NOISE ASSESSMENT

Capalina Apartments Residential Development
GPA22-0003
R22-0003
SDP22-0007
City of San Marcos, CA

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GLOSSARY OF COMMON TERMS

Sound Pressure Level (SPL): a ratio of one sound pressure to a reference pressure (L_{ref}) of 20 μPa. Because of the dynamic range of the human ear, the ratio is calculated logarithmically by 20 log (L/L_{ref}).

A-weighted Sound Pressure Level (dBA): Some frequencies of noise are more noticeable than others. To compensate for this fact, different sound frequencies are weighted more.

Minimum Sound Level (L_{min}): Minimum SPL or the lowest SPL measured over the time interval using the A-weighted network and slow time weighting.

Maximum Sound Level (L_{max}): Maximum SPL or the highest SPL measured over the time interval the A-weighted network and slow time weighting.

Equivalent sound level (L_{eq}): the true equivalent sound level measured over the run time. Leq is the A-weighted steady sound level that contains the same total acoustical energy as the actual fluctuating sound level.

Day Night Sound Level (Ldn): Representing the Day/Night sound level, this measurement is a 24 –hour average sound level where 10 dB is added to all the readings that occur between 10 pm and 7 am. This is primarily used in community noise regulations where there is a 10 dB "Penalty" for nighttime noise. Typically, Ldn's are measured using A weighting.

Community Noise Exposure Level (CNEL): The accumulated exposure to sound measured in a 24-hour sampling interval and artificially boosted during certain hours. For CNEL, samples taken between 7 pm and 10 pm are boosted by 5 dB; samples taken between 10 pm and 7 am are boosted by 10 dB.

Octave Band: An octave band is defined as a frequency band whose upper band-edge frequency is twice the lower band frequency.

Third-Octave Band: A third-octave band is defined as a frequency band whose upper band-edge frequency is 1.26 times the lower band frequency.

Response Time (F,S,I): The response time is a standardized exponential time weighting of the input signal according to fast (F), slow (S) or impulse (I) time response relationships. Time response can be described with a time constant. The time constants for fast, slow and impulse responses are 1.0 seconds, 0.125 seconds and 0.35 milliseconds, respectively.

EXECUTIVE SUMMARY

This noise study has been completed to determine the noise impacts to and from the proposed residential project. The project is located north of State Route 78 (SR-78) and east of Rancho Santa Fe Road between Mission Road and Capalina Road in the City of San Marcos CA.

Construction Noise

The grading equipment will be spread out over the project site from distances near the occupied property lines to distances of 200 feet or more away. Based upon the site plan the majority of the grading operations, on average, will occur more than 100 feet from the property lines. At an average distance of 100 feet from the construction activities to the nearest property line, noise levels will comply with the 75 dBA Leq standard over 8 hours at the property lines. The material haulage is also anticipated to comply with the City's thresholds. Therefore, no impacts are anticipated and no mitigation is required during construction of the proposed Project. Additionally, all equipment should be properly fitted with mufflers and all staging and maintenance should be conducted as far away from the existing residence as possible. No blasting or rock crushing is anticipated during the grading operations. Therefore, no impulsive noise sources are expected and the Project will comply with Section 17.60.06 of the City Noise Ordinance.

Onsite Transportation Noise

The results of this analysis indicate that future vehicle noise from Mission Road, Capalina Road, State Route 78 (SR-78) and the Sprinter commuter rail are the principal sources of noise that will impact the site. Due to the combined roadway and train activities, the outdoor use areas were found to exceed the City's 65 dBA CNEL threshold without noise control measures. Noise control recommendations in the form of 5-foot barriers installed at the balconies/decks for the units having direct line of sight to Mission Road is needed to comply with the City of San Marcos Noise standards for multi-family uses based on transportation related noise sources (i.e., vehicle).

Additionally, a final noise assessment is required prior to the issuance of the first building permit since the building facades are above 60 dBA CNEL. This final report would identify the interior noise requirements based upon architectural and building plans. It should be noted; interior noise levels of 45 dBA CNEL can be obtained with conventional building construction methods and providing a closed window condition requiring a means of mechanical ventilation (e.g., air conditioning) and upgraded windows for all sensitive rooms (e.g., bedrooms and living spaces).

Offsite Transportation Noise

The Project does not create a noise increase of more than 3 dBA CNEL on any of the analyzed roadway segments. Therefore, the Project's contributions to off-site roadway noise increases will not cause any significant impacts to any existing or future noise sensitive land uses.

Operational Noise

Based on noise levels, the distances to the property lines and the proposed parapet walls, the noise levels from the proposed roof-mounted HVAC would be considered less than significant at the residential property line to the south and the commercial uses to the east and west. Therefore, the operational noise levels are in compliance with the City of San Marcos Municipal Code Sections 10.24 and 20.300.

1.0 PROJECT INTRODUCTION

1.1 Purpose of this Study

The purpose of this Noise study is to determine potential noise impacts (if any) created from the proposed construction operations and to determine potential noise impacts (if any) to the site generated from offsite sources. Should impacts be determined, the intent of this study would be to recommend suitable measures to bring those impacts to a level that would meet local requirements.

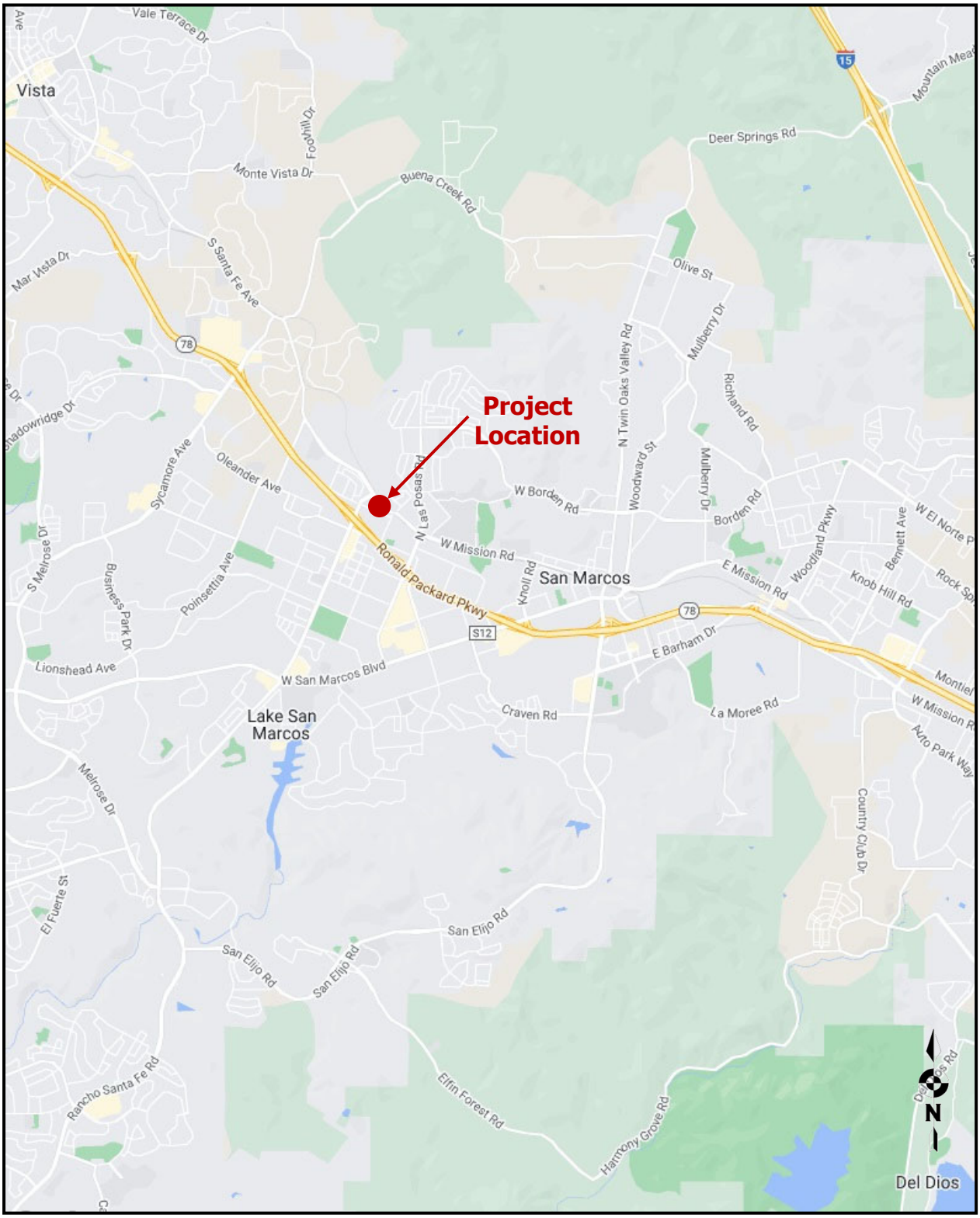
1.2 Project Location

The vacant 2.51 acre project site having an Assessor Parcel Number (APN) of 219-115-3300 is located along Capalina Road in the Business/Industrial Community in the City of San Marcos. Specifically, the project site is located north of State Route 78 (SR-78) and east of Rancho Santa Fe Road between Mission Road and Capalina Road. A project vicinity map and location map are shown in Figure 1-A. The existing site is currently vacant. The project is bounded by existing commercial and retails uses on the east and west, by Mission Road to the north, and by Capalina Road to the south. The nearest residential use is the mobile home park located south across Capalina Road.

1.3 Project Description and Purpose

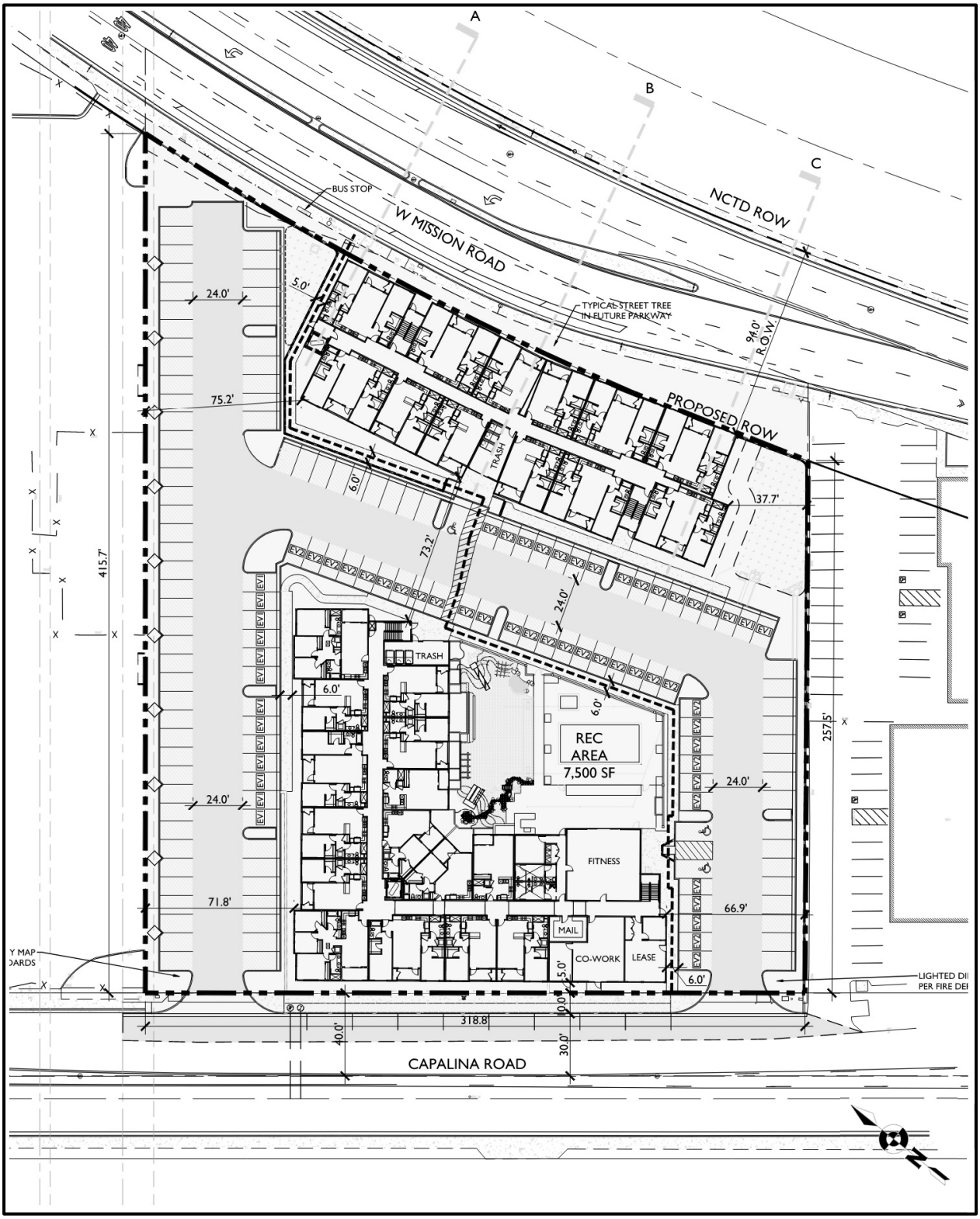
The project proposes up to 119 multi-family residential units within two four-story buildings situated on approximately 2.51 gross acres. The project would also include up to 4,000 s.f. of commercial use. Additionally, the Project proposes as many as 147 outdoor parking spaces of which 8 will be equipped with Electric Vehicle (EV) chargers and 15 will be EV capable. The project seeks a General Plan Amendment (GPA) and to rezone the property from Mixed Use (MU-3) to Mixed Use (MU-2). The project development plan is shown on Figure 1-B of this report.

Figure 1-A: Project Vicinity Map



Source: (Google, 2023)

Figure 1-B: Residential Development Details



Source: (Summa Architecture, 2023)

2.0 FUNDAMENTALS

2.1 Acoustical Fundamentals

Noise is defined as unwanted or annoying sound which interferes with or disrupts normal activities. Exposure to high noise levels has been demonstrated to cause hearing loss. The individual human response to environmental noise is based on the sensitivity of that individual, the type of noise that occurs and when the noise occurs. Sound is measured on a logarithmic scale consisting of sound pressure levels known as a decibel (dB). The sounds heard by humans typically do not consist of a single frequency but of a broadband of frequencies having different sound pressure levels. The method for evaluating all the frequencies of the sound is to apply an A-weighting to reflect how the human ear responds to the different sound levels at different frequencies. The A-weighted sound level adequately describes the instantaneous noise whereas the equivalent sound level depicted as Leq represents a steady sound level containing the same total acoustical energy as the actual fluctuating sound level over a given time interval.

The Community Noise Equivalent Level (CNEL) is the 24 hour A-weighted average for sound, with corrections or penalties for evening and nighttime hours. The corrections require an addition of 5 decibels to sound levels in the evening hours between 7 p.m. and 10 p.m. and an addition of 10 decibels to sound levels at nighttime hours between 10 p.m. and 7 a.m. These additions are made to account for the increased sensitivity during the evening and nighttime hours when sounds appear louder.

A vehicle's noise level is from a combination of the noise produced by the engine, exhaust and tires. The cumulative traffic noise levels along a roadway segment are based on three primary factors: the amount of traffic, the travel speed of the traffic, and the vehicle mix ratio or number of medium and heavy trucks. The intensity of traffic noise is increased by higher traffic volumes, greater speeds and increased number of trucks.

Because mobile/traffic noise levels are calculated on a logarithmic scale, a doubling of the traffic noise or acoustical energy results in a noise level increase of 3 dBA. Therefore, the doubling of the traffic volume, without changing the vehicle speeds or mix ratio, results in a noise increase of 3 dBA. Mobile noise levels radiant in an almost oblique fashion from the source and drop off at a rate of 3 dBA for each doubling of distance under hard site conditions and at a rate of 4.5 dBA for soft site conditions. Hard site conditions consist of concrete, asphalt and hard pack dirt while soft site conditions exist in areas having slight grade changes, landscaped areas and vegetation. On the other hand, fixed/point sources radiate outward uniformly as it travels away from the source. Their sound levels attenuate or drop off at a rate of 6 dBA for each doubling of distance.

The most effective noise reduction methods consist of controlling the noise at the source, blocking the noise transmission with barriers or relocating the receiver. Any or all of these methods may be required to reduce noise levels to an acceptable level.

2.2 Vibration Fundamentals

Vibration is a trembling or oscillating motion of the ground. Like noise, vibration is transmitted in waves, but in this case through the ground or solid objects. Unlike noise, vibration is typically felt rather than heard. Vibration can be either natural as in the form of earthquakes, volcanic eruptions, or manmade as from explosions, heavy machinery, or trains. Both natural and manmade vibration may be continuous, such as from operating machinery; or infrequent, as from an explosion.

As with noise, vibration can be described by both its amplitude and frequency. Amplitude may be characterized in three ways: displacement, velocity, and acceleration. Particle displacement is a measure of the distance that a vibrated particle travels from its original position and for the purposes of soil displacement is typically measured in inches or millimeters. Particle velocity is the rate of speed at which soil particles move in inches per second or millimeters per second. Particle acceleration is the rate of change in velocity with respect to time and is measured in inches per second or millimeters per second. Typically, particle velocity (measured in inches or millimeters per second) and/or acceleration (measured in gravities) are used to describe vibration. Table 2-1 shows the human reaction to various levels of peak particle velocity.

Vibrations also vary in frequency and this affects perception. Typical construction vibrations fall in the 10 to 30 Hz range and usually occurring around 15 Hz. Traffic vibrations exhibit a similar range of frequencies; however, due to their suspension systems, it is less common, to measure traffic frequencies above 30 Hz.

Propagation of ground-borne vibrations is complicated and difficult to predict because of the endless variations in the soil through which the waves travel. There are three main types of vibration propagation: surface, compression, and shear waves. Surface waves, or Rayleigh waves, travel along the ground's surface. These waves carry most of their energy along an expanding circular wave front, similar to ripples produced by dropping an object into water. P-waves, or compression waves, are waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal. S-waves, or shear waves, are also body waves that carry energy along an expanding spherical wave front. However, unlike P-waves, the particle motion is transverse, or side-to-side and perpendicular to the direction of propagation.

As vibration waves propagate from a source, the energy is spread over an ever-increasing area such that the energy level is reduced with the distance from the energy source. This geometric spreading loss is inversely proportional to the square of the distance. Wave energy is also reduced

with distance as a result of material damping in the form of internal friction, soil layering, and special voids. The amount of attenuation provided by material damping varies with soil type and condition as well as the frequency of the wave.

Table 2-1: Human Reaction to Typical Vibration Levels

Vibration Level Peak Particle Velocity (in/sec)	Human Reaction	Effect on Buildings
0.006–0.019	Threshold of perception, possibility of intrusion	Vibrations unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibration begins to annoy people	Virtually no risk of "architectural" (i.e., not structural) damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk to "architectural" damage to normal dwelling – houses with plastered walls and ceilings
0.4–0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause "architectural" damage and possibly minor structural damage
Source: Caltrans, Division of Environmental Analysis, *Transportation Related Earthborne Vibration, Caltrans Experiences*, Technical Advisory, Vibration, TAV-02-01-R9601, 2020 (Caltrans, 2020).		

3.0 SIGNIFICANCE THRESHOLDS AND STANDARDS

3.1 Construction Noise

The City of San Marcos Municipal Code addresses the limits grading, extraction and construction activities between 7:00 a.m. and 4:30 p.m. Monday through Friday and no grading, extraction or construction is allowed on the weekends or holidays. The Municipal code does not set noise limits on construction activities. Commonly, the City has utilized Section 36.409 of the County of San Diego's Noise Ordinance noise limit of 75 dBA Leq (8-hour) for other projects.

3.2 Vibration Standards

The City of San Marcos has not yet adopted vibration criteria. The United States Department of Transportation Federal Transit Administration (FTA) provides criteria for acceptable levels of groundborne vibration for various types of special buildings that are sensitive to vibration. For purposes of identifying potential project-related vibration impacts, the FTA criteria will be used. The human reaction to various levels of vibration is highly subjective. The upper end of the range shown for the threshold of perception, or roughly 65 VdB, may be considered annoying by some people. Vibration below 65 VdB may also cause secondary audible effects, such as a slight rattling of doors, suspended ceilings/fixtures, windows, and dishes, any of which may result in additional annoyance. Table 3-1 shows the FTA groundborne vibration and noise impact criteria for human annoyance.

In addition to the vibration annoyance standards presented above, the FTA also applies the following standards for construction vibration damage. Table 3-2 on the following page, structural damage is possible for typical residential construction when the peak particle velocity (PPV) exceeds 0.2 inch per second (in/sec). This criterion is the threshold at which there is a risk of damage to normal dwellings.

In the context of this analysis, the noise and vibration impacts associated with the construction operations will be conditioned to comply with the thresholds stated above. No blasting or rock crushing is anticipated during construction. The potential noise and vibration impacts are analyzed separately below.

Table 3-1: Groundborne Vibration and Noise Impact Criteria (Human Annoyance)

	Groundborne Vibration Impact Levels (VdB re 1 microinch/second)			Groundborne Noise Impact Levels (dB re 20 micropascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where low ambient vibration is essential for interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: United States Department of Transportation Federal Transit Administration (FTA), *Transit Noise and Vibration Impact Assessment,* 2018 (FTA, 2018).

[1] "Frequent Events" are defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.

[2] "Occasional Events" are defined as between 30 and 70 vibration events of the same source per day. Most commuter truck lines have this many operations.

[3] "Infrequent Events" are defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

[5] Vibration-sensitive equipment is not sensitive to groundborne noise.

Table 3-2: Groundborne Vibration Impact Criteria (Structural Damage)

Building Category	PPV (in/sec)	VdB
I. Reinforced-concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Source: United States Department of Transportation Federal Transit Administration (FTA), *Transit Noise and Vibration Impact Assessment,* 2018 (FTA, 2018).

Notes: RMS velocity calculated from vibration level (VdB) using the reference of one microinch/second.

3.3 Transportation Noise Standards

The City's General Plan Chapter 7 Noise Element uses the Noise Compatibility Guidelines listed in Table 7-3 of the General Plan Noise Element (provided below as Table 3-3) to determine the compatibility of land use when evaluating proposed development projects. The Noise Compatibility Guidelines indicate ranges of compatibility and are intended to be flexible enough to apply to a range of projects and environments (City of San Marcos General Plan, 2012). For example, a commercial project would be evaluated differently than a residential project.

A land use located in an area identified as "acceptable" indicates that standard construction methods would attenuate exterior noise to an acceptable indoor noise level and that people can carry out outdoor activities with minimal noise interference. Land uses that fall into the "conditionally acceptable" noise environment should have an acoustical study that considers the type of noise source, the sensitivity of the noise receptor, and the degree to which the noise source may interfere with sleep, speech, or other activities characteristic of the land use. For land uses indicated as "conditionally acceptable," structures must be able to attenuate the exterior noise to the indoor noise level as indicated in the Noise Standards listed in Table 7-4 of the General Plan Noise Element (provided below as Table 3-4). For land uses where the exterior noise levels fall within the "unacceptable" range, new construction generally should not be undertaken.

Table 3-3: Noise Compatibility Guidelines

Table 7-3
Noise and Land Use Compatibility Guidelines for Transportation-related Noise

		Exterior Noise Level (CNEL)					
Land Use Category		55	60	65	70	75	80
A	Residential—single family residences, mobile homes, senior/age-restricted housing						
B	Residential—multifamily residences, mixed use (residential/commercial)						
C	Lodging—hotels, motels						
D[2]	Schools, churches, hospitals, residential care facility, child care facilities						
E[2]	Passive recreational parks, nature preserves, contemplative spaces, cemeteries						
F[2]	Active parks, golf courses, athletic fields, outdoor spectator sports, water recreation						
G[2]	Office/professional, government, medical/dental, commercial, retail, laboratories						
H[2]	Industrial, manufacturing, utilities, agriculture, mining, stables, ranching, warehouse, maintenance/repair						

Acceptable - Specified land use is satisfactory, based upon the assumption that any buildings involved

Conditionally Acceptable - New construction or development should be undertaken only after a detailed noise analysis is conducted to determine if noise reduction measures are necessary to achieve acceptable levels for land use. Criteria for determining exterior and interior noise levels are listed in Table 7-4, Noise Standards. If a project cannot mitigate noise to a level deemed Acceptable, the appropriate County decision-maker must determine that mitigation has been provided to the greatest extent practicable or that extraordinary circumstances exist.

Unacceptable - New construction or development shall not be undertaken.

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Table 3-4: Noise Standards

Table 7-4
Noise Standards[1]

1. The exterior noise level (as defined in Item 3) standard for Category A shall be 60 CNEL, and the interior noise level standard for indoor habitable rooms shall be 45 CNEL.

2. The exterior noise level standard for Categories B and C shall be 65 CNEL, and the interior noise level standard for indoor habitable rooms shall be 45 CNEL.

3. The exterior noise level standard for Categories D and G shall be 65 CNEL and the interior noise level standard shall be 50 dBA Leq (one hour average).

4. For single-family detached dwelling units, "exterior noise level" is defined as the noise level measured at an outdoor living area which adjoins and is on the same lot as the dwelling, and which contains at least the following minimum net lot area: (i) for lots less than 4,000 square feet in area, the exterior area shall include 400 square feet, (ii) for lots between 4,000 square feet to 10 acres in area, the exterior area shall include 10 percent of the lot area; (iii) for lots over 10 acres in area, the exterior area shall include 1 acre.

5. For all other residential land uses, "exterior noise level" is defined as noise measured at exterior areas which are provided for private or group usable open space purposes. "Private Usable Open Space" is defined as usable open space intended for use of occupants of one dwelling unit, normally including yards, decks, and balconies. When the noise limit for Private Usable Open Space cannot be met, then a Group Usable Open Space that meets the exterior noise level standard shall be provided. "Group Usable Open Space" is defined as usable open space intended for common use by occupants of a development, either privately owned and maintained or dedicated to a public agency, normally including swimming pools, recreation courts, patios, open landscaped areas, and greenbelts with pedestrian walkways and equestrian and bicycle trails, but not including off-street parking and loading areas or driveways

6. For non-residential noise sensitive land uses, exterior noise level is defined as noise measured at the exterior area provided for public use.

7. For noise sensitive land uses where people normally do not sleep at night, the exterior and interior noise standard may be measured using either CNEL or the one-hour average noise level determined at the loudest hour during the period when the facility is normally occupied.

8. The exterior noise standard does not apply for land uses where no exterior use area is proposed or necessary, such as a library.

9. For Categories E and F the exterior noise level standard shall not exceed the limit defined as "Acceptable" in by the City, or an equivalent one-hour noise standard.

(1) Exterior Noise Level compatibility guidelines for Land Use Categories A-H are identified in Table 3.11-6, Noise Compatibility Guidelines.
Note: "Category(ies)" discussed in this table refer to lettered Land Use Category(ies) in Table 7-3 of this Element.

3.4 Operational Noise Standards

The City noise regulations that apply to the Project are found in Chapter 20.300 Site Planning and General Development Standards of the City Municipal Code. These regulations aim to prohibit unnecessary, excessive, and annoying noises from all sources, as certain noise levels are detrimental to the health and welfare of individuals. The standards of this section and of Chapter 10.24 Noise of the Municipal Code apply to all land uses in all Zones unless otherwise specified. No person shall create or allow the creation of exterior noise that causes the noise level to exceed the noise standards established by Table 20.300-4 (provided in Table 3-3 on the following page).

The City Ordinance limits noise generation in commercial/and multi-family zones to 65 dB Leq (one-hour average) between the hours of 7 am and 10 pm and 55 dB Leq between the hours of 10 pm and 7 am as measured at the project property line as shown above in Table 3-3. Per the City of San Marcos General Plan Noise Element (GPNE), noise standards for commercial, multi-family, and mixed-use land uses are the same, and are higher than single-family residential areas because they reflect a more urban environment (GPNE, pg. 7-10). Higher thresholds are permitted due to the integrated mix of residential and commercial activity and their usual location near major arterials (GPNE, pg. 7-9). Properties directly surrounding the project site are all designated as commercial/mixed under the City General Plan. The nearest residential use is the mobile home park located south across Capalina Road which is zoned multi-family. Therefore, the City Ordinance limits of 65 dBA hourly noise standard during the daytime hours between 7 a.m. and 10 p.m., a 55 dBA standard during the nighttime hours between 10 p.m. and 7 a.m. would apply at all property lines.

Table 3-5: Sound Level Limits

Zone	Allowable Noise Level (dBA Leq) Measured from the Property Line
Single-Family Residential (A, R-1, R-2) [1, 2]	
7 a.m. to 10 p.m. (daytime)	60
10 p.m. to 7 a.m. (overnight)	50
Multifamily Residential (R-3) [1, 2]	
7 a.m. to 10 p.m. (daytime)	65
10 p.m. to 7 a.m. (overnight)	55
Commercial (C, O-P, SR) [3]	
7 a.m. to 10 p.m. (daytime)	65
10 p.m. to 7 a.m. (overnight)	55
Industrial	
7 a.m. to 10 p.m. (daytime)	65
10 p.m. to 7 a.m. (overnight)	60

1. For single-family detached dwelling units, the "exterior noise level" is defined as the noise level measured at an outdoor living area which adjoins and is on the same lot as the dwelling, and which contains at least the following minimum net lot area: (i) for lots less than 4,000 square feet in area, the exterior area shall include 400 square feet, (ii) for lots between 4,000 square feet to 10 acres in area, the exterior area shall include 10 percent of the lot area; (iii) for lots over 10 acres in area, the exterior area shall include 1 acre.
2. For all other residential land uses, "exterior noise level" is defined as noise measured at exterior areas which are provided for private or group usable open space purposes. "Private Usable Open Space" is defined as usable open space intended for use of occupants of one dwelling unit, normally including yards, decks, and balconies. When the noise limit for Private Usable Open Space cannot be met, then a Group Usable Open Space that meets the exterior noise level standard shall be provided. "Group Usable Open Space" is defined as usable open space intended for common use by occupants of a development, either privately owned and maintained or dedicated to a public agency, normally including swimming pools, recreation courts, patios, open landscaped areas, and greenbelts with pedestrian walkways and equestrian and bicycle trails, but not including off-street parking and loading areas or driveways.
3. For non-residential noise sensitive land uses, exterior noise level is defined as noise measured at the exterior area provided for public use.

4.0 CONSTRUCTION NOISE

4.1 Construction Noise Prediction Methodology

Construction noise represents a short-term impact on the ambient noise levels. Noise generated by construction equipment includes haul trucks, water trucks, graders, dozers, loaders and scrapers can reach relatively high levels. Grading activities typically represent one of the highest potential sources for noise impacts. The most effective method of controlling construction noise is through local control of construction hours and by limiting the hours of construction to normal weekday working hours.

The U.S. Environmental Protection Agency (U.S. EPA) has compiled data regarding the noise generating characteristics of specific types of construction equipment. Noise levels generated by heavy construction equipment can range from 60 dBA to in excess of 100 dBA when measured at 50 feet. However, these noise levels diminish rapidly with distance from the construction site at a rate of approximately 6 dBA per doubling of distance. For example, a noise level of 75 dBA measured at 50 feet from the noise source to the receptor would be reduced to 69 dBA at 100 feet from the source to the receptor and reduced to 63 dBA at 200 feet from the source.

Using a point-source noise prediction model, calculations of the expected construction noise impacts were completed. The essential model input data for these performance equations include the source levels of each type of equipment, relative source to receiver horizontal and vertical separations, the amount of time the equipment is operating in a given day, also referred to as the duty-cycle and any transmission loss from topography or barriers. The equipment needed for the most intensive grading activities will consist of a medium sized rubber tire tractor/backhoe, a large bulldozer, a medium sized front loader, a water truck, and a small to medium sized paver/blade. Based on the EPA noise emissions, empirical data and the amount of equipment needed, worst case noise levels from the construction equipment for site preparation would occur during the grading operations.

The potential noise sensitive uses are located adjacent or near the property lines. The affected land uses include the existing retail uses adjacent to the project to the east and west, and the existing residential uses across Capalina Road to the south over 100-feet from the proposed construction activities. Mission Road and the railroad line are located to the north and are not considered sensitive uses. Existing ambient noise levels were determined to be 66.9 dBA Leq without construction noise as identified in Section 5.1 of this report.

4.2 Construction Noise Findings

The grading activities will consist of the preparation of internal roadways, parking and the finished pads. The equipment will be spread out over the project site from distances near the occupied

property lines to distances of 200 feet or more away. Based upon the site plan the majority of the grading operations, on average, will occur more than 100 feet from the property lines. This means that most of the time the average distance from all the equipment to the nearest property line is 100 feet.

As can be seen in Table 4-1, at an average distance of 100 feet from the construction activities to the nearest property line would result in a noise attenuation of 6.0 dBA without shielding. Given this, the noise levels will comply with the 75 dBA Leq standard at the property lines. Therefore, the construction noise impacts would be considered less than significant and no mitigation is required during construction of the proposed Project. Additionally, all equipment should be properly fitted with mufflers and all staging and maintenance should be conducted as far away from the existing residence as possible.

Table 4-1: Construction Noise Levels

Equipment Type	Quantity Used	Source @ 50 Feet (dBA)	Cumulative Noise Level @ 50 Feet (dBA)
Tractor/Backhoe	1	72	72.0
Dozer D9 Cat	1	74	74.0
Loader/Grader	1	73	73.0
Water Trucks	1	70	70.0
Paver/Blade	1	75	75.0
		Cumulative Level	80.1
		Distance to Sensitive Use	100
		Noise Reduction due to Distance	-6.0
		Property Line Noise Level	**74.1**

Haulage

Grading of the Project site will require 8,240 CY of import. Assuming there could be up to 8 trucks in an hour. Community noise level changes greater than 3 dBA are often identified as audible and considered potential significant, while changes less than 1 dBA will not be discernible to local residents. In the range of 1 to 3 dBA, residents who are very sensitive to noise may perceive a slight change. There is no scientific evidence available to support the use of 3 dBA as the significance threshold. Community noise exposures are typically over a long time period rather than the immediate comparison made in a laboratory situation. Therefore, the level at which changes in community noise levels become discernible is likely greater than 1 dBA and 3 dBA appears to be appropriate for most people. For the purposes for this analysis a direct and

cumulative roadway noise impacts would be considered significant if the project increases noise levels for a noise sensitive land use by 3 dBA CNEL and if the project increases noise levels above an unacceptable noise level per the City's General Plan in the area adjacent to the roadway segment.

Typically, it requires a project to double (or add 100%) to the traffic volumes to result in a 3 dBA CNEL which is considered a potential impact. Based on a current traffic volume of approximately 4,200 ADT or more on the roadways along the site and along the anticipated haul route, the additional trucks would add less than 0.5 dBA to the overall noise level. This is well below a 3 dBA increase that is considered a potential impact. No noise impacts are anticipated at the residential uses that are located along the roadway and the low volume of trucks.

4.3 Construction Vibration Findings

The nearest vibration-sensitive uses are the existing mobile homes to the south located 100 feet or more from the center of the proposed construction. Table 4-2 lists the average vibration levels that would be experienced at the nearest vibration sensitive land uses from the temporary construction activities.

The FTA has determined vibration levels that would cause annoyance to a substantial number of people and potential damage to building structures. The FTA criterion for vibration induced structural damage is 0.20 in/sec for the peak particle velocity (PPV). Project construction activities would result in PPV levels below the FTA's criteria for vibration induced structural damage. Therefore, project construction activities would not result in vibration induced structural damage to residential buildings near the construction areas. The FTA criterion for infrequent vibration induced annoyance is 80 Vibration Velocity (VdB) for residential uses. Construction activities would generate levels of vibration that would not exceed the FTA criteria for nuisance for nearby residential uses. Therefore, vibration impacts would be less than significant.

No blasting or rock crushing is anticipated during the grading operations. Therefore, no impulsive noise sources are expected and the Project will comply with Section 17.60.06 of the City Noise Ordinance.

Table 4-2: Vibration Levels from Construction Activities (Residential Receptors)

Equipment	Approximate Velocity Level at 25 Feet (VdB)	Approximate PPV Level at 25 Feet (in/sec)	Approximate Velocity Level at 100 Feet (VdB)	Approximate PPV Level at 100 Feet (in/sec)
Large Dozer	87	0.089	68.9	0.0111
Backhoe Ram	87	0.089	68.9	0.0111
Jackhammer	79	0.035	60.9	0.0044
Loaded Trucks	86	0.076	67.9	0.0095
FTA Criteria			80	0.2
		Significant Impact?	**No**	**No**

[1] PPV at Distance D = PPVref x $(25/D)^{1.5}$

4.4 Construction Noise Conclusions

The grading equipment will be spread out over the project site from distances near the occupied property lines to distances of 200 feet or more away. Based upon the site plan the majority of the grading operations, on average, will occur more than 100 feet from the property lines. At an average distance of 100 feet from the construction activities to the nearest property line, noise levels will comply with the 75 dBA Leq standard over 8 hours at the property lines. The material haulage is also anticipated to comply with the City's thresholds. Therefore, no impacts are anticipated and no mitigation is required during construction of the proposed Project. Additionally, all equipment should be properly fitted with mufflers and all staging and maintenance should be conducted as far away from the existing residence as possible. No blasting or rock crushing is anticipated during the grading operations. Therefore, no impulsive noise sources are expected and the Project will comply with Section 17.60.06 of the City Noise Ordinance.

5.0 TRANSPORTATION NOISE

5.1 Existing Noise Environment Onsite

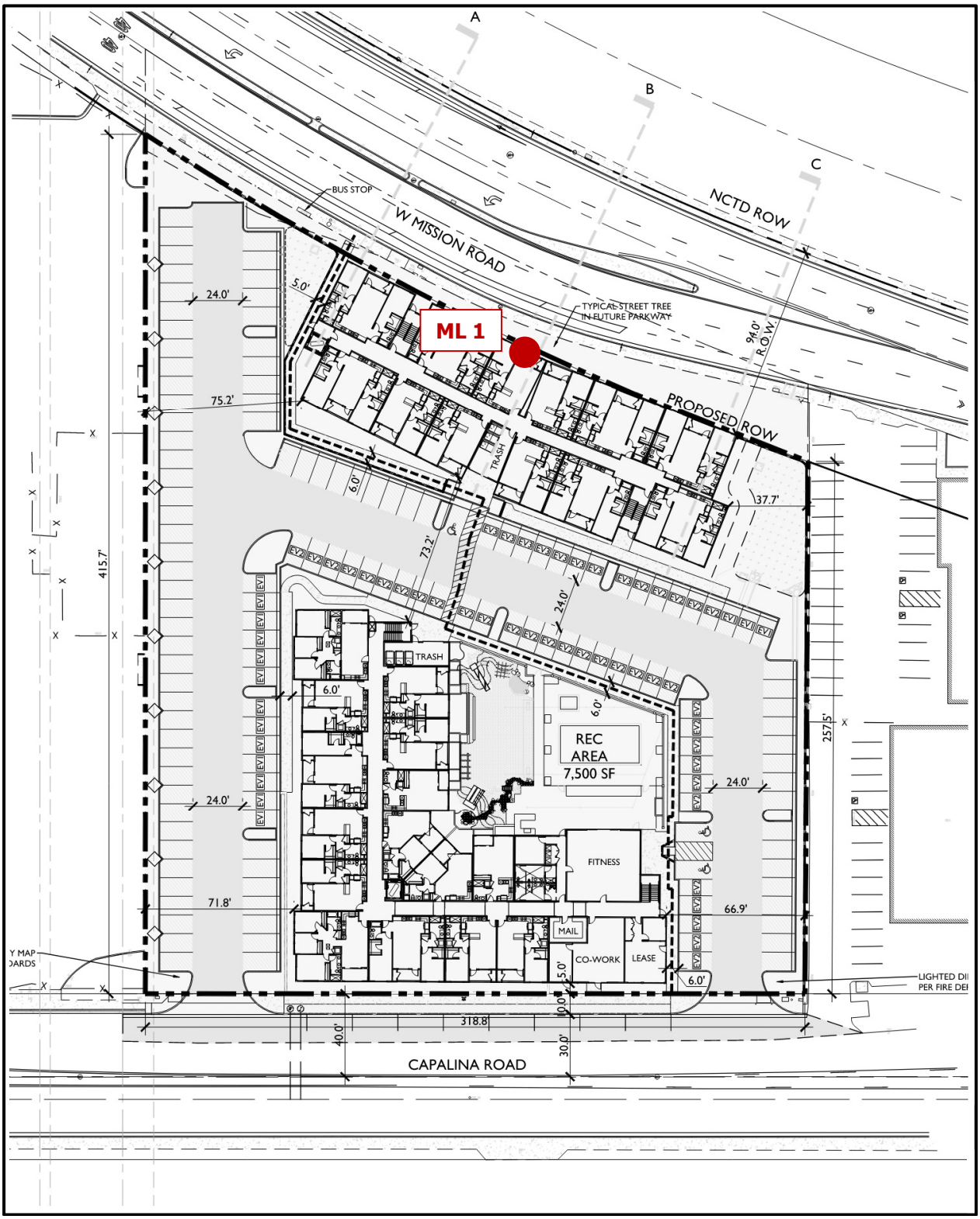
Noise measurements were taken using a Larson-Davis Model LxT Type 1 precision sound level meter, programmed, in "slow" mode, to record noise levels in "A" weighted form. The sound level meter and microphone were mounted on a tripod, five feet above the ground and equipped with a windscreen during all measurements. The sound level meter was calibrated before and after the monitoring using a Larson-Davis calibrator, Model CAL 200.

The ambient measurements were conducted on October 11, 2022 between 11:00 am – 11:15 am. The results of the noise level measurements are presented in Table 5-1. The measurements were taken on site to establish a baseline of the vehicle noise from Mission Road. The measurements were free of obstruction and had a direct line of sight to the roadways. The overall sound level was found to be 66.9 dBA. The statistical indicators Lmax, Lmin, L10, L50 and L90, are also given for the monitoring location. The noise monitoring locations can be seen in Figure 5-A on the following page.

Table 5-1: Measured Ambient Noise Levels

Measurement Identification	Description	Time	Noise Levels (dBA Leq)					
			Leq	Lmax	Lmin	L10	L50	L90
ML 1	Mission Road	11:00 a.m. – 11:15 a.m.	66.9	79.6	43.2	70.7	62.4	48.0
Source: Ldn Consulting October 11, 2022								

Figure 5-A: Ambient Monitoring Locations



5.2 Future Onsite Roadway Noise

To determine the future noise environment, the roadway segment noise levels projected in this report were calculated using the methods in the Highway Noise Model published by the Federal Highway Administration (Source: (FHWA, 1978)). The FHWA Model uses the traffic volume, vehicle mix, speed, and roadway geometry to compute the equivalent noise level. The peak hour traffic volumes range between 6-12% of the average daily traffic (ADT) and 10% is generally acceptable for noise modeling.

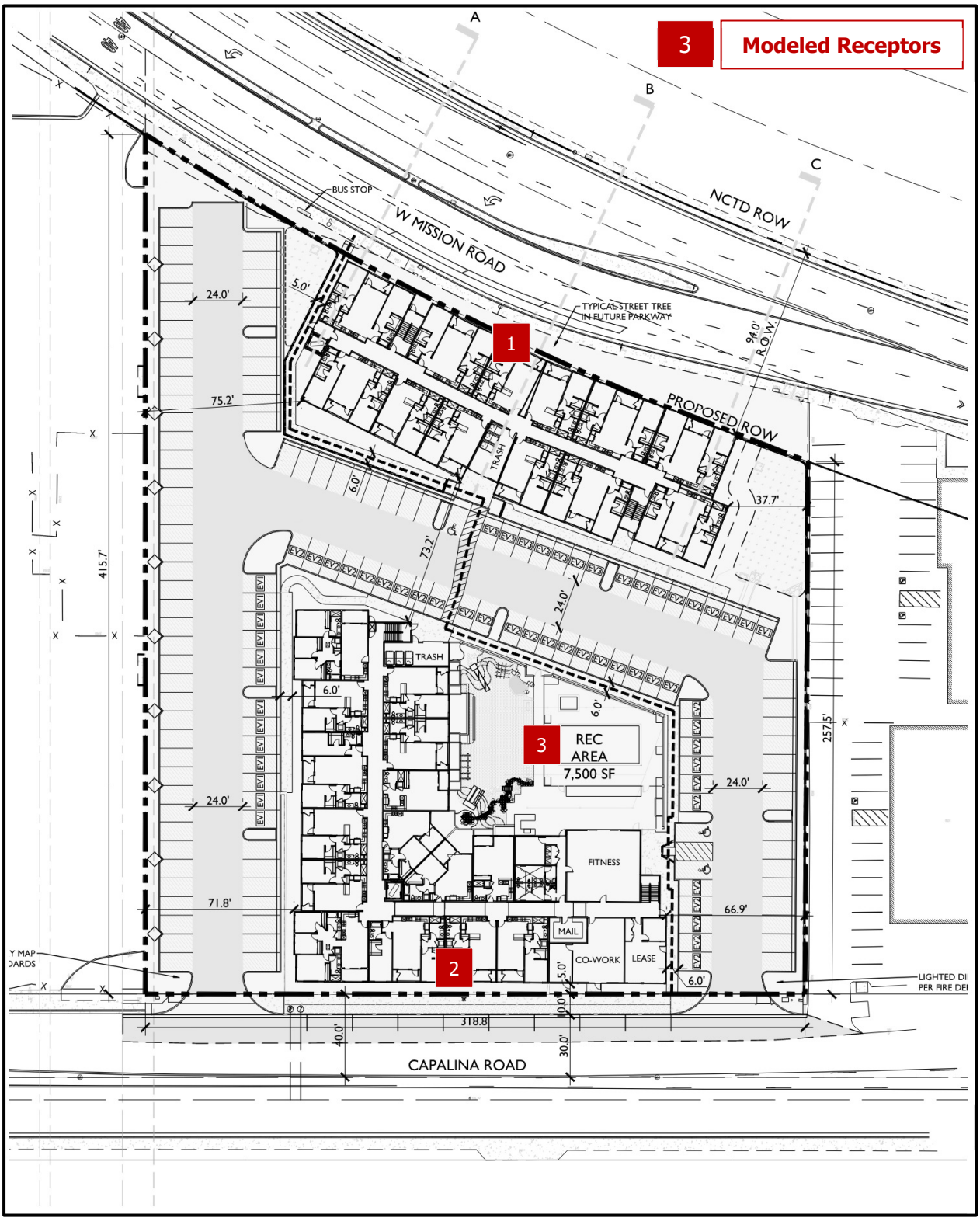
Table 5-2 presents the roadway parameters used in the analysis including the peak traffic volumes, vehicle speeds and the hourly traffic flow distribution (vehicle mix). The vehicle mix provides the hourly distribution percentages of automobiles, medium trucks and heavy trucks for input into the FHWA Model. The Buildout conditions for Mission Road and Capalina Road include the future year 2050 traffic volume forecasts provided by the project traffic study by CR Associates, (CR Associates, 2023). In addition, the Project is located over 800 feet north of SR-78. According to the City of San Marcos' General Plan Noise Element, background noise levels from future traffic along SR-78 is 60 dBA CNEL at approximately 800 feet. The noise contours for this area would also include Mission Road and Sprinter noise that may contribute to that contour. The modeled observer locations for the potential outdoor use areas for are presented in Figure 5-B.

Table 5-2: Future Traffic Parameters

Roadway	Average Daily Traffic (ADT)[1]	Peak Hour Volumes[1]	Modeled Speeds (MPH)	Vehicle Mix %[2]		
				Auto	Medium Trucks	Heavy Trucks
Mission Road	24,579	2,460	40	96	2	2
Capalina Road	5,174	517	35	96	2	2

[1] Source: CR Associates, Capalina Development Draft Local Transportation Analysis, Year 2050
[2] Typical City vehicle mix

Figure 5-B: Modeled Receptor Locations



5.3 Onsite Rail Line Noise

The proposed Project is located approximately 155 feet from the San Diego Northern Railroad (SDNR) consisting of Sprinter service operated by the NCTD. According to the City of San Marcos General Plan Noise Element, the 65 dBA CNEL noise contour from the rail activity, with no shielding, is located 130 feet from the centerline of the railroad.

5.4 Cumulative Noise Levels

The noise levels determined for the roadway and train activities were combined to determine the overall cumulative noise levels at the proposed receptors. Sound levels are logarithmic and so cannot be manipulated without being converted back to a linear scale. You must first antilog each number, add or subtract and then log them again in the following way.

$$L = 10 * Log \sum_{i}^{n} 10^{\frac{Li}{10}} \; or \; L = 10 * Log\,[10^{\frac{54}{10}} + 10^{\frac{59}{10}}] = 60 \text{ dBA CNEL}$$

A spreadsheet calculation was used which computes equivalent noise levels for each of the time periods used in the calculation of CNEL. Weighting these equivalent noise levels and summing them gives the CNEL for the traffic projections. The modeling results for the adjacent roadways and the cumulative noise levels with the background noise from SR-78 and train noise are provided in Figure 5-C, on the following page.

Based upon these findings, noise control recommendations are necessary at the ground floor patios and upper floor balconies along Mission Road to comply with the City Noise Standard of 65 dBA CNEL. To determine the required barrier heights at the patios and balconies along Mission Road, the Fresnel Barrier Reduction Calculations based on distance, source height, receiver elevation and the top of barrier were modeled. The Fresnel calculations are provided as an ***Attachment A.***

It was determined that 5-foot noise barriers located at the private patios and balconies would provide a 7.9 dBA noise reduction from the roadway and a 6.9 dBA noise reduction from the train for an overall noise reduction of 7.7 dBA. The resultant cumulative noise level would be reduced to 64.4 dBA CNEL. Based upon these findings the future noise levels at the patios and balconies were found to comply with the City's 65 dBA CNEL noise standard. These recommendations are shown in Figure 5-C for the ground floor patios and upper floor balconies. The barriers must be constructed of a non-gapping material consisting of masonry, ¼ inch thick glass, earthen berm or any combination of these materials.

Additionally, three decibels of attenuation is allowed for the first row of buildings when they block 40 to 65% of the line of sight to the noise source, and five decibels of attenuation is allowed when the buildings obstruct more than 65% of the line of sight (Source: (Caltrans, 2006)). The

line of sight to the roadways and the rail line from the park/outdoor use areas are blocked by the existing and proposed structures by more than 65%, therefore a factor of 5 dBA was taken into account. It was determined that the outdoor noise levels are expected to be as high as 63.6 dBA CNEL at the park/outdoor use area and would comply with the City's 65 dBA CNEL noise standard. Therefore, noise control measures are required for the common outdoor areas.

Figure 5-C: Future Unmitigated Exterior Noise Levels

Traffic Volumes, Mix and Speeds

	Autos	Med. Trucks	Heavy Trucks
Mix Ratio by Percent	96.0	2.0	2.0
Propagation Rule	Hard		

Roadway	**ADT**	**Speed MPH**	**Distance**	**CNEL**
Mission Road	24,579	40	50	72.0
Capalina Road	5,174	35	50	64.0
SR-78			800	60.0
Sprinter			130	65.0

Noise Reduction due to Distance

Receptor 1

	Distance	**Reduction**	**Resultant Level**
Mission Road	60	-0.79	71.2
Sprinter	135	-0.16	64.8
Cumulative Noise Level			**72.1**

Receptor 2

	Distance	**Reduction**	**Resultant Level**
Capalina Road	55	-0.41	63.6
SR-78	890	-0.46	59.5
Cumulative Noise Level			**65.0**

Common Area

	Distance	**Reduction**	**Resultant Level**
Mission Road	200	-6.02	66.0
Capalina Road	120	-3.80	60.2
SR-78	990	-0.93	59.1
Sprinter	290	-3.48	61.5
Cumulative Noise Level			**68.6**

Table 5-3: Future Mitigated Exterior Noise Levels

Receptor Number	Receptor Location	Noise Level @ Receptor (dBA CNEL) [1]	Reduction Due to Shielding (dBA CNEL)	Resultant Noise Level (dBA CNEL)
1	Building Facades along Mission Road	72.1	-7.7	64.4
2	Building Facades along Capalina Road	65.0	-	65.0
3	Park/Outdoor Area	68.6	-5.0	63.6

[1] FHWA Highway Traffic Noise Prediction Model, FHWA-RD-77-108

Additionally, a final interior noise assessment is required prior to the issuance of the first building permit since the exterior noise levels at the building facades are above 60 dBA CNEL. This final report would identify the interior noise requirements based upon architectural and building plans to meet the City's established interior noise limit of 45 dBA CNEL. It should be noted; interior noise levels of 45 dBA CNEL can easily be obtained with conventional building construction methods and providing a closed window condition requiring a means of mechanical ventilation (e.g., air conditioning) for each building and upgraded windows for all sensitive rooms (e.g., bedrooms and living spaces).

5.5 Project Related Offsite Transportation Noise

To determine if direct or cumulative off-site noise level increases associated with the development of the proposed project would create noise impacts, the traffic volumes for the existing conditions were compared with the traffic volume increase of existing plus the proposed project. The project is estimated to only generate 874 daily trips with a peak hour volume of 80 trips according to the project traffic study (Source: (CR Associates, 2023)). The existing average daily traffic (ADT) volumes on the adjacent roadways is several thousand ADT. Typically, it requires a project to double (or add 100%) the traffic volumes to have a direct impact of 3 dBA CNEL or be a major contributor to the cumulative traffic volumes. The project would not double the traffic volumes to any adjacent roadway volumes. Therefore, no direct or cumulative impacts are anticipated.

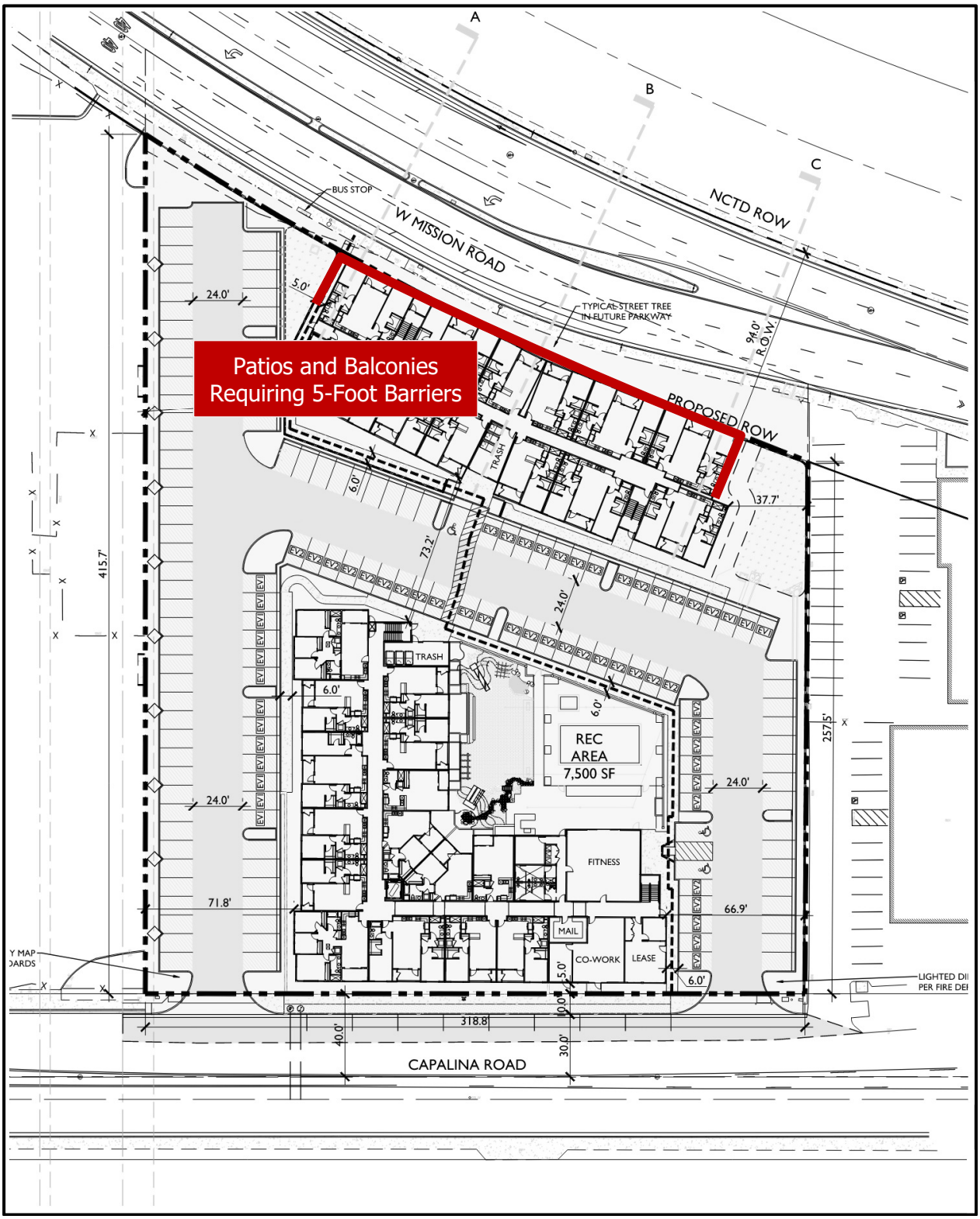
5.6 Transportation Noise Conclusions

The results of this analysis indicate that future vehicle noise from Mission Road, Capalina Road, State Route 78 (SR-78) and the Sprinter commuter rail are the principal sources of noise that will impact the site. Due to the combined roadway and train activities, the outdoor use areas were found to exceed the City's 65 dBA CNEL threshold without noise control measures. Noise control recommendations in the form of 5-foot barriers installed at the balconies/decks for the units having direct line of sight to Mission Road is needed to comply with the City of San Marcos Noise standards for multi-family uses based on transportation related noise sources (i.e., vehicle).

Additionally, a final noise assessment is required prior to the issuance of the first building permit since the building facades are above 60 dBA CNEL. This final report would identify the interior noise requirements based upon architectural and building plans. It should be noted; interior noise levels of 45 dBA CNEL can be obtained with conventional building construction methods and providing a closed window condition requiring a means of mechanical ventilation (e.g., air conditioning) and upgraded windows for all sensitive rooms (e.g., bedrooms and living spaces).

The Project does not create a noise increase of more than 3 dBA CNEL on any of the analyzed roadway segments. Therefore, the Project's contributions to off-site roadway noise increases will not cause any significant impacts to any existing or future noise sensitive land uses.

Figure 5-D: Noise Control Recommendations



6.0 OPERATIONAL NOISE

This section examines the potential operational noise source levels associated with the development and operation of the proposed project. Noise from a fixed or point source drops off at a rate of 6 dBA for each doubling of distance. Which means a noise level of 70 dBA at 5 feet would be 64 dBA at 10 feet and 58 dBA at 20 feet. A review of the proposed project indicates that noise sources such as the roof mounted mechanical ventilation system (HVAC) are the primary source of stationary noise.

Properties directly surrounding the project site are all designated as commercial/mixed under the City General Plan. The nearest residential use is the mobile home park located south across Capalina Road which is zoned R-MHP which is the same threshold as multi-family. Therefore, the City Ordinance limits of 65 dBA hourly noise standard during the daytime hours between 7 a.m. and 10 p.m., a 55 dBA standard during the nighttime hours between 10 p.m. and 7 a.m. would apply at all property lines.

Roof-top mechanical ventilation units (HVAC) will be installed at the proposed residential units. The project anticipates installing Carrier CA15NA (Series, 24-A) or equivalent HVAC units with a reference noise level of 71 dBA at 3-feet (Source: Carrier). The manufacturer's specifications and noise levels are provided in Attachment B. The HVAC units will cycle on and off throughout the day. Typically, HVAC units run for approximately 20 minutes each operating cycle to provide the necessary heating or cooling. It is anticipated that the HVAC units will operate twice in any given hour or run for 40 minutes in any given hour. Noise levels drop 3 decibels each time the duration of the source is reduced in half.

Therefore, hourly HVAC noise level over a 40-minute period would be reduced approximately 2 decibels to 69 dBA based on operational time. To predict the property line noise level, a reference noise level of 69 dBA at 3-feet was used to represent the HVAC units.

The HVAC units are located a minimum of 160 feet from the residential property lines and will be shielded by the parapet walls that will break the line of sight to the HVAC units and will provide a minimum 5 dBA reduction. The typical locations of the proposed HVAC units are shown in Figure 6-1. Up to 15 units will be clustered together closest to the nearest residential property line to the south. The remainder of the units are separated by at least 80 feet and this separation would result in a 20 dBA difference between other HVAC clusters and would not cumulatively increase the noise levels. Therefore, the worst-case combined noise from the HVAC would occur from 15 units.

Utilizing a 6 dBA decrease per doubling of distance, noise levels at the nearest residential property line as described above were calculated for the HVAC. The HVAC units are located a minimum of 160 feet from the nearest residential property lines. The noise level reductions due to distance

and the building for the nearest property line is provided in Table 6-1 below.

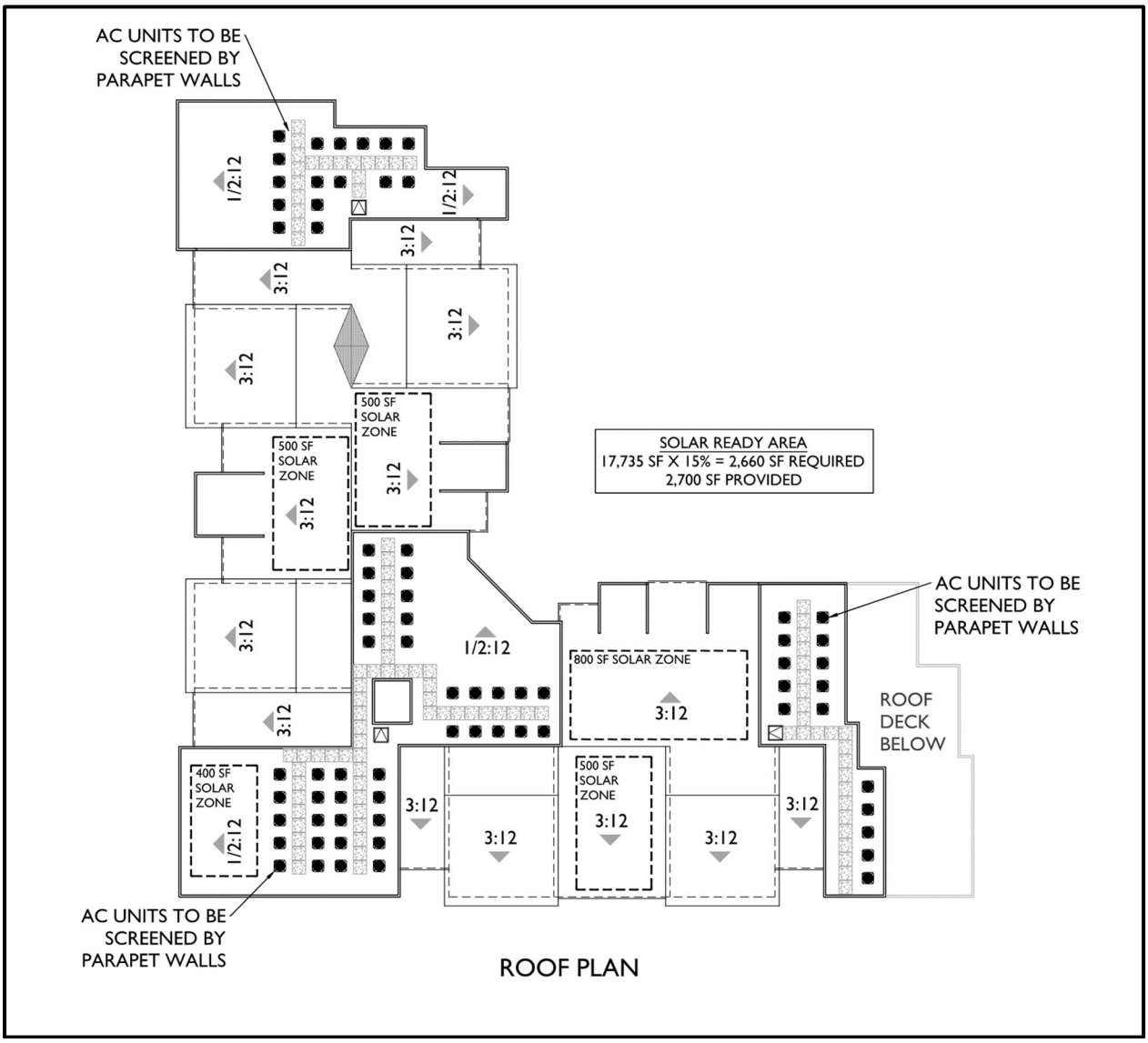
Table 6-1: Project HVAC Noise Levels (Southern Residential Property Line)

Distance to Nearest Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due to Distance (dBA)	Reduction Due to Buildings (dBA)	Noise Level at Property Line (dBA)	Quantity	Property Line Cumulative Noise Level (dBA)*
160	69.0	3.0	-34.5	-5.0	29.5	15	**41.2**
*Complies with the nighttime Noise Standard of 55 dBA.							

Additionally, the noise levels at the nearest retail uses adjacent to the project to the west were analyzed using the same methodology described above. Up to 20 units will be clustered closest to the western property line and would be separated by the remaining HVAC units by parapet walls and distance. Based on the distance to the property line to the west, noise associated with the operation of the HVAC units are expected to be 46.0 dBA or lower, which is below the 55 dBA nighttime threshold for commercial uses.

The noise levels from the proposed roof-mounted HVAC would be considered less than significant at the residential property line to the south and the commercial lines to the west and east with the proposed parapet walls and are in compliance with the City of San Marcos Municipal Code Sections 10.24.

Figure 6-1: Locations of Proposed HVAC Units



7.0 SUMMARY OF PROJECT IMPACTS, MITIGATION & CONCLUSION

Construction Noise

The grading equipment will be spread out over the project site from distances near the occupied property lines to distances of 200 feet or more away. Based upon the site plan the majority of the grading operations, on average, will occur more than 100 feet from the property lines. At an average distance of 100 feet from the construction activities to the nearest property line, noise levels will comply with the 75 dBA Leq standard over 8 hours at the property lines. The material haulage is also anticipated to comply with the City's thresholds. Therefore, no impacts are anticipated and no mitigation is required during construction of the proposed Project. Additionally, all equipment should be properly fitted with mufflers and all staging and maintenance should be conducted as far away from the existing residence as possible. No blasting or rock crushing is anticipated during the grading operations. Therefore, no impulsive noise sources are expected and the Project will comply with Section 17.60.06 of the City Noise Ordinance.

Onsite Transportation Noise

The results of this analysis indicate that future vehicle noise from Mission Road, Capalina Road, State Route 78 (SR-78) and the Sprinter commuter rail are the principal sources of noise that will impact the site. Due to the combined roadway and train activities, the outdoor use areas were found to exceed the City's 65 dBA CNEL threshold without noise control recommendations. Noise control measures in the form of 5-foot barriers installed at the balconies/decks for the units having direct line of sight to Mission Road is needed to comply with the City of San Marcos Noise standards for multi-family uses based on transportation related noise sources (i.e., vehicle).

Additionally, a final noise assessment is required prior to the issuance of the first building permit since the building facades are above 60 dBA CNEL. This final report would identify the interior noise requirements based upon architectural and building plans. It should be noted; interior noise levels of 45 dBA CNEL can be obtained with conventional building construction methods and providing a closed window condition requiring a means of mechanical ventilation (e.g., air conditioning) and upgraded windows for all sensitive rooms (e.g., bedrooms and living spaces).

Offsite Transportation Noise

The Project does not create a noise increase of more than 3 dBA CNEL on any of the analyzed roadway segments. Therefore, the Project's contributions to off-site roadway noise increases will not cause any significant impacts to any existing or future noise sensitive land uses.

Operational Noise

Based on noise levels, the distances to the property lines and the proposed parapet walls, the noise levels from the proposed roof-mounted HVAC would be considered less than significant at the residential property line to the south and are in compliance with the City of San Marcos Municipal Code Sections 10.24.

8.0 REFERENCES

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ATTACHMENT A

FRESNEL BARRIER CALCULATIONS

Mission Road

Source to Receiver Horizontal Distance (ft) = 65.00
Source to Barrier Horizontal Distance (ft) = 60.00
Barrier to Receiver Horizontal Distance (ft) = 5.00
Source Height (ft) = 0.00
Receiver Height (ft) = 9.00
Barrier Height (ft) = 10.00
Distance Source to Receptor (ft) d = 65.62
Distance Source to Barrier top (ft) d1 = 60.83
Distance Barrier top to Receiver (ft) d2 = 5.10

Frequency (Hz) = 500 Attenuation (db) = 7.9 Fresnel N = 0.272

Sprinter

Source to Receiver Horizontal Distance (ft) = 140.00
Source to Barrier Horizontal Distance (ft) = 135.00
Barrier to Receiver Horizontal Distance (ft) = 5.00
Source Height (ft) = 0.00
Receiver Height (ft) = 9.00
Barrier Height (ft) = 10.00
Distance Source to Receptor (ft) d = 140.29
Distance Source to Barrier top (ft) d1 = 135.37
Distance Barrier top to Receiver (ft) d2 = 5.10

Frequency (Hz) = 500 Attenuation (db) = 6.9 Fresnel N = 0.160