NOISE ASSESSMENT

Artis Assisted Living Facility Development
City of San Marcos

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April 9, 2019

Project: 18-44 Artis Assisted Living Noise

TABLE OF CONTENTS

TABLE OF CONTENTS II
LIST OF FIGURES III
LIST OF TABLES III
ATTACHMENTS III
GLOSSARY OF COMMON TERMS IV
EXECUTIVE SUMMARY V
1.0 PROJECT INTRODUCTION 1
1.1 PURPOSE OF THIS STUDY 1
1.2 PROJECT DESCRIPTION 1
1.3 PROJECT LOCATION 1
2.0 FUNDAMENTALS 4
2.1 ACOUSTICAL FUNDAMENTALS 4
2.2 VIBRATION FUNDAMENTALS 5
3.0 SIGNIFICANCE THRESHOLDS AND STANDARDS 7
3.1 CONSTRUCTION NOISE 7
3.2 TRANSPORTATION NOISE STANDARDS 7
3.3 VIBRATION STANDARDS 7
3.4 TRANSPORTATION NOISE STANDARDS 9
4.0 CONSTRUCTION NOISE AND VIBRATION 11
4.1 CONSTRUCTION NOISE PREDICTION METHODOLOGY 11
4.2 GRADING ACTIVITIES NOISE FINDINGS AND MITIGATION 11
4.3 CONSTRUCTION VIBRATION FINDINGS AND MITIGATION 12
5.0 TRANSPORTATION NOISE 14
5.1 EXISTING NOISE ENVIRONMENT ONSITE 14
5.2 FUTURE ONSITE NOISE PREDICTION 16
5.3 ONSITE NOISE FINDINGS AND MITIGATION 18
5.4 PROJECT RELATED OFFSITE TRANSPORTATION NOISE 18

LIST OF FIGURES

FIGURE 1-A: PROPOSED PROJECT SITE DEVELOPMENT PLAN 2
FIGURE 1-B: PROJECT VICINITY MAP 3
FIGURE 5-A: AMBIENT MONITORING LOCATIONS 15
FIGURE 5-B: MODELED RECEPTOR LOCATIONS 17

LIST OF TABLES

TABLE 2-1: HUMAN REACTION TO TYPICAL VIBRATION LEVELS 6
TABLE 3-1: GROUNDBORNE VIBRATION AND NOISE IMPACT CRITERIA (HUMAN ANNOYANCE) 8
TABLE 3-2: GROUNDBORNE VIBRATION IMPACT CRITERIA (STRUCTURAL DAMAGE) 8
TABLE 3-3: NOISE COMPATIBILITY GUIDELINES 9
TABLE 3-4: NOISE STANDARDS 10
TABLE 4-1: CONSTRUCTION NOISE LEVELS 12
TABLE 4-2: VIBRATION LEVELS FROM CONSTRUCTION ACTIVITIES 12
TABLE 5-1: MEASURED AMBIENT NOISE LEVELS 14
TABLE 5-2: FUTURE TRAFFIC PARAMETERS 16
TABLE 5-3: FUTURE EXTERIOR NOISE LEVELS 18
TABLE 5-4: EXISTING NOISE LEVELS 20
TABLE 5-5: EXISTING + PROJECT NOISE LEVELS 20
TABLE 5-6: EXISTING VS. EXISTING + PROJECT NOISE LEVELS (DBA CNEL) 20

ATTACHMENTS

FUTURE EXTERIOR NOISE MODELING 21

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 night time 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 and vibration impacts to and from the proposed Artis Assisted Living Facility Project (Project). Requested entitlements for the proposed Project includes a Specific Plan Amendment to the University Commons Specific Plan to modify the current designation on the project site from Light Industrial to Senior Residential and approval of a Site Development Plan.

The proposed Project would construct a 64-unit residential assisted living facility focused exclusively on memory care on an undeveloped 2.18 acre lot within the City of San Marcos. All phases (i.e. grading, paving and construction) of the proposed Project are anticipated to start in 2020 and be fully operational in 2021.

Construction Noise

Grading will also be required for the proposed project. The grading equipment will be spread out over the project site from distances near the occupied property lines to distances of 350 feet or more away. Based upon the site plan the majority of the construction activities, on average, will occur 175 feet from the property lines. At an average distance of 175 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. 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 for the existing uses as possible.

Construction Vibration

The nearest vibration-sensitive uses is the Prestige Preschool located 65 feet or more from the proposed construction. The average vibration levels that would be experienced at the nearest vibration sensitive land uses to the east from 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 buildings near the demolition and construction areas. The FTA criterion for infrequent vibration induced annoyance is 83 Vibration Velocity (VdB) for institutional 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.

Onsite Transportation Noise

The outdoor areas, which include ground floor patios, were modeled to determine if shielding/mitigation is required to reduce the noise levels below the City's 60 dBA CNEL threshold. Based on the future traffic volumes, the proposed outdoor use area will comply with the City of San Marcos Noise standards of 60 dBA CNEL without mitigation.

The building facades were found to be above 60 dBA CNEL and an interior noise assessment is required prior to the issuance of the 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 to meet the City's established interior noise limit of 45 dBA CNEL.

Offsite Transportation Noise

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

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 mitigation measures to bring those impacts to a level that would be considered less then significant.

1.2 Project Description

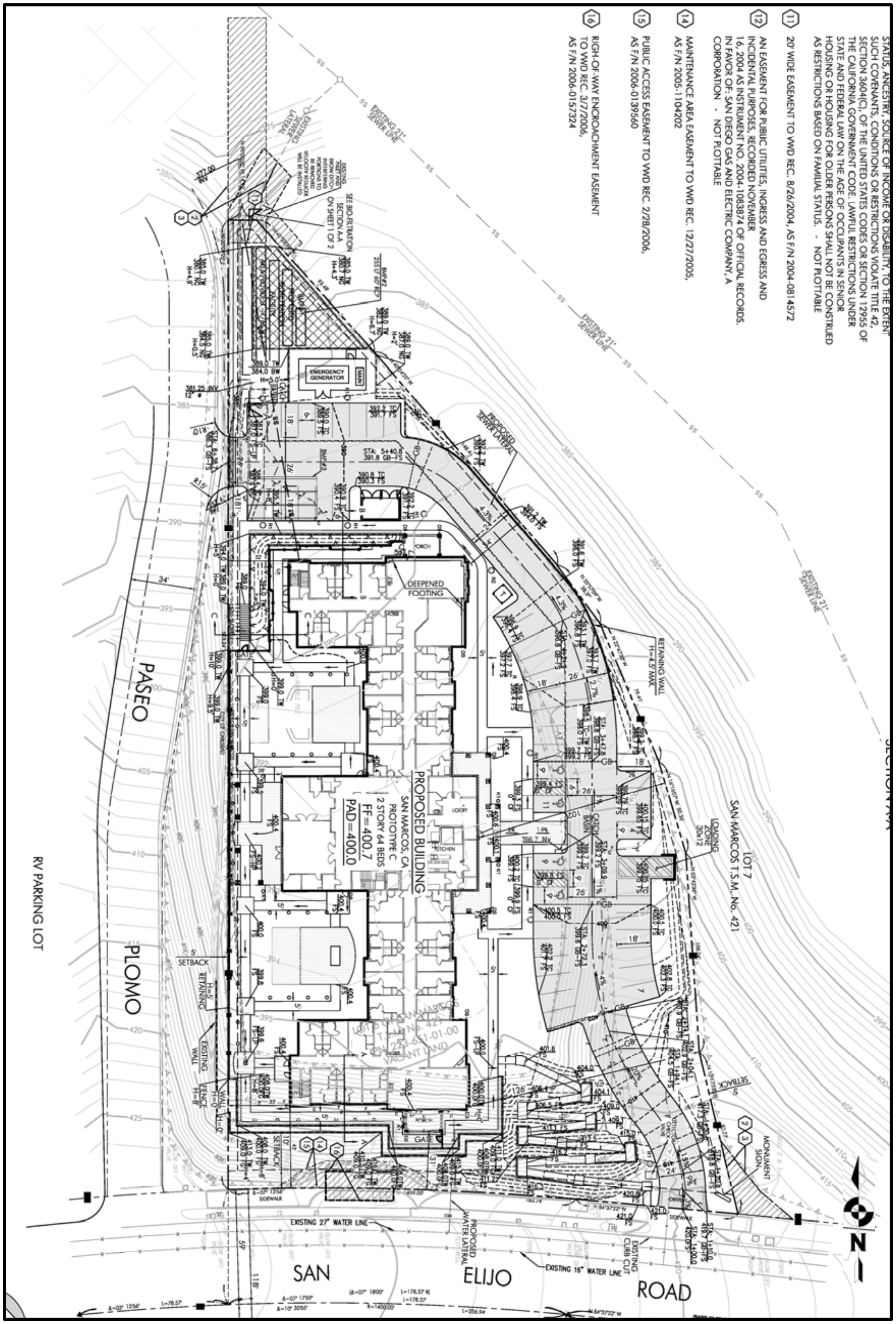
The project proposes to develop a 64-unit residential assisted living facility on an undeveloped lot within the City of San Marcos. All phases (i.e. grading, paving and construction) of the proposed Project are anticipated to start in 2020 and be fully operational in 2021. The project development plan is shown on Figure 1-A of this report.

The property is zoned light industrial in the University Commons Specific Plan Area. A specific plan amendment to allow Senior Residential in the SPA will be requested to allow for an assisted living facility to be allowed in this zone.

1.3 Project Location

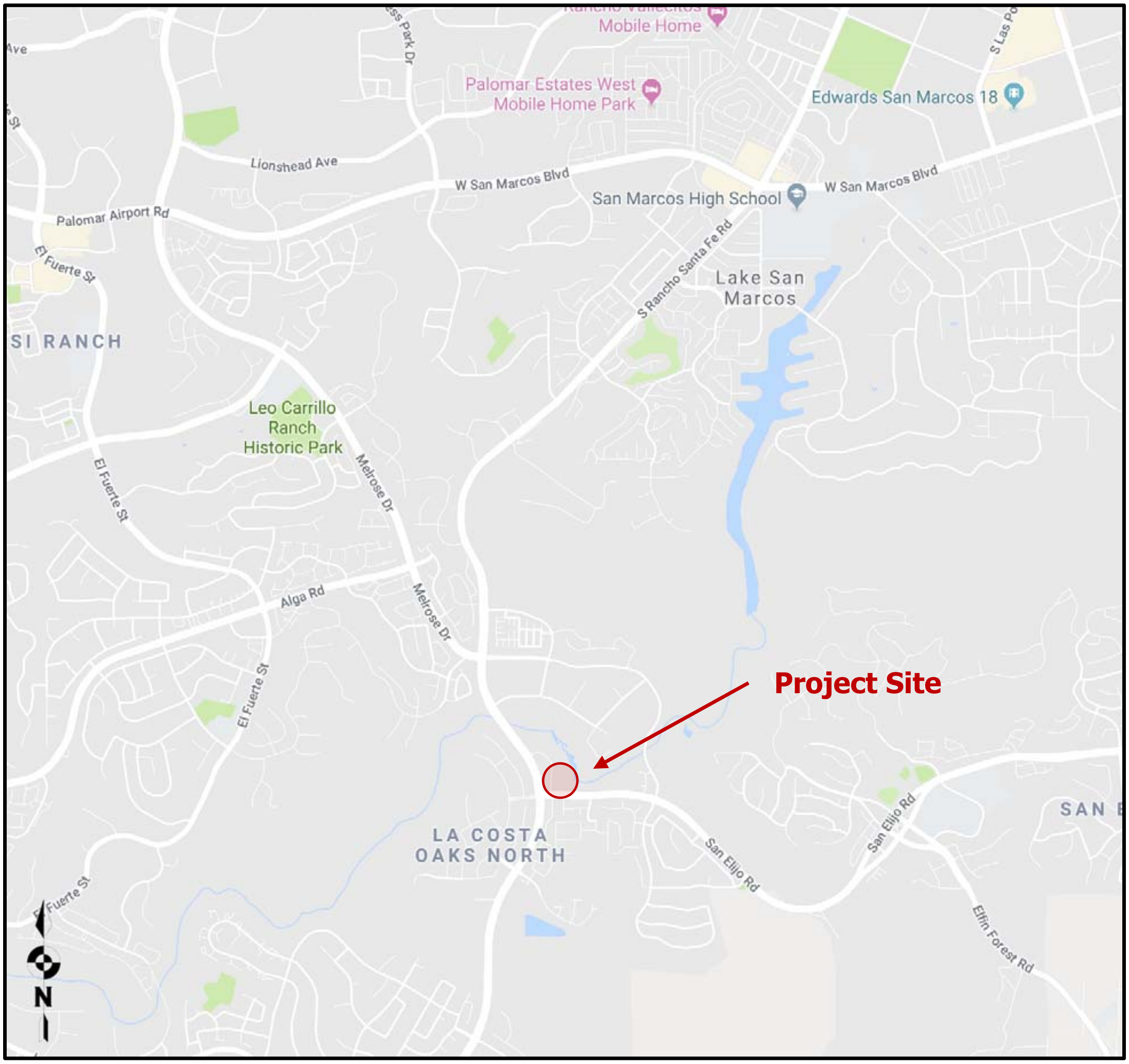
The Project site is located on the north side of San Elijo Road and east of Rancho Santa Fe Road. The Project site is an undeveloped 2.18 acre parcel. The Project site is bounded by Prestige Preschool and a recreational vehicle parking lot to the west, and Multi-Family to the south. A project vicinity map and location map are shown in Figure 1-B.

Figure 1-A: Proposed Project Site Development Plan



Source: (Pacific Coast Civil, Inc., 2018)

Figure 1-B: Project Vicinity Map



Source: (Google, 2018)

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 appears louder.

A vehicles 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, 2002.		

3.0 SIGNIFICANCE THRESHOLDS AND STANDARDS

3.1 Construction Noise

Grading, excavation or other related earth moving operations, including warm-up and maintenance activities, shall be limited to the hours of 7:00 a.m. to 4:30 p.m., Monday through Friday. No work shall be allowed on Saturdays, Sundays and holidays.

All construction operations authorized by building permits, including the delivery, setup and use of equipment must be conducted on premises during the hours of 7:00 AM and 6:00 PM on Monday through Friday, and on Saturday between 8:00 AM and 5:00 PM. No work shall be conducted on Sundays or Holidays observed by the City.

3.2 Transportation Noise Standards

To control transportation related noise sources such as arterial roads, freeways, airports and railroads, the City of San Marcos has established guidelines for acceptable community noise levels in the Noise Element of the General Plan. For noise sensitive rural and single family residential uses, schools, libraries, parks and recreational areas the City Noise Element requires an exterior noise level of less than 60 dBA CNEL for outdoor usable areas. For multi-family developments the standard is 65 dBA CNEL and a standard of 70 dBA CNEL is typically applied to commercial uses. The City has also established an interior noise limit of 45 dBA CNEL for all residential uses.

3.3 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.

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: US Department of Transportation Federal Transit Administration (FTA), *Transit Noise and Vibration Impact Assessment,* June 2006.
[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.

In addition to the vibration annoyance standards presented above, the FTA also applies the following standards for construction vibration damage. As shown in Table 3-2, structural damage is possible for typical 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. The potential noise and vibration impacts are analyzed separately below.

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: US Department of Transportation Federal Transit Administration (FTA), *Transit Noise and Vibration Impact Assessment,* June 2006.
Notes: RMS velocity calculated from vibration level (VdB) using the reference of one microinch/second.

3.4 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.

Table 3-3: Noise Compatibility Guidelines

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

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

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.

City of San Marcos GENERAL PLAN | Noise | Page 7-8

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).

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.

City of San Marcos GENERAL PLAN | Noise | Page 7-9

4.0 CONSTRUCTION NOISE AND VIBRATION

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 development will consist of up to two large bulldozers, haul trucks, two rubber tire dozers, four scrapers, a water truck, a medium sized front loader, a medium sized excavator and a small to medium sized road grader. 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.

4.2 Grading Activities Noise Findings and Mitigation

The grading activities will consist of the preparation of graded slopes, bioretention basins, internal roadways, and the finished building pad. Earthwork activities will include 250 cubic yards (cy) of cut and 24,443 cy of fill material. The grading equipment will be spread out over the project site from distances near the property lines to distances of 350 feet. Based upon the site plan the majority of the grading operations, on average, will occur an average of 175 feet from the nearest off-site property line to the west that includes a child care facility and the multi-family residential located to the south across San Elijo Road. This means that most of the time the average distance from all the equipment to the same property line is 175 feet or more. As can be seen in Table 4-1, at an average distance of 175 feet from the construction activities to the nearest property line would result in a noise attenuation of -6.0 dBA without shielding.

Table 4-1: Construction Noise Levels

Equipment Type	Quantity Used	Source @ 50 Feet (dBA)	Cumulative Noise Level @ 50 Feet (dBA)
Tractor/Backhoe	2	72	75.0
Grader	2	75	78.0
Water Truck	1	70	70.0
Haul Trucks	2	75	78.0
		Cumulative Level	82.2
		Distance to Sensitive Use	175
		Noise Reduction due to Distance	-10.9
		Property Line Noise Level	**71.4**

Given this, the noise levels will comply with the 75 dBA Leq standard at the adjacent property lines. 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 for the existing uses as possible.

4.3 Construction Vibration Findings and Mitigation

The nearest vibration-sensitive uses is the Prestige Preschool located as close as 65 feet from the nearest proposed construction activities. Table 4-2 lists the average vibration levels that would be experienced at the nearest vibration sensitive land uses from the temporary construction activities.

Table 4-2: Vibration Levels from Construction Activities

Equipment	Approximate Velocity Level at 25 Feet (VdB)	Approximate RMS Velocity at 25 Feet (in/sec)	Approximate Velocity Level at 200 Feet (VdB)	Approximate RMS Velocity at 200 Feet (in/sec)
Small bulldozer	58	0.003	48	0.0010
Jackhammer	79	0.035	70	0.0122
Loaded trucks	86	0.076	74	0.0266
Large bulldozer	87	0.089	78	0.0311
		FTA Criteria	83	0.2
		Significant Impact?	**No**	**No**
[1] PPV at Distance D = PPVref x $(25/D)^{1.5}$				

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 buildings near the demolition and construction areas. The FTA criterion for infrequent vibration induced annoyance is 83 Vibration Velocity (VdB) for institutional 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.

5.0 TRANSPORTATION NOISE

5.1 Existing Noise Environment Onsite

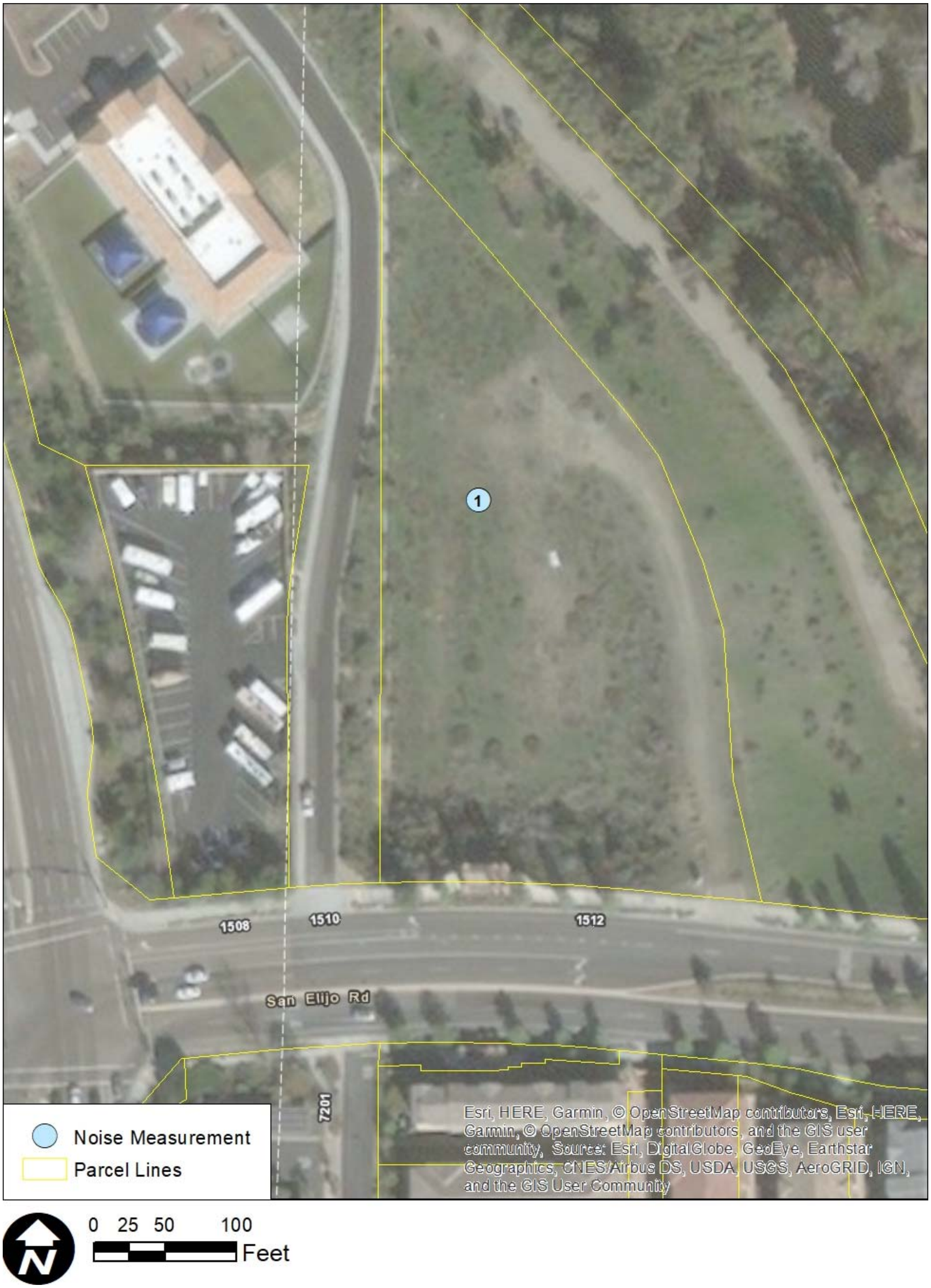
Noise measurements were taken using a Larson-Davis Model LxT Type 1 precision sound level meter, programmed, in "slow" mode, to record noise levels in "A" weighted form. The sound level meter and microphone were mounted on a tripod, five feet above the ground and equipped with a windscreen during all measurements. The sound level meter was calibrated before and after the monitoring using a Larson-Davis calibrator, Model CAL 150.

The ambient measurements were conducted on November 5, 2018 between 1:15 – 1:30 pm. 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 adjacent Rancho Santa Fe Road and San Elijo Road. The overall sound level was found to be 48.3 dBA. The overall noise levels were relatively low due to the site being depressed below the roadways and the existing RV storage facility and child care facility blocking direct line of sight to the roadway. 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	Central portion of site	1:15-1:26 p.m.	48.3	67.6	41.3	50.9	47.5	44.2
Source: Ldn Consulting November 5, 2018								

Figure 5-A: Ambient Monitoring Locations



5.2 Future Onsite Noise Prediction

To determine the future noise environment and impact potentials the Sound32 model was utilized. The critical model input parameters, which determine the projected vehicular traffic noise levels, include vehicle travel speeds, the percentages of automobiles, medium trucks and heavy trucks in the roadway volume, the site conditions and the peak hour traffic volume. 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 automobile, medium trucks and heavy trucks for input into the Sound32 Model. The 2035 Buildout conditions include the future traffic volume forecasts provided by SANDAG Traffic Forecast Model.

Table 5-2: Future Traffic Parameters

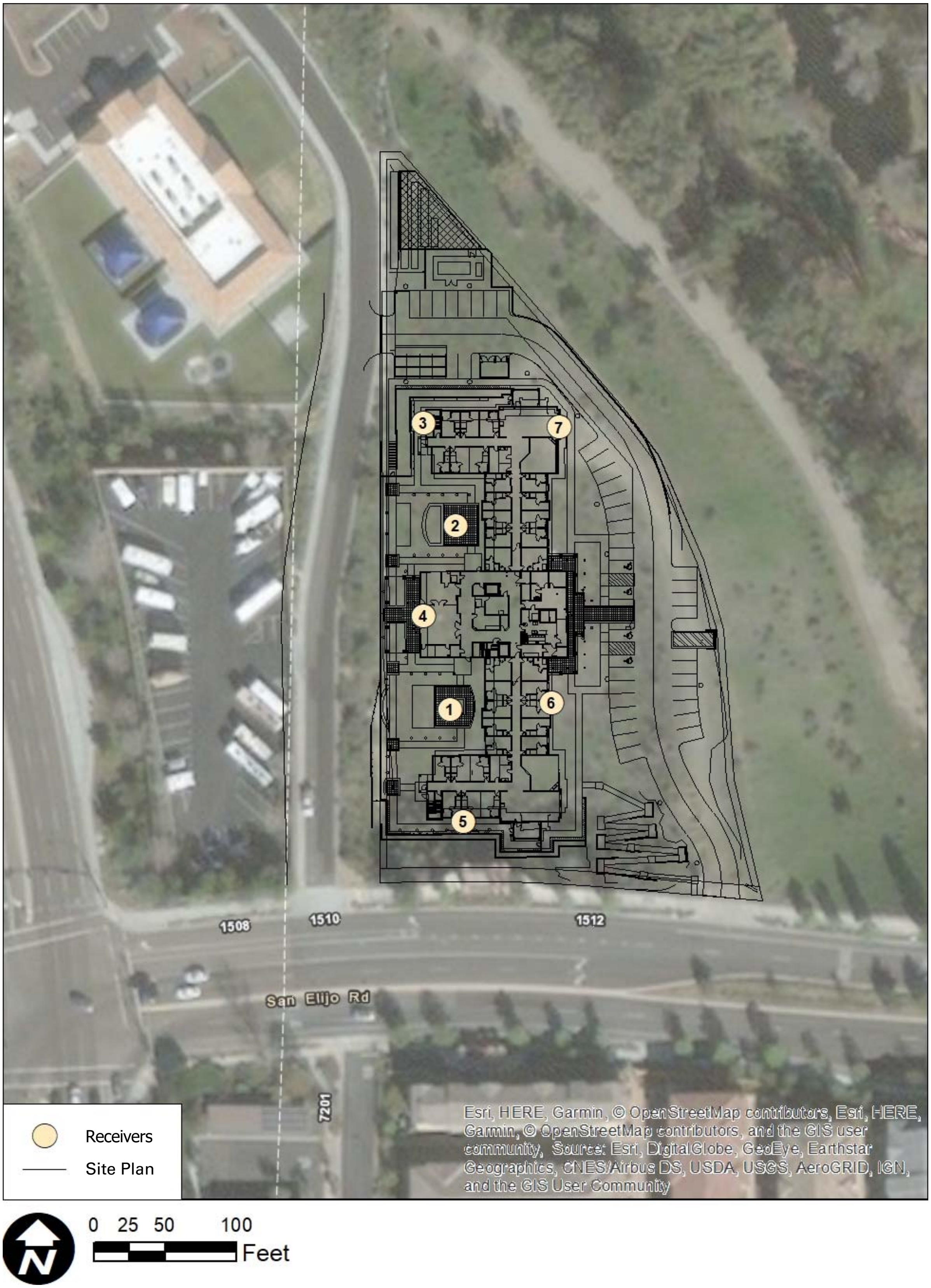
Roadway	Average Daily Traffic (ADT)[1]	Peak Hour Volumes[1]	Modeled Speeds (MPH)	Auto	Medium Trucks	Heavy Trucks
San Elijo Road	27,200	2,720	40	2,611	54	54
Rancho Santa Fe Road (North of San Elijo Road)	37,400	3,740	55	3,590	75	75
Rancho Santa Fe Road (South of San Elijo Road)	48,700	4,870	55	4,675	97	97

[1] Source: SANDAG 2018
[2] Typical City vehicle mix = 96%/2%/2%

The required coordinate information necessary for the noise model input was taken from the conceptual site plans provided by Pacific Cost Civil, Inc. October 2018. The conceptual plans were used to identify the pad elevations, roadway elevations, and the relationship between the noise source(s) and the outdoor receptor areas.

To evaluate the potential noise impacts on the proposed development, outdoor observers were located in the sensitive use areas provided by common use recreation areas. No private ground floor patios or balconies are proposed. The receptors were placed five feet above the pad elevation and near the center of the use area. Building façade noise levels were also determined using a height of 15 feet above the pad elevations for the second floor locations. The modeled observer locations for the potential outdoor use areas and building facades are presented in Figure 5-B.

Figure 5-B: Modeled Receptor Locations



5.3 Onsite Noise Findings and Mitigation

The outdoor common use areas were modeled to determine if shielding/mitigation is required to reduce the noise levels below the City's 60 dBA CNEL threshold. It was determined that the ground level outdoor use areas will comply with the City's noise standard of 60 dBA CNEL. The modeling results are provided in Table 5-3 for the ground floor outdoor use areas, depicted as receptor numbers 1 and 2. There is no outdoor access from second floor porches for the residences. The first floor and second floor building facades were modeled to determine if interior noise reductions will be needed. Based upon these findings, no noise mitigation would be necessary to comply with the City of San Marcos noise standard of 60 dBA CNEL at the outdoor useable areas. The modeling results for building second floor facades are provided in Table 5-3. The modeling input and outputs are provided in ***Attachment A***.

The building facades were found to be above 60 dBA CNEL and an interior noise assessment is required prior to the issuance of the 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 to meet the City's established interior noise limit of 45 dBA CNEL.

Table 5-3: Future Exterior Noise Levels

Receptor Number	Receptor Location	First Floor/Building Façade Noise Levels (dBA CNEL)*	Second Floor Building Façade Noise Levels (dBA CNEL)*
1	Southern Patio	54	NA
2	Northern Patio	58	NA
3	Northwest Façade	64	66
4	Central west Façade	58	65
5	Southern Façade	55	59
6	Southeast Facade	57	61
7	Northeast Facade	63	64

* Interior Noise Assessment required if façade noise level is above 60 dBA CNEL. The building will be constructed to comply with interior noise requirements per the building code.

5.4 Project Related Offsite Transportation Noise

The off-site Project related roadway segment noise levels projected in this report were calculated using the methods in the Highway Noise Model published by the Federal Highway Administration (FHWA Highway Traffic Noise Prediction Model, FHWA-RD-77-108, December, 1978). The FHWA Model uses the traffic volume, vehicle mix, speed, and roadway geometry to compute the equivalent noise level. 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 noise contours are then established by iterating the equivalent noise level over many distances until the distance to the desired noise contour(s) are found.

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.

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.

To determine if off-site noise level increases associated with the development of the Project will create noise impacts. The noise levels for the existing conditions were compared with the noise level increase from the Project. Utilizing the Project's traffic assessment (Source: SANDAG Series 13) noise levels were developed for the following traffic scenarios:

> Existing: SANDAG Series 13, year 2012 traffic conditions without construction of the project.
> Existing Plus Project: SANDAG Series 13, year 2012 traffic conditions plus the completion of the project.
> Existing vs. Existing Plus Project: Comparison of the direct project related noise level increases in the vicinity of the project site.

The noise levels at 50 feet for the roadways in the vicinity of the Project site are given in Table 5-4 for the Existing Scenario and in Table 5-5 for the Existing Plus Project Scenario. Note that the values given do not take into account the effect of any noise barriers or topography that may affect ambient noise levels. Table 5-6 presents the comparison of the Existing Year with and without Project related noise levels. The overall roadway segment noise levels will increase 0.1 dBA CNEL with the development of the Project. The Project does not create a noise increase of more than 3 dBA CNEL on any roadway segment. 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.

Table 5-4: Existing Noise Levels

Roadway	Roadway Segment	ADT[1]	Vehicle Speeds (MPH)[1]	Noise Level @ 50-Feet (dBA CNEL)
San Elijo Road	East of Rancho Santa Fe Road	24,800	40	78.1
Rancho Santa Fe	North of San Elijo Road	31,000	55	82.2
Rancho Santa Fe	South of San Elijo Road	43,200	55	83.7
[1] Source: SANDAG Series 13, Year 2012 Volumes				

Table 5-5: Existing + Project Noise Levels

Roadway	Roadway Segment	ADT[1]	Vehicle Speeds (MPH)[1]	Noise Level @ 50-Feet (dBA CNEL)
San Elijo Road	East of Rancho Santa Fe Road	24,992	40	78.2
Rancho Santa Fe	North of San Elijo Road	31,096	55	82.3
Rancho Santa Fe	South of San Elijo Road	43,296	55	83.7
[1] Source: SANDAG Series 13, Year 2012 Volumes				

Table 5-6: Existing vs. Existing + Project Noise Levels (dBA CNEL)

Roadway	Roadway Segment	Existing Noise Level	Existing Plus Project Noise Level	Project Related Noise Increase
San Elijo Road	East of Rancho Santa Fe Road	78.1	78.2	0.1
Rancho Santa Fe	North of San Elijo Road	82.2	82.3	0.1
Rancho Santa Fe	South of San Elijo Road	83.7	83.7	0.0

ATTACHMENT A

FUTURE EXTERIOR NOISE
MODELING

No.	Receiver r	Building side	Floor	Limit Day dB(A)	Night	Level Day dB(A)	Night	Conflict Day dB	Night
1	1	-	1.Fl	-	-	54	0	-	-
2	2	-	1.Fl	-	-	58	0	-	-
3	3	-	1.Fl	-	-	64	0	-	-
3	3	-	2.Fl	-	-	66	0	-	-
4	4	-	1.Fl	-	-	58	0	-	-
4	4	-	2.Fl	-	-	65	0	-	-
5	5	-	1.Fl	-	-	55	0	-	-
5	5	-	2.Fl	-	-	59	0	-	-
6	6	-	1.Fl	-	-	57	0	-	-
6	6	-	2.Fl	-	-	61	0	-	-
7	7	-	1.Fl	-	-	63	0	-	-
7	7	-	2.Fl	-	-	64	0	-	-

Station	ADT	Traffic values Vehicles type	Vehicle na	day	night	Speed	Control device	Road surface
km	Veh/24h			Veh/h	Veh/h	km/h		
San Elijo E of RSF WB		Traffic direction:		In entry direction				
0+000	40800	Total	-	2720	-	-	none	Average (of DGAC and PCC)
0+000	40800	Automobiles	-	2611	-	64	none	Average (of DGAC and PCC)
0+000	40800	Medium trucks	-	54	-	64	none	Average (of DGAC and PCC)
0+000	40800	Heavy trucks	-	54	-	64	none	Average (of DGAC and PCC)
0+000	40800	Buses	-	-	-	-	none	Average (of DGAC and PCC)
0+000	40800	Motorcycles	-	-	-	-	none	Average (of DGAC and PCC)
0+000	40800	Auxiliary vehicle	-	-	-	-	none	Average (of DGAC and PCC)
0+648	-	-	-	-	-	-		
Ranch Santa Fe - N of SE SB		Traffic direction:		In entry direction				
0+000	56100	Total	-	3740	-	-	none	Average (of DGAC and PCC)
0+000	56100	Automobiles	-	3590	-	89	none	Average (of DGAC and PCC)
0+000	56100	Medium trucks	-	75	-	89	none	Average (of DGAC and PCC)
0+000	56100	Heavy trucks	-	75	-	89	none	Average (of DGAC and PCC)
0+000	56100	Buses	-	-	-	-	none	Average (of DGAC and PCC)
0+000	56100	Motorcycles	-	-	-	-	none	Average (of DGAC and PCC)
0+000	56100	Auxiliary vehicle	-	-	-	-	none	Average (of DGAC and PCC)
0+862	-	-	-	-	-	-		
Ranch Santa Fe - S of SE SB		Traffic direction:		In entry direction				
0+862	73050	Total	-	4870	-	-	none	Average (of DGAC and PCC)
0+862	73050	Automobiles	-	4675	-	89	none	Average (of DGAC and PCC)
0+862	73050	Medium trucks	-	97	-	89	none	Average (of DGAC and PCC)
0+862	73050	Heavy trucks	-	97	-	89	none	Average (of DGAC and PCC)
0+862	73050	Buses	-	-	-	-	none	Average (of DGAC and PCC)
0+862	73050	Motorcycles	-	-	-	-	none	Average (of DGAC and PCC)
0+862	73050	Auxiliary vehicle	-	-	-	-	none	Average (of DGAC and PCC)
1+312	-	-	-	-	-	-		
San Elijo W of RSF WB		Traffic direction:		In entry direction				
0+648	1875	Total	-	125	-	-	none	Average (of DGAC and PCC)
0+648	1875	Automobiles	-	120	-	40	none	Average (of DGAC and PCC)
0+648	1875	Medium trucks	-	3	-	40	none	Average (of DGAC and PCC)
0+648	1875	Heavy trucks	-	3	-	40	none	Average (of DGAC and PCC)
0+648	1875	Buses	-	-	-	-	none	Average (of DGAC and PCC)
0+648	1875	Motorcycles	-	-	-	-	none	Average (of DGAC and PCC)
0+648	1875	Auxiliary vehicle	-	-	-	-	none	Average (of DGAC and PCC)
0+817	-	-	-	-	-	-		
San Elijo E of RSF EB		Traffic direction:		In entry direction				
0+000	40800	Total	-	2720	-	-	none	Average (of DGAC and PCC)
0+000	40800	Automobiles	-	2611	-	64	none	Average (of DGAC and PCC)
0+000	40800	Medium trucks	-	54	-	64	none	Average (of DGAC and PCC)
0+000	40800	Heavy trucks	-	54	-	64	none	Average (of DGAC and PCC)
0+000	40800	Buses	-	-	-	-	none	Average (of DGAC and PCC)
0+000	40800	Motorcycles	-	-	-	-	none	Average (of DGAC and PCC)
0+000	40800	Auxiliary vehicle	-	-	-	-	none	Average (of DGAC and PCC)
0+649	-	-	-	-	-	-		
San Elijo W of RSF EB		Traffic direction:		In entry direction				
0+000	1875	Total	-	125	-	-	none	Average (of DGAC and PCC)
0+000	1875	Automobiles	-	120	-	40	none	Average (of DGAC and PCC)
0+000	1875	Medium trucks	-	3	-	40	none	Average (of DGAC and PCC)
0+000	1875	Heavy trucks	-	3	-	40	none	Average (of DGAC and PCC)
0+000	1875	Buses	-	-	-	-	none	Average (of DGAC and PCC)
0+000	1875	Motorcycles	-	-	-	-	none	Average (of DGAC and PCC)
0+000	1875	Auxiliary vehicle	-	-	-	-	none	Average (of DGAC and PCC)
0+167	-	-	-	-	-	-		
Ranch Santa Fe - S of SE NB		Traffic direction:		In entry direction				

0+000	73050	Total	-	4870	-	-		none	Average (of DGAC and PCC)
0+000	73050	Automobiles	-	4675	-		89	none	Average (of DGAC and PCC)
0+000	73050	Medium trucks	-	97	-		89	none	Average (of DGAC and PCC)
0+000	73050	Heavy trucks	-	97	-		89	none	Average (of DGAC and PCC)
0+000	73050	Buses	-	-	-	-		none	Average (of DGAC and PCC)
0+000	73050	Motorcycles	-	-	-	-		none	Average (of DGAC and PCC)
0+000	73050	Auxiliary vehicle	-	-	-	-		none	Average (of DGAC and PCC)
0+463	-	-	-	-	-	-			
Ranch Santa Fe - N of SE NB			Traffic direction:	In entry direction					
0+000	56100	Total	-	3740	-	-		none	Average (of DGAC and PCC)
0+000	56100	Automobiles	-	3590	-		89	none	Average (of DGAC and PCC)
0+000	56100	Medium trucks	-	75	-		89	none	Average (of DGAC and PCC)
0+000	56100	Heavy trucks	-	75	-		89	none	Average (of DGAC and PCC)
0+000	56100	Buses	-	-	-	-		none	Average (of DGAC and PCC)
0+000	56100	Motorcycles	-	-	-	-		none	Average (of DGAC and PCC)
0+000	56100	Auxiliary vehicle	-	-	-	-		none	Average (of DGAC and PCC)
0+864	-	-	-	-	-	-			