 2 (2023) – Year 6 (2028) LOA

March 2023

Presented To:

PNSY Public Works Department

Portsmouth Naval Shipyard Kittery, ME 03904

By: 381 Constructors

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ACRONYMS AND ABBREVIATIONS

µPa	micropascal
dB	decibel
dBA	decibel with A-weighted filter
dB SELcum	cumulative sound exposure level
DTH	down-the-hole
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometer
LOA	Letter of Authorization
Leq	equivalent sound level
m	meter
Navy	United States Department of the Navy
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PTS	permanent threshold shift
re 1µPa	referenced at 1 micropascal
re 20µPa	referenced at 20 micropascal
ROI	Region of Influence
RMS	root mean square
sec	second
SEL	sound exposure level
Shipyard	Portsmouth Naval Shipyard
SPL	sound pressure level
TL	transmission loss
TTS	temporary threshold shift
WFA	weighted factor adjustment

A. Introduction

The following is the hydroacoustic monitoring plan for Portsmouth Naval Shipyard (PNSY) P-381 Multi-Mission Dry Dock #1 Project. Monitoring under this plan will include the pile types and numbers indicated in Table 3 of the LOA. In-water rock excavation (rotary drilling or down-the-hole [DTH] excavation) activities are expected to occur between 2023 and 2027. All hydroacoustic monitoring will be done in compliance with the April 1, 2023 issued Letter of Authorization (LOA) from National Marine Fisheries Service (NMFS). The LOA covers in-water construction activities occurring from April 1, 2023 through March 31, 2028.

Considering the LOA will cover a 5-year span, the onsite hydroacoustic measurements may be used to recalculate the limits of shutdown, Level A and/or Level B harassment zones, as appropriate and with NMFS concurrence. For any proposed recalculation of zones, 381 Constructors will provide the Navy a full explanation including reviewed data that will be submitted for NMFS approval.

The Project's in-water construction activities occurring from 2023 to 2028 may produce a variety of high intensity underwater sound levels within the project area, propagating out into portions of the Piscataqua River. These high levels of underwater sound pressure have the potential to harass and possibly injure marine mammals that can be found in the Piscataqua River.

Sound is one of the main methods marine mammals use to communicate, navigate, and forage for food. The impacts to marine mammals by introducing temporary threshold shifts (TTS) and permanent threshold shifts (PTS) are still being researched as more data is collected. However, it is known that the impact of high-pressure underwater sound levels have the potential to affect an animal's physical condition.

The main course of action is to collect and evaluate underwater acoustic levels for the rock excavation (rotary drilling or DTH excavation) activities to determine the source level produced by those sound sources. All in-water work capable of producing noise harmful to marine mammals will be limited to daylight hours.

During the LOA period, the Navy will collect and evaluate data from rock excavation (rotary drilling or DTH excavation) activities conducted up to a maximum limit of 10 piles/holes. The numbers of piles/holes to be monitored for rock excavation are as follows and as noted in Table 18 of the Project's proposed LOA published in the Federal Register (88 Fed. Reg. 3146; January 18, 2023).

- 10 126-inch shaft utilizing rotary drilling
- 10 84-inch shaft utilizing rotary drilling
- 10 108-inch shaft utilizing DTH Cluster Drill
- 10 84-inch shaft utilizing DTH Cluster Drill
- 10 72-inch shaft utilizing DTH Cluster Drill

Due to the dynamic nature of the Project, it is possible that the number of piles and/or pile types may change depending on site conditions. If any changes need to be made, they will be brought to the attention of the Navy and NMFS to discuss and adjust monitoring as needed. Appendix B – In-water Pile-Driving and Drilling for Construction Year 2 – Year 6 denotes the current list of pile types as well as the updated schedule for installation/removal of year 2 – year 6 work.

B. Requirements

Hydroacoustic monitoring will comply with the ***Request for Letter of Authorization under the Marine Mammal Protection Act for the Multifunctional Expansion of Dock 1 at Portsmouth Naval Ship Yard, Kittery, Maine (April 1, 2023 through March 31, 2028)*** dated August 2022 and the ***Letter of Authorization*** dated April 2023.

For the activities that will be monitored, 100% of the data will be analyzed and reported. Monitoring is necessary as specified in the authorization. At a minimum, two hydrophones will be deployed in the near field and far field for activities. Near-field monitoring will occur 10 meters (33 feet) from noise generating equipment when possible.

The near-field hydrophone deployment will be considered a fluid location as 10 meters is dependent on the location of the respective pile being installed. It is likely the near-field hydrophone will be deployed from the barge/platform performing in-water work as it will have adequate access to the noise generating activity. Far-field monitoring will occur at a representative monitoring location at an intermediate distance between the cetacean and phocid shutdown zones of 50 (164 feet) and 200 meters (656 feet), respectively. Far-field hydrophone deployment will also be considered a fluid location as it will also be dependent on the location of pile being installed. A far-field monitoring hydrophone will be deployed from a location protected (outside the basin) by the bubble curtain. This will give an adequate idea of the attenuation of the bubble curtain as well as an accurate representation of the noise propagating into the Piscataqua River.

A consistent fixed location was chosen for year 1 of the P-381 Project for far-field hydroacoustic monitoring. In practice, however, this location proved to be difficult for obtaining accurate data collection. In summary, choosing a fixed location for multiple different sources (i.e rotary drill, cluster drill, DTH mono-hammer) proved ineffective against the complex dynamics of each respective source.

Attenuation rates were greater than originally anticipated in year 1 due to an effective bubble curtain system (multiple hoses located in the Entrance Structure) as well as the location and physical structure of the West Closure Wall and Entrance Structure providing additional barriers to keep noise from propagating into the Piscataqua River.

The notional source point for pile driving is located near the future Dry Dock 1 North and Dry Dock 1 West entrances. The depth at this location is 19.812 meters (65 feet) between the water surface and river substrate. Following NMFS guidance of 20 meters x 19.812 meters (the depth of river at pile installation location), this leaves the monitoring location 396.24 meters (1300 feet) from the source pile. Monitoring from a location at this distance would reflect various interferences from channel traffic in the Piscataqua River and from obstructions related to the project construction.

Direct communication between the in-water construction crew, PSOs, and hydroacoustic engineers is critical. There will always be a direct line of communication between all teams to ensure no in-water construction activity occurs before the hydrophone(s) is appropriately set and operational if the construction activity is scheduled to be monitored.

In order to maintain project schedules, it is likely that multiple pieces of equipment will operate at the same time within the basin. Given the spatial constraints of the project area, a maximum of five pieces of equipment could potentially operate in the project area at a single time. It is assumed such overlap could occur up to five times per day at the peak of construction activity.

The extent to which simultaneous construction activities could occur within a day is unknown and difficult to quantify. Construction activities would be intermittent with multiple stops and starts of the equipment occurring to allow for adjustments and for progress to be measured and documented. Therefore, while some activities, such as DTH drilling may occur for hours, overlapping activities such as vibratory pile driving or rock hammering would occur intermittently.

For all concurrent activities, distance from the hydrophones to all noise generating activities will be noted as well as the stop and start times for each respective activity. Isolated events will be monitored if possible.

The Contractor shall operate a bubble curtain across the openings of the basin to help attenuate sound as described in Section 4(h) of the authorization. The Contractor will record hydroacoustic measurements inside and outside of the bubble curtain at the start of operations. Should the results of the recording inside the bubble curtain show that thresholds are not being exceeded by the activity occurring, the Contractor may submit results for review to reduce the requirement for the bubble curtain. The bubble curtain will remain in use until data is reviewed and approved by Navy and NMFS.

Due to the requirement of a bubble curtain, additional hydrophones may be deployed. All additional hydrophone data collected will be processed and reported.

C. Reporting

Measuring Hydroacoustics

A reference value is necessary if one is to give absolute pressure (or intensity levels) in dB. The pressure reference used for underwater acoustics is: 1 μPa. As well as a reference value, a pressure definition must also be clearly defined. There are three pressure definitions that are commonly used in underwater acoustics: root mean square (RMS), peak, and peak-to-peak.

When analyzing noise, instantaneous values of sound pressure are constantly fluctuating. It becomes necessary to average data as one specific instant in time cannot represent the statistical variations in the values fluctuating over time.

An RMS value requires a duration over which to average the pressure of the signal. RMS will vary drastically depending on the duration over which the signal is averaged. The longer the duration, the lower the RMS value will be.

A peak value is the maximum absolute amplitude value in the signal. This value is measured from zero to the maximum absolute amplitude. This could be the crest or trough, whichever is greater. Peak-to-peak value is the amplitude of a waveform that is measured from the crest (top of the waveform) to the trough (bottom of the waveform).

The hydroacoustic monitoring reports will include, at minimum, the following informational elements for all LOA required noise generating activities based on the LOA dated March 2023:

- Hydrophone equipment and methods: location/coordinates, recording device, sampling rate, distance (m) from the pile where recordings were made; depth of water and recording device(s);
- Calibration details, methods, and results;
- Type and size of pile being driven, substrate type, method of driving during recordings (e.g., hammer model and energy), and total pile driving duration;
- Whether a sound attenuation device is used and, if so, a detailed description of the device used and the duration of its use per pile;
- For impact pile driving (per pile) of DTH: Number of strikes and strike rate; depth of the substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1uPa): root mean square sound pressure level (SPL_{rms}); cumulative sound exposure level (SEL_{cum}), peak sound pressure level (SPL_{peak}), and single-strike sound exposure level ($SEL_{s\text{-}s}$);
- For vibratory pile driving/removal (per pile), rotary drilling, and rock hammering: Duration of driving per pile; mean, median, and maximum sound levels (dB re: 1uPa): root mean square sound pressure level (SPL_{rms}), cumulative sound exposure level (SEL_{cum}) (and timeframe over which the sound is averaged); and
- One-third octave band spectrum and power spectral density plot; and
- Environmental data will be collected, including but not limited to, the following: wind speed and direction, air temperature, humidity, surface water temperature, water depth, wave height (BSS), weather conditions, and other factors that could contribute to influencing the airborne and underwater sound levels (*e.g.*, aircraft, boats, etc.).

Monitoring for LOA Required Impulsive Noise Activities:
DTH Cluster Drill Use

A DTH cluster drill uses both rotary drilling in conjunction with percussive hammering (approximately 13 strikes per second) to fracture rock inside shafts greater than 42-inches in diameter. As the drill bit rotates under pressure from the drill rig, multiple hammers located within the bit are forced into the rock repeatedly.

Because DTH cluster drilling involves both drilling (non-impulsive) and hammering (impulsive) to penetrate rocky substrates, it is treated by NMFS as both an impulsive and non-impulsive noise source. This section will cover the informational elements that will be reported on based on impulsive (hammering) elements of DTH cluster drilling.

Hydroacoustic reports for LOA required impulsive noise activities will include the following informational elements:

- Hydrophone equipment and methods: location/coordinates, recording device, sampling rate, distance (m) from the pile where recordings were made; depth of water and recording device(s);
- Calibration details, methods, and results;
- Type and size of pile being driven, substrate type, hammer model/energy, total pile driving duration, number of strikes and strike rate, and depth of substrate to penetrate;
- Whether a sound attenuation device is used and, if so, a detailed description of the device used and the duration of its use per pile;
- Pulse Duration: Duration for each pulse is calculated based the 90% energy criterion. This calculation refers to when the cumulative signal energy exceeds 5% of the total signal energy and ends when it reaches 95%. The pulse duration is expressed in units of seconds (s).
- SPL_{peak}: Maximum absolute amplitude value in the signal. This maximum value will originate from the phase of pile driving during which hammer energy was also at maximum (referred to as Level 4).
        - Reference: dB re 1 μPa
            - Pressure Definition: Peak
                - Peak Duration: 90% energy window
- SPL_{rms}: Log transformed square root of the average square pressure of the signal over a specific time interval
    - Median, mean, minimum, and maximum SPL_{rms}
        - Reference: dB re 1 μPa
            - Pressure Definition: RMS
                - RMS Duration: 90% energy window
- $SEL_{s\text{-}s}$: Determined by the squared sound pressure integrated over the duration of the strike.
    - Median, mean, minimum, and maximum $SEL_{s\text{-}s}$
        - Reference: dB re 1 $\mu Pa^2 \cdot$ sec
            - Pressure Definition: RMS
                - RMS Duration: 90% energy window (single strike)

- SEL_{cum}: Cumulative sound exposure level an animal is exposed to during a specified duration of time. This will be computed from all the strikes associated with each pile occurring during all phases, i.e., soft start, Level 1 to Level 4.
  - Reference: dB re 1 μPa^2 · sec
    - Pressure Definition: RMS
      - RMS Duration: 90% energy window (applied to calculate SEL_{s-s} before calculating SEL_{cum})
        - Formula: $SEL_{cum} = SEL_{s-s} + 10*\log$ (# of hammer strikes)
- Power Spectral Density: The average power in a sound during a certain time range and in a certain frequency range. This will be able to give a visualization for which frequency variations are strong and which are weak.
  - Reference: dB re μPa^2 per Hz
    - The power spectral density will be computed based on all strikes with a similar sound. Spectral resolution will be 1 Hz, and the spectrum will cover a nominal range from 7 Hz to 20kHz.
- One-Third Octave Band Spectrum: A frequency band whose bandwidth is one third of an octave, where an octave represents a doubling of frequency. For accurate representation of third-octave band levels at low frequencies, a long duration is required (sufficient accuracy at 10 Hz requires a duration of at least 30 seconds).

Monitoring for LOA Required Continuous Noise Activities:
Rotary Drilling and/or DTH Cluster Drill (per pile) Use
A rotary drill will be utilized to set 126-inch and 84-inch diameter casings into bedrock. In rotary drilling, the drill bit rotates on the rock while the drill rig applies pressure. The bit rotates and grinds continuously to fracture the rock and create a hole. Rotary drilling is considered an intermittent, non-impulsive noise source, similar to vibratory pile-driving.

Because DTH cluster drilling involves both drilling (non-impulsive) and hammering (impulsive) to penetrate rocky substrates, it is treated as both an impulsive and non-impulsive noise source. This section will cover the informational elements that will be reported on based on continuous (drilling) elements of DTH cluster drilling.

Hydroacoustic reports for LOA required continuous noise activities will include the following informational elements:

- Hydrophone equipment and methods: location/coordinates, recording device, sampling rate, distance (m) from the pile where recordings were made; depth of water and recording device(s);
- Calibration details, methods, and results;
- Type and size of pile being driven, substrate type, hammer model/energy, and total pile driving duration;
- Whether a sound attenuation device is used and, if so, a detailed description of the device used and the duration of its use per pile;
- $\underline{SPL_{rms}}$: Log transformed square root of the average square pressure of the signal over a specific time interval
    - Median, mean, minimum, and maximum SPL_{rms}
        - Reference: dB re 1 μPa
            - Pressure Definition: RMS
                - RMS Duration: 1-second intervals
- $\underline{SEL_{cum}}$: Cumulative sound exposure level an animal is exposed to during a specified duration of time.
        - Reference: dB re 1 $\mu Pa^2 \cdot$ sec
            - Pressure Definition: RMS
                - RMS Duration: Timeframe over which the sound is averaged will be noted
- Power Spectral Density: The average power in a sound during a certain time range and in a certain frequency range. This will be able to give a visualization for which frequency variations are strong and which are weak.
        - Reference: dB re μPa^2 per Hz
            - For vibratory driving/removal, the power spectral density will be computed over the entire duration of the total active vibratory driving/removal. This will exclude periods of hammer shut-down to ensure results computed only include duration of total active vibratory driving/removal time.
- One-Third Octave Band Spectrum: A frequency band whose bandwidth is one third of an octave, where an octave represents a doubling of frequency. For accurate representation of third-octave band levels at low frequencies, a long duration is required (sufficient accuracy at 10 Hz required a duration of at least 30 seconds).

Final Reporting

Reports on all monitoring conducted by the Contractor under the 2023-2028 LOA will be submitted to the Navy within 90 calendar days of the completion of monitoring on an annual basis, with the first report due to NMFS by the end of June 2024. 381 Constructors must submit all reports to the Navy a minimum of 30 days before the due date to NMFS for internal review.

The Navy shall submit annual draft reports to NMFS for each construction year within 90 calendar days of the completion of hydroacoustic monitoring as well as a draft 5-year comprehensive summary report 90 days after the completion of the project.

Final annual report(s) (each portion of the project and comprehensive) must be prepared and submitted to NMFS within 30 days following resolution of any NMFS comments on the draft reports. If no comments are received from NMFS within 30 days of receipt of the draft reports, the report shall be considered final. If comments are received, a final report addressing NMFS comments must be submitted within 30 days after receipt of comments.

All draft and final hydroacoustic monitoring reports will be submitted by the Navy to *PR.ITP.MonitoringReports@noaa.gov* and *ITP.tyson.moore@noaa.gov*.

If any results of monitoring are analyzed and weighted by respective marine mammal functional hearing groups to report on sound attenuation or distances, P-381 Constructors will follow the guidance as defined by NMFS (NOAA. Guidance Document: Sound Propagation Modeling to Characterize Pile Driving Sounds Relevant to Marine Mammals. Fisheries Website, https://media.fisheries.noaa.gov/dam-migration/characterize_sound_propagation_modeling_guidance_memo.pdf, 01/25/2023). The two groups being monitored in the Piscataqua River are; phocid pinnipeds (PW) and high frequency (HF) cetaceans. The hearing range of these two groups are as follows:

Table 1. Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range*
High-frequency (HF) cetaceans	275 Hz to 160 kHz
Phocid pinnipeds (PW) underwater	50 Hz to 86 kHz

* Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

Source: NOAA Fisheries. Marine Mammal Acoustic Technical Guidance. 2021.

Auditory weighting and exposure parameters have been set by NOAA by respective hearing groups. Applying auditory weighting functions (band-pass filter) is necessary as not all frequencies are perceived equally by the respective hearing groups. Weighting functions are used to reflect the susceptibility of each hearing group to noise-induced hearing loss based on frequency. The weighted functions take into account sensitivity to a range of frequencies in the respective hearing group. These functions often result in smaller isopleths as certain frequencies are attenuated.

These weightings take into account a variety of factors based on studies of each respective hearing group. Filters with various weightings (A, B, C, D, and Z weighted) attempted to correspond to loudness as perceived by respective hearing group. This example can be found in humans as the typically hearing range is 20 Hz – 20 kHz. Although this is a spectrum of frequencies, A-weighting is commonly used as it has been found to be the most accurate at representing the average perceived loudness of the human ear.

Weighted functions will not be applied until post processing. This is recommended as it leaves the total spectrum of frequencies captured to be fully analyzed. This is important as one could potentially find a source beyond the frequencies of interest that is producing a frequency that in turn, is producing harmonics/subharmonics that fall into the interested frequency range. Attempts to attenuate the source could then be made to ensure harmonics/subharmonics in the interested frequency range are also attenuated to more acceptable levels.

Both received level and duration of exposure are taken into account when factoring the weighted SEL_{cum} metric. This metric is recommended to apply to individual activities/sources, not multiple activities occurring within the same area. The SEL_{cum} metric is used to determine the TTS and PTS ROI for marine mammals.

For each species group, a low frequency cutoff (f_{low}) and high frequency cutoff (f_{high}) is applied to filter out data below the range of functional hearing for that group. For high frequency cetaceans f_{low} is 200 Hz and for pinnipeds f_{low} is 75 Hz. For all hearing groups, f_{high} is 20 kHz, the frequency above which minimal sound energy is typically produced by pile driving activities.

If any weighting is applied in post processing, reports will include both weighted and non-weighted analytics.

D. Equipment and Procedures

The hydrophones to be used for hydroacoustic aspects of P-381 are Cetacean Research CR3 omnidirectional piezoelectric element hydrophones. These hydrophones have a receiving sensitivity of -210 dB re 1uV/Pa and a linear frequency response from 25Hz – 92kHz (usable from 10Hz – 93kHz). Hydrophones will be suspended midway in the water column. Within and outside the basin, this would result in placement between 20-30 feet, depending on the tide. The hydrophone will be attached to a weighted nylon cord to maintain a constant depth and distance from the pile. The nylon cord or chain will be attached to a float or tied to a static line. Hydrophones will be strategically deployed as to avoid flat surfaces, fixed structures, or other obstructions that may reflect frequencies and further obscure data. Depth will be confirmed by weighted tape measure and/or depth sounder.

Data acquired from the hydrophones will be routed via coaxial cable to a SpectraDAQ-200. The length of the coaxial cable will be adequate to reach the shallowest depth of the river (4.5 meters) and the deepest depths of the river (21 meters). The SpectraDAQ-200 is a custom designed precision data acquisition sound card that allows for real time, recording/playback and post processing of up to two channels. The data acquired from the SpectraDAQ-200 for continuous and impulsive noise will be captured at a sample rate of 92kHz per channel with a resolution of 24 bit. The use of a 24-bit resolution will allow for 144 dB of headroom in the recording.

The overall system will be able to handle up to 230 dB before overloading. Use of a higher bit depth will reduce the risk of clipping without increasing quantization errors.

The input channels of the SpectraDAQ-200 provides 4 fixed gain steps (+/- 10V, +/- 2.5V, +/- 625mV, +/- 156mV). This allows SpectraPLUS-SC to be calibrated directly to volts, millivolts, or to the transducer sensitivity providing quick and accurate calibration for the CR3 hydrophones. Maximum input voltage for the A/D converters can be set in any of the 4 fixed gain steps. If the input range is changed, the calibration will automatically apply the correct gain to the measurement. The input range is applied to both channels. Hydrophones are calibrated to the transducer sensitivity which will be verified using a pistonphone.

Information captured from the hydrophone and transmitted through the DAQ will be recorded into an external LaCie hard drive. The hard drive will remain in the CIA. NAVFAC will develop a security plan that P-381 Constructors will be required to follow regarding the safeguard of recorded data.

RMS SPL, peak SPL, and frequency content computed from the hydrophone data will be displayed in real time, monitored, and inspected frequently during all measurements.

Monitoring will not take place if any kind of vessel in the surrounding area is creating enough noise to affect the recordings. No monitoring may occur when a submarine is moving anywhere near the Shipyard, both via tug or under its own power. No monitoring may occur when a submarine is within line of sight of the hydrophone. The hydrophone will be removed from the water prior to a submarine moving to a berth within line of sight of noise creating activities. NAVFAC will provide 7 days' notice before any submarine movements. Three days prior to a submarine moving near the Shipyard, P-381 Constructors will submit recorded data to Shipyard security for review before being removed from the Shipyard or stored on non-Government devices. It is not anticipated that there will be acoustic monitoring of pile installation work while submarines are at berth or in transit. If monitoring is allowed when a submarine is at berth on the Shipyard, P-381 Constructors will coordinate with NAVFAC and Shipyard security on best practices for submitting all recordings for review before the data is removed from the Shipyard or stored on non-Government devices.

The GPS position of the hydrophone locations will be recorded using a Garmin eTrex 10. Distances to piles will be verified with a laser rangefinder.

Calibration on both the hydrophones and data acquisition system will be performed at the start and end of each day. Calibration will be performed with a G.R.A.S intelligent pistonphone with electronic temperature and pressure compensation. It produces 10 Pa (114 dB re 20 μPa air) (140 dB re 1 μPa water) @ 250Hz. This pistonphone will be custom made with a coupler that will create an airtight locking seal to the CR3 hydrophone.

All data will be monitored, recorded, and post-processed in SpectraPLUS-SC software (version 5.3.1.1) as well as Aquatic Acoustic Metric Interface software (version 1.3.0).

Equipment data sheets are included in <u>Appendix A – Equipment Data Sheets</u> of this document.

Appendix A
Equipment Data Sheet

Cetacean Research Technology

4728 12th Avenue NE Seattle, Washington 98105-4402 (206) 297-1310
crtinfo@cetrestec.com www.cetrestec.com

Hydrophone Specifications

Model Number	CR1A	CR2	CR3
Linear Frequency Range (±3dB) [kHz]	0.00016† – 48	0.0019† – 28	0.0004† – 180
Useable Frequency Range (+3/-12dB) [kHz]	0.00005† – 68	0.0005† – 60	0.0001† – 240
Sensitivity [dB, re 1V/µPa]	-199‡	-214	-207‡
SPL Equiv. Noise at 1kHz [dB, re 1µPa/√Hz]	38 (< *Sea State Zero*)	68	54
Maximum Operating Depth [m]	500	370	980
Operating Temperature Range [ºC]	-25 to 60‡	-40 to 70	-40 to 90‡
Capacitance [nF]	12	0.82	6.7
Dimensions [mm]	85L x 32 dia.	56L x 14 dia.	50L x 18 dia.
Coaxial Cable Length [m]	15	10	15
Directionality	Omni below 10kHz	Omni below 10kHz	Omnidirectional

† Requires a preamplifier with 100MΩ input impedance, such as VP1000. If a preamplifier with 330kΩ input impedance is used, such as the USB Dual Pre, then the low frequency -3dB point will be increased by a factor of 300 (e.g. 48Hz instead of 0.16Hz for the CR1A).

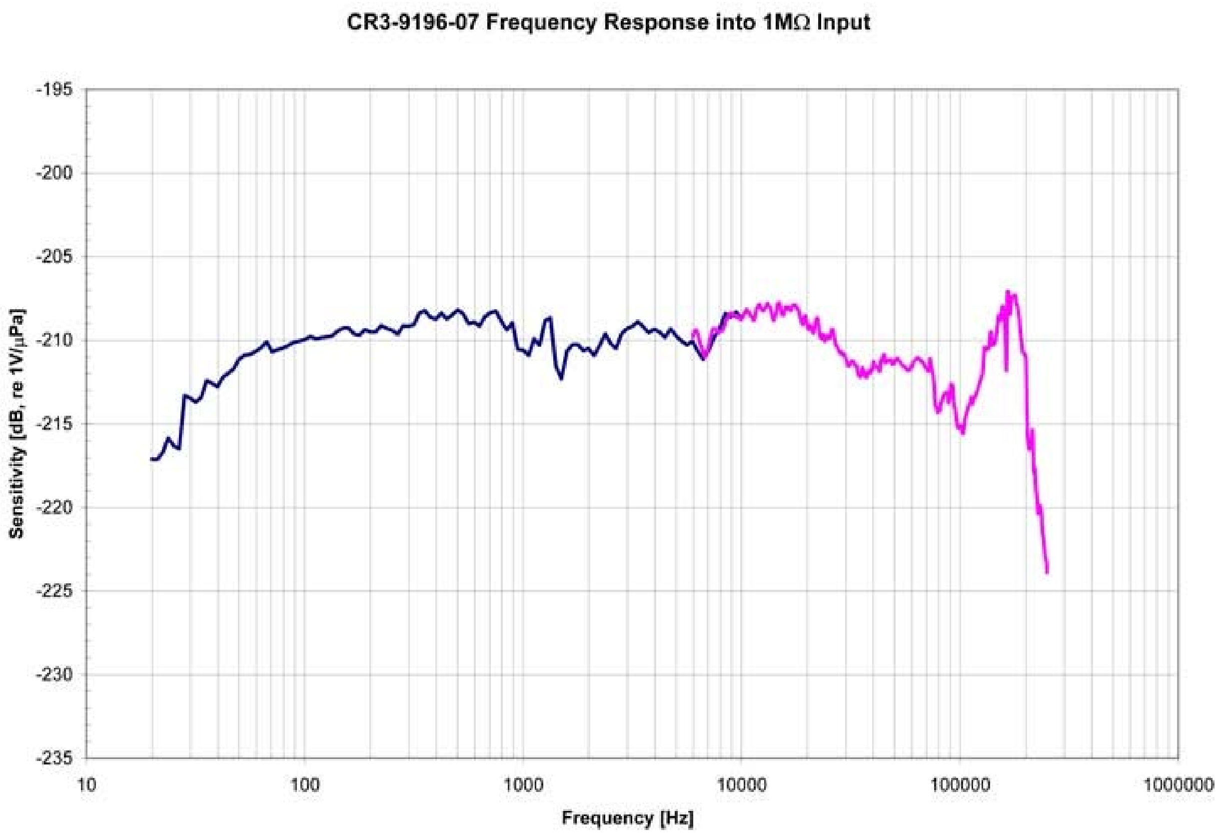
‡ Hydrophone is spot calibrated at the factory; calibration is guaranteed between -5C and 30C. Calibrated frequency response measurements can be performed for an additional fee.

Hydrophones not in stock will ship within 8 weeks of the receipt of payment. Add 4 weeks to delivery time for custom orders. Acceptable payment includes: check or money order made out in US funds and drawn on a US bank; VISA, MasterCard, Discover or American Express cards; or money wire transfers. There is an added fee for foreign wire transfers. Qualifying nonprofit organizations may receive discounts.

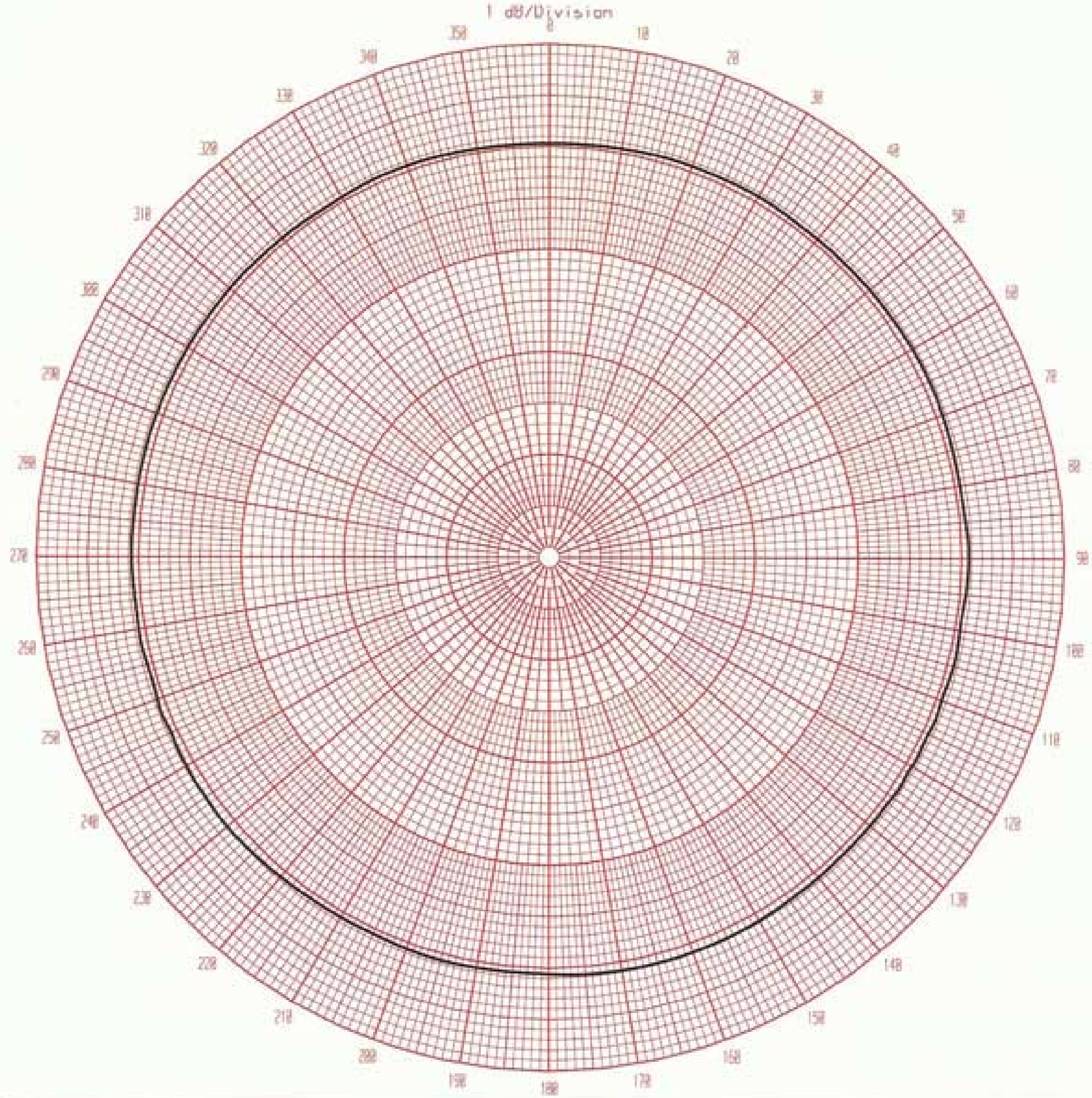
All hydrophones carry a 90-day limited warranty. Extended warranties are available. Units will either be repaired or replaced at the discretion of Cetacean Research Technology. Misuse or damage to the connectors or cable voids the warranty. Prices are for *advance payment only* and subject to change without notice. **All sales are final**.

CR3 Hydrophone Specifications

Linear Frequency Range (±3dB) [kHz]	0.0004‡ to 180
Usable Frequency Range (+3/-12dB) [kHz]	0.0001‡ to 240
Transducer Sensitivity [dB, re 1V/µPa]	-207‡
Preamplifier Gain [dB]	N/A
SPL Equiv. Self Noise at 1kHz [dB, re 1µPa/√Hz]	54
Power Requirement [Vdc]	N/A
RMS Overload Acoustic Pressure [dB, re 1µPa]	N/A
Maximum Operating Depth [m]	980
Operating Temperature Range [°C]	-40 to 90‡
Capacitance [nF]	6.7
Dimensions [mm]	50 L x 18 dia
Coaxial Cable Length [m]	30m
Directionality	omnidirectional
Battery / Connector box	no power required

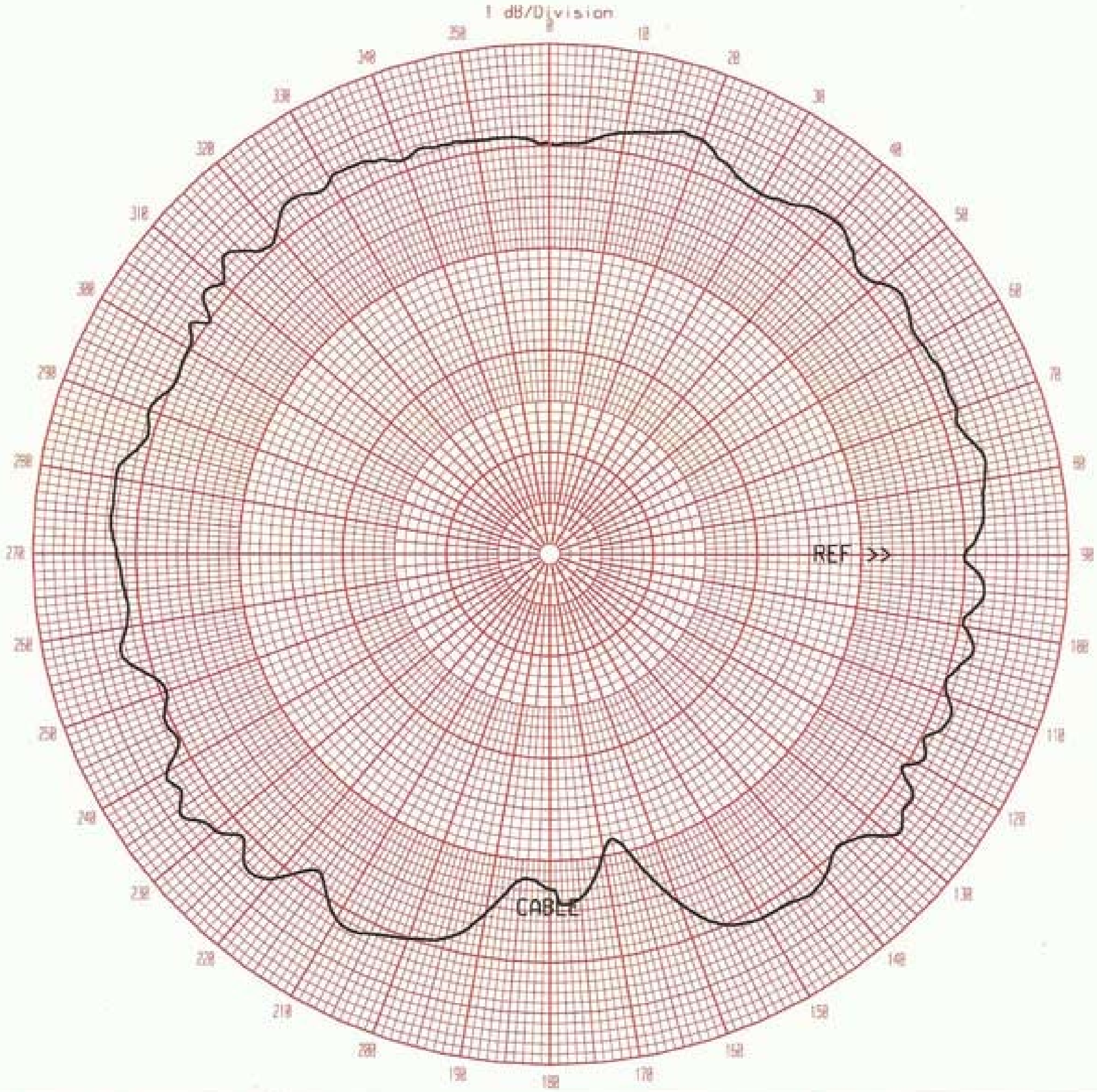


CR3-9196-07 Frequency Response into 1MΩ Input
-195
-200
-205
-210
-215
-220
-225
-230
-235
Sensitivity [dB, re 1V/μPa]
10
100
1000
10000
100000
1000000
Frequency [Hz]



Water Temp 11.8 C	RECEIVING DIRECTIVITY RESPONSE	Acoustic Test Facility NUWC Keyport
Frequency 50 kHz		Time 14:09:59
Spacing 3.16 M	CR3 SER.# 9196-07	Date 22 Apr 2010
Depth 3.81 M		
Plane XY		
Console 1		Technician MF

High Amp:-9.1 High angle: 232.5 Low Amp:-9.8 Low Angle: 359.9 Total Plot Variation is .7 dB



Water Temp 11.7 C	RECEIVING DIRECTIVITY RESPONSE	Acoustic Test Facility NUWC Keyport
Frequency 50 kHz		
Spacing 3.16 M	CR3 SER.# 9196-07	Time 13:52:53
Depth 3.81 M		Date 22 Apr 2010
Plane XZ		
Console 1		Technician MF

SPECTRADAQ-200

SpectraDAQ-200 is a precision data acquisition sound card optimized for test and measurement applications. Designed specifically for use with SpectraPLUS it features fixed gain steps for easy calibration to the transducer sensitivity, IEPE power for accelerometers or microphones, and standard BNC connectors. It is housed in a rugged steel case and powered by USB 3.0.

Excellent Performance

The A/D and D/A converters are state of the art and provide incredible dynamic range and extremely low distortion.

Direct Calibration

The input channels provide 4 fixed gain steps. This allows SpectraPLUS to be calibrated directly to volts, millivolts or to the transducer sensitivity providing quick and accurate calibration for microphones, accelerometers and other sensors.

IEPE Power

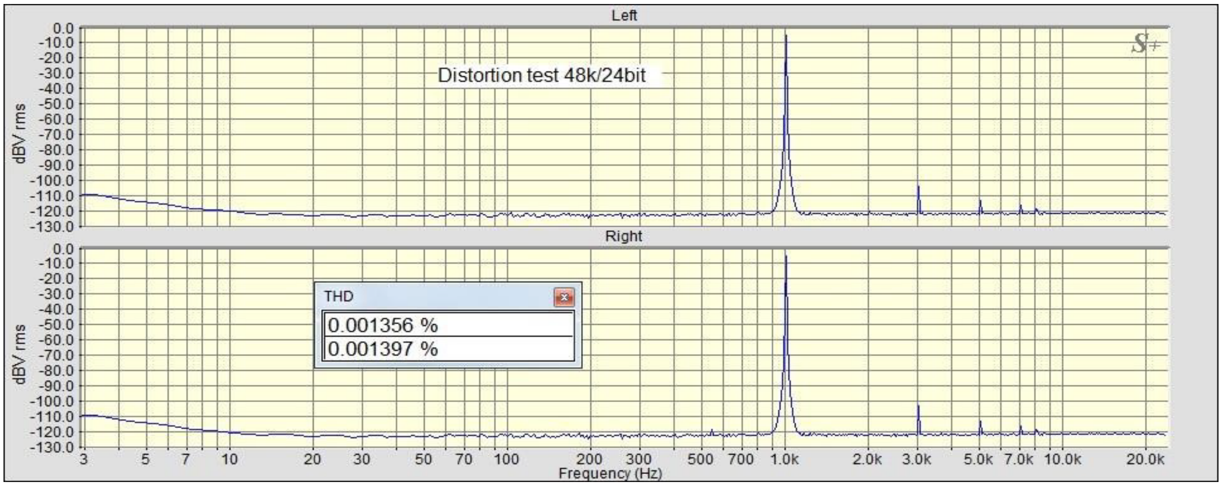
Accelerometers, microphones and hydrophones often use IEPE powered sensors; IEPE power is a 4ma constant current supply that is built-in to the input circuitry of the module. It is enabled via the SpectraPLUS software. IEPE is also known as ICP (trademarked by PCB electronics).

Input Voltage Ranges (software selectable)	+/-10V, +/-2.5, +/-625mV, +/-156mV
Sampling Rate	Up to 192kHz
Sampling Precision	24 bit
Input Channels	2
Input Impedance	0.5 Meg Ohm
IEPE power (software selectable)	4ma constant current
Frequency Response	4 Hz to 92 kHz (-1dB)
Low Frequency cutoff	2 Hz (-3dB)
Total Harmonic Distortion (THD)	< 0.002% (0.5 Vrms signal level, 2.5 V gain)
Spurious Free Dynamic Range	> 95 dB
Noise Floor (terminated inputs)	< -130 dBVrms
Channel Separation	> 90 dB
Input Connectors	2 BNC (single ended)
Output Voltage	+/-1.4 V (1 Vrms)
Output Channels	2

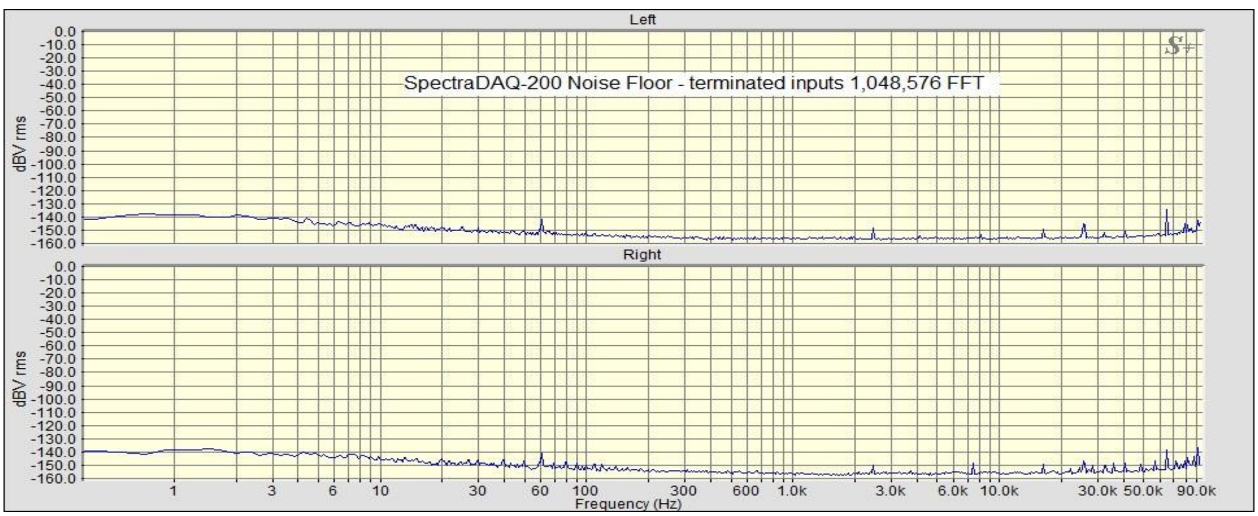
Output Connectors	1 BNC, 3.5 mm stereo
Digital I/O	3 Input, 3 Output (RJ45 connectors)
Drivers (Vista/Win7/8/10, x32 and x64)	MME (Windows Multimedia Extensions) ASIO (Steinberg Audio Stream Input/Output)
PC Interface	USB 3.0 (cable included)
Operating Temperature range	0 to 50 C
Dimensions	5.5 x 3 x 1 in (140 x 77 x 26 mm)
Weight	9 oz (250 grams)
Warranty	I year

Pricing, availability and specifications are subject to change without notice

Distortion measurement with the output looped back to the inputs



Noise floor measured with terminated inputs



Cetacean Research Technology

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crtinfo@cetrestec.com   www.cetrestec.com

SpectraPLUS Features and Specifications

Key Feature	SpectraPLUSRT	SpectraPLUS-SC	SpectraPLUS-DT
Hardware Supported	Multimedia Sound Cards	Multimedia Sound Cards	Data Translation DT9800 Industrial A/D modules
Maximum Sampling Rate	200 kHz*	200 kHz*	2.0 MHz*
Maximum Channels	2	2	16
Maximum Sampling Precision	24 bit*	24 bit*	24 bit*
Composite Channels (Transfer Function, Multichannel average, etc)	0	1	16
Supported Modes	Real Time	Real Time, Record/Playback, Post Process	Real Time, Record/Playback, Post Process
Available Displays	Spectrum	Time Series, Spectrum, Phase, Spectrogram, 3-D Surface	Time Series, Spectrum, Phase, Spectrogram, 3-D Surface
Frequency Resolution	Fixed FFT size, 1/1 Octave, 1/3 Octave	Selectable FFT size, 1/1 through 1/96 Octave	Selectable FFT size, 1/1 through 1/96 Octave
Input Gain	Variable* (4 fixed steps#)	Variable* (4 fixed steps#)	Fixed Steps*
Calibrated Inputs	Uncalibrated (Volts or Millivolts#)	Uncalibrated (Volts or Millivolts#)	Volts or Millivolts
Calibration to Transducer	Use external reference signal (use transducer sensitivity#)	Use external reference signal (use transducer sensitivity#)	Use actual transducer sensitivity or external reference signal
Transducer Power	Phantom* (IEPE#)	Phantom* (IEPE#)	IEPE*
Triggering	No	Analog Input	Analog or TTL with User Accept/Reject option
Tachometer channel support	No	No	Yes
Order Analysis	No	No	Yes
Automation Support	No	Yes	Yes
** Hardware dependent* *#When SpectraDAQ-200 is used*			

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SpectraPLUS-SC Options

SpectraPLUS-SC consists of a base analyzer plus a set of 10 additional options so you can purchase only the features you need. Additional options can be purchased at anytime and activated with a simple phone call. The downloaded software includes all options for the 30 day evaluation period.

Base Analyzer		**Features include Single Channel Operation, Real Time Mode, Spectrum, Time Series, and Phase displays, Narrowband FFT sizes through 32,768 points, 1/1, and 1/3 Octave Analysis, Triggering, Markers, Overlays, Averaging, Peak Hold, Decimation, Mic Compensation, A, B, C Spectral Weighting**
Option /01	Dual Channel Processing	Dual Channel Operations - Real and Complex Transfer Functions, Coherence, Average, Cross Spectrum and cross channel delay compensation
Option /02	Recording and Post Processing Modes	Recorder and Post Processing modes - allows direct hard disk recording and playback. Post Processing mode provides comprehensive analysis from WAV files. Includes Digital Filtering capability
Option /03	Signal Generator Utility	Advanced Signal Generation - Pink/White noise, Noise Burst, Frequency Sweep, Frequency Step, Level Sweep, 1 kHz tone, Multiple Tones, Saw, Square, Pulse, IMD test tones and User Defined WAV source. Can generate different signals in each channel
Option /04	Color Spectrogram Display	Spectrogram View - displays the spectrum versus time in greyscale or color format for advanced joint time-frequency analysis.
Option /05	3-D Surface Display	3-D Surface View - displays the spectrum versus time in a 3-Dimensional perspective format
Option /06	Distortion Analysis Utilities	Distortion Analysis - measurement utilities for THD, THD+N, IMD, SNR, NF, SINAD. Each measurement is displayed in real time in a separate resizeable window. Also includes a dedicated THD+N versus Frequency utility that quickly and conveniently measures the distortion characteristics of your device over a range of frequencies.
Option /07	High Resolution Analysis	Adds 24 bit sampling precision and sampling rates above 48kHz

		(sound card dependent). Adds FFT sizes up to 1,048,576 points, and Octave scaling to 1/96
Option /08	Advanced Scaling and Calibration	Adds independent channel calibration and scaling for left and right channels with separate views for each. Useful for applications requiring separate channel scaling and calibration such as simultaneous sound and vibration measurements. This option also includes calibration conversions from Acceleration to Velocity or Displacement; also adds Power Specral Density scaling option for accurate noise measurements
Option /09	Acoustic Tools	Reverberation Time (RT60) utility features bar graph of reverberation time versus frequency band, 3-D Surface plot of the decay versus frequency and individual decay plots versus time. Delay Finder measures delay between two channels in milliseconds, feet or meters. Speed of sound - converts the delay value between milliseconds, feet or meters. Equivalent Noise (Leq) utility provides comprehensive noise level calculations for LeqT, Leq, Lpk , Lsel, Lmax, Lmin, L10, L50, L90. Stereo Phase Scope for real-time monitoring and analysis of signal phase. Phase scope mode displays a standard oscilloscope X- Y orientation (lissajous pattern) for analysis of phase, polarity, missing channel detection and stereo separation monitoring
Option /10	Automation Tools	Macro Command Processor utility allows you to easily automate measurements, record SPL and spectral data at user specified intervals/duration with time/date stamp, save files with user-defined names using a script-based programming language. It uses the underlying DDE syntax for an automation solution without requiring a third party program. Automation interface API allows the capability for an external program to control and read results from the analyzer in real time. Works with any program that supports COM such as C++, VB, Excel, and others. Dynamic Data Exchange (DDE) allows the capability for an external program to control and read results from the analyzer in real time. Works with any program that supports DDE such as C++, VB, Excel, Access and others. Data Logging utility produces an output text file containing selected spectral parameters + time-stamp for dynamic signal tracking and unattended event monitoring.

Appendix B

In-water Pile Driving and Drilling for Construction Year 2 – Year 6

In-water Construction Activities (March 15, 2023 – December 31, 2026)

Activity ID	*Activity*	*Total Amount and Estimated Dates (Construction years)*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
1	Berth 11 – Remove Shutter Panels	Remove 112 panels *Apr-23[1] to May 23 (Const. year 2)*	Concrete shutter panels	Hydraulic rock hammering	5 hours/day	56[2]
2	Berth 1 – Remove Sheet Piles	Remove 168 sheet piles *Apr -23[1] to Jun 24 (Const. years 2, 3)*	25-inch-wide Z-shaped	Vibratory extraction	4 piles/day	42[2]
3	Berth 1 – Remove Granite Block Quay Wall	2,800 cy *Apr -23[1] to Jun 24 (Const. years 2, 3)*	Removal of granite blocks	Hydraulic rock hammering	2.5 hours/day	47[2]
4	Berth 1 - Top of Wall Removal for Waler Installation	320 lf *Apr -23[1] to Jun 24 (Const. years 2, 3)*	Mechanical concrete removal	Hydraulic rock hammering	10 hours/day	74[2]
5	Berth 1 – Install southeast corner Support of Excavation (SOE)	Install 28 sheet piles *Apr 23 – Jul 23 (Const. year 2)*	28-inch-wide z-shaped	Impact with initial vibratory set	4 piles/day 5 minutes/pile and 300 blows/pile	8[3]
6	Berth 11 - Mechanical Rock Removal at Basin Floor	700 cy *Apr -23[1] to Aug 23 (Const. year 2)*	Excavate Bedrock	Hydraulic rock hammering	12 hours/day	60[2,3]
7	Berth 11 Face - Mechanical Rock Removal at Basin Floor	Drill 924 relief holes *Apr -23[1] to Aug 23 (Const. year 2)*	4-6 inch diameter holes	DTH mono-hammer	27 holes/day 22 min/hole	35[2]
8	Install Temporary cofferdam extension	Install 14 sheet piles *Apr 23 to Jun 23 (Const. year 2)*	28-inch-wide z-shaped	Impact with initial vibratory set	4 piles/day 5 minutes/pile and 300 blows/pile	4
9a	Gantry crane Support Piles at Berth 1 West	Drill 16 shafts *Apr 23 to Aug 23 (Const. year 2)*	Set 102-inch diameter casing	Rotary drill	1 shaft/day 1 hours/day	16
9b			Pre-drill 102-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	16

In-water Construction Activities (March 15, 2023 – December 31, 2026)

Activity ID	*Activity*	*Total Amount and Estimated Dates (Construction years)*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
9c			Remove 102-inch casing	Rotary drill	1 casing/day 15 minutes/casing	16
9d			72-inch diameter shafts	Cluster drill DTH	5 days/shaft 10 hours/day	80
10	Berth 1 - Mechanical Rock Removal at Basin Floor	500 cy *Apr 23[1] - to Sep 23* *(Const. year 2)*	Excavate Bedrock	Hydraulic rock hammering	13 cy/day 12 hours/day	40[2,3]
11	Dry Dock 1 North Entrance - Drill Tremie Tie Downs	Drill 50 rock anchors *Apr -23[1] to Oct 23* *(Const. year 2)*	9-inch diameter holes	DTH mono-hammer	2 holes/day 5 hours/hole	25[2]
12	Center Wall – Install Tie-In to Existing West Closure Wall	Install 15 sheet piles *Apr -23 to Dec 23* *(Const. year 2)*	28-inch wide Z-shaped	Impact with initial vibratory set	4 piles/day 5 minutes/pile and 300 blows/pile	4
13a	Dry Dock 1 North – Temporary Work Trestle Piles	Drill 20 shafts *May 23 to Nov 24* *(Const. years 2, 3)*	Set 102-inch diameter casing	Rotary drill	1 shaft/day 1 hours/day	20
13b			Pre-drill 102-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	20
13c			Remove 102-inch casing	Rotary drill	1 casing/day 15 minutes/casing	20
13d			84-inch diameter shafts	Cluster drill DTH	3.5 days/shaft 10 hours/day	70
14	Dry Dock 1 North-Remove Temporary Work Trestle Piles	Remove 20 piles *May 23 to Nov 24* *(Const. years 2, 3)*	84-inch diameter drill piles	Rotary drill	1 day/pile 15 minutes/pile	20
15a	Dry Dock 1 North – Install Leveling Piles (Diving Board Shafts)	Drill 18 shafts May 23 – Nov 24 *(Const. years 2, 3)*	Set 84-inch casing	Rotary Drill	1 shaft/day 1 hours/day	18
15b			Pre-drill 84-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	18
15c			Remove 84-inch casing	Rotary drill	1 casing/day 15 minutes/casing	18
15d			78-inch diameter shaft	Cluster drill DTH	7.5 days/shaft 10 hours/day	135
16a	Wall Support Shafts for Dry Dock 1 North (Berth 11 face and head wall)	Drill 20 shafts *Jun 23 to Nov 24* *(Const. years 2, 3)*	Set 102-inch diameter casing	Rotary drill	1 shaft/day 1 hours/day	20
16b			Pre-drill 102-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	20
16c			Remove 102-inch casing	Rotary drill	1 casing/day 15 minutes/casing	20
16d			Drill 78-inch diameter shaft	Cluster drill DTH	7.5 days/shaft 10 hours/day	150
17a	Foundation (Floor) Shafts for Dry Dock 1 North (foundation support piles)	Drill 23 shafts *Jun 23 to Nov 24* *(Const. years 2, 3)*	Set 126-inch diameter Casing	Rotary drill	1 shaft/day 1 hours/day	23
17b			Pre-drill 126-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	23
17c			Remove 126-inch casing	Rotary drill	1 casing/day 60 minutes/casing	23
17d			Drill 108-inch diameter shafts	Cluster drill DTH	8.5 days/shaft 10 hours/day	196

In-water Construction Activities (March 15, 2023 – December 31, 2026)

Activity ID	*Activity*	*Total Amount and Estimated Dates (Construction years)*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
18	Berth 11 End Wall - Remove Temporary Guide Wall	Remove 60 sheet piles *Jul 23 to Aug 23 (Const. year 23)*	28-inch wide Z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	10[3]
19	Remove Berth 1 southeast corner SOE	Remove 28 sheet piles *Jul 23 to Sep 23 (Const. year 2)*	28-inch-wide z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	5[3]
20	Removal of Berth 1 Emergency Repair Sheet Piles	Remove 216 sheet piles *Aug 23 to Mar 24 (Const. year 2)*	28-inch-wide z-shaped	Vibratory extraction	6 piles/day 5 minutes/pile	36
21	Removal of Berth 1 Emergency Repair Tremie Concrete	1,000 cy *Aug 23 to Mar 24 (Const. year 2)*	Mechanical concrete removal	Hydraulic rock hammering	4 hours/day	30
22	Center wall foundation -Drill in monolith Tie Downs	Install 72 rock anchors *Aug 23 to May 24 (Const. years 2, 3)*	9-inch diameter holes	DTH mono-hammer	2 holes/day 5 hours/hole	36
23	Center Wall – Remove tie-in to existing west closure wall (Dry Dock 1 North)[4]	Remove 16 sheet piles[4] *Aug 23 to Aug 24 (Const. years 2, 3)*	28-inch-wide z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	3[3]
24	Center wall East- sheet pile tie-in to Existing Wall	Install 23 sheet piles *Aug 23 to Oct 24 (Const. years 2, 3)*	28-inch wide z-shaped	Impact with initial vibratory set	2 piles/day 5 minutes/pile and 300 blows/pile	12
25	Remove tie-in to West Closure Wall (Dry Dock 1 West)	Remove 15 sheet pile *Dec 23 to Dec 24 (Const. years 2, 3)*	28-inch wide z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	3[3]
26	Remove Center wall East- sheet pile tie-in to Existing Wall (Dry Dock 1 West)	Remove 23 sheet piles *Dec 23 to Dec 24 (Const. years 2, 3)*	28-inch wide z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	12[3]
27	Dry Dock 1 north entrance - Remove Temporary Cofferdam	Remove 96 sheet piles *Jan 24 to Sep 24 (Const. years 2, 3)*	28-inch wide z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	12
28	Remove temporary cofferdam extension	Remove 14 sheet piles *Jan 24 to Sep 24 (Const. years 2, 3)*	28-inch wide z-shaped	Vibratory extraction	8 piles/day 5 minutes/pile	2
29a	Dry Dock 1 West - Install Temporary Work Trestle Piles	Drill 20 shafts *Apr 24 to Feb 26 (Const. years 3, 4)*	Set 102-inch diameter casing	Rotary drill	1 shaft/day 1 hours/day	20
29b			Pre-drill 102-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	20
29c			Remove 102-inch casing	Rotary drill	1 casing/day 15 minutes/casing	20
29d			84-inch diameter shafts	Cluster drill DTH	3.5 days/shaft 10 hours/day	70

In-water Construction Activities (March 15, 2023 – December 31, 2026)

Activity ID	*Activity*	*Total Amount and Estimated Dates (Construction years)*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
30	Dry Dock 1 West - Remove Temporary Work Trestle Piles	Remove 20 piles *Apr 24 to Feb 26* *(Const. years 3, 4)*	84-inch diameter piles	Rotary drill	1 day/pile 15 minutes/pile	20
31a	Wall Support Shafts for Dry Dock 1 West (Berth 1 face)	Drill 22 shafts *Jun 24 to Feb 26* *(Const. years 3, 4)*	Set 102-inch diameter casing	Rotary drill	1 shaft/day 1 hours/day	22
31b			Pre-drill 102-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	22
31c			Remove 102-inch casing	Rotary drill	1 casing/day 15 minutes/casing	22
31d			78-inch diameter shaft	Cluster drill DTH	7.5 days/shaft 10 hours/day	165
32a	Foundation (Floor) Shafts for Dry Dock 1 West (foundation support piles)	Drill 23 shafts *Jun 24 to Feb 26* *(Const. years 3, 4)*	Set 126-inch casing	Rotary Drill	1 shaft/day 1 hours/day	23
32b			Pre-drill 126-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	23
32c			Remove 126-inch casing	Rotary drill	1 casing/day 15 minutes/casing	23
32d			Drill 108-inch diameter shaft	Cluster drill DTH	8.5 days/shaft 10 hours/day	196
33a	Dry Dock 1 West - Install Leveling Piles (Diving Board Shafts)	Drill 18 shafts *Jun 24 to Feb 26* *(Const. years 3, 4)*	Set 84-inch casing	Rotary Drill	1 shaft/day 1 hours/day	18
33b			Pre-drill 84-inch rock socket	Rotary drill	1 shaft/day 9 hours/day	18
33c			Remove 84-inch casing	Rotary drill	1 casing/day 15 minutes/casing	18
33d			Drill 78-inch diameter shaft	Cluster drill DTH	7.5 days/shaft 10 hours/day	135
34	Dry Dock 1 North - Tie Downs	Install 36 rock anchors Jul 24 to Jul 25 *(Const. years 3, 4)*	9-inch diameter holes	DTH mono-hammer	2 holes/day 5 hours/hole	18
35	Dry Dock 1 West – Install Tie Downs	Install 36 rock anchors *Dec 25 to Dec 26* *(Const. years 4, 5)*	9-inch diameter hole	DTH mono-hammer	2 holes/day 5 hours/hole	18
Total excavated holes/drilled shafts/sheet piles		1,118/180/520				

Notes: 1 - These activities began in construction year 1

2 - These activities began in year 1. ONLY the number of production days occurring in construction years 2 through 6 are presented.

3 - Additional production days have been added to account for equipment repositioning

4 - Sheet piles were installed in construction year 1

Source: 381 Constructors, 2022.

Appendix C

Hydroacoustic Monitoring Report: Impact Sample

P381 Constructors

Hydroacoustic Monitoring Report

Date: **Project:** 3121020 PNSY Multi-Mission Dry Dock 1

Project Information

Project Name: P381 Multi-Mission Dry Dock #1
Location: Portsmouth Naval Shipyard, Kittery, Maine
Project/Contract Number: N40085-21-C-0011
Hydroacoustic Engineer - Lead: Theodore Hallett

Hydrologic and Geologic Information

Body of Water: Portsmouth – Lower Piscataqua River
Type: Estuarine
Hydrologic Unit: 01060003
Geology: Glacial Till, Phyllite, Quartzite, Diorite and/or Shale

Equipment Information

Hydrophone: Cetacean Research CR3
Recording Device: Spectra DAQ-200
Sampling Rate: 96kHz
Bit Depth: 24 Bit

Weather

Meteorological Conditions:
Cloud Cover: 00%
Air Temperature: 00°F
Humidity: 00%
Wind Speed: 00 mph
Wind Direction:
Beaufort Sea State:
Water Temperature: 00°F

Pile #

Pile Type: **Activity:** **IHA Count:**

Hammer Make: **Hammer Model:** **Noise Type:** Impact

Start Time: **Stop Time:** **Active Hammer Duration:** 00 seconds

<u>BLUE UNIT</u>

Hydrophone Distance from Drill: 00 meters

Latitude: **Longitude:**

Water Column Depth: 00.00 meters **Hydrophone Deployed Depth:** 00.00 meters

<u>GREEN UNIT</u>

Hydrophone Distance from Drill: 00 meters

Latitude: **Longitude:**

Water Column Depth: 00.00 meters **Hydrophone Deployed Depth:** 00.00 meters

Notes:

RMS SPL, Peak SPL, SELss, and SELcum data included in **Table 0.**

One-third octave band spectra and Power Spectral Density included in **Figure 0-0.**

Data unweighted.

Pile #	Pile Name	Date	Pile Type	Hammer Make/Model	Noise Type	Start Time	Stop Time	Active Hammer Duration (seconds)	Hammer Strike(s)	Pulse Duration (seconds)	Distance From Pile (meters)	RMS unweighted (SPL dB re 1uPa)				Peak unweighted (SPL dB re 1uPa)				SEL unweighted (dB re 1uPa^2.s)				SELcum unweighted (dB re 1uPa^2.s)
												Median	Mean (average)	Min	Max	Median	Mean (average)	Min	Max	Median	Mean (average)	Min	Max	
1			108" Casing	Cluster Drill	Impulsive																			
2			108" Casing	Cluster Drill	Impulsive																			
3			108" Casing	Cluster Drill	Impulsive																			
4			108" Casing	Cluster Drill	Impulsive																			
5			108" Casing	Cluster Drill	Impulsive																			
6			108" Casing	Cluster Drill	Impulsive																			
7			108" Casing	Cluster Drill	Impulsive																			
8			108" Casing	Cluster Drill	Impulsive																			
9			108" Casing	Cluster Drill	Impulsive																			
10			108" Casing	Cluster Drill	Impulsive																			

Table X. Data Summary of Piles Monitored (108” Casing)

Pile #	Pile Name	Date	Pile Type	Hammer Make/Model	Noise Type	Start Time	Stop Time	Active Hammer Duration (seconds)	Hammer Strike(s)	Pulse Duration (seconds)	Distance From Pile (meters)	RMS unweighted (SPL dB re 1uPa)				Peak unweighted (SPL dB re 1uPa)				SEL unweighted (dB re 1uPa^2.s)				SELcum unweighted (dB re 1uPa^2.s)
												Median	Mean (average)	Min	Max	Median	Mean (average)	Min	Max	Median	Mean (average)	Min	Max	
1			84" Casing	Cluster Drill	Impulsive																			
2			84" Casing	Cluster Drill	Impulsive																			
3			84" Casing	Cluster Drill	Impulsive																			
4			84" Casing	Cluster Drill	Impulsive																			
5			84" Casing	Cluster Drill	Impulsive																			
6			84" Casing	Cluster Drill	Impulsive																			
7			84" Casing	Cluster Drill	Impulsive																			
8			84" Casing	Cluster Drill	Impulsive																			
9			84" Casing	Cluster Drill	Impulsive																			
10			84" Casing	Cluster Drill	Impulsive																			

Table X. Data Summary of Piles Monitored (84" Casing)

Pile #	Pile Name	Date	Pile Type	Hammer Make/Model	Noise Type	Start Time	Stop Time	Active Hammer Duration (seconds)	Hammer Strike(s)	Pulse Duration (seconds)	Distance From Pile (meters)	RMS unweighted (SPL dB re 1uPa)				Peak unweighted (SPL dB re 1uPa)				SEL unweighted (dB re 1uPa^2.s)				SELcum unweighted (dB re 1uPa^2.s)
												Median	Mean (average)	Min	Max	Median	Mean (average)	Min	Max	Median	Mean (average)	Min	Max	
1			72" Casing	Cluster Drill	Impulsive																			
2			72" Casing	Cluster Drill	Impulsive																			
3			72" Casing	Cluster Drill	Impulsive																			
4			72" Casing	Cluster Drill	Impulsive																			
5			72" Casing	Cluster Drill	Impulsive																			
6			72" Casing	Cluster Drill	Impulsive																			
7			72" Casing	Cluster Drill	Impulsive																			
8			72" Casing	Cluster Drill	Impulsive																			
9			72" Casing	Cluster Drill	Impulsive																			
10			72" Casing	Cluster Drill	Impulsive																			

Table X. Data Summary of Piles Monitored (72" Casing)

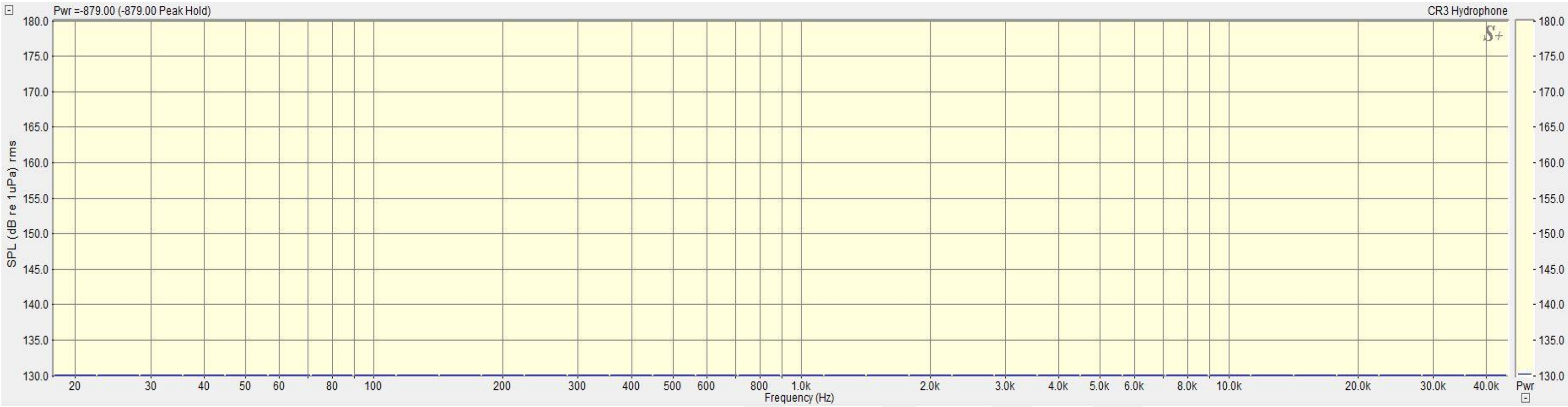

Figure X. 1/3 Octave Band Spectra from X meters for Sheet X installed MONTH DAY, YEAR at TIME

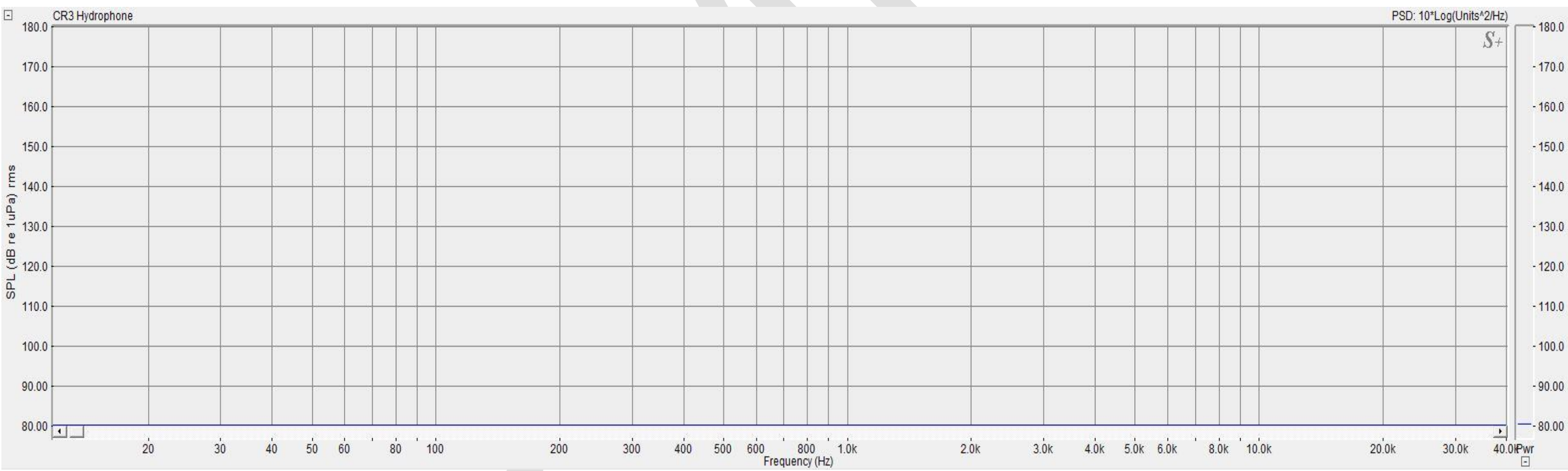

Figure X. Power Spectral Density from X meters for Sheet X installed MONTH DAY, YEAR at TIME

Appendix D

Hydroacoustic Monitoring Report: Continuous Sample

P381 Constructors

Hydroacoustic Monitoring Report

Date: **Project:** 3121020 PNSY Multi-Mission Dry Dock 1

Project Information

Project Name: P381 Multi-Mission Dry Dock #1
Location: Portsmouth Naval Shipyard, Kittery, Maine
Project/Contract Number: N40085-21-C-0011
Hydroacoustic Engineer - Lead: Theodore Hallett

Hydrologic and Geologic Information

Body of Water: Portsmouth – Lower Piscataqua River
Type: Estuarine
Hydrologic Unit: 01060003
Geology: Glacial Till, Phyllite, Quartzite, Diorite and/or Shale

Equipment Information

Hydrophone: Cetacean Research CR3
Recording Device: Spectra DAQ-200
Sampling Rate: 96kHz
Bit Depth: 24 Bit

Weather

Meteorological Conditions:
Cloud Cover: 00%
Air Temperature: 00°F
Humidity: 00%
Wind Speed: 00 mph
Wind Direction:
Beaufort Sea State:
Water Temperature: 00°F

Pile #

Pile Type: **Pile Name:** **IHA Count:**

Hammer Make: **Hammer Model:** **Noise Type:** Continuous/Vibratory

Start Time: **Stop Time:** **Active Hammer Duration:** 00 seconds

BLUE UNIT

Hydrophone Distance from Pile: 00 meters

Latitude: **Longitude:**

Water Column Depth: 00.00 meters **Hydrophone Deployed Depth:** 00.00 meters

GREEN UNIT

Hydrophone Distance from Pile: 00 meters

Latitude: **Longitude:**

Water Column Depth: 00.00 meters **Hydrophone Deployed Depth:** 00.00 meters

Notes:

RMS SPL and SELcum data included in **Table 0.**

One-third octave band spectra and Power Spectral Density included in **Figure 0-0.**

Data unweighted.

Pile #	Pile Name	Date	Pile Type	Hammer Make/Model	Noise Type	Start Time	Stop Time	Active Hammer Duration (seconds)	Distance From Pile (meters)	RMS unweighted (SPL dB re 1uPa)				SELcum unweighted (dB re 1uPa^2.s)
										Median	Mean (average)	Min	Max	
1			126" Casing	Rotary Drill	Continuous / Vibratory									
2			126" Casing	Rotary Drill	Continuous / Vibratory									
3			126" Casing	Rotary Drill	Continuous / Vibratory									
4			126" Casing	Rotary Drill	Continuous / Vibratory									
5			126" Casing	Rotary Drill	Continuous / Vibratory									
6			126" Casing	Rotary Drill	Continuous / Vibratory									
7			126" Casing	Rotary Drill	Continuous / Vibratory									
8			126" Casing	Rotary Drill	Continuous / Vibratory									
9			126" Casing	Rotary Drill	Continuous / Vibratory									
10			126" Casing	Rotary Drill	Continuous / Vibratory									

Table X. Data Summary of Piles Monitored (126” Casing)

Pile #	Pile Name	Date	Pile Type	Hammer Make/Model	Noise Type	Start Time	Stop Time	Active Hammer Duration (seconds)	Distance From Pile (meters)	RMS unweighted (SPL dB re 1uPa)				SELcum unweighted (dB re 1uPa^2.s)
										Median	Mean (average)	Min	Max	
1			84" Casing	Rotary Drill	Continuous / Vibratory									
2			84" Casing	Rotary Drill	Continuous / Vibratory									
3			84" Casing	Rotary Drill	Continuous / Vibratory									
4			84" Casing	Rotary Drill	Continuous / Vibratory									
5			84" Casing	Rotary Drill	Continuous / Vibratory									
6			84" Casing	Rotary Drill	Continuous / Vibratory									
7			84" Casing	Rotary Drill	Continuous / Vibratory									
8			84" Casing	Rotary Drill	Continuous / Vibratory									
9			84" Casing	Rotary Drill	Continuous / Vibratory									
10			84" Casing	Rotary Drill	Continuous / Vibratory									

Table X. Data Summary of Piles Monitored (84” Casing)

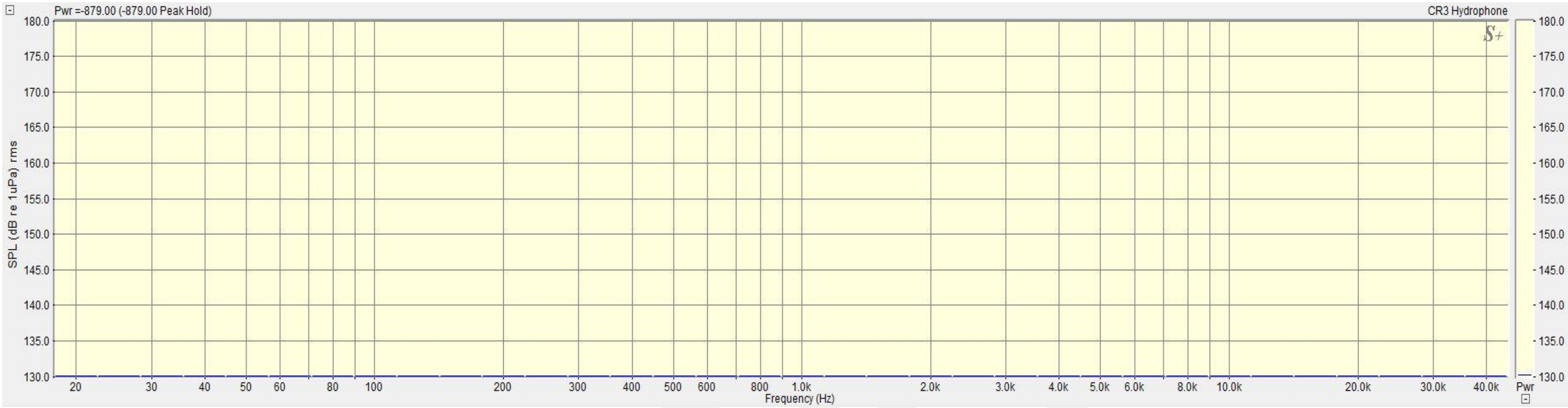

Figure X. 1/3 Octave Band Spectra from X meters for Sheet X installed MONTH DAY, YEAR at TIME

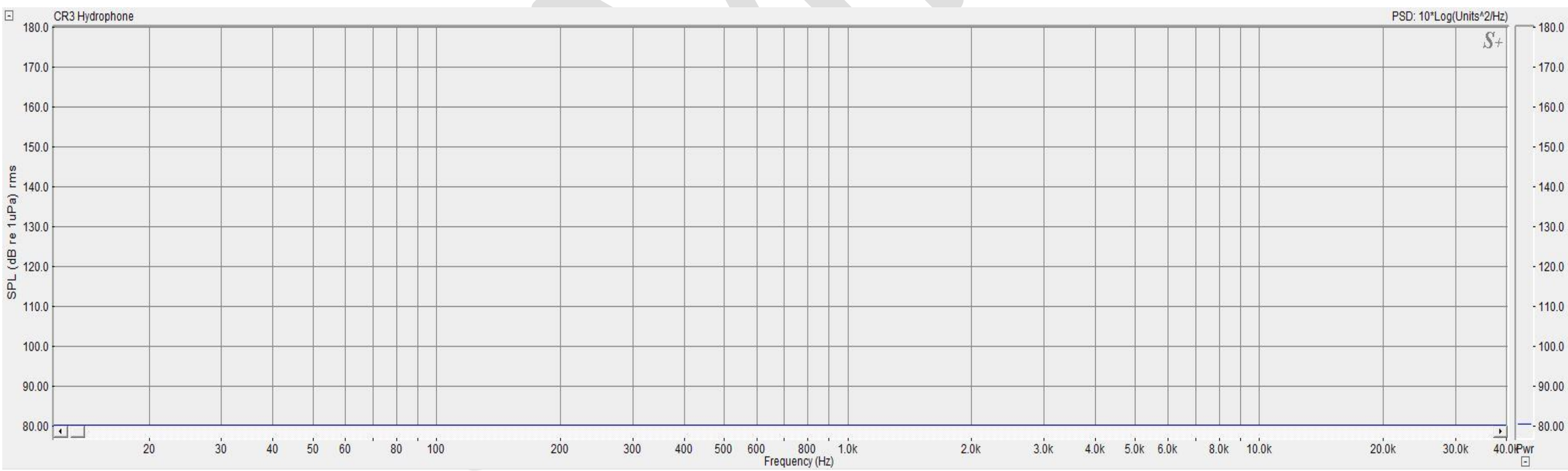

Figure X. Power Spectral Density from X meters for Sheet X installed MONTH DAY, YEAR at TIME

Appendix E

Example Daily Log and Calibration Record

P381 Constructors

CALIBRATION RECORD

Date	February 22, 2023
Calibration Device	Pistonphone
Calibration Device Serial Number	387303
Manufacturer	G.R.A.S
Model	42AP
Adapter	Cetacean Research PC-CR3
K-Factor	+0.3 dB

Hydrophone Serial Number	Calibrated By
134	TH 2/22/23
135	TH 2/22/23

Remarks:

114.03 dB re 20 µPa @ 250 Hz

140.03 dB re 1 µPa @ 250 Hz

2/22/23 - Fill out operations start card
- Prep & clean Pistonphone for calibration
- Calibrate hydrophones
- Calibrate DAQs
- Fill out Calibration log
- Fill out daily report log
↳ Check weather
- 7:30 ENV POD
- 9:00 Env meeting
↳ Bore holes Started @ 9:19am
- Deploy hydrophone from barge (MLC 300)
↳ 20 meters from drill
- Deploy hydrophone from Entrance Structure
- Collect equipment
- clean / Sanitize equipment
- Calibrate equipment
↳ hydrophones & DAQs
- Plug in power packs
- Back up collected data
- Care & storage of equipment

Note: Borehole data collected