APPENDIX F

Noise and Vibration Technical Study

MEMORANDUM

Date: 24 May, 2021

To: Geoff Reilly, Senior Associate Environmental Planner, WRA, Inc.

From: Lisa Luo, Environmental Engineer II, Baseline Environmental Consulting

Subject: **Noise and Vibration Technical Study, Sheila Tank Replacement Project, Pacifica, California.**

Baseline Environmental Consulting (Baseline) has prepared this Noise and Vibration Technical Study to evaluate the potential noise and vibration impacts associated with implementation of the proposed Sheila Tank Replacement Project (project) located at 1141 Sheila Lane in Pacifica, California. The proposed project includes replacing an existing redwood water tank with a partially buried, prestressed concrete tank, with a capacity of 0.6 million gallons and site improvements. The purpose of this study is to support environmental review of the proposed project under the California Environmental Quality Act (CEQA). This technical memorandum includes an overview of fundamental noise and vibration concepts, a description of the existing noise conditions in the project vicinity, and an analysis of the potential noise and vibration impacts associated with construction and operation of the proposed project.

NOISE AND VIBRATION CONCEPTS

Noise Concepts and Terminology

Noise is commonly defined as unwanted sound that annoys or disturbs people and can have an adverse psychological or physiological effect on human health. Sound is measured in decibels (dB), which is a logarithmic scale. Decibels describe the purely physical intensity of sound based on changes in air pressure, but they cannot accurately describe sound as perceived by the human ear since the human ear is only capable of hearing sound within a limited frequency range. For this reason, a frequency-dependent weighting system is used and monitoring results are reported in A-weighted decibels (dBA).

Groundborne Vibration Concepts and Terminology

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Several different methods are used to quantify vibration. Typically, groundborne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration. Sensitive receptors to vibration include structures (especially older masonry structures), people (especially residents, the elderly, and sick), and vibration-sensitive equipment. Vibration amplitudes are usually

expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous peak of the vibration signal. PPV is appropriate for evaluating potential damage to buildings, but it is not suitable for evaluating human response to vibration because it takes the human body time to respond to vibration signals. The response of the human body to vibration is dependent on the average amplitude of a vibration. The RMS of a signal is the average of the squared amplitude of the signal and is more appropriate for evaluating human response to vibration. PPV is normally described in units of inches per second (in/sec), and RMS is also often described in vibration decibels (VdB).

EXISTING SETTING

Regulatory Thresholds

City of Pacifica General Plan

Chapter 9 of the City of Pacifica General Plan[1] contains the following policy that is applicable to the proposed project:

> NO-I-6 Construction Noise. Continue to limit hours for certain construction and demolition work to reduce construction-related noises.

City of Pacifica Municipal Code

Section 5-10.03 of the Pacifica Municipal Code prohibits the use of pile drivers, hammers, and similar equipment between 8 p.m. and 7 a.m.

Ambient Noise Environment

The primary source of noise in the vicinity of the project site is traffic on Sheila Lane. To quantify the current existing ambient noise levels, Baseline conducted a noise monitoring survey in the vicinity of the project site. The survey was conducted on February 18, 2021, and consisted of three 15-minute noise measurements. All the measurements were collected using a Casella CEL-633C1 Type 1 sound level meter (SLM). The SLM was calibrated before the noise monitoring survey to ensure accuracy. The measurement locations are included in **Appendix A**. The summary of the ambient noise level measurements is provided in **Table 1**.

[1] City of Pacifica, 2014. Draft City of Pacifica General Plan, Chapter 9 Noise. March.

Table 1: Summary of Ambient Noise Measurements

Location ID and Description	Date and Time Collected	Noise Levels (dBA Leq)	Apparent Noise Sources
ST-1, representing the noise environment of the closest residences along Sheila Lane	2/18/2021 12:39 p.m. - 12:54 p.m.	50.0	Traffic from Sheila Lane, dog barking, birds chipping, truck noise from downhill
ST-2, representing the noise environment of the closest residences along Alvarado Avenue	2/18/2021 1:18 p.m. – 1:33 p.m.	41.7	Traffic from Alvarado Avenue, nearby residences, dog barking, plane
ST-3, representing the noise environment of the closest residences along Duran Court	2/18/2021 1:48 p.m. – 2:03 p.m.	36.9	Birds chipping

Notes:
Leq – The average A-weighted noise level during the measurement period.
Sound measurement reports are included in **Appendix A**.

Sensitive Receptors

Some land uses are considered more sensitive to ambient noise levels than others because of the amount of noise exposure (in terms of both exposure duration and insulation from noise) and the types of activities typically involved for those land uses. The City of Pacifica General Plan defines noise-sensitive land uses as residences, schools, churches, and hospitals.[2] The project site is surrounded by residences. The closest residences are located along Sheila Lane, Alvarado Avenue, and Duran Court.

According to the Federal Transit Administration (FTA), residences are also considered vibration-sensitive receptors. In addition, extreme vibration could cause minor cosmetic or substantial building damage. Historic buildings are generally more susceptible to vibration impacts depending on the condition of the buildings. The closest building to the proposed project is a residence located along Sheila Lane about 25 feet from the excavation boundary of the project site. There are no historic buildings in the project vicinity.

TECHNICAL ANALYSIS

Thresholds of Significance

Construction Noise Thresholds

The Pacifica Municipal Code does not have a quantitative threshold for evaluating potential impacts from construction noise. Because a 10-dBA increase in noise is subjectively perceived

[2] City of Pacifica, 2014. Draft City of Pacifica General Plan, Chapter 9 Noise. March.

as an approximate doubling in loudness, this analysis considers a 10-dBA increase in noise from project construction activities as a substantial increase in the ambient noise level.

Construction Vibration Thresholds

As shown in **Table 2** and **Table 3**, FTA has developed maximum vibration thresholds to evaluate potential impacts from construction vibration on people and structures. Construction vibrations that equal to or exceed the maximum vibration thresholds could result in potential impacts. The vibration thresholds for potential disturbances to residences located adjacent to the project site are summarized in **Table 2**. In this analysis, the "infrequent events" threshold (80 VdB) is applied for construction equipment based on the nature of proposed construction activities. The vibration thresholds for potential damage to structures are summarized in **Table 3**. In this analysis, the vibration threshold of 0.3 in/sec PPV for engineered concrete and masonry buildings is used to represent the building types adjacent to and near the project site based on the apparent age of the buildings.

Table 2: Vibration Thresholds for Human Impacts

Human Impact	Maximum RMS (VdB)		
	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Nighttime disturbance of residence where people normally sleep	72	75	80

Notes:
[a] More than 70 vibration events of the same kind per day or vibration generated by a long freight train.
[b] Between 30 and 70 vibration events of the same kind per day.
[c] Fewer than 30 vibration events of the same kind per day.
Source: Federal Transit Administration, 2018. Transit Noise and Vibration Impact Assessment Manual. FTA Report No.0123. September.

Table 3: Vibration Thresholds for Structural Impacts

Building Category	Maximum PPV (in/sec)	Maximum RMS (VdB)
Reinforced-concrete, steel or timber (no plaster)	0.5	102
Engineered concrete and masonry (no plaster)	0.3	98
Non-engineered timber and masonry buildings	0.2	94
Buildings extremely susceptible to vibration damage	0.12	90

Source: Federal Transit Administration, 2018. Transit Noise and Vibration Impact Assessment Manual. FTA Report No.0123. September.

Analysis

Construction Noise

Noise from Construction Equipment
The primary noise impacts from construction of the proposed project would occur from noise generated by the operation of construction equipment on the project site. Construction activities would temporarily increase noise levels in the vicinity of the project site. Construction noise levels would vary from day-to-day, depending on the number and condition of the equipment being used, the types and duration of activity being performed, the distance between the noise source and the receptor, and the presence or absence of barriers, if any, between the noise source and receptor.

In accordance with FTA guidance, potential construction noise impacts were evaluated by quantifying the noise levels associated with the simultaneous operation of the two noisiest pieces of equipment expected to be used during each construction phase.[3] The types of construction equipment that would be used on the project site and the associated noise calculations are included in **Appendix B**. This analysis assumed demolition, retaining wall construction and site preparation, and tank construction would occur at the existing tank location, while the backfill and grading, as well as access road paving would occur in the center of the project site. Noise levels at the closest residences along Sheila Lane, Alvarado Avenue, and Duran Court were estimated using the SoundPLAN Essential model (version 4.1). Seamless digital elevation model datasets were incorporated in the SoundPLAN Essential model to characterize elevations in the project vicinity. The estimated noise levels at the closest residences in the project vicinity are summarize in **Table 4** and a copy of the model results is included in **Appendix C**.

Table 4: Potential Noise Impacts from Project Construction Equipment

Construction Phase	Noise Levels at Closest Residences (dBA Leq)		
	Sheila Lane	Alvarado Avenue	Duran Court
Demolition	**67.0**	**69.7**	43.5
Retaining Wall Construction and Site Prep	**66.0**	**68.7**	42.5
Tank Construction	**66.0**	**68.7**	42.5
Backfill and Grading	**66.8**	**65.0**	**52.3**
Access Road Paving	**67.8**	**66.0**	**53.3**
Existing Noise Levels (dBA Leq)	50.0	41.7	36.9

Note:
Bolded numbers indicate potential noise impacts that exceed the ambient noise levels by 10 dBA.
Noise calculations are included in **Appendix B** and a copy of the model results is included in **Appendix C**.

[3] Federal Transit Administration (FTA), 2018. Transit Noise and Vibration Impact Assessment Manual, FTA Report No.0123, September.

As shown in **Table 4**, construction activities have the potential to exceed the existing noise levels by 10 dBA during all phases at the closest residences along Sheila Lane and Alvarado Avenue. Along Duran Court, construction activities would not exceed the existing ambient noise levels by 10 dBA at the closest residences during the demolition, retaining wall construction and site preparation, and tank construction phases; however, construction activities have the potential to exceed the existing noise levels by 10 dBA during the backfill and grading and access road paving phases. Construction activities would be required to comply with Section 5-10.03 of the Pacifica Municipal Code, which prohibits the use of pile drivers, hammers, and similar equipment during nighttime hours between 8 p.m. and 7 a.m. This requirement would prevent the disturbance of sleep for the neighboring residences.

Noise from Increased Traffic Flow

During construction, secondary sources of noise would include increased traffic flow from the transport of workers, equipment, and materials to the project site. As a worst-case assumption, construction of the proposed project could generate up to 21 truck trips per day during backfill and grading.[4] Noise levels from truck traffic were estimated using the Federal Highway Administration's TNM Version 2.5 model and a copy of the traffic model outputs is included in **Appendix D**. It was assumed that trucks would access and exit the project site along Sheila Lane. The construction truck trips could generate noise levels of up to approximately 50.9 dBA Leq at the closest residence along Shelia Lane. Because the existing noise levels along Sheila Lane are 50 dBA Leq, noise from increased truck traffic during construction would not have the potential to exceed the ambient noise levels by 10 dBA.

Construction Vibration

Construction activities can result in varying degrees of ground vibration, depending on the equipment, activity, and soil conditions. The buffer distances that would potentially result in vibration levels at or above the FTA vibration thresholds for disturbances to residences and damage to buildings are summarize in **Table 5**.

[4] Soil and concrete export and import volumes are provided by the project applicant.

Table 5: Buffer Distances for Potential Vibration Impacts from Project Construction Equipment

Equipment	Buffer Distance for Potential Vibration Impacts (feet)	
	Human Impacts	Structural Impacts
Vibratory Roller	73	20
Large Bulldozer	43	11
Caisson Drilling	43	11
Loaded Trucks	40	10
Small Bulldozer	5	1

Notes:
Equipment list and supporting calculations are included in **Appendix B**.
The following FTA thresholds were used to calculate the buffer distances from construction equipment:

1) People – Maximum vibration threshold of 80 VdB for nighttime disturbance of sleeping residences from infrequent construction events (**Table 2**).
2) Structures – Maximum vibration threshold of 0.3 in/sec PPV for engineered concrete and masonry buildings (**Table 3**).

As shown in **Table 5**, the construction equipment that would generate the largest buffer distance from vibration levels is a vibratory roller. Vibration from a vibratory roller could exceed the 80-VdB threshold at residences located within 73 feet. As discussed above, the closest residence is located about 25 feet from the excavation boundary. Therefore, construction activities could generate vibration levels with the potential to disturb adjacent residences sleeping during the nighttime. However, construction activities would be limited to daytime hours and be required to comply with Section 5-10.03 of the Pacifica Municipal Code, which prohibits the use of pile drivers, hammers, and similar equipment during nighttime hours between 8 p.m. and 7 a.m. Therefore, construction activities would not generate vibration with the potential to disturb residences sleeping during the nighttime.

As shown in **Table 5**, vibration from a vibratory roller could exceed the 0.3 in/sec PPV threshold at buildings located within 20 feet. All of the buildings surrounding the project site would be located outside of the 20-foot buffer where a vibratory roller could exceed the 0.3 in/sec PPV threshold. Therefore, construction activities would not generate vibration with the potential to damage adjacent buildings.

Operational Noise and Vibration

During operation, the proposed project may require inspection and cleaning at a frequency of around once every 5 to 10 years and after major seismic events. The proposed project may also require recoating every 20 years if the proposed tank would be coated for aesthetic purposes.[5] Based on the frequency and the type of work, no operation-period impact would occur.

[5] Konecny Kaitlyn, Staff Civil Engineer at Brown and Caldwell, 2021. Email correspondence with Reida Khan, Assistant Environmental Planner II at WRA, Inc. February 24.

Airport or Private Airstrip

The proposed project would not introduce new residents or users to the project site. Therefore, the proposed project would not expose people in the project area to excessive noise from any public use airport or private airstrip.

Noise Control Measures

Construction activities could generate noise that would exceed the existing noise levels by 10 dBA at the closest residences. Therefore, the proposed project should incorporate noise control measures during construction. Note that because high-noise-generating construction activities often generate high vibration levels, noise reduction measures would also help to reduce vibration impacts.

Construction Control Measures

Notification
Two weeks prior to the commencement of construction, notification must be provided to surrounding residences disclosing the construction schedule, including the various types of activities that would be occurring throughout the duration of the construction period.

Complaint Tracking
Prior to the issuance of construction-related permit, the applicant shall submit to the City for review and approval a set of procedures for responding to and tracking complaints pertaining to construction noise. These measures shall include: (1) a sign posted on-site describing noise complaint procedures and a complaint hotline number; (2) designation of an on-site construction compliance and enforcement manager for the project; (3) protocols of receiving, responding to, and tracking received complaints; and (4) maintenance of a complaint log that records received complaints and how complaints were addressed, which shall be submitted to the City for review upon the City's request.

Best Management Practices
Noise reduction measures shall be implemented to reduce noise impacts related to construction. Noise reduction measures include, but are not limited to, the following:

1. Equipment and trucks used for project construction shall use the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically-attenuating shields or shrouds), wherever feasible.

2. Except as provided herein, impact tools (e.g., jack hammers and pavement breakers) used for project construction shall be hydraulically or electrically powered to avoid noise

associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used, if such jackets are commercially available; this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever such procedures are available and consistent with required construction procedures.

3. Stationary noise sources shall be located as far from nearby receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures to provide equivalent noise reduction.

CONCLUSIONS

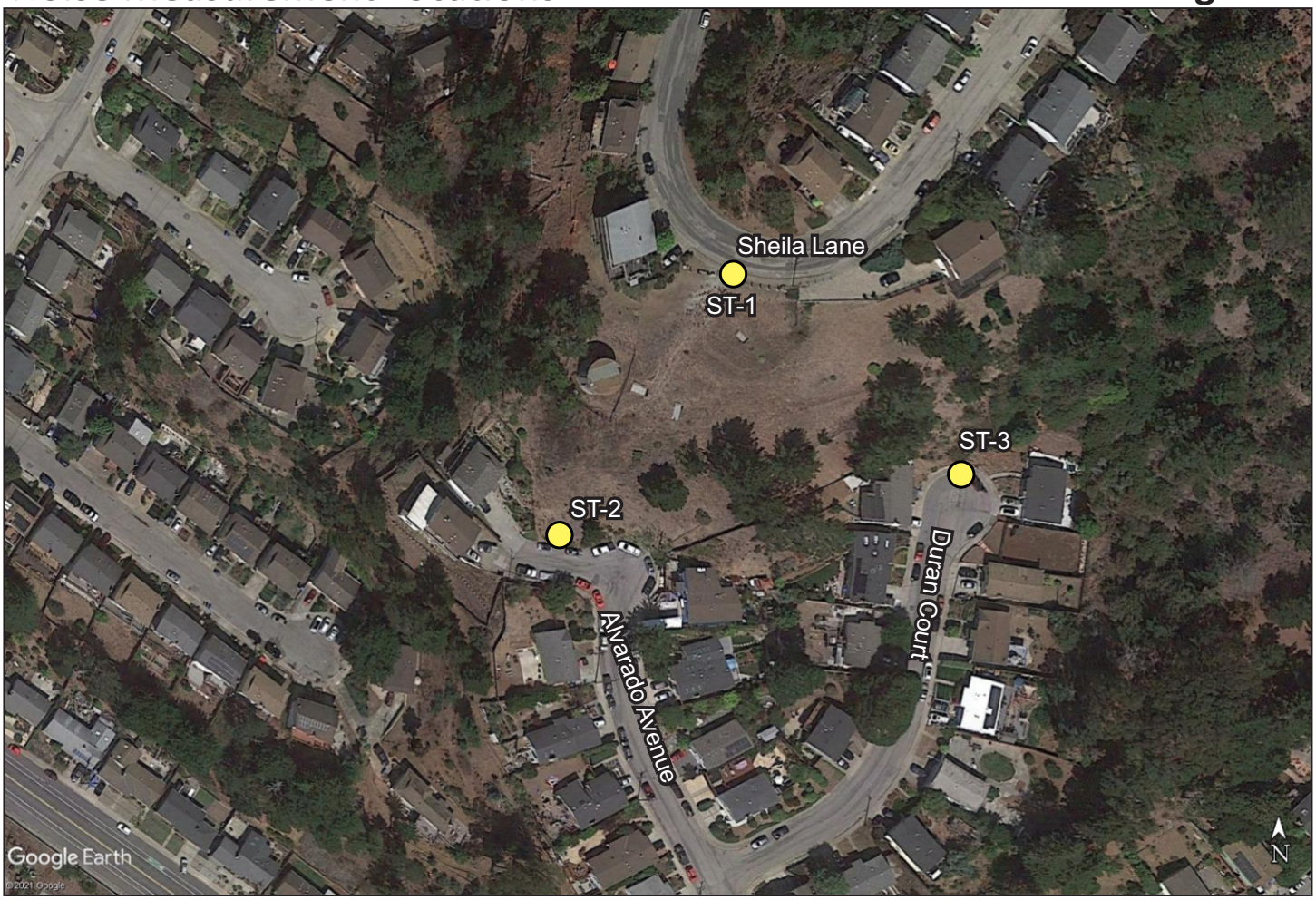
Based on the estimated noise levels that could be generated by construction activities, implementation of the proposed project could impact people at nearby residences and control measures are required to reduce the impacts. Based on the estimated vibration levels that could be generated by construction activities, implementation of the proposed project is not expected to disturb nearby residences or cause damage to nearby buildings. Operation of the proposed project is not expected to result in any noise or vibration impacts. The proposed project would not expose people to excessive noise impacts from any public use airport or private airstrip.

APPENDIX A

Noise Measurements

Noise Measurement Locations

Figure 1



Base: Google Aerial Map, 2021.

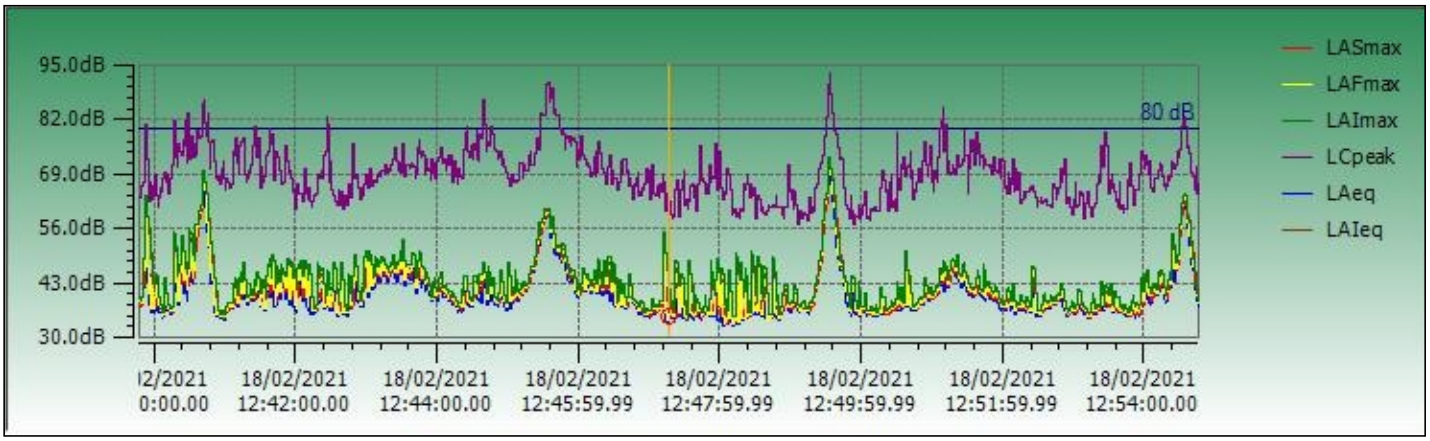
Legend

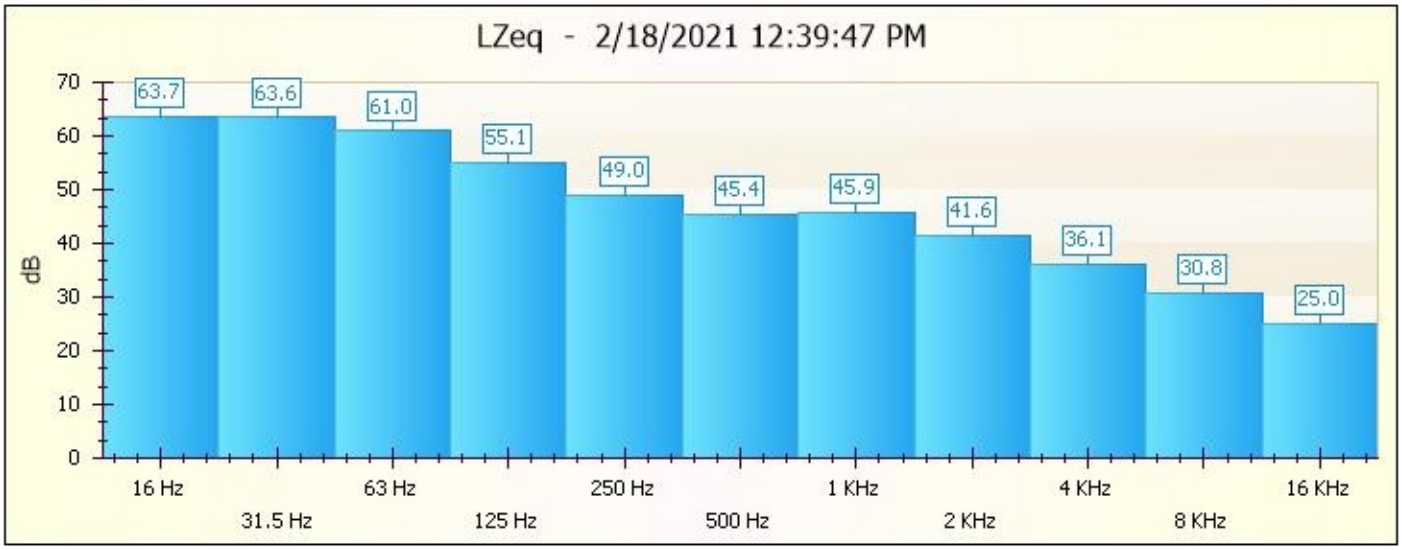
ST-1 ○ Short-term noise measurement locations

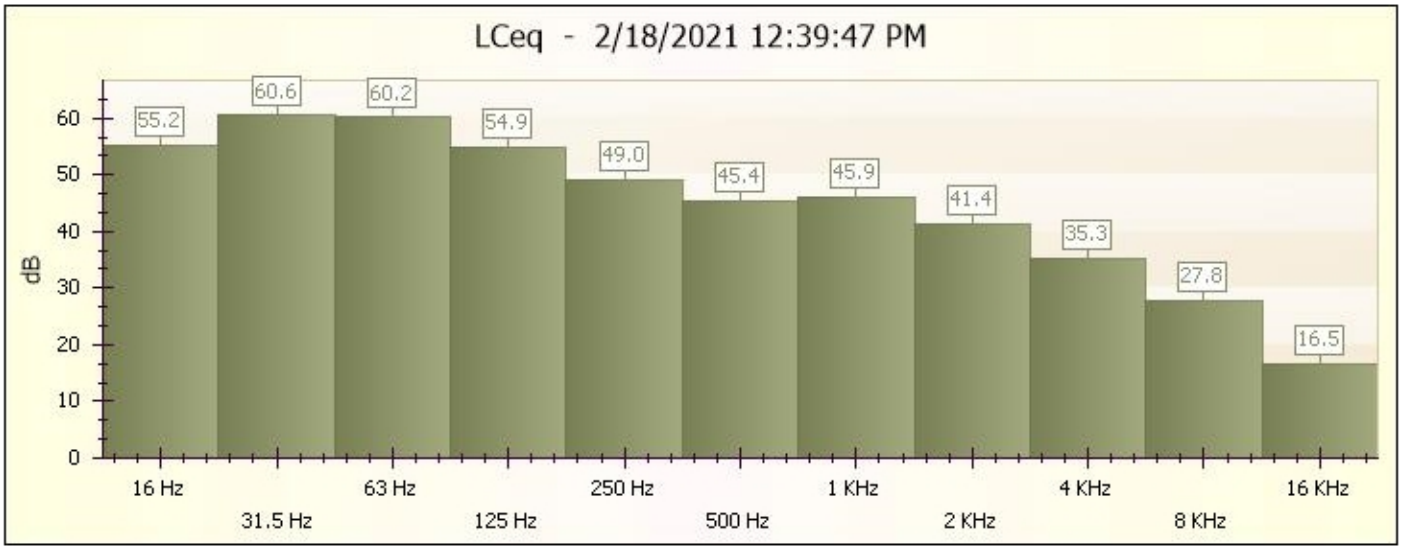
Sheila Tank Replacement Project
Pacifica

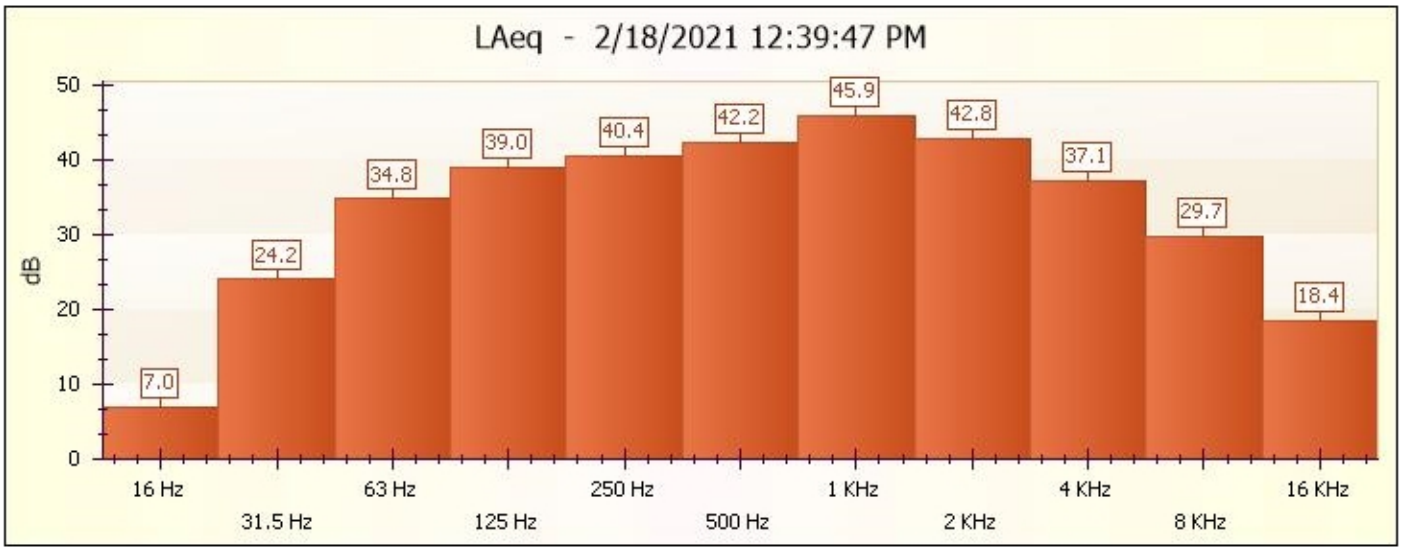
BASELINE ENVIRONMENTAL CONSULTING

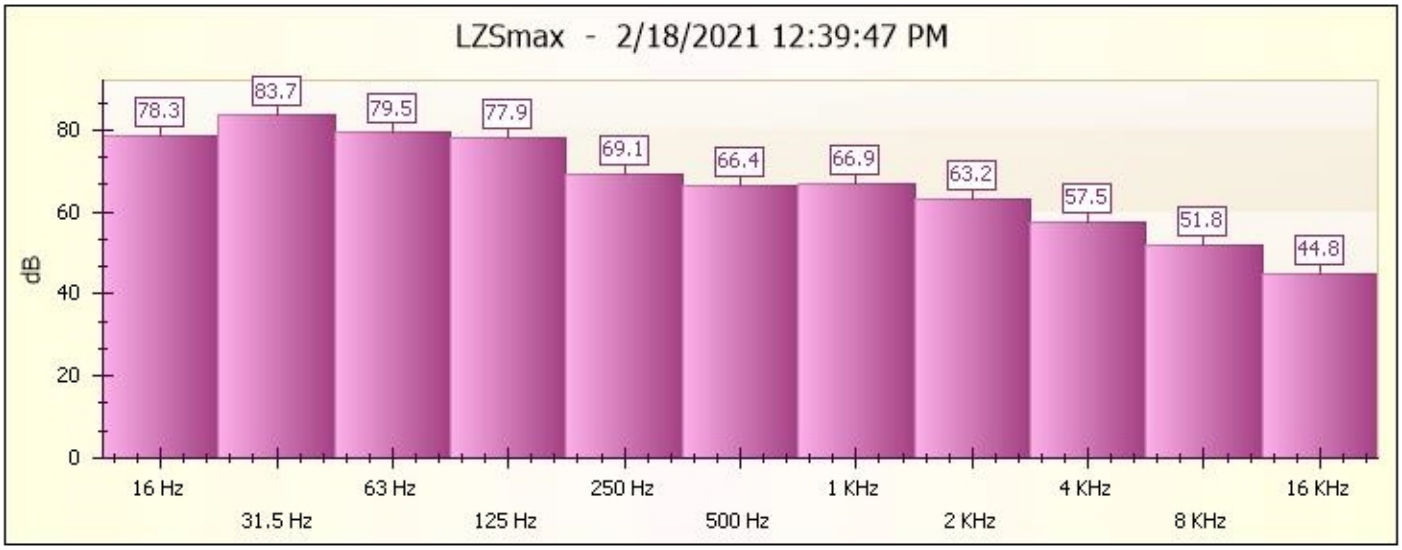
Instrument Model	**CEL-633C**
Serial Number	2145334
Run Number	2
Site	FA01770
Location	2/22/21
Person	Unallocated
Process	Unallocated
Start Date & Time	2/18/2021 12:39:47 PM
Duration	00:15:00 HH:MM:SS
Lavg Q=5	44.8 dB
LZpeak with Time	98.7 dB (2/18/2021 12:51:10 PM)
TWA Q=5 (Projected)	44.8 dB
LASmax with Time	70.9 dB (2/18/2021 12:49:34 PM)
LASmin with Time	33.1 dB (2/18/2021 12:48:12 PM)
Notes	
LAeq	50 dB
Response	Random
End Date & Time	2/18/2021 12:54:47 PM
Pause Duration	00:00:00 HH:MM:SS
Calibration (Before) Date	2/18/2021 12:36:04 PM
Calibration (Before) SPL	114 dB
Calibration (After) Date	
Calibration Drift	-1.5 dB
Overload	No
Battery Low	No
Result	Cumulative

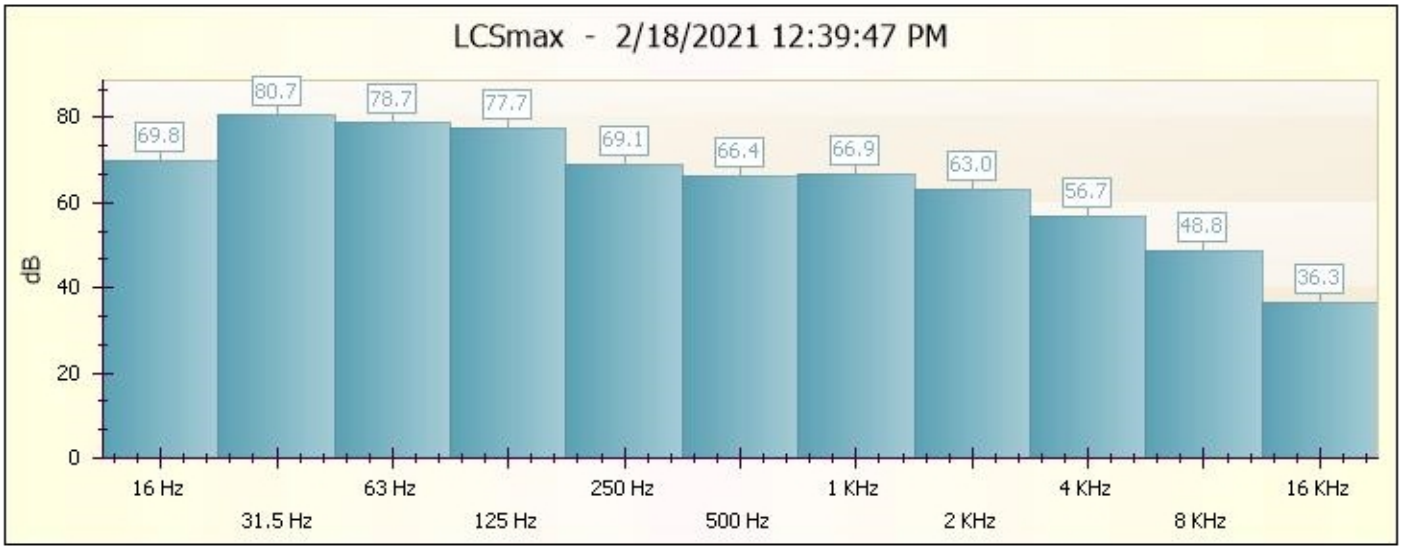


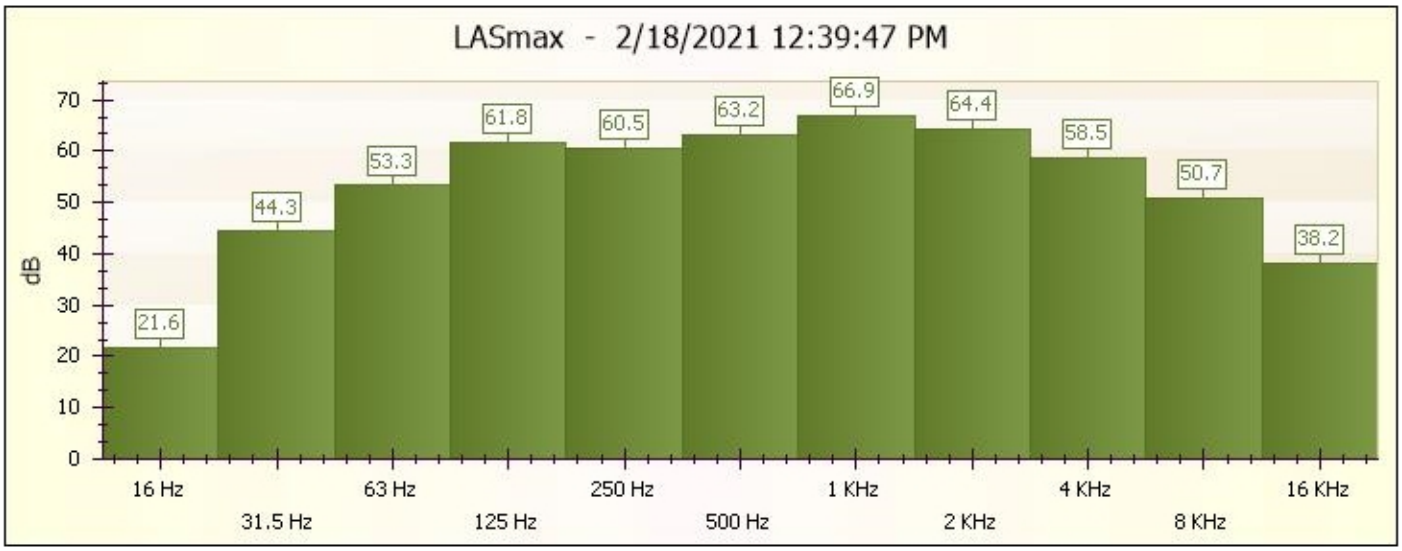

LZeq - 2/18/2021 12:39:47 PM
dB
70
60
50
40
30
20
10
0
63.7
63.6
61.0
55.1
49.0
45.4
45.9
41.6
36.1
30.8
25.0
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LCeq - 2/18/2021 12:39:47 PM
dB
60
50
40
30
20
10
0
55.2
60.6
60.2
54.9
49.0
45.4
45.9
41.4
35.3
27.8
16.5
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

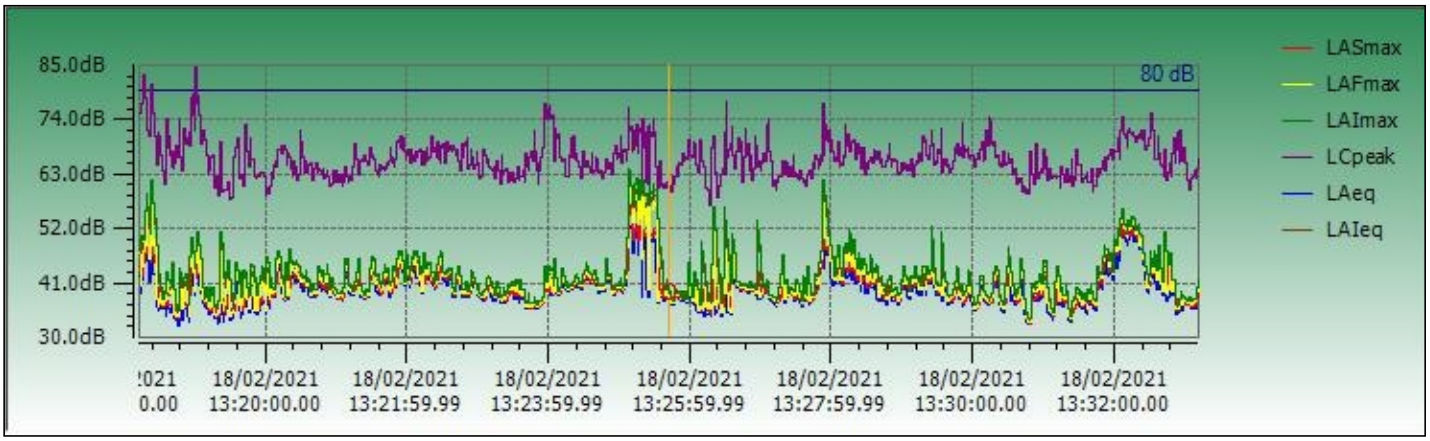

LAeq - 2/18/2021 12:39:47 PM
dB
50
40
30
20
10
0
7.0
24.2
34.8
39.0
40.4
42.2
45.9
42.8
37.1
29.7
18.4
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

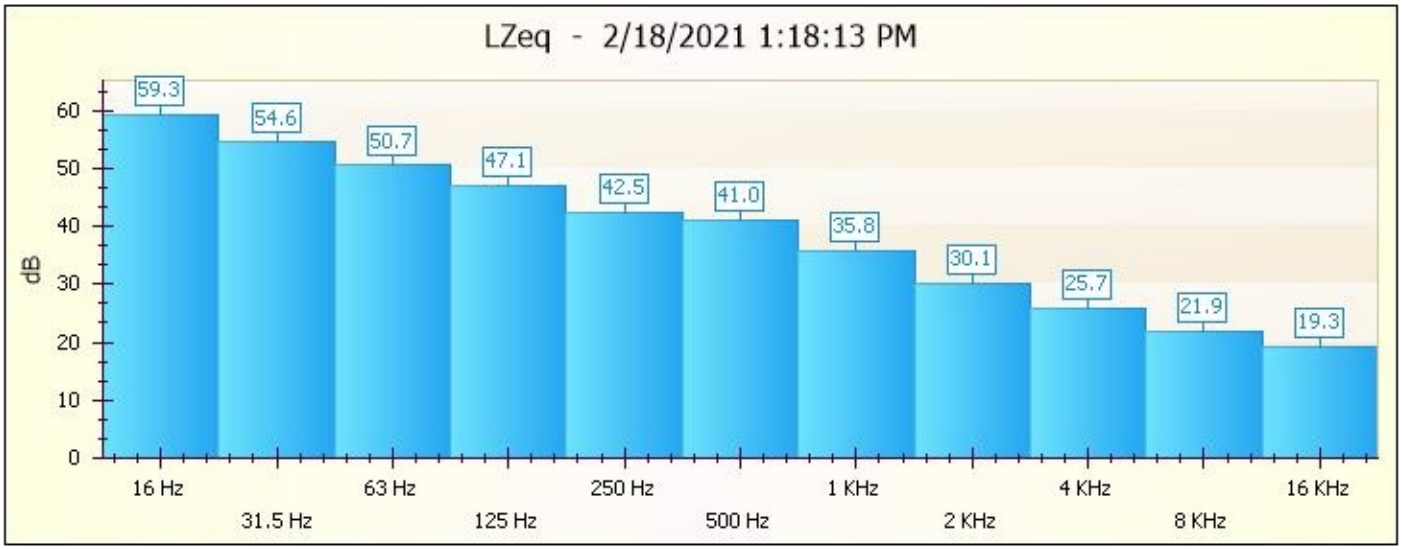

LZSmax - 2/18/2021 12:39:47 PM
dB
0
20
40
60
80
78.3
83.7
79.5
77.9
69.1
66.4
66.9
63.2
57.5
51.8
44.8
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

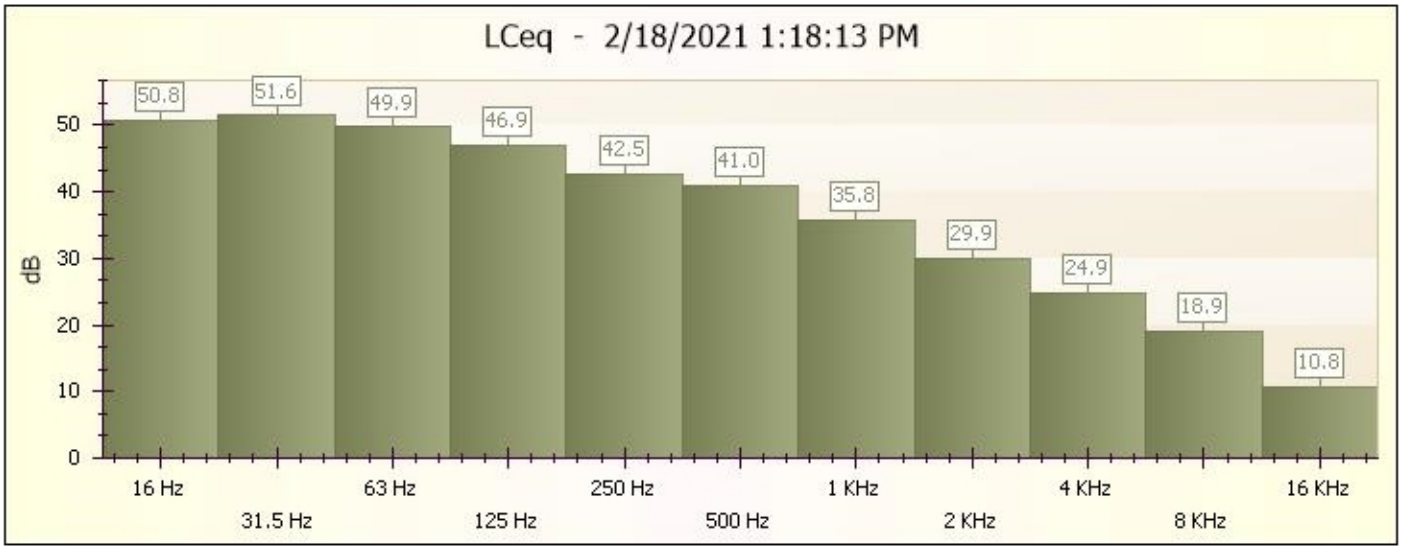

LCSmax - 2/18/2021 12:39:47 PM
dB
0
20
40
60
80
69.8
80.7
78.7
77.7
69.1
66.4
66.9
63.0
56.7
48.8
36.3
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

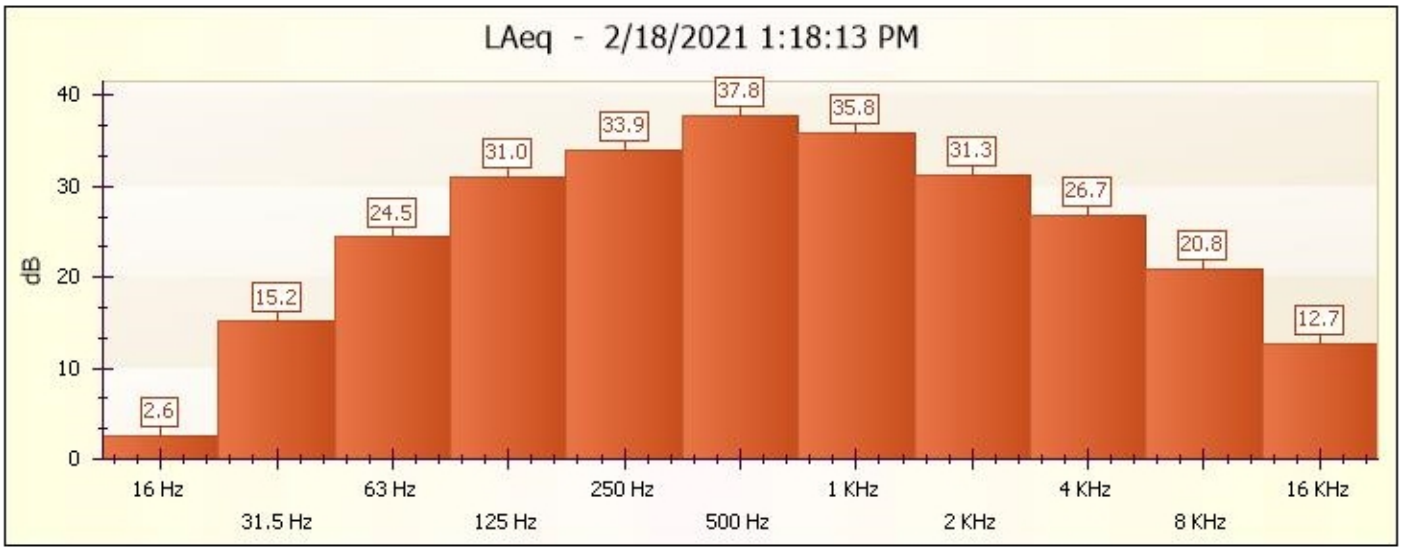

LASmax - 2/18/2021 12:39:47 PM
dB
0
10
20
30
40
50
60
70
21.6
44.3
53.3
61.8
60.5
63.2
66.9
64.4
58.5
50.7
38.2
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

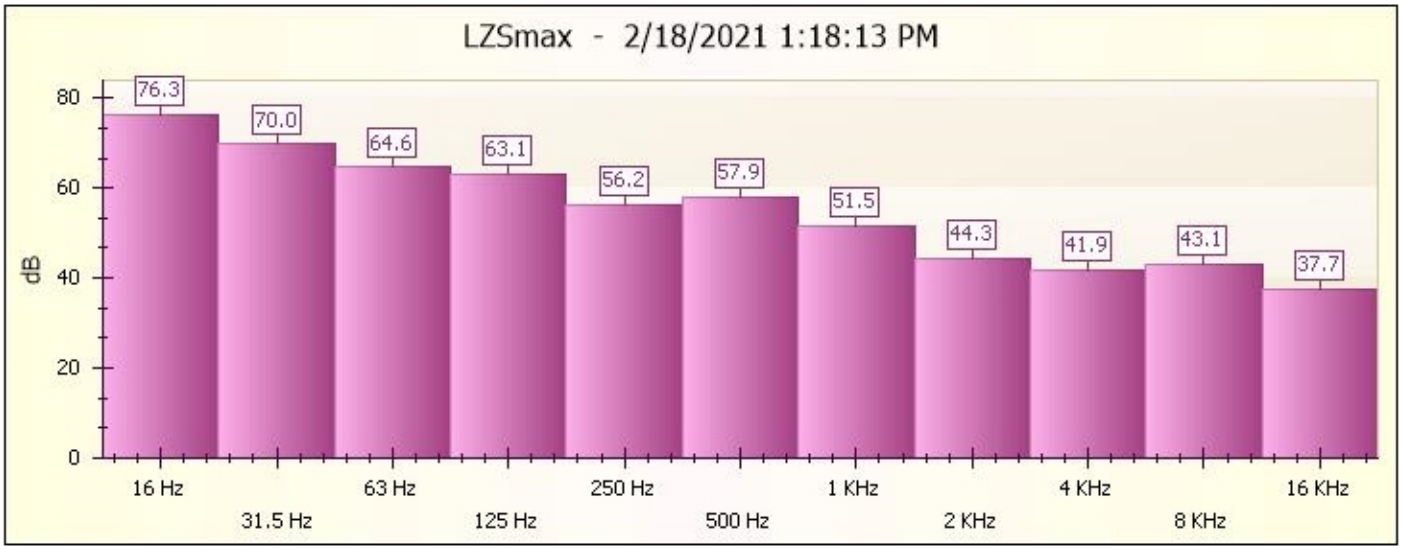
Instrument Model	**CEL-633C**
Serial Number	2145334
Run Number	3
Site	FA01770
Location	2/22/21
Person	Unallocated
Process	Unallocated
Start Date & Time	2/18/2021 1:18:13 PM
Duration	00:15:00 HH:MM:SS
Lavg Q=5	40.8 dB
LZpeak with Time	97.6 dB (2/18/2021 1:19:01 PM)
TWA Q=5 (Projected)	40.8 dB
LASmax with Time	56.7 dB (2/18/2021 1:25:09 PM)
LASmin with Time	32.6 dB (2/18/2021 1:30:49 PM)
Notes	
LAeq	41.7 dB
Response	Random
End Date & Time	2/18/2021 1:33:13 PM
Pause Duration	00:00:00 HH:MM:SS
Calibration (Before) Date	2/18/2021 12:36:04 PM
Calibration (Before) SPL	114 dB
Calibration (After) Date	
Calibration Drift	-1.5 dB
Overload	No
Battery Low	No
Result	Cumulative

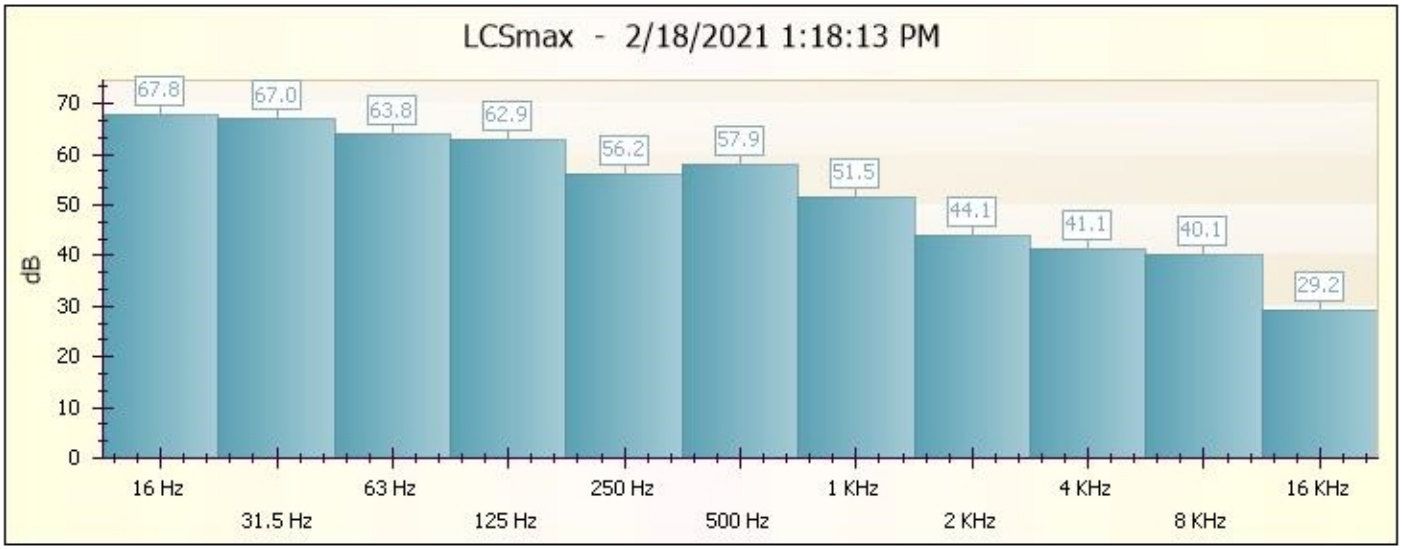


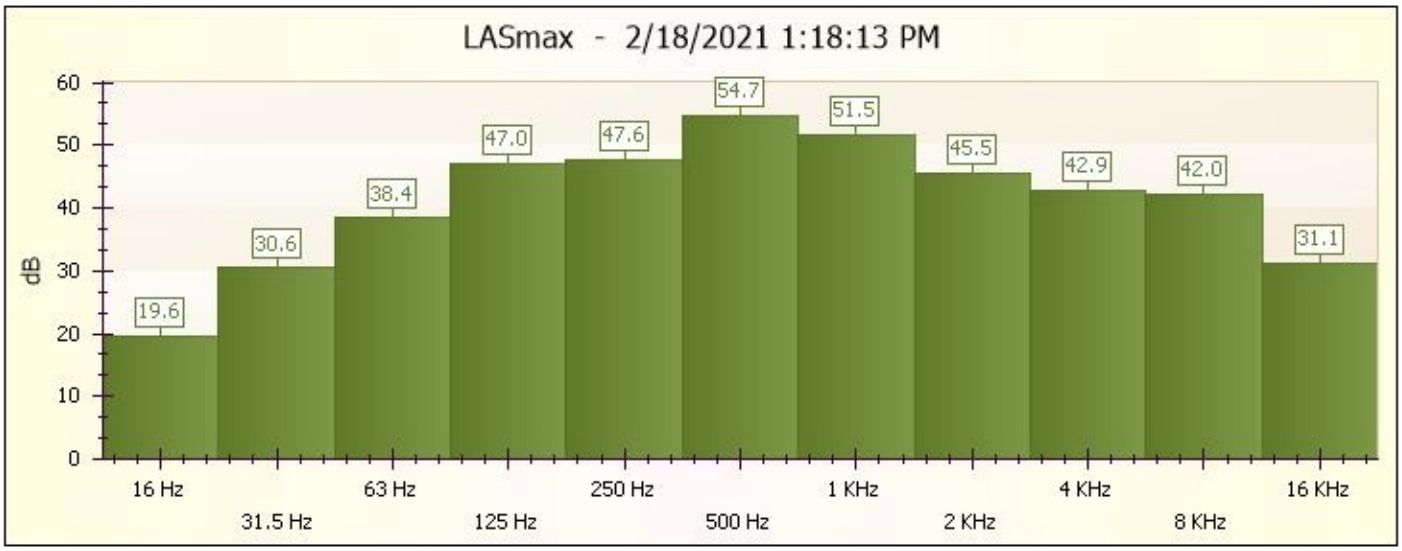

LZeq - 2/18/2021 1:18:13 PM
dB
59.3
54.6
50.7
47.1
42.5
41.0
35.8
30.1
25.7
21.9
19.3
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LCeq - 2/18/2021 1:18:13 PM
dB
50.8
51.6
49.9
46.9
42.5
41.0
35.8
29.9
24.9
18.9
10.8
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

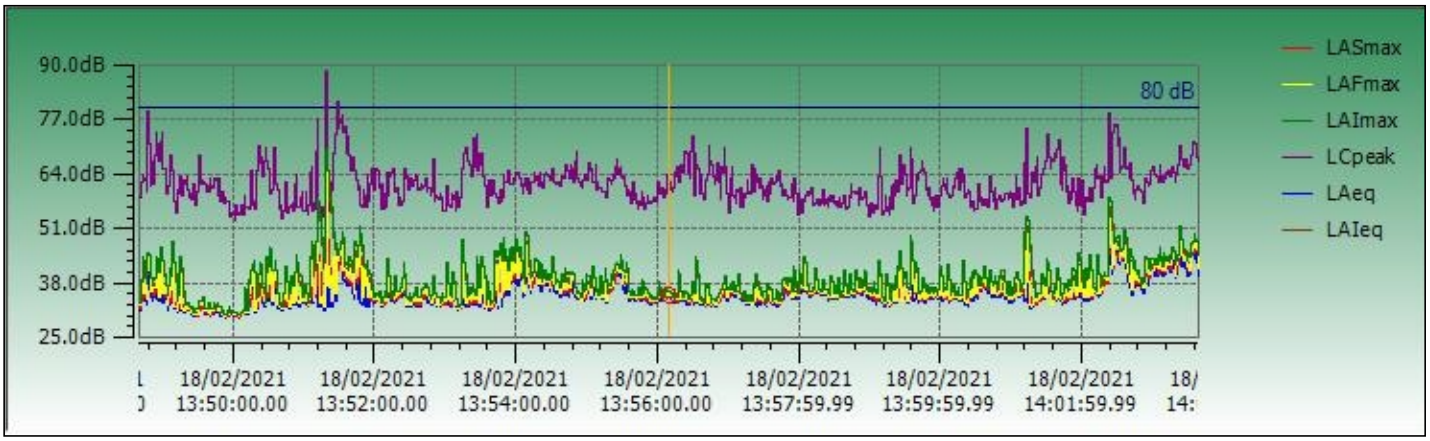

LAeq - 2/18/2021 1:18:13 PM
dB
2.6
15.2
24.5
31.0
33.9
37.8
35.8
31.3
26.7
20.8
12.7
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

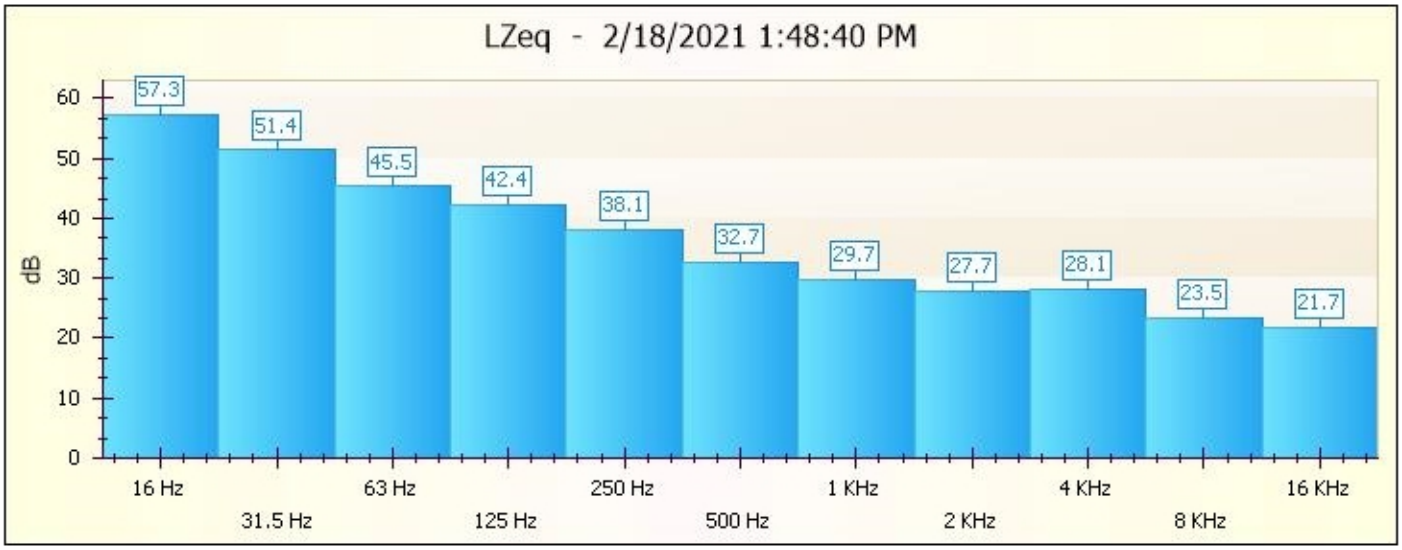

LZSmax - 2/18/2021 1:18:13 PM
dB
80
60
40
20
0
76.3
70.0
64.6
63.1
56.2
57.9
51.5
44.3
41.9
43.1
37.7
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

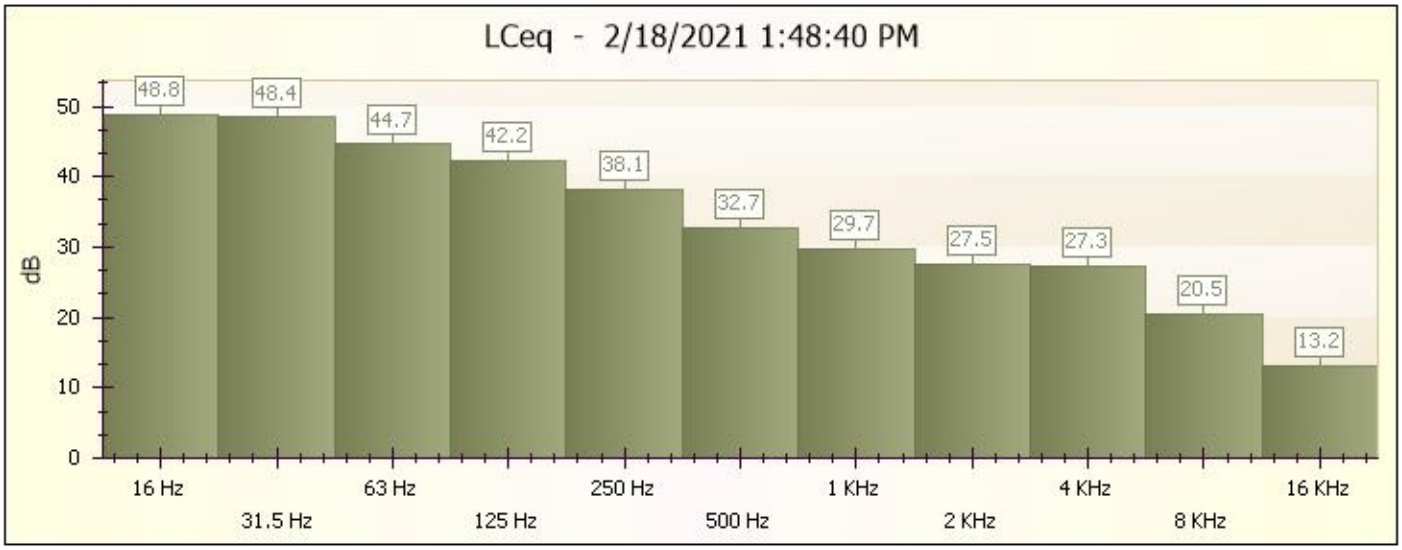

LCSmax - 2/18/2021 1:18:13 PM
dB
70
60
50
40
30
20
10
0
67.8
67.0
63.8
62.9
56.2
57.9
51.5
44.1
41.1
40.1
29.2
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

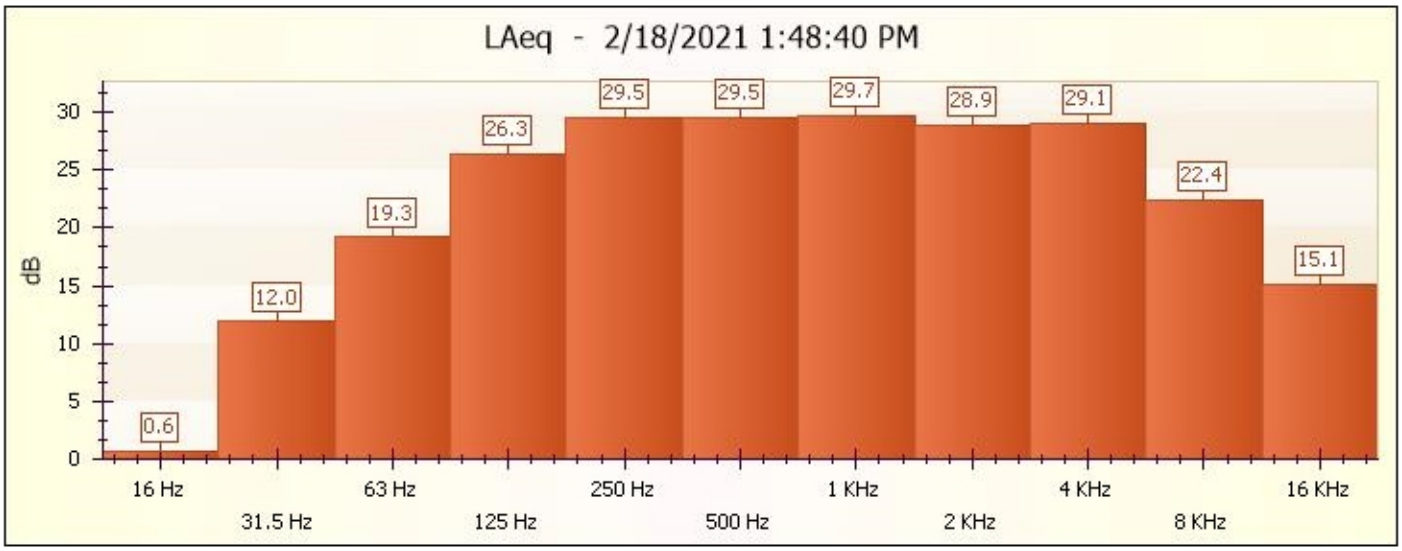

LASmax - 2/18/2021 1:18:13 PM
dB
60
50
40
30
20
10
0
19.6
30.6
38.4
47.0
47.6
54.7
51.5
45.5
42.9
42.0
31.1
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

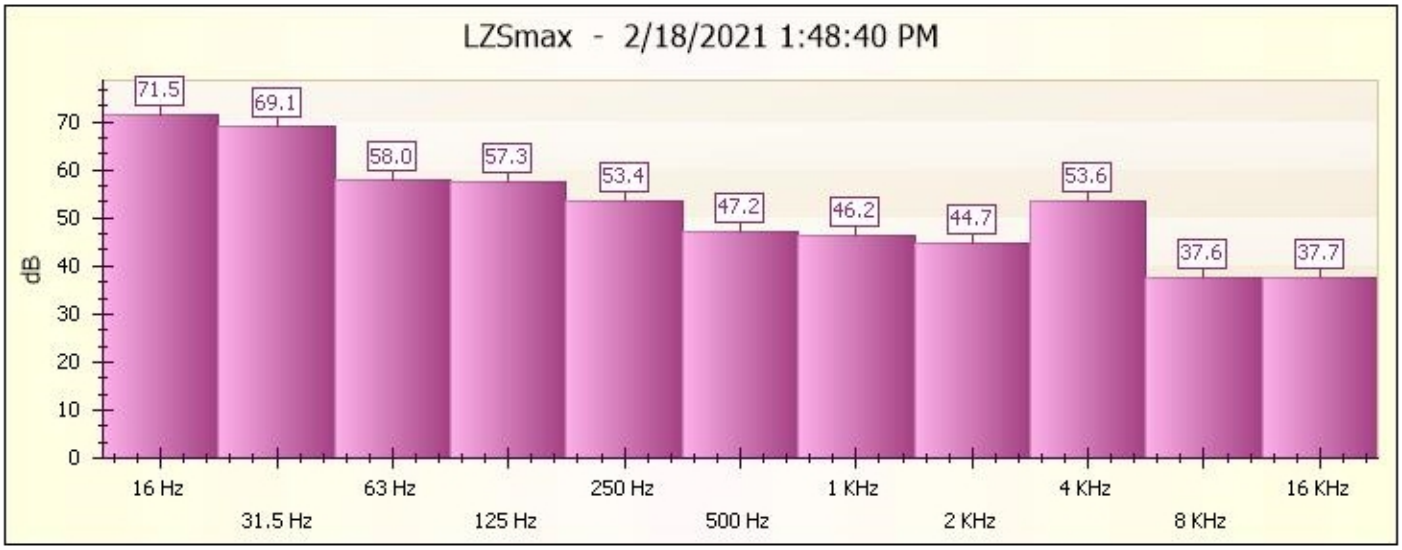
Instrument Model	**CEL-633C**
Serial Number	2145334
Run Number	4
Site	FA01770
Location	2/22/21
Person	Unallocated
Process	Unallocated
Start Date & Time	2/18/2021 1:48:40 PM
Duration	00:15:00 HH:MM:SS
Lavg Q=5	36 dB
LZpeak with Time	96.4 dB (2/18/2021 1:48:48 PM)
TWA Q=5 (Projected)	36 dB
LASmax with Time	55.9 dB (2/18/2021 1:51:18 PM)
LASmin with Time	29.8 dB (2/18/2021 1:49:54 PM)
Notes	
LAeq	36.9 dB
Response	Random
End Date & Time	2/18/2021 2:03:40 PM
Pause Duration	00:00:00 HH:MM:SS
Calibration (Before) Date	2/18/2021 12:36:04 PM
Calibration (Before) SPL	114 dB
Calibration (After) Date	
Calibration Drift	-1.5 dB
Overload	No
Battery Low	No
Result	Cumulative

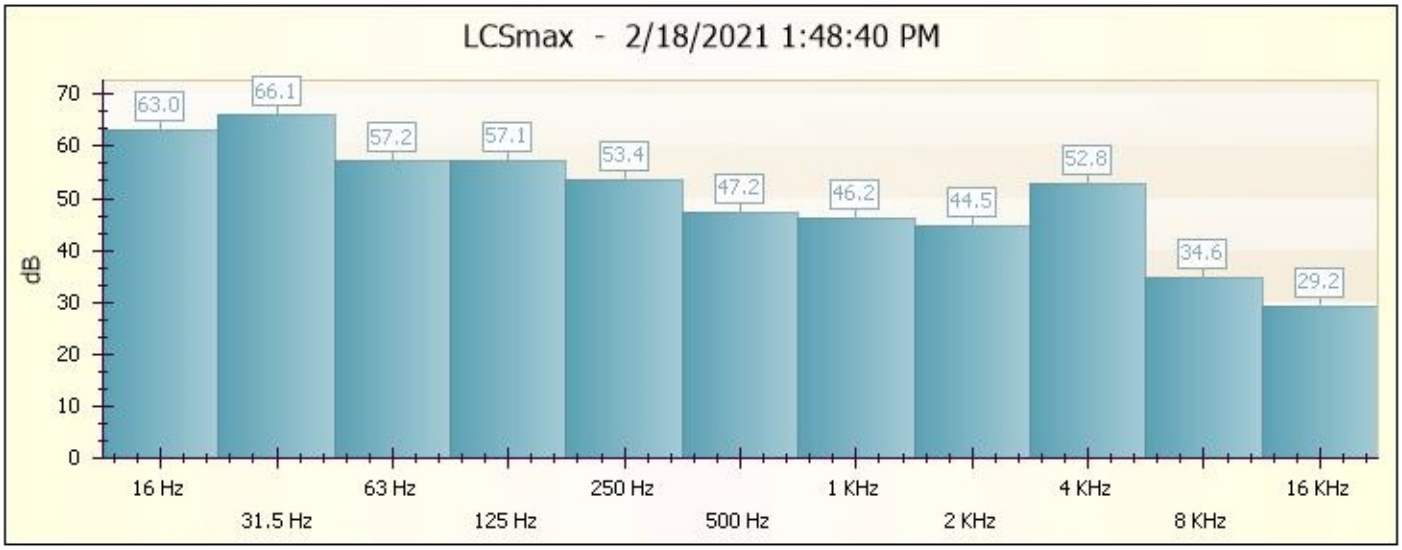


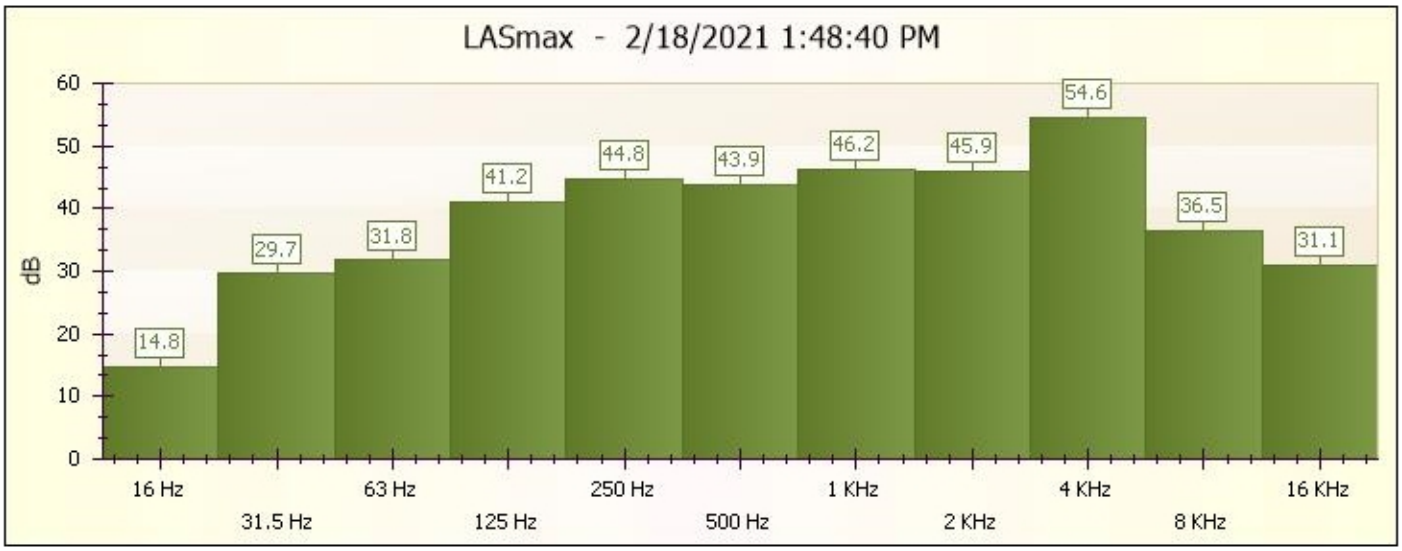

LZeq - 2/18/2021 1:48:40 PM
dB
60
50
40
30
20
10
0
57.3
51.4
45.5
42.4
38.1
32.7
29.7
27.7
28.1
23.5
21.7
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LCeq - 2/18/2021 1:48:40 PM
dB
50
40
30
20
10
0
48.8
48.4
44.7
42.2
38.1
32.7
29.7
27.5
27.3
20.5
13.2
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LAeq - 2/18/2021 1:48:40 PM
dB
30
25
20
15
10
5
0
0.6
12.0
19.3
26.3
29.5
29.5
29.7
28.9
29.1
22.4
15.1
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LZSmax - 2/18/2021 1:48:40 PM
dB
71.5
69.1
58.0
57.3
53.4
47.2
46.2
44.7
53.6
37.6
37.7
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LCSmax - 2/18/2021 1:48:40 PM
dB
63.0
66.1
57.2
57.1
53.4
47.2
46.2
44.5
52.8
34.6
29.2
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz


LASmax - 2/18/2021 1:48:40 PM
dB
14.8
29.7
31.8
41.2
44.8
43.9
46.2
45.9
54.6
36.5
31.1
16 Hz
31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
4 KHz
8 KHz
16 KHz

FIELD LOG

Project name:	Sheila Tank Replacement	Project no.:	21202-01
Date:	2/18/2021	Duration:	15 minutes
Weather conditions:	Temp: 14°	Wind:	S 6 mph
	Humidity: 52%	Pressure:	30.36 inHg
Location ID:	ST- 1		
Site personnel:	Lisa Luo		

Time	Field Activities
12:40	start
12:41	a car passing by from downhill.
	dog barking occasionally.
	music from a house nearby
12:46	noise from downhill truck.
	a car passing by from downhill.
12:47	birds sound.
12:48	birds.
	door shutting.
12:50	a ~~car~~ pass by ~~small truck~~ pickup from downhill.
12:55	a car passing by from uphill

RESULTS

Leq =	50.0		dBA	L10 =	46	dBA
Lmax =	70.9	12:49:34	dBA	L90 =	35	dBA
Lmin =	33.1	12:48:12	dBA	L99 =	33	dBA

FIELDLOG.XLS (10/21/2016)

FIELD LOG

Project name:	Sheila Tank Replacement	Project no.:	21202-01
Date:	2/18/2021	Duration:	15 minutes
Weather conditions:	Temp: 14°	Wind:	WSW 6 mph.
	Humidity: 56%	Pressure:	30.36 in Hg
Location ID:	ST- 2		
Site personnel:	Lisa Luo		

Time	Field Activities
1:19	start
	a car started its engine
1:22	noise from a nearby house.
1:26	dog barking.
1:27	a car started its engine.
	mostly very quiet. compared to ST-1
1:32	occasional noise from far beyond.
1:33	a plane passing by.

RESULTS

Leq =	41.7		dBA	L10 =	43.5	dBA
Lmax =	56.7	13:25:09	dBA	L90 =	35.5	dBA
Lmin =	32.6	13:30:49	dBA	L99 =	33.0	dBA

BASELINE ENVIRONMENTAL CONSULTING

5900 Hollis Street, Suite D · Emeryville, CA 94608 · (510) 420-8686

FIELD LOG

Project name:	Sheila Tank Replacement	Project no.:	21202-01
Date:	2/18/2021	Duration:	15 minutes
Weather conditions:	Temp: 13°	Wind:	WSW 6 mph
	Humidity: 62%	Pressure:	30.35 inHg
Location ID:	ST- 3		
Site personnel:	Lisa Luo		

Time	Field Activities
1:49	start
1:51	birds chipping.
	crow.
1:53	birds chipping
	quiet
	noise from far beyond.
	This site doesn't have direct line of site to the tank. However, the adjacent receptors have direct line of site from their backyards. The noise measurement is considered similar to noise at receptors' backyards.

RESULTS						
Leq =	36.9		dBA	L10 =	39.5	dBA
Lmax =	55.9	13:51:18	dBA	L90 =	32.0	dBA
Lmin =	29.8	13:49:54	dBA	L99 =	30.0	dBA

BASELINE ENVIRONMENTAL CONSULTING

5900 Hollis Street, Suite D · Emeryville, CA 94608 · (510) 420-8686

APPENDIX B

Project-Related Noise and Vibration Calculations

Construction Information and Calculations

Project Name: Sheila Tank Replacement

Phase	Construction Sequence	Activity	Start Date	End Date	Duration (Work Days)	Equipment	Quantity	Acoustical Usage Factor	Spec Lmax	Actual Measured Lmax	Leq	Two noisiest
Demolition	1	Temporary Site Access	9/1/2021	9/28/2021	20	Graders	1	40	85	N/A	81	
						Dozer	1	40	85	82	81	
						Hydraulic Excavator	1	40	85	81	81	
	2	Demolition	9/29/2021	10/26/2021	20	Truck Tractor, Backhoe Loader	1	40	84	N/A	80	
						Hydraulic Excavator	1	40	85	81	81	
						Backhoe Loader	1	40	80	78	76	
						Hydraulic Hammer	1	50	85	N/A	82	
						Concrete Saw	1	20	90	90	83	85
Retaining Wall and Site Prep	3	Temporary Retaining Wall	10/27/2021	11/23/2021	20	Dump Trailer	2	40	84	76	80	
						Backhoe Loader	1	40	80	78	76	
	4	Excavation and Site Prep	11/24/2021	12/23/2021	20	Grader	1	40	85	N/A	81	
						Sheepsfoot Roller	1	20	85	80	78	
						Dozer	1	40	85	82	81	
						Flatbed Trailer	1	40	84	74	80	
						Dump Trailer	6	40	84	76	80	
						Hydraulic crane	1	16	85	81	77	
						Truck Tractor	1	40	84	N/A	80	84
						Aerial Lifts (Man Lift)	1	20	85	75	78	
						Air Compressors	2	40	80	78	76	
						Cranes	1	16	85	81	77	
						Forklifts	1					
	5	Tank Construction - w/foundation	12/27/2021	5/16/2022	100	Generator Sets	2	50	82	81	79	
						Other Construction Equipment (Prestressing Machine)	1	50	85	N/A	82	
						Other Construction Equipment (Waterblaster)	1					
						Pressure Washers	1					
						Pumps	1	50	77	81	74	
						Rough Terrain Forklifts	1					
Tank Construction	6	Tank Leak Testing and Disinfection	5/17/2022	5/30/2022	10	Water Tank Trailer, 5,000 gallon, Flatbed Truck Gas 1.5 ton	1	40	84	74	80	
	7	Electrical Work	12/27/2021	1/11/2022	10	Truck Tractor, Backhoe Loader	1	40	84	N/A	80	
	8	Tank Startup and Testing	5/17/2022	5/19/2022	2	Water Tank Trailer, 5,000 gallon, Flatbed Truck Gas 1.5 ton	1	40	84	74	80	
						Skid Steer	1	40	80	79	76	
						Backhoe Loader	1	40	80	78	76	
	9	Landscaping	5/19/2022	6/1/2022	10	Loader	1	40	80	79	76	
						Truck Tractor	1	40	84	N/A	80	
	10	Demobilization	6/1/2022	6/6/2022	3	Truck Tractor	1	40	84	N/A	80	
	11	Piping Connections	6/6/2022	6/9/2022	4	Welder Gas Engine 300 amp, 50' Air Hoses, Air Compressor 365 cfm	1	40	80	78	76	84
Backfill and Grading	12	Backfill and Grading	6/9/2022	6/15/2022	5	Grader	1	40	85	N/A	81	
						Sheepsfoot Roller	1	20	85	80	78	
						Roller Vibratory	1	20	85	80	78	
						Dozer	1	40	85	82	81	
						Flatbed Trailer	1	40	84	74	80	
						Dump Trailer	1	40	84	74	80	
						Truck Tractor	1	40	84	N/A	80	84
Access Road Paving	13	Fencing and Gates	6/15/2022	6/21/2022	5	Manual fence post auger gas, flat bed truck gas 1.5 ton	1	40	84	74	80	
	14	Driveway	6/21/2022	7/5/2022	10	Grader	1	40	85	N/A	81	
						Concrete pump	1	50	77	81	74	
						Concrete saw	1	20	90	90	83	
						Flatbed truck gas 3 ton	1	40	84	74	80	
						Gas engine vibrator	1	50	85	N/A	82	
						Hydraulic Crane	1	16	85	81	77	85

Combined noise levels are calculated based on the following equation
L=10*log(10^(L1/10)+10^(L2/10))
L is the combined noise level
L1 is the noise level for one noisiest piece of equipment
L2 is the noise level for the other noisiest piece of equipment

Vibration Calculations

Equipment	Reference RMS at 25 Feet (VdB)	Requied Buffer Distance -Sleep Threshold 80 VdB (feet)	Reference PPV at 25 Feet (in/sec)	Requied Buffer Distance - Building Damage Threshold 0.3 PPV (feet)
	25	80	25	0.3
Vibratory Roller	94	73	0.21	20
Large bulldozer	87	43	0.089	11
Caisson drilling	87	43	0.089	11
Loaded trucks	86	40	0.076	10
Small bulldozer	58	5	0.003	1

Based on vibration levels at 25 feet, the following propagation adjustment was applied to estimate buffer distance required to reduce vibration levels at a receptor to 0.3 PPV:

PPV2 = PPV1 x (D1/D2)^1.5

Where: PPV1 is the reference vibration level at a specified distance.
PPV2 is the calculated vibration level.
D1 is the reference distance (in this case 25 feet).
D2 is the distance from the equipment to the receiver.

Based on vibration levels at 25 feet, the following propagation adjustment (FTA, 2018) was applied to estimate buffer distance required to reduce RMS vibration levels at a receptor to 80 VdB (residential receptor).

RMS2 = RMS1 – 30 Log10 (D2/D1)

Where: RMS1is the reference vibration level at a specified distance.
RMS2 is the calculated vibration level.
D1 is the reference distance (in this case 25 feet).
D2 is the distance from the equipment to the receiver.

Source: PPV and RMS vibration levels at 25 feet from the FTA (2018) Transit Noise and Vibration Impact Assessment.

APPENDIX C

SoundPLAN Essential Model Outputs

Sheila Tank Project

Noise levels from demolition of 85 dBA Leq.

Signs and symbols

- Receiver
- Demolition of 85 dBA Leq
- Level tables

1 : 901

0 4.5 9 18 27 36 m

Receiver list

No.	Receiver name	Building side	Floor	Limit Day dB(A)	Level Day dB(A)	Conflict Day dB
1	Closest residences along Sheila Lane	-	1.Fl	-	67.0	-
2	Closest residences along Alvarado Avenue	-	1.Fl	-	69.7	-
3	Closest residences along Duran Court	-	1.Fl	-	43.5	-

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
				63	125	250	500	1	2	4	Cwall	CI	CT
			dB(A)	Hz	Hz	Hz	Hz	kHz	kHz	kHz	dB(A)	dB(A)	dB(A)
noise source of 85 dBA Leq	Lw/unit	Day	116.7	100.0	98.0	106.0	109.0	113.0	110.0	104.0	-	-	-

Sheila Tank Project

Noise levels from retaining wall and site prep, and tank construction of 84 dBA Leq.

Signs and symbols

- Receiver
- Retaining Wall, Site Prep, and Tank Construction of 84 dBA Leq
- Level tables

1 : 901

0 4.5 9 18 27 36 m

Receiver list

No.	Receiver name	Building side	Floor	Limit Day dB(A)	Level Day dB(A)	Conflict Day dB
1	Closest residences along Sheila Lane	-	1.Fl	-	66.0	-
2	Closest residences along Alvarado Avenue	-	1.Fl	-	68.7	-
3	Closest residences along Duran Court	-	1.Fl	-	42.5	-

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
			dB(A)	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	Cwall dB(A)	CI dB(A)	CT dB(A)
noise source of 84 dBA Leq	Lw/unit	Day	115.7	99.0	97.0	105.0	108.0	112.0	109.0	103.0	-	-	-

Receiver list

No.	Receiver name	Building side	Floor	Limit Day dB(A)	Level Day dB(A)	Conflict Day dB
1	Closest residences along Sheila Lane	-	1.Fl	-	66.8	-
2	Closest residences along Alvarado Avenue	-	1.Fl	-	65.0	-
3	Closest residences along Duran Court	-	1.Fl	-	52.3	-

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
				63	125	250	500	1	2	4	Cwall	CI	CT
			dB(A)	Hz	Hz	Hz	Hz	kHz	kHz	kHz	dB(A)	dB(A)	dB(A)
noise source of 84 dBA Leq	Lw/unit	Day	115.7	99.0	97.0	105.0	108.0	112.0	109.0	103.0	-	-	-

Sheila Tank Project

Noise levels from access road paving of 85 dBA Leq.

Signs and symbols

- Receiver
- Access Road Paving of 85 dBA Leq
- Level tables

1 : 901

0 4.5 9 18 27 36 m

Receiver list

No.	Receiver name	Building side	Floor	Limit Day dB(A)	Level Day dB(A)	Conflict Day dB
1	Closest residences along Sheila Lane	-	1.Fl	-	67.8	-
2	Closest residences along Alvarado Avenue	-	1.Fl	-	66.0	-
3	Closest residences along Duran Court	-	1.Fl	-	53.3	-

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
				63	125	250	500	1	2	4	Cwall	CI	CT
			dB(A)	Hz	Hz	Hz	Hz	kHz	kHz	kHz	dB(A)	dB(A)	dB(A)
noise source of 85 dBA Leq	Lw/unit	Day	116.7	100.0	98.0	106.0	109.0	113.0	110.0	104.0	-	-	-

APPENDIX D

Traffic Noise Model Outputs

Construction Truck Trips

	Import (cy)	Export (cy)	Material	Total truck trips	Total Days	Average Truck trips per day	Average Truck trips per hour
Retaining Wall and Site Prep		3089		386	40	10	1
Tank Construction			Concrete	700	119	6	1
Backfill and Grading	858			107	5	21	3

*Assume a truck can haul 16 cubic yard.

Assume that trucks would access and exit the project site along Sheila Lane.

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

construction trucks during backfill and grading

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	0.0
Average automobile speed (mph):	0.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	3.0
Average heavy truck speed (mph):	20.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	50.9