MIG

1650 Spruce Street, STE 106
Riverside, CA 92507
951.787.9222
WWW.MIGCOM.COM

Memo

To: Sean Reilly, Principal Planner, City of Redlands

CC: Cameron Hile and Bob Prasse, MIG

From: Kasey Kitowski and Chris Dugan

Date: February 2, 2024

SUBJECT: Noise and Vibration Analysis for Tennessee Village Project, Redlands, CA

MIG, Inc. (MIG) has prepared this memorandum at the request of the city of Redlands. This memorandum evaluates the potential noise and vibration impacts resulting from the implementation of the proposed Tennessee Village Project (proposed project). As explained in this memorandum, the proposed project would not exceed applicable noise and vibration standards with mitigation, would not otherwise result in a substantial increase in ambient noise levels in the vicinity of the project, and would not be subjected to excessive airport-related noise levels. The proposed project, therefore, would not have the potential to result in significant noise or vibration impacts with the mitigation.

PROJECT DESCRIPTION

The proposed project involves the construction of a mixed-use development of 11 buildings on two parcels of undeveloped land in the northern part of Redlands, California.

The approximately 13.48-acre project site is located near the northeast corner of Tennessee Street and Lugonia Avenue. The proposed project would include 646,089 square feet of gross building space, 203,873 square feet of landscaped space for private yards and for a central common area, and 255,373 square feet of impervious surfaces such as walkways, drive aisles, driveways, and parking spaces. The project would include 460 apartment units. Each dwelling unit would range from approximately 758 to 1,599 square feet. The site would contain 670 parking spaces consisting of open stalls, EV charging spaces, garages, carports, and subterranean stalls. The site would be connected to Tennessee Street via two entries, one along the south portion of the site and another along the western portion, and by Pennsylvania Avenue via one entry in the northeastern corner of the site. Refer to Attachment 01 for the proposed project site plan.

The project site is bound on the north by the Pennsylvania Avenue right-of way, on the west by Tennessee Street and Interstate 210 (I-210), on the south and east by vacant land. Existing residential and commercial uses are located approximately 880 feet east of the site (across Karon Street) and 600 feet south of the project site (across Lugonia Avenue), respectively; however, the vacant lands to the east and south of the site are planned for residential (Lugonia Village project) and commercial (Tennessee and Lugonia Shopping Center project) development. The project site is located adjacent to the I-210 and approximately 0.4 miles north of I-10. The nearest airport, San Bernardino International Airport, is approximately 2.1 miles northwest of the project site and the nearest school, Citrus Valley High School, is located approximately 0.5 miles north of the project site. The nearest park, Texonia Park, is located approximately 0.3 miles east of the project site, along Texas Street.

The proposed project would involve site preparation, grading, new building construction, paving, and architectural coating. Construction activities are assumed to begin as early as 2024 and last approximately 18 months. The proposed project's construction schedule and anticipated equipment usage is listed in Table 1.

Table 1: Tennessee Village Project Construction Activities

Construction Phase	Duration (Days)	Typical Equipment Used
Site Preparation	10	Dozer, Tractor
Grading	30	Excavator, Grader, Dozer, Scraper, Tractor
Building Construction	261	Crane, Forklift, Backhoe, Generator, Welder
Paving	20	Paver, Roller, Paving Equipment
Architectural Coating	45	Air Compressor

The project is expected to be operational in 2026. Once operational, the proposed project would operate as a mixed-use residential and commercial land use. These uses would be similar to the area's existing land uses, such as residential uses to the east and northeast of the project site and commercial uses to the south and west of the project site.

The following sections describe the ambient noise environment near the proposed project and evaluate the proposed project's potential to impact the existing noise environment near the project. Please refer to Attachment 02 for background information on environmental noise and vibration, including commonly used terminology.

EXISTING NOISE ENVIRONMENT

The proposed project is located in northern Redlands, in an area classified and designated as Special Development District and as Commercial by the city's Zoning Code and General Plan, respectively. The city's General Plan identifies transportation corridors as noise sources that are of particular attention to the city and states that future residential development will need to meet land use compatibility and noise standards (city of Redlands, 2017).

Existing ambient noise levels in the project area were monitored on December 12, 2023 (MIG, 2023; see Attachment 03). Noise levels were measured with two Larson Davis Model LxT, Type 1, sound level meters and one Piccolo II, Type 2 sound level meter. The meters' receiving microphones were set at a high of roughly five feet above ground level to approximate a human receptor. Noise monitoring was conducted in one-minute intervals. Conditions during the monitoring were partly cloudy with temperatures ranging from the high 50s to the low 70s, with light, approximately five (5) mile per hour (mph) winds.

Three (3) short-term measurements were conducted to determine typical ambient noise levels in the vicinity of the project area, provide direct observations of existing noise sources at and in the vicinity of the project area, and evaluate project noise levels at nearby sensitive receptors. The three monitoring locations are described below and shown in Figure 1.

- Location ST-1 was at the central eastern portion of the project site, approximately 62 feet east of the centerline of Tennessee Street and approximately 930 feet north of the centerline of Lugonia Avenue.
- Location ST-2 was at the south central portion of the project site, approximately 435 feet east of the centerline of Tennessee Street and approximately 800 feet north of the centerline of Lugonia Avenue.

- Location ST-3 was at the central eastern of the project site, approximately 695 feet east of the centerline of Tennessee Street and approximately 980 feet north of the centerline of Lugonia Avenue.

Figure 1: Ambient Noise Monitoring Locations

Based on observations made during the ambient noise monitoring, the existing noise environment in the project vicinity consists primarily of vehicles on Tennessee Street and I-210. Table 2 summarizes the results of the ambient noise monitoring. Refer to Attachment 03 for detailed ambient noise monitoring results.

Table 2: Measured Short-Term Ambient Noise Levels (dBA)

Monitor	Duration	Measured Noise Level		
		L_{eq}	L_{min}	L_{max}
ST-1	4 hours	70.3	61.7	96.2
ST-2	3.5 hours	62.2	57.1	72.4
ST-3	3.75 hours	60.3	54.8	75.0
Source: MIG, 2023 (See Attachment 03)				

As shown in Table 2, measured ambient noise levels were highest along Tennessee Street (ST-1) while noise levels on the interior of the site (ST-2 and ST-3) were much lower. These noise levels indicate traffic noise levels at the site attenuate at rate of approximately 3 decibel per doubling of distance from the roadway centerline.

Noise monitoring was also recently (December 2022) conducted for the Neighborhoods at Lugonia Village Project, which borders the proposed project site to the east (at the southeast corner of the intersection of Karon Street and Pennsylvania Avenue). The results of this recent noise monitoring provide 24-hour data at the existing residential area on Karon Street to the east of the project site, approximately 1,690 feet from the centerline of Tennessee Avenue (LSA, 2023). As shown in Table 3, the measured noise levels at the Lugonia Village project are approximately 10.4 dBA L_{eq} lower than the noise level measured at ST-1. The 24-hour noise level at Karon Street and Pennsylvania Avenue was 62.8 CNEL. Using the difference between the ST-1 site and the LT-1 site, it is expected that the 24-hour noise level along Tennessee Street would be up to 73.2 CNEL.

Table 3 Measured Noise Levels (dBA) and Calculated CNEL

Time	**Duration**	**Measured Noise Level (L_{eq})**		
		ST-1	**Lugonia Village LT-1**	**Difference**
3 PM	1 hour	70.4	60.0	10.4
4 PM	1 hour	69.7	61.3	8.4
5 PM	1 hour	71.0	59.5	11.5
6 PM	1 hour	70.0	58.9	11.1
			Average	10.4

Source: MIG, 2023 (see Attachment 03) and LSA, 2023

NOISE AND VIBRATION ANALYSIS

The proposed project would generate noise during construction and operation of the proposed facilities. The following analysis evaluates if the project would:

- Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of the standards established in:
  - Redlands Municipal Code Section 8.06.070 (Exterior Noise Limits), Section 8.06.080 (Interior Noise Standards), Section 8.06.100 (Residential Air Conditioning Or Air Handling Equipment), or Section 8.06.120 (Exemptions); or
  - The Redlands General Plan Healthy Community Chapter;
- Generate excessive groundborne vibration or groundborne noise levels; or
- Expose people residing or working in the project area to excessive airport-related noise levels.

With regard to item a), the city's Municipal Code and General Plan establish the following standards and policies that would apply to the proposed project's construction and operational noise sources:

- Construction Noise (Redlands Municipal Code Title 8, Health and Safety, Chapter 8.06, Community Noise Control):
  - Section 8.06.090(E) prohibits loading and unloading activities between the hours of 10 PM and 6 AM in such a manner as to cause a noise disturbance across a residential property line or at any time in violation of the Municipal Code's general noise regulation (Section 8.060.030), which prohibits noise that disturbs the peace and quiet of any neighborhood or which causes discomfort or annoyance to a reasonable person of normal sensitivity.

  - Section 8.06.090(F) prohibits the operation of tools or equipment used in construction, drilling, repair, alteration, or demolition work between weekday house of 6 PM and 7 AM, including Saturdays, or at anytime on Sundays or holidays, such that the sound therefrom creates a noise disturbance across a residential or commercial property line, and requires all mobile or stationary internal combustion engine powered equipment or machinery to be equipped with exhaust and air intake silencers in proper working order, or suitable to meet applicable Municipal Code standards.
  - Section 8.06.120(G) exempts construction activity from noise regulations between the hours of 7 AM and 6 PM on Monday through Saturday. Construction shall not occur on Sundays and federal holidays. All motorized equipment used in such activities is required to be equipped with functioning mufflers.
- Construction Noise (Redlands General Plan Healthy Communities Chapter):
  - Policy 9.0w requires limiting hours for all construction or demolition work where site-related noise is audible beyond the site boundary.
- Operational Noise (Redlands Municipal Code Title 8, Health and Safety, Chapter 8.06, Community Noise Control):
  - Section 8.060.070 (Exterior Noise Limits) sets forth the maximum permissible sound level that may be generated by a project at single-family and multi-family residential districts is 60 dBA L_{eq} during the daytime (7 AM to 10 PM) and 50 dBA L_{eq} during the nighttime (10 PM to 7 AM). The maximum permissible sound level that may be generated by a project at commercial district is 66 dBA L_{eq} during the daytime (7 AM to 10 PM) and 60 dBA L_{eq} during the nighttime (10 PM to 7 AM). The Municipal Code also establishes:
    - The noise standard is not to be exceeded for a cumulative period of more than 30 minutes any hour.
    - The exterior noise standard plus five (5) dBA is not to be exceeded for a cumulative period of more than 15 minutes in any hour.
    - The exterior noise standard plus 10 dBA is not to be exceeded for a cumulative period of more than 5 minutes in any hour.
    - The exterior noise standard plus 15 dBA is not to be exceeded for a cumulative period of more than one (1) minute in any hour.
    - The exterior noise standard plus 20 dBA, or the maximum measured ambient noise level, is not to be exceed at any period of time.
  - Section 8.060.080 (Interior Noise Limits) sets forth the maximum permissible sound level that may be generated by a project at single-family and multi-family residential districts is 45 dBA L_{eq} at any time. The Municipal Code also establishes:
    - The interior noise standard is not to be exceed for a cumulative period of more than five (5) minutes any hour.
    - The interior noise standard plus five (5) dBA is not to be exceeded for a cumulative period of more than one (1) minute in any hour.
    - The interior noise standard plus 10 dBA or the maximum measured ambient noise level, is not to be exceeded at any time.
  - Section 8.060.100 (Residential Air Conditioning or Air Handling Equipment) specifically identifies that it is unlawful to operate or permit the operation of any air

conditioning or air handling equipment in such a manner as to exceed the exterior noise standards set forth in Municipal Code Section 8.06.070 (see above).

- Operational Noise (Redlands General Plan Healthy Communities Chapter):
  - Policy 9.0s requires mitigation to ensure that indoor noise levels for residential living spaces do not exceed 45 dBA CNEL due to the combined effect of all exterior noise sources.
  - Policy 9.0v considers the following increases in noise levels to be possibly significant:
    - An increase in exposure of four (4) dB or more if the resulting noise level would exceed that described as clearly compatible for the affected land use as established in General Plan Table 7-10 and Table 7-11.
    - Any increase of six (6) dB or more due to the potential for adverse community response.

With regard to item b), the city's Municipal Code establishes the following standards that would apply to the proposed project's potential vibration sources:

- Groundborne Vibration and Noise (Redlands Municipal Code):
  - Section 8.06.090(G) prohibits the operating or permitting the operation of device that creates a vibration which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property or at one hundred fifty feet (150') from the source if on a public space or public right of way. Municipal Code Section 8.06.020 defines the vibration perception threshold of 0.01 inches/second peak particle velocity (PPV).

Increases in Ambient Noise Levels in Excess of Applicable Standards

Project Construction

The proposed project involves construction activities including site preparation, grading, building construction, paving and architectural coating on an undeveloped parcel in an existing residential area of the city. Construction activities are anticipated to begin in 2024 and may last approximately 18 months in total.

In general, construction activities would involve the use of worker vehicles, delivery trucks, dump trucks, and heavy-duty construction equipment such as (but not limited to) dozers, backhoes, tractors, loaders, graders, excavators, scrapers, welders, rollers, cranes, material lifts, generators, pavers, paving equipment, and air compressors. These types of construction activities would generate noise and vibration from the following sources:

- Heavy equipment operations at different work areas. Some heavy equipment would consist of mobile equipment such as a loader and excavator that would move around work areas; other equipment would consist of stationary equipment (e.g., cranes or material hoists/lifts) that would generally operate in a fixed location until work activities are complete. Heavy equipment generates noise from engine operation, mechanical systems, and components (e.g., fans, gears, propulsion of wheels or tracks), and other sources such as back-up alarms. Mobile equipment generally operates at different loads, or power outputs, and produces higher or lower noise levels depending on the operating load. Stationary equipment generally operates at a steady power output that produces a constant noise level.
- Vehicle trips, including worker, vendor, and haul truck trips. These trips are likely to primarily occur on Lugonia Avenue and Tennessee Street.

Typical construction equipment noise levels at different distances are shown in Table 4.

Table 4: Potential Project Construction Equipment Noise Levels

Typical Equipment	**Noise Level at 50 feet (L_{max})(A)**	**Percent Usage Factor(B)**	**Predicted Equipment Noise Levels (L_{eq})(C)**						
			25 Feet	**50 Feet**	**100 Feet**	**200 Feet**	**300 Feet**	**425 Feet**	**850 Feet**
Air Compressor	80	40	82	76	70	64	56	57	44
Bulldozer	85	40	87	81	75	69	65	62	56
Backhoe	80	40	82	76	70	64	56	57	51
Compact Roller	80	20	79	73	67	61	57	54	48
Concrete Mixer	85	40	87	81	75	69	65	57	56
Crane	85	16	83	77	71	65	61	58	52
Delivery Truck	85	40	87	81	75	69	65	57	56
Excavator	85	40	87	81	75	69	65	57	56
Grader	85	40	87	81	75	69	65	57	56
Generator	82	50	85	79	73	67	66	60	54
Paver	85	50	88	82	76	70	66	63	57
Pneumatic Tools	85	50	88	82	76	70	66	63	57
Tractor	84	40	86	80	74	68	64	61	55
Scraper	85	40	87	81	75	69	65	62	56
Welder	73	40	75	69	63	57	53	50	44

Sources: Caltrans, 2013 and FTA, 2010.

(A) L_{max} noise levels based on manufacturer's specifications.

(B) Usage factor refers to the amount (percent) of time the equipment produces noise over the time period.

(C) Estimate does not account for any atmospheric or ground attenuation factors. Calculated noise levels based on Caltrans, 2013: L_{eq} (hourly) = L_{max} at 50 feet – 20log (D/50) + 10log (UF), where: L_{max} = reference L_{max} from manufacturer or other source; D = distance of interest; UF = usage fraction or fraction of time period of interest equipment is in use.

With regard to construction noise, site preparation and grading phases typically result in the highest temporary noise levels due to the use of heavy-duty equipment such as dozers, excavators, graders, tractors, scrapers, and trucks. Construction noise impacts generally occur when construction activities occur in areas immediately adjoining noise sensitive land uses, during noise sensitive times of the day, or when construction durations last over extended periods of time.

The proposed project would have a limited potential to result in construction noise impacts at existing sensitive receptor locations because the closest residential properties are located approximately 880 feet north of the project boundary. As shown in Table 4, typical construction noise levels would not exceed 57 dBA L_{eq} at a distance of approximately 850 feet. Thus, the proposed project's potential construction noise levels would be less than the measured ambient levels along Karon Avenue in December 2022 (see Table 3) and would not result in a significant impact at existing sensitive receptor locations on Karon Avenue. In addition, the proposed project would be required to comply with all applicable Municipal Code requirements pertaining to the control of construction noise, including Section 8.06.090(F) and 8.06.120(G), which limits construction activities to the hours of 7 AM to 6 PM, Monday through Saturday, with no activities taking place on Sunday or holidays and requires all equipment to include air intake silencers and exhaust mufflers in good work order. These mandatory requirements would further reduce the project's less than significant construction noise levels.

As explained above, the vacant land that borders the proposed project to the east (between the proposed project's eastern boundary and Karon Avenue) is the site of the planned Lugonia Village residential project and subdivision, which would consist of 451 apartment units, 72 townhomes, and 18 single-family detached homes on approximately 24.4 acres of land. The Lugonia Village project is anticipated to begin construction by June 2025 and complete construction by January 2028 (LSA, 2023, Table B). Based on this published schedule, the Lugonia Village project would result in adjacent sensitive residential receptors no sooner than January 2028. In contrast, the proposed project is anticipated to be constructed over an 18-month period beginning in 2024 and concluding, at latest (i.e., assuming construction begins in December 2024), by May 2026. Thus, the proposed project's construction activities would be complete before the Lugonia Village project is occupied. The proposed project, therefore, would not have the potential to impact future receptors at the Lugonia Village project.

It is noted that, based on their respective schedules, the proposed project's construction activities would combine with the Lugonia Village project's construction activities to result in a cumulative noise impact to existing sensitive receptors on Karon Avenue. Specifically, it could be possible for the proposed project's building construction, paving, and architectural coating phases to overlap with grading and other activities associated with the Lugonia Village project. If this were to occur, the proposed project would not result in a cumulatively considerable contribution to total construction noise levels on Karon Avenue because the proposed project's work activities would be located more than 850 feet from Karon Avenue and result in substantially lower noise levels than heavy equipment operations in the Lugonia Village project area that would be occurring much closer to Karon Avenue receptors.

Finally, based on their respective schedules, the proposed project may be occupied by sensitive residential receptors prior to the completion of Lugonia Village construction activities. Specifically, Lugonia Village building construction, paving, and architectural coating activities may still be occurring after May 2026, when the proposed project would be occupied. The Initial Study / Mitigated Negative Declaration (IS/MND) prepared for the Lugonia Village project included standard conditions requiring Lugonia Village construction activities to occur in accordance with the Municipal Code's allowable time periods and all construction equipment to be equipped with exhaust and air intake silencers in good working order. With implementation of these conditions, the IS/MND concluded Lugonia Village noise impacts on adjacent sensitive receptors would be less than significant.

In conclusion, the proposed project's construction activities would occur more than 850 feet away from existing sensitive receptors and would not result in significant construction noise levels at existing sensitive receptor locations. The proposed project also would not have the potential to impact future receptors in the Lugonia Village project because the Lugonia Village project is anticipated to be occupied after the proposed project is constructed. Regardless of the timing of the Lugonia Village project, the proposed project's construction activities would occur in compliance with Municipal Code limits on allowable work hours and requirements for intake and exhaust mufflers. The proposed project's construction noise levels, therefore, would be less than significant.

Project Operation (On-Site Noise Sources)

The proposed project would generate noise from human activity (e.g., use of open space areas), vehicle parking activities, garbage collection activities, landscaping activities, stationary heating, ventilation, and air conditioning (HVAC) equipment, and other residential and commercial activities (e.g., building maintenance). These new sources of noise could be audible at adjacent properties; however, the project would have a limited potential to generate significant on-site noise levels or substantially change overall noise levels in the vicinity of the project for the following reasons:

- Residential uses: Residential land uses, including high density and mixed-use residential development, are a not a substantial source of noise because:
    - Buildings and equipment are setback from front, side, and rear property lines;
    - Mechanical equipment associated with elevators, amenities (e.g., pools,) are typically enclosed within closets, sheds, or equipment rooms;
    - Heating, ventilation, and air conditioning (HVAC) equipment is typically roof mounted behind a parapet wall or screened from public view by landscaping, fences, or walls and, therefore, shielded from adjacent property lines; and
    - Residential activities are subject to the Municipal Code requirements that control and abate unnecessary, excessive, or annoying noise, including . . . .
    - Pursuant to Assembly Bill 1307, for residential projects, the effects of noise generated by project occupants and their guests on human beings is not a significant effect on the environment for the purposes of CEQA.
- Commercial uses: Ground level commercial uses would be located in the southwest corner of the project (in Building 8 and Building 10). The commercial space is intended to create a walkable environment for residents to have easy access to goods and services, as well as access to the potential commercial development to the south of the project area (between the proposed project's southern boundary and Lugonia Avenue). The commercial area would, at closest, be more than 1,300 feet away from existing sensitive receptors on Karon Avenue, and more than 450 feet away from future sensitive receptors associated with the Lugonia Village project to the east (between the proposed project's eastern boundary and Karon Avenue). In addition, residential buildings 3, 6, 7, and 9 would serve to partially or fully shield ground-level potential commercial noise from sensitive, off-site receptors to the east. Finally, the proposed project's commercial uses do not include intensive operations or features that could generate elevated exterior noise levels, such as drive-throughs with speaker boxes. The commercial area would include a gated loading dock that would be located at least 75 feet from any residential building façade and the loading dock would operate in accordance with Municipal Code Section 8.06.090(E), which prohibits loading and unloading activities between the hours of 10 PM and 6 AM or at any time in violation of the Municipal Code's general noise regulation contained in Section 8.06.030.
- Project layout: The proposed project layout generally places the housing units around the perimeter of the site, which would shield adjacent properties from noise originating on-site. For example, the courtyards would be shielded from existing and future residences to the east by the proposed project's residential buildings. Indoor common space such as the fitness center and club room would also be shielded from receptors by the project's residential buildings. The roof deck, which is located near the center of the site, would be located over 400 feet from the nearest sensitive receptors and would not generate substantial noise levels at shared property lines.

Once constructed, the proposed project's primary on-site stationary noise source would be HVAC equipment, which would be located on the roof of the project's three- and four-story buildings, at least 30 or 40 feet above the ground, respectively. HVAC units would be located on a platform in the center of each building (or building wing), with approximately one unit per tenant. Although the exact make and model of the HVAC units are unknown at this time, the type of HVAC unit anticipated to be installed is a small fan-type residential unit capable of generating noise levels between 70 and 76 dBA at a distance of three (3) feet, depending on the type of model installed (Carrier, 2021). A parapet wall would shield the HVAC units from adjacent property lines and increase the effective distance equipment noise must travel to reach the property line. Each building's parapet wall would provide a different level of HVAC noise attenuation due to differences in distance between the HVAC platform and the parapet wall and the parapet wall and the adjacent property line, as well as differences in receiver, source (i.e., HVAC), and top of wall elevations. For the purposes of this analysis, only HVAC equipment noise associated with perimeter buildings adjacent to shared property lines was estimated. The proposed project's estimated HVAC unit noise levels with distance and barrier attenuation are provided in Table 5 (residential property lines) and Table 6 (commercial property lines). Refer to Attachment 04 for detailed HVAC noise level estimates.

Table 5: Potential HVAC System Noise Levels at Residential Property Lines

HVAC System Variable	**Building 2**	**Building 3**	**Building 7**
Reference HVAC Noise Level at 3 Feet	76.0 dBA L_{eq}	76.0 dBA	76.0 dBA
Distance to Residential Property Line$^{(A)}$	200 Feet	90 Feet	240 Feet
Number of HVAC Units Operating	42	32	20
Estimated Total Noise Level	42.8	50.0	43.6
Residential Daytime Standard (7 AM – 10 PM)	60 dBA L_{eq}	60 dBA L_{eq}	60 dBA L_{eq}
Residential Nighttime Standard (10 PM – 7 AM)	50 dBA L_{eq}	50 dBA L_{eq}	50 dBA L_{eq}
Standards Exceeded?	No	No	No

Source: MIG (see Attachment 04)

(A) Distance is as measured from the center of the HVAC platform to the closest point on the property line.
(B) Total noise level includes attenuation with distance and shielding by parapet wall.

Table 6: Potential HVAC System Noise Levels at Commercial Property Lines

HVAC System Variable	**Building 7**	**Building 8**	**Building 10**
Reference HVAC Noise Level at 3 Feet	76.0 dBA L_{eq}	76.0 dBA	76.0 dBA
Distance to Residential Property Line$^{(A)}$	45 Feet	30 Feet	50Feet
Number of HVAC Units Operating	20	16	24
Estimated Total Noise Level	51.3	52.5	46.9
Residential Daytime Standard (7 AM – 10 PM)	65 dBA L_{eq}	65 dBA L_{eq}	65 dBA L_{eq}
Residential Nighttime Standard (10 PM – 7 AM)	60 dBA L_{eq}	60 dBA L_{eq}	60 dBA L_{eq}
Standards Exceeded?	No	No	No

Source: MIG (see Attachment 04)

(A) Distance is as measured from the center of the HVAC platform to the closest point on the property line.
(B) Total noise level includes attenuation with distance and shielding by parapet wall.

As shown in Table 5 and Table 6, the proposed project's potential HVAC noise levels would not exceed the city's daytime or nighttime noise standards for residential or commercial districts. The HVAC estimates provided in Table 5 and Table 6 are considered conservative (i.e., likely to overestimate potential noise levels) because the estimated noise levels assume all HVAC units in a given area are operating at the same time, for a full 30 minutes. In actuality, this condition is unlikely to occur. Although estimated HVAC noise levels would not exceed a city standard, Building 3 HVAC noise levels would be equal to the Municipal Code's residential nighttime standard of 50 dBA L_{eq}. To allow for potential small differences in assumed and final setback distances and building elevations, MIG recommends Mitigation Measure NOI-1 be incorporated into the project to ensure Building 3 HVAC noise levels do not exceed the city's nighttime noise standard of 50 dBA L_{eq}.

Mitigation Measure NOI-1: Reduce Potential Building 3 HVAC Noise Levels

To reduce potential noise levels from Building 3 heating, ventilation, and air conditioning (HVAC) equipment, the city shall:

1) Prohibit the installation of HVAC units or systems that generate a noise level greater than 75 dBA (at 3 feet) for units located within 90 lateral feet of the project's eastern property line; or
2) Require the project design the parapet wall for any building with an HVAC unit or system within 90 feet of the project's eastern property line to be at least 1 foot taller than the top of the tallest installed HVAC unit.

The implementation of Mitigation Measure NOI-1 would provide a minimum of 1 dBA of additional HVAC noise attenuation along the shared eastern property line and ensure that HVAC noise levels would not exceed the city's 50 dBA L_{eq} exterior nighttime noise standard, nor any other exterior noise standard (e.g., the city's 60 dBA L_{eq} daytime standard for residential properties).

The project also would not have the potential to result in noise levels that exceed the city's maximum permissible interior noise limit of 45 dBA L_{eq} for residential properties. Noise levels inside existing residential buildings would be approximately 12 dBA to 30 dBA lower than estimated exterior noise levels, depending on whether windows and doors were open or closed. Thus, potential HVAC-related interior noise levels at existing residential receptors adjacent to the project would be less than 40 dBA L_{eq} even with windows open, which is less than the city's 45 dBA L_{eq} interior noise standard.

Finally, it is noted that HVAC equipment does not operate continuously and would not affect ambient noise levels when the equipment is not in use. For these reasons, potential HVAC equipment would not generate noise levels that have the potential to exceed the 45 dBA CNEL interior noise standard established by General Plan Policy 9.0s. Furthermore, with Mitigation Measure NOI-1, potential HVAC noise is estimated to be less than 50.0 dBA L_{eq} when in operation, which is approximately 10 dBA less than the CNEL measured on Karon Avenue for the Lugonia Village project (see Table 3 and related discussion of existing ambient noise levels above). The proposed project, therefore, would not substantially change noise levels in the vicinity of the project, result in incompatible noise levels at sensitive receptor locations, or otherwise result in a substantial permanent increase in ambient noise levels in the vicinity of the project (considered by General Plan Policy 9.0v to be 4 dBA if a land use compatibility threshold is exceeded or 6 dBA in any situation).

As described above, the proposed project would not result in a substantial permanent increase in ambient noise levels in the vicinity of the project in excess of city standards with the incorporation of Mitigation Measure NOI-1. This impact would be less than significant with mitigation.

Project Operation (Off-Site Vehicle Trip Noise)

The Transportation Study Screening Analysis prepared for the proposed project indicates the project would result in a net increase of 2,704 daily vehicle trips (Translutions, 2023). Currently, there are approximately 5,058 passenger car equivalent (PCE) trips per day at the intersection of SR-210 West Bound Ramps and Tennessee Street, 4,828 PCE per day at the intersection of

SR-210 East Bound Ramps and San Bernardino Avenue, 6,186 PCE trips per day at the intersection of Tennessee Street and Lugonia Avenue, and 4,162 PCE trips per day at the intersection of Tennessee Street and I-10 West Bound ramps, and 5,174 PCE trips per day at the intersection of Tennessee Street and I-10 East Bound ramps (Translutions, 2023). In general, it takes a doubling of traffic to increase traffic noise volumes by 3 dBA, which is considered an audible increase for exterior noise environments by the city's General Plan (Caltrans, 2013 and city of Redlands, 2017). The addition of 2,704 passenger cars to the roadway system would not result in a doubling of traffic on any roadway segment at or in the vicinity of the project site and, therefore, would result in a less than 3 dBA increase in noise levels on local roads used to access the project site. The proposed project would not result in a substantial, permanent increase in noise levels along the roadways used to access the proposed project as compared to existing or future conditions. This impact would be less than significant.

Groundborne Vibration

Construction vibration impacts generally occur when construction activities occur in close proximity to buildings and vibration-sensitive areas, during evening or nighttime hours, or when construction activities last extended periods of time. The potential for groundborne vibration is typically greatest when vibratory or large equipment such as rollers or bulldozers are operated adjacent to or in proximity of occupied buildings and structures. For the proposed project, large equipment would primarily operate during the site preparation, grading, and paving phases; however, the proposed project is currently bordered by vacant land on the east and south, with the closest existing structures being residences located 880 feet east of the project. The proposed project, therefore, does not have the potential to result in excessive groundborne vibrations at existing structures. In addition, as described above, the planned Lugonia Village residential project and subdivision is anticipated to begin construction by June 2025 and complete construction by January 2028 (LSA, 2023, Table B). In contrast, the proposed project is anticipated to be constructed over an 18-month period beginning in 2024 and concluding, at latest (i.e., assuming construction begins in December 2024), by May 2026. Thus, the proposed project's site preparation, grading, and paving activities would be complete before the Lugonia Village project is constructed and occupied. The proposed project, therefore, would not have the potential to result in ground-borne vibrations during construction that could impact existing or future off-site receptors or structures. This impact would be less than significant impact.

Once operational, the proposed project would consist of a mix of residential and commercial uses that would not involve any large equipment or other operations that would generate excessive groundborne vibration levels. This impact would be less than significant.

Airport-Related Noise

The proposed project is located approximately 2.3 miles southeast of the San Bernardino International Airport. The project site is located outside of the 65 CNEL noise contour for the San Bernardino International Airport and is not located within any other airport planning boundary (SBIAA, 2019; city of Redlands, 2003). The proposed project, therefore, would not expose people living or working at the site to excessive airport-related noise levels.

Other Planning Considerations (Noise / Land Use Compatibility)

The California Supreme Court in *California Building Industry Association v. Bay Area Air Quality Management District*, 62 Cal.4th 369 (2015) ruled that CEQA review is focused on a project's impact on the environment "and not the environment's impact on the project." Per this ruling, a Lead Agency is not required to analyze how existing conditions might impact a project's existing or future population except where specifically required by CEQA; however, a Lead Agency may elect to disclose information relevant to a project even if it not is considered an impact under CEQA. Furthermore, the city's General Plan sets noise standards for receiving land uses which require evaluation for consistency and compliance even if such evaluation is not required by CEQA to be identified as a physical impact of the project. Specifically, General Plan Table 7-10 establishes that the clearly compatible and normally incompatible noise levels for commercial mixed uses with residential units are 75 CNEL and 85 CNEL, respectively, while General Plan Table 7-11 establishes 60 CNEL and 45 CNEL as the exterior and interior noise standard for multi-family residential uses, respectively, with the 60 CNEL exterior standard only applicable to private patios and balconies that are served by a means of exit from inside (i.e., provide egress from the dwelling unit to areas outside the dwelling unit balcony).

<u>Exterior Noise Exposure</u>

As described above, traffic noise modeling conducted for the city's General Plan indicates existing exterior ambient noise levels along the segments of Tennessee Street and the I-210 adjacent to the proposed project site are 67.0 and 82.5 CNEL (at a distance of 50 feet from the centerline of the outermost travel lane), respectively, and will increase to 70.2 CNEL and 83.7 CNEL by 2035. The ambient noise monitoring conducted at the project site approximately 200 feet from the outermost lane of the I-210 recorded noise levels (73.2 CNEL) is consistent with the General Plan's existing traffic noise level estimate of 82.5 CNEL at 50 feet (which attenuates to 73.5 CNEL at 200 feet, assuming 4.5 dBA of attenuation per doubling of distance), but higher than Tennessee Street noise levels. This indicates the I-210 is the predominant contributor to the ambient noise environment at the project site, and that future noise levels at the project site may change as I-210 traffic noise changes (i.e., may increase by approximately 1.2 CNEL by 2035).

The proposed project property line is approximately 52 feet and 200 feet from the centerline of the outermost lane of Tennessee Street and I-210, respectively. At these distances, the total combined exterior noise levels at the project property line fronting Tennessee Street could be up to approximately 74.3 CNEL under existing conditions and 75.9 CNEL in 2035, respectively. The proposed project includes an approximately 25- to 35-foot landscaped area adjacent to Tennessee Street that is not considered private or common open space that would not be occupied or used by project residents. Therefore, existing and future noise levels in this area are considered compatible for the proposed project.

The nearest building façade (associated with exterior walls of Buildings 10 and 11) would be at least approximately 85 feet from the centerline of Tennessee Street and 225 feet from the centerline of the outermost lane of I-210. This building façade would include windows, Juliet balconies (not accessible private open space), and private ground floor patios and upper-level balconies in unit types A3 (100 square foot patio/balcony), B4 (71 square foot patio/balcony), and B5 (77 square foot patio/balcony). The balconies would be accessible from individual units but would not provide a means of egress from the unit itself. Based on the above distances, the exterior noise levels at the exterior building façade (and private patio/balcony areas) on Tennessee Street could be up to approximately 73.3 CNEL under existing conditions and 74.7 CNEL in 2035, respectively. These values do not exceed the city's clearly compatible 75 CNEL noise level for commercial mixed-uses with residential units. In addition, since individual balconies would not provide a means of exit from dwelling units to areas outside the property, the city's 60 CNEL exterior standard for residential uses does not apply to the project. Therefore, existing and future noise levels at private patios and balconies are considered compatible for the proposed project.

The proposed project also includes other private and common outdoor open space areas, such as courtyards, pool areas, private patios and balconies, and small roof decks. These open space areas would be on the interior of the site, at least 210 feet and 350 feet or more from the centerline of the outermost lane of Tennessee Street and the I-210. These areas would also be located behind one or more of the project's three- and four-story buildings, and thus either partially or fully shielded from traffic noise emanating from Tennessee Street and the I-210. With distance and shielding, exterior noise levels in the center and eastern part of the project area are estimated to be less than 60 CNEL, which is below the city's clearly compatible 75 CNEL noise level for commercial mixed uses with residential units and 60 CNEL standard for residential uses.

As described above, the proposed project would be compatible with the city General Plan guidelines and standards. Exterior noise exposure is an effect of the environment on the project. In *California Building Industry Association v. Bay Area Air Quality Management District* 62 Cal.4th 369 (2015), the Supreme Court ruled that the environment's impact on a project is not an impact under CEQA, and the proposed project would not result in on- or off-site noise levels that would substantially exacerbate noise exposure conditions.

Interior Noise Compatibility

The California Building Standards Code establishes that interior noise levels attributable to exterior noise sources shall not exceed 45 DNL or CNEL (as established by the local General Plan) for residential developments. As described above, daily noise exposure levels at the exterior façade and patio/balcony areas of Building 10 and Building 11 could be exposed to noise levels up to 74.7 CNEL by 2035. These units would require enhanced noise attenuation features to ensure interior noise levels do not exceed 45 CNEL. In general, any unit with an exterior wall located less than 300 feet from the center of the outermost lane of Tennessee Street (equal to 438 feet from the outermost lane of the I-210) could be exposed to façade noise levels above 70 CNEL and would require enhanced interior noise attenuation measures.

Typical building construction provides an exterior-to-interior noise reduction of approximately 12 dBA with windows open and approximately 25 dBA with windows closed. [1] For this study, typical standard construction techniques include a basic framed wall with an STC rating of 39, consisting of 5/8" siding, ½" insulation board sheathing, 2"x4" studs spaced every 16", standard fiberglass insulation, and ½" drywall; windows and doors are rated STC 27 and occupy no more than 50% of the exterior wall area. Exterior stucco walls, such as that included in the proposed project, provide greater exterior to noise attenuation (approximately 27 to 30 dBA with windows closed) provided window and door coverings also do not exceed 50% of the exterior wall surface (which is the case for the proposed project). Cracks and openings in window and door assemblies can reduce exterior to interior noise attenuation. Mechanical ventilation must also be provided to allow for use of residential areas with windows closed.

The CALGreen Code establishes additional standards for interior noise levels that may apply to residential developments if a building is located within a 65 CNEL noise contour of an airport, freeway, railroad, industrial source, etc. or otherwise exposed to a noise level of 65 dBA on an

---

[1] The U.S. Department of Housing and Urban Development (HUD) Noise Guidebook and supplement (2009a, 2009b) includes information on noise attenuation provided by building materials and different construction techniques. As a reference, a standard exterior wall consisting of 5/8-inch siding, wall sheathing, fiberglass insulation, two by four wall studs on 16-inch centers, and 1/2-inch gypsum wall board with single strength windows provides approximately 35 dBs of attenuation between exterior and interior noise levels. Increasing window space may also decrease attenuation, with a reduction of 10 dBs possible if windows occupy 30% of the exterior wall façade.

hourly L_{eq} basis. As summarized above, the noise exposure levels at the exterior façade of Building 10 and Building 11 could be exposed to noise levels up to 74.7 CNEL by 2035. The proposed project, therefore, would be subject to the prescriptive or performance standard requirements of the CALGreen Code, which requires that exterior wall and roof-ceiling assemblies exposed to the noise source meet specific sound transmission class (STC) or outdoor-indoor transmission class (OITC) ratings. The STC and OITC exterior wall and roof assembly requirements set forth by the CALGreen Code generally require the assembly to have an STC of 40 or an OITC of 30, which would be sufficient to meet the interior noise standard of 45 CNEL; however, the final exterior assemblies would need to be reviewed and confirmed.

MIG recommends the project implement the following BMPs to reduce interior noise levels in residential dwelling units:

Interior Noise Control BMPs

To reduce residential unit interior noise levels to 45 CNEL or less, the project shall incorporate the following interior noise control measures into the project design:

1) **Provide mechanical ventilation.** All units shall include forced air mechanical ventilation to permit occupancy of units with windows closed.
2) **Window and sliding door sound transmission class (STC) ratings.** To ensure exterior wall assemblies provide adequate exterior to interior noise reduction:
    a. All windows and doors (including sliding doors) included in exterior residential wall assemblies directly facing Tennessee Street and the I-210 shall have a minimum STC rating of 40.
    b. All other windows and doors (including sliding doors) included in exterior residential wall assemblies with a line of sight to and within 300 feet of the center of the outermost lane of Tennessee Street shall have a minimum STC rating of 30.
    c. Window and door treatments for all units within 300 feet of the center of the outermost lane of Tennessee Street shall not exceed 50% of the wall surface area.
3) **Window and door assemblies.** Solid core doors shall be used in all non-sliding exterior door designs. All window and door assemblies (including sliding doors) shall be well-fitted, sealed, and weather-stripped. Window and door assemblies (perimeter of assembly, any gaps during assembly installation) shall be sealed with an acoustical caulk/sealant to reduce noise transmission.
4) **Prepare final acoustical analysis.** The project shall prepare a final acoustical analysis demonstrating the final exterior wall assembly for all residential units within 300 feet of the centerline of the outermost lane of Tennessee Street provides exterior-to-interior noise reduction that achieves an interior noise level of 45 CNEL and complies with CALGreen Code requirements for residential units exposed to noise levels above 65 CNEL.

The implementation of the interior noise control BMPs above would require the project to verify the final design of exterior residential wall assemblies reduces interior noise to levels 45 CNEL or less and meets CALGreen Code noise standards.

CONCLUSION

As described in this memo, the proposed project would not generate temporary or permanent noise levels that would exceed the city's standards or otherwise result in a substantial increase in ambient noise levels, would not generate excessive groundborne vibration or groundborne noise levels, and would not expose people residing or working in the project area to excessive aircraft noise levels. The proposed project, therefore, would not result in a substantial, adverse noise-related effect on the environment. It is noted the proposed project may be subjected to incompatible exterior and interior noise levels, which is not a CEQA impact. Accordingly, MIG recommends the proposed project prepare and submit to the city a final acoustical analysis that documents, based on the final project design, compliance with the city's interior noise limits.

REFERENCES

The following references were used to prepare this memorandum:

AO Architects, 2023. Tennessee Village Design Review Submittal. October 10, 2023.

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

_______2020. Transportation and Construction Vibration Guidance Manual. Sacramento, California. April 2020.

City of Redlands, 2003. Redlands Municipal Airport Land Use Compatibility Plan. May 6, 2003. https://raacp.org/wp-content/uploads/2016/07/Redlands-Airport-Land-Use-Compatibility-Plan.pdf

______2017. General Plan 2035. Adopted December 5, 2017. Available online at: https://www.cityofredlands.org/post/planning-division-general-plan

LSA, 2023. The Neighborhoods at Lugonia Village Project. Appendix G-1 Noise Survey Sheets. December 6, 2023. https://ceqanet.opr.ca.gov/2023120124

San Bernardino International Airport Authority (SBIAA). 2019. Final Environmental Assessment Eastgate Air Cargo Facility. December 2019.

Translutions 2023. Tennessee Street and Lugonia Avenue Mixed-Use Measure U Growth Management Analysis. October 12, 2023.

U.S. Federal Transit Administration (FTA) 2018. *Transit Noise and Vibration Impact Assessment Manual*. FTA Report No. 0123. Prepared by John A. Volpe National Transportation Systems Center. Washington, DC. September 2018.

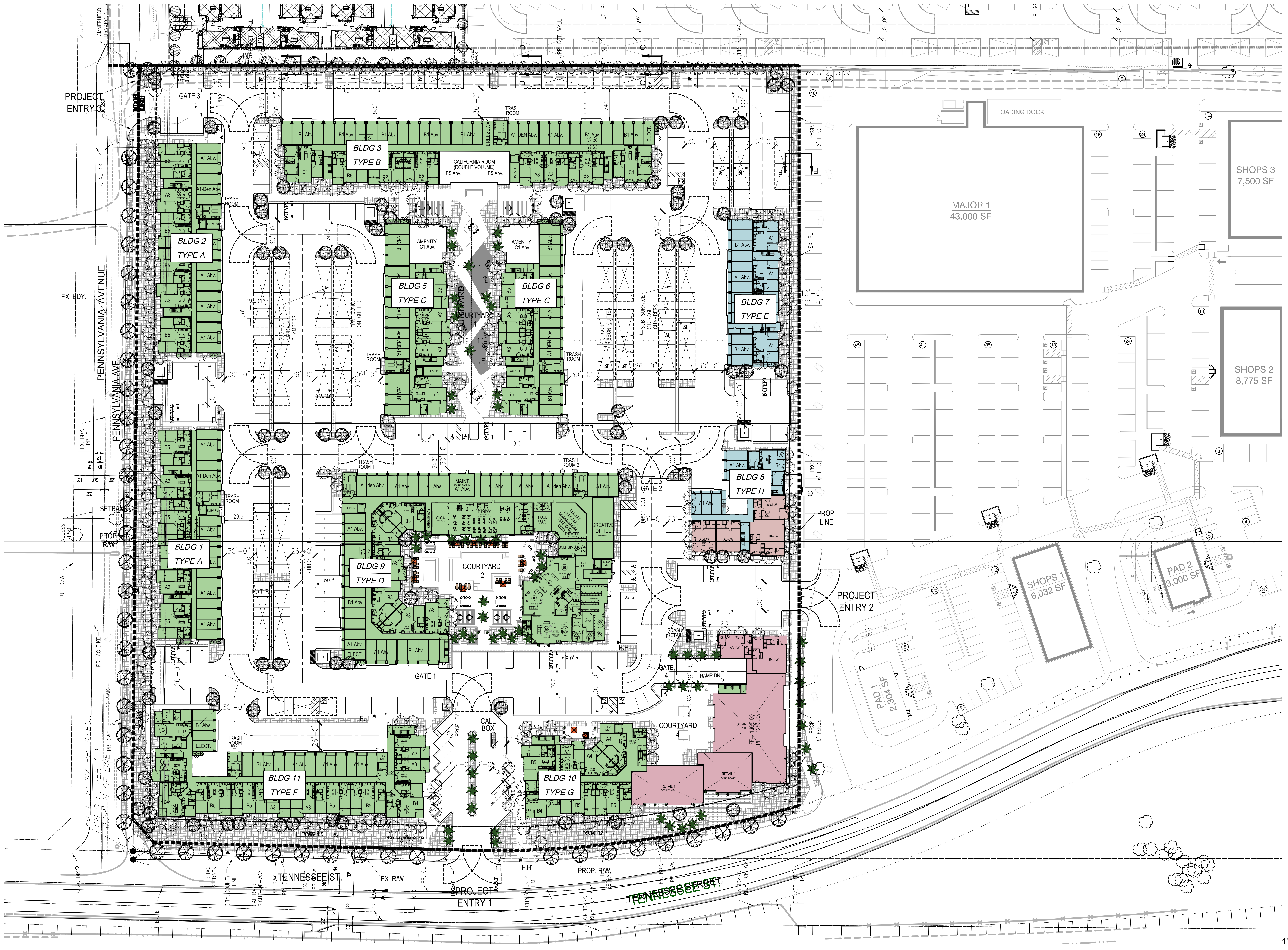
U.S. HUD. 2009a.HUD Noise Guidebook. Prepared by the Environmental Planning Division, Office of Environment and Energy. March 2009.

_______2009b. HUD Noise Guidebook, Chapter 4 Supplement: Sound Transmission Class Guidance. Prepared by the Environmental Planning Division, Office of Environment and Energy. March 2009.

Attachment 01

Project Site Plan

This page was intentionally left blank,



NORTH

1"=40'-0" 0 20' 40' 80' 120'

🟥	RETAIL/ COMMERICIAL
🟦	3 STORY
🟩	4 STORY

APN: 0167-171-07
0167-171-14

A-1.0

TENNESSEE VILLAGE

REDLANDS, CA 92374

CONCEPTUAL SITE PLAN

DATE: 10-10-2023
JOB NO.: 2020-322

DIVERSIFIED PACIFIC
10621 CIVIC CENTER DRIVE, RANCHO CUCAMONGA, CA 91730
(909) 373-2628

AO ARCHITECTS
144 NORTH ORANGE ST., ORANGE, CA 92866
(714) 639-9860

Architecture.
Design.
Relationships.

This page was intentionally left blank.

Attachment 02

Environmental Noise Background

This page was intentionally left blank.

ENVIRONMENTAL NOISE BACKGROUND

Noise may be defined as loud, unpleasant, or unwanted sound. The frequency (pitch), amplitude (intensity or loudness), and duration of noise all contribute to the effect on a listener, or receptor, and whether the receptor perceives the noise as objectionable, disturbing, or annoying.

The Decibel Scale (dB)

The decibel scale (dB) is a unit of measurement that indicates the relative amplitude of a sound. Sound levels in dB are calculated on a logarithmic basis. An increase of 10 dB represents a tenfold increase in acoustic energy, while 20 dBs is 100 times more intense, 30 dBs is 1,000 more intense, and so on. In general, there is a relationship between the subjective noisiness, or loudness of a sound, and its amplitude, or intensity, with each 10 dB increase in sound level perceived as approximately a doubling of loudness. Due to the logarithmic basis, decibels cannot be directly added or subtracted together using common arithmetic operations:

$$50\ decibels + 50\ decibels\ \neq 100\ decibels$$

Instead, the combined sound level from two or more sources must be combined logarithmically. For example, if one noise source produces a sound power level of 50 dBA, two of the same sources would combine to produce 53 dB as shown below.

$$10 *\ 10\,log\left(10^{\left(\frac{50}{10}\right)} +\ 10^{\left(\frac{50}{10}\right)}\right) = 53\ decibels$$

In general, when one source is 10 dB higher than another source, the quieter source does not add to the sound levels produced by the louder source because the louder source contains ten times more sound energy than the quieter source.

Sound Characterization

There are several methods of characterizing sound. The most common method is the “A-weighted sound level,” or dBA. This scale gives greater weight to the frequencies of sound to which the human ear is typically most sensitive. Thus, most environmental measurements are reported in dBA, meaning decibels on the A-scale.

Human hearing matches the logarithmic A-weighted scale, so that a sound of 60 dBA is perceived as twice as loud as a sound of 50 dBA. In a quiet environment, an increase of 3 dB is usually perceptible, however, in a complex noise environment such as along a busy street, a noise increase of less than 3 dB is usually not perceptible, and an increase of 5 dB is usually perceptible. Normal human speech is in the range from 50 to 65 dBA. Generally, as environmental noise exceeds 50 dBA, it becomes intrusive and above 65 dBA noise becomes excessive. Nighttime activities, including sleep, are more sensitive to noise and are considered affected over a range of 40 to 55 dBA.

Sound levels are typically not steady and can vary over a short time period. The equivalent noise level (L_{eq}) is used to represent the average character of the sound over a period of time. The L_{eq} represents the level of steady noise that would have the same acoustical energy as the sum of the time-varying noise measured over a given time period. L_{eq} is useful for evaluating shorter time periods over the course of a day. The most common L_{eq} averaging period is hourly, but L_{eq} can describe any series of noise events over a given time period.

Variable noise levels are values that are exceeded for a portion of the measured time period. Thus, L_{01} is the level exceeded one percent of the time and L90 is the level exceeded 90 percent of the time. The L_{90} value usually corresponds to the background sound level at the measurement location.

Noise exposure over the course of an entire day is described by the day/night average sound level, or DNL (also referred to as L_{dn}), and the community noise equivalent level, or CNEL. Both descriptors represent the 24-hour noise impact on a community. For DNL, the 24-hour day is divided into a 15-hour daytime period (7 AM to 10 PM) and a nine-hour nighttime period (10 PM to 7 AM) and a 10 dB “penalty” is added to measure nighttime noise levels when calculating the 24-hour average noise level. For example, a 45-dBA nighttime sound level would contribute as much to the overall day-night average as a 55-dBA daytime sound level. The CNEL descriptor is similar to DNL, except that it includes an additional 5 dBA penalty beyond the 10 dBA for sound events that occur during the evening time period (7 PM to 10 PM). The artificial penalties imposed during DNL and CNEL calculations are intended to account for a receptor’s increased sensitivity to sound levels during quieter nighttime periods.

Sound Propagation

The energy contained in a sound pressure wave dissipates and is absorbed by the surrounding environment as the sound wave spreads out and travels away from the noise generating source. Theoretically, the sound level of a point source attenuates, or decreases, by 6 dB with each doubling of distance from a point source. Sound levels are also affected by certain environmental factors, such as ground cover (asphalt vs. grass or trees), atmospheric absorption, and attenuation by barriers. Outdoor noise is also attenuated by the building envelope so that sound levels inside a residence are from 10 to 20 dB less than outside, depending mainly on whether windows are open for ventilation or not.

For an ideal “point” source of sound, the energy contained in a sound pressure wave dissipates and is absorbed by the surrounding environment as the sound wave spreads out in a spherical pattern and travels away from the point source. Theoretically, the sound level attenuates, or decreases, by 6 dB with each doubling of distance from the point source. The change in noise levels between two distances can be calculated according to Equation 1 (California Department of Transportation [Caltrans], 2013) as follows:

Equation 1

$$dBA2 = dBA1 + 20\log(D1/D2)$$

Where:

dBA1 = Known noise level, such as a reference noise level
D1 = Distance associated with dBA1
dBA2 = Noise level at distance 2
D2 = Distance associated with dBA2

For an ideal line source of sound, the energy contained in a sound pressure wave dissipates and is absorbed by the surrounding environment as the sound wave spreads out in a cylindrical pattern from the source. Theoretically, the sound level attenuates, or decreases, by 3 dB with each doubling of distance from the line source. The change in noise levels between two distances can be calculated according to Equation 2 as follows:

Equation 2

$$dBA2 = dBA1 + 10\log(D1/D2)$$

Where:

dBA1 = Known noise level, such as a reference noise level
D1 = Distance associated with dBA1
dBA2 = Noise level at distance 2
D2 = Distance associated with dBA2

Noise Effects on Humans

Noise effects on human beings are generally categorized as:

- Subjective effects of annoyance, nuisance, and/or dissatisfaction
- Interference with activities such as speech, sleep, learning, or relaxing
- Physiological effects such as startling and hearing loss

Most environmental noise levels produce subjective or interference effects; physiological effects are usually limited to high noise environments such as industrial manufacturing facilities or airports.

Predicting the subjective and interference effects of noise is difficult due to the wide variation in individual thresholds of annoyance and past experiences with noise; however, an accepted method to determine a person's subjective reaction to a new noise source is to compare it the existing environment without the noise source, or the "ambient" noise environment. In general, the more a new noise source exceeds the ambient noise level, the more likely it is to be considered annoying and to disturb normal activities.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1-dB changes in sound levels when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000–8,000 Hz) range. In typical noisy environments, changes in noise of 1 to 2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness that would almost certainly cause an adverse response from community noise receptors.

When exposed to high noise levels, humans may suffer hearing damage. Sustained exposure to high noise levels (e.g., 90 dBs for hours at a time) can cause gradual hearing loss, which is usually temporary, whereas sudden exposure to a very high noise level (e.g., 130 to 140 dBs) can cause sudden and permanent hearing loss. In addition to hearing loss, noise can cause stress in humans and may contribute to stress-related diseases, such as hypertension, anxiety, and heart disease (Caltrans, 2013).

Vibration

Vibration is the movement of particles within a medium or object such as the ground or a building. As is the case with airborne sound, groundborne vibrations may be described by amplitude and frequency. Vibration amplitudes are usually expressed in peak particle velocity (PPV) or root mean squared, in inches per second (in/sec). PPV represents the maximum instantaneous positive or negative peak of a vibration signal and is most appropriate for evaluating the potential for building damage. Human response to groundborne vibration is subjective and varies from person to person

This page was intentionally left blank.

Attachment 03
Ambient Noise Monitoring Data

This page was intentionally left blank.

Tennessee Village Project

Tennessee Avenue, Redlands, CA

Attachment 03: Ambient Noise Monitoring Summary

TABLE 1: SUMMARY OF SHORT-TERM NOISE MONITORING DATA

Site	Date	Time	Duration	Leq	Lmin	Lmax	L1.7	L8.3	L16.7	L25.0	L50.0	L90.0
ST-01	12/12/2023	3:00 PM	4 hours	70.3	61.7	96.2	76.3	72.9	71.7	71.0	69.4	66.6
ST-02	12/12/2023	3:04 PM	3.5 hours	62.2	57.1	72.4	63.1	63.4	--	62.9	62.3	61.5
ST-03	12/12/2023	3:10 PM	3.75 hours	60.3	54.8	75.0	62.5	61.6	61.1	60.8	60.1	59.1

Note: Detailed ambient noise monitoring records are available upon request.

This page was intentionally left blank.

Attachment 04

HVAC Noise Level Estimates

This page was intentionally left blank.

Tennessee Village Project
Tennessee Avenue, Redlands, CA

Attachment 04: On-site HVAC Noise and Barrier Attenuation Estimates

Prepared by: MIG, Inc.
February 2024

Contents:

Tennessee Village Project
Tennessee Avenue, Redlands, CA
Attachment 04: On-site HVAC Noise and Barrier Attenuation Estimates

Sheet 1: Project HVAC Noise Level Estimates (dBA Leq)

Table 1: Estimated HVAC Noise Levels at Building Roof Line (No Parapet)

Building / Receptor	Reference Noise Data		Roof Line (one source)		Roof Line (all sources)	
	Distance	Hourly Leq dBA	Distance	Hourly Leq dBA	No. Sources	Hourly Leq dBA
Bldg 2 - East Residential	3	76.0	115	44.3	42	60.6
Bldg 3 - East Residential	3	76.0	35	54.7	32	69.7
Bldg 7 - East Residential	3	76.0	80	47.5	20	60.5
Bldg 7 - South Commercial	3	76.0	25	57.6	20	70.6
Bldg 8 - South Commercial	3	76.0	20	59.5	16	71.6
Bldg 10 - South Commercial	3	76.0	40	53.5	24	67.3

Table 2: Estimated HVAC Noise Levels at Elevated Property Line Plane (No Parapet)

On-Site Noise Source	Reference Noise Data		Property Line (one source)		Property Line (all sources)	
	Distance	Hourly Leq dBA	Distance	Hourly Leq dBA	No. Sources	Hourly Leq dBA
Bldg 2 - East Residential	3	76.0	200	39.5	42	55.8
Bldg 3 - East Residential	3	76.0	90	46.5	32	61.5
Bldg 7 - East Residential	3	76.0	240	37.9	20	50.9
Bldg 7 - South Commercial	3	76.0	45	52.5	20	65.5
Bldg 8 - South Commercial	3	76.0	30	56.0	16	68.0
Bldg 10 - South Commercial	3	76.0	50	51.6	24	65.4

Table 3: Estimated HVAC Noise Levels at Elevated Property Line (With Building Elevations and Parapet Wall)

On-Site Noise Source	Reference Noise Data		Property Line (all sources, with Parapet))		
	Distance	Hourly Leq dBA	Distance	No. Sources	Hourly Leq dBA
Bldg 2 - East Residential	3	76.0	200	42	42.8
Bldg 3 - East Residential	3	76.0	90	32	50.0
Bldg 7 - East Residential	3	76.0	240	20	43.6
Bldg 7 - South Commercial	3	76.0	45	20	51.3
Bldg 8 - South Commercial	3	76.0	30	16	52.5
Bldg 10 - South Commercial	3	76.0	50	24	46.9

Tennessee Village Project
Tennessee Avenue, Redlands, CA
Attachment 04: On-site HVAC Noise and Barrier Attenuation Estimates

Sheet 2: Elevation and Parapet Wall Attenuation Estimates

Table 1: Source/ Property Line Receiver Information

Noise Source:	Residential Fan-type HVAC Unit (Low)								
Source Noise Level:	PL=	55.8	61.5	50.9	65.5	68.0	65.4		
Receptor Noise Level:	PL=	50.0	50.0	50.0	60.0	60.0	60.0		
Noise Reduction Level:	PL=	5.8	11.5	0.9	5.5	8.0	5.4		
Source Frequency:	125	Hertz							

Note: "PL" = Property Line

Table 2: Source, Receptor, and Barrier Elevation Data

Receptor	Elevation Above Mean Sea Level					
	Receiver Grade	Receiver Height	Source Grade	Effective Source Height	Barrier Grade	Top of Barrier
Bldg 2 - East Residential	0.0	5.0	41.0	44.0	40.0	43.0
Bldg 3 - East Residential	0.0	5.0	41.0	44.0	40.0	43.0
Bldg 7 - East Residential	0.0	5.0	31.0	34.0	30.0	33.0
Bldg 7 - South Commercial	0.0	5.0	31.0	34.0	30.0	33.0
Bldg 8 - South Commercial	0.0	5.0	31.0	34.0	30.0	33.0
Bldg 10 - South Commercial	0.0	5.0	41.0	44.0	40.0	43.0

Table 3: Barrier Insertion Loss Summary

Property Line	Preliminary Barrier Insertion Loss Estimate		
	Predicted Noise Level	Barrier Attenuation	Noise Level with Barrier
Bldg 2 - East Residential	55.8	13.0	42.8
Bldg 3 - East Residential	61.5	11.5	50.0
Bldg 7 - East Residential	50.9	7.3	43.6
Bldg 7 - South Commercial	65.5	14.2	51.3
Bldg 8 - South Commercial	68.0	15.5	52.5
Bldg 10 - South Commercial	65.4	18.5	46.9

Table 4: Building 2 Barrier Attenuation 3-Foot High Wall (East Residential)

Receptor	A	B	C	D	D1	D2	H1	H2
Property Line	115.00	93.11	203.77	200	115	85	39.0	38.0

Table 5: Fresnel Number (N_0) and Barrier Insertion Loss Estimate (West - South)

Receptor	δ (Feet)	λ (Feet)	N_0	Insertion Loss (dB)
Property Line	4.34	9.00	0.9655	13.0

Table 6: Building 3 Barrier Attenuation 3-Foot High Wall (East Residential)

Receptor	A	B	C	D	D1	D2	H1	H2
Property Line	35.01	75.29	107.34	100	35	65	39.0	38.0

Table 7: Fresnel Number (N_0) and Barrier Insertion Loss Estimate (West - Mid)

Receptor	δ (Feet)	λ (Feet)	N_0	Insertion Loss (dB)
Property Line	2.97	9.00	0.6602	11.5

Table 8: Building 7 Barrier Attenuation 3-Foot High Wall (East Residential)

Receptor	A	B	C	D	D1	D2	H1	H2
Property Line	80.01	162.43	241.75	240	80	160	29.0	28.0

Table 9: Fresnel Number (N_0) and Barrier Insertion Loss Estimate (North - West)

Receptor	δ (Feet)	λ (Feet)	N_0	Insertion Loss (dB)
Property Line	0.69	9.00	0.1538	7.3

Table 10: Building 7 Barrier Attenuation 3-Foot High Wall (South Commercial)

Receptor	A	B	C	D	D1	D2	H1	H2
Property Line	25.02	34.41	53.54	45	25	20	29.0	28.0

Table 11: Fresnel Number (N_0) and Barrier Insertion Loss Estimate (North - Mid)

Receptor	δ (Feet)	λ (Feet)	N_0	Insertion Loss (dB)
Property Line	5.89	9.00	1.3098	14.2

Table 12: Building 8 Barrier Attenuation 3-Foot High Wall (South Commercial)

Receptor	A	B	C	D	D1	D2	H1	H2
Property Line	20.02	29.73	41.73	30	20	10	29.0	28.0

Table 13: Fresnel Number (N_0) and Barrier Insertion Loss Estimate (North - Mid)

Receptor	δ (Feet)	λ (Feet)	N_0	Insertion Loss (dB)
Property Line	8.03	9.00	1.7849	15.5

Table 14: Building 10 Barrier Attenuation 3-Foot High Wall (South Commercial)

Receptor	A	B	C	D	D1	D2	H1	H2
Property Line	40.01	39.29	63.41	50	40	10	39.0	38.0

Table 15: Fresnel Number (N_0) and Barrier Insertion Loss Estimate (North - Mid)

Receptor	δ (Feet)	λ (Feet)	N_0	Insertion Loss (dB)
Property Line	15.89	9.00	3.5322	18.5

Tennessee Village Project
Tennessee Avenue, Redlands, CA
Attachment 04: On-site HVAC Noise and Barrier Attenuation Estimates

Sheet 3: Traffic Noise Compatibility Estimates

Table 1: Existing and Future Traffic Noise Levels at Project Property Line

Road	General Plan Traffic Noise Level 50 Feet from Outermost Lane (CNEL)	Distance to Property Line	Estimated Traffic Noise Level at Property Line (CNEL)
Tennessee (Existing)	67.0	52.0	66.7
I-210 (Existing)	82.5	200.0	73.5
Total (Existing)	--	--	74.3
Tennessee (Future)	70.2	52.0	69.9
I-210 (Future)	83.7	200.0	74.7
Total (Future)	--	--	75.9

Table 2: Existing and Future Traffic Noise Levels at Building 10 and 11 Façades

Road	General Plan Traffic Noise Level 50 Feet from Outermost Lane (CNEL)	Distance to Building Façade	Estimated Traffic Noise Level at Building Facade (CNEL)
Tennessee (Existing)	67.0	85.0	63.5
I-210 (Existing)	82.5	225.0	72.7
Total (Existing)	--	--	73.2
Tennessee (Future)	70.2	85.0	66.7
I-210 (Future)	83.7	225.0	73.9
Total (Future)	--	--	74.7

This page was intentionally left blank.