APPENDIX L

Environmental Noise Assessment and Prediction
Report Hawaiian Memorial Park
Kāne'ohe, O'ahu, Hawai'i – May 2018

Prepared by: Censeo AV + Acoustics

ENVIRONMENTAL NOISE ASSESSMENT AND PREDICTION REPORT

HAWAIIAN MEMORIAL PARK

KANEOHE, OAHU, HAWAII

May 2018

Prepared For:

HHF Planners

Prepared By:

CENSEO AV+ACOUSTICS

www.CENSEO.design

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1 Executive Summary

CENSEO AV+Acoustics completed a preliminary environmental noise assessment detailing the impact of the proposed Hawaiian Memorial Park (HMP) expansion on the surrounding community.

Potential noise impacts are most likely at residences near the proposed expanded area. Impacts are most likely during project construction. Noise impacts from future operations and future traffic levels are unlikely.

Construction noise mitigation could include spacing out noisy construction tasks or placing sound-absorbing barriers in between noisy equipment and nearby residences. Without implementing any construction noise mitigation methodologies, noise impacts due to construction may be likely. However, by incorporating reasonable mitigation measures during construction, the potential for noise impacts may be greatly reduced.

2 Introduction

An expansion to Hawaiian Memorial Park (HMP) has been proposed. CENSEO AV+Acoustics visited Hawaiian Memorial Park and the surrounding neighborhood on November 2, 2017, and November 9, 2017, to observe existing conditions and conduct ambient noise level measurements at the location of the future park expansion. This environmental noise assessment summarizes our measurement results, site observations, and recommendations. The purpose of this environmental noise assessment is to estimate the noise resulting from the construction and operation of the expanded cemetery area, identify potential noise impacts in the surrounding area, and make recommendations to mitigate those impacts.

3 Project Location Description

Hawaiian Memorial Park (HMP) is a cemetery located in Kane'ohe, Hawaii. Due to an anticipated increase in demand, HMP has proposed expanding the cemetery grounds. A map of the existing and proposed HMP grounds is shown in Figure 1.

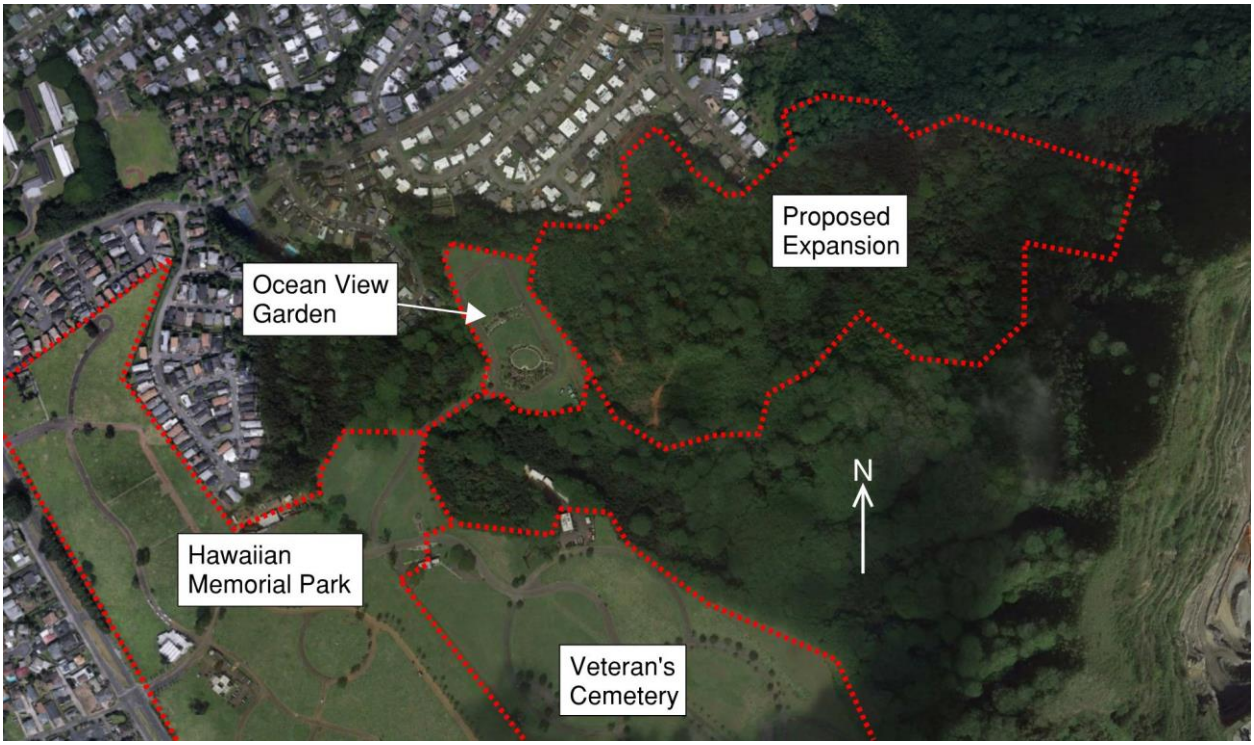

Figure 1: Hawaiian Memorial Park Site Map

The proposed expansion is currently planned to be adjacent to the Ocean View Garden section of the park. The area surrounding the park is mainly residential. In some cases, residences are adjacent to the proposed park expansion. For reference, the direct line-of sight distances between the park and representative residences are provided in Table 1 below.

Table 1: List of Noise Sensitive Receivers

Receiver	Receiver Type	Primary Project Noise Source	Distance to Nearest Potential Noise Source
45-171 Ohaha Place	Single Family Residence	Construction	30 ft
45-420 Ohaha Street	Single Family Residence	Construction	75 ft
45-458 Lipalu Street	Single Family Residence	Construction	30 ft
45-501 Halekou Road	Single Family Residence	Traffic Increase	30 ft
Ocean View Garden	Open Space	Construction	70 ft

These noise sensitive receivers are the basis for the ambient noise measurement locations.

3.1 Park Normal Operations

Normal operations for HMP includes the following activities:

- Memorial Services
- Grave Digging and Burials
- Grounds Maintenance

Normal operations may include noise from commercial vehicles. Temporary noise from construction vehicles like backhoes is also possible. Maintenance equipment like lawn mowers are also noise sources during normal operations.

3.2 Park Operating Hours

HMP is open during daylight hours.

4 Sound Regulations and Guidelines

4.1 State of Hawaii Administrative Rules, Department of Health (DOH)

Hawaii Administrative Rules, Title 11 – Department of Health, Chapter 46 – Community Noise Control regulates environmental noise limits within the state of Hawaii. The table below shows the maximum permissible noise levels for each zoning district.

Table 2: DOH Maximum Permissible Noise Levels

Land Use	Day Noise Limit (L_{eq}) 7am – 10pm	Night Noise Limit (L_{eq}) 10pm – 7am
Class A – Residential, conservation, preservation, public space, open space, or similar	55 dBA	45 dBA
Class B – Multi-family dwellings, apartment, business, commercial, hotel, resort, or similar	60 dBA	50 dBA
Class C – Agriculture, country, industrial, or similar	70 dBA	70 dBA

In mixed zoning areas, the primary land use designation is used for determining the zoning district. The maximum permissible sound levels shall not be exceeded (at or beyond the property line) by more than 10% of the time for any 20-minute period. The maximum permissible sound levels for impulsive sounds can be up to 10 dB above the maximum sound levels in the table above.

These sound level limits apply to *"stationary noise sources, and equipment related to agriculture, construction, and industrial activities".* The noise regulation further defines stationary sources as *"any mechanical source of noise fixed in or on a station, course, or mode within any premises, including but not limited to mechanical air conditioning units, exhaust systems, generators, compressors, pumps, or other similar equipment".* Therefore, sounds generated by vehicles, hand tools, etc. are not required to satisfy the noise limits shown in Table 2, since these sources do not qualify as a stationary noise sources (defined by the noise regulation).

4.2 Federal Transit Administration – Traffic Noise

The expansion of HMP is expected to result in more traffic in and out of the grounds. The state noise ordinance is not applicable to traffic noise sources. The Federal Transit Administration (FTA) presents allowable traffic noise exposure increases based on existing exposure levels (Table 3-3 from Publication FTA-VA-90-1003-06). Based on measured sound levels (see Acoustical Measurements section below), an increase of 1 dB due to project traffic noise is considered acceptable for highway noise. Farther into the park and in residential areas, the ambient noise level is lower so a total noise increase of 5 dB is considered acceptable.

4.3 State Department of Health, Noise Reference Manual, Oahu Edition – Construction Noise

The Hawaii State Department of Health allows construction to occur with the appropriate community noise permits during specific hours, as shown on Table 3. Any excessive noise outside of these hours requires an approved Community Noise Variance.

Table 3: Oahu Construction Hours

Equipment Used	Allowed Hours of Operation
Pile Drivers, Jackhammers, Impact Hammers, Demolition Equipment, etc.	9:00 am – 5:30 pm Monday - Friday
Normal Construction Equipment	7:00 am – 6:00 pm Monday – Friday 9:00 am – 6:00 pm Saturday

The State Department of Health does not quantify allowable construction sound levels. For this analysis, FTA noise limits proposed as "reasonable criteria for assessment" are utilized. Though these construction noise limits are defined at the property line, they are also applied to the construction area boundary for analyzing impacts to Ocean View Garden by construction noise. The Construction Noise Limit guidelines are summarized in Table 4.

Table 4: FTA General Assessment Construction Noise Limits

Land Use	One-hour L_{eq} (dBA)	
	Day (7am – 10pm)	Night (10pm – 7am)
Residential	90 dBA	80 dBA
Commercial	100 dBA	100 dBA
Industrial	100 dBA	100 dBA

For this project, a recommended 1-hour L_{eq} level of 90 dBA is recommended as the maximum daytime construction noise level at the construction area boundary due to the adjacent residential land uses.

4.4 State Department of Health, Construction Noise Permits

A Notification of Intent to Construct must be submitted if the total project cost is less than $250,000 and if noise doesn't exceed 78 dBA. Otherwise, a Community Noise Permit must be submitted and approved by the state before construction can begin. Loud construction activities outside of normal construction hours require an approved Community Noise Variance.

All relevant noise forms can be found at the Hawaii Department of Health website.
http://health.hawaii.gov/irhb/noiseforms/

5 Existing Ambient Sound Environment

5.1 Sound Measurement Equipment and Procedure

Ambient noise level measurements were conducted to assess the existing acoustical environment near the HMP expansion project site and to assess potential noise impacts to the surrounding area. Long-term and short-term measurements were performed. Sound levels were time-averaged over the measurement period. The measurement equipment used for the sound measurements is described in the table below.

Table 5: Summary of Noise Measurement Equipment

Equipment Type	Manufacturer	Model No.	Equipment Quantity
Sound Level Meter	Larson Davis	831	2
Pre-amp	PCB	PRM831	2
Microphone	PCB	377B02	2
Calibrator	Larson Davis	CAL200	2

At each sound measurement location, the sound level meter was mounted on a tripod (approximately 5 feet above grade). The microphone was directly connected to the sound level meter and an open-cell polyurethane foam wind screen covered the microphone.

Efforts were made to select sound level measurement locations that were generally representative of the existing ambient sound environment in the vicinity of the project location.

5.2 Sound Measurement Locations

A total of one (1) long-term noise measurement location and four (4) short term noise measurement locations were selected. These noise measurement locations are shown in Figure 2 and described in Table 6 below.

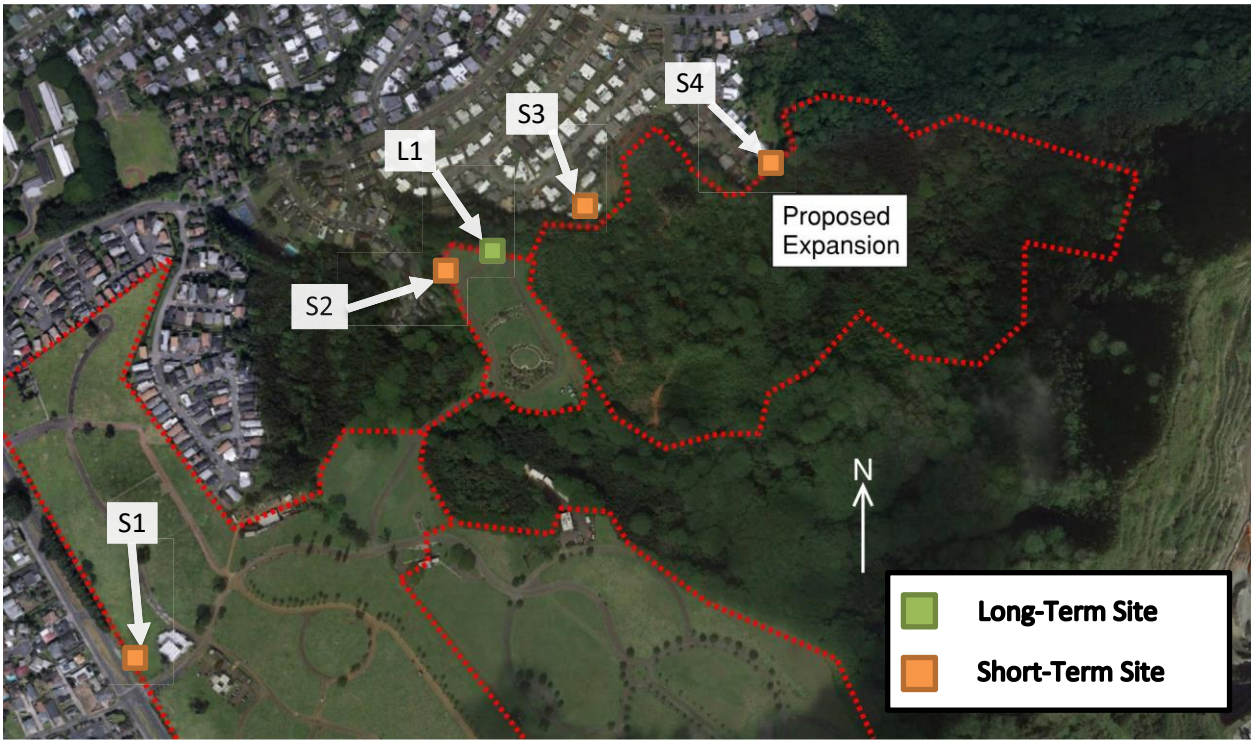

Figure 2: Noise Measurement Locations

These sound level measurement locations, descriptions of the ambient environments, and measurement results are described in Table 6 below.

Table 6: Measurement Location Summary

Site Name	Location	Sound Sources	Duration	Start Time
L1	Hawaiian Memorial Park: Ocean View Garden North	Dominant: Park maintenance/vehicles	6 days	12:00 am 11/3/17
S1	Kamehameha Hwy. Main Entrance	Dominant: Traffic	20 minutes	3:31 pm 11/2/17
S2	Hawaiian Memorial Park: Ocean View Garden NW	Dominant: Park maintenance/vehicles	20 minutes	3:06 pm 11/2/17
S3	Ohaha Place	Dominant: Dogs, roosters Secondary: Air/regular traffic	20 minutes	2:13 pm 11/2/17
S4	Lipalu Place	Dominant: Dogs Secondary: Air/regular traffic	20 minutes	2:16 pm 11/2/17

For a subjective reference to common sound levels, a few examples are provided below. A more comprehensive list with a wider range of sound levels can be found in Appendix B.

Common Outdoor Sounds	Sound Pressure Level (dBA)
Gas lawn mower at 4 feet	90 dBA
Car traveling at 55 mph at 150 feet	60 dBA
Small town residential area	50 dBA
Rustling leaves	30 dBA

5.2.1 Long-Term Measurements

One (1) long-term measurement was performed on the northern boundary of the Ocean View Garden section of Hawaiian Memorial Park. The measurements were continuous from November 2, 2017, through November 9, 2017. The long-term measurement location is shown in Figure 3.

Figure 3: Photograph of Long-Term Measurement Location

5.2.2 Short-Term Measurements

Four (4) short-term measurements were performed in the area surrounding the HMP project site, as described above. Noise levels were measured for twenty (20) minutes in each location and the data was averaged over the duration of the measurement to determine the approximate ambient noise level for each measurement location. The measurements were performed on the afternoon of November 2, 2017.

5.3 Sound Measurement Results

5.3.1 Long-Term Measurement Results

The results of our long-term measurements are shown in Figure 4.

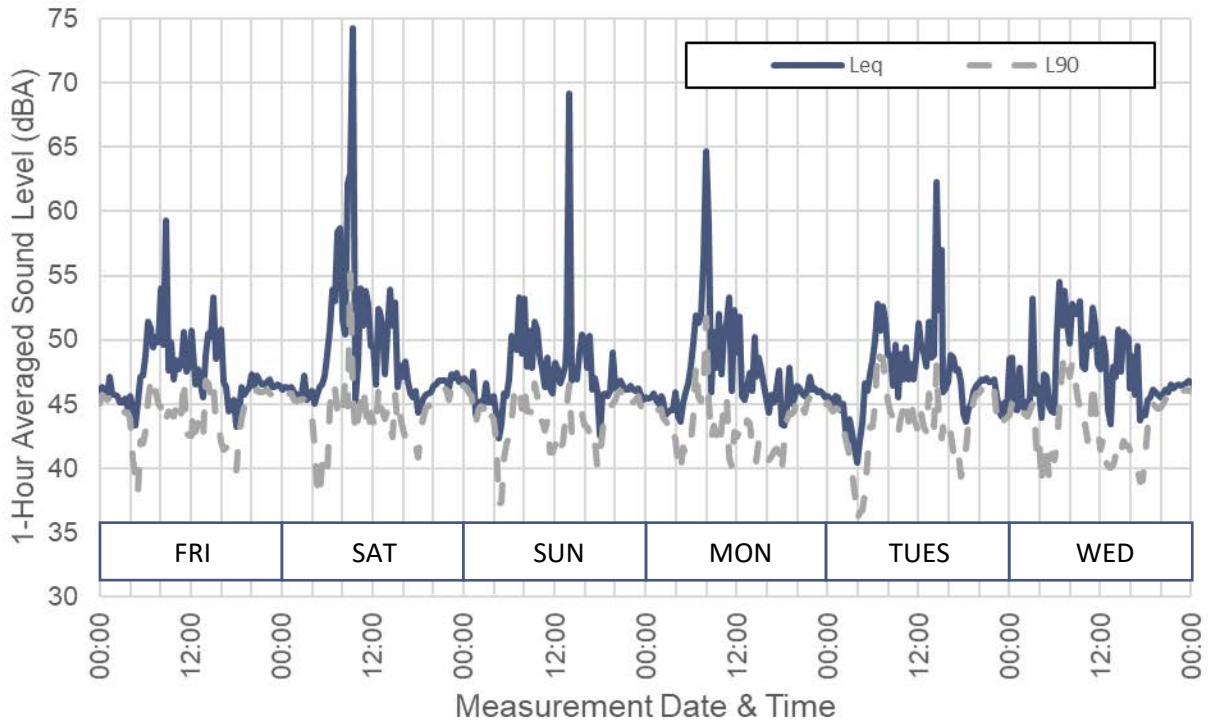

Figure 4: Long-Term Measurement Sound Level

Figure 4 shows the measured 1-hour equivalent sound level (L_{eq}) and the 90% exceedance level (L_{90}). The L_{90} noise level is widely accepted as the standard for determining the background noise level. The range of background noise levels was somewhat consistent day-to-day. The highest measured sound levels during the week are due to trucks or construction vehicles on the park grounds. Dogs, roosters, air traffic, and traffic from Kamehameha Highway also contributed to the ambient noise levels. Using the long-term measurement data, we calculated the overall daily average sound levels, which are shown in Table 7.

Table 7: Overall Daily Average Sound Levels

Average (Day) Sound Level – $L_{eq\ (day)}$[1]	Average (Night) Sound Level - $L_{eq\ (night)}$[2]	Average Day/Night Level - L_{dn}[3]
54 dBA	47 dBA	55 dBA

Notes:

1. $L_{eq\ (day)}$ is an average of the equivalent sound levels during the daytime hours only (between 7am and 10pm) within a 24-hour measurement period.
2. $L_{eq\ (night)}$ is an average of the equivalent sound levels during the nighttime hours only (between 10pm and 7am) within a 24-hour measurement period.
3. The L_{dn} is the 24-hour L_{eq} obtained after addition of 10 dBA to the sound levels from 10pm to 7am.

5.3.2 Short-Term Measurement Results

Traffic noise was the dominant noise source at the Kamehameha Highway measurement site, location S1. Noise from maintenance vehicles, though intermittent, resulted in the highest sound levels inside the park, location S2. Ambient noise inside the park typically originated from traffic on Kamehameha Highway or from roosters. Animals were the main noise source in the surrounding neighborhood, locations S3 and S4. It was observed that ambient noise levels in the neighborhood vary depending on the number of dogs or roosters nearby and not on the proximity to the nearest road because traffic is minimal. Short-term measurement results are shown in Table 8.

Table 8: Measurement Results Summary

Location ID	Location Description	L_{eq} [1]
S1	Kamehameha Hwy	70 dBA
S2	Ocean View Garden	48 dBA
S3	Ohaha Place	45 dBA
S4	Lipalu Street	57 dBA

Notes:

1. Average sound level

6 Construction Noise Level Prediction

The primary intent of this environmental assessment is to predict construction sound levels from the proposed HMP expansion to the noise sensitive areas in the surrounding community. Special attention was focused on the surrounding residential buildings since this type of building tends to be more noise sensitive compared to most industrial and commercial spaces.

6.1 Construction Noise Assessment Procedure, Methodology, and Source Levels

Table 9 taken from the FTA Noise and Vibration Manual, shows reference noise levels for various pieces of construction equipment from 50 ft away. These are the loudest pieces of equipment expected to be used in this project. Construction noise levels at nearby residences can vary significantly. The types and quantity of equipment used, equipment distance from the residence, and ground type are all factors that can affect the noise levels. These levels shown in Table 9 can be adjusted based on these criteria to develop a worst-case construction noise level. We can then determine if construction noise exceeds the recommended 90 dBA threshold at the nearest residences.

Table 9: Construction Equipment Noise Levels

Equipment	Typical Noise Level 50 ft from Source
Backhoe	80 dBA
Grader	85 dBA
Loader	85 dBA
Paver	89 dBA
Mounted impact hammer (hoe ram)	90 dBA [A]
Tractor	84 dBA [A]
Scraper	89 dBA
Truck	88 dBA

Notes: Abridged version of Table 12-1 from FTA Noise and Vibration Manual, 2006
[A] From FHWA Construction Noise Handbook, Table 9.1

6.2 Construction Noise Assumptions

The majority of construction work consists of grading and general earthwork. Breakers, tractors, scrapers, and truck/haulers will be the major noise sources used during the earthwork phase. Backhoes and pavers will be used after the earthwork phase to install roads and utilities.

Breakers and tractors will be primarily used in the excavation areas. Pavers will be used on the proposed roadways after the earthwork phase. The remainder of the equipment will be used throughout the project area. Additional work will be performed at the end of Lipalu Street to connect to an existing storm drain inlet.

During the earthwork phase, three breakers, tractors, scrapers, and truck/haulers for a total of twelve vehicles are assumed to be running at the same time. In the post-earthwork phase, two backhoes and a paver are assumed to be running at the same time. The assumed location of equipment use is near the project boundary unless like the paver or breaker the equipment is generally restricted to a certain part of the project area.

The HMP terrain is mostly grass on soft ground. A ground factor (G) of 0.4 is used to calculate ground attenuation.

6.3 Construction Noise Assessment and Prediction Results

Predicted noise levels at nearby sensitive receivers from the various construction phases are shown in Table 10 below. The overall sound levels are shown in A-weighted decibels.

Table 10: Predicted Construction Noise Levels at Nearby Residences

Sensitive Receiver	Distance to Earthwork Boundary	Earthwork Phase Noise Level	Post-Earthwork Phase Noise Level
Kumakua Place Residences	400 ft	75 dBA	67 dBA
45-440 to 45-450 Ohaha Street	220 ft	81 dBA	67 dBA
Ohaha Place Residences	180 ft	83 dBA	70 dBA
45-420 Ohaha Street	260 ft	79 dBA	64 dBA
45-450 to 45-470 Lipalu Street	85 ft	91 dBA	70 dBA
Lipalu Place Residences	370 ft	76 dBA	62 dBA
45-150 to 45-170 Namoku Street	470 ft	74 dBA	60 dBA

The earthwork phase is the main noise concern. The scrapers and truck/haulers are the dominant noise sources since the breakers and tractors will generally be restricted to the excavation area towards the center of the project area.

7 Potential Noise and Vibration Impact of the Park Expansion

7.1 Compliance with the State of Hawaii Administrative Rules, Department of Health (DOH), Noise Regulation

Although the State of Hawaii Administrative Rules establish maximum permissible noise levels (at the property line), the noise regulation is only enforceable for stationary mechanical equipment and other similar devices. The noise regulation is not applicable to vehicle noise, mobile maintenance equipment noise, or other typical noises that may be radiating from HMP. Currently, there are no plans to install heavy mechanical equipment, such as generators, air-handling equipment, etc. However, if such equipment is included with the project, it must not exceed the maximum permissible noise limits, as addressed in the Administrative Rules.

7.2 Comparison of Construction Noise Levels to the Proposed Construction Noise Threshold

Construction noise exceeds the 90 dBA threshold when the scrapers and truck/haulers are within 100 ft of the nearest residence. This only occurs at section of the construction area at the end of Lipalu Street.

As described in this report, the predicted sound levels do not include any sound mitigation methods and design techniques. Sound mitigation options are discussed within Section 8 of this report.

7.3 Comparison of Future Operations Noise Levels to the Existing Ambient Sound Environment

As shown in Table 7, the average daytime sound level inside the park is 54 dBA. At residences adjacent to the proposed expansion, the ambient noise is mostly in the 45-50 dBA range depending on proximity to Kamehameha Highway and neighborhood pets (i.e., barking dogs).

Backhoes are used during normal operations to dig graves. Though this noise source will likely exceed ambient noise levels at nearby residences, this occurs sparingly and only during daytime hours. Likewise, park maintenance equipment like lawn mowers and weed eaters will most likely exceed the residential ambient noise levels. Since these are temporary and mobile noise sources, like the backhoe, they are not subject to the DOH administrative rules.

7.4 Comparison of Future Traffic Noise Levels to the Existing Ambient Sound Environment

Expected increases in traffic volumes are contained in the Traffic Impact Analysis Report for this project. The expected 2% increase in traffic along Kamehameha Highway due to the project corresponds to an increase in sound levels of less than a decibel and is considered negligible.

Traffic noise within the park as a whole is expected to increase 1 dB due to the park expansion project. General park traffic noise along with traffic noise specifically in the new park expansion are shown in Table 11.

Table 11: Project Traffic Noise Levels

Source	Typical Noise Level 50 ft from Source[1]
2040 Park Traffic: No Project	58 dBA
Project Traffic	53 dBA
2040 Park Traffic: With Project	59 dBA

Notes:

1. Peak-hour average sound level

Though noise from park traffic may be audible at nearby homes, noise events should be intermittent during peak operation hours. HMP closes its gates to traffic at night so nighttime traffic noise from within the park is not expected. To reduce the chance of noise impacts, vehicles should refrain from honking horns and idling for extended periods of time. Potential on-site vehicle noise can be further reduced by locating on-site roadways away from nearby residences.

7.5 Construction Vibration Levels

Construction vibration can be an annoyance, however, extreme cases such as close-proximity pile driving can cause structural damage. It is best practice for pile drivers and hydraulic breakers to not be used within 50 ft of normal residential buildings. Great care should be taken when using pile drivers and hydraulic breakers within 100 ft of structures. Vibration propagation is dependent on ground/soil conditions. Vibration from normal construction vehicles may be perceptible but this vibration does not typically generate significant complaints, because the vibration tends to be short term and at moderate amplitude levels. It is also important to note that most people are less sensitive to vibration during the day compared to the night hours (typical sleeping hours). The construction period is expected to be during the day and not during the nighttime hours.

7.6 Summary

Potential sound impacts from the proposed HMP expansion are most likely during project construction. Future traffic and park operations are unlikely to significantly impact nearby residents. Residential units that are closest to the proposed expansion and have a direct line-of-sight with construction equipment have the highest risk of a sound impact. The results also indicate that sounds from the proposed park expansion may exceed the acceptable sound levels established for construction by the FTA. These sound level predictions do not include the benefit gained by implementing any sound mitigation techniques, which are described below. Reducing construction noise to a level that significantly reduces the potential sound impact is certainly feasible.

Recommendations for reducing the impact on the surrounding buildings/community are outlined below.

8 Sound Mitigation Methods and Techniques, and Future Sound Studies

8.1 Construction Noise Mitigation

To keep noise levels below the recommended 90 dBA threshold, construction crews should refrain from using loud equipment within 50 feet of a residence. If that is unavoidable, noise impacts may be reduced by utilizing equipment intermittently or by blocking the line-of-sight from noise sources to noise-sensitive receivers with sound-absorbing barriers, material piles, or other designed construction noise mitigation measures. Particularly noisy tasks, especially those in the same general area should be separated throughout the work schedule if possible. All work must be done during approved construction hours.

Continuous plywood barriers are a commonly used noise barrier option. They are reasonably low cost to fabricate and acoustically effective. However, a potential sound reflection path off the plywood barrier in the opposite direction should be considered. If barrier-reflected noise is an issue, quilted mass-loaded vinyl barriers are an effective noise mitigation option.

8.2 Use of Trees, Shrubs, or other Vegetation for Sound Mitigation

The addition of trees, plants, shrubs, or other vegetation is typically not an effective sound mitigation technique. Unless the vegetation is several hundred feet thick, the sound reduction by vegetation is often negligible. Therefore, assuming vegetation between the construction activities and the residences will reduce construction sound levels is not reasonable for most scenarios, including the HMP Expansion project.

8.3 Construction Vibration Mitigation

If vibration from the hydraulic breaker is disturbing to nearby residents and generating neighborhood complaints, we recommend that the vibration inducing activities be scheduled for the middle of the day when many residents are least likely to be home.

9 Conclusions

Although a permanent noise impact due to the project is not expected, temporary noise impacts may occur during construction of the Hawaiian Memorial Park Expansion. Construction must be confined to normal construction hours and abide by the Department of Health rules for construction activities that generate noise. It is recommended that construction activities within 50 feet of residences be carefully monitored due to the close proximity to the residence. For general construction activities, a temporary plywood noise barrier (or similar barrier material) blocking the line-of-sight between the noise source and noise receiver can significantly reduce temporary noise impacts due to construction activities.

Cemetery activities, such as grave excavation and grounds maintenance are short-term, occur during daytime hours, and are not expected to generate a noise impact to the surrounding residences.

On-site traffic noise impacts to adjacent residential properties are expected to be negligible or minimal due to restricted vehicle entry at night. Locating on-site roadways away from the nearby residential neighborhoods will further reduce potential noise impacts.

APPENDIX A

REFERENCES

1. State of Hawaii, Department of Health, Noise Reference Manual: Oahu Edition, July 2017

2. State of Hawaii, Department of Health, Chapter 46, *Community Noise Control*, Administrative Rules, Title 11, September 23, 1996 - HDOH 9/23/1996

3. Federal Transit Administration, Chapter 3, *Noise Impact Criteria*, Transit Noise and Impact Assessment, May 2006

4. Federal Transit Administration, Chapter 12, *Noise and Vibration During Construction*, Transit Noise and Impact Assessment, May 2006

5. Federal Highway Administration, Chapter 9, *Construction Equipment Noise Levels and Ranges,* August 2006

APPENDIX B

ACOUSTIC TERMINOLOGY

Sound Pressure Level

Sound pressure level (SPL) is a logarithmic measure of the sound pressure relative to a reference value, as defined by the follow equation:

$$SPL = 10Log_{10}\left(\frac{{p_{rms}}^2}{{p_o}^2}\right) = 20Log_{10}\left(\frac{p_{rms}}{p_o}\right) \text{ [dB]}$$

Where p_{rms} is the room mean square sound pressure, measured in Pa, and p_o is the reference sound pressure, measured in Pa. Typically, p_o is defined as being 20 µPa, the smallest sound pressure detectable by the human ear.

It is common that a 1 to 2 dB increase or decrease of sound is too difficult for most listeners to discern. A 3 dB change in sound level is often considered to be the "just noticeable difference". A 6 dB change in sound level is significant to most listeners, and a 10 dB change in sound level is often considered to be twice (or half) as loud.

A-Weighted Sound Level (re: dBA)

A-weighting is applied measured sound levels in effort to account for the relative loudness perceived by the human ear. The typical human ear is less sensitive to low frequency sounds and high frequency sounds. Individual weighting values (applied for either octave bands or one-third octave bands) are determined by the A-weighting curve as an international standard.

Equivalent Sound Level, L_{eq}

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual instantaneous noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise.

Exceedance/Statistical Sound Level, LN

The Exceedance/Statistical Sound Level is the A-weighted sound levels equaled or exceeded by a fluctuating sound level for "N" percent of the time. In other words, an L_{90} equal to 63 dBA means that the sound levels equal 63 dBA, or higher, for 90% of the measurement period. The L_{10} level is commonly called the 'intrusive sound level', and the L_{90} is commonly called the 'residual sound level'. The L_{90} is often used in environmental measurements and assessments.

Common Sound Levels in dBA

Common Outdoor Sounds	Sound Pressure Level (dBA)	Common Indoor Sounds	Subjective Evaluation
Auto horn at 10 ft Jackhammer at 50 ft	**100**	Printing plant	Deafening
Gas lawn mower at 4 ft Pneumatic drill at 50 ft	**90**	Auditorium during applause Food blender at 3 ft	Very Loud
Concrete mixer at 50 ft Jet flyover at 5000 ft	**80**	Telephone ringing at 8 ft Vacuum cleaner at 5 ft	
Large dog barking at 50 ft Large transformer at 50 ft	**70**	Electric shaver at 1 ft	Loud
Automobile at 55 mph at 150 ft Urban residential	**60**	Normal conversation at 3 ft	
Small town residence	**50**	Office noise Dishwasher in adjacent room	Moderate
	40	Soft stereo music in residence Library	
Rustling leaves	**30**	Average bedroom at night Soft whisper at 3 ft	
Quiet rural nighttime	**20**	Broadcast and recording studio	Faint
	10	Human breathing	Very Faint
	0	Threshold of hearing (audibility)	