NOISE AND VIBRATION STUDY

1642 S. CENTRAL AVENUE APARTMENT PROJECT

CITY OF GLENDALE, CALIFORNIA

LSA

July 2022

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CITY OF GLENDALE, CALIFORNIA

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INTRODUCTION

This noise and vibration study has been prepared to evaluate the potential noise and vibration impacts and project features associated with the 1642 S. Central Avenue Apartment Project (proposed project) in Glendale, California. This analysis is intended to satisfy the City of Glendale (City) requirements for a project-specific noise and vibration impact analysis by examining the impacts of the proposed project on noise-sensitive uses in the project area and evaluating the necessary minimization measures that would be incorporated as part of the project design.

Project Description and Location

The proposed project is located at 1642 S. Central Avenue, south of S. Central Avenue and east of Gardena Avenue in the City of Glendale, California. The project will construct a five (5) story apartment building consisting of 31 units and 3,173 square feet (sf) of common space on top of one (1) subterranean parking level. The roof deck is surrounded by a 6-foot high glass barrier.

The regional location is illustrated on Figure 1, and the site plan is illustrated on Figure 2.

Existing Sensitive Land Uses in the Project Area

The project site is surrounded primarily by residential, commercial, and industrial development. The areas adjacent to the project site include the following uses:

- **North:** Existing industrial warehouse uses opposite S. Central Avenue, 65 feet away
- **East:** Existing Peak Auto Body repair shop, immediately adjacent
- **South:** Existing single-family homes, the closest is 3 feet of the southern property line
- **West:** Existing parking lot associated with the Glendale Station opposite Gardena Avenue, 55 feet away

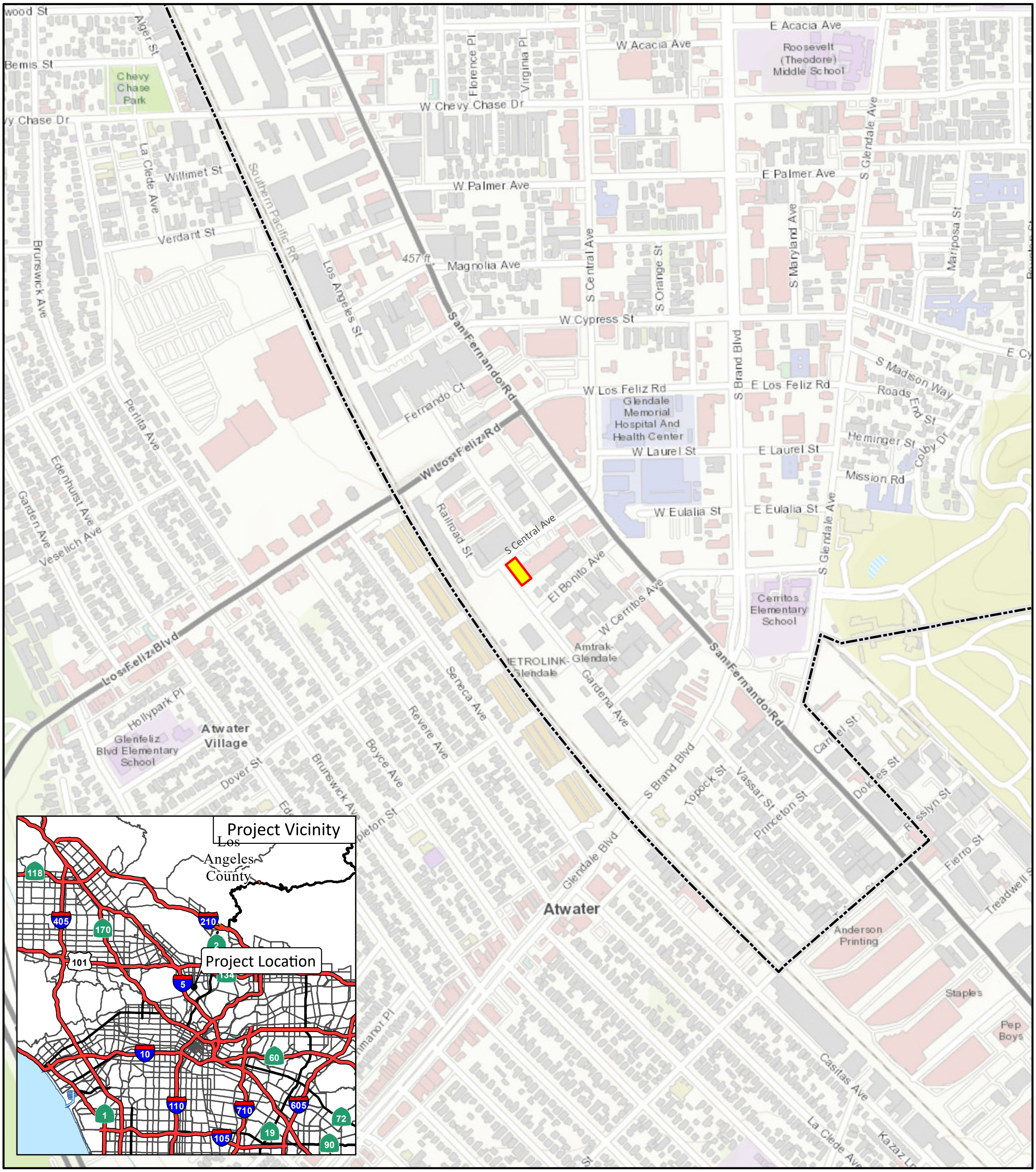

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FIGURE 1

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Project Site

City Boundary

N

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SOURCE: ArcGIS Online Topographic Map

1642 S. Central Avenue

Project Location

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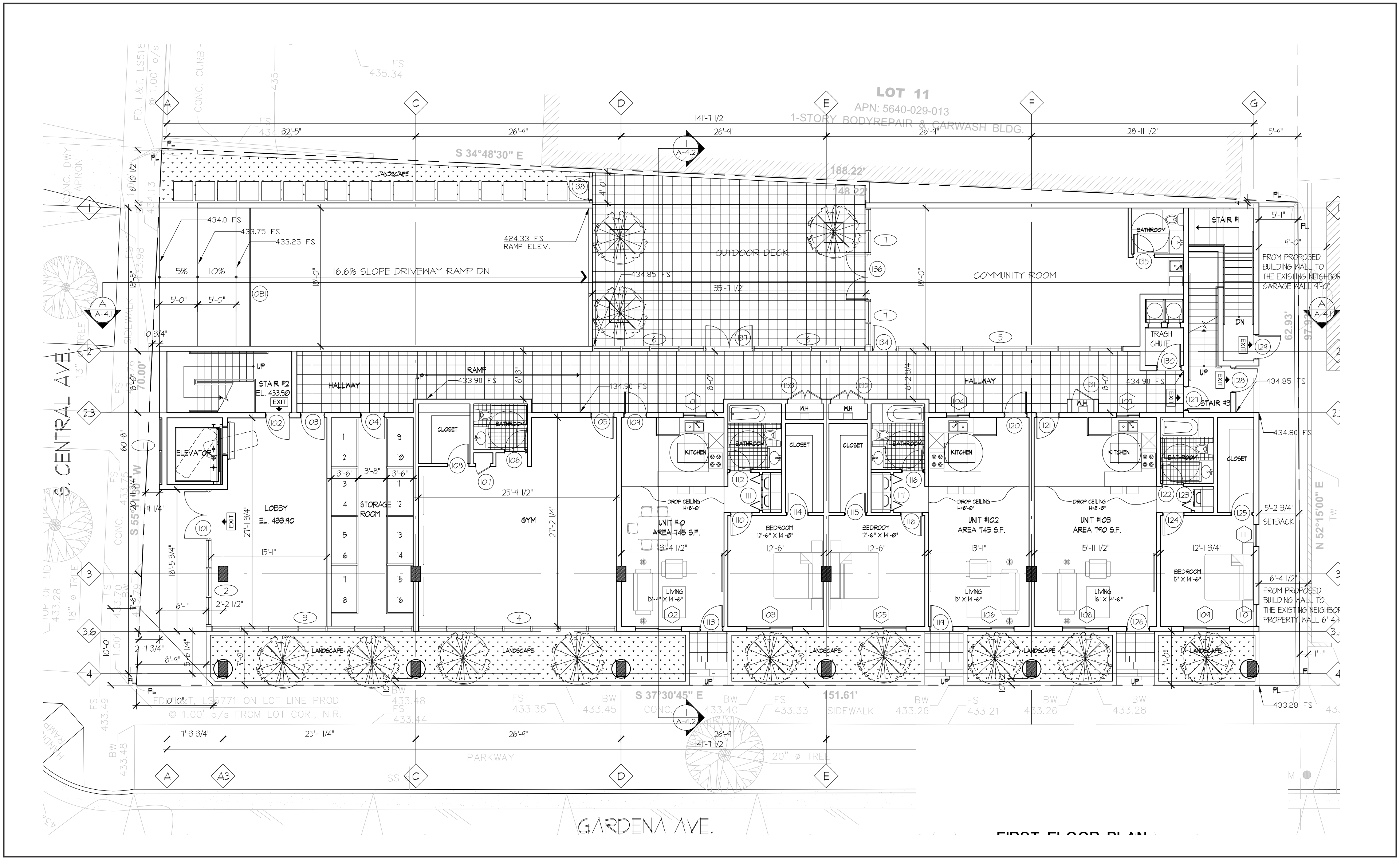
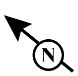


FIGURE 2



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SOURCE: Alajajian Marcoosi Architects, Inc.

1642 S. Central Avenue
Site Plan

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CHARACTERISTICS OF SOUND

Noise is usually defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep.

To the human ear, sound has two significant characteristics: pitch and loudness. Pitch is generally an annoyance, while loudness can affect the ability to hear. Pitch is the number of complete vibrations, or cycles per second, of a wave resulting in the tone's range from high to low. Loudness is the strength of a sound that describes a noisy or quiet environment and is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves combined with the reception characteristics of the human ear. Sound intensity refers to how hard the sound wave strikes an object, which in turn produces the sound's effect. This characteristic of sound can be precisely measured with instruments. The analysis of a project defines the noise environment of the project area in terms of sound intensity and its effect on adjacent sensitive land uses.

Measurement of Sound

Sound intensity is measured through the A-weighted scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound similar to the human ear's de-emphasis of these frequencies. Unlike linear units (e.g., inches or pounds), decibels are measured on a logarithmic scale representing points on a sharply rising curve.

For example, 10 decibels (dB) is 10 times more intense than 1 dB, 20 dB is 100 times more intense than 1 dB, and 30 dB is 1,000 times more intense than 1 dB. Thirty decibels (30 dB) represent 1,000 times as much acoustic energy as 1 dB. The decibel scale increases as the square of the change, representing the sound pressure energy. A sound as soft as human breathing is about 10 times greater than 0 dB. The decibel system of measuring sound gives a rough connection between the physical intensity of sound and its perceived loudness to the human ear. A 10 dB increase in sound level is perceived by the human ear as only a doubling of the loudness of the sound. Ambient sounds generally range from 30 dB (very quiet) to 100 dB (very loud).

Sound levels are generated from a source, and their decibel level decreases as the distance from that source increases. Sound dissipates exponentially with distance from the noise source. For a single-point source, sound levels decrease approximately 6 dB for each doubling of distance from the source. This drop-off rate is appropriate for noise generated by stationary equipment. If noise is produced by a line source (e.g., highway traffic or railroad operations) the sound decreases 3 dB for each doubling of distance in a hard site environment. Similarly, line sources with intervening absorptive vegetation or line sources that are located at a great distance to the receptor would decrease 4.5 dB for each doubling of distance, which is consistent with information provided in the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA RD-77-108).

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. The equivalent continuous sound level (L_{eq}) is the total sound energy of time-varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the L_{eq} and Community Noise Equivalent Level (CNEL) or the day-night average noise level (L_{dn}) based on A-weighted decibels (dBA). CNEL is the time-varying noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly L_{eq} for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours), and a 10 dBA weighting factor applied to noises occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). L_{dn} is similar to the CNEL scale but without the adjustment for events occurring during the evening hours. CNEL and L_{dn} are within 1 dBA of each other and are normally interchangeable. The City uses the CNEL noise scale for long-term noise impact assessment.

Other noise rating scales of importance when assessing the annoyance factor include the maximum instantaneous noise level (L_{max}), which is the highest exponential time-averaged sound level that occurs during a stated time period. The noise environments discussed in this analysis for short-term noise impacts are specified in terms of maximum levels denoted by L_{max}, which reflects peak operating conditions and addresses the annoying aspects of intermittent noise. L_{max} is often used together with another noise scale or noise standards in terms of percentile noise levels in noise ordinances for enforcement purposes. For example, the L_{10} noise level represents the noise level exceeded 10 percent of the time during a stated period. The L_{50} noise level represents the median noise level (i.e., half the time the noise level exceeds this level, and half the time it is less than this level). The L_{90} noise level represents the noise level exceeded 90 percent of the time and is considered the background noise level during a monitoring period. For a relatively constant noise source, the L_{eq} and L_{50} are approximately the same.

The human perception of noise level increases can be described in three categories:

- **Inaudible/Not Perceptible:** Changes in noise levels of less than 1 dB are inaudible to the human ear and often referred to as not perceptible.

- **Potentially Audible/Barely Perceptible:** A potentially audible impact refers to a 1 to 3 dB change in noise levels. This range of noise levels has been found to be noticeable in low-noise environments.

- **Audible/Readily Perceptible:** An audible impact refers to a noticeable increase in noise for humans. Audible increases in noise levels generally refer to a change of 3 dB or greater because this level has been found to be readily perceptible in exterior environments. For reference, a 10 dB increase is experienced by humans as a doubling of sound or perceived to be twice as loud.

Only readily perceptible changes in existing ambient or background noise levels are considered potentially significant.

Physiological Effects of Noise

Exposure to prolonged high noise levels has been found to have effects on human health (Suter 1991; World Health Organization 1999), including physiological and psychological effects to humans. Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA.

Exposure to high noise levels affects the entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. In comparison, extended periods of noise exposure above 90 dBA would result in permanent cell damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear, even with short-term exposure. This level of noise is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by the feeling of pain in the ear (the threshold of pain). A sound level of 160 to 165 dBA will result in dizziness or loss of equilibrium. The ambient or background noise problem is widespread and is generally more concentrated in urban areas than in outlying, less developed areas.

Table A lists definitions of acoustical terms, and Table B shows common sound levels and their sources.

Table A: Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of measurement that denotes the ratio between two quantities that are proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
Frequency, Hz	Of a function periodic in time, the number of times that the quantity repeats itself in 1 second (i.e., number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter deemphasizes the very low- and very high-frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. (All sound levels in this report are A-weighted, unless reported otherwise.)
L_{01}, L_{10}, L_{50}, L_{90}	The fast A-weighted noise levels that are equaled or exceeded by a fluctuating sound level 1%, 10%, 50%, and 90% of a stated time period.
Equivalent Continuous Noise Level, L_{eq}	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time-varying sound.
Community Noise Equivalent Level, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 5 dBA to sound levels occurring in the evening from 7:00 PM to 10:00 PM and after the addition of 10 dBA to sound levels occurring in the night between 10:00 PM and 7:00 AM.
Day/Night Noise Level, L_{dn}	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 dBA to sound levels occurring in the night between 10:00 PM and 7:00 AM.
L_{max}, L_{min}	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging.
Ambient Noise Level	The all-encompassing noise associated with a given environment at a specified time; usually a composite of sound from many sources at many directions, near and far; no particular sound is dominant.
Intrusive	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content, as well as the prevailing ambient noise level.

Source: *Handbook of Acoustical Measurements and Noise Control* (Harris 1991).

Table B: Common Sound Levels and Their Noise Sources

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Evaluations
Near Jet Engine	140	Deafening	128 times as loud
Civil Defense Siren	130	Threshold of Pain	64 times as loud
Hard Rock Band	120	Threshold of Feeling	32 times as loud
Accelerating Motorcycle at a Few Feet Away	110	Very Loud	16 times as loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very Loud	8 times as loud
Ambulance Siren; Food Blender	95	Very Loud	—
Garbage Disposal	90	Very Loud	4 times as loud
Freight Cars; Living Room Music	85	Loud	—
Pneumatic Drill; Vacuum Cleaner	80	Loud	2 times as loud
Busy Restaurant	75	Moderately Loud	—
Near Freeway Auto Traffic	70	Moderately Loud	—
Average Office	60	Quiet	One-half as loud
Suburban Street	55	Quiet	—
Light Traffic; Soft Radio Music in Apartment	50	Quiet	One-quarter as loud
Large Transformer	45	Quiet	—
Average Residence without Stereo Playing	40	Faint	One-eighth as loud
Soft Whisper	30	Faint	—
Rustling Leaves	20	Very Faint	—
Human Breathing	10	Very Faint	Threshold of Hearing
—	0	Very Faint	—

Source: Compiled by LSA (2017).

FUNDAMENTALS OF VIBRATION

Vibration refers to ground-borne noise and perceptible motion. Ground-borne vibration is almost exclusively a concern inside buildings and is rarely perceived as a problem outdoors, where the motion may be discernible, but without the effects associated with the shaking of a building there is less adverse reaction. Vibration energy propagates from a source through intervening soil and rock layers to the foundations of nearby buildings. The vibration then propagates from the foundation throughout the remainder of the structure. Building vibration may be perceived by occupants as the motion of building surfaces, the rattling of items sitting on shelves or hanging on walls, or a low-frequency rumbling noise. The rumbling noise is caused by the vibration of walls, floors, and ceilings that radiate sound waves. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by 10 dB or more. This is an order of magnitude below the damage threshold for normal buildings.

Typical sources of ground-borne vibration are construction activities (e.g., blasting, pile-driving, and operating heavy-duty earthmoving equipment), steel-wheeled trains, and occasional traffic on rough roads. Problems with both ground-borne vibration and noise from these sources are usually localized to areas within approximately 100 feet (ft) from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 ft (Federal Transit Authority [FTA] 2018). When roadways are smooth, vibration from traffic, even heavy trucks, is rarely perceptible. It is assumed for most projects that the roadway surface will be smooth enough that ground-borne vibration from street traffic will not exceed the impact criteria; however, construction of the project could result in ground-borne vibration that may be perceptible and annoying.

Ground-borne noise is not likely to be a problem because noise arriving via the normal airborne path will usually be greater than ground-borne noise.

Ground-borne vibration has the potential to disturb people and damage buildings. Although it is very rare for train-induced ground-borne vibration to cause even cosmetic building damage, it is not uncommon for construction processes such as blasting and pile-driving to cause vibration of sufficient amplitudes to damage nearby buildings (FTA 2018). Ground-borne vibration is usually measured in terms of vibration velocity, either the root-mean-square (RMS) velocity or peak particle velocity (PPV). The RMS is best for characterizing human response to building vibration, and PPV is used to characterize potential for damage. Decibel notation acts to compress the range of numbers required to describe vibration. Vibration velocity level in decibels is defined as:

$$L_v = 20 \log_{10} [V/V_{ref}]$$

where "L_v" is the vibration velocity in decibels (VdB), "V" is the RMS velocity amplitude, and "V_{ref}" is the reference velocity amplitude, or 1×10^{-6} inches/second (in/sec) used in the United States.

OVERVIEW OF THE EXISTING NOISE ENVIRONMENT

This section describes the existing noise environment in the project site vicinity. Noise monitoring was used to quantify existing noise levels at the project site. In the City, vehicle traffic is the primary source of noise. Other significant local noise sources include train pass-bys and stations operations, airport noise, industrial noise, and mechanical equipment noise.

The proposed project is located approximately 315 feet east of an existing rail corridor that carries both passenger trains (Amtrak and Metrolink) and freight trains (Union Pacific Railroad, formerly known as Southern Pacific Lines). Current passenger train operations have been reduced due to the current pandemic conditions, and are estimated to be approximately half of typical operations based information provided on the Metrolink website. This reduction in activity will be accounted for in the impacts section of this report. Furthermore, the rail corridor may include the future operations of the proposed California High-Speed Rail Project. These operations, while not captured in the existing noise measurements, will also be accounted for in the impacts section.

Existing Noise Level Measurements

To assess existing noise levels, LSA conducted two long-term noise measurements at the project site to understand the range of level near the perimeter of the project site and general noise environment at the surrounding uses described above on Page 1. The instruments used are Larson

Davis Spark 706RC Dosimeters which are Type 2 certified with a range of 40 dB to 143 dB. Both instruments are both laboratory calibrated and were also field calibrated at the time of the measurements. Both meters were set to measure A-weighted levels and utilized a fast response time to accurately capture any peak noise events. The long-term noise measurements were recorded from Tuesday, June 9 through Wednesday, June 10, 2020 which represents standard mid-week condition given the proximity to the existing commuter and freight rail lines. The long-term noise measurements captured data in order to calculate the hourly L_{eq} and CNEL at each location, which incorporate the nighttime hours. Sources that dominate the existing noise environment include traffic on adjacent roadways, train traffic on the existing rail line to the east, parking lot activities, and operations from the commercial and industrial uses. Noise measurement data collected is summarized in Table C and shown in Figure 3. Noise measurement sheets are provided in Appendix A.

Table C: Long-Term Noise Level Measurements

Location	Daytime Noise Levels[1] (dBA L_{eq})	Evening Noise Levels[2] (dBA L_{eq})	Nighttime Noise Levels[3] (dBA L_{eq})	Average Daily Noise Level (dBA CNEL)
LT-1: Western edge of the project site on Gardena Avenue.	62.1-70.7	59.2-63.0	48.4-63.4	67.0
LT-2: Northeast corner of the project site, across on S. Glendale Avenue.	61.4-68.4	57.7-63.9	48.0-64.7	66.3

Source: Compiled by LSA. (May 2022).
1 Daytime Noise Levels = noise levels during the hours of 7:00 a.m. to 7:00 p.m.
2 Evening Noise Levels = noise levels during the hours of 7:00 p.m. to 10:00 p.m.
3 Nighttime Noise Levels = noise levels during the hours of 10:00 p.m. to 7:00 a.m.
dBA = A-weighted decibels
CNEL = Community Noise Equivalent Level
L_{eq}=equivalent continuous sound level

Aircraft Related Noise Impacts

The project is approximately 7.25 miles (mi) southeast of Burbank Airport and 14.5 mi northeast of Los Angeles International Municipal Airport. As shown on the Los Angeles County Airport Land Use Commission (ALUC) noise maps, the proposed project is located well outside the 65 dBA CNEL noise contours of these airports; therefore, noise-related impacts due to airport activities would not represents a significant source of existing noise.

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Project Location

LT-1 Long-term Noise Monitor Location

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SOURCE: Google Earth, 2020

FIGURE 3

1642 S. Central Avenue

Noise Monitoring Locations

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REGULATORY SETTING

This section describes the applicable noise and vibration standards for the proposed project. The project would be entirely within the City of Glendale. Noise in the City is regulated by the City's General Plan and Municipal Code.

Applicable Noise Standards

Noise Element of the General Plan

The noise standards specified in Table 2 of the City's General Plan Noise Element (shown in Table D of this document) are used as design standards to be used in the project design stage. Compliance with these standards should be incorporated by conditions of approval or environmental mitigation measures and evaluated as part of City Development Review and building permit plan check.

Table D: Interior and Exterior Noise Standards Energy Average (CNEL)

Land Use Categories		Energy Average (CNEL)	
Categories	**Uses**	**Interior**	**Exterior**
Residential	Single-Family	45[1]	65[2]
	Multi-Family	45[1]	65[3]
	Residential within Mixed Use	45[1]	—
Commercial	Hotel, Motel, Transient Lodging	45[1]	—
Institutional	Hospital, School Classroom, Church, Library	45	—
Open Space	Parks[4]	—	65

Source: City of Glendale Noise Element, Table 2 (2007).

1 Interior environment excludes bathrooms, toilets, closets, and corridors.

2 Applies to the outdoor environment limited to the private yard of single family residences (normally rear yard).

3 Applies to the patio area where there is an expectation of privacy (i.e. not a patio area which also serves as, or is adjacent to, the primary entrance to the unit).

4 Only applies to parks where peace and quiet are determined to be of prime importance, such as hillside open space areas open to the public. Generally would not apply to urban parks or active-use parks.

CNEL = Community Noise Equivalent Level

The Glendale General Plan Noise Element, Section 4.4.3, Non-Transportation Noise Sources, discusses key issues which are regulated by the City's Noise Ordinance contained in the Glendale Municipal Code. It states:

> Construction noise is addressed in the Noise Ordinance [contained Glendale Municipal Code] Section 8.36.080. The exempts construction activities from compliance with the noise ordinance limits under certain circumstances. If construction occurs within 500 feet of a residential zone, then construction is prohibited from 7 p.m. to 7 a.m. every night and from 7 p.m. on Saturday to 7 a.m. on Monday (i.e., no Sunday construction). Construction on certain holidays is also prohibited. To respond to complaints about noise from construction on the weekend, The General Plan Noise Element Program 4.1 proposes to change the Noise Ordinance by restricting construction on Saturday to the hours of 9 a.m. to 5 p.m. This level of control is consistent with the approach used by most other jurisdictions, with the exception that other jurisdictions usually prohibit construction on Saturday as well as

Sunday. Some jurisdictions do not have a distance limit in their ordinance and essentially prohibit construction anywhere in their city at night and on weekends and holidays.

Municipal Code

Section 8.36.040 of the City's Municipal Code establishes the presumed noise standards. Table E provides the City's noise standard based on the noise zone, the location of the noise (exterior/interior), and the time period. Section 8.36.050 goes on to clarify the following:

- Where the actual ambient is less than the presumed ambient, the actual ambient shall control and any noise in excess of the actual ambient, plus 5 dBA, shall be a violation
- Where the actual ambient is equal to or more than the presumed ambient, the actual ambient shall control and any noise may not exceed the actual ambient by more than five dBA; however, in no event may the actual ambient exceed the presumed noise standards by five dBA.

Table E: Exterior and Interior Noise Standards (dBA L_{eq})

Land Use Type	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)
Exterior		
Cemetery and Residential (Single-Family and Duplex)	55	45
Residential (Multi-family, hotels, motels and transient lodgings)	60	-
Central Business District and Commercial	65	-
Industrial	70	-
Interior		
Residential	55	45

Source: City of Glendale, Municipal Code (2020).
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

Section 8.36.080 of the City's Municipal Code Noise Ordinance states the following as it relates to construction activities:

It is unlawful for any person within a residential zone, or within a radius of 500 feet therefrom, to operate equipment or perform any outside construction or repair work on buildings, structures or projects within the city between the hours of 7:00 p.m. on one day and 7:00 a.m. of the next day or from 7:00 p.m. on Saturday to 7:00 a.m. on Monday or from 7:00 p.m. preceding a holiday, as designated in Chapter 3.08 of this code, to 7:00 a.m. following such holiday unless beforehand a permit therefor has been duly obtained from the building official. No permit shall be required to perform emergency work as defined in this chapter.

Federal Transit Administration

Given that the Municipal Code exempts construction activities and that no standard criteria for assessing construction noise impacts is provided, for the purposes of determining the significance of the noise increase experienced at noise-sensitive uses surrounding the project during construction, the guidelines within the FTA *Transit Noise and Vibration Impact Assessment Manual* (2018) are used in this analysis for construction noise impact identification. The general assessment criteria for construction noise identifies a 1-hour noise level of 90 dBA L_{eq} for residential uses during daytime hours and a 1-hour noise level of 100 dBA L_{eq} for commercial and industrial uses as the threshold for potential noise impact. This provides reasonable criteria for assessing construction noise impacts based on the potential for adverse community reaction when the noise criteria are exceeded.

Applicable Vibration Standards

Municipal Code

In order to assess the potential for vibration annoyance, the City of Glendale has defined "vibration perception threshold" as:

> "..the minimal ground or structure borne vibrational motion necessary to cause a normal person to be aware of the vibration by such direct means as, but not limited to, sensation by touch or visual observation of moving objects. The perception shall be presumed to be a motion velocity of 0.01 in./sec. over the range of one to one hundred Hz."

Section 8.36.210, Vibration, of the City's Municipal Code states that:

> "Operating or permitting the operation of any device that creates a vibration which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property or at one hundred fifty feet from the source if on a public space or public right-of-way shall be a violation."

Federal Transit Administration

In order to assess the potential for vibration damage, FTA guidelines show that a vibration level of up to 0.3 in/sec in PPV is considered safe for buildings consisting of engineered concrete or masonry, and would not result in any construction vibration damage. For non-engineered timber and masonry buildings, the construction building vibration damage criterion is 0.2 in/sec in PPV.

IMPACT ASSESSMENT

Short-Term Construction Impacts

Construction noise and vibration impacts from the proposed project would be associated with demolition of the existing structures on-site and construction of the new apartment building. Construction is expected to begin in August 2023 and finish in May 2024.

Short-Term Off-Site Construction Noise Impacts

Short-term noise impacts would be associated with demolition of the existing structures, excavation, grading, and construction of the proposed project. Construction-related short-term noise levels would be higher than existing ambient noise levels in the vicinity of the project site, but would no longer occur once construction of the proposed project is completed.

Two types of short-term noise impacts could occur during construction of the proposed project. The first type of short-term construction noise would result from transport of construction equipment and materials to the project site, hauling activities, and construction worker commutes. These transportation activities would incrementally raise noise levels on access roads leading to the site. It is expected that large trucks used in hauling activities would generate higher noise impacts than trucks associated with worker commutes. As shown in Table F, the single-event noise from equipment trucks passing at a distance of 50 feet from a sensitive noise receptor would reach a maximum level of 84 dBA L_{max}. The total number of daily vehicle trips associated with hauling during the grading phase is estimated to be approximately 14 and would be minimal when compared to existing traffic volumes on the affected streets. Therefore, the daily traffic noise level change associated with these trips would not be perceptible. Therefore, construction related traffic impacts would be short term and would not result in a significant off-site noise impact.

The second type of potential short-term noise impact is related to noise generated during demolition, site preparation, grading, building construction, and paving. Construction is completed in discrete steps, each of which has its own mix of equipment and consequently its own noise characteristics. These various sequential phases would change the character of the noise generated on the site and therefore the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase.

Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full-power operation followed by 3 or 4 minutes at lower power settings.

In addition to the reference maximum noise level, the usage factor provided in Table F is utilized to calculate the hourly noise level impact for each piece of equipment based on the following equation:

$$L_{eq}(equip) = E.L. + 10\log(U.F.) - 20\log\left(\frac{D}{50}\right)$$

where: $L_{eq}(equip)$ = L_{eq} at a receiver resulting from the operation of a single piece of equipment over a specified time period

E.L. = noise emission level of the particular piece of equipment at a reference distance of 50 ft

U.F. = usage factor that accounts for the fraction of time that the equipment is in use over the specified period of time

D = distance from the receiver to the piece of equipment

Each piece of construction equipment operates as an individual point source. Utilizing the following equation, a composite noise level can be calculated when multiple sources of noise operate simultaneously:

$$Leq\ (composite) = 10 * \log_{10}\left(\sum_{1}^{n} 10^{\frac{Ln}{10}}\right)$$

Using the equations from the methodology above, the reference information in Table F, and the construction equipment list provided, the composite noise level of each construction phase was calculated as presented in Appendix B. The project construction composite noise levels at a distance of 50 feet would range from 74 dBA L_{eq} to 88 dBA L_{eq} with the highest noise levels occurring during the grading phase. For all other phases, based on calculations in Appendix B, construction noise levels are expected to be lower that those during grading activities.

Once composite noise levels are calculated, reference noise levels can then be adjusted for distance using the following equation:

$$Leq\ (at\ distance\ X) = Leq\ (at\ 50\ feet) - 20 * \log_{10}\left(\frac{X}{50}\right)$$

In general, this equation shows that doubling the distance would decrease noise levels by 6 dBA, while halving the distance would increase noise levels by 6 dBA.

Table F: Typical Maximum Construction Equipment Noise Levels (L_{max})

Type of Equipment	Acoustical Usage Factor	Suggested Maximum Sound Levels for Analysis (dBA L_{max} at 50 ft)
Air Compressor	40	80
Backhoe	40	80
Cement Mixer	50	80
Concrete/Industrial Saw	20	90
Crane	16	85
Excavator	40	85
Forklift	40	85
Generator	50	82
Grader	40	85
Loader	40	80
Pile Driver	20	101
Paver	50	85
Roller	20	85
Rubber Tire Dozer	40	85
Scraper	40	85
Tractor	40	84
Truck	40	84
Welder	40	73

Source: FHWA. *Highway Construction Noise Handbook* (August 2006).
dBA = A-weighted decibel(s)
FHWA = Federal Highway Administration
ft = foot/feet
L_{max} = maximum instantaneous noise level

As shown in Table G, it is expected that the average noise levels during the construction of the project at the nearest noise-sensitive use, the existing single-family home to the south at 1616 Gardena Avenue, would range from 69 dBA L_{eq} to 83 dBA L_{eq}, depending on phase, based on an average distance of 85 ft from the center of construction activities. Therefore, the noise impacts would not exceed the 90 dBA L_{eq} 1-hour construction noise level criteria established by the FTA for residential uses based on the average condition. When construction activities occur near the property line, noise levels could approach 104 dBA L_{eq}. For the single-family homes further to the south on El Bonito Avenue, due to additional distance and shielding from existing intervening structures, construction noise levels would be further reduced. While construction-related impacts are short-term and would no longer occur once project construction is completed, they have the potential to be higher than existing ambient noise levels by more than 5 dBA, a typical threshold of perceptibility in an outdoor environment, in the project area. Construction noise impacts would be potentially significant.

Table G: Potential Construction Noise Impacts at Surrounding Residences

Receptor (Location)	Composite Noise Level (dBA L_{eq}) at 50 feet[1]	Average Distance (feet)	Range of Composite Construction Noise Levels (dBA L_{eq})	Exceed 90 dBA L_{eq} Threshold?	Result in a 5 dBA Increase Over Ambient Conditions?
1616 Gardena Avenue	76 -88	85	69-83	No	Yes
335 El Bonito Avenue		175	63-77	No	Yes
337 El Bonito Avenue		120	66-80	No	Yes
339 El Bonito Avenue		170	63-77	No	Yes
343 El Bonito Avenue		150	64-78	No	Yes

Source: Compiled by LSA (2022).

[1] The composite construction noise level represents the range of noise levels with the grading phase generating the higher noise levels as compared to other phases.

dBA L_{eq} = average A-weighted hourly noise level

Compliance with the time restrictions within the City's Noise Ordinance would ensure that construction noise does not disturb the residential and sensitive office uses during hours when ambient noise levels are likely to be lower (i.e., at night). Although construction noise would be higher than the ambient noise in the project vicinity, construction noise would cease to occur once project construction is completed. In addition to compliance with appropriate construction times, with the incorporation of the construction noise mitigation measures presented in the summary of this analysis, which would be implemented during construction, construction noise impacts would be reduced to the greatest extent feasible, however, the impact would be significant and unavoidable.

Short-Term Off-Site Construction Vibration Impacts

The following section presents reference vibration information for construction equipment, applicable vibration damage and annoyance criteria, and an impact assessment related to vibration impacts from proposed project.

Groundborne vibration from construction activity would generally be low to moderate. While there is currently limited information regarding vibration source levels, to provide a comparison of vibration levels expected for a project of this size, equipment such as a large bulldozer, as shown in Table H, would generate approximately 0.089 PPV in/sec groundborne vibration when measured at 25 feet, based on the *Transit Noise and Vibration Impact Assessment* (FTA 2018).

Table H: Vibration Source Amplitudes for Construction Equipment

Equipment	Reference Level at 25 ft PPV (in/sec)
Large Bulldozer, Hoe Ram, Caisson Drilling	0.089
Loaded Trucks	0.076
Jackhammer	0.035
Small Bulldozer	0.003

Source: *Transit Noise and Vibration Impact Assessment* (FTA 2018).
ft = feet
FTA = Federal Transit Administration
in/sec = inches per second
PPV = peak particle velocity

As stated above, the City considers a vibration annoyance impact to occur when levels exceed 0.01 in/sec and the FTA has established a vibration damage threshold of and 0.3 in/sec for structures that consist of engineered concrete or masonry walls and 0.2 in/sec for structures that consist of non-engineered timber or masonry walls. The formula for vibration transmission is provided below:

$$PPV_{equip} = PPV_{ref} \times (25/D)^{1.5}$$

In order to assess the potential for vibration impact, the distance measured between the nearest off-site buildings and the construction boundary (assuming the construction equipment would be used approximately 5 feet from the construction boundary) is utilized.

A summary of potential vibration impacts is presented in Table I. Based on the information in Table I, vibration has the potential to cause damage to the commercial use to the north at 1638 S. Central Avenue and the residential use to the east at 1616 Gardena Avenue if large construction equipment operates within 15 feet of the building façade. Additionally, vibration has the potential to cause annoyance to residential uses if large construction equipment operates within 110 feet of the building façade.

Table I: Summary of Construction Vibration Levels

Land Use	Address	Equipment Reference	Reference Vibration Level (PPV) at 25 ft	Distance (ft)[1]	Maximum Vibration Level (PPV)	Exceed Damage Criteria of 0.2 PPV in/sec?	Exceed Annoyance Criteria of 0.01 PPV in/sec?
Commercial	1638 S. Central Avenue	Large Bulldozers	0.089	5	0.995	Yes	No[1]
Residential	1616 Gardena Avenue			8	0.492	Yes	Yes
Residential	335 El Bonito Avenue			92	0.013	No	Yes
Residential	337 El Bonito Avenue			37	0.049	No	Yes
Residential	339 El Bonito Avenue			87	0.014	No	Yes
Residential	343 El Bonito Avenue			75	0.017	No	Yes

Source: Compiled by LSA (2022).
Note: Due to the associated indoor uses at the commercial use to the north, construction activities are not expected to cause annoyance.
ft = foot/feet
FTA = Federal Transit Administration
in/sec = inch/inches per second
PPV = peak particle velocity

Because these residences in Table I fall within the 110-foot contour for annoyance and the commercial use to the north at 1638 S. Central Avenue and the residential use to the east at 1616 Gardena Avenue fall within the potential damage contour, there would be a potentially significant impact. With the incorporation of the vibration minimization measures presented in the summary of this analysis, vibration damage would be avoided. Additionally, with the standard construction best practices discussed in the summary of this analysis, vibration impacts would be further reduced, however, vibration levels could still exceed the applicable annoyance criteria resulting a significant and unavoidable impact.

Long-Term Off-Site Noise Impacts

The proposed project would have HVAC equipment distributed across the project's rooftop. The greatest noise impact related to HVAC operations would occur at the existing single-family homes located south of the proposed project. The roof plan identifies 31 HVAC units that would vary in distance from 30 feet to 140 feet from the closest single-family home façade. To be conservative, it was assumed that all units would be in operation simultaneously at the acoustical average distance to the receptor of approximately 75 feet. This distance is calculated by taking the square root of the closest source distance times the furthest source distance.

Research of several manufacturers' (e.g., Trane) technical data revealed that that there are residential air conditioners with noise levels with an approximate range from 57 to 75 LwA (sound power level) or 42.3 to 60.3 dBA L_{eq} when measured at a distance of 5 ft from an individual unit.

Utilizing the equation below, a composite level of 51.7 dBA L_{eq} at the nearest receptor to the south.

$$Leq\ (at\ distance\ D\ feet) = \left(Number\ of\ Units * 10^{\frac{Leq(at\ 5\ feet)}{10}}\right) - 20 * \log_{10}\left(\frac{D}{5}\right)$$

Additionally, the proposed screening walls would provide an additional reduction from the HVAC units. It can be assumed that a minimum reduction of 6 dBA would occur with screening walls that break the line-of-site between source and receptor. With the noise reduction associated with distance and additional reduction from screening walls, HVAC noise levels will be approximately 45.7 dBA L_{eq} and would be below the existing quietest nighttime ambient noise levels of 48.4 dBA L_{eq}. No mitigation is required.

Long-Term On-Site Noise Impacts

Exterior Noise Level Assessment

Based on monitoring results shown in Table C, noise levels at the project site currently approach 67 dBA CNEL. In order to account for the decrease in activity associated with the current pandemic, for purposes of this analysis, it is estimated that the primary sources of noise in the project vicinity, including the rail line to the west and associated parking lot activities, are currently about 50 percent of t typical operations. With a doubling of operations, it is expected that noise levels would be 3 dBA higher, resulting in a level of 70 dBA CNEL.

In addition to the existing noise sources, the project site would be potentially impacted by the future California High Speed Rail (CAHSR) operations. The results of the noise model presented in the Burbank to Los Angeles Project Section EIR/EIS (California Rail Authority 2020) indicates that noise levels experienced at the project site due to CAHSR operations would approach 64 dBA CNEL.

The combination of the exiting sources of noise with the future CAHSR operations would result in an exterior noise level of 71 dBA CNEL at the project site. As described in Table D above, exterior noise standards are only applicable to private areas at which privacy is expected. While the proposed project does not have any such areas, for reporting purposes, the rooftop desk would be considered a gathering space that may benefit from lower noise levels. The proposed 6-foot-high glass barrier around the perimeter of the roof deck would reduce noise levels by approximately 6 dBA CNEL to a a level of 65 dBA CNEL. While measures to reduce exterior noise levels are not required; the project must demonstrate compliance with the interior noise standard of 45 dBA CNEL.

Interior Noise Assessment

Based on a review of the architectural plans from the proposed project (Alajajian Marcoosi Architects Inc. 2020), the noise sensitive rooms would have a means of mechanical ventilation; therefore, the interior noise assessment assumes a windows-and-doors-closed condition. Using the architectural plans for the proposed project, LSA conducted interior noise calculations for the bedrooms facing west toward Gardena Avenue and the existing rail corridor. INSUL, a software program for predicting interior noise environments from wall construction and window selections, was used to assess a standard exterior-to-interior noise level reduction for the proposed project.

Based on a discussion with the project architect, the assumed minimum specifications for the proposed wall assembly, which would have an STC rating of 41, are as follows:

- 7/8-inch stucco exterior
- Single layer of 5/8-inch plywood
- 2-inch by 6-inch wood studs, 16 inches off center, filled with a minimum of 3.5-inch thick fiberglass insulation
- Single layer of 5/8-inch Type-X gypsum board

At this time, the specific window supplier has yet to be chosen; therefore, this information references Milgard Windows for comparison purposes. Utilizing a window with an STC rating of 33, the INSUL model indicates that a reduction of approximately 28 dBA can be expected. Given the proximity to a number of noise sources, it is recommended that all sliding glass doors and windows have a minimum rating of STC-33.

Summary of Recommendations

Based on the analysis above, the City should verify, as a condition of approval, that final design plans reflect the following measures in order for all exterior and interior noise sensitive spaces to comply with the City's noise standards:

- Standard building construction requirements shall consist of wall construction with a minimum rating of STC-41 as described above and windows and glass doors throughout the building at sensitive rooms shall meet a minimum STC rating of STC-33.

The City shall require that the construction contractor(s) use all feasible construction noise and vibration mitigation measures to minimize construction noise and vibration annoyances as well as avoid damage to all adjacent buildings. The mitigation shall include the following:

Noise Mitigation Measures

- **Construction Noise Mitigation.** Prior to issuance of demolition permits, the Building Official of the Glendale (City) Department of Building and Safety, or designee, shall verify that all construction plans include notes stipulating the following:
    - Grading and construction contractors shall use equipment that generates lower vibration levels, such as rubber-tired equipment rather than metal-tracked equipment.
    - Construction haul truck and materials delivery traffic shall avoid residential areas whenever feasible.
    - The construction contractor shall place noise- and vibration-generating construction equipment and locate construction staging areas away from sensitive uses whenever feasible.

- The construction contractor shall use on-site electrical sources to power equipment rather than diesel generators where feasible.

- The construction contractor shall ensure that a minimum 12-foot-high barrier, such as plywood structures or flexible sound control curtains, shall be erected between on the proposed project site and adjacent to the sensitive receptors to minimize the amount of noise during construction. A 12-foot-high construction noise barrier would provide approximately 12 dBA reduction to the closest residential receptors to the south.

- All residential units located within 500 feet of the construction site shall be sent a notice regarding the construction schedule. A sign legible at a distance of 50 feet shall also be posted at the construction site. All notices and the signs shall indicate the dates and durations of construction activities, as well as provide a telephone number for the "noise disturbance coordinator."

Vibration Mitigation Measures

- **Maintaining Buffer Distances.** Maintain a safe distance between the operation of vibration-generating construction equipment and the potentially affected building and/or structure to avoid damage to the extent possible as presented in Table I, based on site constraints; and

- **Alternative Construction Equipment.** To the extent feasible, the construction contractor shall use alternative construction techniques or equipment, such as hand excavation to avoid or reduce unnecessary construction vibration.

- **Prepare a Monitoring Plan.** The property owner shall undertake a monitoring program to avoid or reduce project-related construction vibration damage to adjacent buildings and/or structures and to ensure that any such damage is documented and repaired. The monitoring program shall apply to all potentially affected buildings and/or structures adjacent to the project site. Prior to issuance of any demolition or building permit, the property owner shall submit the construction vibration monitoring plan to the City for approval. The monitoring plan shall include, at a minimum, the following components, as applicable.

    - **Vibration Monitoring.** To ensure that construction vibration levels do not exceed the established standard, an acoustical consultant shall monitor vibration levels at each affected building and/or structure on adjacent properties when heavy construction occurs in close proximity. Based on direction from the acoustical consultant, vibratory construction activities that generate vibration levels in excess of the standard shall be prohibited.

    - **Alternative Construction Techniques.** Should construction vibration levels be observed in excess of the established standard, the contractor(s) shall halt construction and put alternative construction techniques into practice, to the extent feasible. Following incorporation of the alternative construction techniques, vibration monitoring shall recommence to ensure that vibration levels at each affected building and/or structure on adjacent properties are not exceeded.

- **Periodic Inspections.** A historic architect or qualified historic preservation professional (for effects on historic buildings and/or structures) and/or structural engineer (for effects on non-historic buildings and/or structures) shall conduct regular periodic inspections as specified in the vibration monitoring plan of each affected building and/or structure on adjacent properties during vibration-generating construction activity on the project site. Should damage to any building and/or structure occur, the building(s) and/or structure(s) shall be remediated to their pre-construction condition at the conclusion of vibration-generating activity on the site.

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APPENDIX A

NOISE MONITORING FIELD SHEETS

Noise Measurement Survey – 24 HR

Project Number: SSG2001
Project Name: 1642 S. Central Ave Apt Proj

Test Personnel: Corey Knips
Equipment: Larson Davis Spark 706RC
Serial Number: 18905

Site Number: LT-1 Date: 6/9/20

Time: From 11:00 AM To 11:00 AM

Site Location: 1642 Central Avenue, in tree along Gardena Avenue.

Primary Noise Sources: Light traffic on Gardena Avenue and Central Avenue, Glendale train station – very light activity compared to normal schedule.

Weather: Temperature ranging from 60 degrees at 6 am to 94 degrees at 5 pm Winds are calm to light for the majority of the measurement period with slightly higher winds in the afternoon hours. Typical weather conditions for the area.

Location Photo:

Noise Measurement Survey – 24 HR

Project Number: SSG2001
Project Name: 1642 S. Central Ave Apt Proj

Test Personnel: Corey Knips
Equipment: Larson Davis Spark 706RC
Serial Number: 18906

Site Number: LT-2 Date: 6/9/20

Time: From 11:00 AM To 11:00 AM

Site Location: 1642 Central Avenue, in tree along Central Avenue.

Primary Noise Sources: Light traffic on Gardena Avenue and Central Avenue, Glendale train station – very light activity compared to normal schedule.

Location Photo:

APPENDIX B

CONSTRUCTION NOISE CALCULTATIONS

Construction Calculations

Phase: Demolition

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Concrete Saw	1	90	20	50	0.5	90	83
Tractor	2	84	40	50	0.5	84	83
Dozer	1	82	40	50	0.5	82	78

	Lmax	Leq
Combined at 50 feet	**91**	**87**
Combined at Receptor 1616 Gardena Avenue 85 feet	**87**	**82**
Combined at Receptor 335 El Bonito Avenue 175 feet	**81**	**76**
Combined at Receptor 337 El Bonito Avenue 120 feet	**84**	**79**
Combined at Receptor 339 El Bonito Avenue 170 feet	**81**	**76**
Combined at Receptor 343 El Bonito Avenue 150 feet	**82**	**77**

Phase: Site Preparation

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Tractor	1	84	40	50	0.5	84	80
Grader	1	85	40	50	0.5	85	81

	Lmax	Leq
Combined at 50 feet	**88**	**84**
Combined at Receptor 1616 Gardena Avenue 85 feet	**83**	**79**
Combined at Receptor 335 El Bonito Avenue 175 feet	**77**	**73**
Combined at Receptor 337 El Bonito Avenue 120 feet	**80**	**76**
Combined at Receptor 339 El Bonito Avenue 170 feet	**77**	**73**
Combined at Receptor 343 El Bonito Avenue 150 feet	**78**	**74**

Phase: Grading

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Concrete Saw	1	90	20	50	0.5	90	83
Tractor	2	84	40	50	0.5	84	83
Grader	1	85	40	50	0.5	85	81
Dozer	1	82	40	50	0.5	82	78

	Lmax	Leq
Combined at 50 feet	**92**	**88**
Combined at Receptor 1616 Gardena Avenue 85 feet	**88**	**83**
Combined at Receptor 335 El Bonito Avenue 175 feet	**77**	**77**
Combined at Receptor 337 El Bonito Avenue 120 feet	**69**	**80**
Combined at Receptor 339 El Bonito Avenue 170 feet	**59**	**77**
Combined at Receptor 343 El Bonito Avenue 150 feet	**49**	**78**

Phase:Building Construstion

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Crane	1	81	16	50	0.5	81	73
Man Lift	2	75	20	50	0.5	75	71
Tractor	2	84	40	50	0.5	84	83

	Lmax	Leq
Combined at 50 feet	**86**	**84**
Combined at Receptor 1616 Gardena Avenue 85 feet	**82**	**79**
Combined at Receptor 335 El Bonito Avenue 175 feet	**75**	**73**
Combined at Receptor 337 El Bonito Avenue 120 feet	**79**	**76**
Combined at Receptor 339 El Bonito Avenue 170 feet	**75**	**73**
Combined at Receptor 343 El Bonito Avenue 150 feet	**77**	**74**

Phase: Paving

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Paver	1	77	50	50	0.5	77	74
Tractor	1	84	40	50	0.5	84	80
Concrete Mixer Truck	4	79	40	50	0.5	79	81
Roller	1	80	20	50	0.5	80	73

	Lmax	Leq
Combined at 50 feet	**87**	**84**
Combined at Receptor 1616 Gardena Avenue 85 feet	**82**	**80**
Combined at Receptor 335 El Bonito Avenue 175 feet	**76**	**73**
Combined at Receptor 337 El Bonito Avenue 120 feet	**79**	**77**
Combined at Receptor 339 El Bonito Avenue 170 feet	**76**	**74**
Combined at Receptor 343 El Bonito Avenue 150 feet	**77**	**75**

Phase:Architectural Coating

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Compressor (air)	1	78	40	50	0.5	78	74

	Lmax	Leq
Combined at 50 feet	**78**	**74**
Combined at Receptor 1616 Gardena Avenue 85 feet	**73**	**69**
Combined at Receptor 335 El Bonito Avenue 175 feet	**67**	**63**
Combined at Receptor 337 El Bonito Avenue 120 feet	**70**	**66**
Combined at Receptor 339 El Bonito Avenue 170 feet	**67**	**63**
Combined at Receptor 343 El Bonito Avenue 150 feet	**68**	**64**

Sources: RCNM

[1]- Percentage of time that a piece of equipment is operating at full power.

dBA – A-weighted Decibels

Lmax- Maximum Level

Leq- Equivalent Level