APPENDIX B

NOISE AND VIBRATION IMPACT ANALYSIS

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KINGS VIEW RESIDENTIAL PROJECT

REEDLEY, CALIFORNIA

LSA

August 2023

NOISE AND VIBRATION IMPACT ANALYSIS

KINGS VIEW RESIDENTIAL PROJECT

REEDLEY, CALIFORNIA

Submitted to:

City of Reedley
1733 9th Street
Reedley, California 93654

Prepared by:

LSA
3210 El Camino Real, Suite 100
Irvine, California 92602
(949) 553-0666

Project No. 20231068

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TABLE OF CONTENTS

APPENDICES

FIGURES AND TABLES

FIGURES

TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

ADT	average daily trips
CEQA	California Environmental Quality Act
City	City of Reedley
CNEL	Community Noise Equivalent Level
dB	decibel
dBA	A-weighted decibel(s)
EIR	Environmental Impact Report
FHWA	Federal Highway Administration
ft	foot/feet
FTA	Federal Transit Administration
FTA Manual	FTA *Transit Noise and Vibration Impact Assessment Manual*
in/sec	inch/inches per second
L_{dn}	day-night average noise level
L_{eq}	equivalent continuous sound level
L_{max}	maximum instantaneous sound level
mi	mile/miles
Noise Element	City of Reedley General Plan 2030 Noise Element
PPV	peak particle velocity
project	Kings View Residential Project
RMS	root-mean-square
STC	Sound Transmission Class
VdB	vibration velocity decibels

INTRODUCTION

This noise and vibration impact analysis has been prepared to evaluate the potential noise and vibration impacts and reduction measures associated with the proposed Kings View Residential Project (project) in Reedley, California. This report is intended to satisfy the City of Reedley's (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 project site is located along the eastern portion of the San Joaquin Valley floor in Fresno County. Specifically, the project site is located on two Assessor's Parcel Numbers, 365-22-80 and 365-22-81. The project site is currently undeveloped and contains one transformer in the southeast corner. The project site is bounded by South Frankwood Avenue to the east, Cyrier Avenue to the west, single-family residential uses to the south, and single-family residential uses and commercial uses to the north. Some lands in the vicinity of the project site are fallow/vacant lots; however, most of the lands are developed with a mixture of commercial developments, schools, and residential uses. There are no undisturbed open spaces in the vicinity of the project site. See Figure 1, Project Location, and Figure 2, Site Plan, below.

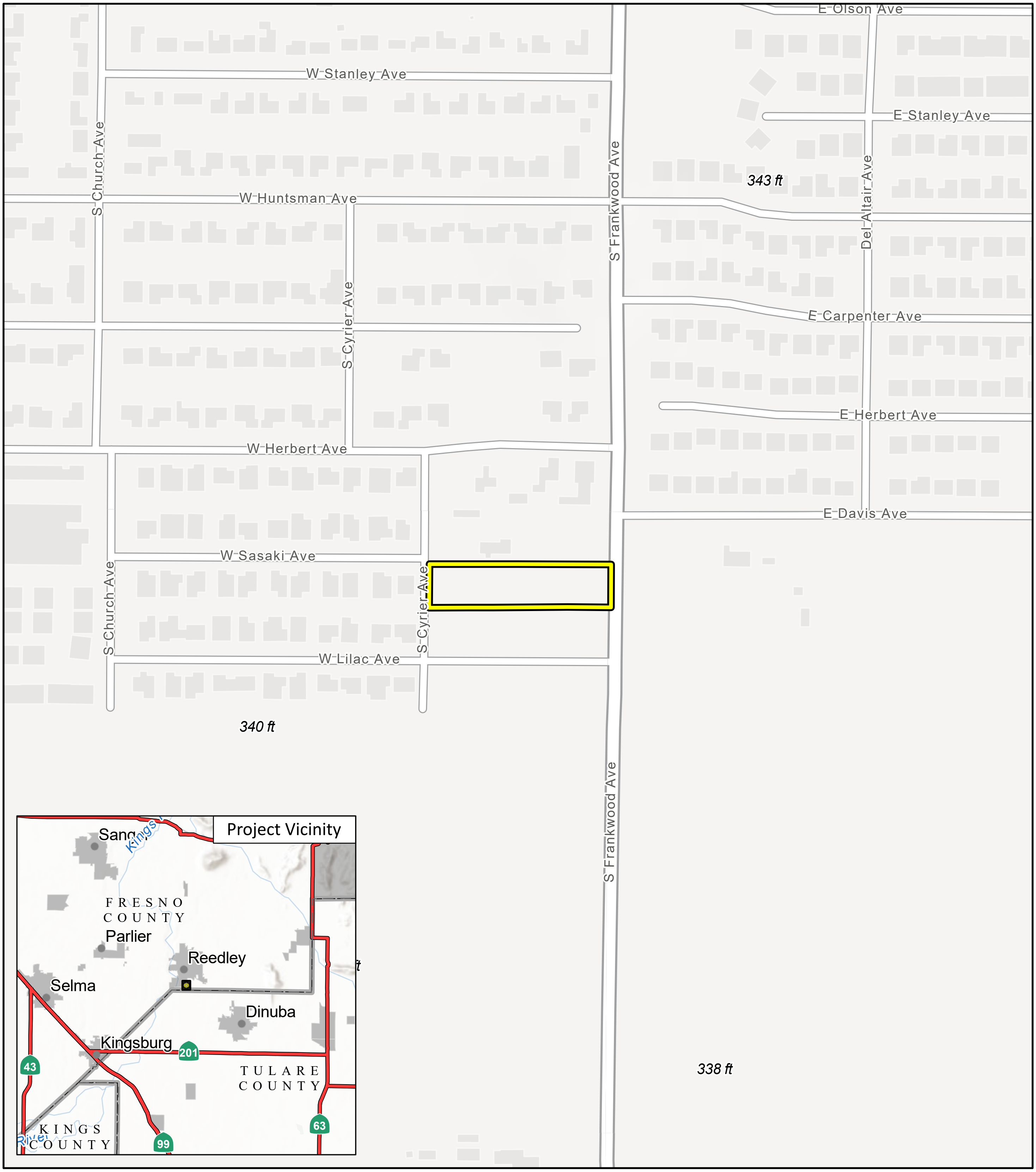
The project involves the construction of six, two-story multi-family residential buildings totaling approximately 8,898 square feet. The following improvements would be included as part of the proposed project: a total of 28 on-site parking spaces; open space and common areas with picnic and play facilities; exterior lighting; approximately 9,600 square feet of landscaped areas; and the construction of trash enclosures designed pursuant to City standards.

EXISTING LAND USES IN THE PROJECT AREA

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

- **North:** Existing single-family residence and auto repair shop;
- **East:** South Frankwood Avenue followed by vacant land;
- **South:** Existing single-family residences; and
- **West:** Existing single-family residences opposite Cyrier Avenue.

The closest sensitive receptors to the project site include single-family homes located immediately adjacent to the south on Lilac Avenue and to the north from the project site boundary approximately 30 feet away.



LSA

Project Location

FIGURE 1

0 350
FEET

Kings View Residential Project

Project Location

SOURCE: Esri Community Maps

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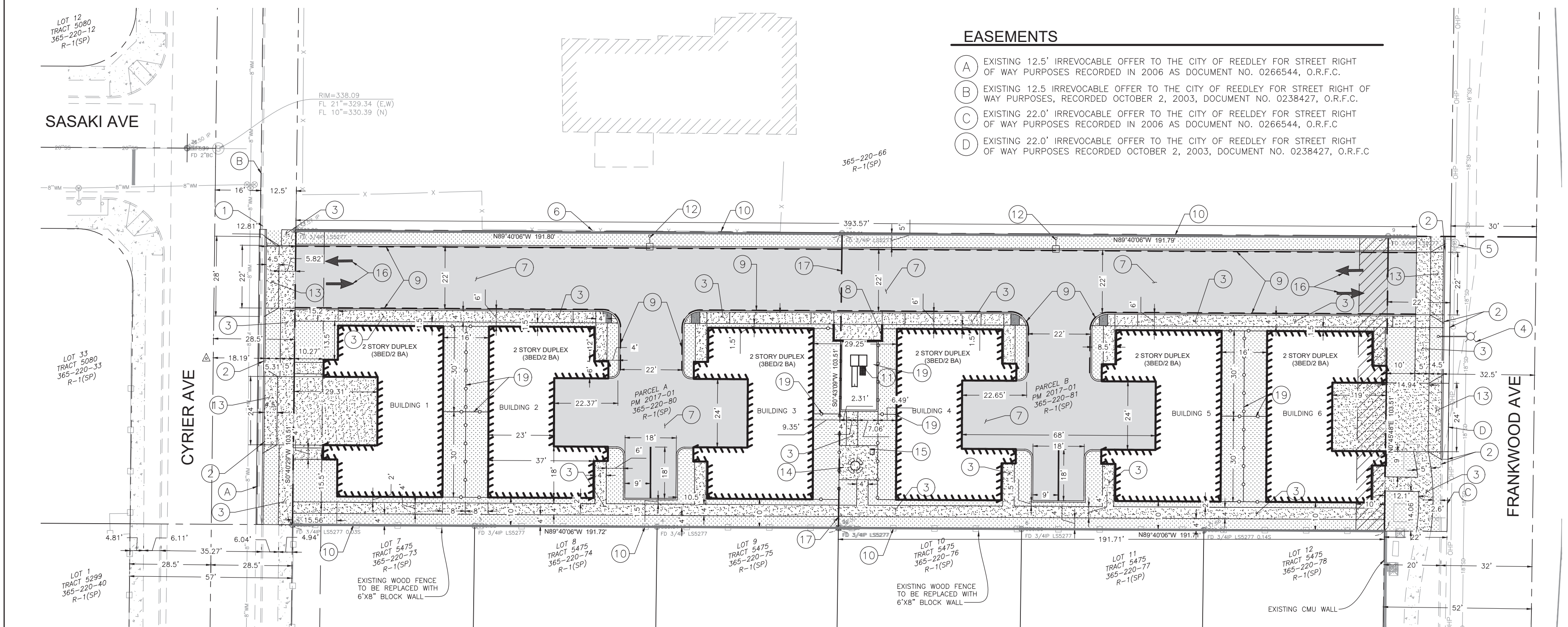


PROJECT INFO:

1" = 20'

PROJECT LOCATION:	AT THE NORTH WEST CORNER OF S. FRANKWOOD AVE. AND W. LILAC AVE.
APN:	365-220-80 & 81
GROSS ACREAGE:	0.90 ACRES
NET ACREAGE:	0.90 ACRES
PROJECT OWNER:	NASSRI JABER MEGALODON PROPERTIES, LLC 521 FINLEY DR TAFT, CA 93268
EXISTING LAND USE:	VACANT/OPEN SPACE
EXISTING ZONING:	R-1(SP)
PROPOSED LAND USE:	MEDIUM DENSITY RESIDENTIAL (8-15 DU/AC)
PROPOSED ZONING:	RM-3
PROPOSED USE:	12 DU
PROPOSED DENSITY:	13.3 DU/AC

PARKING REQUIRED: 3.5 STALLS PER UNIT = 12 X 3.5 = 42 STALLS

PARKING PROVIDED: 28 STALLS

PARKING PROPOSED: 2.3 STALLS PER UNIT AND PUD REQUEST NEEDED

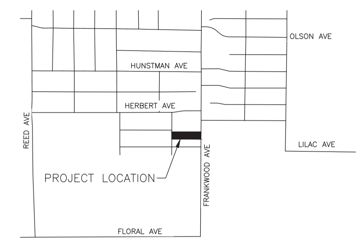
BUILDING 1: 1,483 SF
BUILDING 2: 1,483 SF
BUILDING 3: 1,483 SF
BUILDING 4: 1,483 SF
BUILDING 5: 1,483 SF
BUILDING 6: 1,483 SF

BUILDING TOTAL: 8,898 SF

PROPOSED PAVEMENT: 13,695 SF
PROPOSED LANDSCAPE: 9,601 SF

LEGEND

△	INDICATES STREETS PREVIOUSLY OFFERED FOR DEDICATION
PUE	PUBLIC UTILITY EASEMENT
	EXISTING PUE TO BE VACATED
	SUBDIVISION BOUNDARY
	CENTERLINE/SECTION LINE
	EASEMENT
	PROPOSED LOT
	EXISTING CONCRETE SIDEWALK
	PROPOSED CONCRETE SIDEWALK
	PROPOSED ASPHALT PAVEMENT
	PROPOSED LANDSCAPE



VICINITY MAP
NOT TO SCALE

LSA

FIGURE 2

0 20 40
FEET

SOURCE: Vang Inc. Consulting Engineers, 2/9/2023

Kings View Residential Project
Site Plan

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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 relaxation 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 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.

Sources: (1) Technical Noise Supplement (Caltrans 2013); (2) Transit Noise and Vibration Impact Assessment Manual (FTA 2018).
Caltrans = California Department of Transportation
FTA = Federal Transit Administration

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 (2022).

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 not 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 feet (ft) from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 ft . 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. 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 1×10^{-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 California Code of Regulations and the Noise Element of the City's General Plan 2030 (Noise Element).

California Code of Regulations

Interior noise levels for residential habitable rooms are regulated by Title 24 of the California Code of Regulations California Noise Insulation Standards. Title 24, Chapter 12, Section 1206.4, of the 2019 California Building Code requires that interior noise levels attributable to exterior sources not exceed 45 CNEL in any habitable room. A habitable room is a room used for living, sleeping, eating, or cooking. Bathrooms, closets, hallways, utility spaces, and similar areas are not considered habitable rooms for this regulation (Title 24 California Code of Regulations, Chapter 12, Section 1206.4).

City of Reedley

Noise Element of the General Plan 2030

The Noise 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 goals and policies in the Noise Element:

Goals.

NE 6.1A – To protect the citizens of the City from potential harmful effect due to exposure to excessive noise.

NE 6.1B – To preserve the tranquility of residential and other noise sensitive areas by preventing noise-producing uses from encroaching upon existing and planned noise sensitive uses.

NE 6.1C – To develop a policy framework necessary to achieve and maintain a healthful noise environment.

Policies.

NE 6.1.2: In order to maintain an acceptable noise environment, the following maximum acceptable noise levels should be established for various land use designations (see Tables C and D).

NE 6.1.3: Areas subject to a DNL greater than 60 dBA are identified as noise impact zones. As part of the special permit process the proposed development project will be required to have an acoustical analysis prepared by a license engineer. The report should also include practical and reasonable mitigation measures.

NE 6.1.4: Within noise impact zones, the City will evaluate the noise impact on development proposals. Mitigating measures, including but not limited to the following, may be required:

(a) Setbacks, berms, and barriers.

(b) Acoustical design of structures.

(c) Location of structures.

NE 6.1.5: Design of all proposed development should incorporate features necessary to minimize adverse noise impacts, while also minimizing effects on surrounding lands uses.

Table C: Allowable City-Wide Noise Exposure – Transportation

Location of Measurement	**Allowable Transportation Source Noise Exposure**	
	Noise Sensitive Land Uses	New Transportation Noise Sources
Indoor	45 dBA L_{dn}	45 dBA L_{dn}
Outdoor	60 dBA L_{dn}	60 dBA L_{dn}

Source: City of Reedley (2014).
Notes:
1. This table is applicable to noise sources created by either new development and/or new transportation projects.
2. Based on an evaluation of the existing condition and proposed project, the Community Development Director may allow exterior exposure up to 65 dB L_{dn} where practical application of construction practices has been used to mitigate exterior noise exposure.
dBA = A-weighted decibels
L_{dn} = day-night average noise level

Table D: Allowable Noise Exposure – Stationary Sources

	Allowable Stationary Source Noise Exposure	
	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)
Hourly L_{eq}, dBA	55	50
Maximum Level, dBA	70	65

Source: City of Reedley (2014).
Notes:
1. As determined within outdoor activity areas of existing or planned noise-sensitive uses, if outdoor activity area locations are unknown, the allowable noise exposure shall be determined at the property line of the noise sensitive use.
2. Based on an evaluation of the existing condition and proposed project, the Community Development Director may allow exterior exposure up to 65 dB L_{dn} where practical application of construction practices has been used to mitigate exterior noise exposure.
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

General Plan EIR

Construction Noise Standards. The City has set restrictions to control noise impacts associated with the construction of the proposed project. According to the City's General Plan Environmental Impact

Report (EIR), construction activity is limited to the acceptable daily construction hours of 7:00 a.m. to 5:00 p.m.

Federal Transit Administration

Although the City does not have daytime construction noise level limits for activities that occur within the specified hours to determine potential California Environmental Quality Act (CEQA) noise impacts, construction noise was assessed using criteria from the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018) (FTA Manual). Table E shows the Federal Transit Administration's (FTA) Detailed Assessment Construction Noise Criteria based on the composite noise levels per construction phase.

Table E: Detailed Assessment Daytime Construction Noise Criteria

Land Use	Daytime 8-hour L_{eq} (dBA)
Residential	80
Commercial	85
Industrial	90

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

APPLICABLE VIBRATION STANDARDS

Federal Transit Administration

Vibration standards included in the FTA Manual are used in this analysis for ground-borne vibration impacts on human annoyance. The criteria for environmental impact from ground-borne vibration and noise are based on the maximum levels for a single event. Table F provides the criteria for assessing the potential for interference or annoyance from vibration levels in a building.

Table G lists the potential vibration building damage criteria associated with construction activities, as suggested in the FTA Manual. FTA guidelines show that a vibration level of up to 0.5 in/sec in PPV is considered safe for buildings consisting of reinforced concrete, steel, or timber (no plaster) 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.

Table F: Interpretation of Vibration Criteria for Detailed Analysis

Land Use	Max L_v (VdB)[1]	Description of Use
Workshop	90	Vibration that is distinctly felt. Appropriate for workshops and similar areas not as sensitive to vibration.
Office	84	Vibration that can be felt. Appropriate for offices and similar areas not as sensitive to vibration.
Residential Day	78	Vibration that is barely felt. Adequate for computer equipment and low-power optical microscopes (up to 20×).
Residential Night and Operating Rooms	72	Vibration is not felt, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power microscopes (100×) and other equipment of low sensitivity.

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] As measured in 1/3-octave bands of frequency over a frequency range of 8 to 80 Hertz.
FTA = Federal Transit Administration
Max = maximum
L_V = velocity in decibels
VdB = vibration velocity decibels

Table G: Construction Vibration Damage Criteria

Building Category	PPV (in/sec)
Reinforced concrete, steel, or timber (no plaster)	0.50
Engineered concrete and masonry (no plaster)	0.30
Non-engineered timber and masonry buildings	0.20
Buildings extremely susceptible to vibration damage	0.12

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

OVERVIEW OF THE EXISTING NOISE ENVIRONMENT

The primary existing noise sources in the project area are transportation facilities. Local traffic on the roadways in the vicinity of the project (South Frankwood Avenue and Cyrier Avenue) is a steady source of ambient noise.

AMBIENT NOISE MEASUREMENTS

Noise Measurements

A long-term (24-hour) noise level measurement was conducted on July 25 and 26, 2023, using a Larson Davis Spark 706RC Dosimeter, and a short-term (15-minutes) noise level measurement was conducted using a Larson Davis LxT. Table H provides a summary of the measured hourly noise levels from the noise level measurements. Hourly noise levels at surrounding sensitive uses are as low as 35.2 dBA L_{eq} during nighttime hours and 42.7 dBA L_{eq} during daytime hours. Long-term noise monitoring data results are provided in Appendix A. Figure 3 shows the monitoring locations.

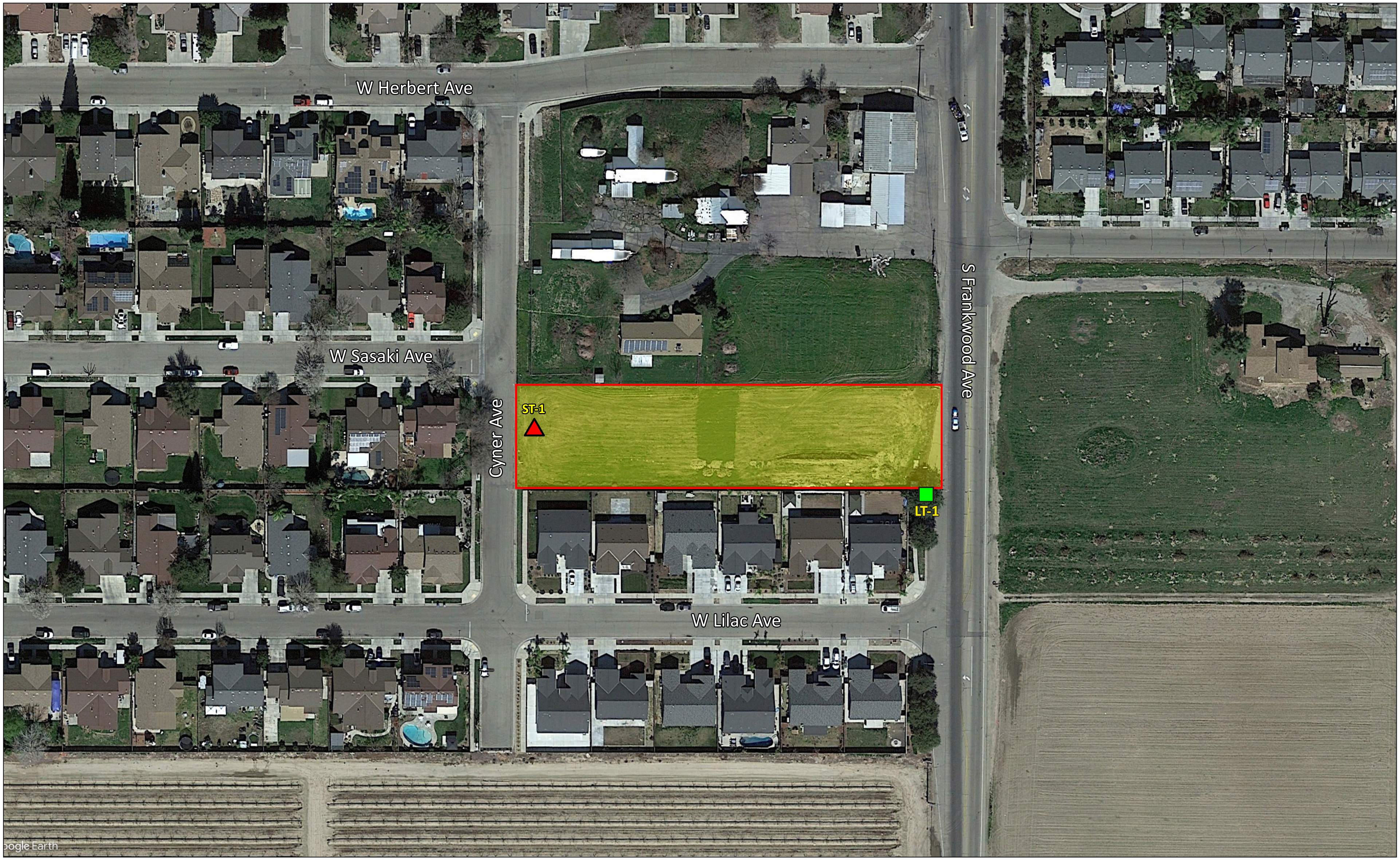
Table H: Ambient Noise Level Measurements

Location		Daytime Noise Levels[1] (dBA L_{eq})	Nighttime Noise Levels[2] (dBA L_{eq})	Daily Noise levels (dBA L_{dn})
LT-1	Near southwest corner of project site, on a tree by transformer, approximately 45 ft from the South Frankwood Avenue centerline.	67.3 – 72.2	59.8 – 73.1	74.9
ST-1[3]	Near western boundary of project site, approximately 25 ft from the Cyrier Avenue centerline.	42.7 – 47.6	35.2 – 48.5	50.3

Source: Compiled by LSA (2023).
Note: Noise measurements were conducted from July 25 to July 26, 2023, starting at 5:00 p.m.
1 Daytime Noise Levels = Noise levels during the hours from 7:00 a.m. to 10:00 p.m.
2 Nighttime Noise Levels = Noise levels during the hours from 10:00 p.m. to 7:00 a.m.
3 Short-term measurement data estimated based on corresponding long-term.
dBA = A-weighted decibels
ft = foot/feet
L_{dn} = day-night noise level
L_{eq} = equivalent continuous sound level

EXISTING AIRCRAFT NOISE

Airport-related noise levels are primarily associated with aircraft engine noise made while aircraft are taking off, landing, or running their engines while still on the ground. The closest airport to the proposed project site is Reedley Municipal Airport, located approximately 6 miles (mi) north of the project site. According to Figure 6.2 of the City's General Plan, the project site is located well outside the 65 dBA CNEL airport noise impact zone. 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

FIGURE 3

LEGEND

Project Site Boundary

ST-1 Short-term Noise Monitoring Location

LT-1 Long-term Noise Monitoring Location

0 125 250

FEET

SOURCE: Google Earth (2023)

Kings View Residential

Noise Monitoring Locations

I:\20231068\G\Noise_Locs.ai (8/22/2023)

PROJECT IMPACT ANALYSIS

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 South Frankwood Avenue. The results of the California Emissions Estimator Model (CalEEMod) for the proposed project indicate that during the grading phase, an additional 240 vehicles, consisting of worker and hauling trips, would be added to the roadway adjacent to the project site. Because the existing traffic volume on South Frankwood Avenue is considerably more than 240, construction-related vehicle trips would not approach existing daily traffic volumes and 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 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 I 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 Federal Highway Administration (FHWA) *Roadway Construction Noise Model* (FHWA 2006).

In addition to the reference maximum noise level, the usage factor provided in Table I 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 I: 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 I, 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 ft would range from

74 dBA L_{eq} to 85 dBA L_{eq}, with the highest noise levels occurring during the grading and paving 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 J 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 J: 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})
Residences (South and North)	85	85	81
Residences (West)		280	70

Source: Compiled by LSA (2023).

[1] The composite construction noise level represents the grading/paving phases, which are expected to result in the greatest noise level as compared to other phases.

dBA = A-weighted decibels

L_{eq} = equivalent continuous sound level

While construction noise will vary, it is expected that composite noise levels during construction at the nearest off-site sensitive residential uses to the south and north would reach an average noise level of 81 dBA L_{eq} 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.

The proposed project would comply with the construction hours specified above, which states that construction activities are allowed between the hours of 7:00 a.m. and 5:00 p.m. As it relates to off-site uses, construction-related noise impacts would exceed the 80 dBA L_{eq} construction noise level criteria, as established by the FTA for residential land uses for the average daily condition as modeled from the center of the project site. However, construction would be temporary and within the acceptable daily construction hours and therefore the impacts will be intermittent and 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 (VdB) 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 calculating vibration levels in PPV is best for characterizing the potential for damage.

Table K shows the PPV and VdB values at 25 ft from the construction vibration source. As shown in Table K, bulldozers and other heavy-tracked construction equipment (expected to be used for this project) generate approximately 0.089 PPV in/sec or 87 VdB 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 K: Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV/L_V at 25 ft	
	PPV (in/sec)	**L_V (VdB)[1]**
Pile Driver (Impact), Typical	0.644	104
Pile Driver (Sonic), Typical	0.170	93
Vibratory Roller	0.210	94
Hoe Ram	0.089	87
Large Bulldozer[2]	**0.089**	**87**
Caisson Drilling	0.089	87
Loaded Trucks[2]	**0.076**	**86**
Jackhammer	0.035	79
Small Bulldozer	0.003	58

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

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

$$L_v dB\ (D) = L_v dB\ (25\ ft) - 30\ Log\ (D/25)$$

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

As shown in Table F, above, the threshold at which vibration levels would result in annoyance would be 78 VdB for daytime residential uses. As shown in Table G, 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.

Table L: Potential Construction Vibration Annoyance Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (VdB) at 25 ft[1]	Distance (ft)[2]	Vibration Level (VdB)
Residences (South and North)	87	85	71
Residences (West)		280	56

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
VdB = vibration velocity decibels

Table M: Potential Construction Vibration Damage Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (PPV) at 25 ft[1]	Distance (ft)[2]	Vibration Level (PPV)
Residences (South and North)	0.089	30	0.068
Residences (West)		65	0.021

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
PPV = peak particle velocity

Based on the information provided in Table L, vibration levels are expected to approach 71 VdB at the closest residential uses located immediately south and north of the project site, which is below the 78 VdB threshold for annoyance.

Based on the information provided in Table M, vibration levels are expected to approach 0.068 PPV in/sec at the nearest surrounding structures and would not exceed the 0.2 PPV in/sec damage threshold considered safe for non-engineered timber and masonry buildings. Vibration levels at all other buildings would be lower. Therefore, construction would not result in any vibration damage, and impacts would be less than significant.

Because construction activities are allowed between the hours of 7:00 a.m. and 5:00 p.m., vibration impacts would not occur during the more sensitive nighttime hours.

LONG-TERM OFF-SITE TRAFFIC NOISE IMPACTS

In order to assess the potential traffic impacts related to the proposed project, LSA estimates that the proposed project would result in an increase of 81 average daily trips (ADT). The existing (2004) ADT on South Frankwood Avenue is 4,260 (City of Reedley Technical Library – Traffic Engineering Studies and Maps). While the current traffic volume on South Frankwood Avenue is likely higher, using the 2004 volumes would be considered conservative. The following equation was used to determine the potential impacts of the project:

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

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 0.1 dBA CNEL is expected along South Frankwood Avenue. 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.

STATIONARY OPERATIONAL NOISE IMPACTS TO OFF-SITE RECEIVERS

It expected that the proposed residential uses would install heating, ventilation, and air conditioning equipment. It is expected that the equipment installed at each proposed building would comply with the City's noise standards presented in Table D.

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. Based on a reference vibration level of 0.076 in/sec PPV, structures greater than 20 ft from the roadways that contain project trips would experience vibration levels below the most conservative standard of 0.12 in/sec PPV; therefore, vibration levels generated from project-related traffic on the adjacent roadways would be less than significant, and no mitigation measures are required.

LAND USE COMPATIBILITY

The dominant source of noise in the project vicinity is traffic noise from roadways in the vicinity of the project.

EXTERIOR NOISE ASSESSMENT

To assess exterior noise levels at the project site, as shown in Table H, long-term noise level measurements were gathered. The daily noise levels show that noise levels at the project site approach 75 dBA L_{dn} at the proposed building closest to South Frankwood Avenue (Building 6). Furthermore, hourly noise levels at the project site are as high as 73.1 dBA L_{eq} during nighttime hours and 72.2 dBA L_{eq} during daytime hours. As specified above, for residential uses, an exterior noise level of 60 dBA L_{dn} or less is acceptable. The closest amenity area where humans will spend time is the private yard area between Building 5 and Building 6. After distance attenuation and a minimum reduction of 15 dBA provided by shielding from Building 6, the noise level at the private yard would be reduced below the acceptable level of 60 dBA L_{dn}. Additionally, all other private yards are located farther from South Frankwood Avenue and would be shielded by the proposed buildings. Therefore, noise levels at outdoor noise-sensitive uses would not exceed the City's exterior allowable noise exposure level of 60 dBA L_{dn}.

INTERIOR NOISE ASSESSMENT

As discussed above, per the City's General Plan, an interior noise level standard of 45 dBA L_{dn} or less is required for all noise-sensitive rooms. Based on the expected future exterior noise levels at the project site approaching 75 dBA L_{dn} at the proposed building closest to South Frankwood Avenue (Building 6), a minimum noise reduction of 30 dBA would be required.

Based on reference information from transmission loss test reports for various Milgard windows (Milgard 2008), the necessary reduction can be achieved with standard building construction and upgraded windows with Sound Transmission Class (STC) ratings of 30–35, depending on the window-to-glass ratio, at Building 6, which would not be shielded by a noise barrier. For all other buildings, which are farther from South Frankwood Avenue and would be shielded by the proposed buildings, with standard building construction along with standard windows (typically in the STC 25–28 range), interior noise levels of 45 dBA L_{dn} or less would be achieved.

Once final plans are available to detail the exterior wall construction and a window manufacturer has been chosen, a Final Acoustical Report would be required to confirm the reduction capability of the exterior façades and to identify any specific upgrades necessary to achieve an interior noise level of 45 dBA L_{dn} or below.

BEST CONSTRUCTION PRACTICES

In addition to compliance with the City's General Plan EIR allowed daily hours of construction between 7:00 a.m. and 5:00 p.m., 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.

REFERENCES

California Department of Transportation (Caltrans). 2013. *Technical Noise Supplement to the Traffic Noise Analysis Protocol.* September.

City of Reedley. 2014. *General Plan 2030*. February 18.

Federal Highway Administration (FHWA). 2006. *Roadway Construction Noise Model User's Guide.* January. Washington, D.C. Website: www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf (accessed August 2023).

Federal Transit Administration (FTA). 2018. *Transit Noise and Vibration Impact Assessment Manual*. Office of Planning and Environment. Report No. 0123. September.

Milgard. 2008. Various Transmission Loss Reports.

APPENDIX A

NOISE MONITORING DATA

Noise Measurement Survey – 24 HR

Project Number: 20231068
Project Name: Kings View Residential

Test Personnel: Moe Abushanab
Equipment: Spark 706RC (SN:18571)

Site Number: LT-1 Date: 7/25/2023

Time: From 5:00 p.m. To 5:00 p.m.

Site Location: Near southeast corner of project site, on a tree by transformer, approximately 45 feet from South Frankwood Avenue centerline.

Primary Noise Sources: Regular traffic noise on S. Frankwood Avenue
Occasional aircraft noise

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}
5:00 PM	7/25/23	71.4	82.6	38.5
6:00 PM	7/25/23	70.3	88.1	38.1
7:00 PM	7/25/23	69.8	86.9	40.1
8:00 PM	7/25/23	69.1	86.9	40.9
9:00 PM	7/25/23	67.3	84.1	43.0
10:00 PM	7/25/23	66.0	88.6	39.5
11:00 PM	7/25/23	63.7	83.7	37.3
12:00 AM	7/26/23	61.2	82.4	38.9
1:00 AM	7/26/23	61.2	80.7	39.0
2:00 AM	7/26/23	59.8	82.4	41.3
3:00 AM	7/26/23	62.3	83.2	38.5
4:00 AM	7/26/23	68.6	85.5	39.7
5:00 AM	7/26/23	73.1	84.6	45.6
6:00 AM	7/26/23	71.8	87.8	45.6
7:00 AM	7/26/23	71.5	85.5	46.3
8:00 AM	7/26/23	71.3	84.6	45.4
9:00 AM	7/26/23	72.1	87.1	45.6
10:00 AM	7/26/23	71.3	83.9	40.8
11:00 AM	7/26/23	71.7	86.9	40.5
12:00 PM	7/26/23	71.5	85.3	38.2
1:00 PM	7/26/23	71.6	87.4	39.3
2:00 PM	7/26/23	71.3	84.6	37.9
3:00 PM	7/26/23	72.2	85.5	37.6
4:00 PM	7/26/23	71.4	81.8	46.1

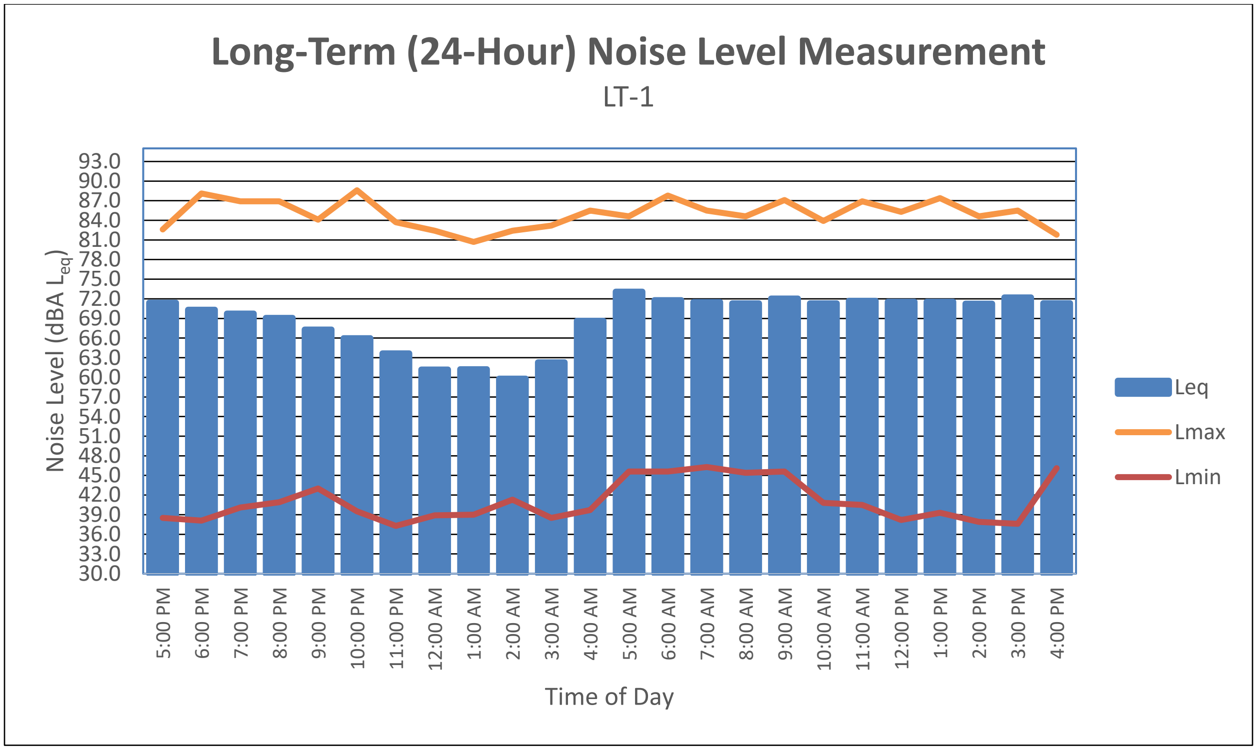
Source: Compiled by LSA Associates, Inc. (2023).

dBA = A-weighted decibel

L_{eq} = equivalent continuous sound level

L_{max} = maximum instantaneous noise level

L_{min} = minimum measured sound level



Long-Term (24-Hour) Noise Level Measurement
LT-1
Noise Level (dBA Leq)
93.0
90.0
87.0
84.0
81.0
78.0
75.0
72.0
69.0
66.0
63.0
60.0
57.0
54.0
51.0
48.0
45.0
42.0
39.0
36.0
33.0
30.0
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
Time of Day
Leq
Lmax
Lmin

Noise Measurement Survey

Project Number: 20231068
Project Name: Kings View Residential

Test Personnel: Moe Abushanab
Equipment: Larson Davis LxT

Site Number: ST-1 Date: 7/25/2023

Time: From 4:18 p.m. To 4:33 p.m.

Site Location: Near western border of project site, approximately 25 feet away from Cyrier Avenue centerline.

Primary Noise Sources: Background traffic noise on S. Frankwood Avenue
Occasional traffic on Cyrier Avenue

Measurement Results

	dBA
L_{eq}	47.4
L_{max}	68.2
L_{min}	36.0
L_{peak}	97.8
L_2	55.8
L_8	49.6
L_{25}	42.9
L_{50}	40.3
SEL	

Atmospheric Conditions:

Maximum Wind Velocity (mph)	7.8
Average Wind Velocity (mph)	4.4
Temperature (F)	98.0
Relative Humidity (%)	17.0
Comments:	

Comments:

Location Photo:

APPENDIX B

CONSTRUCTION NOISE CALCULATIONS

Construction Calculations

Phase: Site Preparation

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Grader	1	85	40	50	0.5	85	81
Tractor	1	84	40	50	0.5	84	80
					Combined at 50 feet	**88**	**84**
					Combined at Receptor 85 feet	**83**	**79**
					Combined at Receptor 280 feet	**73**	**69**

Phase: Grading

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Grader	1	85	40	50	0.5	85	81
Dozer	1	82	40	50	0.5	82	78
Tractor	1	84	40	50	0.5	84	80
					Combined at 50 feet	**89**	**85**
					Combined at Receptor 85 feet	**84**	**80**
					Combined at Receptor 280 feet	**74**	**70**

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
					Combined at 50 feet	**86**	**84**
					Combined at Receptor 85 feet	**82**	**79**

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
Drum Mixer	4	80	50	50	0.5	80	83
Roller	1	80	20	50	0.5	80	73
Tractor	1	84	40	50	0.5	84	80
					Combined at 50 feet	**87**	**85**
					Combined at Receptor 85 feet	**82**	**81**
					Combined at Receptor 280 feet	**72**	**70**

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 85 feet	**73**	**69**

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

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