Appendix D – Noise Technical Memorandum

Stantec

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Reference: Noise Technical Memorandum for Hangar 3 Building Demolition Project

INTRODUCTION

Noise Technical Memo Purpose

The purpose of this Noise Technical Memorandum (Memo) is to support the Hangar 3 Building Demolition Project (Proposed Action, Project) National Environmental Policy Act (NEPA) Environmental Assessment (EA). This Memo has been prepared to analyze the potential noise and vibration generated from the Proposed Action and Partial Preservation Alternative to the neighboring sensitive receptors.

Project Location

The National Aeronautics and Space Administration (NASA) is evaluating impacts from the proposed demolition of Hangar 3 at the NASA Moffett Federal Airfield (MFA) located in the portion of the Ames Research Center (ARC) that NASA has leased to Planetary Ventures, LLC (PV or Lessee). The 1,000-acre MFA Lease area is located at the NASA ARC, in Santa Clara County, California. The ARC is located 35 miles south of San Francisco and 10 miles north of San Jose on approximately 2,000 acres of land in the heart of Silicon Valley. The MFA Lease area includes aircraft runways (Moffett Airfield), Hangar 1, Hangar 2, Hangar 3, assorted structures, and an 18-hole golf course. The project site includes Hangar 3 and is located on federal land held by NASA and leased to PV. The Project site is directly adjacent to both the City of Mountain View and the City of Sunnyvale.

Proposed Action – Building Demolition

The Proposed Action would involve the demolition of Hangar 3 to remedy the unsafe condition of Hangar 3 and eliminate an unacceptable structural hazard. The Proposed Action would consist of pre-demolition activities, including inspections and identification of materials, abatement, demolition activities, and waste disposal and recycling

REGULATORY SETTING

Federal Guidelines

In the past, USEPA coordinated all federal noise control activities through its Office of Noise Abatement and Control. However, in 1981, Congress concluded that noise issues were best handled at the state or local level. As a result, the USEPA phased out the office's funding in 1982 as part of a shift in federal noise control policy to transfer the primary responsibility of regulating noise to state and local governments. However, the Noise Control Act of 1972 and the Quiet Communities Act of 1978 were not rescinded by Congress and remain in effect today although essentially unfunded. Additionally, Title IV – Noise Pollution of the CAA provides guidance to state and local entities for establishing appropriate noise control standards.

For highway projects with Federal Highway Administration (FHWA) involvement, 23 Code of Federal Regulations 722 governs the analysis and abatement of traffic noise impacts. Since this project does not involve a highway with FHWA involvement, no Federal Guidelines apply to the Hangar 3 Building Demolition Project.

State Guidelines

The State of California has adopted noise standards in areas of regulation not preempted by the federal government. State standards regulate noise levels of motor vehicles, sound transmission through buildings, occupational noise control, and noise insulation. Title 24 of the California Code of Regulations, also known as the California Buildings Standards Code, establishes building standards applicable to all occupancies throughout the state. Section 1207 of the California Building Code provides acoustical regulations for both exterior-to-interior sound insulation as well as sound and impact isolation between adjacent spaces of various occupied units. Title 24 regulations generally state that interior noise levels generated by exterior noise sources shall not exceed 45 A-weighted decibels (dBA) day-night sound level (Ldn)/Community Noise Equivalent Level (CNEL), with windows closed, in any habitable room for general residential uses. The Green Buildings Standards Code establishes maximum one-hour Leq exterior noise levels for commercial buildings. Since this project does not involve the construction of any new buildings, no state guidelines apply to the Hangar 3 Building Demolition Project.

Local Guidelines

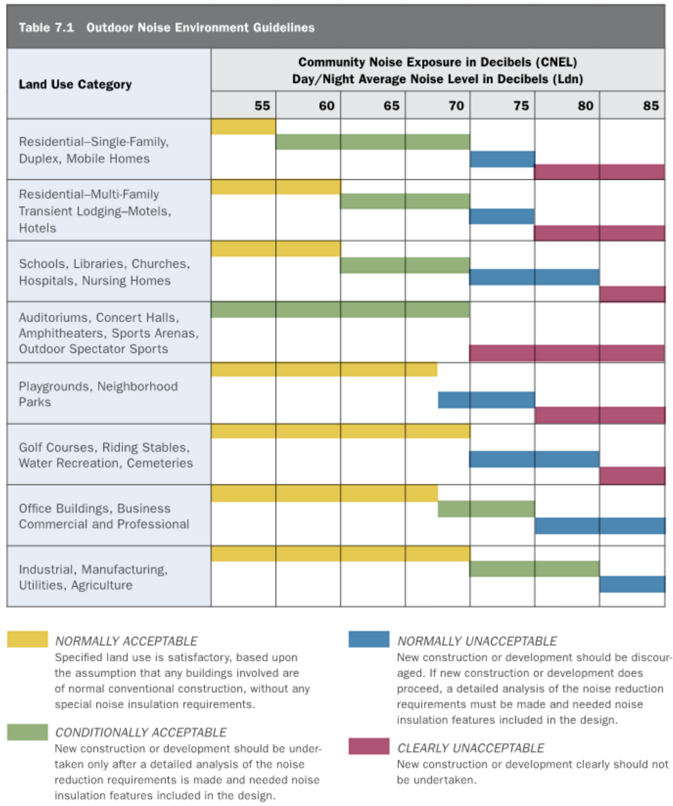
Noise sources associated with construction and demolition activities are generally subject to local control through noise ordinances and general plan policies. Local general plans identify general principles intended to guide and influence development plans.

Mountain View 2030 General Plan

Chapter 7 “Noise” within the Mountain View 2030 General Plan[1] (adopted July 2012) offers policies for addressing exposure to current and projects noise sources in Mountain View. Table 7.1 “Outdoor Noise

[1] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?blobid=10702

Environment Guidelines" in the Mountain View 2030 General Plan is provided below and identifies land use compatibility noise standards for land uses affected by transportation and non-transportation noise sources.



Source: State of California General Plan Guidelines, 2003.

The Mountain View General Plan Action Items List, 2018[2] also identifies the following regarding construction noise:

- NOI 1.6.3 "Truck Traffic". Encourage a limitation on commercial, industrial, and construction truck traffic through residential areas by measures such as requiring truck traffic routes and traffic plans be identified for new construction and new commercial and industrial areas.

Mountain View Municipal Code

Chapter 8 "Buildings", Article VI "Construction Noise", Section 8.70 "Construction noise" of the Mountain View Municipal Code[3] states the following:

a. *Hours of construction. No construction activity shall commence prior to 7:00 a.m. nor continue later than 6:00 p.m., Monday through Friday, nor shall any work be permitted on Saturday or Sunday or holidays unless prior written approval is granted by the chief building official. The term "construction activity" shall include any physical activity on the construction site or in the staging area, including the delivery of materials. In approving modified hours, the chief building official may specifically designate and/or limit the activities permitted during the modified hours.*

b. *Modification. At any time before commencement of or during construction activity, the chief building official may modify the permitted hours of construction upon twenty-four (24) hours written notice to the contractor, applicant, developer, or owner. The chief building official can reduce the hours of construction activity below the 7:00 a.m. to 6:00 p.m. time frame or increase the allowable hours.*

c. *Sign required. If the hours of construction activity are modified, then the general contractor, applicant, developer, or owner shall erect a sign at a prominent location on the construction site to advise subcontractors and material suppliers of the working hours. The contractor, owner or applicant shall immediately produce upon request any written order or permit from the chief building official pursuant to this section upon the request of any member of the public, the police or city staff.*

[2] https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=26547
[3] https://library.municode.com/ca/mountain_view/codes/code_of_ordinances?nodeId=PTIITHCO_CH8BU_ARTVICONO

d. *Violation. Violation of the allowed hours of construction activity, the chief building official's order, required signage or this section shall be a violation of this code.*

City of Sunnyvale Moffett Park Specific Plan

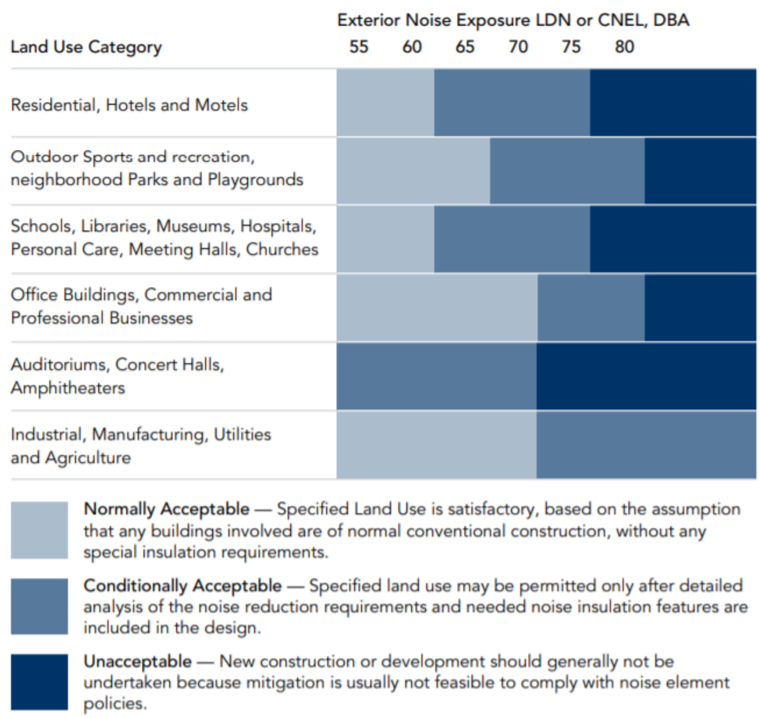
The City of Sunnyvale Moffett Park Specific Plan, Updated 2013[4], identifies planning framework for the land area bordered by Moffett Federal Airfield, the closed Sunnyvale Landfill and the Sunnyvale Materials Recovery and Transfer Station, State Highway 237, and Baylands Park in Sunnyvale, California. This document contains no guidelines or requirements relating to noise.

Sunnyvale General Plan

Chapter 6 "Noise" within the Sunnyvale General Plan[5] (adopted July 2011) offers policies for addressing exposure to current and project noise sources in Sunnyvale. Figure 6-5 "State of California Noise Guidelines for Land Use Planning Summary of Land Use Compatibility for Community Noise Environment" is provided below and identifies noise standards for specific land uses affected by noise.

Figure 6-6 in the Sunnyvale General Plan (shown below) defines a "significant" noise impact based on the Ldn category of an existing development, the exterior noise exposure category listed in Figure 6-5, and the noise increase estimated from a particular new development. For example, if an existing property currently experiences ambient noise levels that are "conditionally acceptable", a significant impact would occur if a new property caused the ambient noise levels to increase more than 3 dB.

Figure 6-5: State of California Noise Guidelines for Land Use Planning Summary of Land Use Compatibility for Community Noise Environment



Source: Illingworth and Rodkin, Inc. / Acoustics – Air Quality, 1997

4 https://sunnyvale.ca.gov/civicax/filebank/blobdload.aspx?blobid=22831
5 https://sunnyvale.ca.gov/civicax/filebank/blobdload.aspx?blobid=23733

Figure 6-6: Significant Noise Impacts from New Development on Existing Land Use

Ldn Category of Existing Development Per Figure 6-4	Noise Increase Considered "Significant" over Existing Noise Levels
Normally Acceptable	An increase of more than 3 dBA and the total Ldn exceeds the "normally acceptable" category
Normally Acceptable	An increase of more than 5 dBA
Conditionally Acceptable	An increase of more than 3 dBA
Unacceptable	An increase of more than 3 dBA

The City of Sunnyvale General Plan also states the following regarding traffic noise from major roadways:

> *"Major roadways cause most of the transportation noise in Sunnyvale. Sunnyvale has an interstate, three highways, two expressways and numerous arterial and collector streets within or near its borders. Virtually all existing homes next to freeways and expressways are protected by sound walls or depressed grades. Traffic noise is generally not an issue for commercial, office, and industrial uses."*

Sunnyvale Municipal Code

Paragraph 16.080.030 "Hours of Construction – Time and Noise Limitations" in the Sunnyvale Municipal Code[6] states the following:

> *Construction activity shall be permitted between the hours of 7a.m. and 6 p.m. daily Monday through Friday. Saturday hours of operation shall be between 8 a.m. and 5 p.m. There shall be no construction activity on Sunday or federal holidays when city offices are closed.*
>
> *No loud environmentally disruptive noises, such as air compressors without mufflers, continuously running motors or generators, loud playing musical instruments, radios, etc., will be allowed where such noises may be a nuisance to adjacent residential neighborhoods.*
>
> *Exceptions:*
>
> *b) As determined by the chief building official:*
>
> *1) No loud environmentally disruptive noises, such as air compressors without mufflers, continuously running motors or generators, loud playing musical instruments, radios, etc., will be allowed where such noises may be a nuisance to adjacent properties.*
>
> *2) Where emergency conditions exist, construction activity may be permitted at any hour or day of the week. Such emergencies shall be completed as rapidly as possible to prevent any disruption to other properties.*

[6] https://qcode.us/codes/sunnyvale/

3) *Where additional construction activity will not be a nuisance to surrounding properties, based on location and type of construction, a waiver may be granted to allow hours of construction other than as stated in this section.*

AFFECTED ENVIRONMENT

Noise Fundamentals and Terminology

Noise is generally defined as unwanted sound that annoys or disturbs people and potentially causes an adverse psychological or physiological effect on human health. Because noise is an environmental pollutant that can interfere with human activities, evaluation of noise is necessary when considering the environmental impacts of a proposed project.

Sound is mechanical energy (vibration) transmitted by pressure waves over a medium such as air or water. Sound is characterized by various parameters that include the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level or energy content (amplitude). In particular, the sound pressure level is the most common descriptor used to characterize the loudness of an ambient (existing) sound level. Although the decibel (dB) scale, a logarithmic scale, is used to quantify sound intensity, it does not accurately describe how sound intensity is perceived by human hearing. The perceived loudness of sound is dependent upon many factors, including sound pressure level and frequency content. The human ear is not equally sensitive to all frequencies in the entire spectrum, so noise measurements are weighted more heavily for frequencies to which humans are sensitive in a process called A-weighting, written as dBA and referred to as A-weighted decibels. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. Table 1 defines sound measurements and other terminology used in this Memo, and Table 2 summarizes typical A-weighted sound levels for different noise sources.

With respect to how humans perceive and react to changes in noise levels, a 1 dBA increase is imperceptible, a 3 dBA increase is barely perceptible, a 5 dBA increase is clearly noticeable, and a 10 dBA increase is subjectively perceived as approximately twice as loud (Egan 2007). These subjective reactions to changes in noise levels were developed on the basis of test subjects' reactions to changes in the levels of steady-state pure tones or broadband noise and to changes in levels of a given noise source. These statistical indicators are thought to be most applicable to noise levels in the range of 50 to 70 dBA, as this is the usual range of voice and interior noise levels. A number of agencies and municipalities have developed or adopted noise level standards consistent with these and other similar studies to help prevent annoyance and to protect against the degradation of the existing noise environment.

Different types of measurements are used to characterize the time-varying nature of sound. These measurements include the equivalent sound level (Leq), the minimum and maximum sound levels (Lmin and Lmax), percentile-exceeded sound levels (such as L_{10} and L_{20}), the day-night sound level (Ldn), and the community noise equivalent level (CNEL). Ldn and CNEL values differ by less than 1 dB. As a matter of practice, Ldn and CNEL values are considered to be equivalent and are treated as such in this assessment.

For a point source such as a stationary compressor or demolition equipment, sound attenuates based on geometry at a rate of 6 dB per doubling of distance. For a line source such as free-flowing traffic on a freeway, sound attenuates at a rate of 3 dB per doubling of distance[7]. Atmospheric conditions, including wind, temperature gradients, and humidity, can change how sound propagates over distance and can affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy also affects sound propagation. Sound that travels over an acoustically absorptive surface, such as

[7] Federal Highway Administration Analysis and Abatement Guidance document 2011, https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/

grass, attenuates at a greater rate than sound that travels over a hard surface, such as pavement. The increased attenuation is typically in the range of 1 to 2 dB per doubling of distance. Barriers, such as buildings and topography that block the line of sight between a source and receiver, also increase the attenuation of sound over distance.

Table 1: Definition of Sound Measurement

Sound Measurements	Definition
Decibel (dB)	A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.
A-Weighted Decibel (dBA)	An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.
C-Weighted Decibel (dBC)	The sound pressure level in decibels as measured using the C- weighting filter network. The C-weighting is very close to an unweighted or flat response. C-weighting is only used in special cases when low-frequency noise is of particular importance. A comparison of measured A- and C-weighted level gives an indication of low frequency content.
Maximum Sound Level (Lmax)	The maximum sound level measured during the measurement period.
Minimum Sound Level (Lmin)	The minimum sound level measured during the measurement period.
Equivalent Sound Level (Leq)	The equivalent steady-state sound level that in a stated period of time would contain the same acoustical energy.
Percentile-Exceeded Sound Level (L_{xx})	The sound level exceeded xx percent of a specific time period. L_{10} is the sound level exceeded 10 percent of the time. L_{90} is the sound level exceeded 90 percent of the time. L_{90} is often considered to be representative of the background noise level in a given area.
Day-Night Level (Ldn)	The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10:00 PM to 7:00 AM.
Community Noise Equivalent Level (CNEL)	The energy average of the A-weighted sound levels occurring during a 24-hour period with 5 dB added to the A-weighted sound levels occurring during the period from 7:00 PM to 10:00 PM and 10 dB added to the A-weighted sound levels occurring during the period from 10:00 PM to 7:00 AM.
Peak Particle Velocity (Peak Velocity or PPV)	A measurement of ground vibration defined as the maximum speed (measured in inches per second) at which a particle in the ground is moving relative to its inactive state. PPV is usually expressed in inches/second.
Frequency: Hertz (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure.

Source: Federal Highway Administration Construction Noise Handbook, 2006 (https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook02.cfm)

Table 2: Typical A-Weighted Sound Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	-110-	Rock band
Jet flyover at 1,000 Feet		
	-100-	
Gas lawnmower at 3 Feet		
	-90-	
Diesel truck at 50 Feet at 50 MPH		Food blender at 3 Feet
Noisy urban area, daytime	-80-	Garbage Disposal at 3 Feet
Gas lawnmower, 100 Feet		
Commercial area	-70-	Vacuum Cleaner at 10 Feet
Heavy traffic at 300 Feet		Normal Speech at 3 Feet
	-60-	
Quiet urban daytime		Large business office
	-50-	Dishwasher in next room
Quiet urban nighttime		
Quiet suburban nighttime	-40-	Theater, large conference room (Background)
Quiet rural nighttime	-30-	Library
	-20-	Bedroom at night, concert hall (Background)
	-10-	Broadcast/recording studio
	-0-	

Source: Caltrans, Technical Noise Supplement Traffic Noise Analysis Protocol, September 2013 (https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/tens-sep2013-a11y.pdf)

Decibel Addition

Because decibels are logarithmic units, sound pressure levels cannot be added or subtracted through ordinary arithmetic. On the dB scale, a doubling of sound energy corresponds to a 3 dB increase. In other words, when two identical sources are each producing sound of the same loudness, their combined sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one source produces a sound pressure level of 70 dBA, two identical sources would combine to produce 73 dBA. The cumulative sound level of any number of sources can be determined using decibel addition.

Vibration Standards

Vibration is like noise such that noise involves a source, a transmission path, and a receiver. While related to noise, vibration differs in that noise is generally considered to be pressure waves transmitted through air, whereas vibration usually consists of the excitation of a structure or surface. As seismic waves travel outward from a vibration source, they excite the particles of rock and soil through which they pass and cause them to oscillate. The actual distance that these particles move is usually only a few ten-thousandths to a few thousandths of an inch. The rate or velocity (in inches per second) at which these particles move is the commonly accepted descriptor of the vibration amplitude, referred to as the peak particle velocity (PPV).

Vibration can be measured in terms of acceleration, velocity, or displacement. A common practice is to monitor vibration measures in terms of PPV. Standards pertaining to perception as well as damage to structures have been developed by the California Department of Transportation for vibration levels defined in terms of peak particle velocities (Tables 3 and 4, respectively).

A person's perception to vibration depends on their individual sensitivity to vibration, as well as the amplitude and frequency of the source and the response of the system that is vibrating. Human and structural response to different vibration levels is influenced by a number of factors, including ground type, distance between source and receptor, duration, and the number of perceived vibration events. Table 3 notes that the general threshold at which human annoyance could occur is 0.1 PPV. Table 4 indicates the threshold for damage to structures ranges from 0.2 to 0.5 PPV, depending on the condition of the structure.

Table 3: Guideline Vibration Annoyance Potential Criteria

Human Response	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Sources
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.1
Severe	2.0	0.4

Notes: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seal equipment, vibratory pile drivers, and vibratory compaction equipment.
In/sec = inches per second
Source: California Department of Transportation 2004

Table 4: Guideline Vibration Damage Potential Criteria

Structure and Condition	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structure	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Note:
in/sec = inches per second
Source: California Department of Transportation 2004.

Operation of heavy construction and demolition equipment creates seismic waves that radiate along the surface of the Earth and downward into the Earth. These surface waves can be felt as ground vibration. Vibration from operation of this equipment can result in effects ranging from annoyance of people to damage of structures. Varying geology and distance will result in different vibration levels containing different frequencies and displacements. In all cases, vibration amplitudes will decrease with increasing distance.

Perceptible groundborne vibration is generally limited to areas within a few hundred feet of construction/demolition activities.

Table 5 summarizes typical vibration source levels generated by various construction/demolition equipment as defined by the FTA Transit Noise and Vibration Impact Assessment Manual. The Manual does not identify specific equipment related to micropile drilling as a major vibration source and states “drilled piles causes lower vibration levels where the geological conditions permit their use”. Therefore, no reference PPV levels are included in the manual for micropile drilling equipment.

Table 5: Vibration Source Levels for Construction/Demolition Equipment

Equipment	PPV at 25 Feet
Large bulldozer	0.089
Loaded trucks	0.076
Small bulldozer	0.003
Pile Driver (Sonic, Typical)	0.17
Pile Driver (Sonic, Upper Range)	0.734

Source: Federal Transit Administration Transit Noise and Vibration Impact Assessment Manual, September 2018

Vibration amplitude attenuates over distance and is a complex function of how energy is imparted into the ground and the soil conditions through which the vibration is traveling. The following equation can be used to estimate the vibration level at a given distance for typical soil conditions (Federal Transit Administration 2018). PPVref is the reference PPV from Table 5:

PPV = PPVref x (25/Distance)^1.5

Identification of Sensitive Receptors and Existing Ambient Noise Levels

Sensitive Receptors

Some land uses are more tolerant of noise than others. For example, schools, hospitals, churches, and residences are more sensitive to noise intrusion than are commercial or industrial activities. Ambient noise levels can also affect the perceived desirability or livability of a development.

Hangar 3 is located at Moffett Field near the cities of Mountain View and Sunnyvale, California. The nearest existing noise-sensitive receptors are the multifamily residential buildings at Wescoat Village at Moffett Field approximately 5,330 feet to the southwest. Exterior active-use areas, such as the Bay Trail and The Golf Club at Moffett Field could also be considered noise-sensitive receptors since walkers, joggers, cyclists, and golfers will be utilizing these spaces for recreation and relaxation. The Project edge is located approximately 3,512’ from the Bay Trail and about 550’ from the golf course.

The nearest vibration-sensitive structure to the Hangar 3 is Building 055, which is located about 57’ from Hangar 3. Hangar 2 is approximately 180 feet from Hangar 3. In addition to Building 055 and Hangar 2, there are existing utilities, which run very close to the area marked for micropile drilling activity.

Ambient Noise Levels

The existing noise environment in a project area is characterized by the area's general level of development due to the high correlation between the level of development and ambient noise levels. Areas that are not urbanized are relatively quiet, while areas that are more urbanized are noisier as a result of roadway traffic, industrial activities, and other human activities.

The area around the project site in the cities of Mountain View and Sunnyvale contains several major noise sources, including highways and busy roadways, such as U.S. Highway 101 (US 101), State Route (SR) 85, SR 237, Central Expressway, and West El Camino Real. Other sources of noise, including rail lines, such as freight rail, Caltrain, and aircraft traffic from Moffett Field, also impact the community.

Noise contours in the Cities of Mountain View and Sunnyvale General Plans were referenced to consider the ambient noise levels at the neighboring properties around the Project site. Figure 7.3, Noise Contours, 2030, in the City of Mountain View 2030 General Plan indicates that the nearest noise-sensitive receptor, Wescoat Village, is located within the 60-70 A-weighted decibels (dBA) Community Noise Equivalent Level (CNEL)/Ldn contour area because of the community's proximity to US 101.

The 2010 Noise Conditions in Sunnyvale, presented in Figure 6-4, 2010 Noise Conditions Map, in the Sunnyvale General Plan shows the noise levels experienced by the commercial properties along Enterprise Way south of 5th Avenue range between below 60 dBA Ldn to greater than 75 dBA Ldn with the loudest ambient noise levels experienced closest to the intersection of SR 237 and US 101.

Figure 5, 2022 Aircraft Noise Contours, in the November 2012 Comprehensive Land Use Plan Santa Clara County Moffett Federal Airfield document, was also referenced to determine previously determined noise conditions at the Project site (SCC ALUC 2012). The figure shows the western edge of the Project site falls between the 70-75 CNEL noise contour. Noise levels from the airfield decrease to the east, away from the runway. The golf course is located outside the 65 dBA CNEL noise contour.

Given the range and age of data in the existing planning documents, noise levels at Wescoat Village were projected using measured ambient noise levels from the May 16, 2019, East Whisman Precise Plan Noise and Vibration Assessment document prepared by Illingworth & Rodkin, Inc. The ambient noise levels from this study were used to estimate the conditions experienced at Wescoat Village referenced because of the more recent timing of the measurements and the similarity between the distance to US 101 measurements were made and distance to US 101 of Wescoat Village.

Long-term and short-term ambient noise measurement locations taken for the East Whisman Precise Plan noise monitoring survey are shown in Figure 1 in the above-cited document. While noise measurements for that Project were taken on the south side of US 101, and varying terrain, screening, and vehicle fleet mix volumes could impact overall noise levels, for the purposes of this analysis, it was considered reasonable to estimate noise north of US 101 at Wescoat Village from these measurements. To be conservative, a line source hemispherical radiation pattern for traffic on US 101 was used and only losses from distance (i.e., not from other sources such as varying terrain or screening) from the roadway were considered. When doing so, it appears that measurements made south of US 101 were comparable to those at the same distance to the north of the US 101.

The noise monitoring survey for the East Whisman Precise Plan was conducted between Tuesday, November 15, and Thursday, November 17, 2016. Measurement Location ST-2 at the corner of National Avenue and Fairchild Drive was approximately 142 feet from the edge of US 101. Measurement Location ST-9 at the parking area west of 516 Clyde Avenue was about 1,481 feet from the edge of US 101. The ambient noise levels measured at these locations were 73 dBA Ldn at ST-2 and 52 dBA Ldn at ST-9.

Wescoat Village occupies an area that is as close as 80 feet and as far as 1,074 feet away from US 101. Accounting for distance attenuation from a line source, expected noise levels at Wescoat Village could be as high as 74 dBA Ldn at the edge of the property closest to US 101 and about 54 dBA Ldn at the edge of the property farthest away from US 101. This estimate presents a slightly wider range of noise levels than shown in the City of Mountain View 2030 General Plan contours. Since this estimation is based on actual noise measurements conducted later than the measurements for the General Plans, the ambient noise levels at Wescoat Village were assumed to range between 54 dBA Ldn and 74 dBA Ldn.

APPROACH TO ANALYSIS

In accordance with NEPA requirements, the noise analysis contained in this Memo evaluates the Proposed Action's noise and vibration sources to determine the impact of the Proposed Action on the existing ambient noise environment. The following approach was used for the analysis:

Construction Traffic

Impacts from future demolition-related traffic, both vehicular and heavy truck, were estimated using predicted traffic counts for the Project provided by Stantec Consulting Services Inc. (Stantec). Noise levels generated by heavy construction truck traffic along 5th Avenue was estimated using the SoundPLAN acoustic modeling software. The impact of noise generated from demolition worker traffic on the surrounding neighborhood was determined using the guidelines listed in the Environmental Protection Agency Region 10 Environmental Impact Statement Guidelines, April 1973. These guidelines have been used as industry standard to determine the potential impact of noise increases on communities.

Traffic noise primarily depends on traffic volumes, speed (tire noise increases with speed) and the proportion of truck traffic (trucks generate engine, exhaust, and wind noise in addition to tire noise). For example, it takes 25 percent more traffic volume with the same vehicle mix to produce an increase of only 1 dBA in the ambient noise level. A doubling of traffic volume with the same vehicle mix results in a 3 dBA increase in noise levels. Increases in the proportion of truck traffic may result in the same ambient noise level increase even if the total traffic volume is less than the examples described above.

Most people will tolerate a small increase in background noise (up to about 5 dBA) without complaint, especially if the increase is gradual over a period of years (such as from gradually increasing traffic volumes). Increases greater than 5 dBA may cause complaints and interference with sleep. Increases above 10 dBA (heard as a doubling of judged loudness) are likely to cause complaints and should be considered a serious increase. Table 6 defines each of the traditional impact descriptions, their quantitative range, and the qualitative human response to changes in noise levels.

Table 6: EPA Impact Guidelines

Increase over Existing or Baseline Sound Levels	Impact Per EPA Region Guidelines	Qualitative Human Perception of Difference in Sound Levels
0 dB to 5 dB	Minimum Impact	Imperceivable or Slight Difference
6 dB to 10 dB	Significant Impact	Significant Noticeable Difference – Complaints Possible
Over 10 dB	Serious Impact	Loudness Changes by a Factor of Two or Greater. Clearly Audible Difference – Complaints Likely

Source: Environmental Protection Agency Region 10 Environmental Impact Statement Guidelines, April 1973

Demolition Noise and Vibration

The FHWA Roadway Construction Noise Model (RCNM) was used to estimate noise generated from construction/demolition activities. The RCNM is used as FHWA's national standard for predicting noise generated from construction and demolition activities. The RCNM analysis includes the calculation of noise levels (Lmax and Leq) at incremental distances for a variety of construction and demolition equipment. The spreadsheet inputs include acoustical use factors, Lmax values, and Leq values at various distances depending on the ambient noise measurement location. Demolition noise levels were calculated for each phase of construction based on a specific equipment list for each phase. The Cities of Mountain View and Sunnyvale do not have explicit noise limits for construction/demolition work to determine impacts. Therefore, the noise limits listed Table 7-3 "Detailed Analysis Construction Noise Criteria" in the 2018 FTA Transit Noise and Vibration Impact Assessment Manual was used to determine impacts from demolition activity. The noise limits listed in Table 7-3 are as follows:

Table 7-3 Detailed Analysis Construction Noise Criteria

Land Use	$L_{eq.equip(8hr)}$, dBA Day	Night	$L_{dn.equip(30day)}$, dBA 30-day Average
Residential	80	70	75
Commercial	85	85	80*
Industrial	90	90	85*

*Use a 24-hour $L_{eq(24hr)}$ instead of $L_{dn.equip(30day)}$.

Since demolition activities would occur during daytime hours only and the closest noise sensitive receptors are residential or recreational uses, the Residential Daytime Leq (8 hour) level from the table above was used as a threshold. Noise impacts associated with the Project would be considered significant if levels exceed 80 dB(A) Leq at the closest sensitive receptors.

Vibration from demolition equipment is analyzed at the surrounding buildings and compared to the applicable California Department of Transportation (Caltrans) building damage criteria to determine whether demolition activities would generate vibration at levels that could result in building damage. Vibration impacts would be significant if any vibrations from continuous/frequent sources would exceed 0.25 in/sec peak particle velocity (PPV) for "historic and some old" buildings. The "historic and some old buildings" category was considered the most appropriate category to reflect the structure and condition of Building 055.

ENVIRONMENTAL CONSEQUENCES

Demolition

Temporary Demolition Noise Impacts

<u>Construction Traffic</u>

Demolition worker traffic would incrementally increase noise levels on access roads leading to the Project site on a temporary and intermittent basis. Medium and heavy truck traffic would travel along Macon Road between the Project site and the 5th Avenue Gate, which is closer to the Project site than the Ellis Street Gate and is designed to accommodate larger vehicles. Demolition workers would travel along Macon Road between the Project site and the Ellis Street Gate. By utilizing these routes, neither the construction worker vehicles nor the construction trucks would be traveling by any noise sensitive receptors or through any noise sensitive neighborhoods on the way to the project site.

As noted in the Air Quality analysis, the pre-demolition phase of this project would involve the highest number of workers on site per day with a maximum of 50 construction workers per day traveling to and from the site.

As stated above, on-site workers would travel along Macon Road between the Project site and the Ellis Street Gate. Assuming a worst-case of all workers driving individual vehicles and entering or existing the site at the same time, this would add 50 vehicles to the peak hour traffic volumes approaching the Ellis Street Gate. According to the traffic analysis memorandum provided by Stantec (Appendix E, Traffic Analysis Memorandum, in the Draft Environmental Assessment [EA] prepared for this project), the 2022 peak hour background traffic volumes at the intersection of Ellis Street and Manilla Avenue are 1,427 vehicles in the AM and 1,147 vehicles in the PM. Adding 50 construction worker vehicles to the background traffic along Macon Road and Ellis Street represents a maximum 4.4% percent increase in traffic volumes, which equates to a 0.17 dBA increase in noise. This small change in ambient noise due to construction worker traffic would result in a less than significant impact.

As stated above, medium and heavy truck traffic would travel along Macon Road between the Project site and the 5th Avenue Gate, which is designed to accommodate larger vehicles. According to the traffic analysis memorandum provided by Stantec (Appendix E, Traffic Analysis Memorandum, in the Draft EA prepared for this project), the 2022 AM peak hour traffic traveling on 5th Avenue near N Mathilda Avenue is 46 vehicles in the westbound direction and 323 vehicles in the eastbound direction. Figure C, "Proposed Action Phase 2 AM Peak Hour Trips – Truck Trips" in the Traffic Analysis Memorandum (see Appendix E of the Draft EA), shows the project will add 12 heavy construction trucks in the westbound direction and 13 heavy construction trucks in the eastbound direction to the background vehicular traffic on 5th Avenue.

To determine the impact of the construction trucks on overall traffic noise levels, the SoundPLAN acoustic modeling software was used as an analysis tool. The SoundPLAN software models both Ldn and Leq traffic noise levels based on a peak hour traffic volume and considers vehicle type (vehicle, heavy truck, medium truck, bus, motorcycle), vehicle speed, and traffic control devices, such as stop signs and traffic lights. Using the 2022 AM peak hour traffic volumes and expected peak hour heavy truck volumes on 5th Avenue listed above, traffic-related noise levels including construction truck traffic on 5th Avenue were modeled to increase 2.3 dB(A). This change in ambient noise due to construction truck traffic is below 3 dB(A) and therefore, would result in a less than significant impact.

Demolition Activity

In addition to noise from construction worker vehicular traffic, noise would result from the demolition of Hangar 3. Each demolition stage would have its own mix of equipment, and consequently, its own noise characteristics. These various operations would change the character of the noise generated at the Project site and, therefore, the noise level as demolition progresses.

The demolition of the Hangar 3 Building Demolition Project would be conducted in three phases, each with its own mix of equipment and resulting noise characteristics and potential effects. Therefore, construction noise levels for the following three phases were analyzed for this Project:

- Phase 1 – Pre-Demolition Activities
- Phase 2 – Demolition
- Phase 3 – Waste Disposal and Recycling

Phase 3 would occur concurrently with both Phase 1 and Phase 2. The main types of noise-producing equipment for each demolition phase are shown in Table 8.

Table 8: Demolition Phases Equipment

Demolition Phase	Demolition Equipment
Phase 1 and Phase 3 - Pre-Demolition Activities and Waste Disposal and Recycling	• Boom Lifts (2) • Reach Forks (2) • Bobcats (2) • Generators (2) • Demolition Excavators (2)

Demolition Phase	Demolition Equipment
	• Manlift (1) • Swing Stages (2) • Haul Trucks (2)*
Phases 2 and 3 - Demolition and Waste Disposal and Recycling	• Demolition Excavators (7) • Crane (1) • Manlifts (2) • Skid Steers (2) • Water Truck (1) • Haul Trucks (12)*
* The number of haul trucks per phase represents the worst-case peak hour volume as taken from the Stantec traffic study.	

Table 9 lists types of Project-related equipment and the maximum and average operational noise level as presented in the RCNM at 5,330 feet from the operating equipment. The 5,330-foot distance represents the approximate distance between the Project and the closest multifamily residential receptors at Wescoat Village at Moffett Field, the 3,512-foot distance is the closest distance between the edge of the project area and the Bay Trail, and the 550-foot distance represents the closest distance between the Project and the golf course. The usage factor in Table 9 is as defined by the RCNM program.

Table 9: Calculated Noise Level from Each Piece of Demolition Equipment

Demolition Equipment Source	Distance to Nearest Noise-Sensitive Receptor	Sound Level at Residence		
		Usage Factor	Lmax, dBA	Leq, dBA
Man Lift (Boom Lift)	5,330 feet	20%	34.1	27.2
	3,512 feet		37.8	30.8
	550 feet		53.9	46.9
Reach Fork[1]	5,330 feet	40%	38.6	34.6
	3,512 feet		42.2	38.2
	550 feet		58.3	54.3
Bobcat[2]	5,330 feet	40%	43.4	39.5
	3,512 feet		47.1	43.1
	550 feet		63.2	59.2
Generator	5,330 feet	50%	40.1	37.1
	3,512 feet		43.7	40.7
	550 feet		59.8	56.8
Excavator	5,330 feet	40%	40.2	36.2
	3,512 feet		43.8	39.8
	550 feet		59.9	55.9
Swing Stage[3]	5,330 feet	20%	34.1	27.2
	3,512 feet		37.8	30.8
	550 feet		53.9	46.9
Crane	5,330 feet	16%	40.0	32.0
	3,512 feet		43.6	35.7

Demolition Equipment Source	Distance to Nearest Noise-Sensitive Receptor	Sound Level at Residence		
		Usage Factor	Lmax, dBA	Leq, dBA
	550 feet		59.7	51.8
Skid Steer[4]	5,330 feet	40%	38.6	34.6
	3,512 feet		42.2	38.2
	550 feet		58.3	54.3
Water Truck[5]	5,330 feet	40%	33.7	29.7
	3,512 feet		37.3	33.3
	550 feet		53.4	49.4
Auger Drill Rig	5,330 feet	20%	43.8	36.8
	3,512 feet		42.2	35.2
	550 feet		58.3	51.3
Haul Truck[6]	5,330 feet	40%	35.9	31.9
	3,512 feet		39.5	35.5
	550 feet		55.6	51.6

Notes:
1. The RCNM program does not have sound levels for a reach fork. Therefore, the noise levels from a front-end loader were used in the analysis to simulate the reach fork.
2. The RCNM program does not have sound levels for a small Bobcat. Therefore, the noise levels from a tractor were used in the analysis to simulate the small Bobcat.
3. The RCNM program does not have sound levels for a swing stage. Therefore, the noise levels from a man lift were used in the analysis to simulate the swing stage.
4. The RCNM program does not have sound levels for a skid steer. Therefore, the noise levels from a front-end loader were used in the analysis to simulate the skid steer.
5. The RCNM program does not have sound levels for a water truck. Therefore, the noise levels from a flatbed truck were used in the analysis to simulate the water truck.
6. The RCNM program does not have sound levels for a haul truck. Therefore, the noise levels from a dump truck were used in the analysis to simulate the haul truck.
Source: Stantec 2020, Federal Highway Administration RCNM 2008

A worst-case condition for demolition activity is presented assuming all noise-generating equipment would be operating at the same time and at the same distance from the closest noise-sensitive receptor. Based on this assumption, the RCNM program calculated the following combined Leq and Lmax noise levels from each phase of demolition as shown in Table 10:

Table 10: Calculated Noise Level from Each Demolition Stage

Demolition Phase	Distance to Closest Noise Sensitive Receptor	Calculated Leq, dBA	Calculated Lmax, dBA
Pre-Demolition Activities and Waste Disposal and Recycling	5,330 feet (WV)	46.8	50.8
	3,512 feet (BT)	50.4	54.5
	550 feet (GC)	66.5	70.6
Demolition and Waste Disposal and Recycling	5,330 feet (WV)	47.6	51.8
	3,512 feet (BT)	51.2	55.4
	550 feet (GC)	67.3	71.5
Notes: WV = Wescoat Village; BT = Bay Trail; GC = Golf Course			

Demolition noise levels at all closest noise-sensitive receptors are expected to be well below the Residential Daytime level of 80 dB(A) Leq (8 hour) impact threshold as defined in Table 7-3 “Detailed Analysis Construction Noise Criteria” in the 2018 FTA Transit Noise and Vibration Impact Assessment Manual. Therefore, the impact of demolition activity noise to the sensitive receptors would be less than significant.

Cumulative Demolition Noise Impacts

The incremental noise effects from the Proposed Action would only occur during the limited timeframe for the removal of Hangar 3 (approximately 9 months). Of the cumulative projects that are near the Proposed Action, only the Airside Fuel Farm and possibly the initial phases of the EAIP have similar construction schedules as the Proposed Action. As shown in Table 10, worst-case Leq noise levels associated with the demolition of Hangar 3 were calculated at 67.3 dB(A) at the golf course, 51.2 dB(A) at the Bay Trail, and 47.6 dB(A) at Wescoat Village at MFA. Combined noise levels from the construction of the Airside Fuel Farm and the EAIP could reach levels of 78.6 dB(A) Leq at the golf course, 54.1 dB(A) at the Bay Trail, and 48.9 dB(A) at the Wescoat Village at MFA site. Using the principles of decibel addition, Leq noise levels at the golf course, Bay Trail, and Wescoat Village at MFA could be increased to 78.9 dB(A), 55.9 dB(A), and 51.8 dB(A), respectively. Even with three active construction project sites occurring simultaneously, and using a worst-case scenario, noise levels at all closest noise-sensitive receptors are expected to be below the Residential Daytime level of 80 dB(A) Leq (8 hour) impact threshold as defined in Table 7-3 “Detailed Analysis Construction Noise Criteria” in the 2018 FTA Transit Noise and Vibration Impact Assessment Manual.

The NASA Housing Project would be located approximately 4,710 feet southwest of Hangar 3. While distant from the Proposed Action in terms of noise impacts (because of the attenuation of noise with distance from the source), this EA examines the potential for cumulative effects of this project with that of the Proposed Action. Worst-case noise levels generated from the Project’s demolition (Pre-Demolition Activities Phase) were calculated at 48.6 dBA Leq at the future NASA Housing Project. Construction noise levels generated on the NASA Housing Project site could be as loud as 95 dBA Leq, depending on the construction equipment used and the distance from the equipment. Using standard logarithmic addition, the noise generated from the demolition activities at Hangar 3 would not increase the noise generated from the construction of the NASA Housing Project site. Therefore, demolition noise from the Hangar 3 Building Demolition Project in combination with construction noise from the future NASA Housing Project would not result in a significant cumulative impact to the surrounding community, particularly residents of Wescoat Village.

Thus, the cumulative effect with the Proposed Action would be temporary and limited to the eastern portion of the MFA where users of the Bay Trail and the golf course, who are transient and would not be affected for the duration of construction, are the only sensitive receptors. The incremental traffic noise from construction traffic would not be noticeable compared to ambient conditions, and worst-case noise effects from demolition activities would not be significant. Furthermore, the Proposed Action also would adhere to noise and vibration protection measures. Further, there would be no long-term noise effects from the Proposed Action, which does not include any operational activities after construction and demolition activities are completed.

Therefore, given the limited and temporary nature of the noise impacts as a result of demolition activities (i.e., no operational effects), the Proposed Action would not be cumulatively significant when combined with past, present, and reasonably foreseeable future actions.

Short-Term Demolition Vibration Impacts

Table 7-4 “Vibration Source Levels for Construction Equipment” in the FTA Transit Noise and Vibration Impact Assessment Manual lists average vibration source levels, in PPV at 25 feet, for the construction and demolition equipment which generates the greatest levels of vibration. The equipment listed in the FTA table includes impact and sonic pile drivers, clam shovel drops, hydromills, vibratory rollers, hoe rams, large bulldozers, caisson drilling, loaded trucks, jackhammers, and small bulldozers. Comparing the equipment list in FTA Table 7-4 to the Project’s equipment list in Table 11, the equipment most likely to generate vibrational energy for the Proposed Action would be large and small bulldozers and loaded trucks.

During demolition, equipment such as small bulldozers (Bobcats) and loaded trucks could be used as close as 57 feet from the nearest vibration-sensitive receptor (Building 055). The 57-foot distance represents the separation between the edge of the fence line to Building 055.

The assessment method as described in the FTA Transit Noise and Vibration Impact Assessment Manual states to “assess potential annoyance and damage effects from construction (demolition) vibration for each piece of equipment individually.” Multiple pieces of equipment operating simultaneously could increase vibration levels but predicting any increase could be difficult. Therefore, using the assessment method as described in the FTA Transit Noise and Vibration Impact Assessment Manual, demolition equipment that would be used during the project is expected to generate vibration levels up to 0.0259 PPV at 57 feet, as shown in Table 11. This vibration level would not be expected to cause damage to the existing nearby buildings onsite. All demolition activities would also follow the hours restrictions and procedures listed in Chapter 8 “Buildings”, Article VI “Construction Noise”, Section 8.70 “Construction noise” of the Mountain View Municipal Code.

As a note, since there are no occupied buildings within close proximity of Hangar 3, the perceptible groundborne vibration criteria listed in Table 3 were not used for this project.

Table 11: Vibration Source Levels for Construction/Demolition Equipment

Type of Equipment	Peak Particle Velocity (PPV) at 57 Feet	Threshold at which Building Damage Could Occur (PPV)	Potential for Proposed Action to Exceed Threshold
Large Bulldozer	0.0259	0.25	None
Loaded Trucks	0.0221	0.25	None
Small Bulldozer	0.0009	0.25	None

Source: Federal Transit Administration Transit Noise and Vibration Impact Assessment Manual, September 2018

In addition to the equipment, the activity of demolition, such as felling and dropping pieces of structure, could also cause vibrational energy. For the Hangar 3 Building Demolition Project, materials would either be tethered and mechanically lowered to the ground or mechanically cut and dropped to the floor if this can be accomplished without damaging the Hangar 3 slab. If materials are dropped to the floor, considerations need to be made including limiting fall distances and considering the weight of the material being dropped to minimize impacts to the slab. The trusses would be supported by the existing hydraulic jack system that would remain in place until trusses were removed, thus limiting the opportunity for the structure to fall to the slab. Reducing stress on the slab lowers the vibrational energy which enters the slab and reduces the vibration impact which could propagate through the ground to Hangar 2 and Building 055.

SUMMARY OF NOISE/VIBRATION REDUCTION MEASURES

The following summary of measures will be followed to help reduce noise and vibration to adjacent sensitive receptors:

- Truck traffic associated with demolition work will either travel along Macon Road between the Project site and the 5th Avenue gate or along Macon Road between the Project site and the Ellis Street gate. These planned routes would travel around the edge of Moffett Field within the City of Sunnyvale and not pass through any noise-sensitive neighborhoods before merging onto the freeway.
- All demolition activities would follow the hours restrictions and procedures listed in Chapter 8 "Buildings", Article VI "Construction Noise", Section 8.70 "Construction noise" of the Mountain View Municipal Code and Paragraph 16.080.030 "Hours of Construction – Time and Noise Limitations" in the Sunnyvale Municipal Code.
- Hangar 2 and Building 055 would be protected by carefully lowering materials to the floor. All demolition materials would either be tethered and mechanically lowered to the ground or mechanically cut and dropped to the floor. If materials are dropped to the floor, considerations would be made including limiting fall distances and considering the weight of the material being dropped to minimize impacts to the slab. Reducing stress on the slab lowers the vibrational energy that enters the slab and reduces the vibration impact that could propagate through the ground to Hangar 2 and Building 055.
- The trusses would be supported by the existing hydraulic jack system that would remain in place until trusses are removed.

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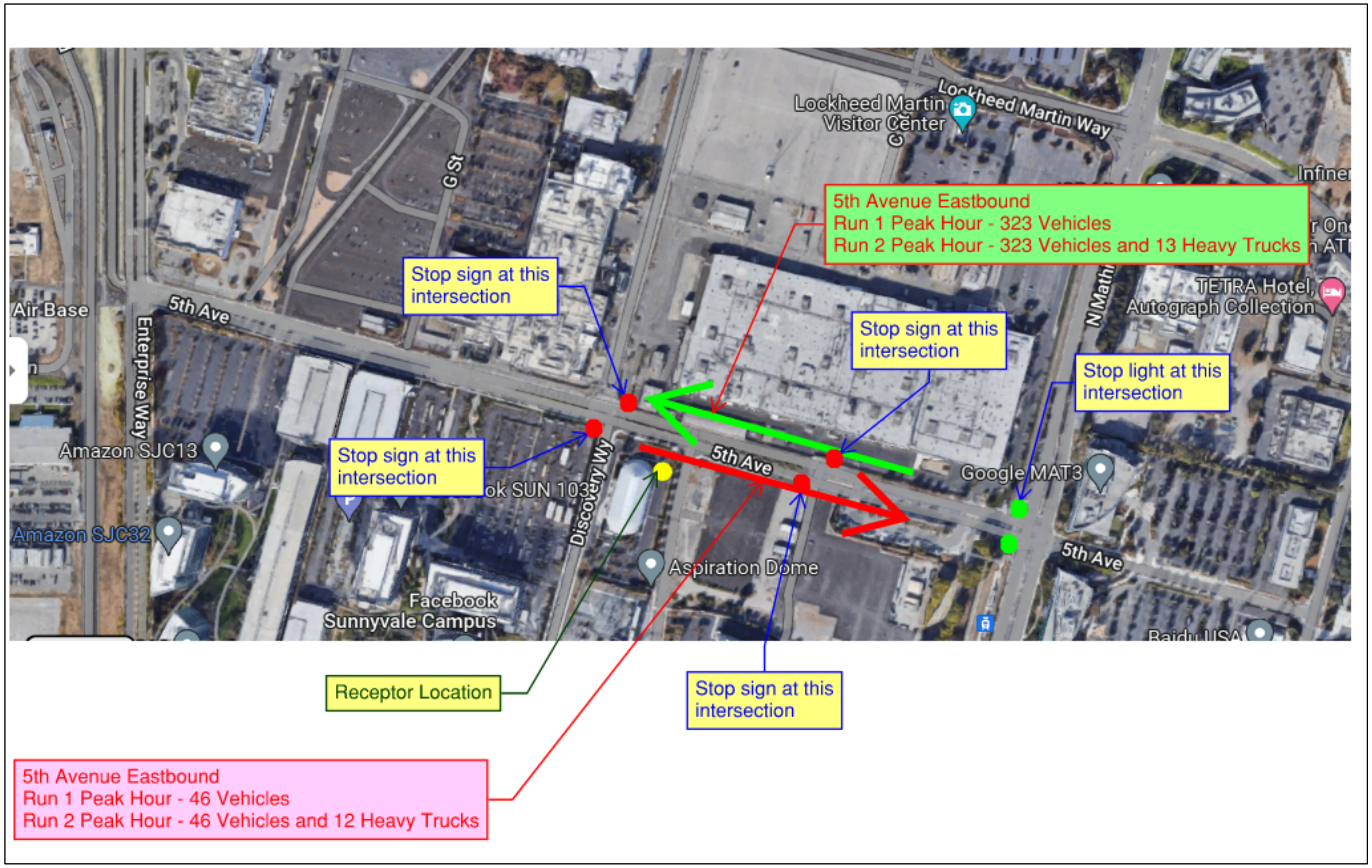
Hangar 3 Project
RUN 1: SoundPLAN Traffic Model Results Along 5th Avenue with Peak Hour Vehicles - NO Construction Trucks
26-May-22

Receiver	Ldn/dB(A)	Leq,d/dB(A)	Leq,n/dB(A)
Receiver about 125' from Centerline of 5th Avenue	62.4	56	56

Time slice	63Hz dB(A)	125Hz dB(A)	250Hz dB(A)	500Hz dB(A)	1kHz dB(A)	2kHz dB(A)	4kHz dB(A)	8kHz dB(A)
Ldn	48.8	53.6	53.8	55.4	57	54.5	47	40.1
Leq,d	42.3	47.2	47.4	49	50.5	48.1	40.6	33.7
Leq,n	42.3	47.2	47.4	49	50.5	48.1	40.6	33.7

Road	ADT Veh/24h	Gradient %
5th Ave Eastbound	1104	0
5th Ave Westbound	7752	0



Hangar 3 Project
RUN 2: SoundPLAN Traffic Model Results Along 5th Avenue with 25 Added Heavy Trucks
26-May-22

Receiver	Ldn/dB(A)	Leq,d/dB(A)	Leq,n/dB(A)
Receiver about 125' from Centerline of 5th Avenue	64.7	58.3	58.3

Time slice	63Hz dB(A)	125Hz dB(A)	250Hz dB(A)	500Hz dB(A)	1kHz dB(A)	2kHz dB(A)	4kHz dB(A)	8kHz dB(A)
Ldn	49.7	55.8	56.6	57.7	59	57.2	50.7	43.9
Leq,d	43.3	49.4	50.2	51.3	52.6	50.8	44.3	37.5
Leq,n	43.3	49.4	50.2	51.3	52.6	50.8	44.3	37.5

Road	ADT Veh/24h	Gradient %
5th Ave Eastbound	1392	0
5th Ave Westbound	8064	0