Elevating acoustical design.

ANC SOUTH AIRPARK CARGO TERMINAL

Environmental Noise Impact Study

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1 Executive Summary

This report is a summary of the environmental noise testing, impact analysis, predictive methods, and recommended noise control measures for the Ted Stevens Anchorage International Airport South Airpark Cargo Terminal addition for cargo plane staging, off-loading, and on-loading (proposed site operations).

The 3-dimensional computer-aided sound propagation and noise abatement model shows that the proposed site operations will not be louder than the current normal daytime and nighttime operations of the Anchorage International Airport during east-west flow operations. The east-west aircraft flow of the Anchorage International Airport was documented in the 2015 Federal Aviation Administration (FAA) FAR Part 150 Noise Compatibility Study to have the quietest Day-Night Average Noise Levels (DNL) for the residential community to the south, compared to the north and south flow patterns. The predicted Day-Night Average Noise Level (DNL) from the new Airpark operations only (21 planes completing 42 trips) is **54 dBA**. This is less than the DNL of 62 dBA from existing airport operations documented for this community. The FTA noise impact criteria note 'No Impact' if the project DNL does not exceed 59 dBA.

The Airpark will include an 25'-0" high landscaped berm on the south side of the site and replant large sections of trees along the south property line to reduce the high-frequency noise from the taxiing engines. The analysis noted that the minimum recommended height for the berm is 11'-0".

2 Noise Impact Criteria

The following are the code or noise criteria used to evaluate the impact from the future aircraft taxiing and air cargo operations.

2.1 Anchorage Chapter 15.70 Noise Control

15.70.060 Prohibited acts and conditions.

A. No person shall unreasonably make, continue or cause to be made or continued any noise disturbance except noncommercial public speaking or public assembly activities conducted on any public space or public right-of-way.

B. The following acts and conditions and the causing thereof are declared to be in violation of this chapter:

1. *Aircraft and airport operations.* No person shall operate aircraft engines while the aircraft is on the ground or operate an airport facility in such a manner as to cause a noise disturbance across a residential real property boundary, on a public space or within a noise-sensitive zone. The department shall consult with the airport proprietor to recommend changes in airport operations to minimize any noise disturbance that the airport owner may have the authority to control in its capacity as proprietor. Nothing in this section shall be construed to prohibit, restrict, penalize, enjoin or in any manner regulate the movement of aircraft that are in all respects conducted in accordance with or pursuant to applicable federal laws or regulations, including but not limited to takeoff, landing or overflight procedures.

2.2 Federal Transit Authority

The Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (the manual) dated September 2018 defines noise impact based on the day-night average noise level (L_{dn} / DNL[1]) of the current conditions compared to the project exposure in Chapter 4 – Noise Impact Analysis.

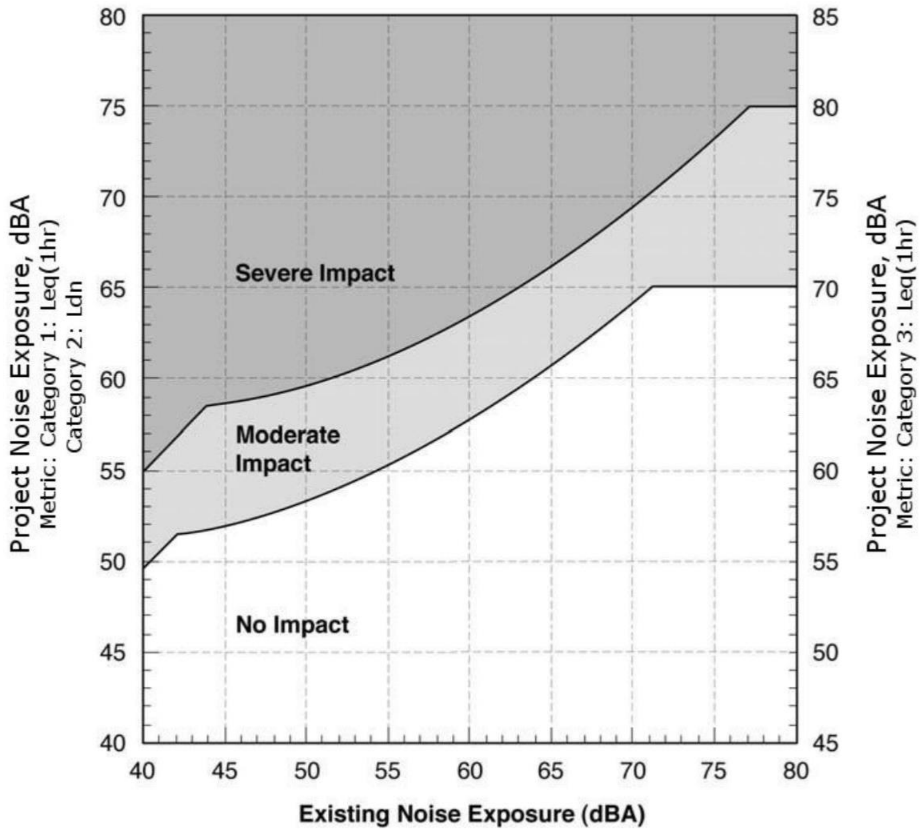

Figure 4-2 Noise Impact Criteria for Transit Projects

The manual is primarily for major transit, and for aircraft noise, the manual states that:

Because airport noise is highly variable based on weather conditions and corresponding runway usage, it is preferable in such cases to base the existing noise exposure on published aircraft noise contours in terms of Annual Average DNL shown in Appendix A.

[1] Day-Night Average Noise Level is denoted as Ldn and DNL.

3 Environmental Noise Assessment

The following sections outline the measurement, analysis, and predictions completed to quantify the noise impact from the proposed South Airpark expansion to the residences south of Raspberry Road.

For this study and analysis, daytime is defined as the hours between 7:00 AM and 10:00 PM and nighttime is defined to be between 10:00 PM and 7:00 AM of the next day.

3.1 Background Noise

3.1.1 Hourly Measurements & Day-Night Average Noise Level (DNL)

To quantify the background noise from current aircraft activities and traffic, the existing average noise level within the neighboring residential community was documented (short-duration measurements). The 24-hour noise measurements were conducted at the southwest corner of the Anchorage Airport (noise monitor locations).

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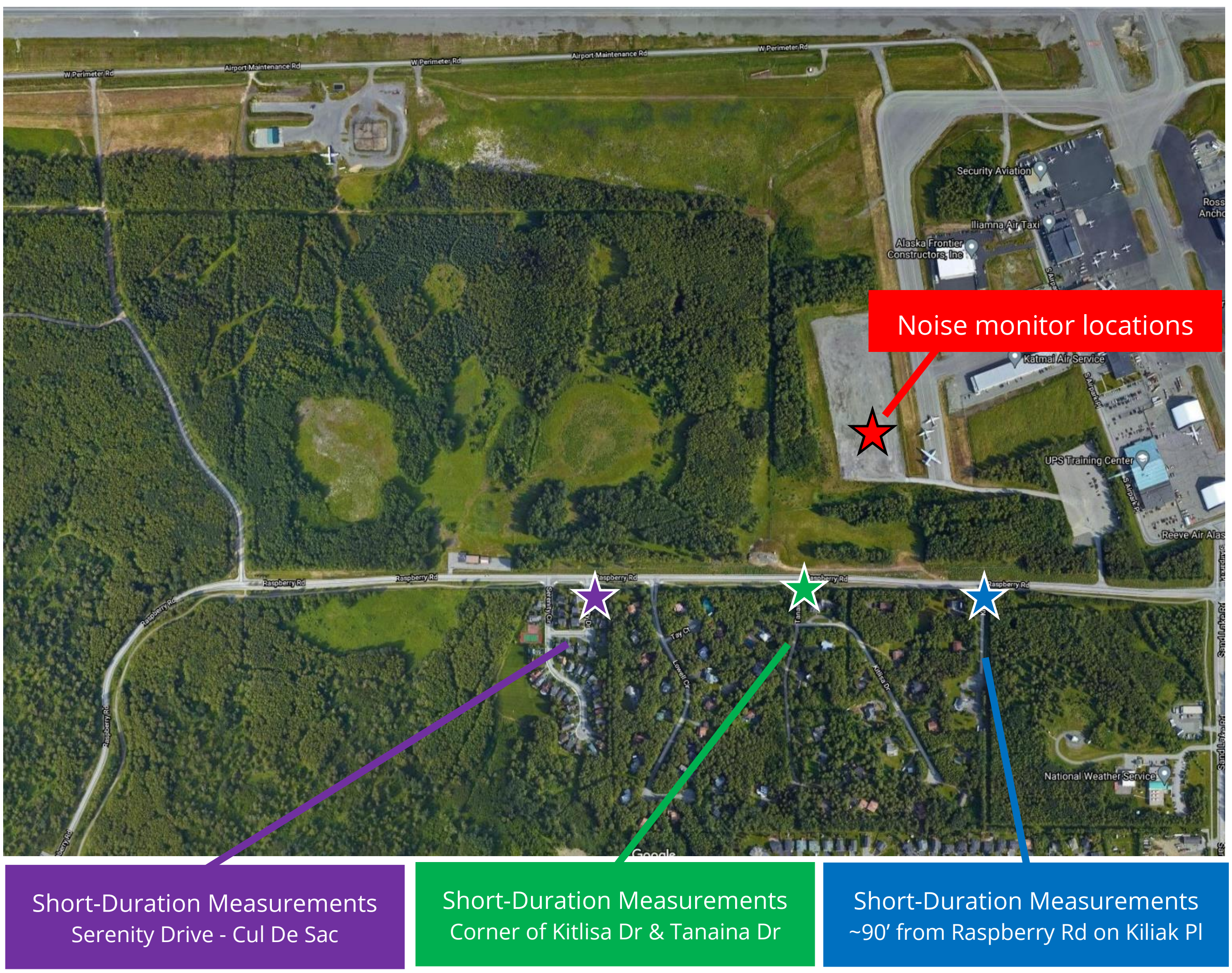


Figure 1: Measurement Locations

The temperatures dropped to 5-degrees Fahrenheit, which is below the performance limit of the noise monitoring equipment batteries. As a result, 12 hours of continuous noise monitoring were recorded, but the evaluation was supplemented with short-duration measurements on the south side of Raspberry Road at the three locations noted.

Based on the measured noise levels, the predicted day-night average noise level (DNL) is **62 dBA** from existing airport operations for the first row of residences on the south side of Raspberry Road. This predicted performance is based on measurements between Monday, November 15th and Tuesday, November 16th, 2021, the FAR Part 150 Noise Compatibility Study yearly DNL contour. The data used for this prediction was from the 2015 Day-Night Noise Level (DNL) Contours for the east, west, and north flow contours. The predicted background noise and existing DNL did not include any noise documented from south flow flights directly over this community, which can occur based on wind and FAA requirements. Each of the published 2015 FAR 150 DNL maps is included in Appendix B of this report.

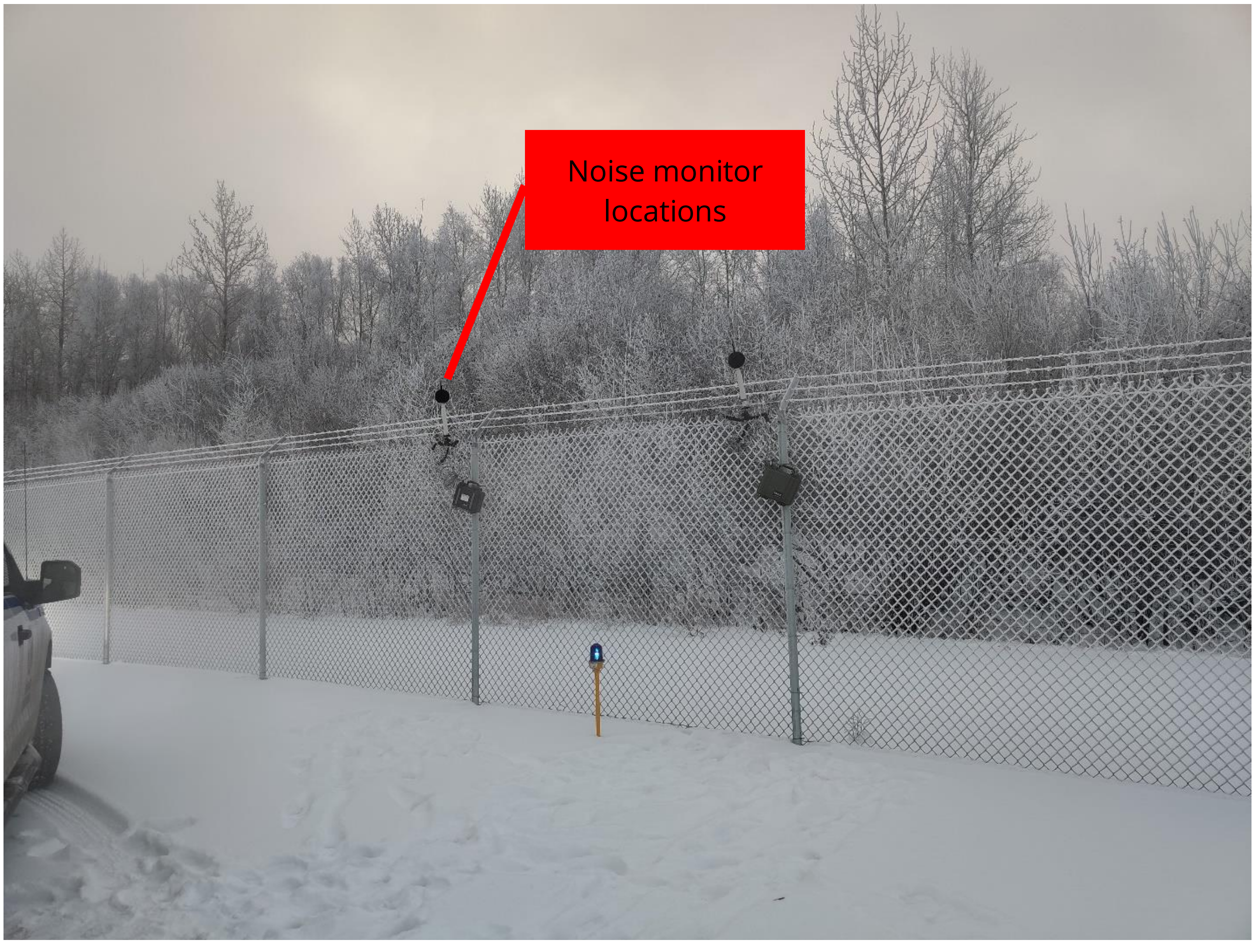


Figure 2: Noise Monitor Locations

The FTA noise impact criteria notes 'No Impact' if the project DNL does not exceed 59 dBA, a 'Moderate Impact' if the project DNL is between 59 – 64 dBA, and 'Severe Impact' if the project DNL is greater than 64 dBA. These impact criteria contextualize the impact from the proposed operations on the overall existing average noise level within the community.

3.1.2 Short-Duration Measurements

To supplement the hourly average measurements, short-duration measurements were completed for 15-minutes at four different times of day (9:30 PM on November 15th; 10:30 AM, 3:00 PM, 5:30 PM on November 16th) at the location marked by a blue star in Figure 1. Short-duration measurements were also completed on December 23, 2021, at 2:30 PM at the intersection of Kitlisa Dr and Tanaina Dr (location marked by a green star in Figure 1) and at 2:50 PM at the cul-de-sac at the mid-point of Serenity Dr (location marked by a purple star in Figure 1). The octave band sound levels for each of these locations are shown in Figure 3.

Corner of Kitlisa Dr and Tanaina Dr

Cul-de-Sac of Serenity Drive

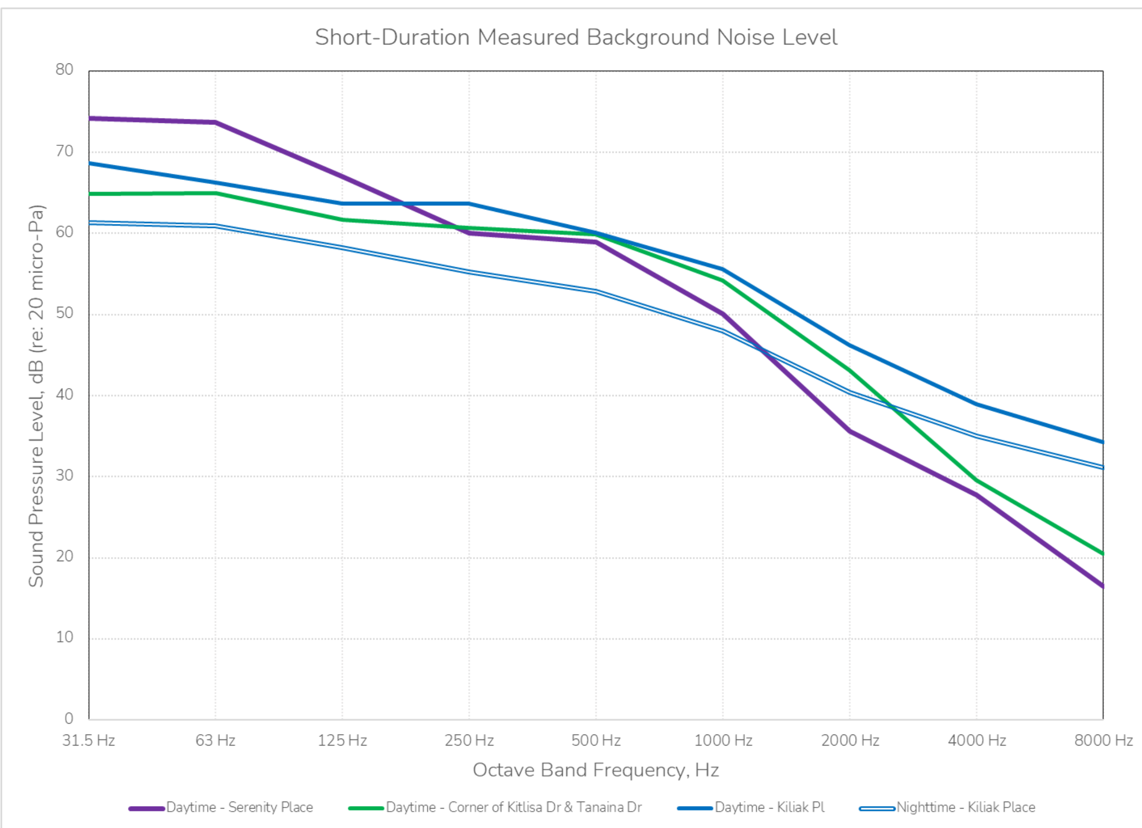


Figure 3: Short-Duration Handheld Measurement Results (Octave Band Unweighted Sound Pressure Levels)

The overall A-weighted sound levels at each of these locations for the noted times are shown in Table 1 below.

Table 1: Average Sound Levels within Community

Measurement Location	LA_{eq},15-minute Average Sound Pressure Level, dBA
Kitlisa Dr and Tanaina Dr (Daytime)	59.6 dBA
Serenity Dr (Daytime)	58.7 dBA
Kiliak Pl (Daytime)	60.4 dBA
Kiliak Pl (Nighttime)	53.5 dBA

All of these measurements were completed using Svantek 971 (Type 1) precision sound level analyzers that were calibrated to 1,000 Hz at 114 dB before and following each measurement period.

The background noise measurements were conducted with at least 12-inches of snow on the ground between the airport and the residential community, which increases ground attenuation when compared with summer conditions (without snow on the ground). Therefore, the measured background noise levels during winter conditions are likely quieter than they would be during the spring and summer months.

3.2 Predictive Noise Impact Model

A detailed 3-dimensional computer-aided sound propagation and noise abatement model was created using DataKustik's CadnaA software. This software predicts the environmental noise impact based on ISO 9613 standards for sound propagation based on topography (elevations, buildings, barriers, berms, etc.), foliage, and other common environmental noise impact variables.

3.2.1 Source – Aircraft Taxiing

The sound power levels for the aircraft used in this analysis are based on detailed measurements noted in the *Aircrafts' taxi noise emission*[2] paper from the Grupo de Investigación en Instrumentación from 2008. This study is the most thorough evaluation and accounting of engine noise during aircraft taxiing.

The researchers measured the noise along a 200 meter length area/runway where operations are representative of aircrafts taxiing in a straight line with constant speed. In this paper, five microphone positions uniformly distributed parallel to the runway were used; two different heights were used (2m and 4m above ground). For each family of aircraft, and each microphone location, sound pressure level spectra were averaged and used to calculate sound power levels. For directivity, the measured time histories were used to calculate the directivity index of noise sources where a function relating time history and the angle between the axis of the aircraft and each microphone were used to express measured levels against time or its related angle then calculated per ISO 9613. Their study evaluated 19 airframes.

[2] Asensio, C., Pagan R., Lopez, J.M., Noise and Vibration Worldwide, 2008.

For the South Airpark model, the Boeing 747 sound data was used from the paper because it is the most common cargo aircraft at Anchorage International Airport and based on the research paper, the Boeing 747 is the loudest airframe with a calculated sound power level of 134 LwA.

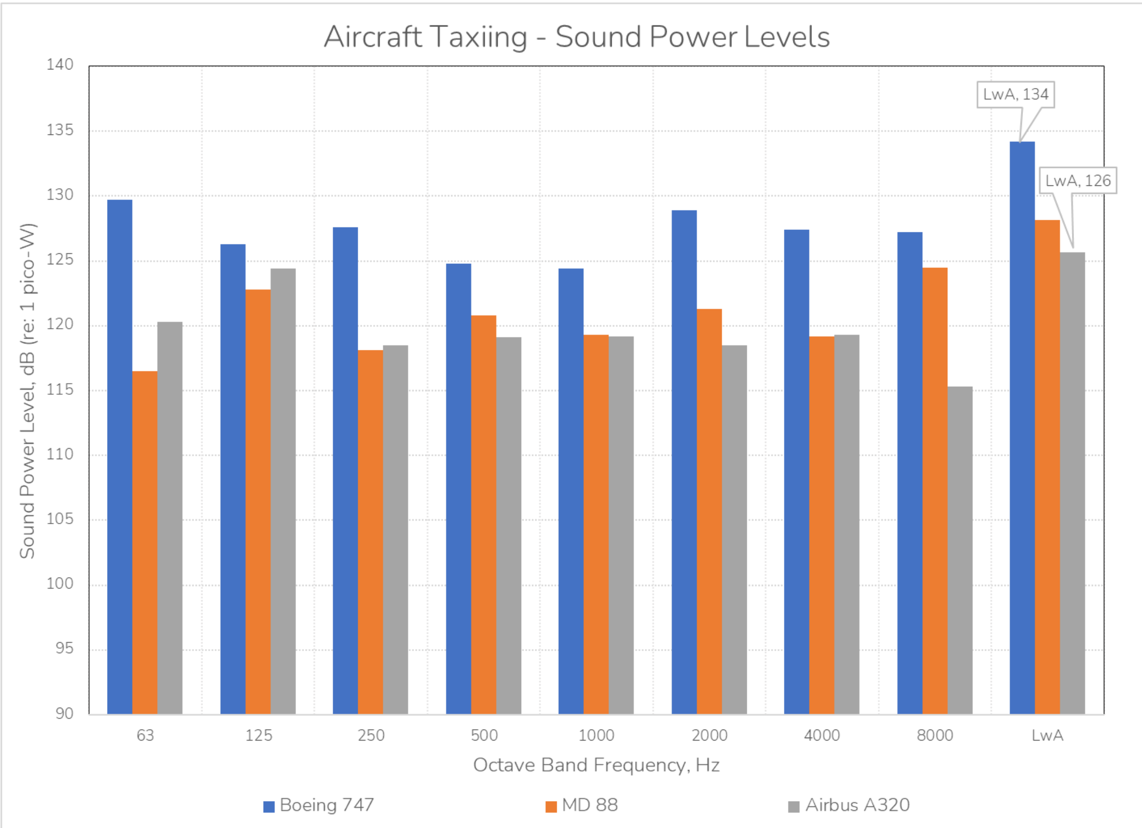
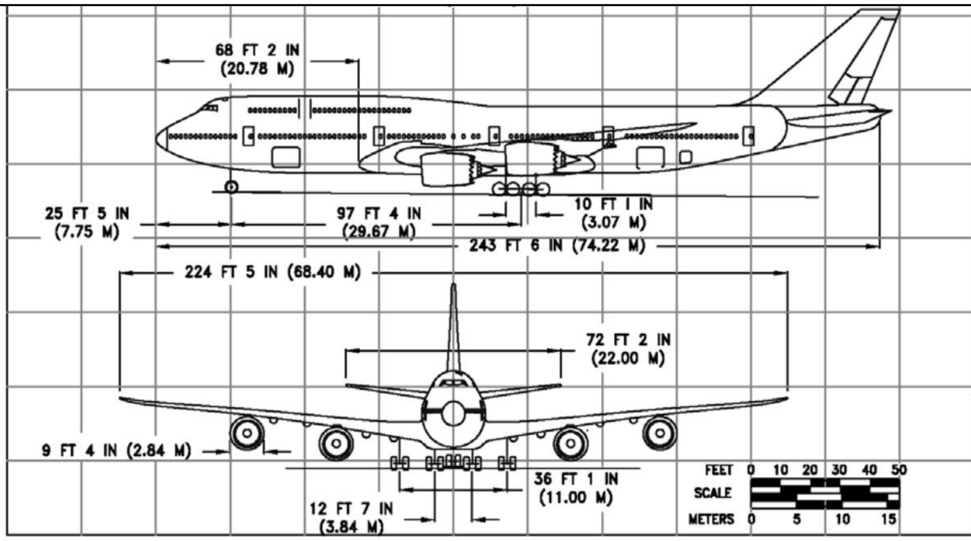


Figure 4: Sound Power Levels for Aircraft Taxiing

The average height of the center of the engine is approximately 9'-0" above the ground as shown in the following schematic of a Model 747-8. This representative engine center height of 9'-0" was used in the model to estimate the potential noise impact at the nearest residential community.



2.2.2 GENERAL DIMENSIONS
MODEL 747-8

Source: [Airplane Characteristics for Airport Planning, Boeing, December 2012]

3.2.2 Modeled Conditions

The topographical model was created to represent the alterations to the area planned for the new cargo area, cargo terminal, hangar, taxiway, and supporting infrastructure. It is noted that the hangar and its location are tentative. Therefore, the hangar is not in the current acoustic model but would have little to no impact on the community direct to the south of the Airpark.

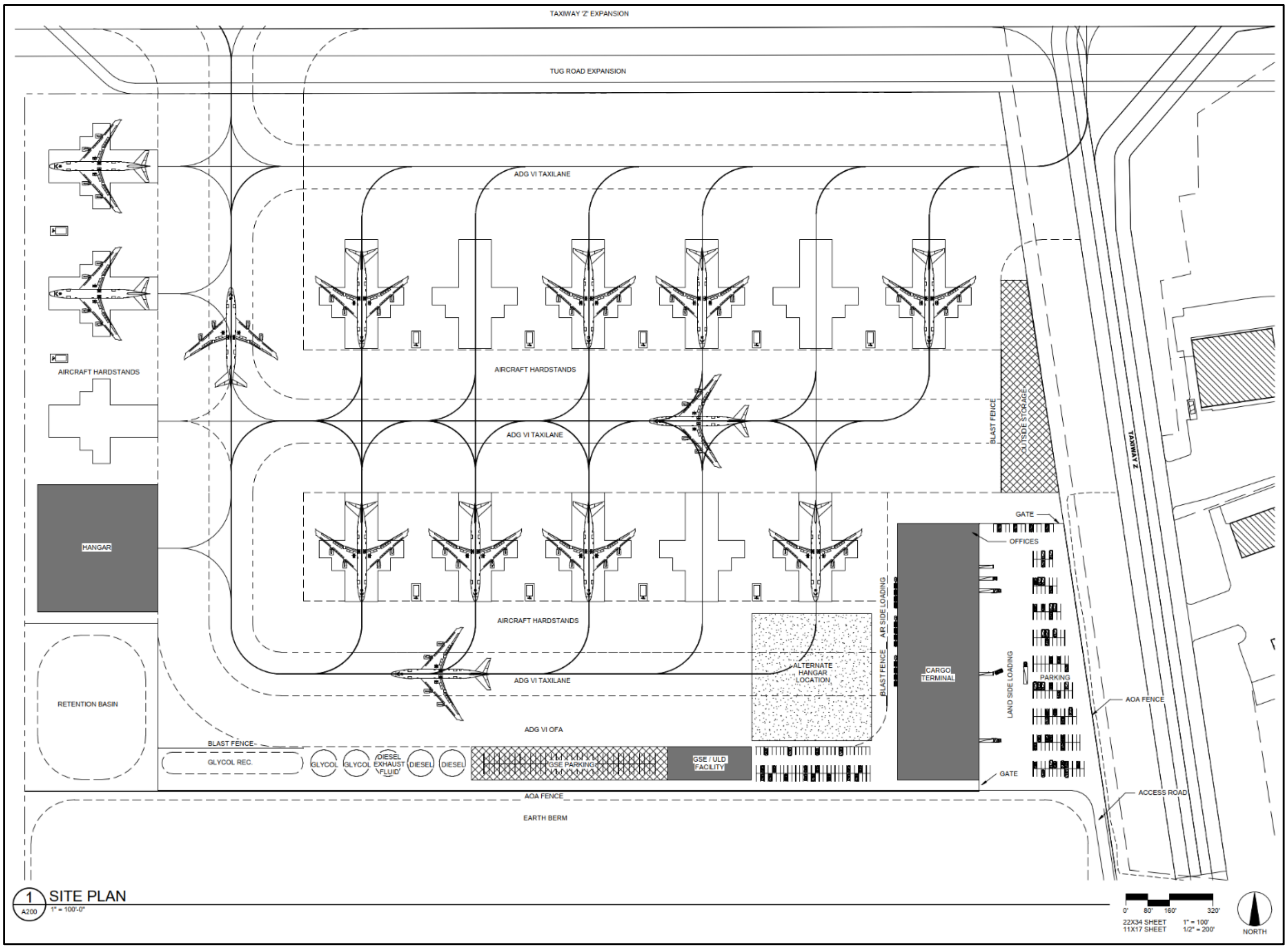


Figure 5: Noise Modeled Airpark Development Plan

Total Daytime Aircraft: 15 planes = 30 Trips

- Each arrival, unload, refueling, reloading takes approximately 90 minutes
- Based on turn-around time, the limited area of the taxiway, and expected airframe safety operation protocols, the maximum number of estimated daytime planes moving concurrently within this area was predicted to be 3 within the noise model and a maximum of 12 movements within a single hour. With the start-up and taxiing lasting approximately 5 to 10 minutes within the Airpark.

Total Nighttime Aircraft: 6 planes = 12 Trips

- Based on the limited number of trips within the 9-hour nighttime window, the maximum number of estimated nighttime planes moving concurrently within this area was predicted to be 2 within the noise model, with the start-up and taxiing lasting approximately 5 to 10 minutes within the Airpark.

The following are the descriptions of the scenarios modeled in the software to quantify the predicted potential noise impact from the proposed Airpark cargo plane operations.

Scenario 1 (Summer Daytime, without berm): Three (3) planes moving concurrently, two (2) near the south edge of the Airpark property

- No earthen berm, effects of existing foliage are considered

Scenario 2 (Summer Nighttime, without berm): Two (2) planes moving concurrently, both near the south edge of the Airpark property

- No earthen berm, effects of existing foliage are considered

Scenario 3 (Summer Daytime, with 11'-high berm): Three (3) planes moving concurrently, 2 near the south edge of the Airpark property

- Noise reduction effects from 11'-0" earthen berm, existing foliage, and replanted foliage sections to represent the expected standard conditions

Scenario 3B (Summer Daytime, with 11'-high & 25'-high berm): Three (3) planes moving concurrently, similar to Scenario 3 but with one plane located near the northwest corner of the Airpark property

- Noise reduction effects from 11'-0" and 25'-0" earthen berm, existing foliage, and replanted foliage sections to represent the expected standard conditions
- Updated noise impact map shows the predicted instantaneous sound level at the eastern edge of Kincaid Park from the South Park operations.

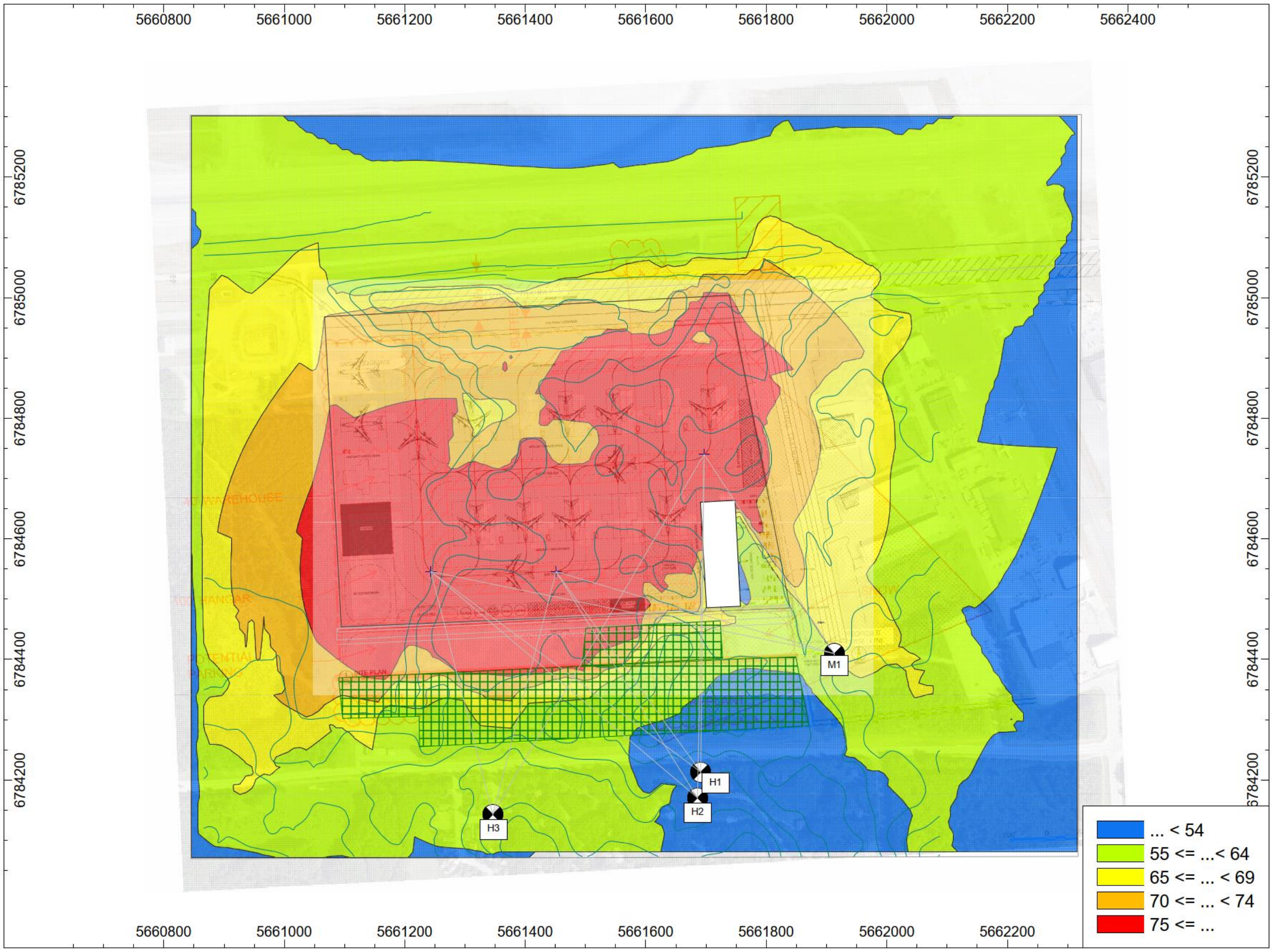
Scenario 4 (Summer Nighttime, with 11'-high & 25'-high berm): Two (2) planes moving concurrently, both near the south edge of the Airpark property

- Noise reduction effects from 11'-0" and 25'-0" earthen berm, existing foliage, and replanted foliage sections to represent the expected standard conditions
- Updated noise impact map shows the predicted instantaneous sound level at the eastern edge of Kincaid Park from the South Park operations.

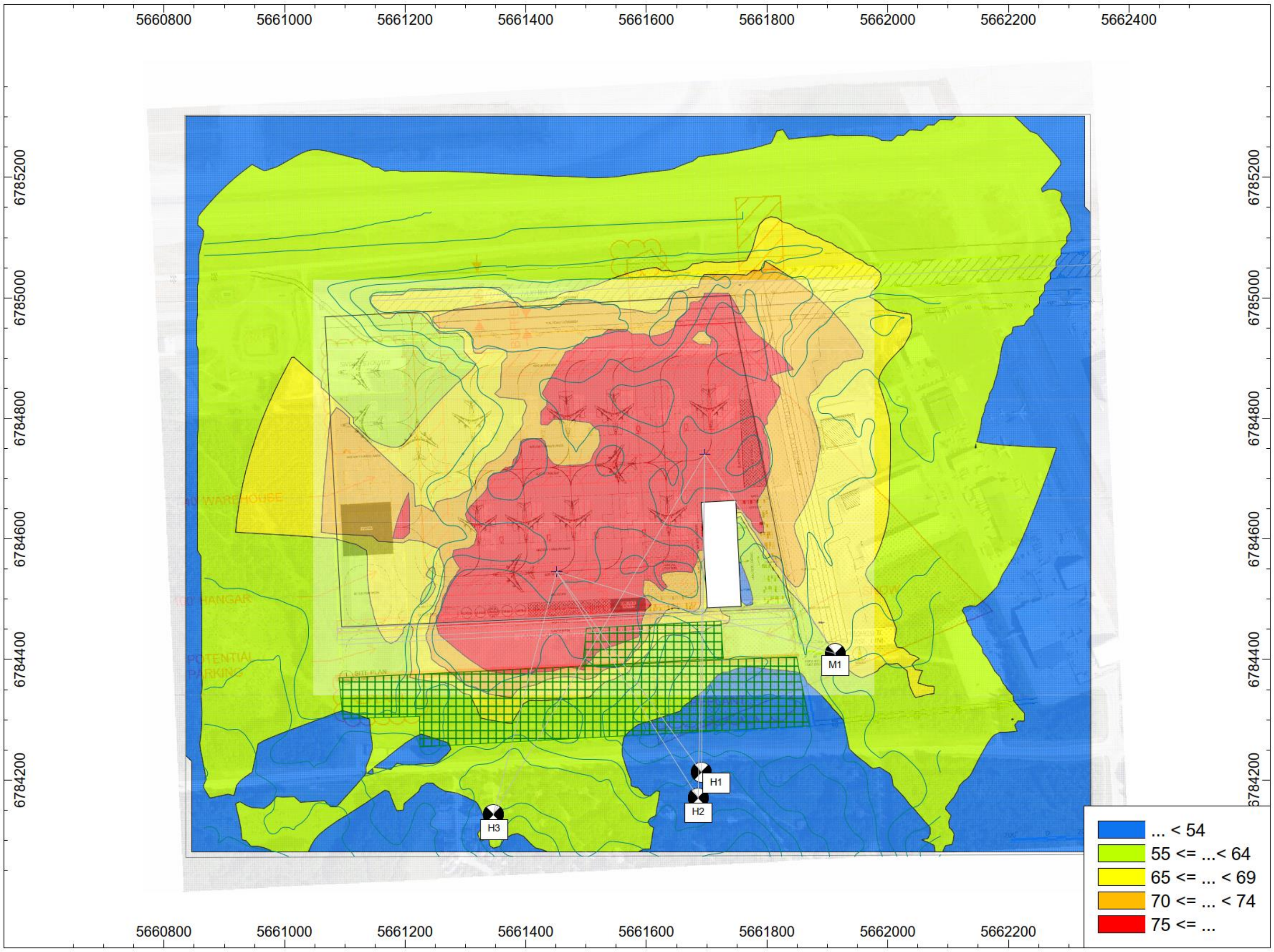
3.2.3 Modeled Results

The following images of the modeled noise impact represent the noise from the engines during taxiing at a moment in time while the planes are taxiing within the Airpark.

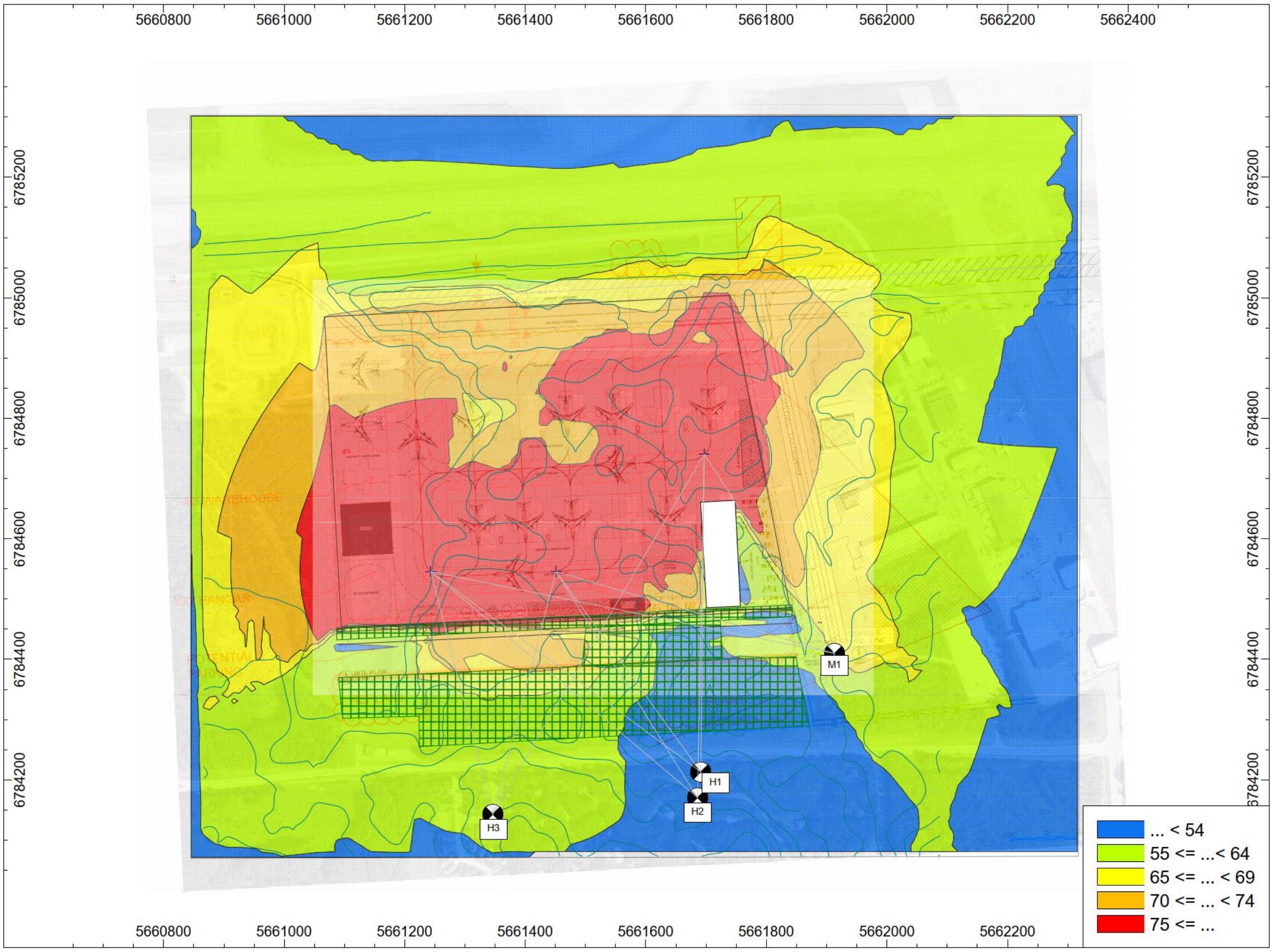
Scenario 1 – Daytime (no berm)



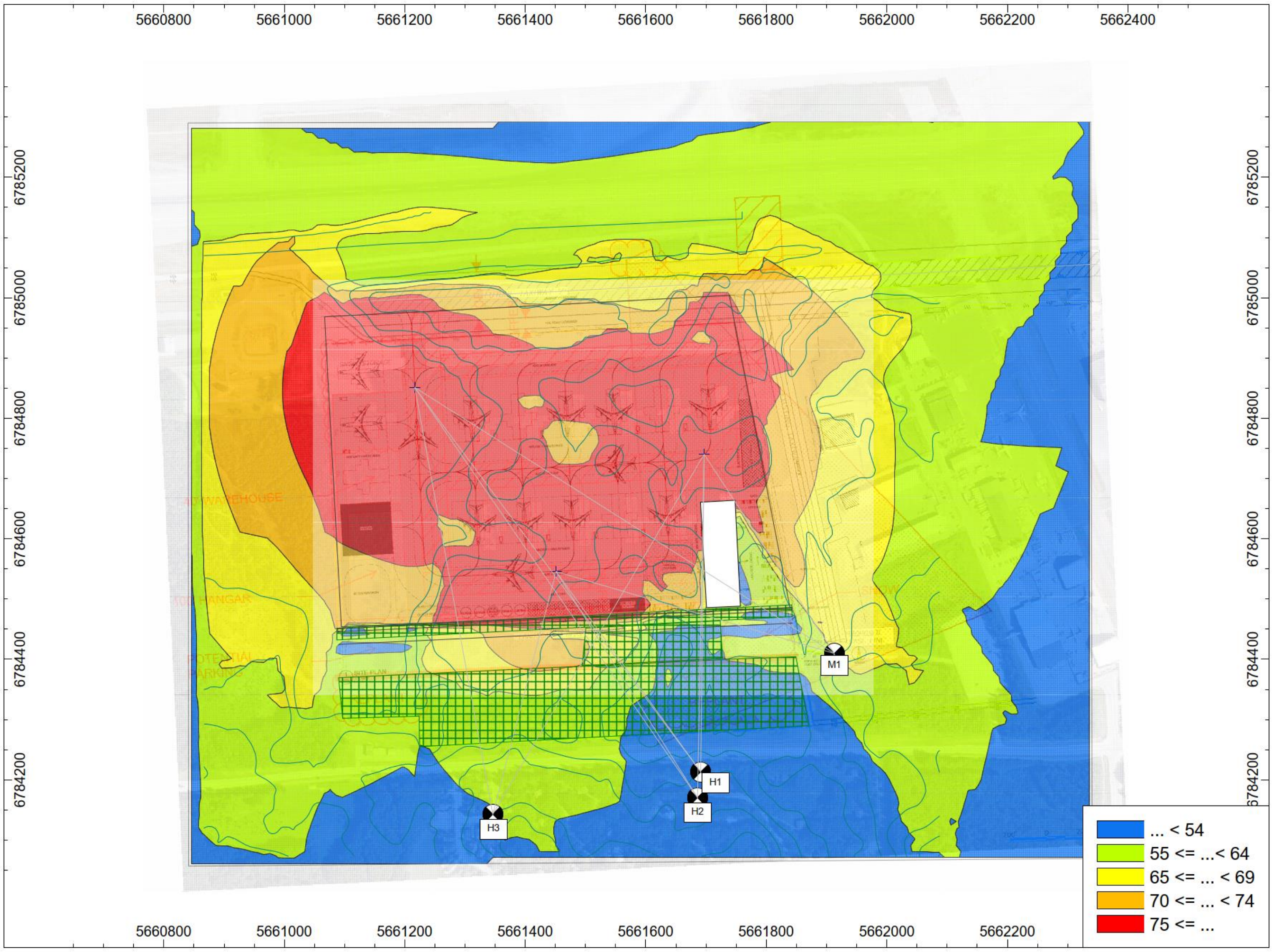
Scenario 2 – Nighttime (no berm)



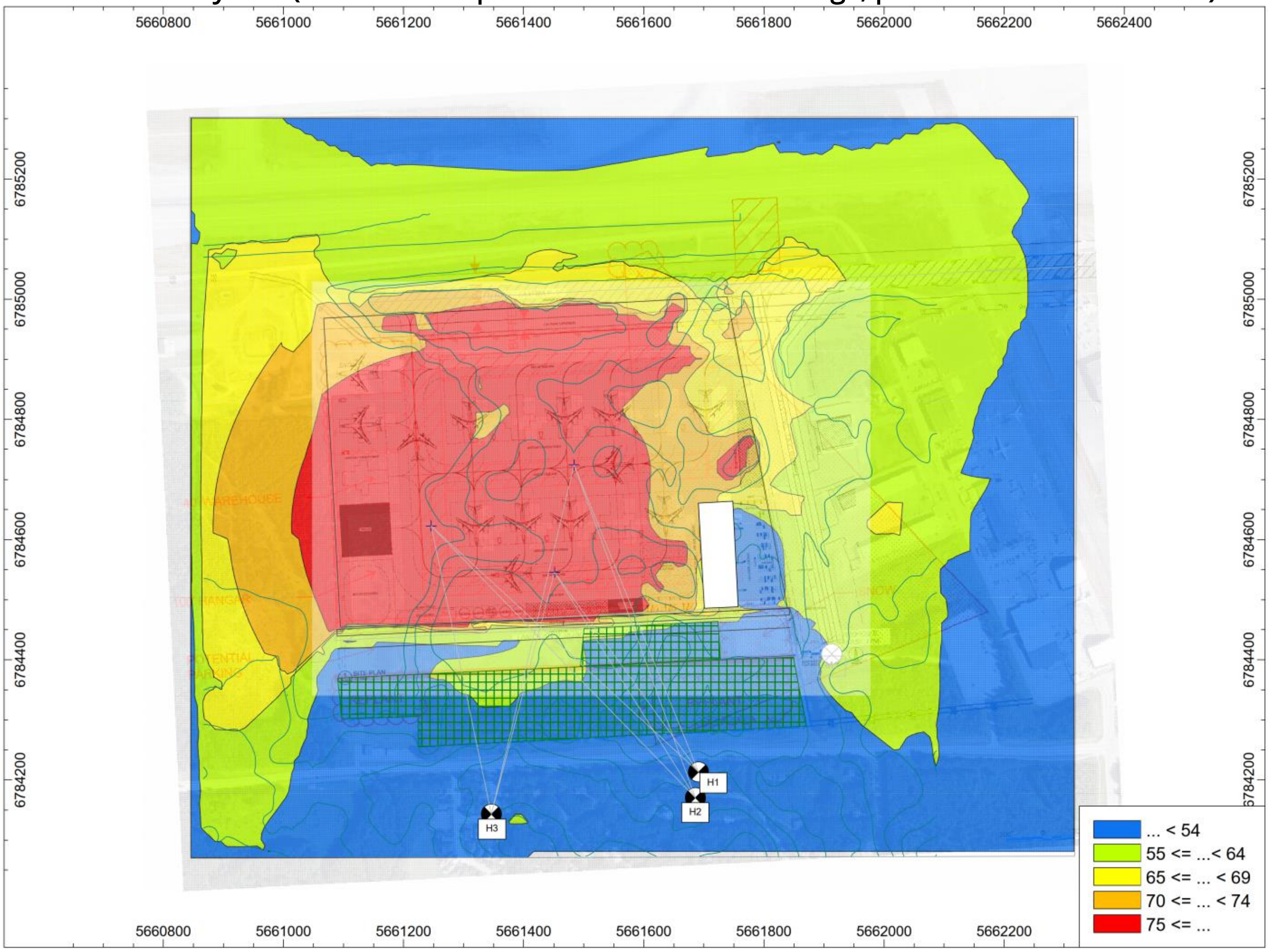
Scenario 3 – Daytime (11'-0" landscaped earthen berm and foliage)



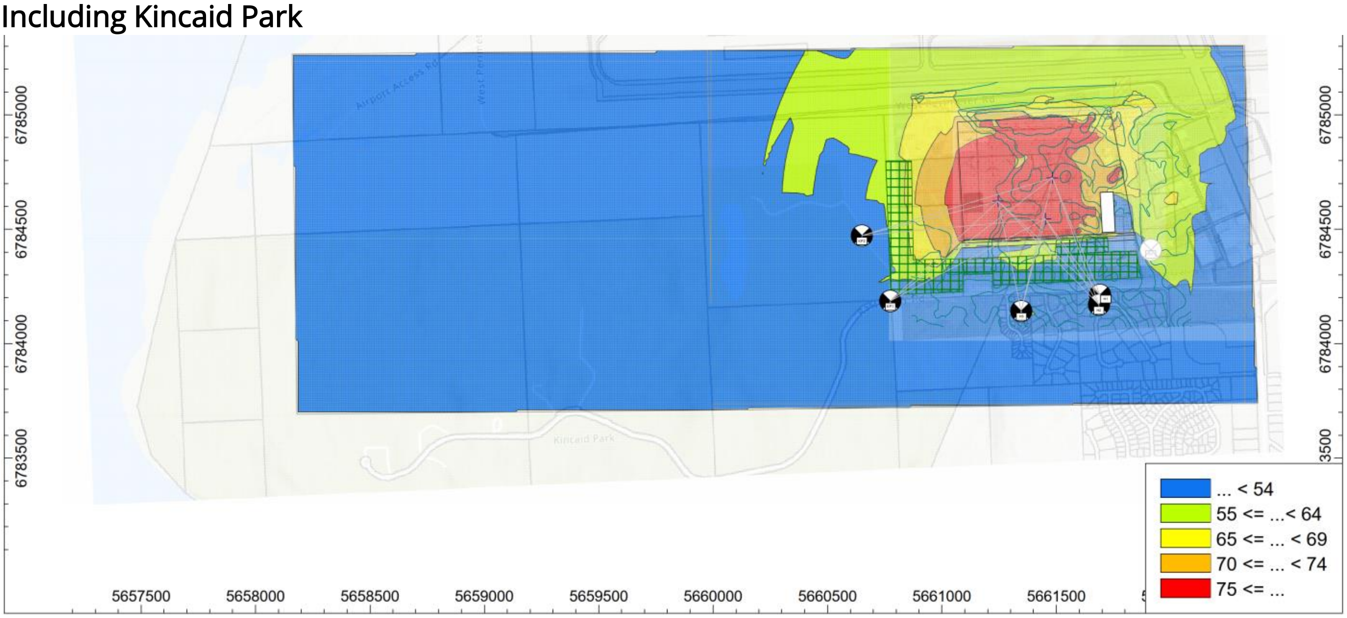
Scenario 3B – Daytime (11'-0" landscaped earthen berm and foliage, plane in northwest corner)



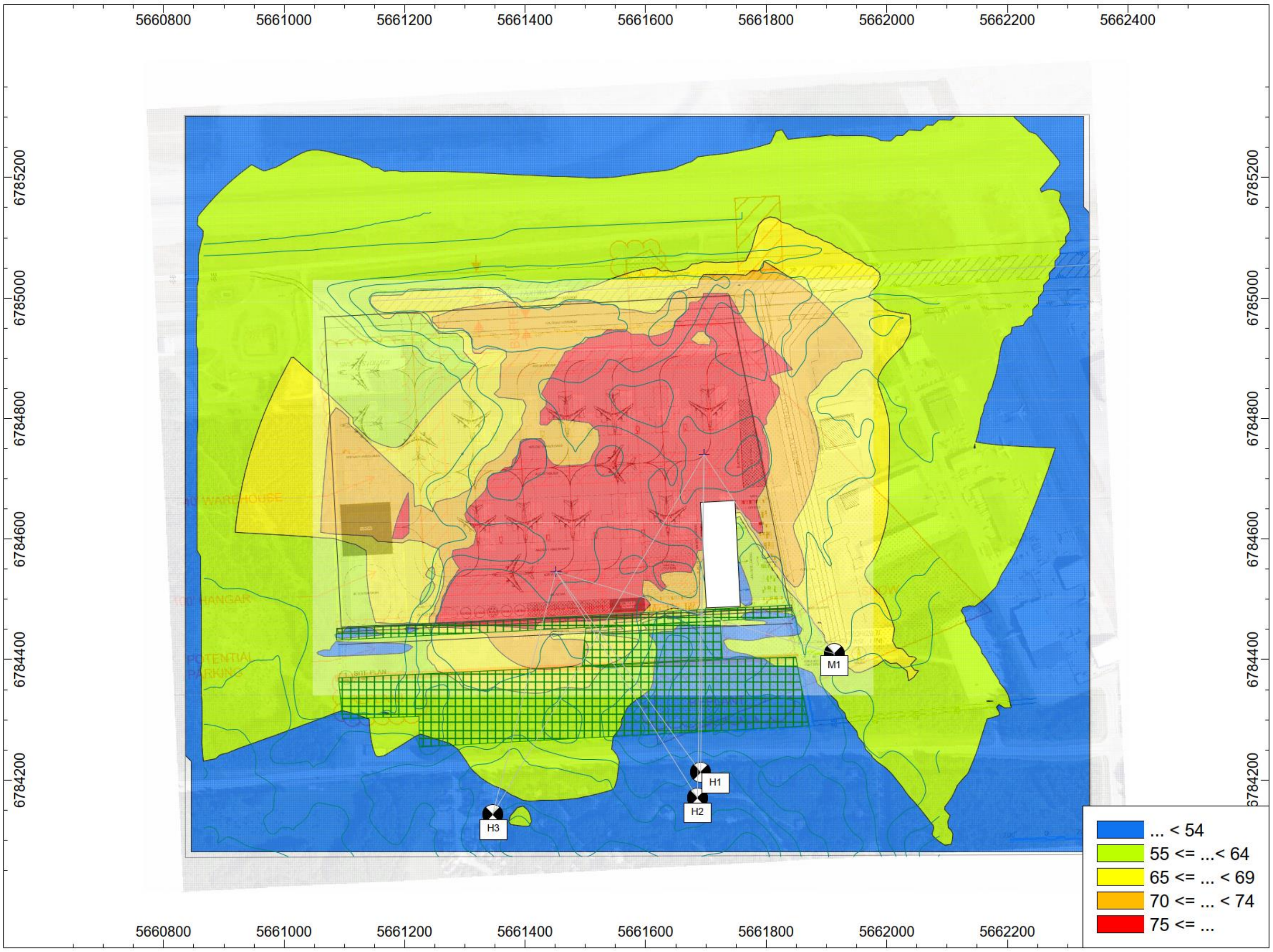
Scenario 3B - Daytime (25'-0" landscaped earthen berm and foliage, plane in northwest corner)



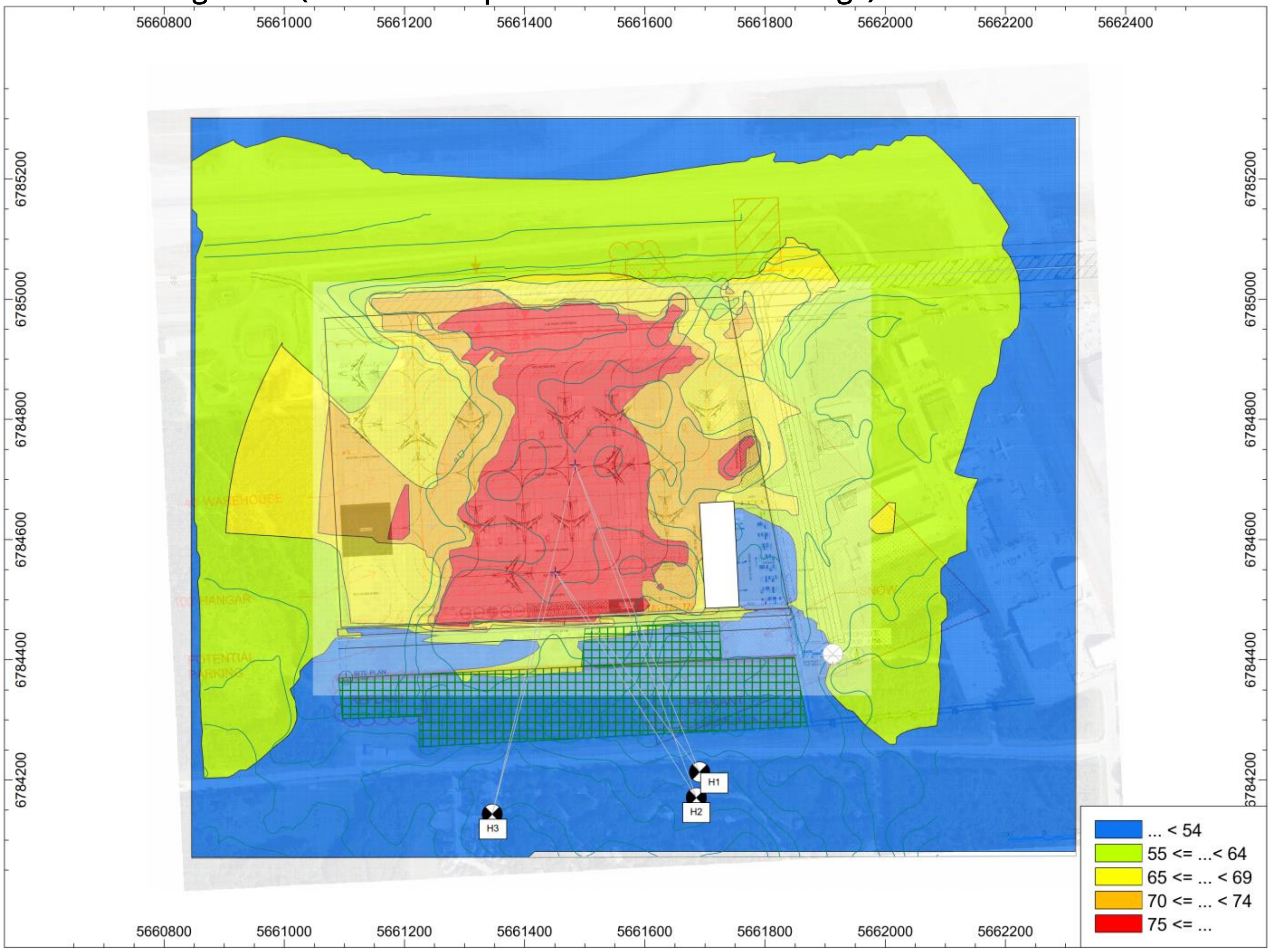
Including Kincaid Park



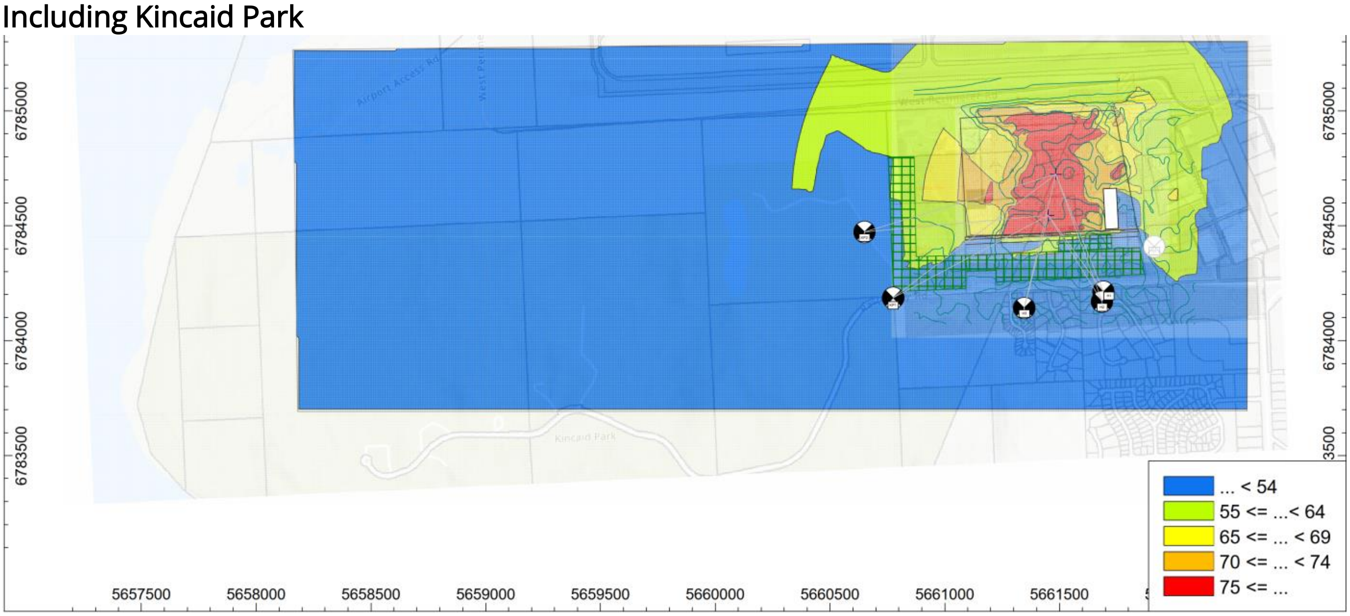
Scenario 4 – Nighttime (11'-0" landscaped earthen berm and foliage)



Scenario 4 – Nighttime (25'-0" landscaped earthen berm and foliage)



Including Kincaid Park



The predicted noise level at the eastern entrance to Kincaid Park is 53 dBA from three concurrent 747 cargo jets taxiing within the Airpark during daytime hours.

3.2.4 Noise Impact Summary

The figures below show daytime and nighttime sound levels (in octave band frequencies) predicted for the proposed site compared with the measured sound levels (in octave band frequencies) within the nearest residential community as follows:

- proposed site operations with existing and replanted foliage, no berm;
- proposed site operations with existing and replanted foliage, 11’-0” high berm; and
- 15-minute measured sound levels within the nearest residential community.

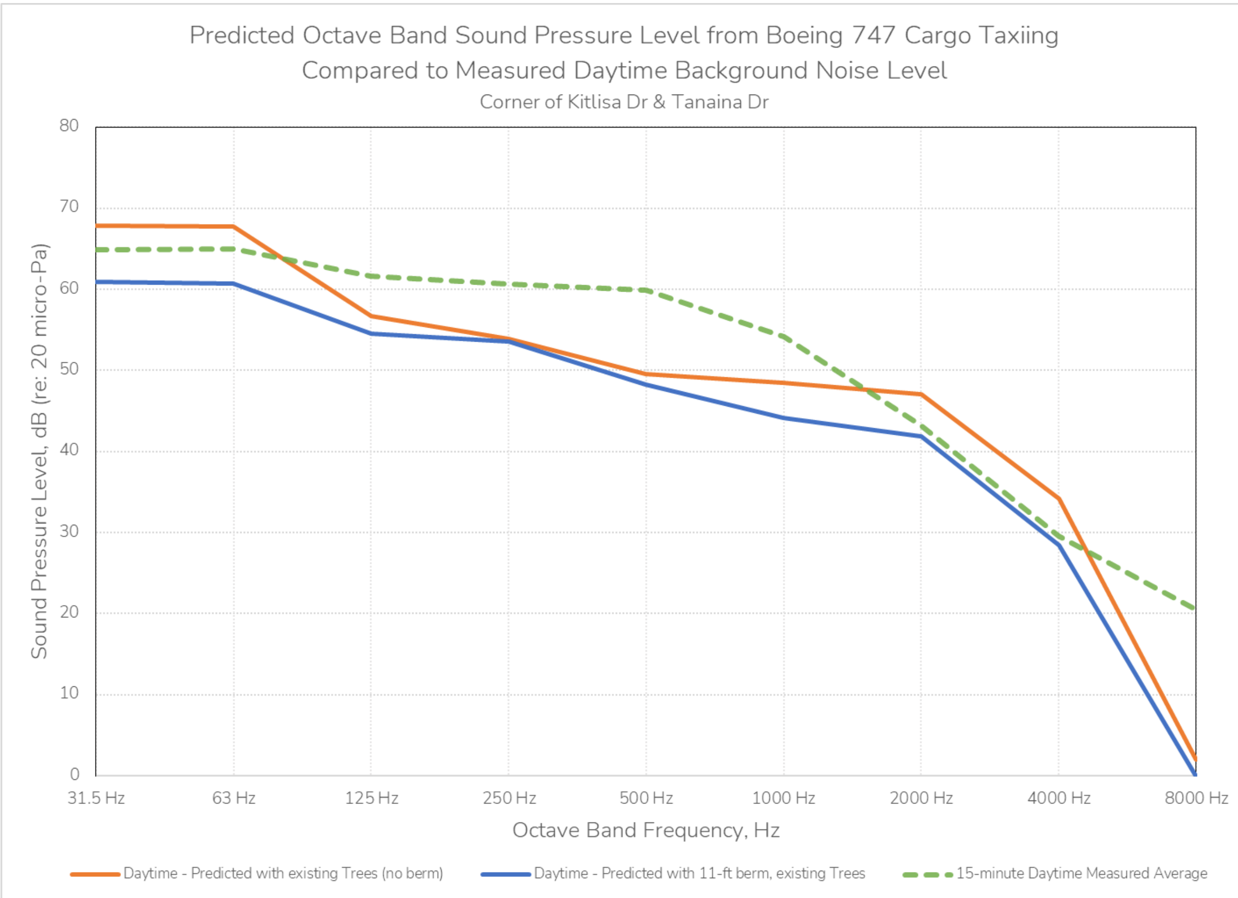


Figure 6: Maximum Predicted Noise Impact from Three Taxiing Aircraft during Daytime Hours (11’-0” berm)

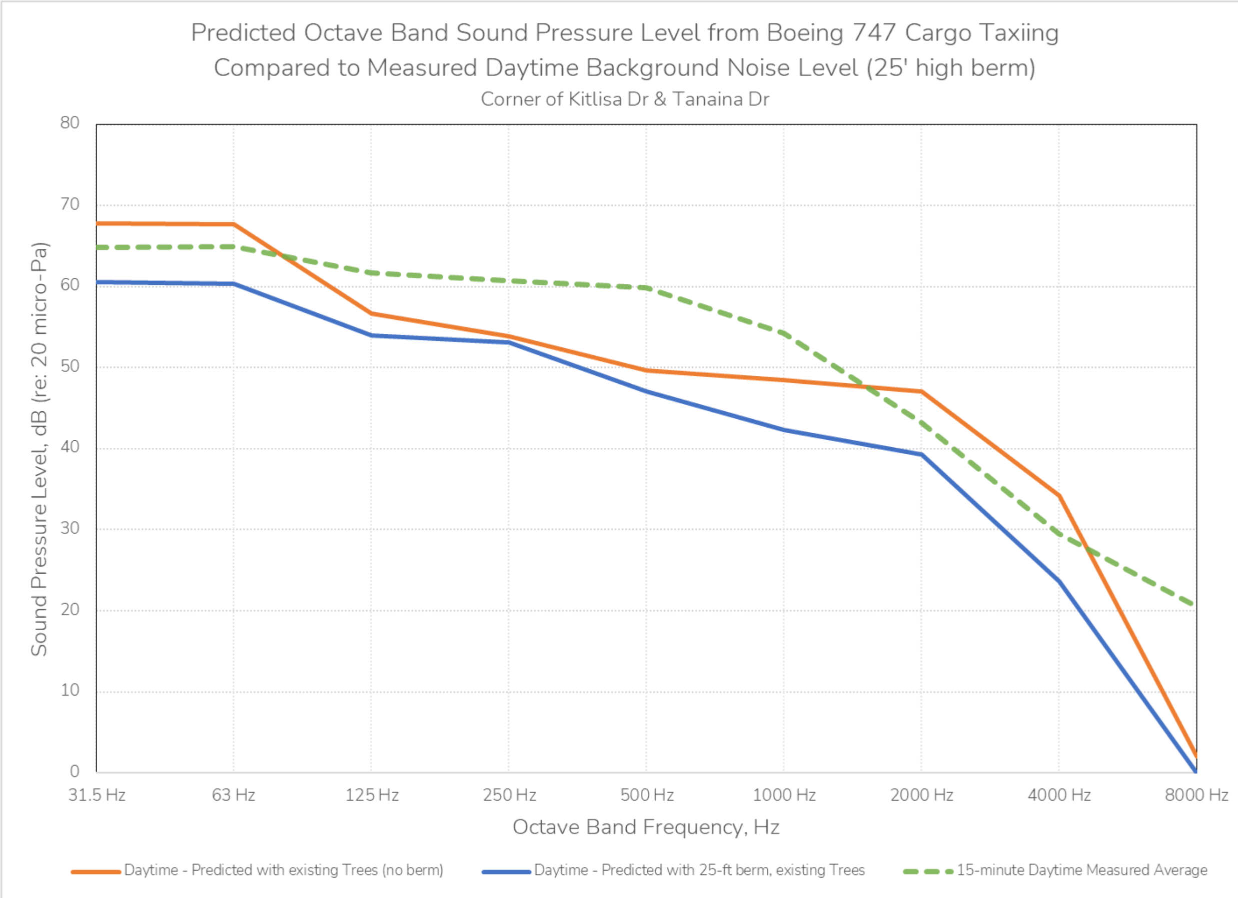


Figure 7: Maximum Predicted Noise Impact from Three Taxiing Aircraft during Daytime Hours (25’-0” berm)

Figure 6 and Figure 7 shows that:

- without the earthen berm the aircraft taxiing might be perceptible at the nearest residential community at low-frequencies and high-frequencies; and
- with the noise control plan and existing foliage the maximum noise from the Airpark planes will be equal to or quieter than the current background noise level measured within the nearest residential community during east and west air traffic flow.

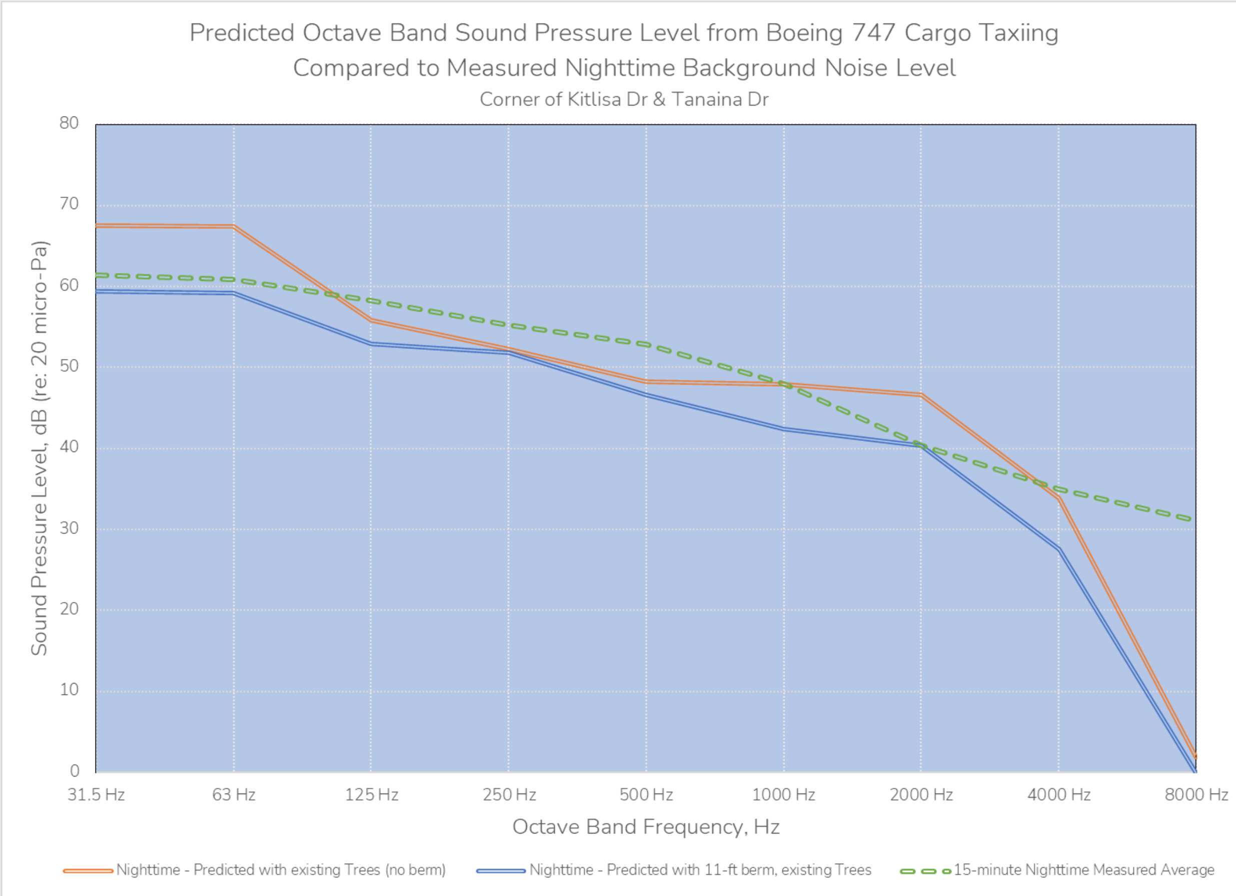


Figure 8: Maximum Predicted Noise Impact from Two Taxiing Aircraft during Nighttime Hours (11'-0" berm)

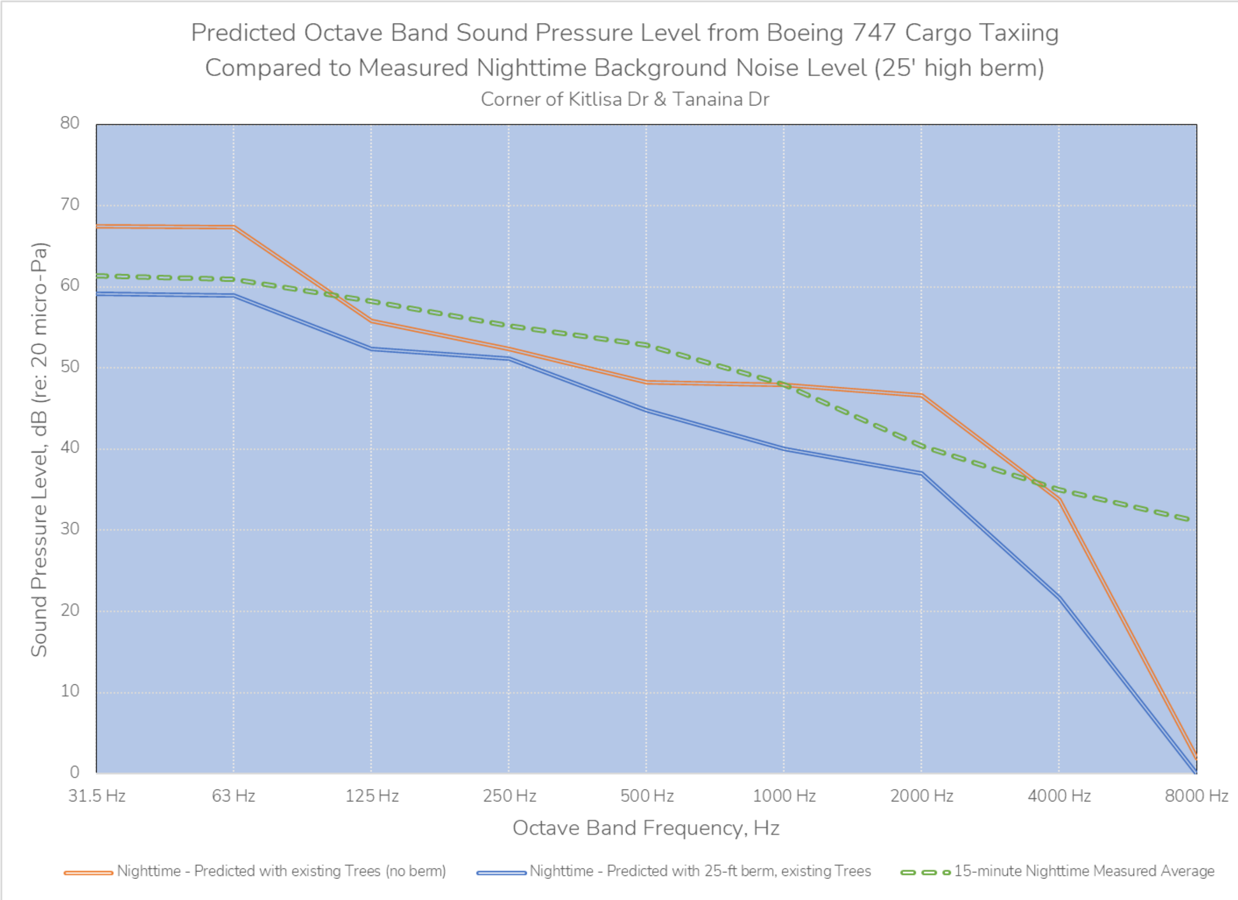


Figure 9: Maximum Predicted Noise Impact from Two Taxiing Aircraft during Nighttime Hours (25'-0" berm)

Figure 8 and Figure 9 shows that:

- without the earthen berm the aircraft taxiing might be perceptible at the nearest residential community at low-frequencies and high-frequencies; and
- with the noise control plan and existing foliage the maximum noise from the Airpark planes will be equal to or quieter than the current background noise level during east and west air traffic flow.

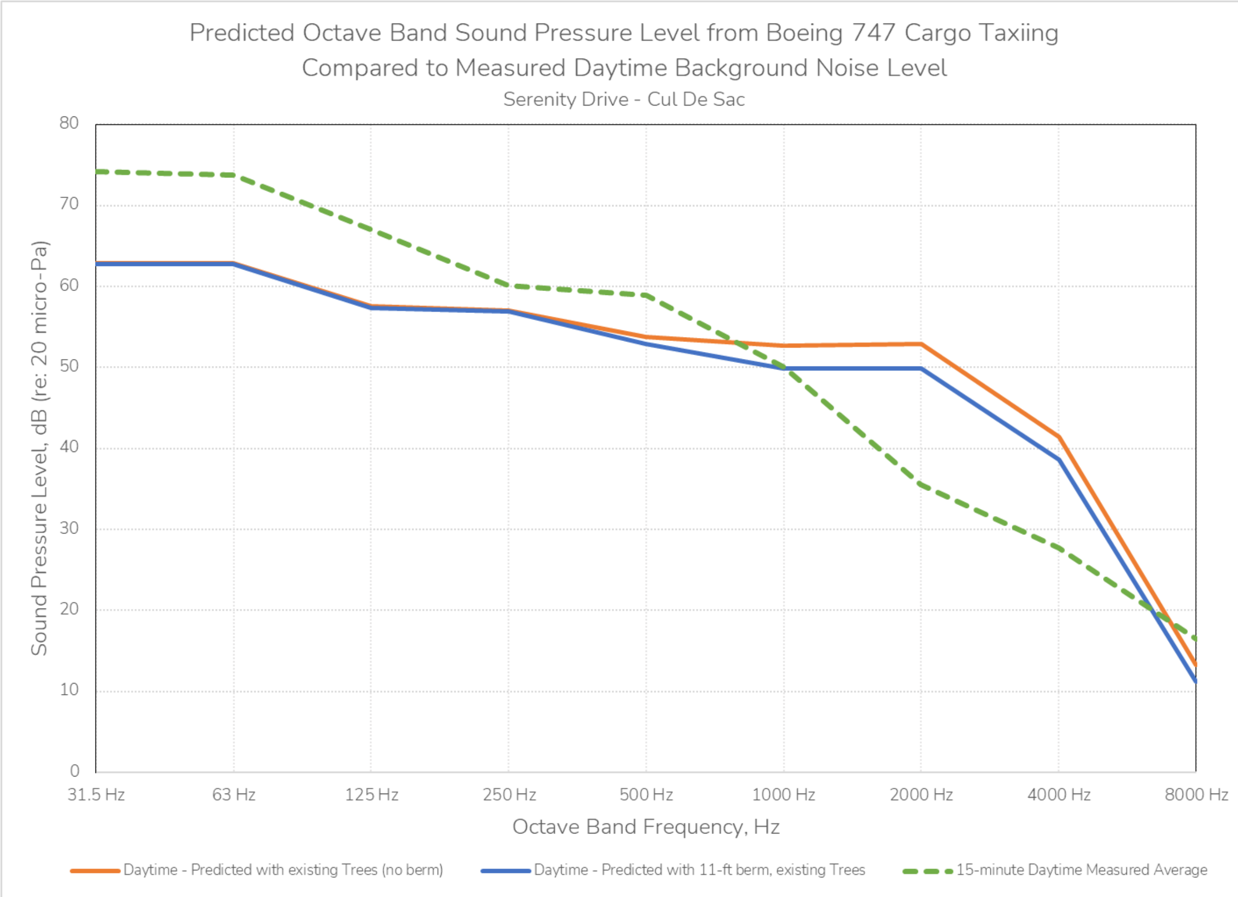


Figure 10: Maximum Predicted Noise Impact from Three Taxiing Aircraft during Daytime Hours (11'-0" berm)

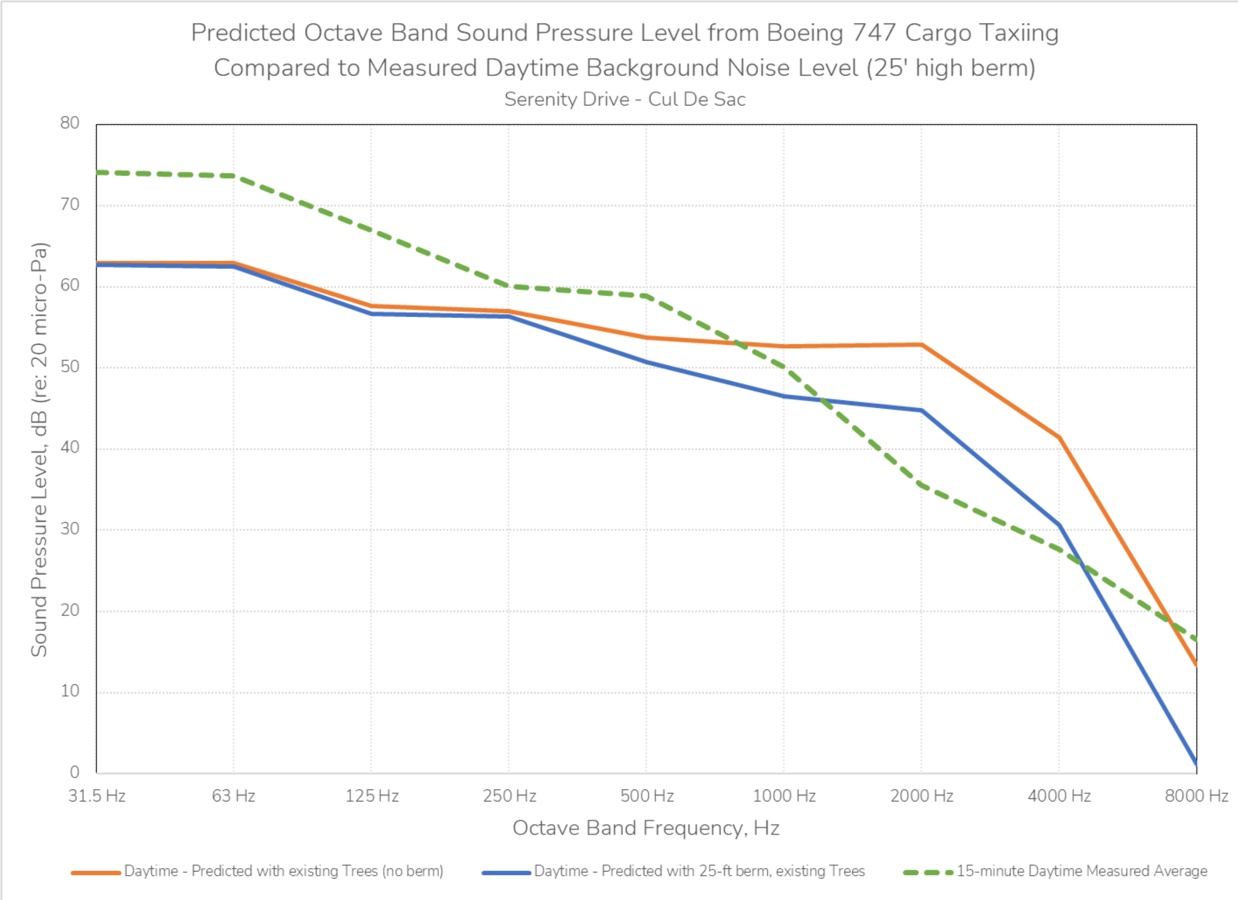


Figure 11: Maximum Predicted Noise Impact from Three Taxiing Aircraft during Daytime Hours (25'-0" berm)

Figure 10 and Figure 11 shows that:

- without the earthen berm the aircraft taxiing may be noticeable; and
- with the noise control plan and existing foliage, the maximum noise from the Airpark planes may be perceptible between 2,000 and 4,000 Hz during east and west air traffic flow. Though the planned 25'-0" berm reduces the noise in these bands by 25% compared to the minimum height berm of 11'-0". The reduced background noise from the measurements is likely a factor of the high sound absorptive performance of snow on the ground during the short-duration measurements. During the 15 minute measurement, four (4) events were equal to or greater than 50 dB at 2,000 Hz, which are comparable to the expected sound level from three (3) aircraft moving concurrently. Based on the findings, the aircraft taxiing operations at the proposed site are not predicted to be a noticeable noise impact on this community compared to the current conditions and will not increase the overall noise within this residential community.

The predicted Day-Night Average Noise Level (DNL) from the new Airpark operations only (21 planes completing 42 trips) is **57 dBA,** with each trip lasting approximately 10 minutes and 54 dBA if the movements last 5 minutes or less. This is less than the DNL of 62 dBA from existing airport operations documented for this community. The FTA noise impact criteria note 'No Impact' if the project DNL does not exceed 59 dBA. Based on the FTA criteria, this project has "No Impact" with respect to noise on the residential community compared to the existing airport operations and existing traffic on Raspberry Road.

The predicted DNL considers the time each plane will taxi within the Airpark in addition to the sound level during taxiing. The modeled sound levels and predicted sound levels presented in Figure 6, Figure 8, and Figure 10 show the instantaneous sound level from multiple aircraft taxiing through the Airpark at a moment in time. The DNL considers the daily impact of the 42 trips through the Airpark based on a conservative duration of taxiing for this relatively small area, which approximately totals 210 to 420 minutes per day or between 3-1/2 to 7 hours depending on the actual time for each aircraft trip time within the Airpark.

4 Noise Control Plan

To optimize the noise reduction between the Airpark and the residential community, the project plan will include a 25'-0" earthen berm that will be landscaped. Our analysis showed that the performance goals can be satisfied with a minimum height berm of 11'-0" above grade. This noise control measure was included in the acoustic model and provided up to 7 dBA of noise reduction (4 dBA from 11'-0" berm and 7 dBA from 25'-0" berm) based on the topography and location of the airframes to the residential receivers.

The operational plan notes that planes will be on engine power during start-up and taxiing. The site will include shore power for all other auxiliary requirements.

5 Conclusion

The modeled results for multiple Boeing 747 (4 engine) aircrafts taxiing concurrently based on the daily operations show that the noise from the Airpark expansion planes are not predicted to be perceptible within the nearest residential community. This project has "No Impact" per the FTA noise impact criteria with respect to noise on the nearest residential community, compared to the existing airport operational noise during east and west aircraft flow charts and compared with measured existing traffic noise along Raspberry Road. The airpark operations are not expected to increase the noise at Kincaid Park compared to current airport operations.

Please contact us with any questions and additional coordination.

All the best,

ERIK MILLER-KLEIN, PE, INCE BOARD CERTIFIED
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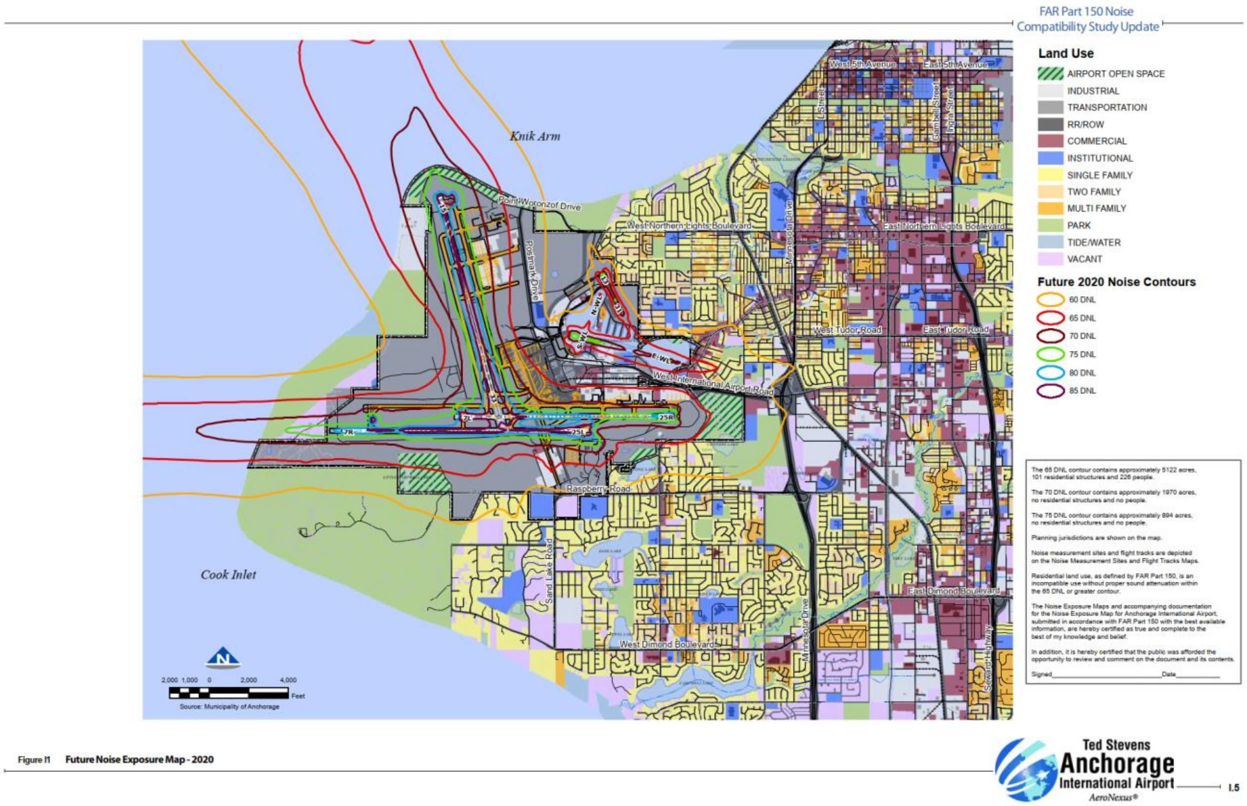
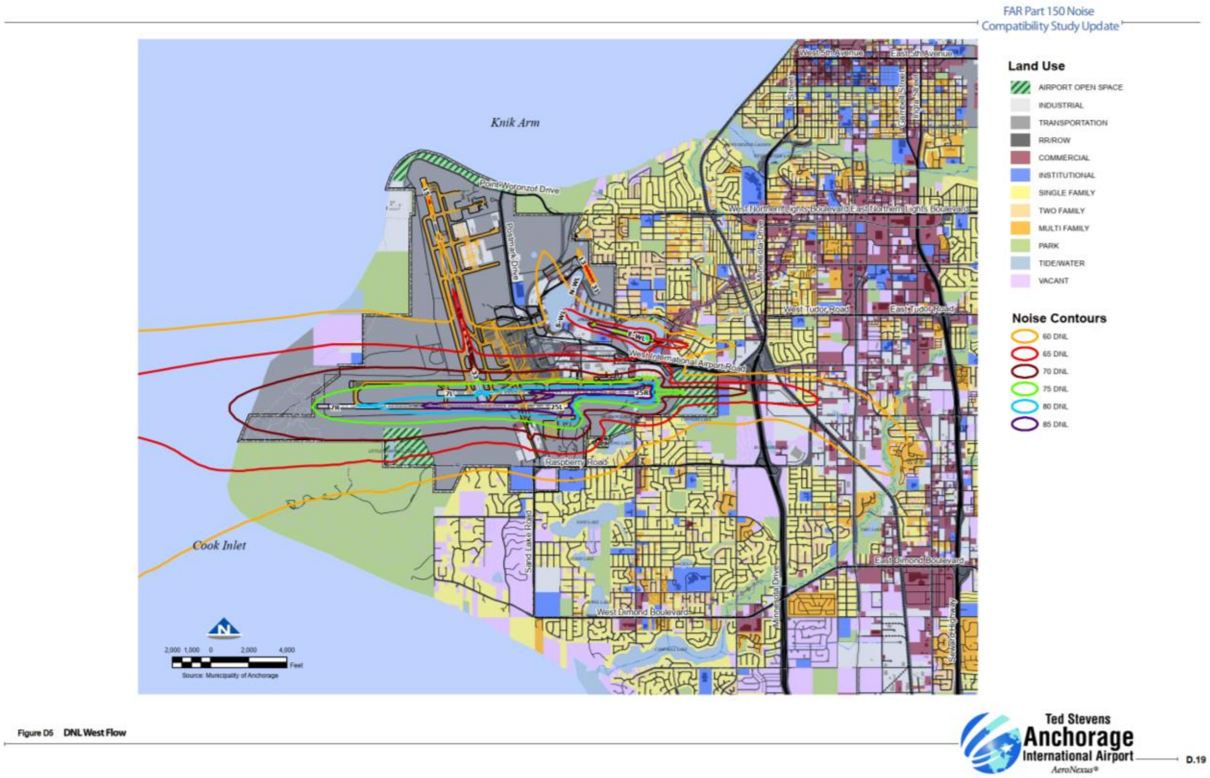
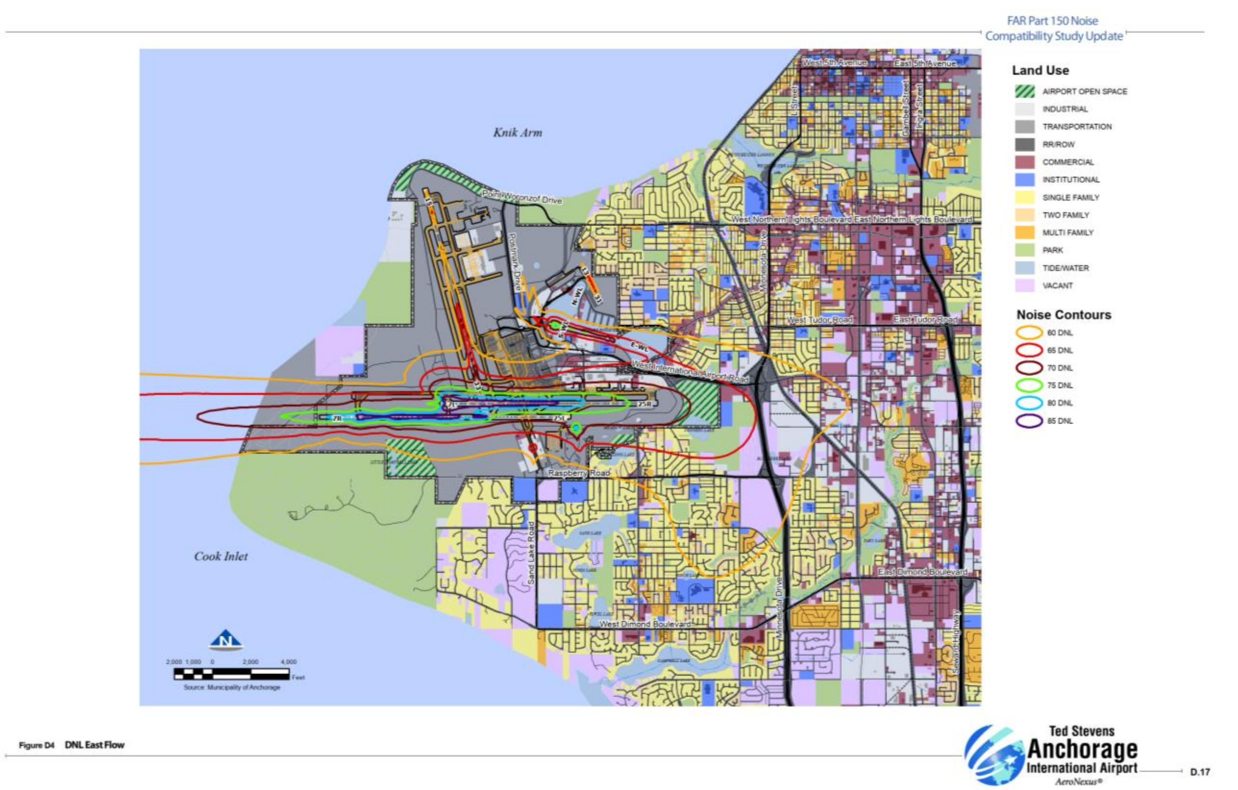
APPENDIX A. 2020 ANC Predicted DNL Noise Contour Map



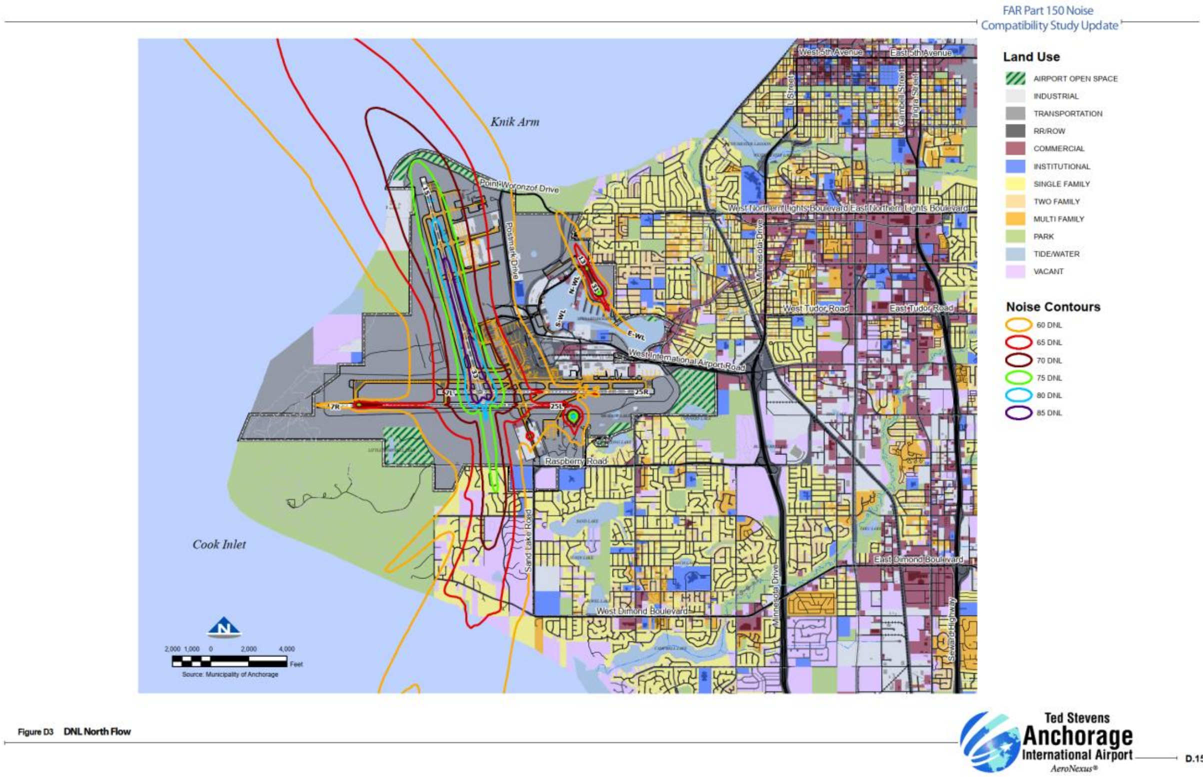
APPENDIX B. 2015 ANC DNL Noise Contour Map by Flow Direction



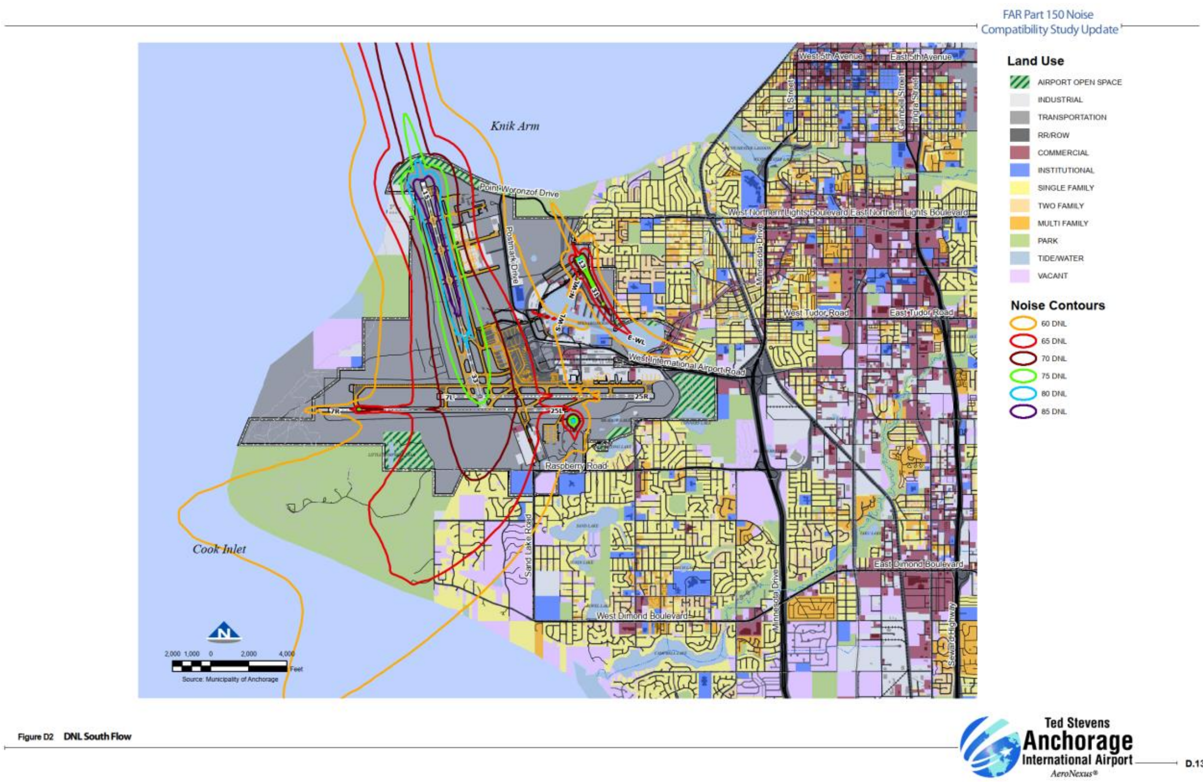
West Flow



East Flow



North Flow



South Flow

APPENDIX C. Descriptors

Sound Pressure Level, L_p – specifies the perceived sound at a receiver or measurement location that is dependent on distance and environmental conditions. This is what a person hears or microphone measures in a location in space, referenced to 20 micro-Pascals.

Sound Power Level, L_w – specifies the sound emission from a source independent of distance and environmental conditions. It is the potential acoustic energy of a source that is calculated and measured based on sound emission and emitting area, referenced to one picowatt.

Average Noise Level (Leq) – is the time-average sound level documented in decibels that is noted with the measured time interval.

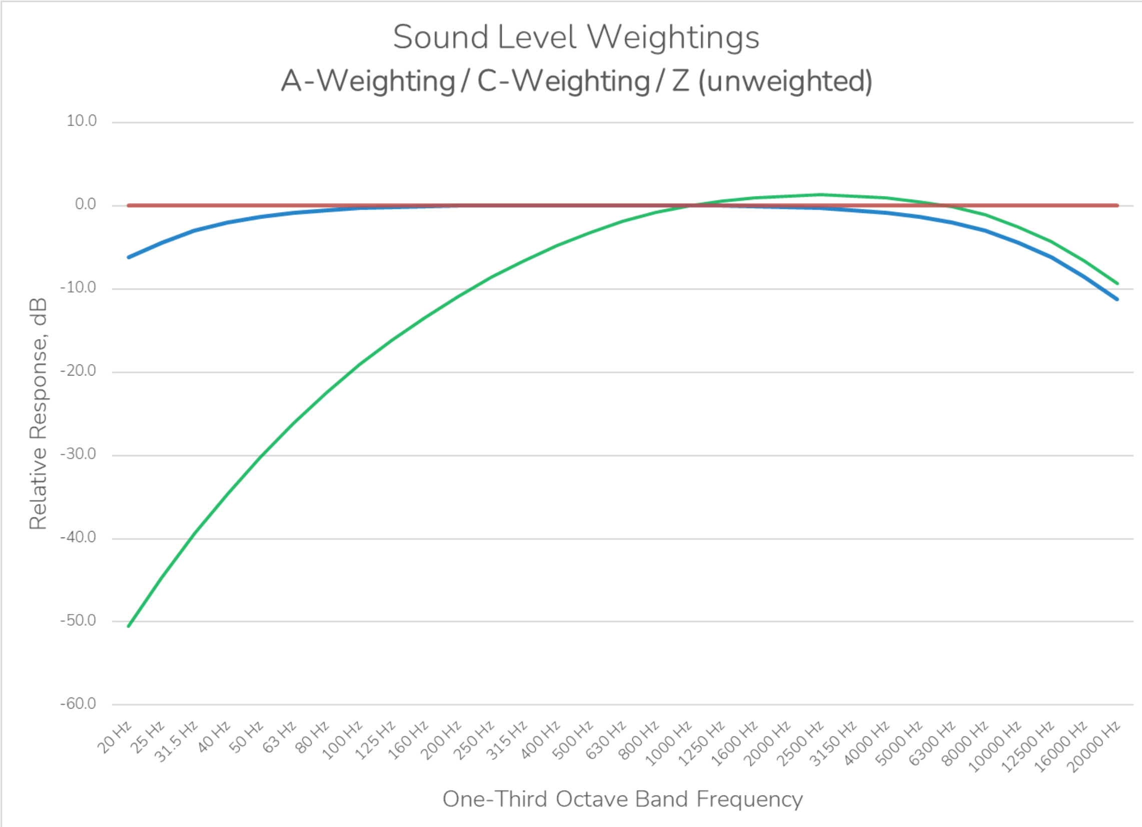
Maximum Sound Level (Lmax) – is the highest sound level measured during a single noise event and is documented with the time response (Slow – 1 second, Fast – 0.125 second, Impulse – 0.035 second).

Day-Night Average Noise Level (Ldn / DNL) – is the average A-weighted sound level for a 24-hour period of time that applies a 10 dB penalty during nighttime (sleeping hours) between 10:00 PM and 7:00 AM the next day. This metric is used to approximate the noise impact from environmental noise on residential communities and multi-family properties/buildings.

A-Weighting (dBA) – is the summed sound level that weighs for the sensitivity of the human ear as a function of frequency for relatively quiet levels of sound. In effect, the A-weighting is based on the 40-phon Fletcher–Munson curves which represented an early determination of the equal-loudness contour for human hearing.

C-Weighting (dBC) – is the summed sound level that weighs for the sensitivity of human hearing for loud sound levels. This weighting follows the inverted shape of the equal-loudness contour passing through 100 dB at 1 kHz. It effectively describes the contribution of low-frequency noise with a single summed value.

Z-Weighting / Unweighted (dBZ) – is the non-weighted summed sound level and is usually used for sound level reporting for one-third and single octave bands.


Sound Level Weightings
A-Weighting / C-Weighting / Z (unweighted)
Relative Response, dB
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
20 Hz
25 Hz
31.5 Hz
40 Hz
50 Hz
63 Hz
80 Hz
100 Hz
125 Hz
160 Hz
200 Hz
250 Hz
315 Hz
400 Hz
500 Hz
630 Hz
800 Hz
1000 Hz
1250 Hz
1600 Hz
2000 Hz
2500 Hz
3150 Hz
4000 Hz
5000 Hz
6300 Hz
8000 Hz
10000 Hz
12500 Hz
16000 Hz
20000 Hz
One-Third Octave Band Frequency