JOINT EXPEDITIONARY FORCE BASE LITTLE CREEK AND CRANEY ISLAND

HYDROACOUSTIC AND AIRBORNE FINAL INTERIM MONITORING REPORT

Interim Report Prepared by

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Acoustics • Air Quality

505 Petaluma Boulevard South
Petaluma, CA 94952

Under Contract to

HDR

Environmental, Operations and Construction, Inc.

29 August 2013
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Job No: 13-012

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Interim Summary

This report summarizes the hydroacoustic monitoring results for sheet piles and H-Piles at the Joint Expeditionary Force Base Little Creek and 24-inch concrete pile at Craney Island near Naval Station Norfolk in Norfolk, Virginia. The plan was to measure sheet piles on 28 and 30 May and measure concrete piles driven on 29 May.

Due to scheduling issues with the construction contractor, measurements only included five sheet piles, removal of one H-pile, and the installation of two H-piles on 28 May. The levels from the sheet pile installation and the H-pile installation and removal were not perceivable above the background levels at the distant location which was across the harbor at the end of Pier A in the Little Creek Marina, approximately 197 meters (650 feet) from the pile driving.

On 29 May noise monitoring was completed on one concrete pile driven at two different times at Craney Island. The pile was being driven to check the bearing and was struck 25 blows the first time and was struck 14 blows the second time. The peak, root mean square (RMS), sound exposure level (SEL), and Cumulative SEL were recorded at two locations, 10 meters (33 feet) and approximately 50 meters (164 feet). The piles were driven using an ICE 220 diesel impact hammer.

On 30 May there were six sheet piles installed and a total of nine H-piles either installed or removed. The sheet piles were installed using an ICE-416 vibratory hammer with an eccentric moment of 25.3 kilograms per meter (kg-m) (2,200 inches per pound [in-lb]), the three H-piles were driven using this hammer and two were removed using this hammer. The other four H-piles were installed or removed using a newer and quieter HPSI-250xl vibratory hammer with an eccentric moment of 28.7 kg-m (2,500 in-lb). The distant location meter was moved to the end of Pier 27 on the Joint Expeditionary Force Base Little Creek, a location approximately 190 meters (625 feet) from the work area. Most of the afternoon data at the 190-meter location was not detectable above the background levels. In the morning, when the water was a little calmer and there was less activity on the docks, the sheet pile installation was detectable above the background levels. The RMS levels ranged from around 115 decibels (dB) to 121 dB re: 1µPa. For the vibratory driving/removal only the root mean square (RMS) are reported. **Table 1** is a Summary Maximum Levels for both the impact and vibratory pile driving measured 28–30 May.

Airborne measurements were also made at a fixed location from the pile driving. On 28 and 30 May the distance to the pile driving ranged from 23 to 35 meters (75–115 feet). The measurement site was the closet safe secure location to place a sound level meter. A Larson Davis 820 sound level meter was used to measure the airborne noise from the pile driving. These measured levels are shown in **Attachment B**.

Table 1: Data Summary Maximum Levels – dB re: 1µPa

Type Pile[A]	Date	Impact/Vib.	Distance (meters)	Peak	RMS	SEL	Cumulative SEL[B]
Sheet Pile	5/28/2013	Vib	11	N/A	149	N/A	N/A
Sheet Pile	5/28/2013	Vib	11	N/A	150	N/A	N/A
Sheet Pile	5/28/2013	Vib	11	N/A	151	N/A	N/A
Sheet Pile	5/28/2013	Vib	9	N/A	163	N/A	N/A
Sheet Pile	5/28/2013	Vib	9	N/A	161	N/A	N/A
H-Pile 1 Removal	5/28/2013	Vib	10	N/A	148	N/A	N/A
H-Pile 2 Installation	5/28/2013	Vib	10	N/A	159	N/A	N/A
24-inch Concrete Pile	5/29/2013	Impact	10	183	169	166	183
24-inch Concrete Pile (Same Pile as Above Less Strikes)	5/29/2013	Impact	10	176	162	153	164
Sheet Pile	5/30/2013	Vib	11	N/A	166	N/A	N/A
Sheet Pile	5/30/2013	Vib	11	N/A	158	N/A	N/A
Sheet Pile	5/30/2013	Vib	11	N/A	162	N/A	N/A
Sheet Pile	5/30/2013	Vib	11	N/A	163	N/A	N/A
Sheet Pile	5/30/2013	Vib	11	N/A	158	N/A	N/A
Sheet Pile	5/30/2013	Vib	11	N/A	166	N/A	N/A
H-Pile 2 Installation	5/30/2013	Vib	13	N/A	160	N/A	N/A
H-Pile 1 Removal	5/30/2013	Vib	13	N/A	164	N/A	N/A
H-Pile 2 Installation	5/30/2013	Vib	19	N/A	154	N/A	N/A
H-Pile 1 Removal	5/30/2013	Vib	21	N/A	158	N/A	N/A
H-Pile 2 Installation	5/30/2013	Vib	15	N/A	160	N/A	N/A

[A] – Sheet piles are typically driven in pairs (two one-foot piles interlocked together see **Figure 1** below)

[B] - dB re $1\mu Pa^2$-sec

Figure 1: One-foot piles that get interlocked during pile driving events.

Measurement Equipment

Reson Model TC-4013 and Reson Model TC-4033 hydrophones with PCB in-line charge amplifiers (Model 422E13) were used. For attended systems, the hydrophones were fed through an in-line charge amplifier into Larson Davis Model 831 Precision Sound Level Meters (LDL 831). The LDL 831 then outputs the signal to a Marantz Model PMD660 solid-state digital data recorder (SSR). The output of the LDL 831 can be adjusted. For unmanned systems that involved signal recordings only, PCB Multi-Gain Conditioners (Model 480M122) were used with the hydrophones and in-line charge amplifier. The multi-gain signal conditioner provides the ability to increase the signal strength (i.e., add gain) so that measurements are made within the dynamic range of the instruments used to analyze the signals. Two types of hydrophones were used due to the differences in sensitivity and the availability of equipment for this program.

The TC-4013 hydrophone is about 13 dB less sensitive than the TC-4033 and better suited for measuring higher sound levels without overloading the measurement system. For this reason, the TC-4013 hydrophone was used for the near measurement sites. The TC-4033 hydrophones have a greater sensitivity and are better suited for the measurement of low-level signals, and therefore, were deployed at positions farther from the pile driving where low-amplitude signals were expected.

During impact driving the maximum peak sound pressures (LZ_{peak}), impulse RMS sound pressure level (LZI_{max}) and the 1-second SEL (LZ_{eq}) were measured “live” using the LDL 831. During vibratory driving the maximum peak sound pressures (LZ_{peak}) and the fast RMS sound pressure level (LZF_{max}) were measured “live” using the LDL 831. The LDL 831 SLM provided measurements of the un-weighted results for each data type, including the one-third octave band spectra for the 1-second LZ_{max}. Additional analyses of the acoustical impulses were performed using the LDL 831 SLMs as well. The LDL 831 captures the signal and stores the measurement data that is retrieved at the completion of a day of measurements.

Airborne measurements were made using 0.5-inch G.R.A.S. Model 40AQ pre-polarized random-incidence microphones. The signals were fed into LDL 820 SLM. The systems were calibrated with a Larson Davis Model CAL200 Acoustic Calibrator. The microphones were calibrated at the beginning and end of each day. Pre-event and post-event calibration levels were within 0.1 dB.

Underwater Sound Descriptors

The acoustic monitoring program reports data in several formats, depending on the type of pile driving and the type of acoustic measurement. Impact pile driving produces pulse-type sounds, while vibratory pile installation produces a more continuous type of sound.

For impact pile driving, data provided include the peak pressure, RMS, and single-strike, cumulative SELs, and the L_{max} one-third octave band frequency spectrum, average of eight pile strikes. For vibratory driving, data reporting includes the RMS sound pressure level and the L_{max} average one-third octave band frequency spectrum over the entire pile-driving event.

Airborne Sound Descriptors

A-weighted airborne data were collected for both impact and vibratory driving. During data collection 1-second and 1-minute intervals were used for measuring airborne data. The airborne data shown on the various time history charts represents the one second “fast” A-weighted RMS (L_{max}). The tables shown in **Attachment B** show the 1-minute data including the one-minute L_{eq}, 1-minute SEL and 1-minute L_{max}, and the peak sound pressure level.

Underwater Sound Measurement Data Management

Data were collected from hydrophones in two ways: (1) measurement of peak, RMS, and SEL sound pressures for each second; and (2) digital audio recording of the sounds for subsequent signal analysis. Each day of measurements, digital data captured by the sound level meters (SLMs) were downloaded to computer systems. The SLMs were primarily used to provide accurate live readings. These readings were recorded in field notebooks from time to time. Digital audio recordings were analyzed for selected impact pile driving events.

Quality Control

The measurement system was calibrated prior to use in the field with a G.R.A.S. Type 42AA pistonphone and hydrophone coupler. The pistonphone, when used with the hydrophone coupler, produces a continuous 136.4 or 145.3 dB (referenced to one microPascal) tone at 250 hertz. The SLM is calibrated to this tone prior to use in the field. The tone is then measured by the SLM and is recorded onto the beginning of the digital audiotapes that were used in the field. The system calibration status was checked at the end of the measurement event by both measuring the calibration tone and recording the post-measurement tone on tape. Signal analysis included the measurement of the calibration tone at the beginning and end of tape recording events. All systems were found to be within 0.5 dB of the calibration levels. The pistonphone output has been certified at an independent facility.

All field notes were recorded in water-resistant field notebooks. Such notebook entries include calibration notes, measurement positions (i.e., distance from source, depth of sensor), system gain settings, and the equipment used to make each measurement. Notebook entries were copied after each measurement day and filed for safekeeping. Recorded media were labeled and stored for subsequent analysis.

ATTACHMENT A

TIME HISTORY OF PILE DRIVING AND 1/3 OCTAVE BAND SPECTRA

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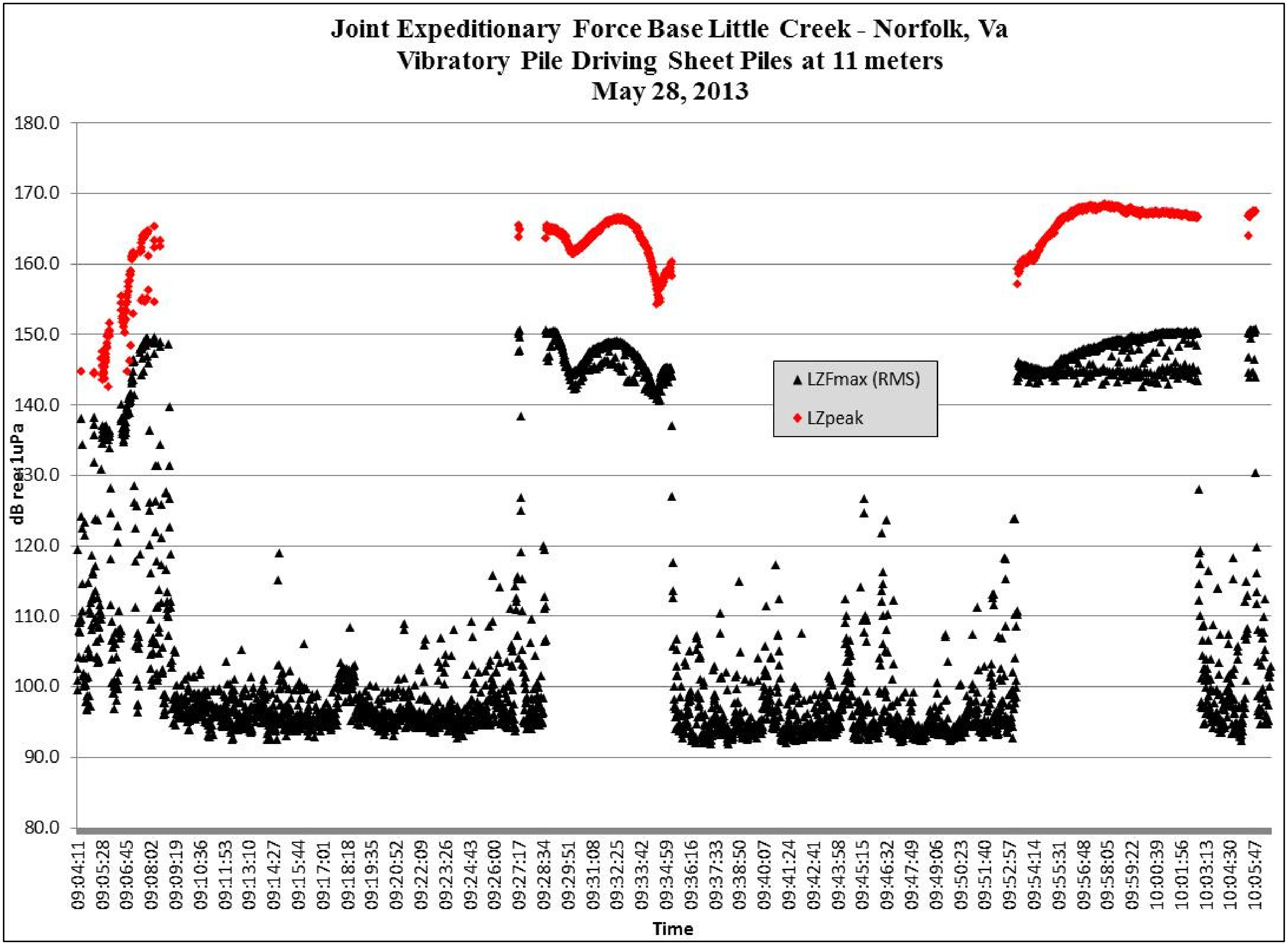
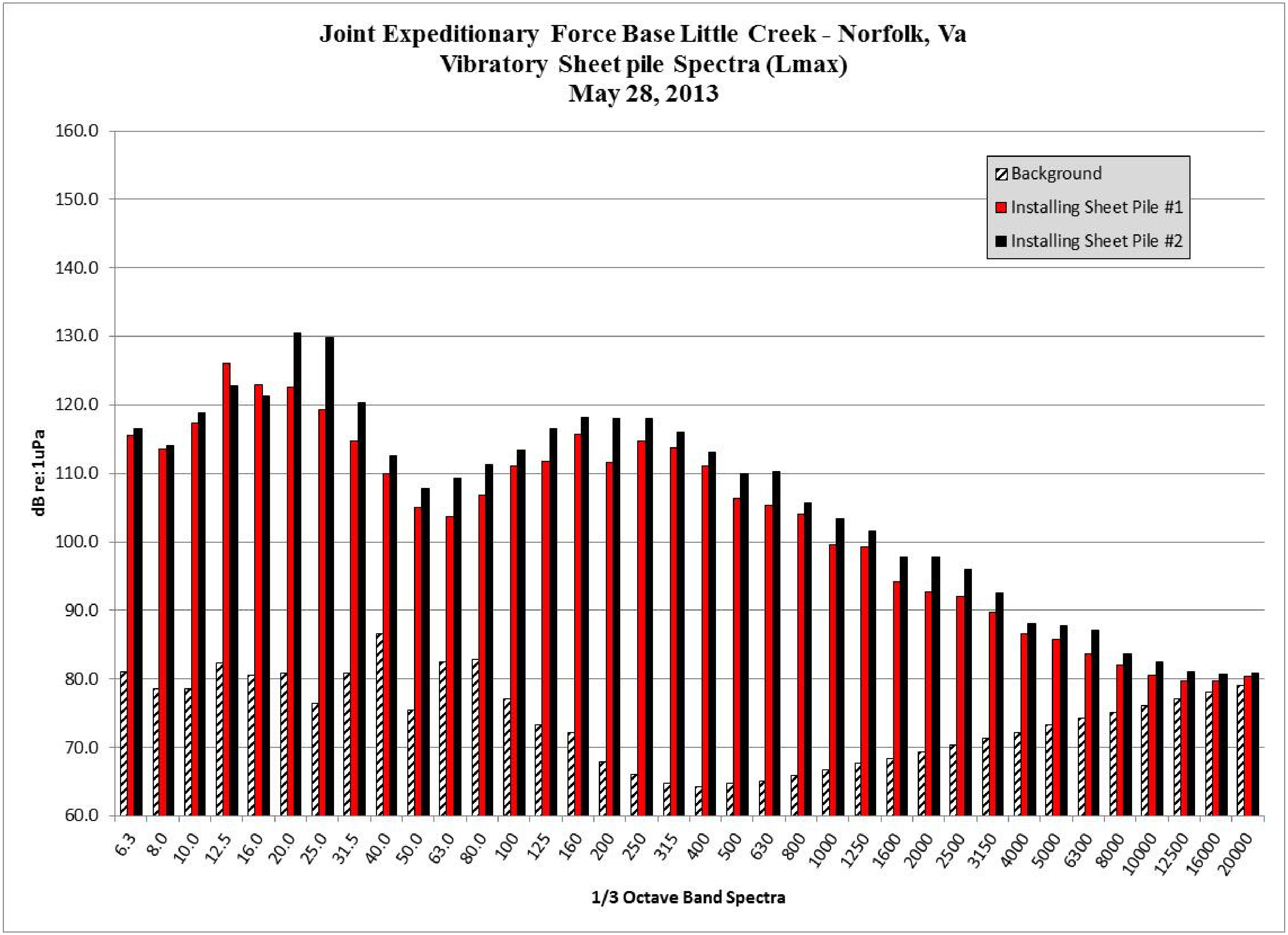
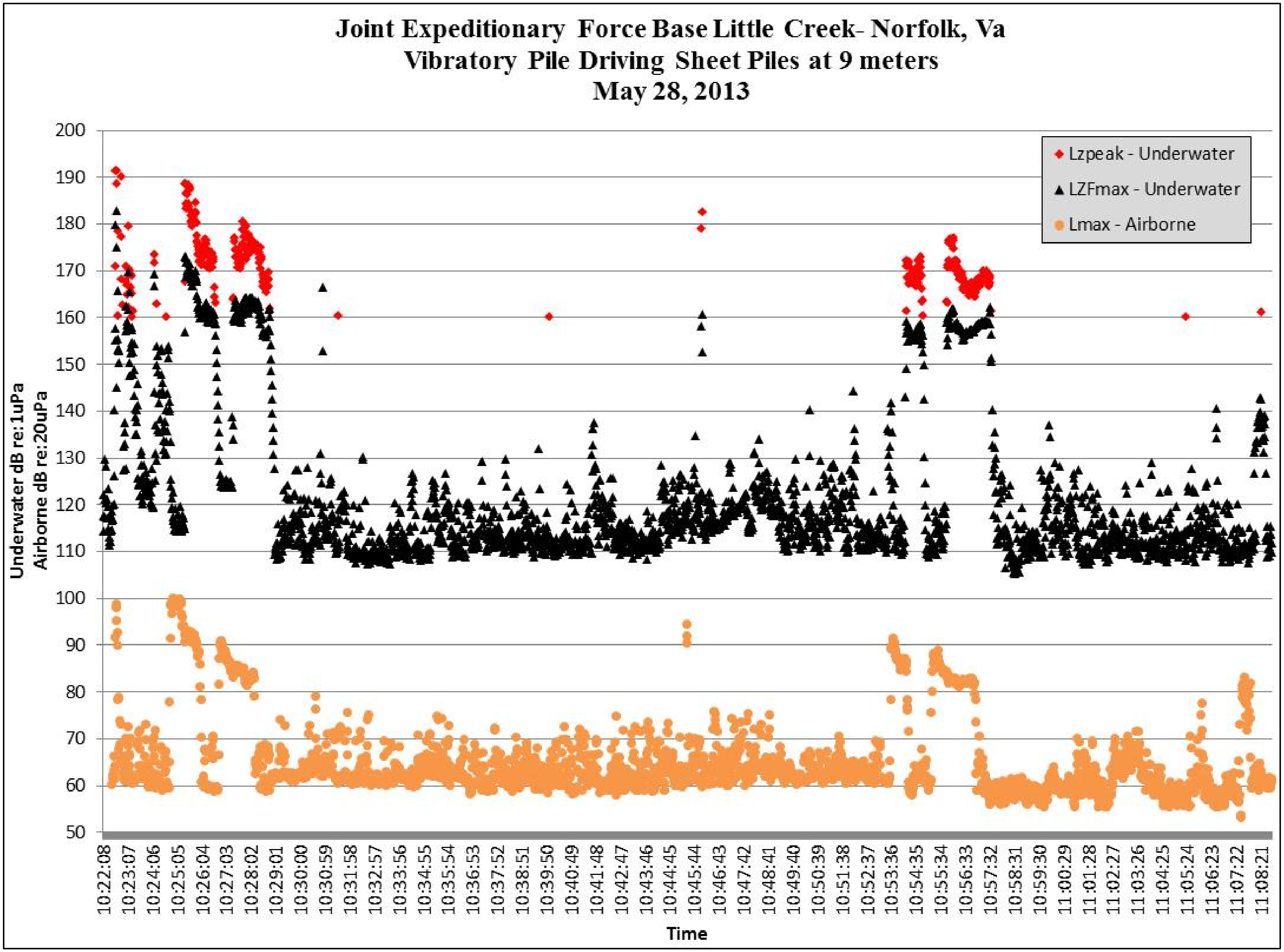

Joint Expeditionary Force Base Little Creek - Norfolk, Va
Vibratory Pile Driving Sheet Piles at 11 meters
May 28, 2013
dB re: 1uPa
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
LZFmax (RMS)
LZpeak
09:04:11
09:05:28
09:06:45
09:08:02
09:09:19
09:10:36
09:11:53
09:13:10
09:14:27
09:15:44
09:17:01
09:18:18
09:19:35
09:20:52
09:22:09
09:23:26
09:24:43
09:26:00
09:27:17
09:28:34
09:29:51
09:31:08
09:32:25
09:33:42
09:34:59
09:36:16
09:37:33
09:38:50
09:40:07
09:41:24
09:42:41
09:43:58
09:45:15
09:46:32
09:47:49
09:49:06
09:50:23
09:51:40
09:52:57
09:54:14
09:55:31
09:56:48
09:58:05
09:59:22
10:00:39
10:01:56
10:03:13
10:04:30
10:05:47
Time


Joint Expeditionary Force Base Little Creek - Norfolk, Va
Vibratory Sheet pile Spectra (Lmax)
May 28, 2013
Background
Installing Sheet Pile #1
Installing Sheet Pile #2
dB re:1uPa
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
6.3
8.0
10.0
12.5
16.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
1/3 Octave Band Spectra


Joint Expeditionary Force Base Little Creek- Norfolk, Va
Vibratory Pile Driving Sheet Piles at 9 meters
May 28, 2013
Underwater dB re:1uPa
Airborne dB re:20uPa
Lzpeak - Underwater
LZFmax - Underwater
Lmax - Airborne
Time
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
10:22:08
10:23:07
10:24:06
10:25:05
10:26:04
10:27:03
10:28:02
10:29:01
10:30:00
10:30:59
10:31:58
10:32:57
10:33:56
10:34:55
10:35:54
10:36:53
10:37:52
10:38:51
10:39:50
10:40:49
10:41:48
10:42:47
10:43:46
10:44:45
10:45:44
10:46:43
10:47:42
10:48:41
10:49:40
10:50:39
10:51:38
10:52:37
10:53:36
10:54:35
10:55:34
10:56:33
10:57:32
10:58:31
10:59:30
11:00:29
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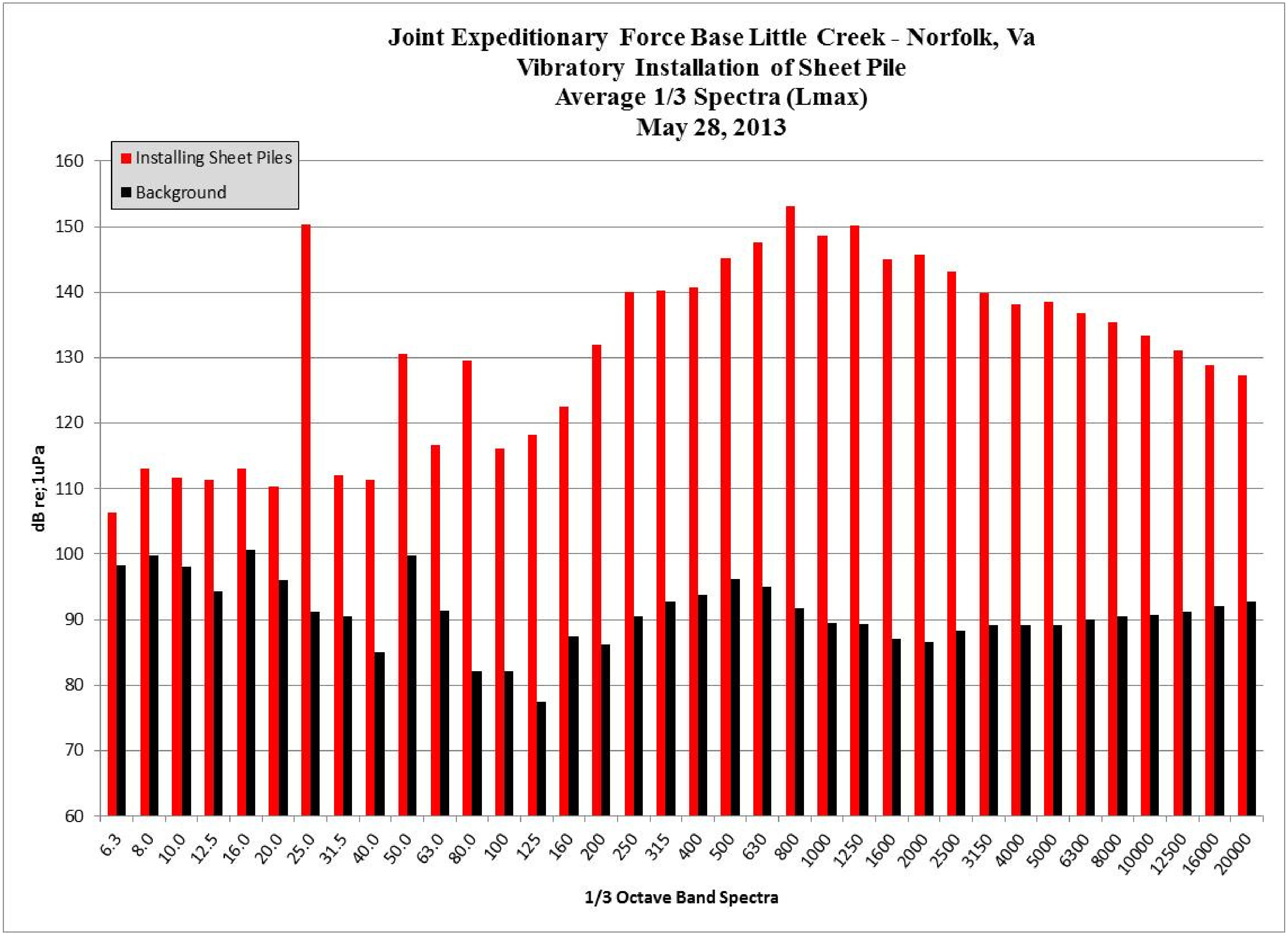
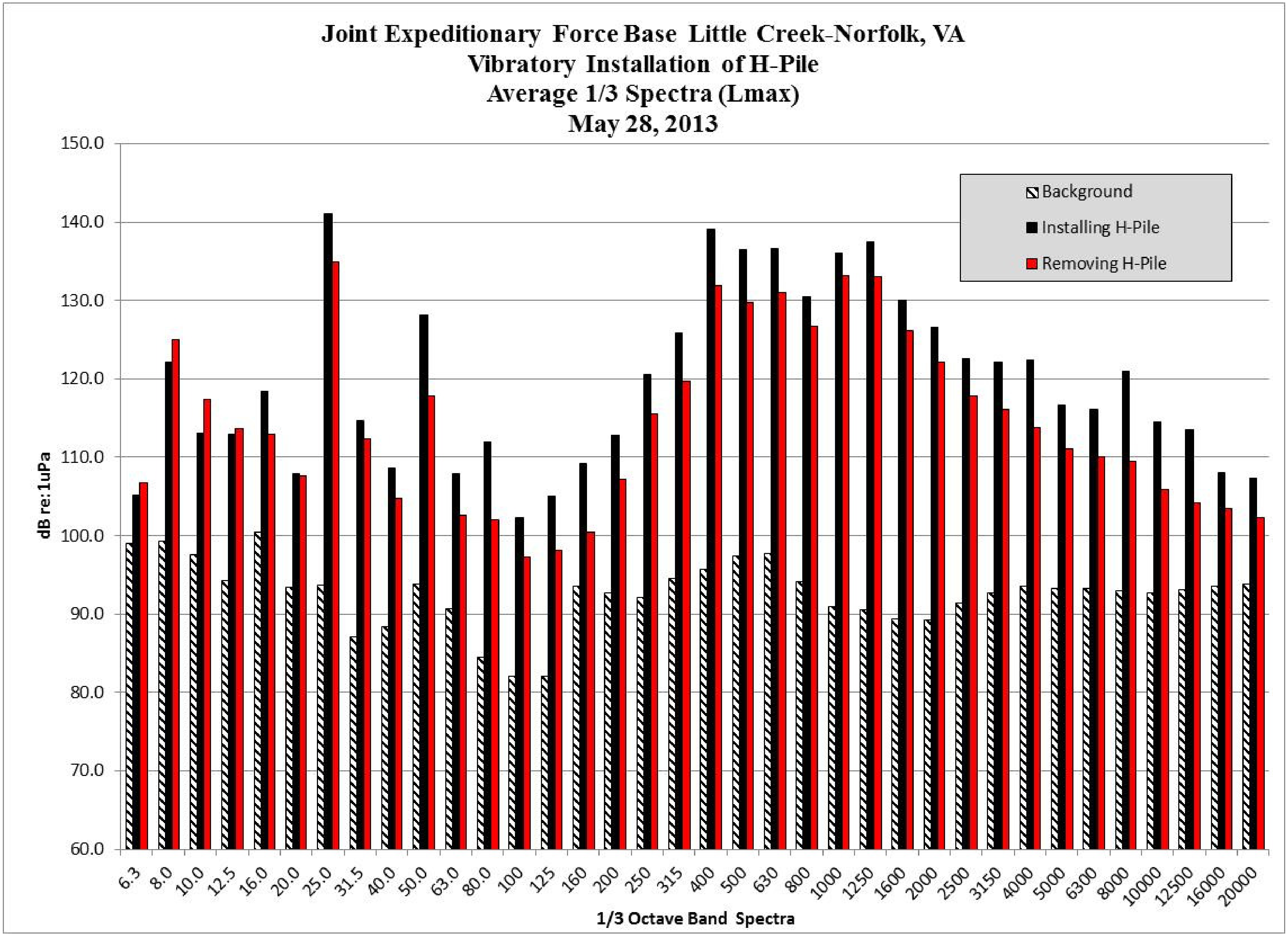
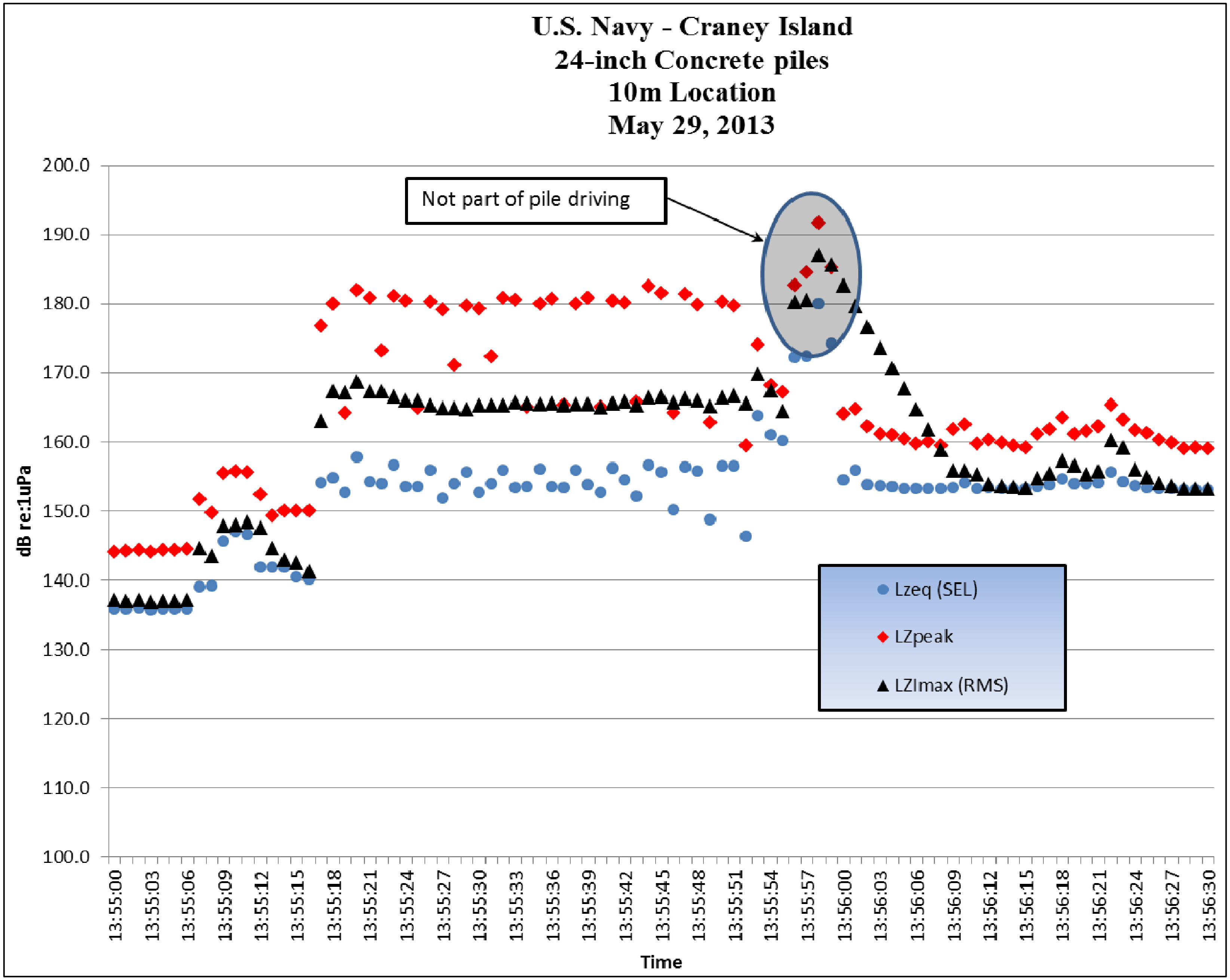
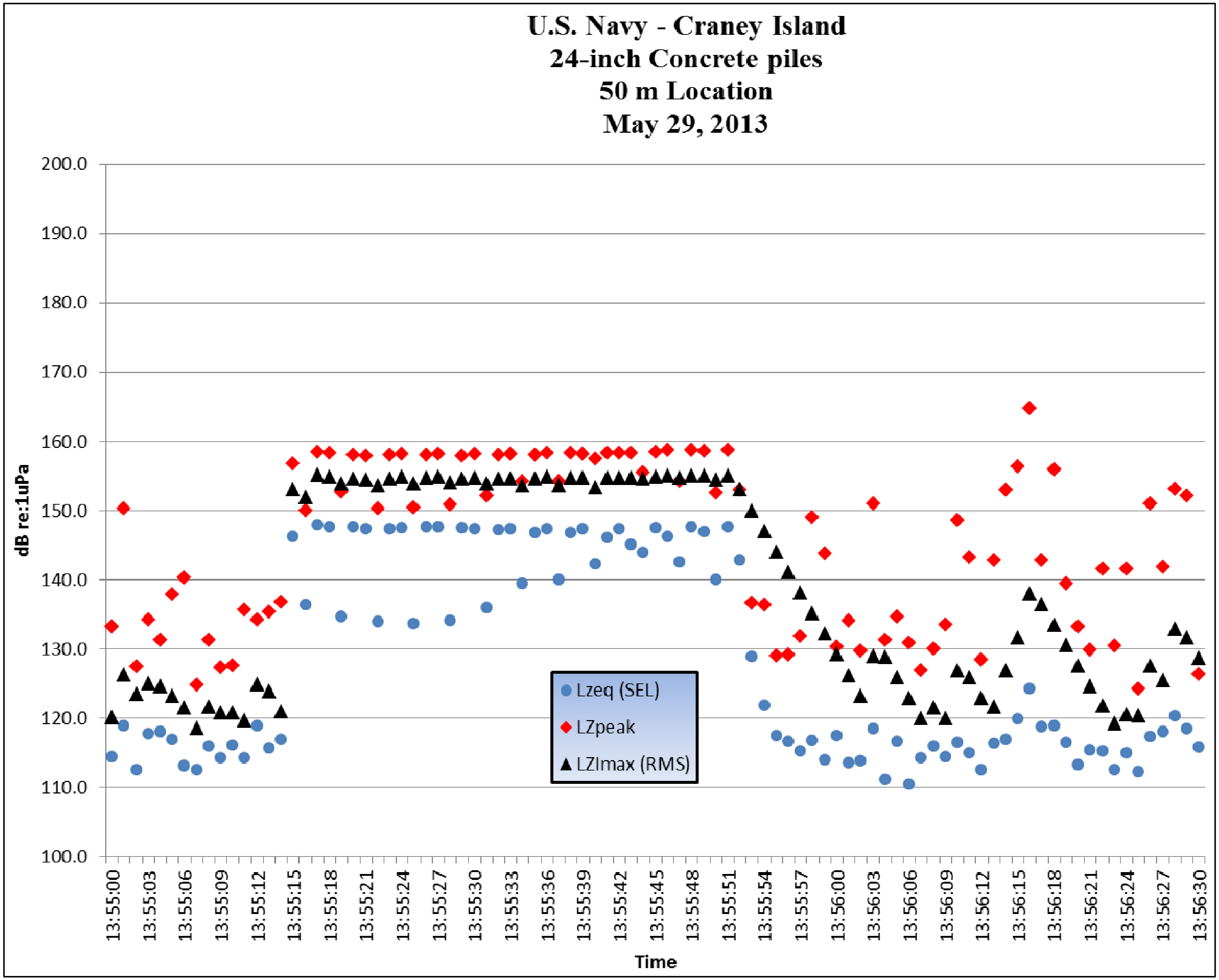
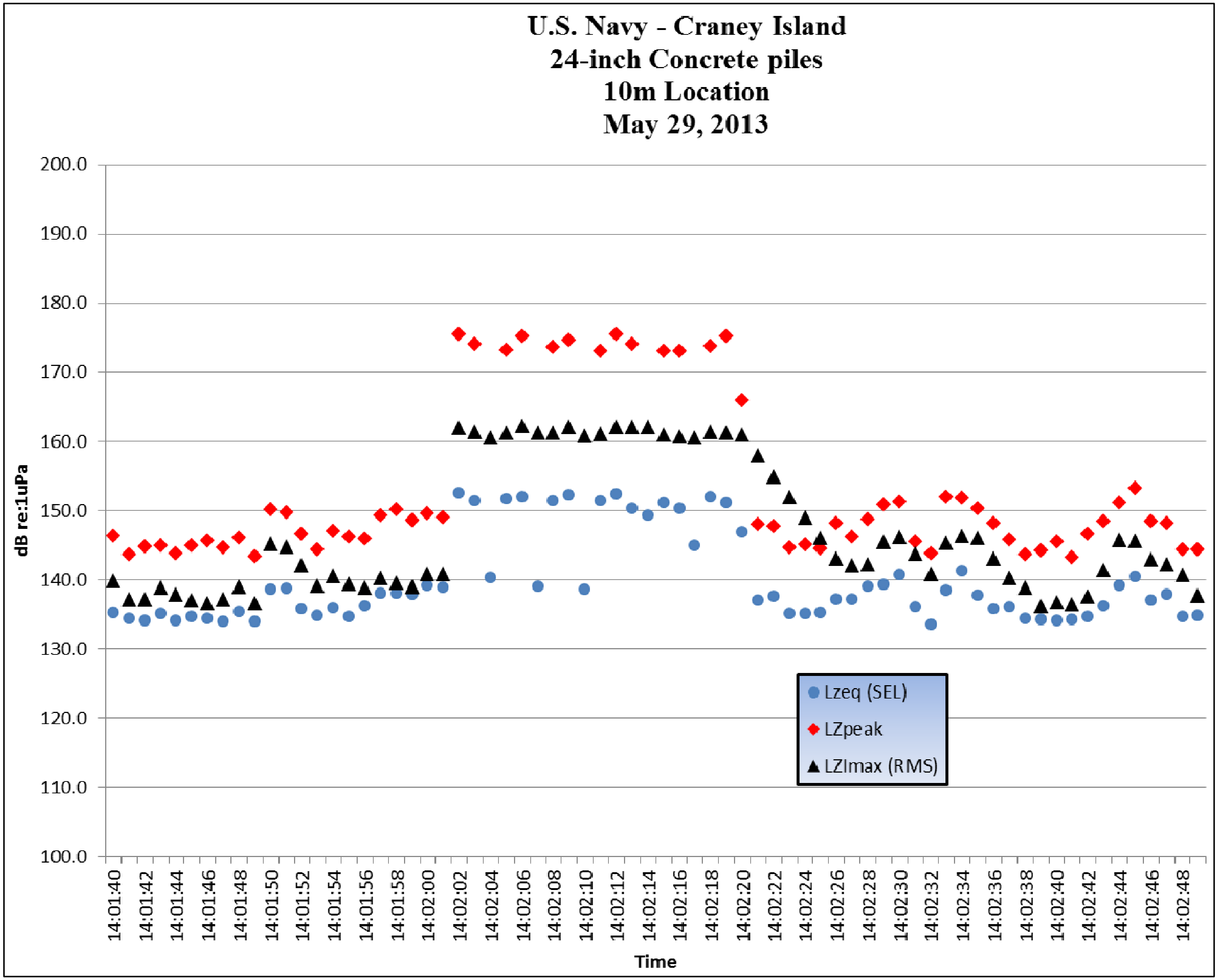
11:07:22
11:08:21

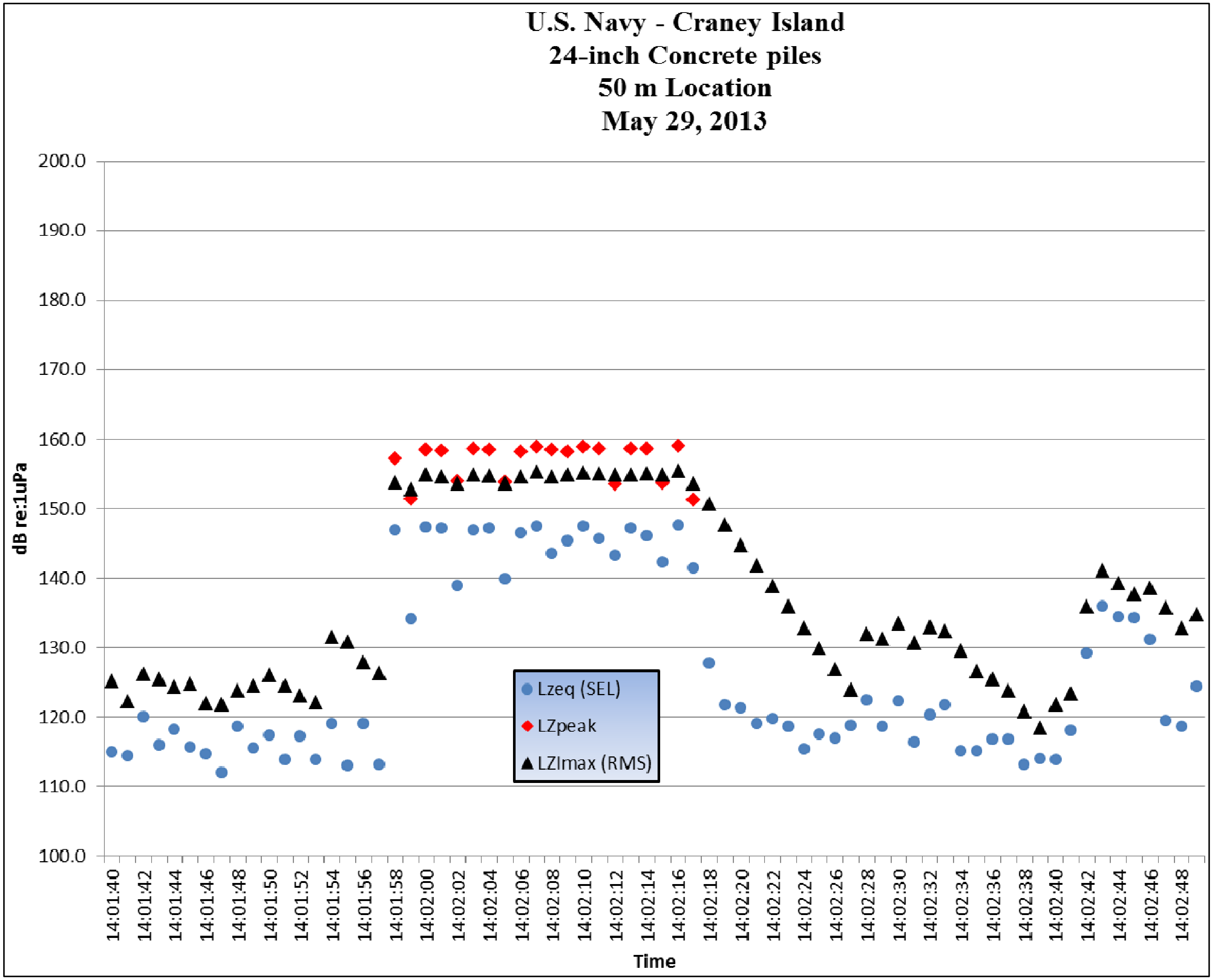

Joint Expeditionary Force Base Little Creek - Norfolk, Va
Vibratory Installation of Sheet Pile
Average 1/3 Spectra (Lmax)
May 28, 2013
Installing Sheet Piles
Background
dB re;1uPa
160
150
140
130
120
110
100
90
80
70
60
6.3
8.0
10.0
12.5
16.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
1/3 Octave Band Spectra


Joint Expeditionary Force Base Little Creek-Norfolk, VA
Vibratory Installation of H-Pile
Average 1/3 Spectra (Lmax)
May 28, 2013
dB re: 1uPa
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
Background
Installing H-Pile
Removing H-Pile
6.3
8.0
10.0
12.5
16.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
1/3 Octave Band Spectra


U.S. Navy - Craney Island
24-inch Concrete piles
10m Location
May 29, 2013
Not part of pile driving
dB re:1uPa
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
13:55:00
13:55:03
13:55:06
13:55:09
13:55:12
13:55:15
13:55:18
13:55:21
13:55:24
13:55:27
13:55:30
13:55:33
13:55:36
13:55:39
13:55:42
13:55:45
13:55:48
13:55:51
13:55:54
13:55:57
13:56:00
13:56:03
13:56:06
13:56:09
13:56:12
13:56:15
13:56:18
13:56:21
13:56:24
13:56:27
13:56:30
Time
Lzeq (SEL)
LZpeak
LZImax (RMS)


U.S. Navy - Craney Island
24-inch Concrete piles
50 m Location
May 29, 2013
dB re:1uPa
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
Lzeq (SEL)
LZpeak
LZImax (RMS)
13:55:00
13:55:03
13:55:06
13:55:09
13:55:12
13:55:15
13:55:18
13:55:21
13:55:24
13:55:27
13:55:30
13:55:33
13:55:36
13:55:39
13:55:42
13:55:45
13:55:48
13:55:51
13:55:54
13:55:57
13:56:00
13:56:03
13:56:06
13:56:09
13:56:12
13:56:15
13:56:18
13:56:21
13:56:24
13:56:27
13:56:30
Time


U.S. Navy - Craney Island
24-inch Concrete piles
10m Location
May 29, 2013
dB re:1uPa
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
14:01:40
14:01:42
14:01:44
14:01:46
14:01:48
14:01:50
14:01:52
14:01:54
14:01:56
14:01:58
14:02:00
14:02:02
14:02:04
14:02:06
14:02:08
14:02:10
14:02:12
14:02:14
14:02:16
14:02:18
14:02:20
14:02:22
14:02:24
14:02:26
14:02:28
14:02:30
14:02:32
14:02:34
14:02:36
14:02:38
14:02:40
14:02:42
14:02:44
14:02:46
14:02:48
Time
Lzeq (SEL)
LZpeak
LZImax (RMS)



U.S. Navy - Craney Island
24-inch Concrete piles
50 m Location
May 29, 2013
dB re:1uPa
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
Lzeq (SEL)
LZpeak
LZlmax (RMS)
14:01:40
14:01:42
14:01:44
14:01:46
14:01:48
14:01:50
14:01:52
14:01:54
14:01:56
14:01:58
14:02:00
14:02:02
14:02:04
14:02:06
14:02:08
14:02:10
14:02:12
14:02:14
14:02:16
14:02:18
14:02:20
14:02:22
14:02:24
14:02:26
14:02:28
14:02:30
14:02:32
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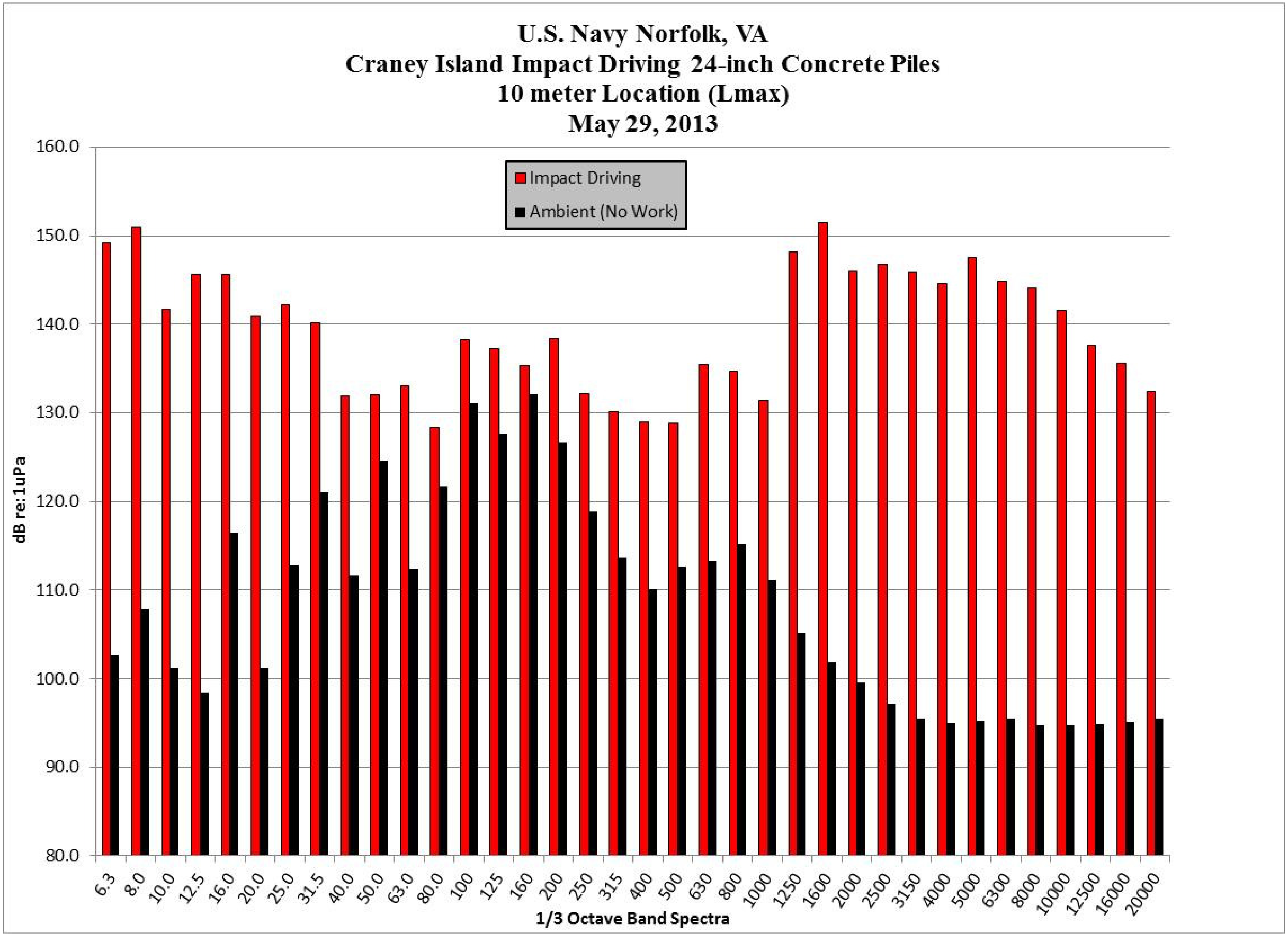
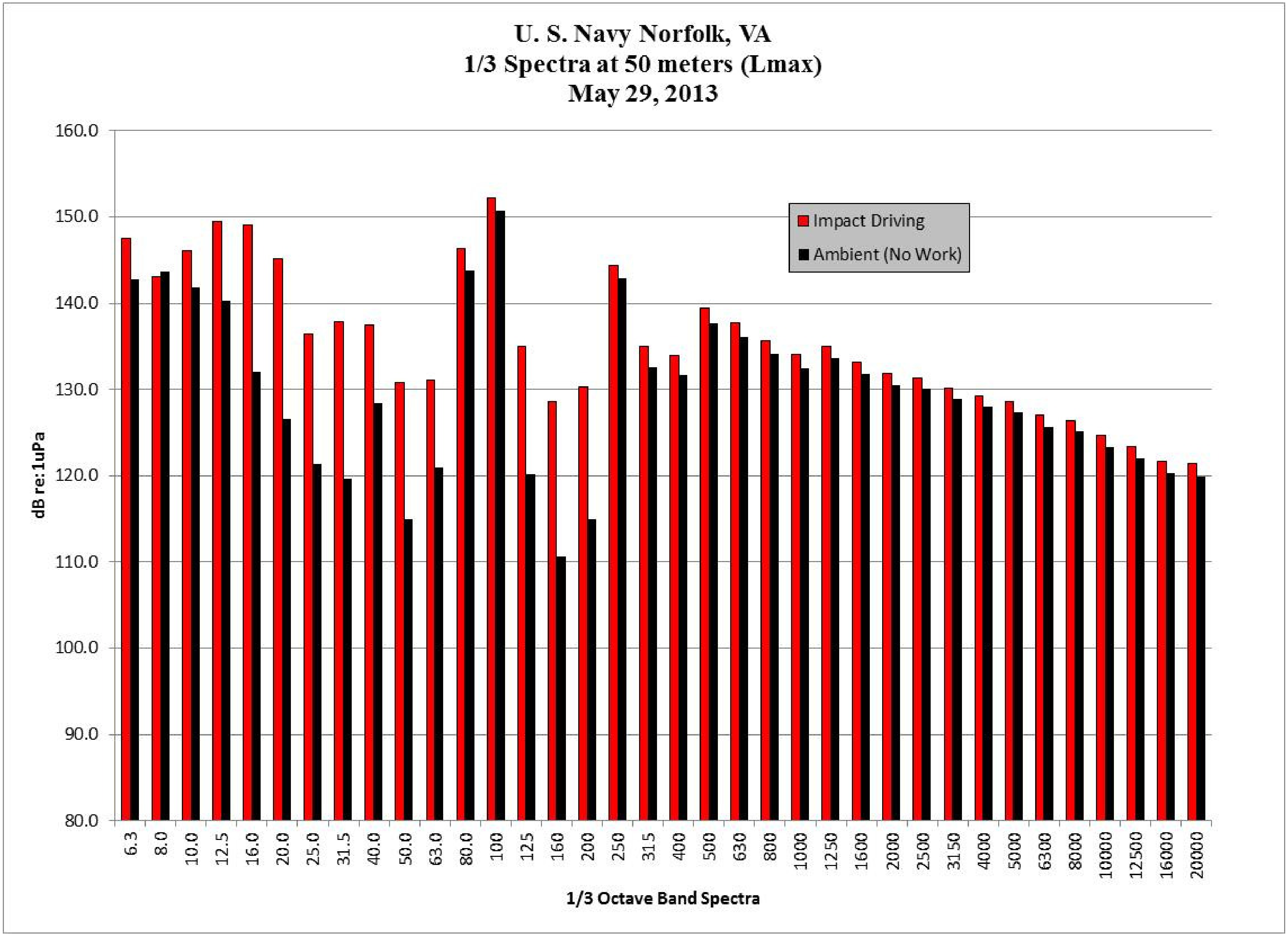
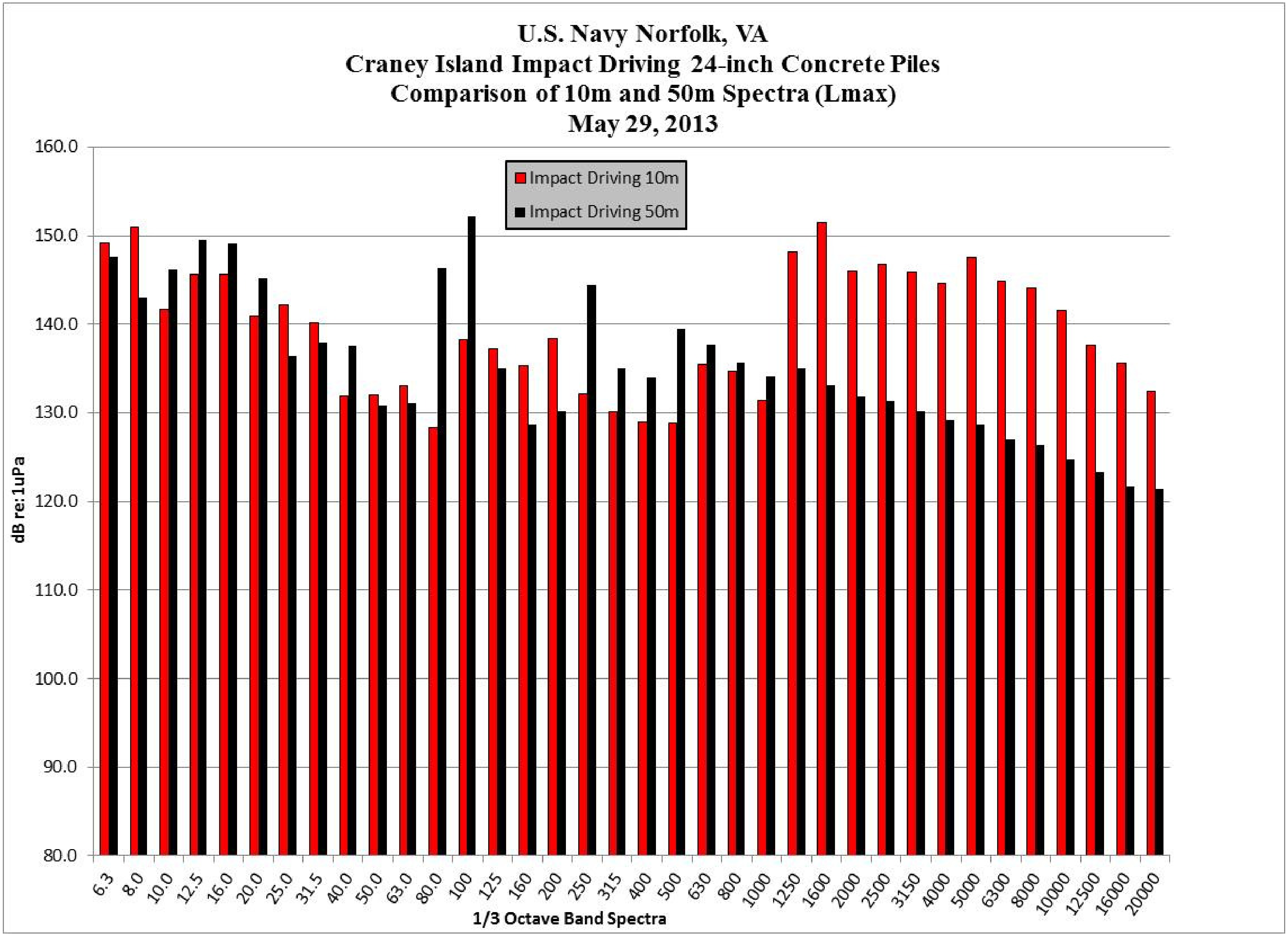
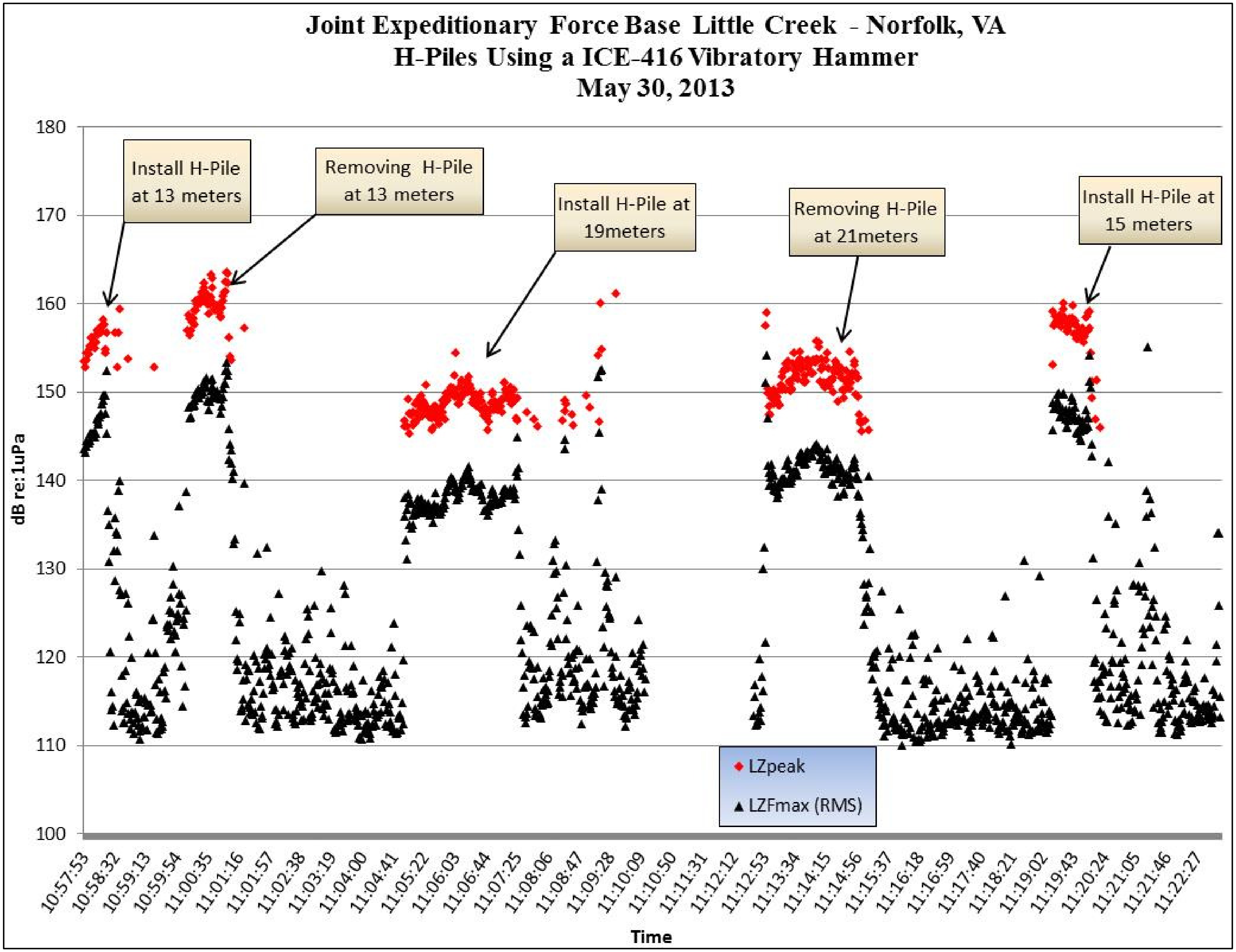
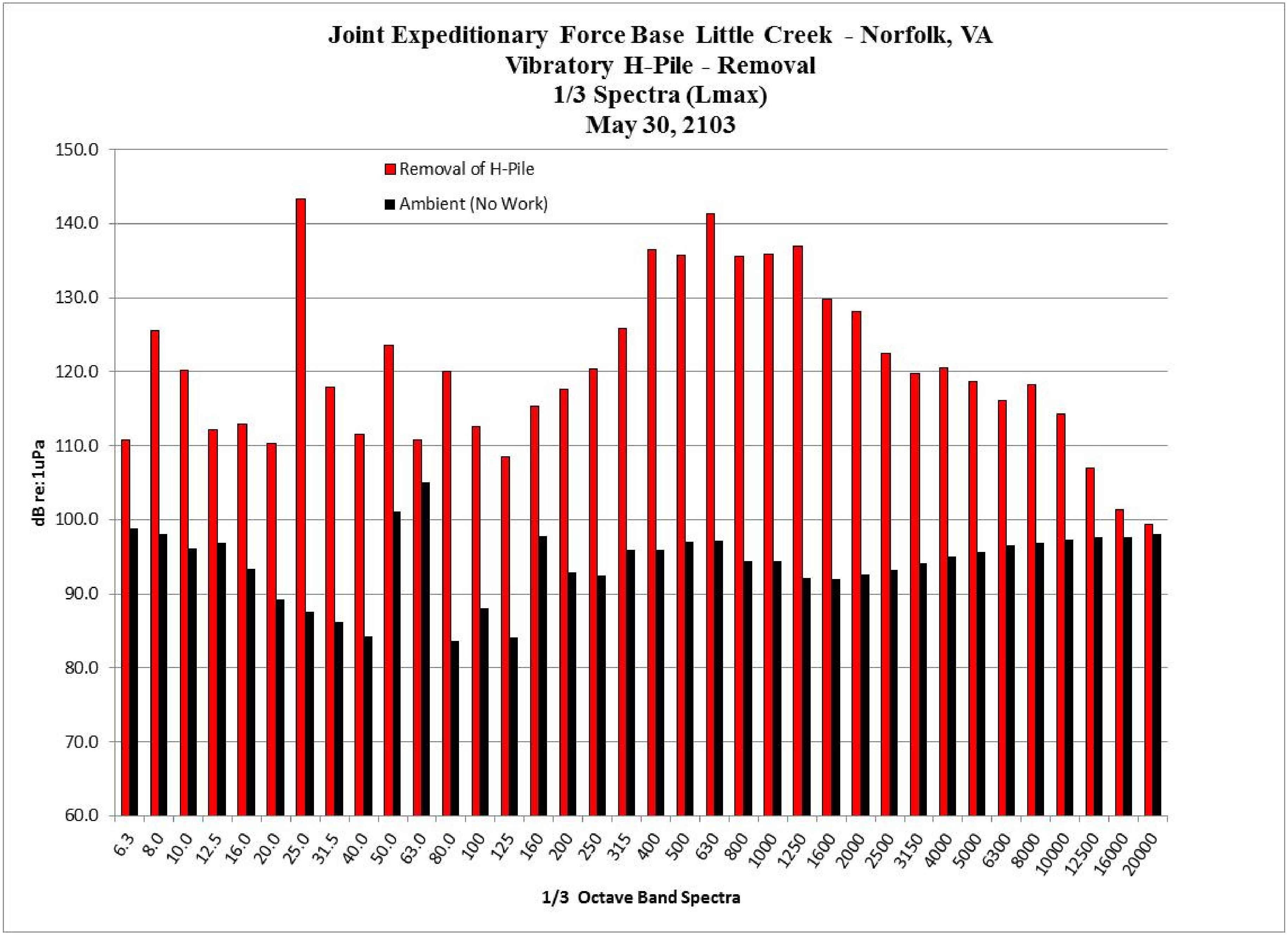
14:02:44
14:02:46
14:02:48
Time

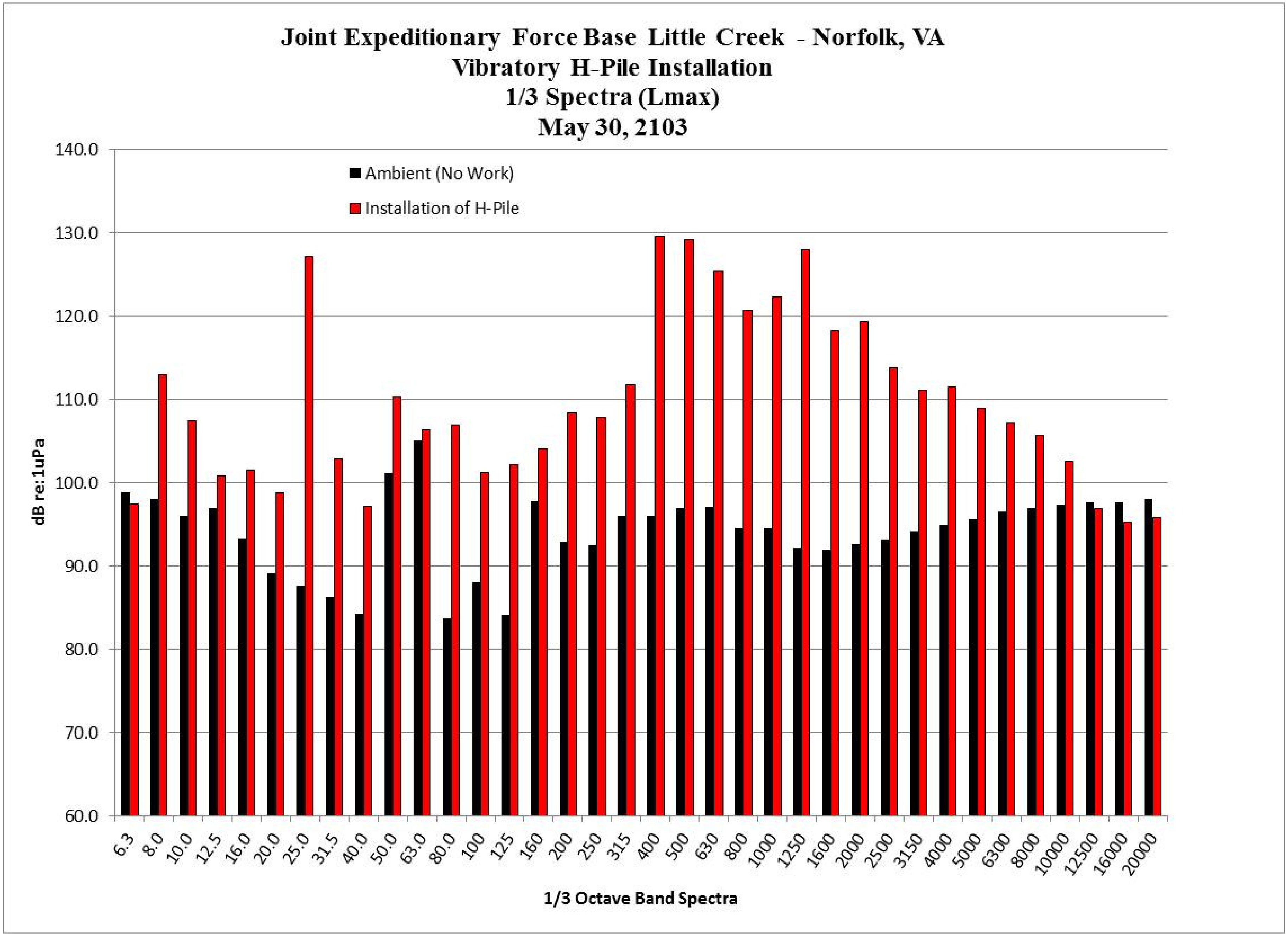

U.S. Navy Norfolk, VA
Craney Island Impact Driving 24-inch Concrete Piles
10 meter Location (Lmax)
May 29, 2013
Impact Driving
Ambient (No Work)
dB re:1uPa
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
6.3 8.0 10.0 12.5 16.0 20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
1/3 Octave Band Spectra

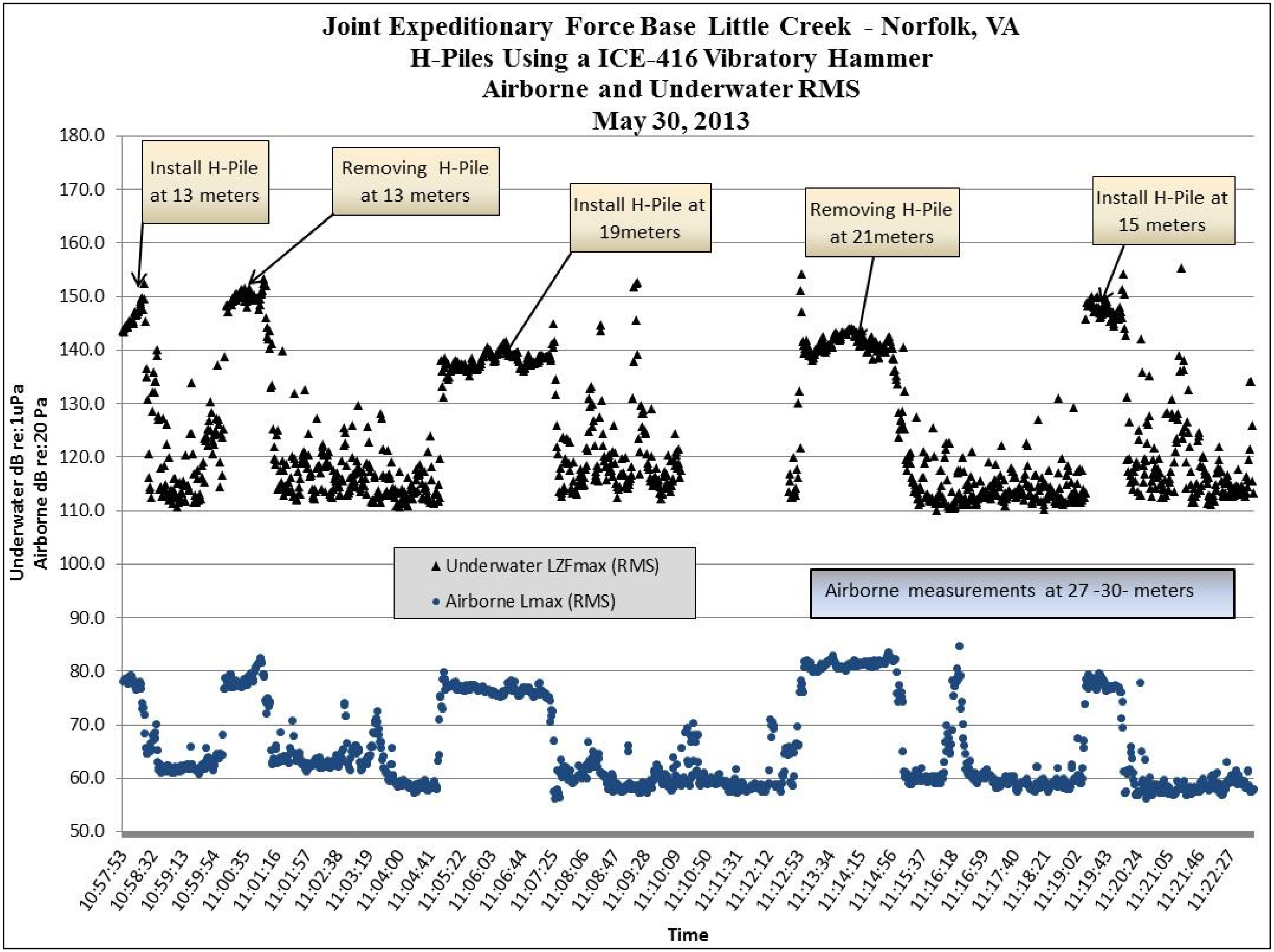

U. S. Navy Norfolk, VA
1/3 Spectra at 50 meters (Lmax)
May 29, 2013
Impact Driving
Ambient (No Work)
dB re:1uPa
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
6.3 8.0 10.0 12.5 16.0 20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
1/3 Octave Band Spectra

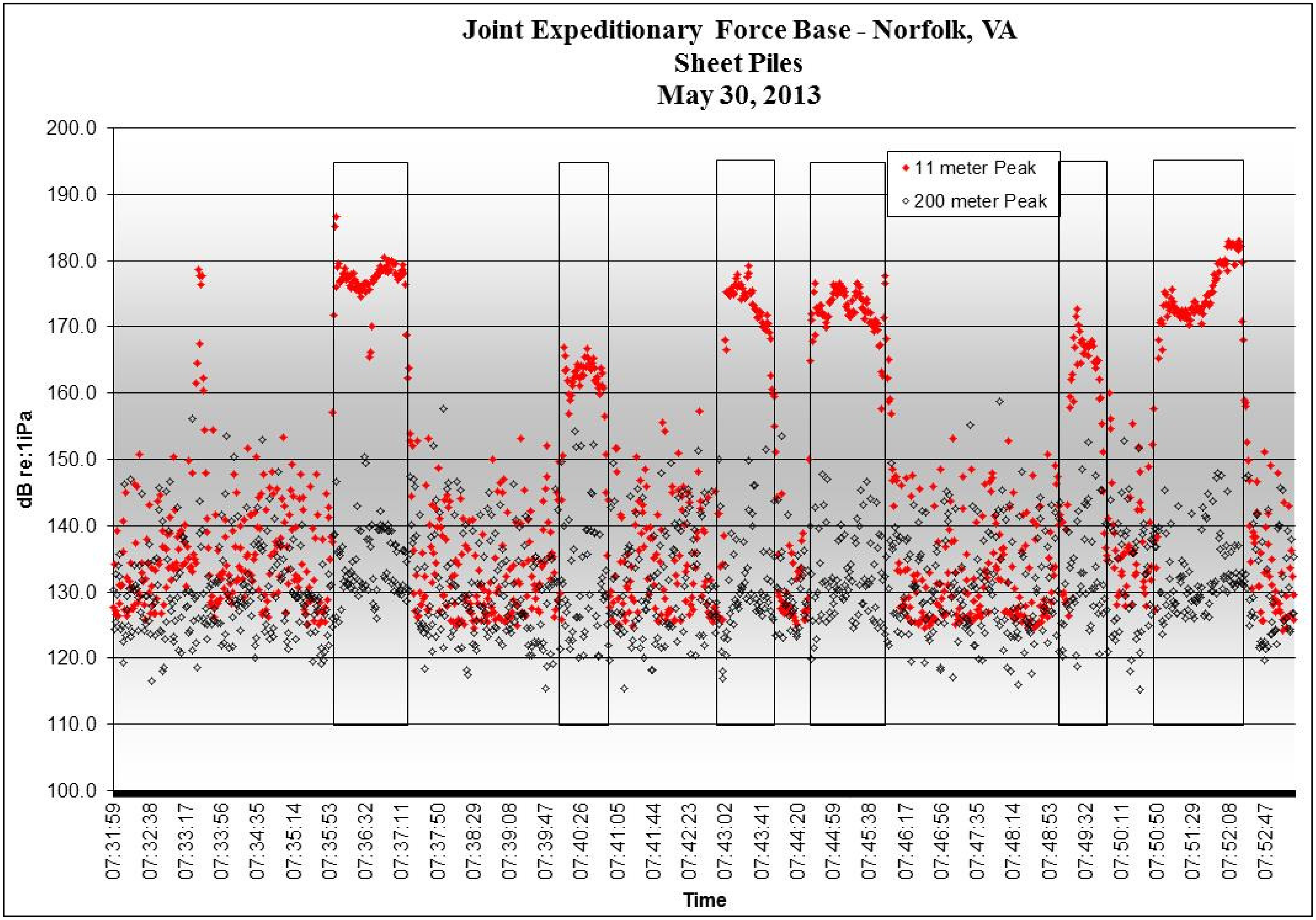

U.S. Navy Norfolk, VA
Craney Island Impact Driving 24-inch Concrete Piles
Comparison of 10m and 50m Spectra (Lmax)
May 29, 2013
Impact Driving 10m
Impact Driving 50m
dB re:1uPa
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
6.3
8.0
10.0
12.5
16.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
1/3 Octave Band Spectra

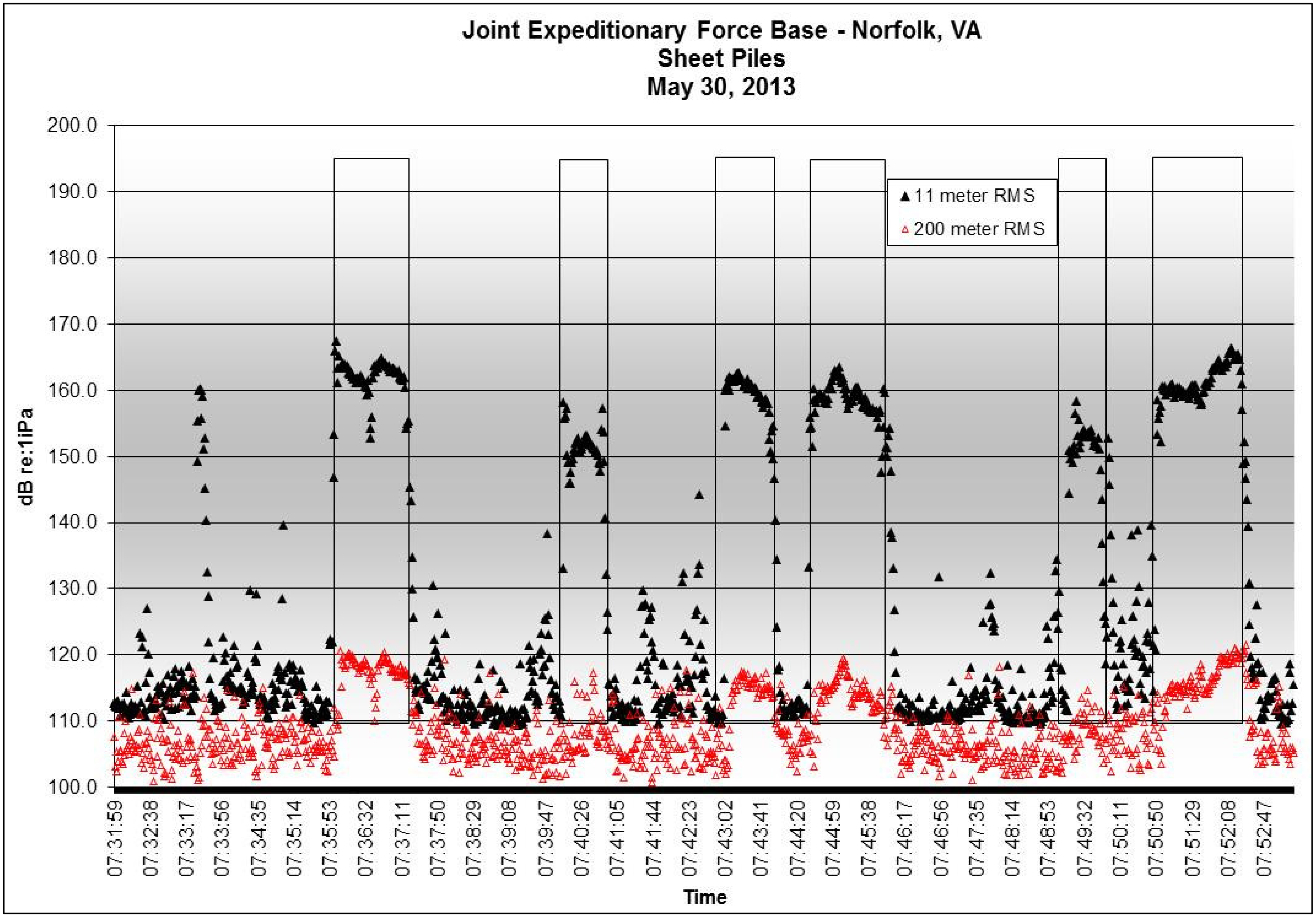

Joint Expeditionary Force Base Little Creek - Norfolk, VA
H-Piles Using a ICE-416 Vibratory Hammer
May 30, 2013
Install H-Pile at 13 meters
Removing H-Pile at 13 meters
Install H-Pile at 19meters
Removing H-Pile at 21meters
Install H-Pile at 15 meters
dB re:1uPa
180
170
160
150
140
130
120
110
100
LZpeak
LZFmax (RMS)
10:57:53
10:58:32
10:59:13
10:59:54
11:00:35
11:01:16
11:01:57
11:02:38
11:03:19
11:04:00
11:04:41
11:05:22
11:06:03
11:06:44
11:07:25
11:08:06
11:08:47
11:09:28
11:10:09
11:10:50
11:11:31
11:12:12
11:12:53
11:13:34
11:14:15
11:14:56
11:15:37
11:16:18
11:16:59
11:17:40
11:18:21
11:19:02
11:19:43
11:20:24
11:21:05
11:21:46
11:22:27
Time

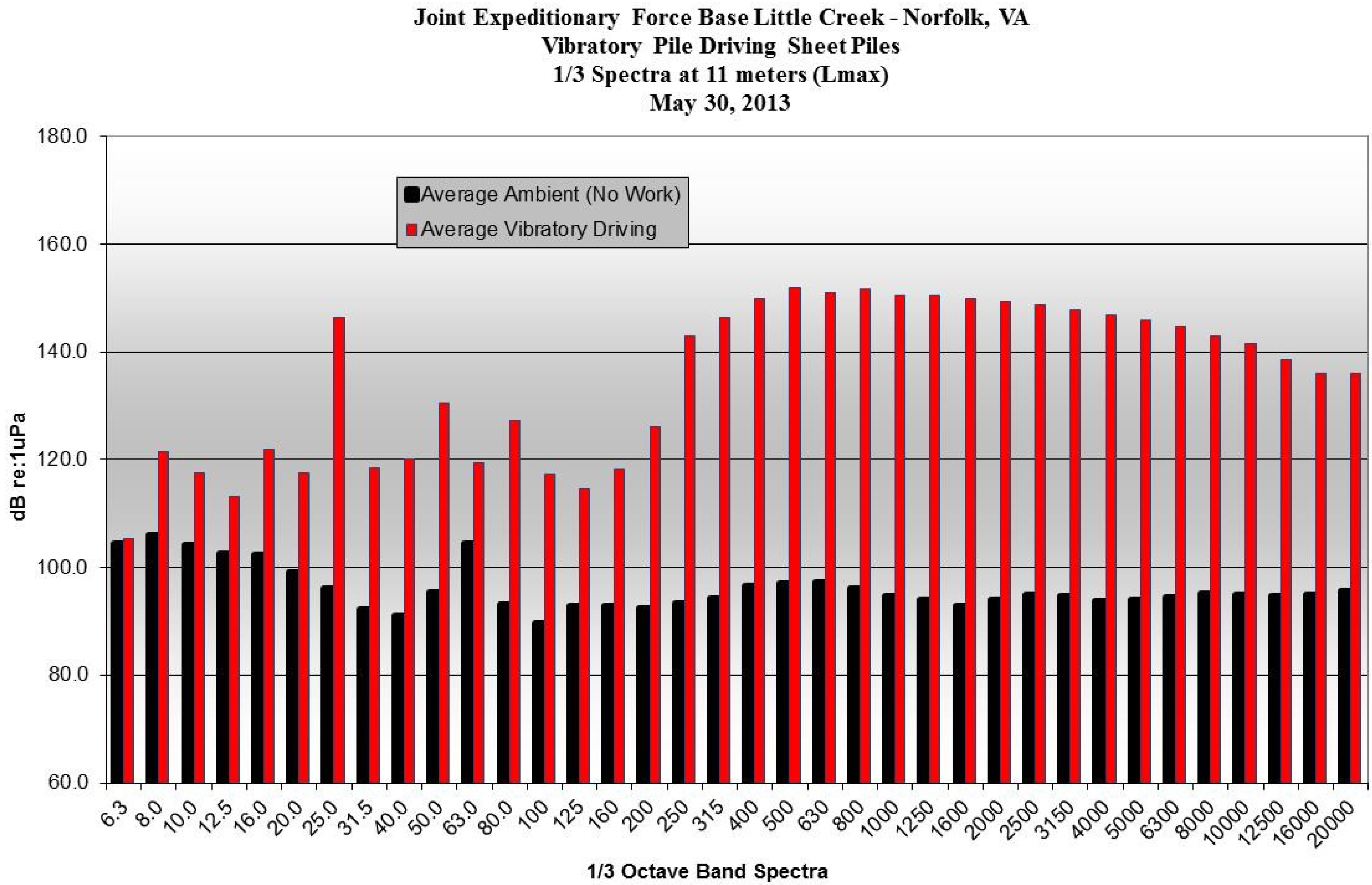

Joint Expeditionary Force Base Little Creek - Norfolk, VA
Vibratory H-Pile - Removal
1/3 Spectra (Lmax)
May 30, 2103
Removal of H-Pile
Ambient (No Work)
dB re: 1uPa
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
6.3 8.0 10.0 12.5 16.0 20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
1/3 Octave Band Spectra

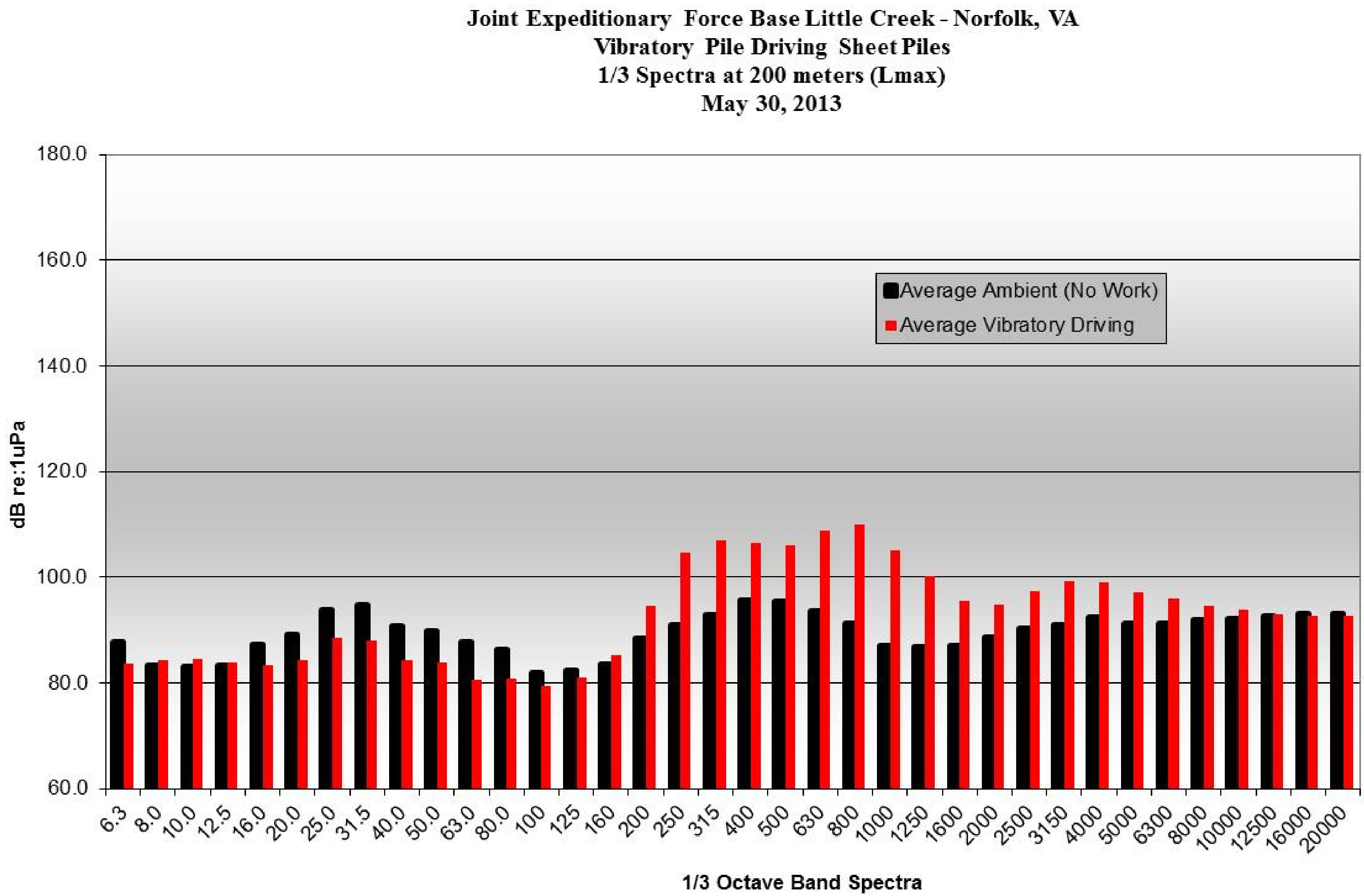

Joint Expeditionary Force Base Little Creek - Norfolk, VA
Vibratory H-Pile Installation
1/3 Spectra (Lmax)
May 30, 2103
Ambient (No Work)
Installation of H-Pile
dB re:1uPa
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
6.3
8.0
10.0
12.5
16.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
1/3 Octave Band Spectra

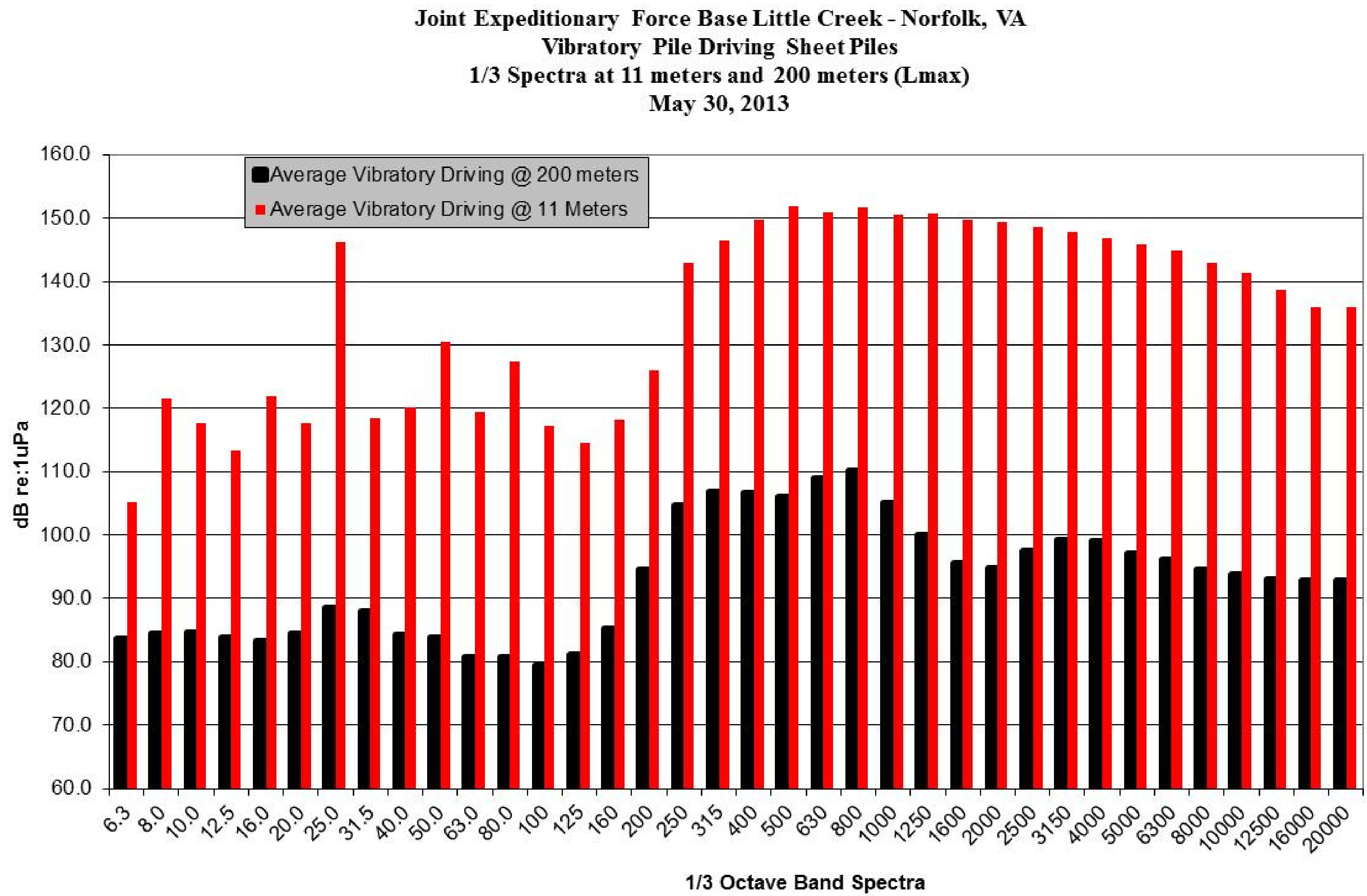

Joint Expeditionary Force Base Little Creek - Norfolk, VA
H-Piles Using a ICE-416 Vibratory Hammer
Airborne and Underwater RMS
May 30, 2013
Install H-Pile at 13 meters
Removing H-Pile at 13 meters
Install H-Pile at 19meters
Removing H-Pile at 21meters
Install H-Pile at 15 meters
Underwater LZFmax (RMS)
Airborne Lmax (RMS)
Airborne measurements at 27 -30- meters
Underwater dB re:1uPa
Airborne dB re:20 Pa
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
10:57:53
10:58:32
10:59:13
10:59:54
11:00:35
11:01:16
11:01:57
11:02:38
11:03:19
11:04:00
11:04:41
11:05:22
11:06:03
11:06:44
11:07:25
11:08:06
11:08:47
11:09:28
11:10:09
11:10:50
11:11:31
11:12:12
11:12:53
11:13:34
11:14:15
11:14:56
11:15:37
11:16:18
11:16:59
11:17:40
11:18:21
11:19:02
11:19:43
11:20:24
11:21:05
11:21:46
11:22:27
Time


Joint Expeditionary Force Base - Norfolk, VA
Sheet Piles
May 30, 2013
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
dB re:1iPa
11 meter Peak
200 meter Peak
07:31:59
07:32:38
07:33:17
07:33:56
07:34:35
07:35:14
07:35:53
07:36:32
07:37:11
07:37:50
07:38:29
07:39:08
07:39:47
07:40:26
07:41:05
07:41:44
07:42:23
07:43:02
07:43:41
07:44:20
07:44:59
07:45:38
07:46:17
07:46:56
07:47:35
07:48:14
07:48:53
07:49:32
07:50:11
07:50:50
07:51:29
07:52:08
07:52:47
Time

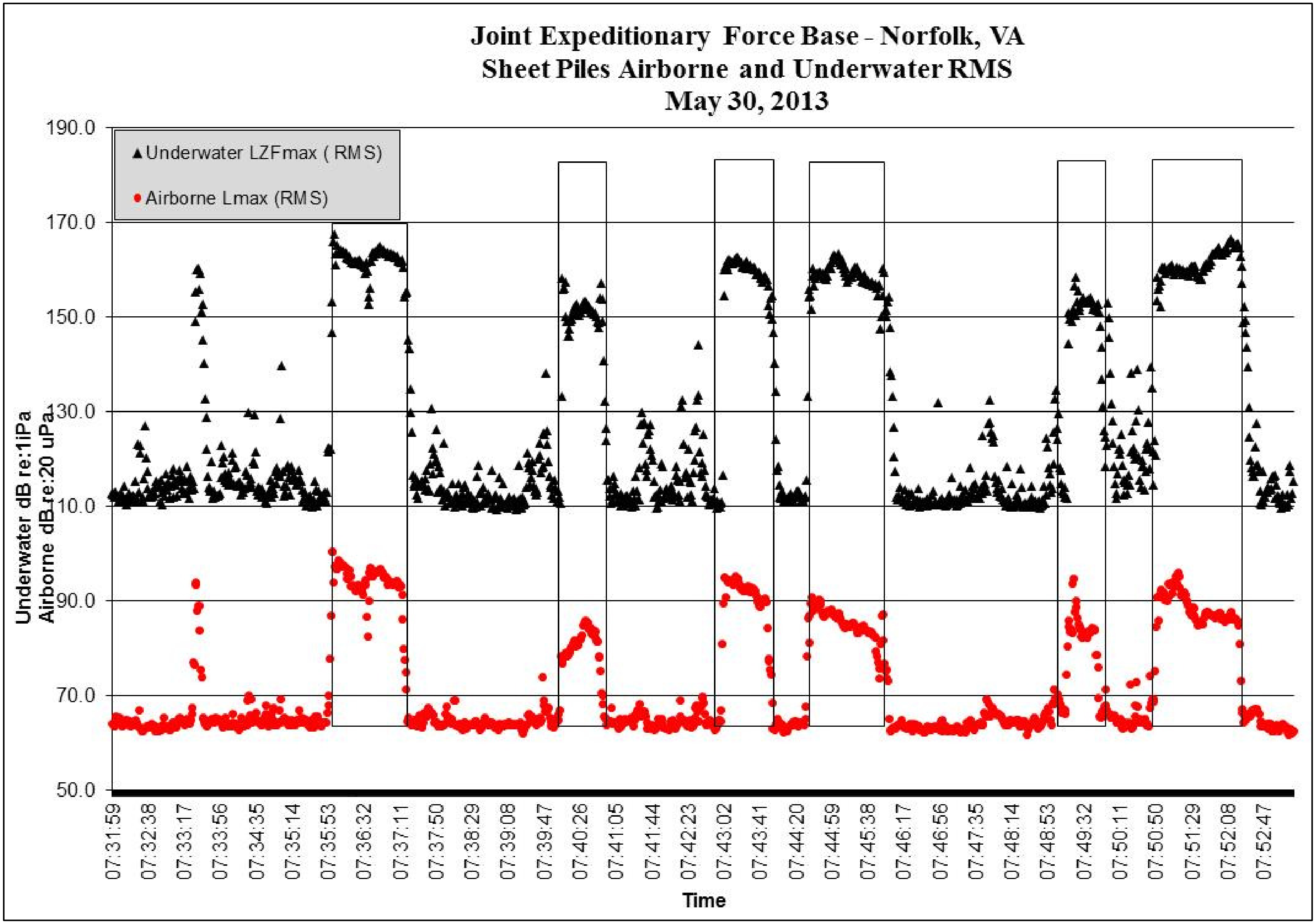

Joint Expeditionary Force Base - Norfolk, VA
Sheet Piles
May 30, 2013
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
dB re:1µPa
11 meter RMS
200 meter RMS
07:31:59
07:32:38
07:33:17
07:33:56
07:34:35
07:35:14
07:35:53
07:36:32
07:37:11
07:37:50
07:38:29
07:39:08
07:39:47
07:40:26
07:41:05
07:41:44
07:42:23
07:43:02
07:43:41
07:44:20
07:44:59
07:45:38
07:46:17
07:46:56
07:47:35
07:48:14
07:48:53
07:49:32
07:50:11
07:50:50
07:51:29
07:52:08
07:52:47
Time

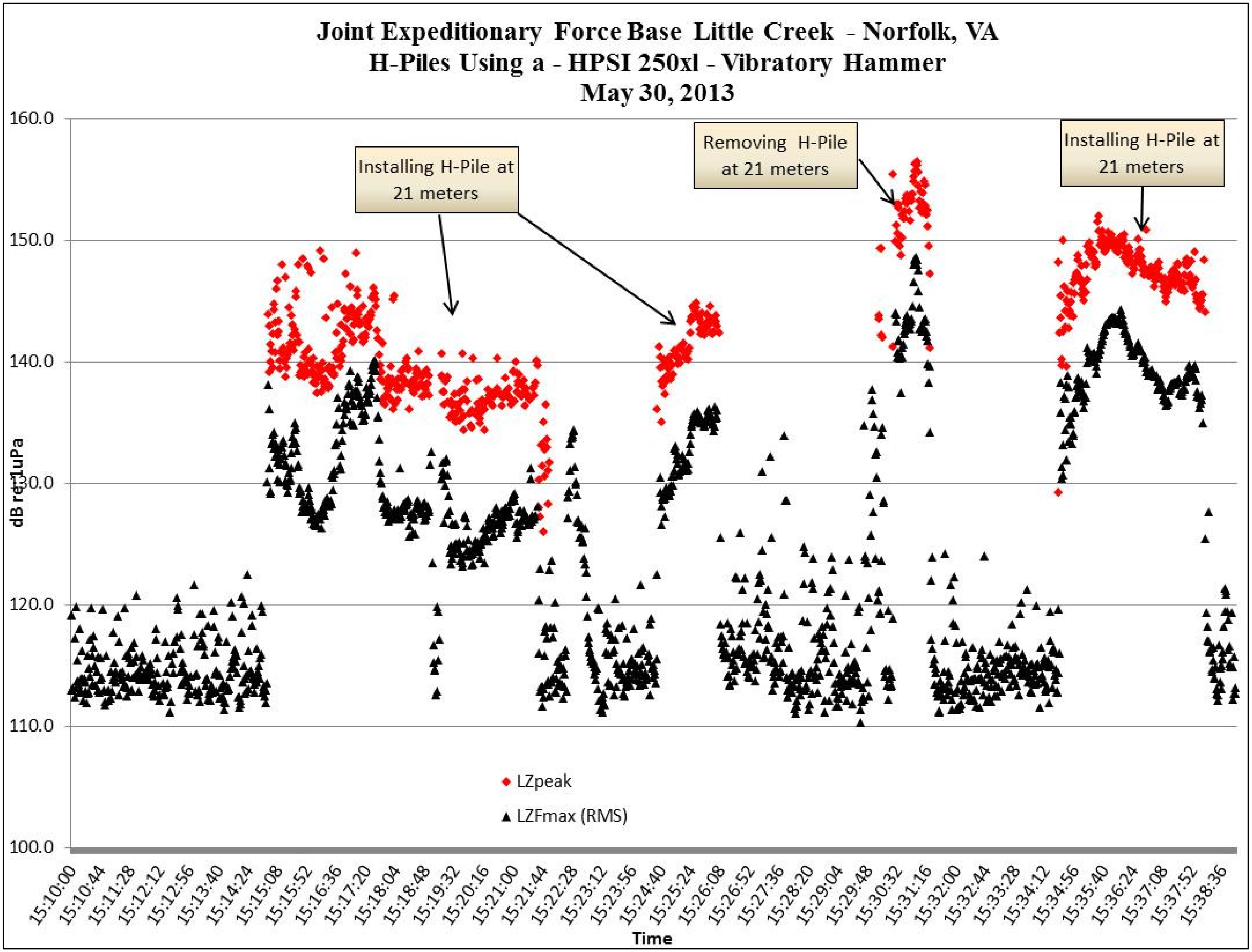

Joint Expeditionary Force Base Little Creek - Norfolk, VA
Vibratory Pile Driving Sheet Piles
1/3 Spectra at 11 meters (Lmax)
May 30, 2013
Average Ambient (No Work)
Average Vibratory Driving
dB re:1uPa
180.0
160.0
140.0
120.0
100.0
80.0
60.0
6.3 8.0 10.0 12.5 16.0 20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
1/3 Octave Band Spectra


Joint Expeditionary Force Base Little Creek - Norfolk, VA
Vibratory Pile Driving Sheet Piles
1/3 Spectra at 200 meters (Lmax)
May 30, 2013
Average Ambient (No Work)
Average Vibratory Driving
dB re:1uPa
180.0
160.0
140.0
120.0
100.0
80.0
60.0
6.3 8.0 10.0 12.5 16.0 20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
1/3 Octave Band Spectra



Joint Expeditionary Force Base Little Creek - Norfolk, VA
Vibratory Pile Driving Sheet Piles
1/3 Spectra at 11 meters and 200 meters (Lmax)
May 30, 2013
Average Vibratory Driving @ 200 meters
Average Vibratory Driving @ 11 Meters
dB re:1uPa
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
6.3 8.0 10.0 12.5 16.0 20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
1/3 Octave Band Spectra


Joint Expeditionary Force Base - Norfolk, VA
Sheet Piles Airborne and Underwater RMS
May 30, 2013
Underwater LZFmax (RMS)
Airborne Lmax (RMS)
Underwater dB re:1lPa
Airborne dB re:20 uPa
190.0
170.0
150.0
130.0
110.0
90.0
70.0
50.0
07:31:59
07:32:38
07:33:17
07:33:56
07:34:35
07:35:14
07:35:53
07:36:32
07:37:11
07:37:50
07:38:29
07:39:08
07:39:47
07:40:26
07:41:05
07:41:44
07:42:23
07:43:02
07:43:41
07:44:20
07:44:59
07:45:38
07:46:17
07:46:56
07:47:35
07:48:14
07:48:53
07:49:32
07:50:11
07:50:50
07:51:29
07:52:08
07:52:47
Time



Joint Expeditionary Force Base Little Creek - Norfolk, VA
H-Piles Using a - HPSI 250xl - Vibratory Hammer
May 30, 2013
Installing H-Pile at 21 meters
Removing H-Pile at 21 meters
Installing H-Pile at 21 meters
dB re 1uPa
160.0
150.0
140.0
130.0
120.0
110.0
100.0
LZpeak
LZFmax (RMS)
Time
15:10:00
15:10:44
15:11:28
15:12:12
15:12:56
15:13:40
15:14:24
15:15:08
15:15:52
15:16:36
15:17:20
15:18:04
15:18:48
15:19:32
15:20:16
15:21:00
15:21:44
15:22:28
15:23:12
15:23:56
15:24:40
15:25:24
15:26:08
15:26:52
15:27:36
15:28:20
15:29:04
15:29:48
15:30:32
15:31:16
15:32:00
15:32:44
15:33:28
15:34:12
15:34:56
15:35:40
15:36:24
15:37:08
15:37:52
15:38:36

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ATTACHMENT B

ONE-MINUTE AIRBORNE DATA

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Table B-1. One Minute Airborne Data

Date	Time	Leq	SEL	Lmax	Peak	
28-May-13	10:23:00	62.4	80.2	73.1	92.4	
28-May-13	10:24:00	90	107.8	99.9	111.5	Installing Sheet Pile
28-May-13	10:25:00	94.8	112.5	99.7	111.5	
28-May-13	10:26:00	81.8	99.6	90.9	103.6	
28-May-13	10:27:00	84.7	102.5	88.9	101.1	
28-May-13	10:28:00	75.8	93.5	84.2	96.5	
28-May-13	10:29:00	62.2	80	73.9	92.4	
28-May-13	10:30:00	64.1	81.9	79.1	90.5	
28-May-13	10:51:00	63	80.8	70.4	87	
28-May-13	10:52:00	61.9	79.6	66.3	81.4	
28-May-13	10:53:00	84	101.7	91.4	103.4	Installing Sheet Pile
28-May-13	10:54:00	79.1	96.8	87.2	99	
28-May-13	10:55:00	83.5	101.3	88.8	100	
28-May-13	10:56:00	81.5	99.3	83	95.1	
28-May-13	10:57:00	60.3	78	70.4	85.6	
28-May-13	10:58:00	58.2	75.9	61.8	78.5	
28-May-13	10:59:00	57.2	75	62.6	80.7	
28-May-13	13:50:00	62.5	80.3	72.7	91.3	
28-May-13	13:51:00	61.9	79.6	75.4	92.6	
28-May-13	13:52:00	69.2	87	80.9	93.4	Removing H-Pile
28-May-13	13:53:00	80.5	98.3	82.4	94.2	
28-May-13	13:54:00	79.6	97.4	83.2	95.8	
28-May-13	13:55:00	64	81.8	70.7	82.2	
28-May-13	13:58:00	59.5	77.3	65.9	78.3	
28-May-13	13:59:00	61.2	78.9	66	77.8	
28-May-13	14:00:00	72.5	90.3	83.2	94.1	Installing H-Pile
28-May-13	14:01:00	76.3	94.1	81.7	95.6	
28-May-13	14:02:00	77.7	95.5	84.3	96.6	
28-May-13	14:03:00	79	96.8	84.4	95.6	
28-May-13	14:04:00	62.8	80.6	74.7	93.7	
28-May-13	14:05:00	70.6	88.4	83.5	94.7	
28-May-13	14:06:00	77	94.8	84.7	95.7	Installing H-Pile
28-May-13	14:07:00	78.9	96.7	83.3	93.2	
28-May-13	14:08:00	78.2	96	81	94.1	
28-May-13	14:09:00	76.7	94.5	81.9	94.6	
28-May-13	14:10:00	73.3	91	81.4	93.2	
28-May-13	14:11:00	64.9	82.7	71.9	83.7	
28-May-13	14:12:00	62.1	79.8	66.2	82.7	
28-May-13	14:13:00	60.2	78	68.1	87.2	
28-May-13	14:14:00	58.3	76.1	65.3	76.5	
28-May-13	14:19:00	57.9	75.6	75.6	93.6	

Table B-1. One Minute Airborne Data (cont.)

Date	Time	Leq	SEL	Lmax	Peak	
30-May-13	7:33:00	78.2	95.9	93.8	104.8	
30-May-13	7:34:00	63.9	81.7	70	85.4	
30-May-13	7:35:00	82.7	100.5	100.4	113.3	Installing Sheet Pile
30-May-13	7:36:00	94.6	112.4	98.5	110.4	
30-May-13	7:37:00	87.2	105	94.3	106.4	
30-May-13	7:38:00	63.6	81.4	69	83.9	
30-May-13	7:39:00	64.2	82	73.9	86.3	
30-May-13	7:40:00	80	97.8	85.8	98.6	Installing Sheet Pile
30-May-13	7:41:00	64.3	82	68.3	80.4	
30-May-13	7:42:00	64.3	82.1	69.7	82.5	
30-May-13	7:43:00	91.1	108.9	95.3	107.4	Installing Sheet Pile
30-May-13	7:44:00	84.1	101.8	90.9	102.5	
30-May-13	7:45:00	84	101.8	87.9	99.2	
30-May-13	7:46:00	63.8	81.6	73.6	89.5	
30-May-13	7:47:00	63.8	81.6	69.2	82.5	
30-May-13	7:48:00	64.1	81.9	67.4	78.5	
30-May-13	7:49:00	82.2	100	94.7	105.8	Installing Sheet Pile Two Sheet Piles
30-May-13	7:50:00	81.1	98.8	92.3	104.3	
30-May-13	7:51:00	89.7	107.4	95.9	107.5	
30-May-13	7:52:00	81.7	99.5	87.6	99.6	
30-May-13	7:53:00	69.3	86.2	84.5	103.4	
30-May-13	10:57:00	78	95.8	80.2	91.9	Install H-Pile
30-May-13	10:58:00	72.8	90.6	79.2	92.3	
30-May-13	10:59:00	61.7	79.5	66	86.7	
30-May-13	11:00:00	77.7	95.5	82.4	92.5	Removing H-Pile
30-May-13	11:01:00	68.2	86	79.4	93.4	
30-May-13	11:02:00	63.8	81.6	74.2	86.5	
30-May-13	11:03:00	64.6	82.3	72.5	85	
30-May-13	11:04:00	63.4	81.2	76.5	89.3	
30-May-13	11:05:00	76.6	94.3	79.9	90.9	Install H-Pile
30-May-13	11:06:00	75.9	93.7	78.3	90.3	
30-May-13	11:07:00	71.4	89.2	77.9	91.4	
30-May-13	11:08:00	60.2	78	66.7	78.8	
30-May-13	11:11:00	58.2	76	61.8	79.7	
30-May-13	11:12:00	67.2	85	78.4	93.6	
30-May-13	11:13:00	80.5	98.2	83	94.1	Removing H-Pile
30-May-13	11:14:00	81.2	99	83.5	94.6	
30-May-13	11:15:00	71.3	89.1	82.3	93.8	
30-May-13	11:16:00	70	87.8	84.8	102.6	

Table B-1. One Minute Airborne Data (cont.)

Date	Time	SEL	Lmax	Peak	
30-May-13	11:17:00	76.7	61.8	76.7	
30-May-13	11:18:00	76.1	62.6	75.1	
30-May-13	11:19:00	93.5	79.7	91.2	Install H-Pile
30-May-13	11:20:00	83.1	77.8	97.2	
30-May-13	11:21:00	75.2	59.9	73.8	
30-May-13	15:12:00	79.8	64.5	77.3	
30-May-13	15:13:00	79.4	64.1	79.7	
30-May-13	15:14:00	81.8	74.3	89.7	Installing H-Pile
30-May-13	15:15:00	86.3	71.9	86.7	
30-May-13	15:16:00	86.9	70.6	85.7	
30-May-13	15:17:00	87.5	71	85.7	
30-May-13	15:18:00	88.3	74.4	89.4	
30-May-13	15:19:00	86.4	73.7	87.3	
30-May-13	15:20:00	89	79.6	90.3	
30-May-13	15:21:00	86.1	75.2	88.8	
30-May-13	15:22:00	79.6	64.1	76.2	
30-May-13	15:23:00	78.7	65.5	77.9	
30-May-13	15:24:00	86.9	73.9	90.1	Installing H-Pile
30-May-13	15:25:00	91.3	75.3	89.1	
30-May-13	15:26:00	85.1	79.9	92.4	
30-May-13	15:27:00	81.6	74.8	90.8	
30-May-13	15:28:00	79.7	65.4	79.2	
30-May-13	15:29:00	80.3	69.5	92.2	
30-May-13	15:30:00	89.2	75.7	89.7	Removing H-Pile
30-May-13	15:31:00	87.4	75.9	89.1	
30-May-13	15:32:00	81.5	68.1	79.9	
30-May-13	15:33:00	79.4	63.6	78.2	
30-May-13	15:34:00	86.9	74	89.9	Installing H-Pile
30-May-13	15:35:00	90.6	74	87.9	
30-May-13	15:36:00	91	74.6	88	
30-May-13	15:37:00	91.1	74.5	87.6	
30-May-13	15:38:00	85.4	78.7	90.5	
30-May-13	15:39:00	82.3	71.5	83.5	
30-May-13	15:40:00	80.1	65.2	77.4	
30-May-13	15:41:00	82.2	71.6	82.1	
30-May-13	15:42:00	83.8	71.7	84	
30-May-13	15:43:00	86.8	81.9	94.3	
30-May-13	15:44:00	80.4	70.7	83.9	
30-May-13	15:45:00	77.7	68.9	91.8	

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