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NOISE AND VIBRATION IMPACT ANALYSIS

301 TENNESSEE STREET WAREHOUSE PROJECT

REDLANDS, CALIFORNIA

LSA

January 2023

NOISE AND VIBRATION IMPACT ANALYSIS

301 TENNESSEE STREET WAREHOUSE PROJECT

REDLANDS, CALIFORNIA

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LSA

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LIST OF ABBREVIATIONS AND ACRONYMS

City	City of Redlands
CNEL	Community Noise Equivalent Level
dBA	A-weighted decibel
EPA	United States Environmental Protection Agency
ft	Feet
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HVAC	heating, ventilation, and air conditioning
in/sec	inches per second
SBD	San Bernardino International Airport
L_{dn}	day-night average noise level
L_{eq}	equivalent continuous sound level
L_{max}	maximum instantaneous sound level
PPV	peak particle velocity
project	301 Tennessee Street Warehouse Project
RMS	root-mean-square
sf	square feet
SPL	sound power level

INTRODUCTION

This noise and vibration impact analysis has been prepared to evaluate the potential noise and vibration impacts and reduction measures associated with 301 Tennessee Street Warehouse Project (project) in Redlands, California. This report is intended to satisfy the City of Redlands (City) requirement for a project-specific noise impact analysis by examining the impacts of the project site and evaluating noise reduction measures that the project may require.

PROJECT LOCATION AND DESCRIPTION

The proposed project is located on at 301 Tennessee Street in the City of Redlands, San Bernardino County, California. The project site encompasses two parcels (Assessor's Parcel Number [0292-192-11-000 and 0292-192-14-0000]), which total approximately 10.98 acres. The project site is currently developed with an existing 193,469 square foot (sf) manufacturing warehouse and a single-family house. The project would be accessible via four driveways, two would be located on Tennessee Street, one in West State Street, and one in Kansas Street. Figure 1 shows the Project Location and Figure 2 illustrates the Site Plan.

The proposed project will consist of 197,397 sf of industrial warehouse facility (with 10 percent cold storage) with office, including landscaping, parking, and other site improvements. The project would include a total of 267 passenger parking spaces including electric vehicles, vanpool, and accessible spaces. The project would also provide 25 loading docks. In addition, the proposed project would have approximately 84,845 sf of ornamental landscaping that would cover 18 percent of the site. The project would be consistent with the City's General Plan and Zoning Ordinance and therefore would not require a change to the General Plan land use designation or the zoning.

Typical operational characteristics include employees traveling to and from the site, delivery of products to the site, and truck loading and unloading. The project is assumed to operate 24 hours per day, 7 days per week; however, this may shift depending on the tenant, as the hours of operation are unknown. Based on the *Focused Traffic Analysis for the 301 Tennessee Street Industrial Building* (EPD Solutions, Inc. 2022), existing conditions typically generate approximately 1,307 average daily trips and the proposed project would generate approximately 1,387 average daily trips resulting in an increase of 71 daily trips.

Construction activities for the project would occur over one phase and include demolition, site preparation, grading, building construction, paving, and architectural coatings. Construction would be anticipated to begin in June 2023 and end in May 2024. Based on the preliminary grading plans, the project would require approximately 23,154 cubic yards of soil import.

LSA

LEGEND

Project Location

FIGURE 1

0 500 1000
FEET

Tennessee Warehouse

Regional Project Location

SOURCE: ArcGIS Online Topographic Map (2020)

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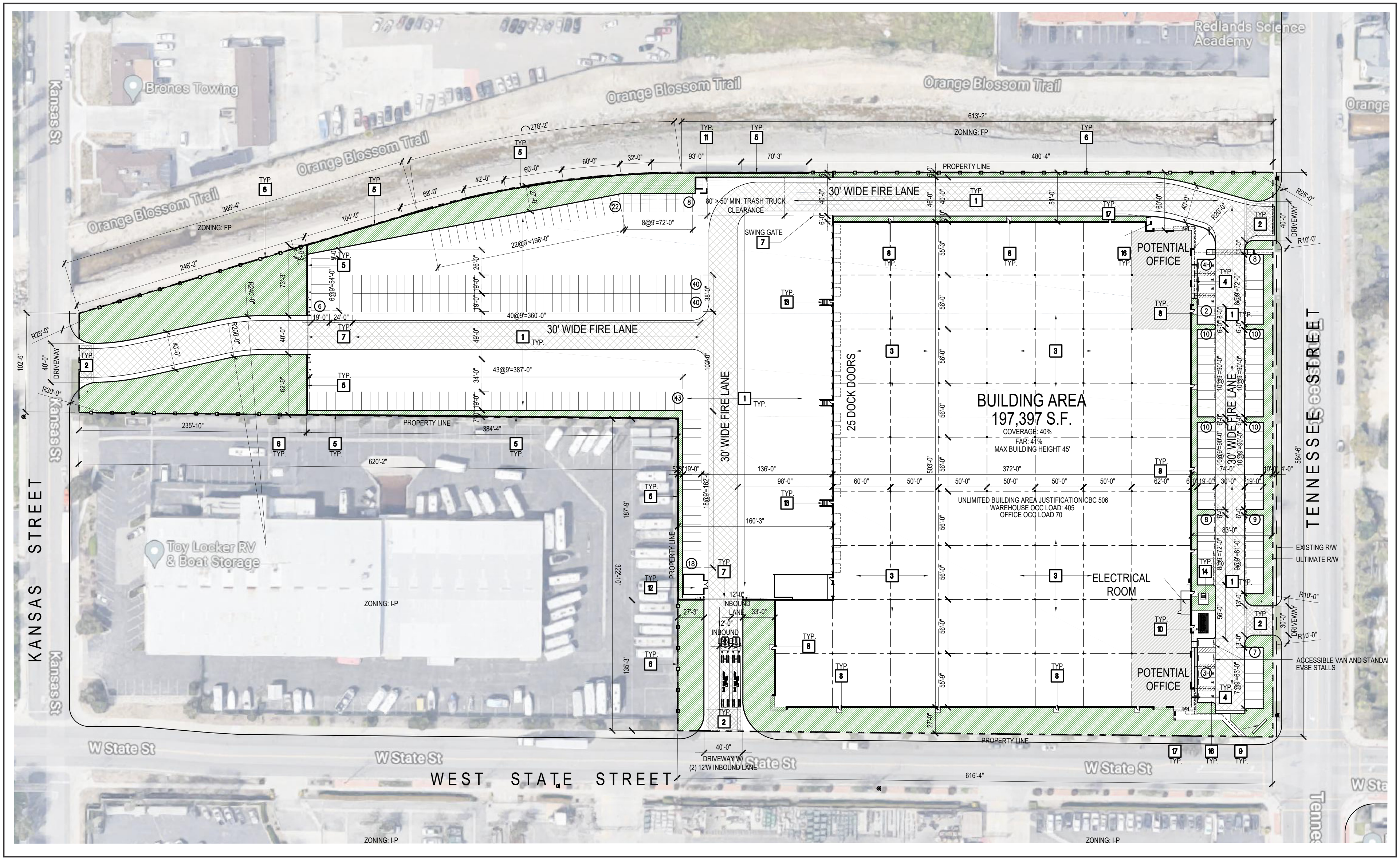

FIGURE 2

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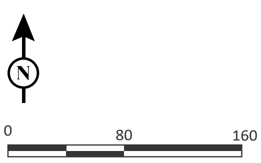

SOURCE: LHA

Tennessee Warehouse

Site Plan

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EXISTING LAND USES IN THE PROJECT AREA

The project site is surrounded primarily by general industrial facilities. The areas adjacent to the project site include the following uses:

- **North:** Existing commercial shopping center;
- **East:** Existing commercial uses and associated parking lot;
- **South:** Existing industrial uses; and
- **West:** Existing industrial uses;

The nearest, non-industrial, receptors are:

- **South:** Redlands Christian Middle School located approximately 380 feet from the project site boundary opposite West State Street.
- **South:** Redlands Adventist Academy Kindergarten Building located approximately 270 feet from the project site boundary southeast of Tennessee Street and West State Street.
- **North:** Existing office uses located approximately 155 feet from the project site boundary.

NOISE AND VIBRATION FUNDAMENTALS

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 sound wave, which results in the tone's range from high to low. Loudness is the strength of a sound, and it describes a noisy or quiet environment; it 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 is the average rate of sound energy transmitted through a unit area perpendicular to the direction in which the sound waves are traveling. 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 with the A-weighted decibel (dBA) 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. Decibels (dB), unlike the linear scale (e.g., inches or pounds), are measured on a logarithmic scale representing points on a sharply rising curve.

For example, 10 dB is 10 times more intense than 0 dB, 20 dB is 100 times more intense than 0 dB, and 30 dB is 1,000 times more intense than 0 dB. Thirty decibels (30 dB) represents 1,000 times as much acoustic energy as 0 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 sound's loudness. 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 levels dissipate exponentially with distance from their noise sources. 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. Line source sound levels decrease 4.5 dB for each doubling of distance in a relatively flat environment with absorptive vegetation.

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. CNEL is the time-weighted average 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 relaxation. 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 traffic 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 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. It 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. 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.

Noise impacts can be described in three categories. The first category includes audible impacts, which are increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3 dB or greater because this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1 dB and 3 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category includes changes in noise levels of less than 1 dB, which are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to sound levels higher than 85 dBA. Exposure to high sound levels affects the entire system, with prolonged sound 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 sound exposure above 90 dBA would result in permanent cell damage. When the sound level reaches 120 dBA, a tickling sensation occurs in the human ear, even with short-term exposure. This level of sound is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by a feeling of pain in the ear (i.e., the threshold of pain). A sound level of 160–165 dBA will result in dizziness or a loss of equilibrium. The ambient or background noise problem is widespread and 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 sound 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., the number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes 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, respectively.
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 p.m. to 10:00 p.m. and after the addition of 10 dBA to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
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 p.m. and 7:00 a.m.
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 from 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, 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	Reference level
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 (2023).

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 less. 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 ft from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 ft (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 the 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 x 10^{-6} inches/second (in/sec) used in the United States.

REGULATORY SETTING

APPLICABLE NOISE STANDARDS

The applicable noise standards governing the project site include the criteria in the City's Healthy Community Element of the General Plan (Noise Element) and the City of Redlands Municipal Code (RMC).

City of Redlands

General Plan 2035

The Healthy Community Element provides the City's goals and policies related to noise, including the land use compatibility guidelines for community exterior noise environments. The City has identified the following policies in the Noise Element:

Policies

Principle 7-P.41: Ensure that new development is compatible with the noise environment by continuing to use potential noise exposure as a criterion in land use planning.

Actions

7-A.135: Use the noise and land use compatibility matrix (General Plan Table 9.1) and Future Noise Contours map (General Plan Figure 7-9) as criteria to determine the acceptability of a given land use, including the improvement/construction of streets, railroads, freeways, and highways. Do not permit new noise-sensitive uses—including schools, hospitals, places of worship, and homes— where noise levels are "normally unacceptable" or higher if alternative locations are available for the uses in the City.

7-A.136: Require a noise analysis be conducted for all development proposals located where projected noise exposure would be other than "clearly" or "normally compatible" as specified in Table 9.1.

7-A.137: For all projects that have noise exposure levels that exceed the standards in Table 9.1, require site planning and architecture to incorporate noise-attenuating features. With mitigation, development should meet the allowable outdoor and indoor noise exposure standards in Table 9.2. When a building's openings to the exterior are required to be closed to meet the interior noise standard, mechanical ventilation shall be provided.

Measure U Policies

> **9.0e:** Use the criteria specified in Table 9.1 to assess the compatibility of proposed land uses with the projected noise environment, and apply the noise standards in Table 9.2, which prescribe interior and exterior noise standards in relation to specific land uses. Do not approve projects that would not comply with the standards in Tables 9.1 and 9.2.
>
> **9.0i:** Require construction of barriers to mitigate sound emissions where necessary or where feasible and encourage use of walls and berms to protect residential or other noise sensitive land uses that are adjacent to major roads, commercial, or industrial areas.
>
> **9.0v:** Consider the following impacts as possibly "significant":
>
> - An increase in exposure of 4 or more dB if the resulting noise level would exceed that described as clearly compatible for the affected land use, as established in Tables 9.1 and 9.2;
> - Any increase of 6 dB or more, due to potential for adverse community response.
>
> **9.0w**: Limit hours of construction or demolition work where site-related noise is audible beyond the site boundary.

City of Redlands Municipal Code

Chapter 8.06 of the City's Municipal Code establishes the City's noise standards and regulations.

The City's noise control guidelines for determining and mitigating non-transportation or stationary noise source impacts from operations in neighboring residential areas are found in Section 8.06.070. The noise standards found in Section 8.06.070 are shown in Table C.

The City has set restrictions to control noise impacts associated with the construction of the proposed Project. According to Section 8.06.090, *Noise Disturbances Prohibited,* construction activities are not allowed: *between weekday hours of six o'clock (6:00) PM and seven o'clock (7:00) AM, including Saturdays or at any time on Sundays or holidays, such that the sound therefrom creates a noise disturbance across a residential or commercial real property line, except for emergency work by public service utilities, the City or another governmental entity.*

Table C: Operational Noise Standards

Maximum Permissible Sound Levels By Receiving Land Use		
Receiving Land Use Category	**Time Period**	**Noise Level – dBA L_{eq}**
Single-family residential districts	10:00 PM – 7:00 AM	50
	7:00 AM – 10:00 PM	60
Multi-family residential districts; public space; institutional	10:00 PM – 7:00 AM	50
	7:00 AM – 10:00 PM	60
Commercial	10:00 PM – 7:00 AM	60
	7:00 AM – 10:00 PM	65
Industrial	Anytime	75

Source: City of Redlands (2023).
Notes:
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

Federal Transit Administration

Because the City does not have construction noise level limits, construction noise was assessed using criteria from the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018). Table D shows the FTA's Detailed Analysist Construction Noise Criteria based on the composite noise levels per construction phase.

Table D: Detailed Assessment Construction Noise Criteria

Land Use	Daytime 1-hour L_{eq} (dBA)	Nighttime 1-hour L_{eq} (dBA)
Residential	80	70
Commercial	85	85
Industrial	90	90

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

APPLICABLE VIBRATION STANDARDS

Municipal Code

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

"The minimum 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 threshold shall be presumed to be a motion velocity of 0.01 inches per second over the range of one to one hundred (100) Hz."

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.

OVERVIEW OF THE EXISTING NOISE ENVIRONMENT

The primary existing noise sources in the project area are surrounding industrial uses and traffic on Kansas Street, Tennessee Street, and State Street.

AMBIENT NOISE MEASUREMENTS

Long-term (24-hour) noise level measurements were conducted on October 13th and 14th , 2022, using two (3) Larson Davis Spark 706RC Dosimeters. Table E provides a summary of the measured hourly noise levels and calculated CNEL level from the long-term noise level measurements. As shown in Table E, the calculated CNEL levels range from 57.8 dBA CNEL to 71.7 dBA CNEL. Hourly noise levels at surrounding sensitive uses are as low as 44.4 dBA L_{eq} during nighttime hours and 54.3 dBA L_{eq} during daytime hours. Long-term noise monitoring data results are provided in Appendix A. Figure 3 shows the long-term monitoring locations.

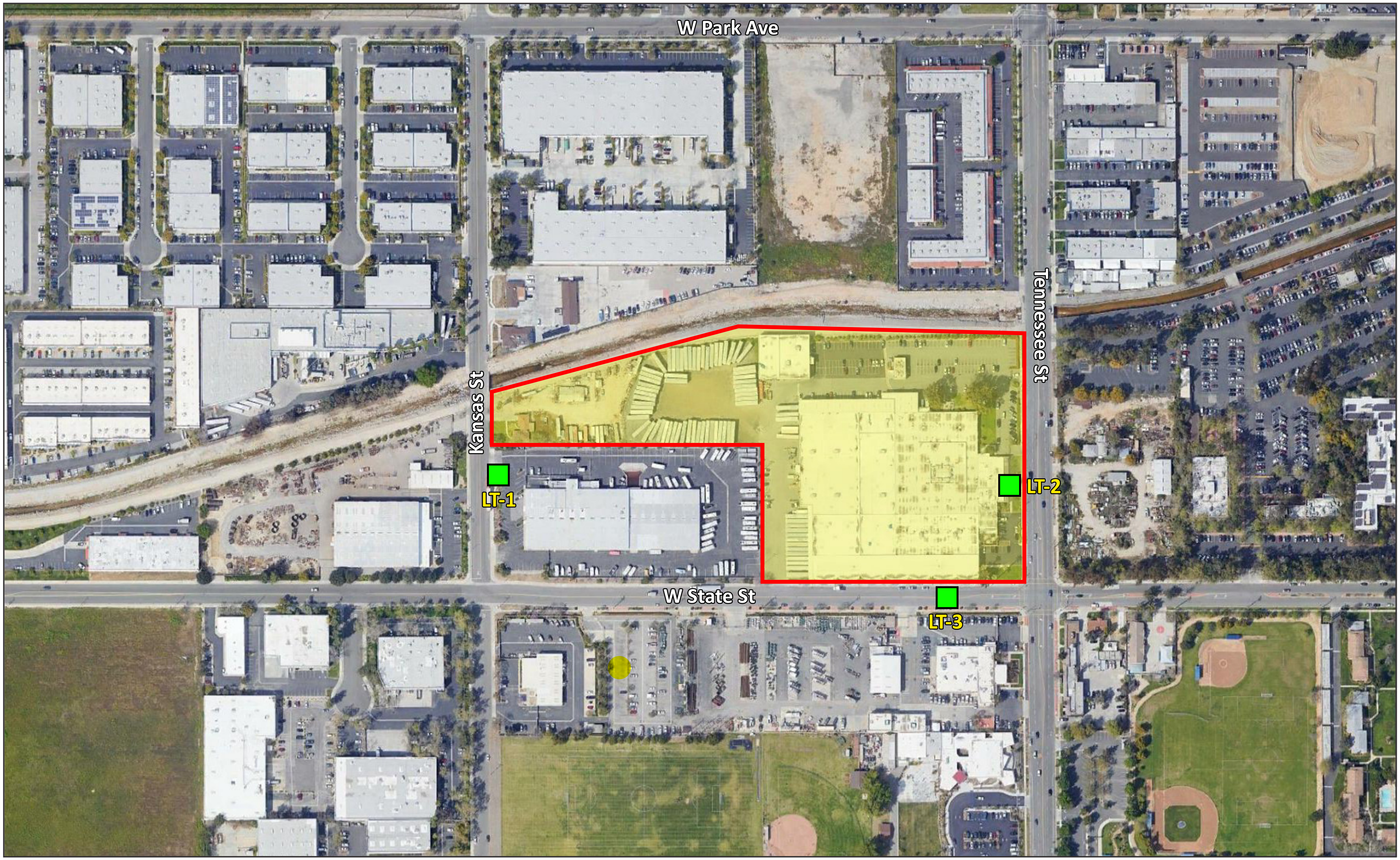
Table E: Long-Term 24-Hour Ambient Noise Monitoring Results

Location		Daytime Noise Levels[1] (dBA L_{eq})	Evening Noise Levels[2] (dBA L_{eq})	Nighttime Noise Levels[3] (dBA L_{eq})	Daily Noise Levels (dBA CNEL)
LT-1	West of project site along Kansas Street, on a tree bordering 300 Kansas Street.	54.3 – 60.3	50.0 – 54.8	44.4 – 52.6	57.8
LT-2	East of project site along Tennessee Street at the building entrance of 301 Tennessee Street.	68.6 – 72.8	65.6 – 68.2	58.5 – 67.2	71.7
LT-3	Southeast corner of the project site near a tree along State Street.	63.7 – 67.9	59.0 – 68.7	49.6 – 62.8	67.9

Source: Compiled by LSA (2023).
Note: Noise measurements were conducted from October 13 to October 14, 2022, starting at 3:00 p.m.
[1] Daytime Noise Levels = noise levels during the hours from 7:00 a.m. to 7:00 p.m.
[2] Evening Noise Levels = noise levels during the hours from 7:00 p.m. to 10:00 p.m.
[3] Nighttime Noise Levels = noise levels during the hours from 10:00 p.m. to 7:00 a.m.
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level
CNEL = Community Noise Equivalent Level

EXISTING AIRCRAFT NOISE

Aircraft flyovers may be audible on the project site due to aircraft activity in the vicinity. The nearest airports to the project are San Bernardino International Airport (SBD) and Redlands Municipal Airport (REI) approximately 3.30 miles to the northwest and northeast of project site, respectively. The project site is located well outside the SBD Airport Influence Area according to the 2017 Existing CNEL Contours and Generalized Land Uses – San Bernardino International Airport (San Bernardino County, 2017) as well as outside the REI 60 dBA CNEL Airport Noise Contour according to Figure 7-7: Airport Hazards in the City's General Plan. Therefore, the project would not be adversely affected by airport/airfield noise, nor would the project contribute to or result in adverse airport/airfield noise impacts.



LSA

LEGEND

Project Site

LT-1 Long-term Noise Monitoring Location

N

0 65 110
FEET

SOURCE: Google Earth 2021

FIGURE 3

301 Tennessee Street

Noise Monitoring Locations

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PROJECT IMPACTS

SHORT-TERM CONSTRUCTION NOISE IMPACTS

Two types of short-term noise impacts could occur during the construction of the proposed project. First, construction crew commutes and the transport of construction equipment and materials to the site for the proposed project would incrementally increase noise levels on access roads leading to the site. Although there would be a relatively high single-event noise-exposure potential causing intermittent noise nuisance (passing trucks at 50 ft would generate up to 84 dBA L_{max}), the effect on longer-term ambient noise levels would be small when compared to existing daily traffic volumes on Kansas Street, West State Street, and Tennessee Street. Because construction-related vehicle trips would not approach existing daily traffic volumes, traffic noise would not increase by 3 dBA CNEL. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, short-term, construction-related impacts associated with worker commute and equipment transport to the project site would be less than significant.

The second type of short-term noise impact is related to noise generated during construction which includes demolition of the existing structures and other site improvements, site preparation, grading, building construction, paving, and architectural coating on the project site. 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. Table F lists typical construction equipment noise levels recommended for noise impact assessments, based on a distance of 50 ft between the equipment and a noise receptor, taken from the FHWA *Roadway Construction Noise Model* (FHWA 2006).

In addition to the reference maximum noise level, the usage factor provided in Table F is used 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.

Table F: Typical Construction Equipment Noise Levels

Equipment Description	Acoustical Usage Factor (%)[1]	Maximum Noise Level (L_{max}) at 50 Feet[2]
Auger Drill Rig	20	84
Backhoes	40	80
Compactor (ground)	20	80
Compressor	40	80
Cranes	16	85
Dozers	40	85
Dump Trucks	40	84
Excavators	40	85
Flat Bed Trucks	40	84
Forklift	20	85
Front-end Loaders	40	80
Graders	40	85
Impact Pile Drivers	20	95
Jackhammers	20	85
Paver	50	77
Pickup Truck	40	55
Pneumatic Tools	50	85
Pumps	50	77
Rock Drills	20	85
Rollers	20	85
Scrapers	40	85
Tractors	40	84
Trencher	50	80
Welder	40	73

Source: FHWA Roadway Construction Noise Model User's Guide, Table 1 (FHWA 2006).
Note: Noise levels reported in this table are rounded to the nearest whole number.
[1] Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.
[2] Maximum noise levels were developed based on Specification 721.560 from the Central Artery/Tunnel program to be consistent with the City of Boston's Noise Code for the "Big Dig" project.
FHWA = Federal Highway Administration
L_{max} = maximum instantaneous sound level

Each piece of construction equipment operates as an individual point source. Using 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. 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 site preparation and grading phases.

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 G shows the nearest sensitive uses to the project site, their distance from the center of construction activities, and composite noise levels expected during construction. These noise level projections do not consider intervening topography or barriers. Construction equipment calculations are provided in Appendix B.

Table G: Potential Construction Noise Impacts at Nearest Receptor

Receptor (Location)	Composite Noise Level (dBA L_{eq}) at 50 feet[1]	Distance (feet)	Composite Noise Level (dBA L_{eq})
Industrial Uses (West)	88	315	72
Industrial Uses (South)		485	68
Commercial Uses (North)		485	68
School (South)		715	65
Kindergarten (Southeast)		765	64

Source: Compiled by LSA (2023).

[1] The composite construction noise level represents the site preparation and paving phases which are expected to result in the greatest noise level as compared to other phases.

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

While construction noise will vary, it is expected that composite noise levels during construction at the nearest off-site industrial uses to the east would reach 72 dBA L_{eq} while construction noise levels would approach 65 dBA L_{eq} at the nearest sensitive use (School) to the south during daytime hours. These predicted noise levels would only occur when all construction equipment is operating simultaneously; and therefore, are assumed to be rather conservative in nature. While construction-related short-term noise levels have the potential to be higher than existing ambient noise levels in the project area under existing conditions, the noise impacts would no longer occur once project construction is completed.

As stated above, noise impacts associated with construction activities are regulated by the City's noise ordinance. The proposed project would comply with the construction hours specified in the City's Noise Ordinance, which states that construction activities are allowed between the hours of 7:00 a.m. and 6:00 p.m. on weekdays, including Saturdays, with no activities taking place at any time on Sundays or federal holidays.

As it relates to off-site uses, construction-related noise impacts would remain below the 80 dBA L_{eq} and 90 dBA L_{eq} construction noise level criteria, as established by the FTA for residential and industrial land uses, respectively, for the average daily condition as modeled from the center of the project site and therefore would be considered less than significant. Best construction practices presented at the end of this analysis shall be implemented to minimize noise impacts to surrounding receptors.

SHORT-TERM CONSTRUCTION VIBRATION IMPACTS

This construction vibration impact analysis discusses the level of human annoyance using vibration levels in RMS (in/sec) and assesses the potential for building damages using vibration levels in PPV (in/sec). This is because vibration levels calculated in RMS are best for characterizing human response to building vibration, while vibration level in PPV is best for characterizing potential for damage.

Table H shows the PPV and RMS values at 25 ft from the construction vibration source. As shown in Table H, bulldozers, and other heavy-tracked construction equipment (expected to be used for this project) generate approximately 0.089 PPV in/sec or 0.063 in/sec RMS of ground-borne vibration when measured at 25 ft, based on the FTA Manual. The distance to the nearest buildings for vibration impact analysis is measured between the nearest off-site buildings and the project construction boundary (assuming the construction equipment would be used at or near the project setback line).

Table H: Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV/RMS at 25 ft	
	PPV (in/sec)	RMS (in/sec)
Pile Driver (Impact), Typical	0.644	0.457
Pile Driver (Sonic), Typical	0.170	0.121
Vibratory Roller	0.210	0.149
Hoe Ram	0.089	0.063
Large Bulldozer[1]	**0.089**	**0.063**
Caisson Drilling	0.089	0.063
Loaded Trucks[1]	**0.076**	**0.054**
Jackhammer	0.035	0.025
Small Bulldozer	0.003	0.002

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] Equipment shown in **bold** is expected to be used on site.
ft = foot/feet
FTA = Federal Transit Administration
in/sec = inch/inches per second
PPV = peak particle velocity
RMS = root-mean-square

The formulae for vibration transmission are provided below and Tables I and J below provide a summary of off-site construction vibration levels.

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

Table I: Potential Construction Vibration Annoyance Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (RMS) at 25 feet[1]	Distance (feet)[2]	Vibration Level (RMS in/sec)
Industrial Uses (West)	0.063	315	0.0014
Industrial Uses (South)		485	0.0007
Commercial Uses (North)		485	0.0007
School (South)		715	0.0004
Kindergarten (Southeast)		765	0.0004

Source: Compiled by LSA (2023).
1 The reference vibration level is associated with a large bulldozer which is expected to be representative of the heavy equipment used during construction.
2 The reference distance is associated with the average condition, identified by the distance from the center of construction activities to surrounding uses
ft = foot/feet
in/sec = inch/inches per second
RMS = root mean square velocity

Table J: Potential Construction Vibration Damage Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (PPV) at 25 feet[1]	Distance (feet)[2]	Vibration Level (PPV in/sec)
Industrial Uses (West)	0.089	100	0.011
Industrial Uses (South)		140	0.007
Commercial Uses (North)		155	0.006
Kindergarten (Southeast)		270	0.003
School (South)		380	0.002

Source: Compiled by LSA (2023).
1 The reference vibration level is associated with a large bulldozer which is expected to be representative of the heavy equipment used during construction.
2 The reference distance is associated with the peak condition, identified by the distance from the perimeter of construction activities to surrounding structures
ft = foot/feet
in/sec = inch/inches per second
PPV = peak particle velocity

As discussed above, the threshold at which vibration levels would result in annoyance would be 0.01 in/sec RMS and the FTA guidelines indicate that for a non-engineered timber and masonry building, the construction vibration damage criterion is 0.2 in/sec in PPV.

Based on the information provided in Table I, vibration levels are expected to approach 0.0014 in/sec RMS at the closest industrial uses to the west and 0.0004 in/sec RMS at the closest sensitive uses (School and Kindergarten) to the south and southeast and would not exceed the annoyance thresholds.

Based on the information provide in Table J, vibration levels are expected to approach 0.011 at the surrounding structures and would be below the 0.2 PPV in/sec threshold. Other building structures surrounding the project site are farther away and would experience further reduced vibration.

Therefore, no construction vibration impacts would occur. No vibration reduction measures are required.

LONG-TERM OFF-SITE TRAFFIC NOISE IMPACTS

As a result of the implementation of the proposed project, off-site traffic volumes on surrounding roadways have the potential to increase. The proposed project trips generated were obtained from the *Focused Traffic Analysis for the 301 Tennessee Street Industrial Building* (EPD Solutions, Inc. 2022). The proposed project would generate a net of 71 passenger car equivalent (PCE) trips. Based on data from the *City of Redlands Maps and Geographic Data*, the existing average daily traffic (ADT) on Tennessee Street is 12,000 (City of Redlands). The following equation was used to determine the potential impacts of the project:

Change in CNEL = $10\ log_{10}[V_{e+p}/V_{existing}]$

where: $V_{existing}$ = existing daily volumes
V_{e+p} = existing daily volumes plus project
Change in CNEL = increase in noise level due to the project

The results of the calculations show that an increase of approximately 0.02 dBA CNEL is expected along the streets adjacent to the project site. A noise level increase of less than 1 dBA would not be perceptible to the human ear; therefore, the traffic noise increase in the vicinity of the project site resulting from the proposed project would be less than significant. No mitigation is required.

LONG-TERM TRAFFIC-RELATED VIBRATION IMPACTS

The proposed project would not generate vibration levels related to on-site operations. In addition, vibration levels generated from project-related traffic on the adjacent roadways are unusual for on-road vehicles because the rubber tires and suspension systems of on-road vehicles provide vibration isolation. Vibration levels generated from project-related traffic on the adjacent roadways would be less than significant and no mitigation measures are required.

LONG-TERM OFF-SITE STATIONARY NOISE IMPACTS

Adjacent off-site land uses would be potentially exposed to stationary-source noise impacts from the proposed on-site mechanical equipment, trash bin activities, and truck deliveries and loading and unloading activities. The potential noise impacts to off-site sensitive land uses from the proposed HVAC equipment, cold storage fan units, trash bin emptying, and truck delivery activities are discussed below. To provide a conservative analysis, it is assumed that operations would occur equally during all hours of the day and that half the 25 loading docks would be active at all times. Additionally, it is assumed that within any given hour, 3 heavy trucks would maneuver to park near or back into one of the proposed loading docks. To determine the future noise impacts from project operations to the noise sensitive uses, a 3-D noise model, SoundPLAN, was used to incorporate the site topography as well as the shielding from the proposed building on-site. A graphic representation of the operational noise impacts is presented in Appendix C.

Heating, Ventilation, and Air Conditioning Equipment

The project would have various rooftop mechanical equipment including HVAC units on the proposed building. To be conservative, it is assumed the project could have eight (8) rooftop HVAC units and operate 24 hours per day and would generate sound power levels (SPL) of up to 87.9 dBA SPL, based on manufacturer data (Trane).

Trash Bin Emptying Activities

The project is estimated to have a trash dumpster near the western property line of the proposed project site. The trash emptying activities would occur for a period less than 1 minute and would generate sound power levels (SPL) of up to 118.6 dBA SPL or 84 dBA L_{eq} at 50 feet, based on reference information within SoundPLAN.

Cold Storage Fan Units

According to the project description, approximately 10% of the project would be cold storage. Noise levels generated by cold storage fan units would be similar to noise readings from previously gathered reference noise level measurements, which generate a noise level of 57.5 dBA L_{eq} at 60 ft based on measurements taken by LSA (*Operational Noise Impact Analysis for Richmond Wholesale Meat Distribution Center* [LSA 2016]).

Truck Deliveries and Truck Loading and Unloading Activities

Noise levels generated by delivery trucks would be similar to noise readings from truck loading and unloading activities, which generate a noise level of 75 dBA L_{eq} at 20 ft based on measurements taken by LSA (*Operational Noise Impact Analysis for Richmond Wholesale Meat Distribution Center* [LSA 2016]). Shorter term noise levels that occur during the docking process taken by LSA were measured to be 76.3 dBA L_8 at 20 ft. Delivery trucks would arrive on site and maneuver their trailers so that trailers would be parked within the loading docks. During this process, noise levels are associated with the truck engine noise, air brakes, and back-up alarms while the truck is backing into the dock. These noise levels would occur for a shorter period of time (less than 5 minutes). After a truck enters the loading dock, the doors would be closed, and the remainder of the truck loading activities would be enclosed and therefore much less perceptible. To present a conservative assessment, it is assumed that truck arrivals and departure activities could occur twice in a given hour for a period of less than five (5) minutes each and unloading activities could occur at 13 docks simultaneously for a period of more than 30 minutes in a given hour.

Combined Project Operations

As show in the Appendix C, the operational noise levels associated with the proposed project would not exceed 75 dBA L_{eq} at the project boundaries, therefore, noise levels would noise exceed the City's exterior noise level limit of 75 dBA L_{eq} anytime for industrial uses. Tables K and L below show the combined hourly noise levels generated by HVAC equipment, cold storage fans, trash emptying activities, and truck delivery activities at the closest off-site, non-industrial, land uses. The project-related noise level impacts would approach 47.5 dBA at the office uses to the north during daytime and nighttime hours, 39.2 dBA at the kindergarten building to the southeast, and 38.5 dBA at the school to the south during daytime hours. These levels would be well below the City's exterior daytime noise standard of 65 dBA L_{eq} for office uses and the exterior daytime standard of 60 dBA L_{eq} for institutional uses (school) as well as 60 dBA L_{eq} for office uses during nighttime hours. It is assumed that project operations during the more sensitive nighttime hours would not affect the school use to the south and kindergarten building to the southeast as the uses would not be in operation during those hours. The project-related noise level impacts would approach 47.5 dBA at the office uses to the north.

Because project noise levels would not generate a noise level increase of 4 dBA when ambient noise levels exceed the City's exterior noise standards or generate a noise level increase of 6 dBA when ambient noise levels are below the City's exterior noise standards, the impact would be less than significant, and no noise reduction measures are required.

Table K: Daytime Exterior Noise Level Impacts

Receptor	Direction	Existing Quietest Daytime Noise Level (dBA L_{eq})	City of Redlands Noise Threshold (dBA L_{eq})	Project Generated Noise Levels (dBA L_{eq})	Potential Operational Noise Impact?[1]
Commercial	North	62.6	65	47.5	No
School	South	62.6	60	38.5	No
Kindergarten	Southeast	62.6	60	39.2	No

Source: Compiled by LSA (2023).

[1] A potential operational noise impact would occur if (1) the quietest daytime ambient hour is greater than the City's exterior noise level standard and project noise impacts increase noise levels by 4 dBA or more, OR (2) the quietest daytime ambient hour is less than the City's exterior noise levels standard and project noise impacts increase noise levels by 6 dBA or more.

dBA = A-weighted decibels

L_{eq} = equivalent noise level

Table L: Nighttime Exterior Noise Level Impacts

Receptor	Direction	Existing Quietest Nighttime Noise Level (dBA L_{eq})	City of Redlands Noise Threshold (dBA L_{eq})	Project Generated Noise Levels (dBA L_{eq})	Potential Operational Noise Impact?[1]
Commercial	North	55.5	60	47.5	No
School[2]	South	-	-	-	-
Kindergarten[2]	Southeast	-	-	-	-

Source: Compiled by LSA (2023).

[1] A potential operational noise impact would occur if (1) the quietest daytime ambient hour is greater than the City's exterior noise level standard and project noise impacts increase noise levels by 4 dBA or more, OR (2) the quietest daytime ambient hour is less than the City's exterior noise levels standard and project noise impacts increase noise levels by 6 dBA or more.

[2] This analysis assumes the school is not in typical daily operations between the hours of 10:00 p.m. and 7:00 a.m. the next day.

dBA = A-weighted decibels

L_{eq} = equivalent noise level

BEST CONSTRUCTION PRACTICES

In addition to compliance with the City's Municipal Code, which states that construction activities are allowed between the hours of 7:00 a.m. and 6:00 p.m. on weekdays, including Saturdays, with no activities taking place at any time on Sundays or federal holidays, the following best construction practices would further minimize construction noise impacts:

- The project construction contractor shall equip all construction equipment, fixed or mobile, with properly operating and maintained noise mufflers consistent with manufacturer's standards.
- The project construction contractor shall locate staging areas away from off-site sensitive uses during the later phases of project development.
- The project construction contractor shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site whenever feasible.

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APPENDIX A

NOISE MONITORING DATA

Noise Measurement Survey – 24 HR

Project Number: ESL2201.41
Project Name: 301 Tennessee Street

Test Personnel: Kevin Nguyendo
Equipment: Spark 706RC (SN:908)

Site Number: LT-1 Date: 10/13/22

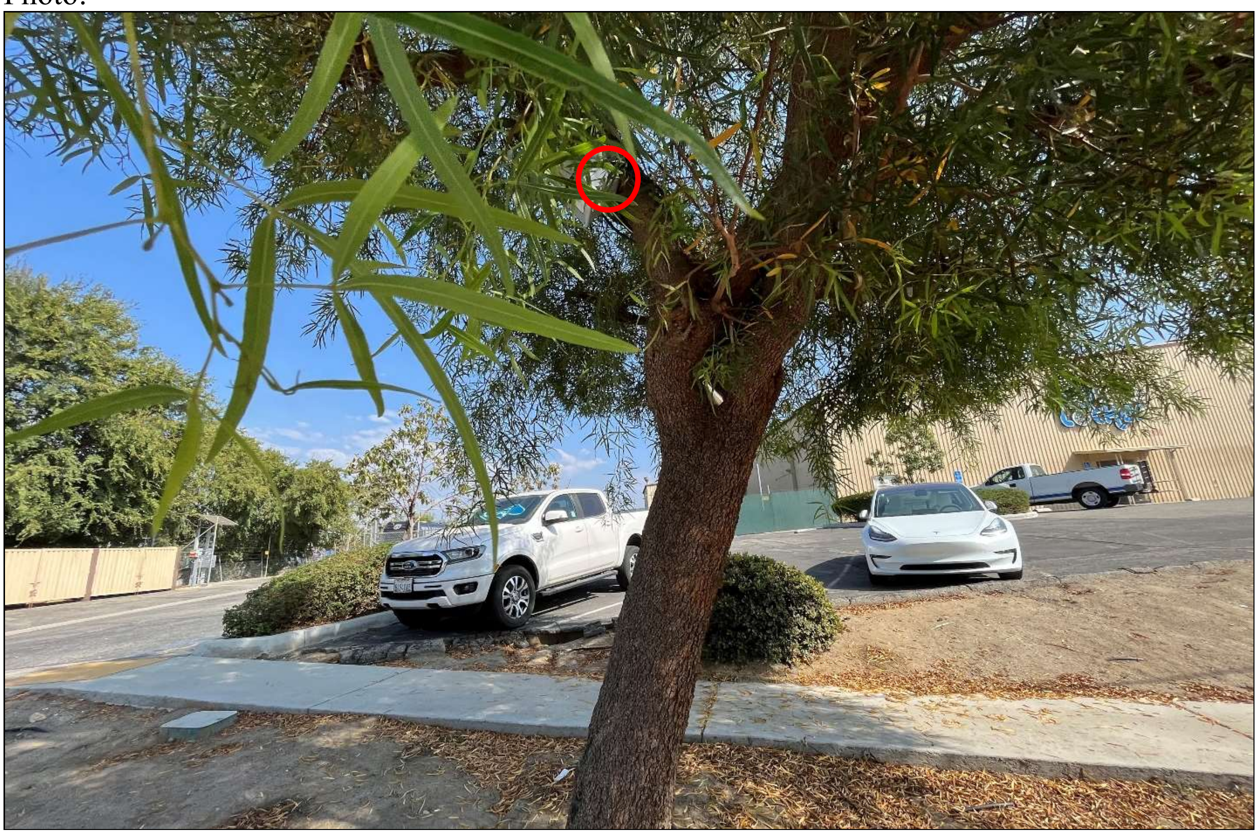
Time: From 3:00 p.m. To 3:00 p.m.

Site Location: West of the project site along Kansas Street on a tree bordering 300 Kansas St, Redlands, CA 92373.

Primary Noise Sources: Traffic noise on Kansas Street.

Comments:

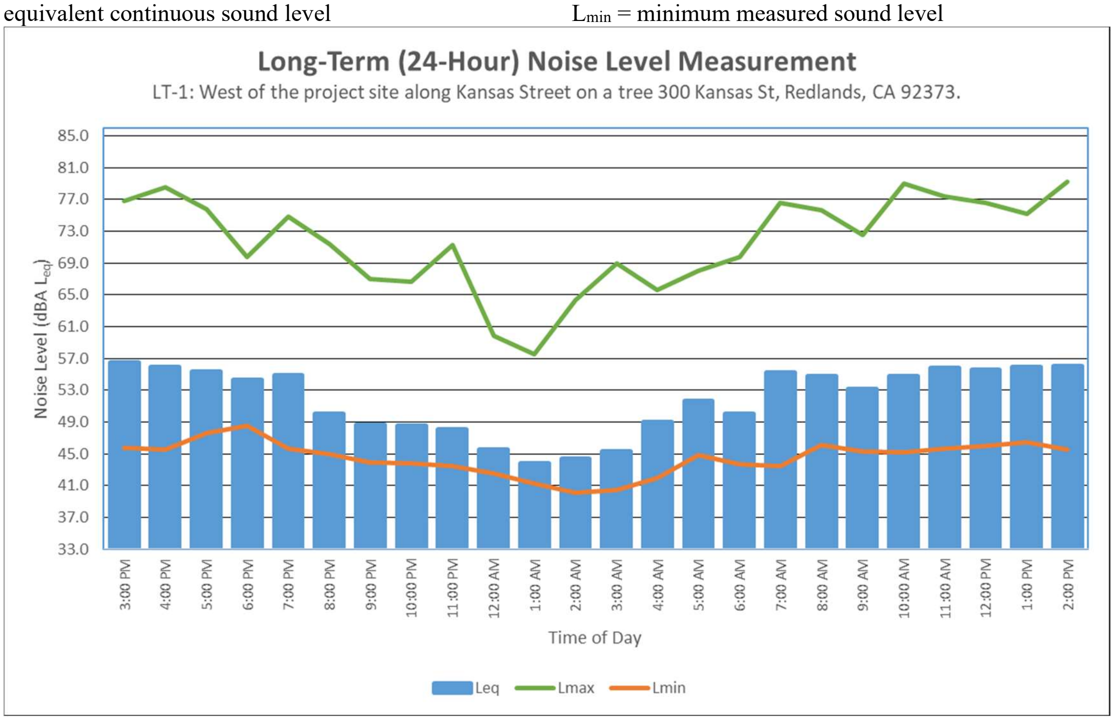
Photo:



Long-Term (24-Hour) Noise Level Measurement Results at LT-1

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
3:00 PM	10/13/22	56.5	76.8	45.7
4:00 PM	10/13/22	55.9	78.6	45.5
5:00 PM	10/13/22	55.3	75.8	47.6
6:00 PM	10/13/22	54.3	69.8	48.5
7:00 PM	10/13/22	54.8	74.8	45.6
8:00 PM	10/13/22	50.0	71.4	44.9
9:00 PM	10/13/22	48.6	67.0	43.9
10:00 PM	10/13/22	48.5	66.7	43.8
11:00 PM	10/13/22	48.0	71.3	43.4
12:00 AM	10/14/22	45.5	59.8	42.5
1:00 AM	10/14/22	43.8	57.5	41.3
2:00 AM	10/14/22	44.4	64.4	40.1
3:00 AM	10/14/22	45.3	69.0	40.5
4:00 AM	10/14/22	49.0	65.6	42.0
5:00 AM	10/14/22	51.6	68.0	44.8
6:00 AM	10/14/22	50.0	69.8	43.7
7:00 AM	10/14/22	55.3	76.6	43.5
8:00 AM	10/14/22	54.8	75.7	46.1
9:00 AM	10/14/22	53.2	72.6	45.3
10:00 AM	10/14/22	54.8	79.0	45.2
11:00 AM	10/14/22	55.8	77.4	45.6
12:00 PM	10/14/22	55.6	76.6	46.0
1:00 PM	10/14/22	56.0	75.2	46.4
2:00 PM	10/14/22	56.0	79.2	45.5

Source: Compiled by LSA Associates, Inc. (2022).
dBA = A-weighted decibel
L_{eq} = equivalent continuous sound level
L_{max} = maximum instantaneous noise level
L_{min} = minimum measured sound level



Noise Measurement Survey – 24 HR

Project Number: ESL2201.41
Project Name: 301 Tennessee Street

Test Personnel: Kevin Nguyendo
Equipment: Spark 706RC (SN:119)

Site Number: LT-2 Date: 10/13/22

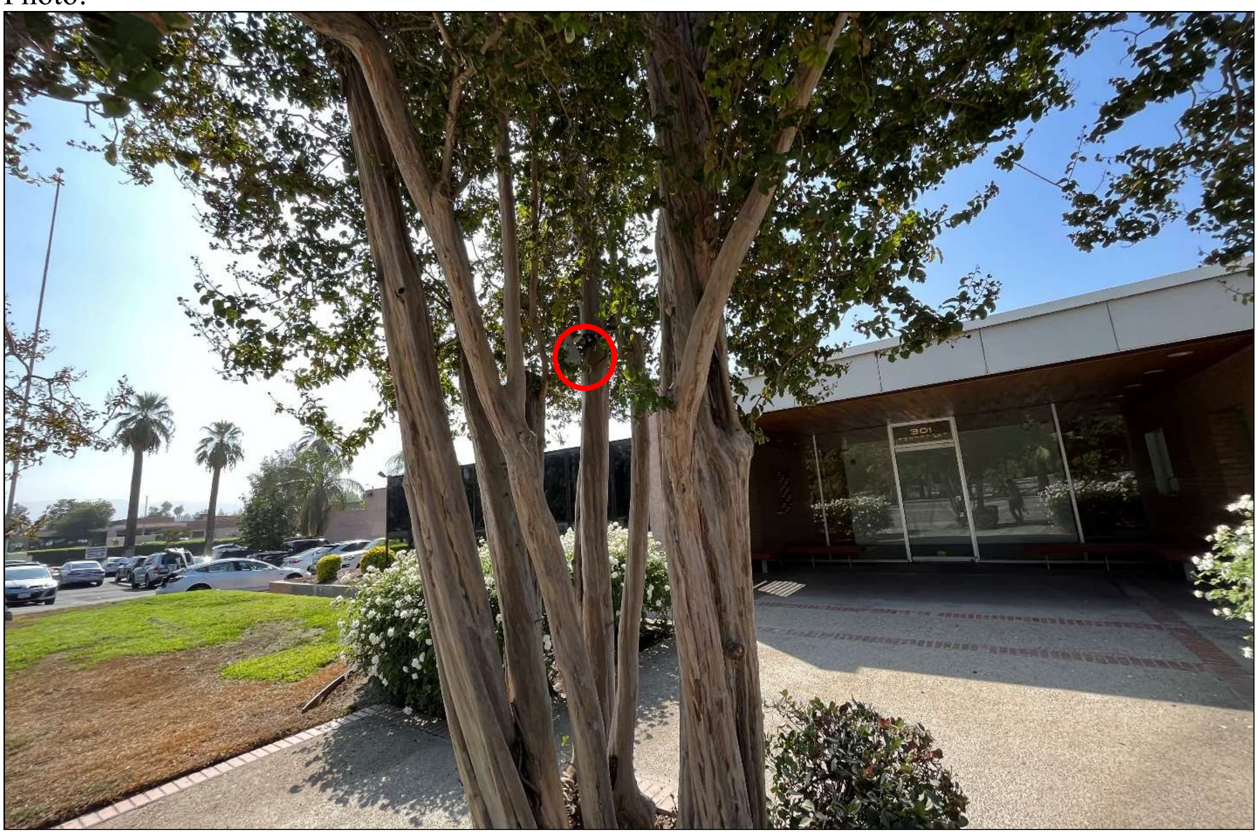
Time: From 3:00 p.m. To 3:00 p.m.

Site Location: East of the project site along Tennessee Street at the building entrance of 301 Tennessee Street.

Primary Noise Sources: Traffic noise on Tennessee Street.

Comments:

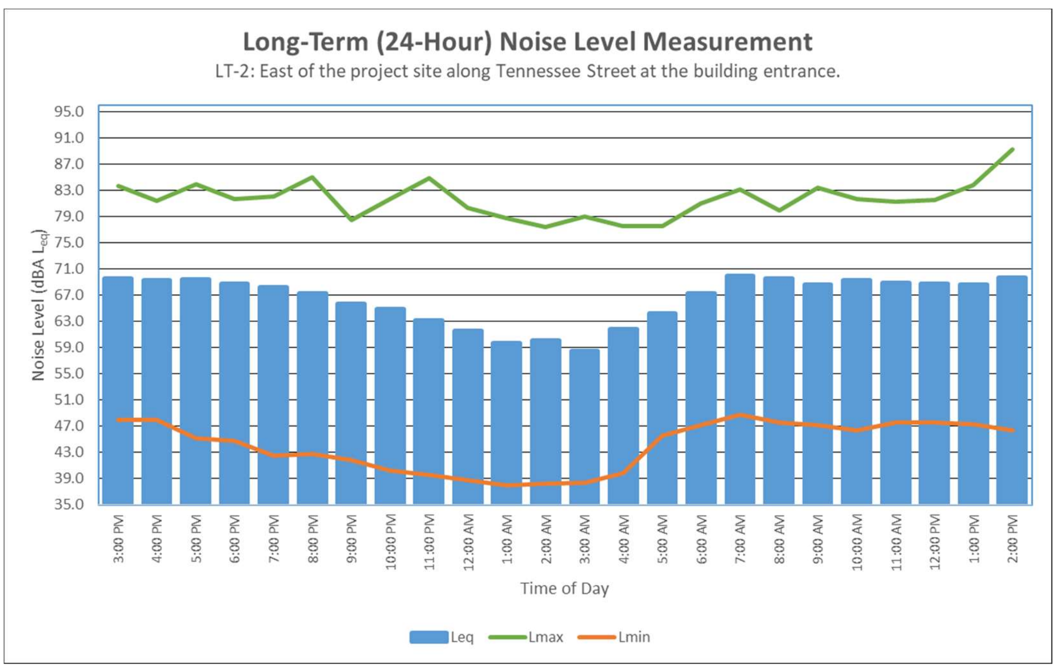
Photo:



Long-Term (24-Hour) Noise Level Measurement Results at LT-2

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
3:00 PM	10/13/22	69.6	83.7	47.9
4:00 PM	10/13/22	69.2	81.4	47.9
5:00 PM	10/13/22	69.5	83.9	45.2
6:00 PM	10/13/22	68.8	81.7	44.8
7:00 PM	10/13/22	68.2	82.1	42.5
8:00 PM	10/13/22	67.3	85.0	42.7
9:00 PM	10/13/22	65.6	78.5	41.8
10:00 PM	10/13/22	64.8	81.6	40.2
11:00 PM	10/13/22	63.1	84.9	39.6
12:00 AM	10/14/22	61.5	80.3	38.8
1:00 AM	10/14/22	59.7	78.7	38.0
2:00 AM	10/14/22	60.1	77.4	38.2
3:00 AM	10/14/22	58.5	79.0	38.3
4:00 AM	10/14/22	61.8	77.5	39.8
5:00 AM	10/14/22	64.2	77.5	45.6
6:00 AM	10/14/22	67.2	81.0	47.1
7:00 AM	10/14/22	70.0	83.1	48.8
8:00 AM	10/14/22	69.5	79.9	47.6
9:00 AM	10/14/22	68.6	83.4	47.1
10:00 AM	10/14/22	69.3	81.6	46.4
11:00 AM	10/14/22	68.9	81.2	47.5
12:00 PM	10/14/22	68.7	81.5	47.6
1:00 PM	10/14/22	68.6	83.8	47.3
2:00 PM	10/14/22	69.6	89.3	46.3

Source: Compiled by LSA Associates, Inc. (2022).
dBA = A-weighted decibel
L_{eq} = equivalent continuous sound level
L_{max} = maximum instantaneous noise level
L_{min} = minimum measured sound level



Noise Measurement Survey – 24 HR

Project Number: ESL2201.41

Project Name: 301 Tennessee Street

Test Personnel: Kevin Nguyendo

Equipment: Spark 706RC (SN:224)

Site Number: LT-3 Date: 10/13/22

Time: From 3:00 p.m. To 3:00 p.m.

Site Location: Southeast corner of the project site near a tree along State Street.

Primary Noise Sources: Traffic noise along State Street.

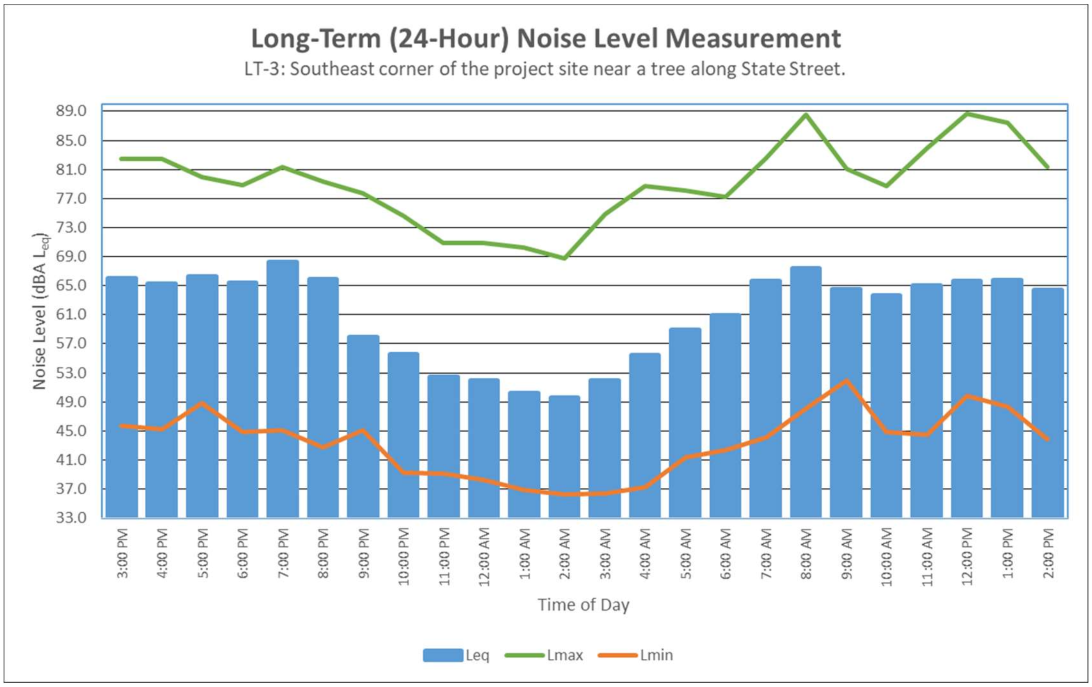
Comments:

Photo:

Long-Term (24-Hour) Noise Level Measurement Results at LT-3

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
3:00 PM	10/13/22	66.0	82.4	45.7
4:00 PM	10/13/22	65.3	82.5	45.2
5:00 PM	10/13/22	66.3	80.0	48.8
6:00 PM	10/13/22	65.4	78.9	44.9
7:00 PM	10/13/22	68.2	81.3	45.1
8:00 PM	10/13/22	65.9	79.4	42.7
9:00 PM	10/13/22	57.9	77.7	45.1
10:00 PM	10/13/22	55.6	74.6	39.3
11:00 PM	10/13/22	52.5	70.9	39.1
12:00 AM	10/14/22	51.9	70.9	38.2
1:00 AM	10/14/22	50.2	70.2	36.9
2:00 AM	10/14/22	49.6	68.7	36.2
3:00 AM	10/14/22	52.0	74.9	36.4
4:00 AM	10/14/22	55.4	78.7	37.2
5:00 AM	10/14/22	58.9	78.1	41.4
6:00 AM	10/14/22	60.9	77.2	42.4
7:00 AM	10/14/22	65.7	82.6	44.1
8:00 AM	10/14/22	67.4	88.6	48.1
9:00 AM	10/14/22	64.6	81.1	52.0
10:00 AM	10/14/22	63.7	78.7	44.8
11:00 AM	10/14/22	65.0	84.0	44.5
12:00 PM	10/14/22	65.6	88.7	49.8
1:00 PM	10/14/22	65.8	87.4	48.4
2:00 PM	10/14/22	64.4	81.3	43.9

Source: Compiled by LSA Associates, Inc. (2022).
dBA = A-weighted decibel
L_{eq} = equivalent continuous sound level
L_{max} = maximum instantaneous noise level
L_{min} = minimum measured sound level



APPENDIX B

CONSTRUCTION NOISE LEVEL CALCULATIONS

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
Excavator	3	81	40	50	0.5	81	82
Dozer	2	82	40	50	0.5	82	81
					Combined at 50 feet	**91**	**87**
					Combined at Receptor 315 feet	**75**	**71**

Phase: Site Preparation

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Dozer	3	82	40	50	0.5	82	83
Tractor	4	84	40	50	0.5	84	86
					Combined at 50 feet	**86**	**88**
					Combined at Receptor 315 feet	**70**	**72**
					Combined at Receptor 485 feet	**66**	**68**
					Combined at Receptor 715 feet	**63**	**65**
					Combined at Receptor 765 feet	**62**	**64**

Phase: Grading

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Excavator	2	81	40	50	0.5	81	80
Grader	1	85	40	50	0.5	85	81
Dozer	1	82	40	50	0.5	82	78
Scraper	2	84	40	50	0.5	84	83
Tractor	2	84	40	50	0.5	84	83
					Combined at 50 feet	**90**	**88**
					Combined at Receptor 315 feet	**74**	**72**

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	3	75	20	50	0.5	75	73
Generator	1	81	50	50	0.5	81	78
Tractor	3	84	40	50	0.5	84	85
Welder / Torch	1	74	40	50	0.5	74	70
					Combined at 50 feet	**87**	**86**
					Combined at Receptor 315 feet	**71**	**70**

Phase:Paving

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Paver	2	77	50	50	0.5	77	77
All Other Equipment > 5 HP	2	85	50	50	0.5	85	85
Roller	2	80	20	50	0.5	80	76
					Combined at 50 feet	**87**	**86**

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
					Combined at 50 feet	**78**	**74**
					Combined at Receptor 315 feet	**62**	**58**

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

APPENDIX C

SOUNDPLAN NOISE MODEL PRINTOUTS

301 Tennessee Street Warehouse

Project No. ESL2201.41

Project Operational Noise Levels

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