NOISE AND VIBRATION IMPACT ANALYSIS

HARDT AND BRIER BUSINESS PARK PROJECT

SAN BERNARDINO, CALIFORNIA

LSA

June 2023

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SAN BERNARDINO, CALIFORNIA

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TABLE OF CONTENTS

FIGURES AND TABLES ii
LIST OF ABBREVIATIONS AND ACRONYMS iii
INTRODUCTION 1
Project Location And Description 1
Existing Land Uses in the project area 4
NOISE AND VIBRATION FUNDAMENTALS 5
Characteristics of Sound 5
Measurement of Sound 5
Physiological Effects of Noise 6
Fundamentals of Vibration 8
REGULATORY SETTING 10
Applicable Noise Standards 10
City of San Bernardino 10
State of California Green Building Standards Code 11
Federal Transit Administration 12
Applicable Vibration Standards 12
Federal Transit Administration 12
OVERVIEW OF THE EXISTING NOISE ENVIRONMENT 14
Ambient Noise Measurements 14
Long-Term Noise Measurements 14
Existing Aircraft Noise 14
PROJECT IMPACTS 16
Short-Term Construction Noise Impacts 16
Short-Term Construction Vibration Impacts 19
Long-Term Off-Site Traffic Noise Impacts 21
Long-Term Traffic-Related Vibration Impacts 21
Long-Term Off-Site Stationary Noise Impacts 23
Heating, Ventilation, and Air Conditioning Equipment 23
Truck Deliveries and Truck Loading and Unloading Activities 23
Trash Enclosure Activities 23
Cumulative Operations Noise Assessment 23
BEST CONSTRUCTION PRACTICES 25
REFERENCES 26

APPENDICES

A: NOISE MONITORING DATA
B: CONSTRUCTION NOISE LEVEL CALCULATIONS
C: FHWA NOISE MODEL PRINTOUTS
D: SOUNDPLAN NOISE MODEL PRINTOUTS

FIGURES AND TABLES

FIGURES

Figure 1: Project Location 2
Figure 2: Site Plan 3
Figure 3: Noise Monitoring Locations 15

TABLES

Table A: Definitions of Acoustical Terms 7
Table B: Common Sound Levels and Their Noise Sources 8
Table C: Detailed Assessment Daytime Construction Noise Criteria 12
Table D: Interpretation of Vibration Criteria for Detailed Analysis 12
Table E: Construction Vibration Damage Criteria 13
Table F: Long-Term 24-Hour Ambient Noise Monitoring Results 14
Table G: Typical Construction Equipment Noise Levels 17
Table H: Potential Construction Noise Impacts at Nearest Receptor 18
Table I: Vibration Source Amplitudes for Construction Equipment 19
Table J: Potential Construction Vibration Annoyance Impacts at Nearest Receptor 20
Table K: Potential Construction Vibration Damage Impacts at Nearest Receptor 20
Table L: Traffic Noise Levels Without and With Proposed Project 22
Table M: Daytime Exterior Noise Level Impacts 24
Table N: Nighttime Exterior Noise Level Impacts 24

LIST OF ABBREVIATIONS AND ACRONYMS

CALGreen	California Green Building Standards Code
City	City of San Bernardino
CNEL	Community Noise Equivalent Level
dB	decibel(s)
dBA	A-weighted decibel(s)
EPA	United States Environmental Protection Agency
ft	feet
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FTA Manual	*Transit Noise and Vibration Impact Assessment Manual*
HVAC	heating, ventilation, and air conditioning
in/sec	inches per second
L_{dn}	day-night average noise level
L_{eq}	equivalent continuous sound level
L_{max}	maximum instantaneous sound level
PPV	peak particle velocity
project	Hardt and Brier Business Park Project
RMS	root-mean-square
SBD	San Bernardino International Airport
SBMC	City of San Bernardino Municipal Code
sf	square feet
SPL	sound power level
VdB	vibration velocity decibels

INTRODUCTION

LSA prepared this noise and vibration impact analysis to evaluate the potential noise and vibration impacts and reduction measures associated with the Hardt and Brier Business Park Project (project) in San Bernardino, California. This report is intended to satisfy the City of San Bernardino (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 5.81-acre project site is between Hardt Street and Brier Drive in San Bernardino, San Bernardino County, California. The project site consists of 8 parcels identified by Assessor's Parcel Numbers 0281-301-17, 0281-311-06, -07, -08, -11, -12, -18, and -19. The project site is currently undeveloped. Regional access to the project site is provided by Interstate 10 and Interstate 215. Local access is provided via Hardt Street and Brier Drive. See Figure 1, Regional Project Location, and Figure 2, Site Plan, below.

The project proposes to construct a business park totaling a maximum of 81,210-square-feet (sf) among five proposed buildings (Buildings A through D1 and D2) with a total of 213 parking spaces. Building A would consist of 17,783 sf (including 1,269 sf of mezzanine space), Building B would consist of 17,586 sf (including 1,286 sf of mezzanine space), Building C would consist of 18,323 sf (including 1,275 sf of mezzanine space), and Buildings D1 and D2 would consist of 13,759 sf each. The project would include 63,147 sf of landscaping which would cover 25 percent of the project site.

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. In addition, the proposed project would generate 1,014 average daily trips. The proposed project would not include an emergency backup generator or fire pumps.

LSA

LEGEND

Project Location

FIGURE 1

N

0 1000 2000

FEET

SOURCE: ESRI Map 2023

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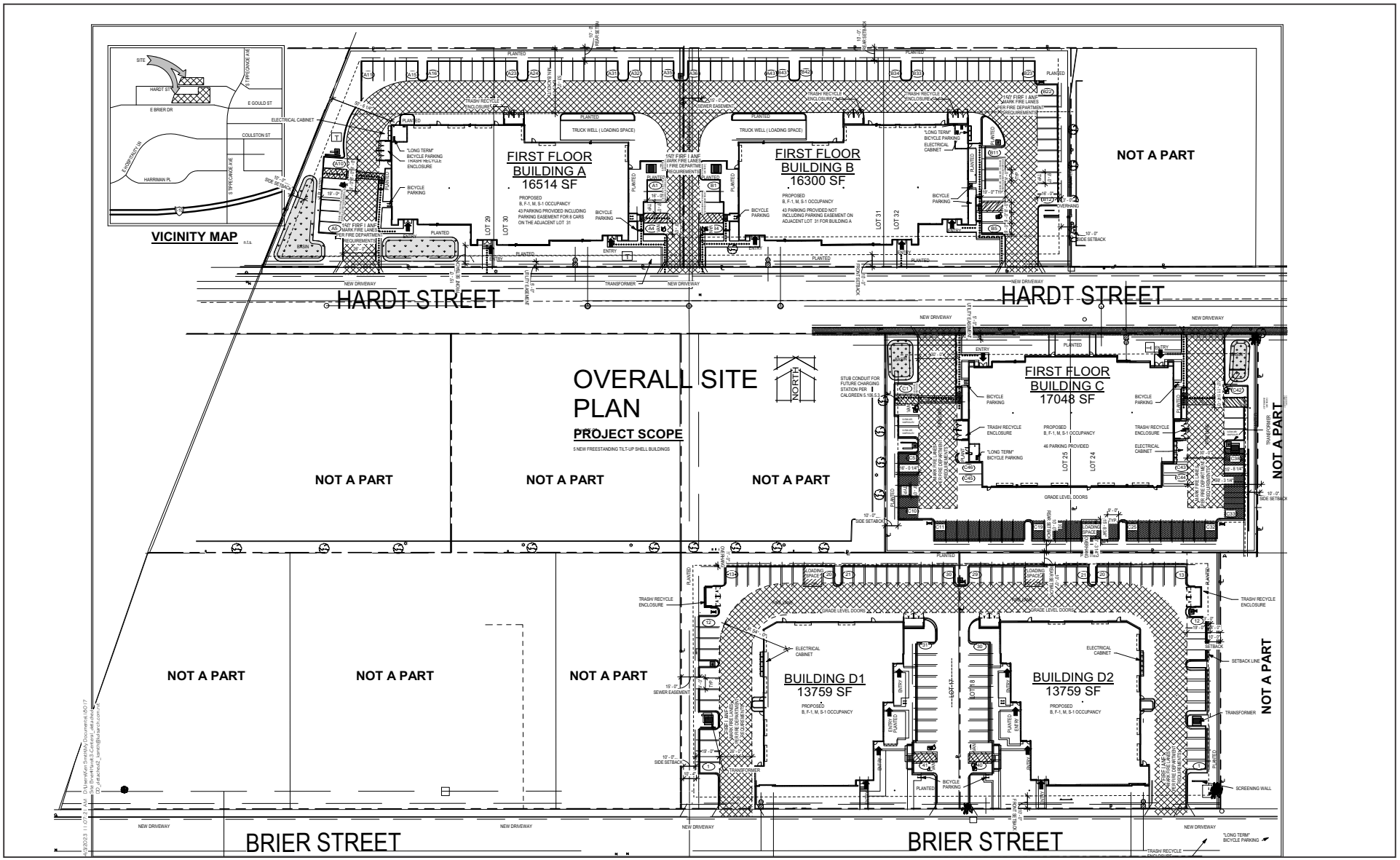
Hardt and Brier Commercial Project

Project Location and Vicinity



LSA

FIGURE 3

0 200 400

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SOURCE: HPA Architecture

Hardt and Brier Commercial Project

Site Plan

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EXISTING LAND USES IN THE PROJECT AREA

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

- **North:** Existing Drainage channel followed by railroad (Metrolink San Bernardino Line) and chemical plant
- **East:** Existing Light industrial warehouse, commercial use, and surface parking lot
- **South:** Existing office and commercial uses with parking opposite East Brier Drive
- **West:** Existing utility infrastructure followed by public institution uses (Summit College and other office uses); vacant undeveloped land
- **Central:** Existing government office and parking

The nearest sensitive receptors are:

- **South:** Premier Outpatient Surgery Center, 355 feet from the project boundary line
- **East:** Single-family residential uses opposite Tippecanoe Avenue, 585 ft away from the project boundary line

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) represent 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 (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 (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 1×10^{-6} inches/second (in/sec) used in the United States.

REGULATORY SETTING

APPLICABLE NOISE STANDARDS

The proposed project site is within the city limits of San Bernardino. The applicable noise standards include the criteria in the City of San Bernardino's Noise Element of the General Plan and the City of San Bernardino Municipal Code (SBMC). To assess potential noise impacts associated with aircraft operations in the project vicinity, the State of California's Green Building Standards Code (CALGreen) standards are also provided below.

City of San Bernardino

Noise Element of the General Plan

The Noise Element of the General Plan (Chapter 14) 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:

Goal.	**14.1**	*Ensure that residents are protected from excessive noise through careful land planning.*
Policies.	**14.1.2**	Require that automobile and truck access to commercial properties abutting residential parcels be located at the maximum practical distance from the residential parcel.
	14.1.4	Prohibit the development of new or expansion of existing industrial, commercial, or other uses that generate noise impacts on housing, schools, heath care facilities or other sensitive uses above a L_{dn} of 65 dBA.
Goal.	**14.2**	*Encourage the reduction of noise from transportation-related noise sources such as motor vehicles, aircraft operations, and railroad movements.*
Policies.	**14.2.3**	Require that development that increases the ambient noise level adjacent to noise-sensitive land uses provide appropriate mitigation measures.
	14.2.8	Minimize noise attributable to vehicular travel in residential neighborhoods by inhibiting through trips by the use of cul-de-sacs, one-way streets, and other traffic controls.
	14.2.19	As may be necessary, require acoustical analysis and ensure the provision of effective noise mitigation measures for sensitive land uses, especially residential uses, in areas significantly impacted by noise.

Goal.	**14.3**	*Protect residents from the negative effects of "spill over" or nuisance noise.*
Policies.	**14.3.1**	Require that construction activities adjacent to residential units be limited as necessary to prevent adverse noise impacts.
	14.3.2	Require that construction activities employ feasible and practical techniques that minimize the noise impacts on adjacent uses.
	14.3.5	Require that the hours of truck deliveries to commercial properties abutting residential uses be limited unless there is no feasible alternative or there are overriding transportation benefits by scheduling deliveries at another hour.

Figure N-1 of the General Plan, *Land Use Compatibility for Community Noise Exposure*, provides noise criteria to evaluate the land use compatibility of transportation-related noise. The criteria indicate that residential uses are considered "normally acceptable" with noise levels below 60 dBA L_{dn} or CNEL and conditionally acceptable with noise levels of less than 70 dBA L_{dn} or CNEL.

City of San Bernardino Municipal Code

The SBMC Noise Control Ordinance (Chapter 8.54) includes regulations to control the negative effects of nuisance noise, but it does not identify specific exterior noise level limits. In addition, SBMC Chapter 19.20 contains exterior and interior noise level standards for residential land uses. Section 8.54.060 states, when "such noises are an accompaniment and effect of a lawful business, commercial or industrial enterprise carried on in an area zoned for that purpose", these activities shall be exempt (Section 8.54.060(B)). However, due to the project's proximity to residential land uses, Section 19.20.030.15(A) limits the operational stationary-source noise from the proposed Project to an exterior noise level of 65 dBA for residential land uses.

Construction Noise Standards. The City has set restrictions to control noise impacts associated with the construction of the proposed project. Section 8.54.070, Disturbances from Construction Activity, limits construction activities to within the hours of 7:00 a.m. and 8:00 p.m.

State of California Green Building Standards Code

The CALGreen contains mandatory measures for non-residential building construction in Section 5.507 on Environmental Comfort. These noise standards are applied to new construction in California for controlling interior noise levels resulting from exterior noise sources. The regulations specify that acoustical studies must be prepared when non-residential structures are developed in areas where the exterior noise levels exceed 65 dBA CNEL, such as within a noise contour of an airport, freeway, railroad, or other noise source. If the development falls within an airport or freeway 65 dBA CNEL noise contour, buildings shall be constructed to provide an interior noise level environment attributable to exterior sources that does not exceed an hourly equivalent level of 50 dBA L_{eq} in occupied areas during any hour of operation.

Federal Transit Administration

Though the City does not have daytime construction noise level limits for activities that occur with the specified hours of Section 8.54.070, to determine potential CEQA noise impacts, construction noise was assessed using criteria from the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018) (FTA Manual). Table C shows the FTA's Detailed Assessment Construction Noise Criteria based on the composite noise levels per construction phase.

Table C: Detailed Assessment Daytime Construction Noise Criteria

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

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
dBA = A-weighted decibels
FTA = Federal Transit Administration
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 D provides the criteria for assessing the potential for interference or annoyance from vibration levels in a building.

Table D: 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 the frequency range 8 to 80 Hertz.
FTA = Federal Transit Administration
VdB = vibration velocity decibels
L_V = velocity in decibels
Max = maximum

Table E 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 E: 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 traffic noise on Brier Drive, Hardt Street, and Tippecanoe Avenue, and parking lot activities.

AMBIENT NOISE MEASUREMENTS

Long-Term Noise Measurements

Long-term (24-hour) noise level measurements were conducted on August 30 and 31, 2022, using two Larson Davis Spark 706RC Dosimeters. Table F provides a summary of the measured hourly noise levels and calculated CNEL level from the long-term noise level measurements. As shown in Table F, the calculated CNEL levels range from 67.6 dBA CNEL to 79.0 dBA CNEL. Hourly noise levels at surrounding sensitive uses are as low as 54.5 dBA L_{eq} during nighttime hours and 63.0 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 F: 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	1194 East Brier Drive, on a tree near southwest corner of the property, approximately 50 feet north of East Brier Drive centerline.	63.0 – 69.2	58.5 – 63.0	54.5 – 61.9	67.6
LT-2	1194 East Brier Drive, on a tree west of Tippecanoe Avenue, approximately 50 feet west of Tippecanoe centerline Avenue and 100 feet south of Hardt Street centerline.	73.6 – 75.7	72.8 – 73.6	69.7 – 73.5	79.0

Source: Compiled by LSA (2023).
Note: Noise measurements were conducted from August 30 to August 31, 2022, starting at 10:00 a.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 airport to the project is San Bernardino International Airport (SBD), 1.4 miles to the northeast. Noise impacts related to aircraft operations may contribute to the aircraft noise in the project area; however, the project site is 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, 2018). 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 Location

LT-1 Long-term Noise Monitoring Location

0 240 480
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SOURCE: Google Earth 2022

FIGURE 3

Hardt and Brier Business Park Project

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 Hardt Street. The results of the California Emissions Estimator Model for the proposed project indicate that during the grading phase, an additional 105 vehicles, consisting of worker and hauling trips, would be added to the roadway adjacent to the project site. Because the existing traffic volume on Hardt Street is considerably more than 105 vehicles, 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 G 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 G 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 G: 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 G, 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 during the site preparation phase.

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 H shows the nearest 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 H: 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})
Government Office (Central)	88	160	78
Industrial Uses (North)		350	70
Industrial Uses (East)		380	68
Commercial Uses (South)		510	68
Public Institutions (West)		700	65
Residences (East)		800	64

Source: Compiled by LSA (2023).

[1] The composite construction noise level represents the grading phase which is 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 office uses central to the site would reach 78 dBA L_{eq}, while construction noise levels would approach 64 dBA L_{eq} at the nearest sensitive residential uses to the east 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 it relates to off-site uses, construction-related noise impacts would remain below the 80 dBA L_{eq} and 85 dBA L_{eq} 8-hour construction noise level criteria for daytime construction noise level criteria as established by the FTA for residential and commercial land uses, respectively, and therefore would be considered less than significant.

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 8:00 p.m.

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 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 vibration level in PPV is best for characterizing potential for damage.

Table I shows the PPV and VdB values at 25 ft from the construction vibration source. As shown in Table I, 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 I: 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 J and K below provide a summary of off-site construction vibration levels.

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

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

Table J: Potential Construction Vibration Annoyance Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (VdB) at 25 feet[1]	Distance (feet) [2]	Vibration Level (VdB)
Government Office (Central)	87	160	63
Industrial Uses (North)		350	53
Industrial Uses (East)		380	52
Commercial Uses (South)		510	48
Public Institutions (West)		700	44
Residences (East)		800	42

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.

VdB = vibration velocity decibels

Table K: Potential Construction Vibration Damage Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (PPV) at 25 feet[1]	Distance (feet) [2]	Vibration Level (PPV)
Government Office (Central)	0.089	80	0.016
Industrial Uses (North)		200	0.004
Industrial Uses (East)		150	0.006
Commercial Uses (South)		355	0.002
Public Institutions (West)		350	0.002
Residences (East)		585	0.001

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.

in/sec = inch/inches per second

PPV = peak particle velocity

As shown in Table D above, the threshold at which vibration levels would result in annoyance would be 78 VdB for daytime residential uses and 84 VdB for office type uses. As shown in Table E, 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 J, vibration levels are expected to approach 63 VdB at the closest office uses located central to the project site and 42 VdB at the closest residential use to the east, which is below the 84 VdB and 78 VdB annoyance threshold for office types uses and for daytime residential uses, respectively. Based on the information provided in Table K, vibration levels are expected to approach 0.016 PPV in/sec at the surrounding structures and would be below the 0.2 PPV in/sec damage threshold.

Because construction activities are regulated by the City's Code of Ordinances, which states temporary construction, maintenance, or demolition activities are not allowed between 8:00 p.m. on one day and 7:00 a.m. of the following day, vibration impacts would not occur during the more sensitive nighttime hours.

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

The guidelines included in the FHWA Highway Traffic Noise Prediction Model (FHWA-RD-77 108) were used to evaluate highway traffic-related noise conditions along roadway segments in the project vicinity. This model requires various parameters, including traffic volumes, vehicle mix, vehicle speed, and roadway geometry to compute typical equivalent noise levels during daytime, evening, and nighttime hours. The resultant noise levels are weighted and summed over 24-hour periods to determine the CNEL values. Table L provides the traffic noise levels for the opening year with and without project scenarios. These noise levels represent the worst-case scenario, which assumes no shielding is provided between the traffic and the location where the noise contours are drawn.

The without and with project scenario traffic volumes were obtained from the *Traffic Impact Analysis Report – Hardt And Brier Business Park Project* (Linscott, Law & Greenspan, engineers, 2023). Appendix C provides the specific assumptions used in developing these noise levels and model printouts. Table L shows that the increase in project-related traffic noise would be no greater than 2 dBA. Noise level increases less than 3 dBA are not perceptible to the human ear. Therefore, traffic noise impacts from project-related traffic on off-site sensitive receptors would be less than significant and no mitigation measures are 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. 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.

Table L: Traffic Noise Levels Without and With Proposed Project

Roadway Segment	Existing		Existing With Project			Buildout (2040)		Buildout With Project (2040)		
	ADT	CNEL (dBA) 50 ft from Centerline of Nearest Lane	ADT	CNEL (dBA) 50 ft from Centerline of Nearest Lane	Increase from Existing Conditions (dBA)	ADT	CNEL (dBA) 50 ft from Centerline of Nearest Lane	ADT	CNEL (dBA) 50 ft from Centerline of Nearest Lane	Increase from Existing Conditions (dBA)
Hardt Street West of Tippecanoe Avenue	980	49.4	1,550	51.4	2.0	1,130	50.0	1,700	51.8	1.8
Brier Drive West of Tippecanoe Avenue	3,890	56.1	4,470	56.7	0.6	5,620	57.6	6,200	58.1	0.5
Tippecanoe Avenue North of Hardt Street	14,930	64.7	15,190	64.8	0.1	21,340	66.2	21,600	66.3	0.1
Tippecanoe Avenue between Hardt Street and Brier Drive	15,510	64.8	16,100	65.0	0.2	22,570	66.5	23,160	66.6	0.1
Tippecanoe Avenue South of Brier Drive	14,800	64.6	15,690	64.9	0.3	21,700	66.3	22,590	66.5	0.2

Source: Compiled by LSA (2023).
Note: Shaded cells indicate roadway segments adjacent to the project site.
ADT = average daily traffic
CNEL= Community Noise Equivalent Level
dBA = A-weighted decibels
ft = foot/feet

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 heating, ventilation, and air conditioning (HVAC) equipment, trash enclosure activity, and truck loading and unloading activities. The potential noise impacts to off-site sensitive land uses from the proposed operations are discussed below. To provide a conservative analysis, it is assumed that operations would occur equally during all hours of the day. Additionally, it is assumed that within any given hour, 6 trucks would maneuver to park at one of the proposed loading spaces. 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 D.

Heating, Ventilation, and Air Conditioning Equipment

The project would have various rooftop mechanical equipment including heating, ventilation and air conditioning (HVAC) units on the proposed building. To be conservative, the analysis assumed the project could have four rooftop HVAC units at each building (a total of 20 units) and would operate 24 hours per day. The HVAC equipment could operate 24 hours per day and would generate sound power levels (SPL) of up to 87 dBA SPL or 72 dBA L_{eq} at 5 feet, based on manufacturer data (Trane n.d.).

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]). To present a conservative assessment, it is assumed that loading and unloading activities could occur at all 6 loading spaces simultaneously for a period of 30 minutes in a given hour.

Trash Enclosure Activities

Noise levels generated by trash enclosures are of short-term duration, less than 1 minute, and are conservatively assumed to occur at all locations within the same clock hour. Noise levels that occur during the unloading of trash enclosures by large trucks typically generate noise levels of approximately 84 dBA at 50 ft based on measurements presented in *Investigation of Dumpster Noise Controls* (Daly-Standlee & Associates, Inc. 2003).

Cumulative Operations Noise Assessment

Tables M and N below show the combined hourly noise levels generated by HVAC equipment, trash enclosure activities, and truck delivery activities at the closest off-site land uses. The project-related noise level impacts would range from 38.7 dBA L_{eq} to 47.8 dBA L_{eq} at the surrounding sensitive receptors. These levels would be well below the City's exterior noise standard of 65 dBA L_{eq}. Because project noise levels would not generate a noise level by 3 dBA or more or exceed the City's thresholds, the impact would be less than significant, and no noise reduction measures are required.

Table M: Daytime Exterior Noise Level Impacts

Receptor (Location)	Direction	Existing Quietest Daytime Noise Level (dBA L_{eq})	Project Generated Noise Levels (dBA L_{eq})	Projected Future Noise Level (dBA L_{eq})[1]	Potential Operational Noise Impact?[2]
Premier Outpatient Surgery Center	South	63.0	47.8	63.1	No
Residential (1575 Tippecanoe Avenue)	East	73.6	40.3	73.6	No

Source: Compiled by LSA (2023).

[1] The projected future noise level is a combination of the existing ambient noise level and the project noise contribution. If the project contribution is 10 dBA or more below the existing ambient noise level, there would be no expected noise increase.

[2] A potential operational noise impact would occur if (1) the quietest daytime ambient hour is less than the applicable hourly standard and project noise impacts would cause an exceedance of said standard, OR (2) the quietest daytime ambient hour is greater than the applicable hourly standard and project noise impacts are 3 dBA greater than the quietest daytime ambient hour.

dBA = A-weighted decibels

L_{eq} = equivalent noise level

Table N: Nighttime Exterior Noise Level Impacts

Receptor (Location)	Direction	Existing Quietest Nighttime Noise Level (dBA L_{eq})	Project Generated Noise Levels (dBA L_{eq})	Projected Future Noise Level (dBA L_{eq})[1]	Potential Operational Noise Impact?[2]
Premier Outpatient Surgery Center	South	54.5	47.3	55.3	No
Residential (1575 Tippecanoe Avenue)	East	69.7	38.7	69.7	No

Source: Compiled by LSA (2023).

[1] The projected future noise level is a combination of the existing ambient noise level and the project noise contribution. If the project contribution is 10 dBA or more below the existing ambient noise level, there would be no expected noise increase.

[2] A potential operational noise impact would occur if (1) the quietest daytime ambient hour is less than the applicable hourly standard and project noise impacts would cause an exceedance of said standard, OR (2) the quietest daytime ambient hour is greater than the applicable hourly standard and project noise impacts are 3 dBA greater than the quietest daytime ambient hour.

dBA = A-weighted decibels

L_{eq} = equivalent noise level

BEST CONSTRUCTION PRACTICES

In addition to compliance with the City's Municipal Code allowed hours of construction of 7:00 a.m. to 8:00 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.

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APPENDIX A

NOISE MONITORING DATA

Noise Measurement Survey – 24 HR

Project Number: ESL2201.27
Project Name: Hardt and Brier

Test Personnel: Corey Knips
Equipment: Spark 706RC (SN:18906)

Site Number: LT-1 Date: 8/30/2022

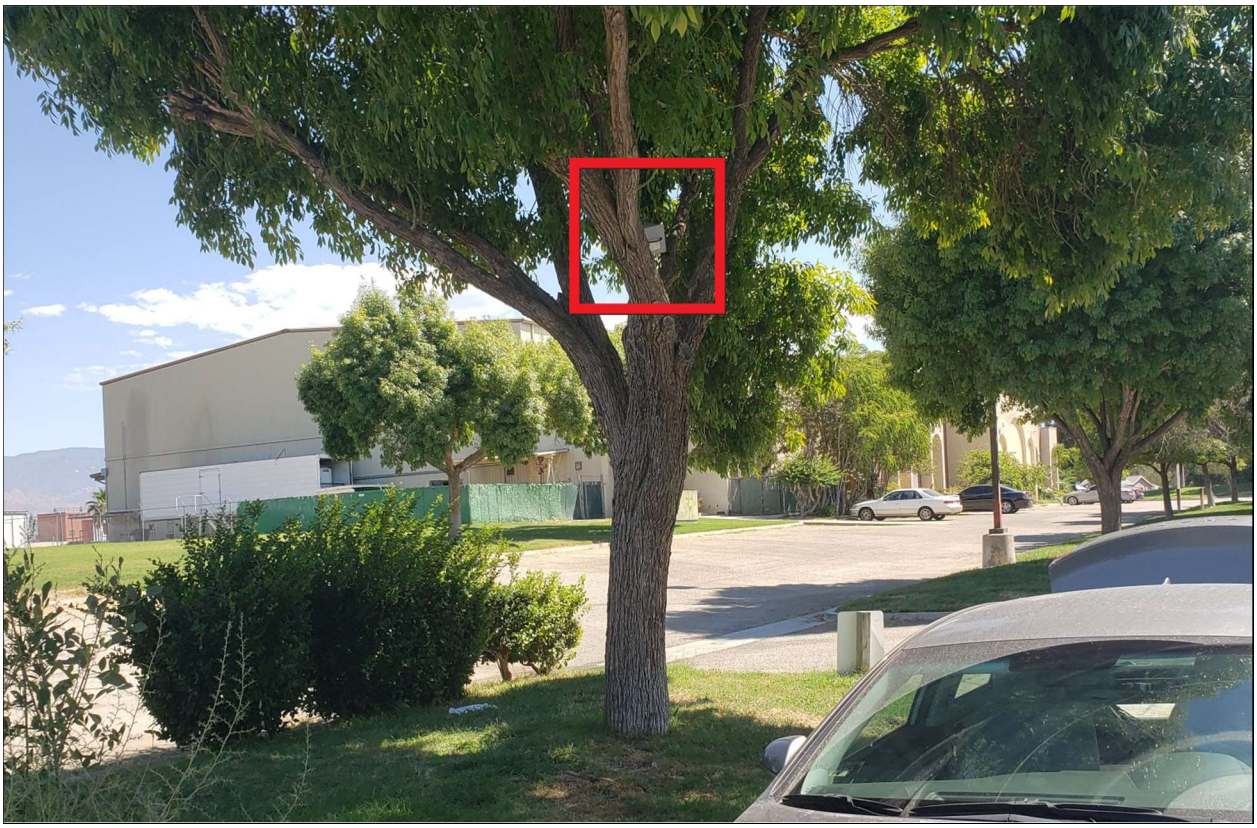
Time: From 10:00 a.m. To 10:00 a.m.

Site Location: 1194 East Brier Drive, San Bernardino, CA, in a tree near southwest corner of the property. Approximately 50 feet north of the centerline for East Brier Drive.

Primary Noise Sources: Light traffic on Brier Drive, faint traffic on Tippecanoe Avenue, and light parking lot activity nearby.

Comments:

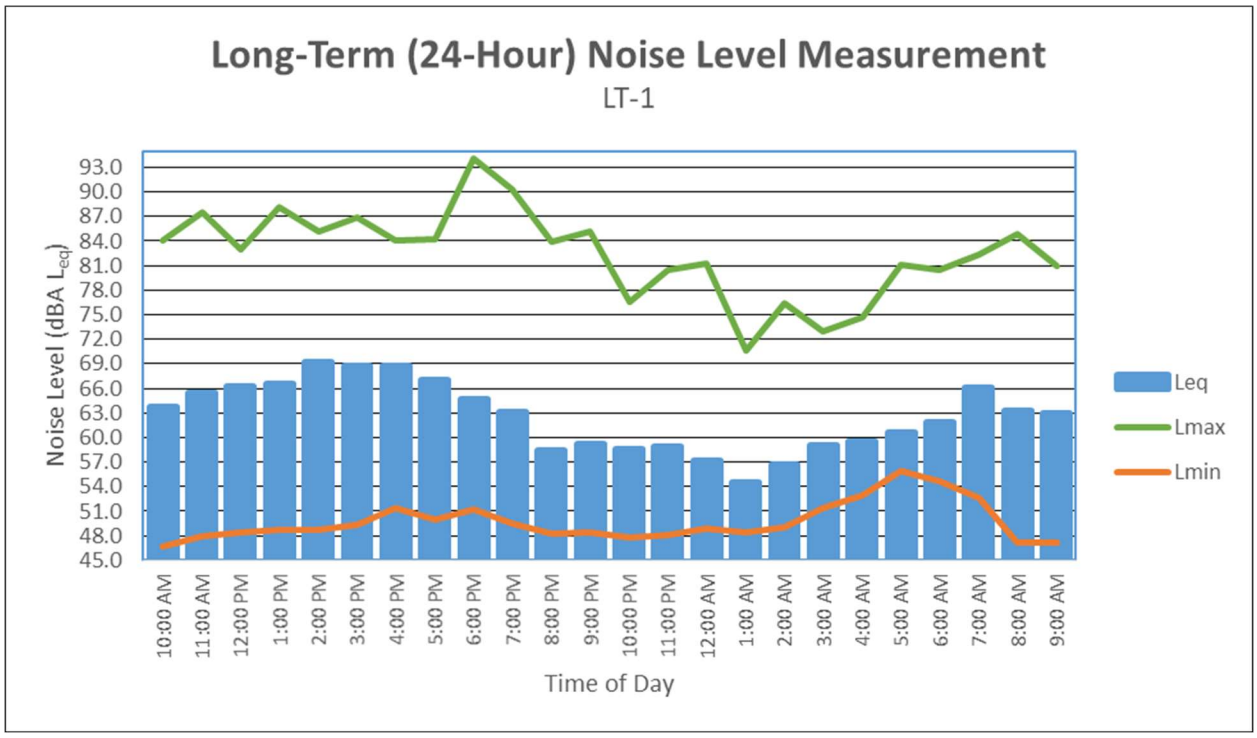
Photo:



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

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
10:00 AM	8/30/2022	63.7	84.1	46.7
11:00 AM	8/30/2022	65.5	87.5	47.9
12:00 PM	8/30/2022	66.2	82.9	48.4
1:00 PM	8/30/2022	66.6	88.2	48.8
2:00 PM	8/30/2022	69.2	85.2	48.8
3:00 PM	8/30/2022	68.8	86.9	49.3
4:00 PM	8/30/2022	68.7	84.1	51.4
5:00 PM	8/30/2022	67.0	84.2	50.0
6:00 PM	8/30/2022	64.7	94.1	51.2
7:00 PM	8/30/2022	63.0	90.3	49.5
8:00 PM	8/30/2022	58.5	83.9	48.2
9:00 PM	8/30/2022	59.2	85.2	48.4
10:00 PM	8/30/2022	58.6	76.6	47.8
11:00 PM	8/30/2022	58.9	80.5	48.1
12:00 AM	8/31/2022	57.2	81.3	48.9
1:00 AM	8/31/2022	54.5	70.6	48.4
2:00 AM	8/31/2022	56.7	76.4	49.1
3:00 AM	8/31/2022	59.0	73.0	51.4
4:00 AM	8/31/2022	59.6	74.7	52.9
5:00 AM	8/31/2022	60.7	81.1	55.9
6:00 AM	8/31/2022	61.9	80.5	54.6
7:00 AM	8/31/2022	66.1	82.4	52.7
8:00 AM	8/31/2022	63.3	84.8	47.2
9:00 AM	8/31/2022	63.0	81.0	47.2

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: ESL2201.27
Project Name: Hardt and Brier

Test Personnel: Corey Knips
Equipment: Spark 703+ (SN:20224)

Site Number: LT-2 Date: 8/30/2022

Time: From 10:00 a.m. To 10:00 a.m.

Site Location: 1194 East Brier Drive, San Bernardino, CA, on tree near Tippecanoe Avenue. Approximately 50 feet west of the centerline of Tippecanoe Avenue and 100 feet south of the centerline of Hardt Street.

Primary Noise Sources: Traffic on Tippecanoe Avenue and faint truck activity to the west.

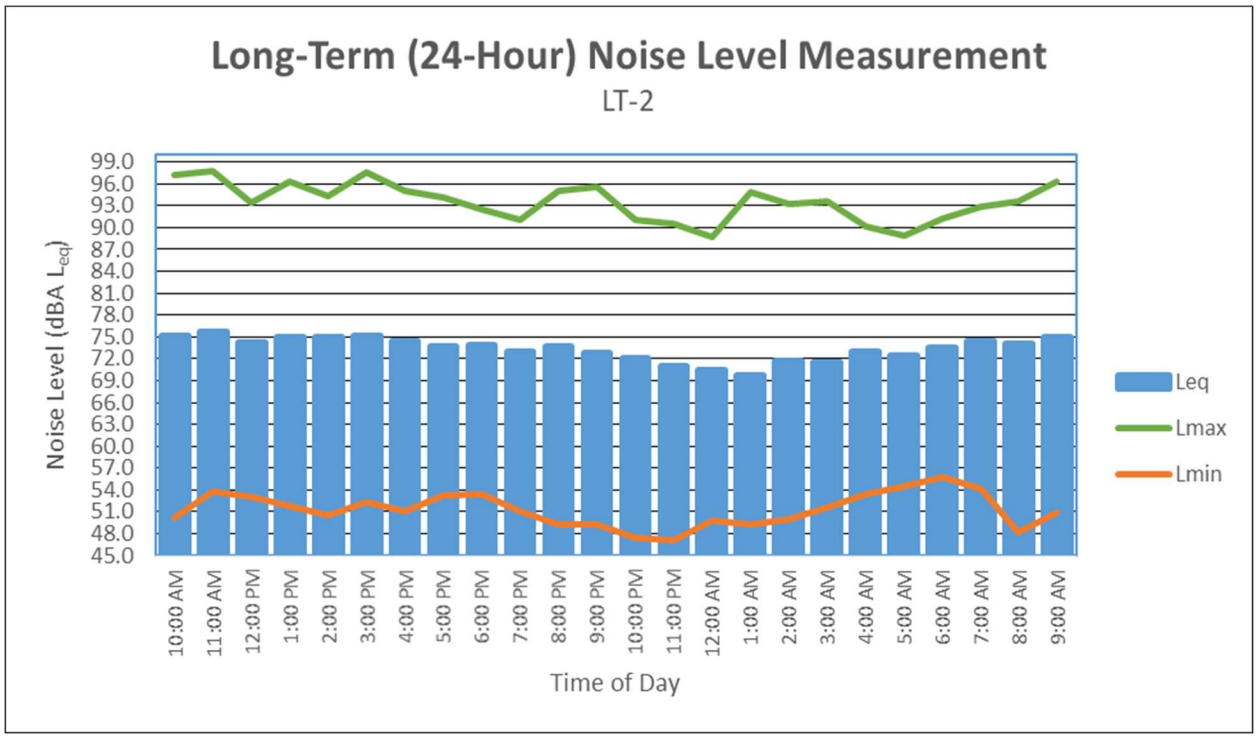
Comments:

Photo:

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

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
10:00 AM	8/30/2022	75.1	97.2	50.1
11:00 AM	8/30/2022	75.7	97.7	53.7
12:00 PM	8/30/2022	74.3	93.4	53.0
1:00 PM	8/30/2022	74.9	96.4	51.8
2:00 PM	8/30/2022	74.9	94.4	50.6
3:00 PM	8/30/2022	75.1	97.6	52.3
4:00 PM	8/30/2022	74.4	95.0	51.1
5:00 PM	8/30/2022	73.6	94.2	53.2
6:00 PM	8/30/2022	73.9	92.5	53.4
7:00 PM	8/30/2022	72.9	91.1	51.0
8:00 PM	8/30/2022	73.6	95.1	49.3
9:00 PM	8/30/2022	72.8	95.6	49.3
10:00 PM	8/30/2022	72.1	91.0	47.5
11:00 PM	8/30/2022	71.0	90.5	47.1
12:00 AM	8/31/2022	70.4	88.7	49.8
1:00 AM	8/31/2022	69.7	94.8	49.2
2:00 AM	8/31/2022	71.6	93.2	50.0
3:00 AM	8/31/2022	71.5	93.6	51.6
4:00 AM	8/31/2022	73.0	90.2	53.5
5:00 AM	8/31/2022	72.5	88.9	54.5
6:00 AM	8/31/2022	73.5	91.3	55.8
7:00 AM	8/31/2022	74.5	92.8	54.1
8:00 AM	8/31/2022	74.1	93.6	48.2
9:00 AM	8/31/2022	75.0	96.3	50.9

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: 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 160 feet	**76**	**78**
					Combined at Receptor 350 feet	**69**	**70**
					Combined at Receptor 380 feet	**66**	**68**
					Combined at Receptor 510 feet	**66**	**68**
					Combined at Receptor 700 feet	**63**	**65**
					Combined at Receptor 800 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	1	81	40	50	0.5	81	77
Grader	1	85	40	50	0.5	85	81
Dozer	1	82	40	50	0.5	82	78
Tractor	3	84	40	50	0.5	84	85
					Combined at 50 feet	**89**	**87**
					Combined at Receptor 160 feet	**79**	**77**

Phase: Building Construction

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	round Effec	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 160 feet	**77**	**76**

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**
					Combined at Receptor 160 feet	**77**	**76**

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 160 feet	**68**	**64**

Sources: RCNM

[1]- Percentage of time that a piece of equipment is operating at full power.
dBA – A-weighted Decibels
Lmax- Maximum Level
Leq- Equivalent Level

APPENDIX C

FHWA TRAFFIC NOISE PRINTOUTS

TABLE Existing -01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Hardt Street West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Existing

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 980 SPEED (MPH): 25 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 20 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 49.41

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	0.0

TABLE Existing -02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Brier Drive West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Existing

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 3890 SPEED (MPH): 30 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 40 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 56.05

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	102.8

TABLE Existing -03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue North of Hardt Street
NOTES: Hardt And Brier Business Park Project - Existing

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 14930 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.68

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	91.4	177.3	372.0

TABLE Existing -04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue between Hardt Street and Brier Drive
NOTES: Hardt And Brier Business Park Project - Existing

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 15510 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.84

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	93.2	181.5	381.5

TABLE Existing -05
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue South of Brier Drive
NOTES: Hardt And Brier Business Park Project - Existing

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 14800 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.64

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	91.0	176.3	369.9

TABLE Existing with Project -01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Hardt Street West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Existing with Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 1550 SPEED (MPH): 25 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 20 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 51.41

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	0.0

TABLE Existing with Project -02

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Brier Drive West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Existing with Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 4470 SPEED (MPH): 30 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 40 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 56.65

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	111.3

TABLE Existing with Project -03

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue North of Hardt Street
NOTES: Hardt And Brier Business Park Project - Existing with Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 15190 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.75

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	92.2	179.2	376.3

TABLE Existing with Project -04

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue between Hardt Street and Brier Drive
NOTES: Hardt And Brier Business Park Project - Existing with Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 16100 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 65.00

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	95.0	185.8	391.0

TABLE Existing with Project -05

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue South of Brier Drive
NOTES: Hardt And Brier Business Park Project - Existing with Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 15690 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.89

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	93.8	182.8	384.4

TABLE Buildout-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Hardt Street West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Buildout

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 1130 SPEED (MPH): 25 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 20 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 50.03

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	0.0

TABLE Buildout-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Brier Drive West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Buildout

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 5620 SPEED (MPH): 30 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 40 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 57.65

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	69.0	127.4

TABLE Buildout-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue North of Hardt Street
NOTES: Hardt And Brier Business Park Project - Buildout

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 21340 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.23

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	110.6	222.2	470.8

TABLE Buildout-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue between Hardt Street and Brier Drive
NOTES: Hardt And Brier Business Park Project - Buildout

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 22570 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.47

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	114.1	230.3	488.5

TABLE Buildout-05
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue South of Brier Drive
NOTES: Hardt And Brier Business Park Project - Buildout

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 21700 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.30

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	111.6	224.5	476.0

TABLE Buildout With Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Hardt Street West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Buildout With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 1700 SPEED (MPH): 25 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 20 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 51.81

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	0.0

TABLE Buildout With Project-02

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Brier Drive West of Tippecanoe Avenue
NOTES: Hardt And Brier Business Park Project - Buildout With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 6200 SPEED (MPH): 30 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 40 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 58.07

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	72.1	135.2

TABLE Buildout With Project-03

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue North of Hardt Street
NOTES: Hardt And Brier Business Park Project - Buildout With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 21600 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.28

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	111.3	223.9	474.5

TABLE Buildout With Project-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue between Hardt Street and Brier Drive
NOTES: Hardt And Brier Business Park Project - Buildout With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 23160 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.58

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	115.8	234.1	496.9

TABLE Buildout With Project-05

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 06/06/2023
ROADWAY SEGMENT: Tippecanoe Avenue South of Brier Drive
NOTES: Hardt And Brier Business Park Project - Buildout With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 22590 SPEED (MPH): 40 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 45 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.48

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	114.1	230.4	488.8

APPENDIX D

SOUNDPLAN NOISE MODEL PRINTOUTS

Hardt and Brier Business Park

Project No. ESL2201.27

Project Operational Noise Levels

C:\Users\MAbushanah\OneDrive - LSA Associates\Documents\Desktop\SoundPLAN\ESL2201.27 - Hardt and Brier BP\Ops.sgs - last edit 6/5/2023