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ASSESSMENT OF ENVIRONMENTAL NOISE

6th STREET and SPEAR AVENUE AFFORDABLE HOUSING NOISE REPORT

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ASSESSMENT OF ENVIRONMENTAL NOISE

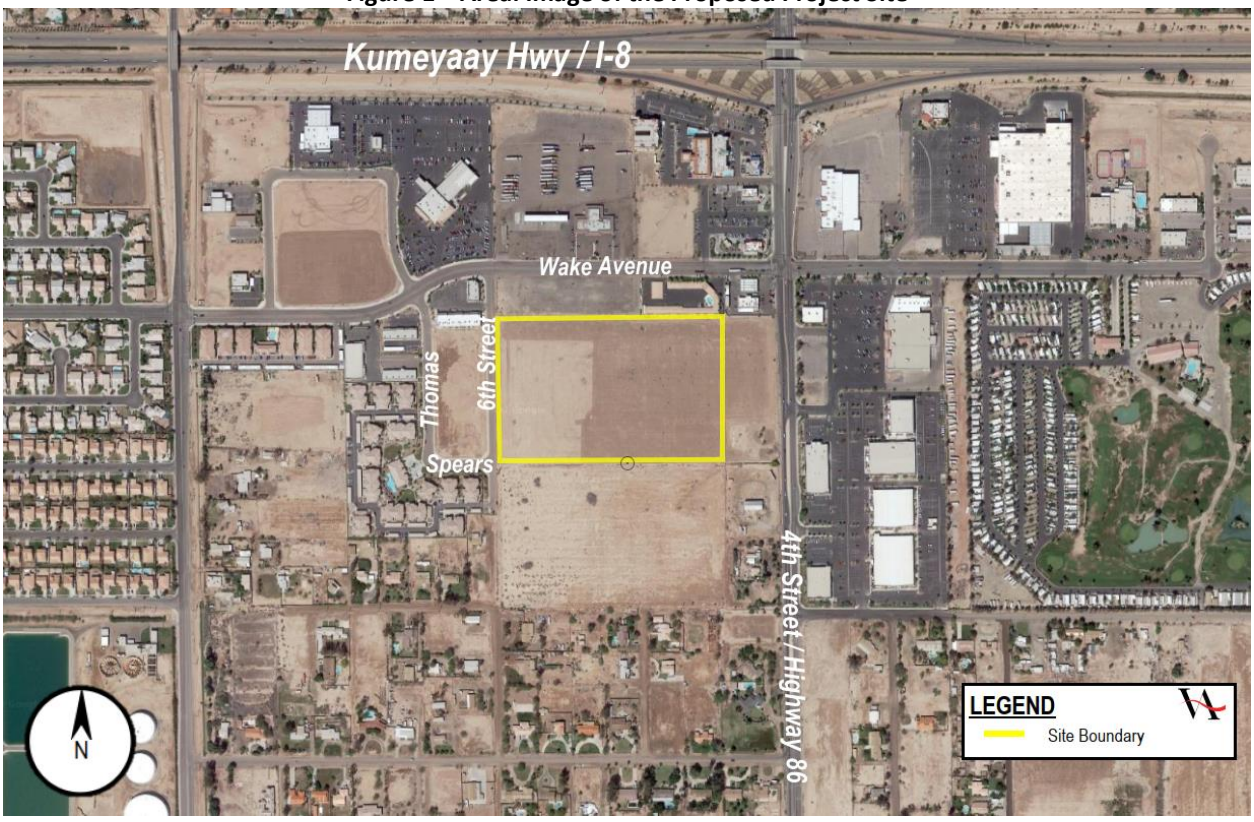
1.0 INTRODUCTION

This report evaluates potential impacts associated with the construction and operation noise of the 6th Street and Spear Avenue Affordable Housing project in El Centro, California.

1.1 Project Description

The proposed project is a 288 – unit multifamily residential development in El Centro, California. The site is located on the northeast intersection of 6th Street and Spear Avenue. The project consists of four parcels with 72 units residential units per parcel, a clubhouse and 520 on-grade parking spaces. The project site is bounded by Wake Avenue to the north, 4th Street to the east, 6th Street to the west, and undeveloped land to the south. According to the El Centro Zoning Map, the project area is classified as CT (Tourist Commercial).

Figure 1 – Areal Image of the Proposed Project Site



1.2 Characteristics of Noise

Noise is usually defined as unwanted sound and can be an undesirable by-product of society's normal day-to-day activities. Sound becomes unwanted when it interferes with normal activities, causes actual physical harm, or has an adverse effect on health.

People judge the relative magnitude of sound sensation in subjective terms such as "noisiness" or "loudness." However, the sound pressure magnitude can be objectively measured and quantified using a logarithmic ratio of pressures which yields the level of sound, utilizing the measurement scale of decibels (dB). The decibel is generally adjusted to the A-weighted level (dBA) which de-emphasizes very low frequencies to better approximate the human ear's range of sensitivity. In practice, the noise level of a sound source is measured using a sound level meter that includes an electronic filter corresponding to the A-weighting curve. Table A.1 in Appendix A of this report defines the decibel along with other technical terms used in this analysis.

Even though the A-weighted scale accounts for the relative loudness perceived by the human ear and, therefore, is commonly used to quantify individual events or general community sound levels, the degree of annoyance or other response effects also depends on several other perceptibility factors, including:

- Ambient (background) sound level
- Magnitude of the event sound level relative to the background noise
- Spectral (frequency) composition (e.g. presence of tones)
- Duration of the sound event
- Number of event occurrences, repetitiveness, and intermittency
- Time of day the event occurs.

In determining the daily level of environmental noise, it is important to account for the difference in human responses to daytime and nighttime noises. At night, exterior background noise levels are generally lower than daytime levels. However, most household noise also decreases at night, and exterior noise may become increasingly noticeable. Further, most people sleep at night and have greater sensitivity to noise intrusion. To account for human sensitivity to nighttime noise levels, a 24-hour descriptor, the Community Noise Equivalent Level (CNEL), has been developed. The CNEL divides the 24-hour day into a daytime period of 7:00 a.m. to 7:00 p.m., an evening period from 7:00 p.m. to 10:00 p.m., and a nighttime period of 10:00 p.m. to 7:00 a.m. In determining the CNEL, noise levels occurring during the evening period are increase by 5 dB, while noise levels occurring during the nighttime period are increased by 10 dB to account for the greater sensitivity during the evening and nighttime periods.

The effects of noise on people fall into three general categories:

- Subjective effects of annoyance and nuisance.
- Interference with activities such as speech, sleep, and learning.
- Physiological effects such as hearing loss.

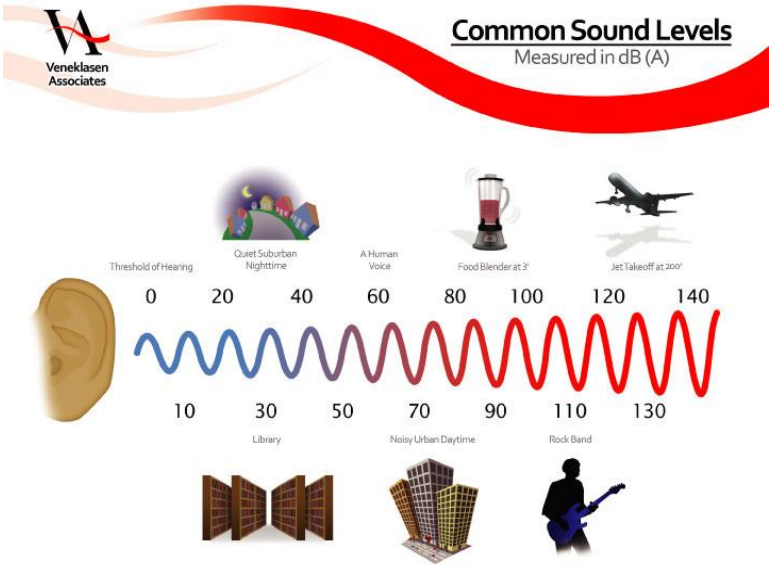
In most cases, the levels associated with environmental noise produce effects only in the first two categories. However, workers in industrial plants may experience noise effects in the last category. There is no completely effective way to measure the subjective effects of noise or the corresponding reactions of annoyance, because of the wide variation in individual thresholds of annoyance and degrees to which people become acclimated to noise. Thus, an important way of determining a person's subjective reaction to a new noise source is by comparison to the existing environment to which they are accustomed (the "ambient environment"). In general, the more the level of a noise event exceeds the prevailing ambient noise level, the less acceptable the noise source will be to those exposed to it.

With regard to increases in A-weighted noise levels, the following relationships are applicable to this analysis:

- Except in carefully controlled laboratory experiments, a 1 dB change cannot be perceived.
- Outside of a laboratory, a 3 dBA change will be generally perceivable by most people.
- A change in level of at least 5 dBA is considered a noticeable change by most people.
- A 10 dBA change will result in the perception of doubling or halving the loudness of the noise.

Common noise levels associated with various activities are shown on Figure 2, Common Noise Levels.

Figure 2 – Common Noise Levels



Noise sources are either "point sources", such as stationary equipment or individual motor vehicles, or "line sources", such as a roadway with a large number of mobile point sources (motor vehicles). Sound generated by a stationary point source typically diminishes (attenuates) at a rate of 6 dBA for each doubling of distance from the source to the receptor at acoustically "hard" sites, and at a rate of 7.5 dBA at acoustically "soft" sites.[1] For example, a 60 dBA noise level measured at 50 feet from a point source at an acoustically hard site would be 54 dBA at 100 feet from the source and it would be 48 dBA at 200 feet from the source. Sound generated by a line source typically attenuates at a rate of 3 dBA and 4.5 dBA per doubling of distance from the source to the receptor for hard and soft sites, respectively.[2] Man-made or natural barriers can also attenuate sound levels.

The minimum attenuation of exterior to interior noise provided by typical structures is provided in Table 1, Outside to Inside Noise Attenuation.

Table 1 – Outside to Inside Noise Attenuation (dBA)

Building Type	Open Windows	Closed Windows[1]
Residences	17	25
Schools	17	25
Churches	20	30
Hospitals/Convalescent Homes	17	25
Offices	17	25
Theaters	20	30
Hotels/Motels	17	25

Source: Transportation Research Board, National Research Council, Highway Noise: A Design Guide for Highway Engineers*, National Cooperative Highway Research Program Report 117.*

[1] *As shown, structures with closed windows can attenuate exterior noise by a minimum of 25 to 30 dBA.*

1.3 Characteristics of Vibration

Vibration is minute variation in pressure through structures and the earth, whereas, noise is minute variation in pressure through air. Some vibration effects can be caused by noise; e.g., the rattling of windows from truck pass-bys. This phenomenon is related to the coupling of the acoustic energy at frequencies that are close to the resonant frequency of the material being vibrated. Ground-borne vibration attenuates rapidly as distance from the source of the vibration increases. Vibration amplitude can be measured as peak particle velocity (PPV), the maximum

1 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (Springfield, Virginia: U.S. Department of Transportation, Federal Highway Administration, September 1980), p. 97. A "hard" or reflective site does not provide any excess ground-effect attenuation and is characteristic of asphalt, concrete, and very hard packed soils. An acoustically "soft" or absorptive site is characteristic of normal earth and most ground with vegetation.

2 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (Springfield, Virginia: U.S. Department of Transportation, Federal Highway Administration, September 1980), p. 97.

instantaneous peak amplitude in inches per second, or root-mean-square (RMS) velocity in inches per second or as vibration level in decibels (VdB) referenced to 1 micro-inch per second. The ratio between the PPV and the maximum RMS amplitude is termed the "crest factor." According to the Federal Transit Administration (FTA), the PPV level for construction equipment is typically 1.7 to 6 times greater than the RMS vibration level. The FTA uses a crest factor of 4 for the conversion of PPV levels to RMS vibration levels. For the purposes of ground-borne vibration analysis of impacts to existing structures, vibration velocity is described in terms of PPV. For the analysis of the human response to vibration, VdB is utilized.

The vibration velocity threshold of perception for humans is approximately 65 VdB, and a vibration velocity of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels for many people[3]. Most perceptible indoor vibration is caused by sources within buildings such as operation of mechanical equipment, movement of people, or the slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. Common ground-induced vibrations related to roadway traffic and construction activities pose no threat to buildings or structures. If a roadway is smooth, the ground-borne vibration from traffic is barely perceptible. The range of interest is from approximately 50 VdB, which is typically the background vibration velocity, to 94 VdB. This 94 VdB vibration level corresponds to 0.2 PPV, which is the general threshold where minor damage can occur in non-engineered timber and masonry buildings.

2.0 REGULATORY FRAMEWORK

Many government agencies have established noise regulations and policies to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise and ground-borne vibration. The City of El Centro has adopted the Noise Element section, which is based in part on Federal and State regulations and is intended to control, minimize, or mitigate environmental noise effects. The regulations and policies that are relevant to project construction and operation noise are discussed below.

2.1 Applicable State Noise Standards

The State of California has adopted noise compatibility guidelines for general land use planning. The types of land uses addressed by the State standards and the acceptable noise categories for each land use are included in the State of California General Plan Guidelines, which is published and updated by the Governor's Office of Planning and Research. The level of acceptability of the noise environment is dependent upon the activity associated with the particular land use. According to the State, an exterior noise environment up to 65 CNEL is "normally acceptable" for single and multi-family residential uses, up to 75 CNEL is "conditionally acceptable" with special noise insulation

[3] – U.S. Department of Transportation, Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, (Washington, DC: U.S. Department of Transportation, Federal Transit Administration, May 2006), p. 7-8.

requirements, while 75 CNEL and above is identified as "clearly unacceptable" noise levels for residential and hotel uses, respectively.[4] The maximum allowable interior noise level for residential structures is 45 CNEL.

The California Environmental Quality Act (CEQA) Guidelines establishes guidelines for the evaluation of significant impacts of environmental noise attributable to a proposed project. The guidelines ask whether the project would result in:

1. Would the project generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

2. Would the project generate excessive ground borne vibration or ground born noise levels?

3. For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

2.2 City of El Centro General Plan Noise Element & Municipal Code

The project site is located in the City of El Centro and therefore would potentially affect receptors within the city from onsite and offsite sources. The City Noise Element of the General Plan is a comprehensive program for including noise management in the planning process, providing a tool for planners to use in achieving and maintaining land uses that are compatible with existing and future environmental noise levels. The Noise Policy identifies noise-sensitive land uses and noise sources and defines areas of noise impact for the purpose of developing programs to ensure that residents in El Centro, and other noise sensitive land uses, will be protected from excessive noise intrusion.

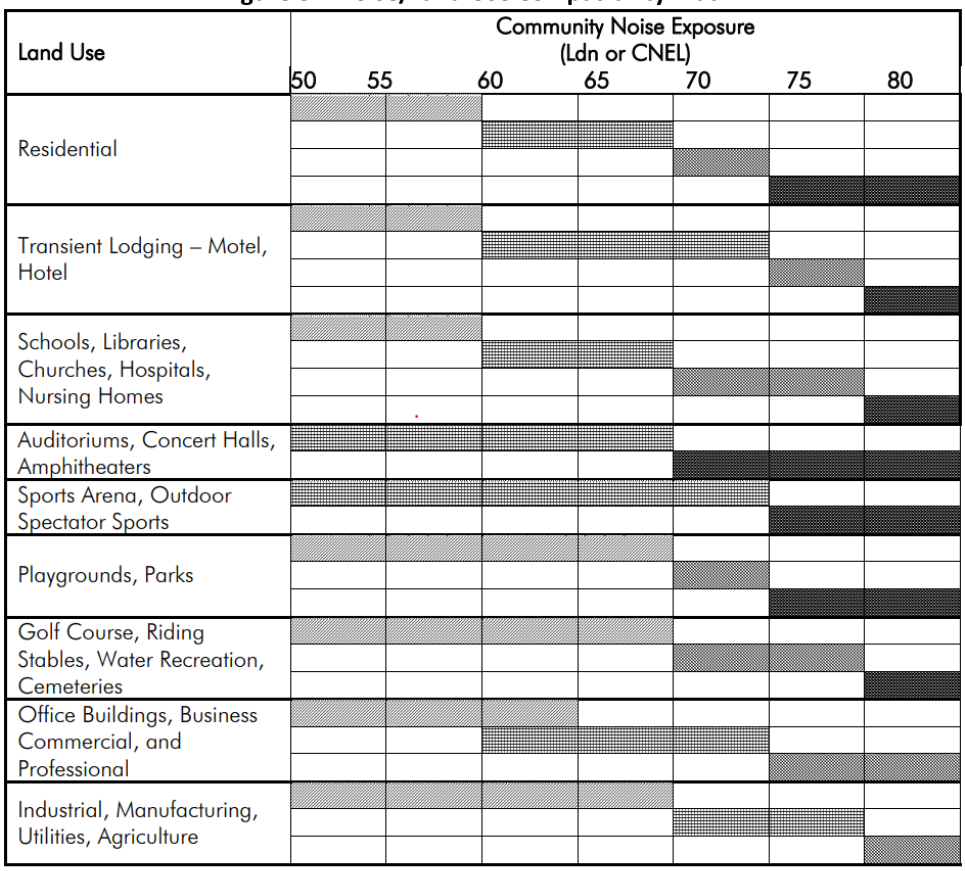
As development proposals are submitted to the City, each is evaluated with respect to the provisions in the Noise Element to ensure that noise impacts are reduced through planning and project design. Through implementation of the policies of the Noise Element, El Centro seeks to reduce or avoid adverse noise impacts for the purposes of protecting the general health, safety, and welfare of the community. The most basic planning strategy to minimize adverse impacts on new land uses due to noise is to avoid designating certain land uses at locations within the city that would negatively affect noise sensitive land users. Users such as schools, hospitals, childcare, senior care, congregate care, churches, and all types of residential use should be located outside of any area anticipated to exceed acceptable noise levels as defined by the Land Use Compatibility Matrix or should be protected from noise through sound attenuation measures such as site and architectural design and sound walls. The City of El Centro has

[4] – State of California, Governor's Office of Planning and Research, *General Plan Guidelines*, (Sacramento, CA: State of California, Governor's Office of Planning and Research, October 2003), p. 250.

adopted guidelines as a basis for planning decisions based on noise considerations. These guidelines are shown in Figure 3.

In the case that the noise levels identified at a proposed project site fall within levels considered normally acceptable, the project is considered compatible with the existing noise environment.

Figure 3 – Noise/Land Use Compatibility Matrix



Source: Modified by CBA from 1998 State of California General Plan Guidelines.

ZONE A - Normally Acceptable: Specified land use is satisfactory, based upon the assumption that any buildings involved meet conventional Title 24 construction standards. No special noise insulation requirements.

ZONE B - Conditionally Acceptable: New construction or development shall be undertaken only after a detailed noise analysis is made and noise reduction measures are identified and included in the project design.

Zone C- Normally Unacceptable: New construction or development is discouraged. If new construction is proposed, a detailed analysis is required, noise reduction measures must be identified, and noise insulation features included in the design.

ZONE D- Clearly Unacceptable: New construction or development clearly should not be undertaken.

El Centro's quality of life can be reduced by excessive noise levels. The goals, policies and implementation actions of the Noise Element address three major issues related to noise. These include:

1) Avoiding the negative effects from noise through the use of land use plaining and noise reduction techniques.
2) Minimizing the impact of transportation related noise.
3) Minimizing the impact of non-transportation related noise.

Noise and Land Use Planning:

Noise Goal 1: Minimize the effect of noise through proper land use planning

Policy 1.1: Use noise/land use compatibility standards as a guide for the future planning and development decisions.

Policy 1.2: Provide noise control measures and sound attenuating construction in areas of new construction or rehabilitation.

Policy 1.3: Promote alternative sound attenuation measures, such as berms, embankments, landscaping, setbacks, and architectural design where appropriate, rather than wall barriers.

Policy 1.4: Support changes in the Uniform Building Code that incorporate new technologies for reducing exterior noise intrusion into structures and the transmission of interior-generated noise within structures.

Transportation Related Noise:

Noise Goal 2: Minimize transportation related noise impacts to preserve the City's overall environment.

Policy 2.1: Reduce transportation related noise impacts to sensitive land uses through the use of noise control measures.

Policy 2.3: Incorporate sound-reduction design in development projects impacted by transportation-related noise.

Non-Transportation-Related Noise:

Noise Goal 3: Minimize non-transportation related noise impacts to preserve the City's overall environment.

Policy 3.1: Reduce the impact of noise producing land uses and activities on noise sensitive land uses.

Policy 3.2: Incorporate sound-reduction design in new construction or rehabilitation projects impacted by non-transportation related noise.

Policy 3.3: Require mitigation measures to ensure that noise resulting from public and private construction projects is reduced to an acceptable level.

2.3 City of El Centro Code of Ordinances

The City of El Centro Noise Element establishes noise/land use compatibility criteria. The city uses land use compatibility standards when planning and marking development decisions to ensure that noise producers do not adversely affect sensitive receptors. Per the Section 17.1-4, Table 2 summarizes the City's noise standards for varies type of land uses. The standards represent the maximum acceptable noise levels and are used to determine potential noise impact.

Table 2 – The City of El Centro Noise Standard

Zone	Time of Day	One hour Average
Single Family Residential Zones	7:00 am – 10:00 pm	50
	10:00 pm – 7:00 am	45
Multi-Family Residential Zone	7:00 am – 10:00 pm	55
	10:00 pm – 7:00 am	50
Commercial Civic and Limited use Zones	7:00 am – 10:00 pm	60
	10:00 pm – 7:00 am	55
Manufacturing Zones	7:00 am – 10:00 pm	75
	10:00 pm – 7:00 am	70

Note 1: Zones which exists on the abutting or nearby property at whose boundary the measurement is taken

The sound level limit at a location on a boundary between two (2) zoning districts is the arithmetic mean of the representative limits for the two (2) districts.

If the measured ambient level exceeds the applicable limit shown in the table, the allowable sound level shall be the ambient noise level minus 5 dB but not less than the sound level limit specified in Table 2.

Fixed location public utility distribution or transmission facilities located on or adjacent to a property line shall be subject to the noise limits of this section, measured at or beyond six (6) boundaries of the easement upon which the equipment is located.

According to Section 17.1-8 Construction Equipment, Except for emergency work, it shall be unlawful for any person to operate construction equipment at any construction site, except as outlined in subsections (a) and (b) below:

(a) It shall be unlawful for any person to operate construction equipment at any construction site on Sundays, and days appointed by the president, governor, or the city council for a public holiday. Notwithstanding the above, a person may operate construction equipment on the above specified days between the hours of 10 a.m. and 5 p.m. in compliance with the requirements of subsection (b) of this section at his residence or for the purpose of constructing a residence for himself, provided such operation of construction equipment is not carried on for profit or livelihood. In addition, it shall be

unlawful for any person to operate construction equipment at any construction site on Mondays through Saturdays except between the hours of 6 a.m. and 7 p.m.

(b) No such equipment, or combination of equipment regardless of age or date of acquisition, shall be operated so as to cause noise at a level in excess of seventy-five (75) decibels for more than eight (8) hours during any twenty-four (24) hour period when measured at or within the property lines of any property which is developed and used either in part or in whole for residential purposes.

In the event that lower noise limit standards are established for construction equipment pursuant to state or federal law, said lower limits shall be used as a basis for revising and amending the noise level limits specified in subsection (b) above.

2.4 City of El Centro – Ground-Borne Vibration

The City of El Centro does not establish criteria for maximum vibration thresholds.

The Federal Transit Administration (FTA) provides standards and guidelines for perceptibility and annoyance for ground-borne vibration as well as construction vibration impact criteria for building damage. As discussed in the *Characteristics of Vibration* section above, in most circumstances common ground-induced vibrations related to roadway traffic and construction activities pose no threat to buildings or structures, and for smooth roadways, the ground-borne vibration from traffic is barely perceptible.

The FTA has published a technical manual titled, "Transit Noise and Vibration Impacts Assessment," that provides ground-borne vibration impact criteria with respect to building damage and human response during construction activities. As discussed above, building vibration damage is measured in peak particle velocity described in the unit of inches per second. Table 3, below, provides the Federal Transit Administration vibration criteria applicable to construction activities. According to Federal Transit Administration guidelines, a vibration criterion of 0.20 inch per second should be considered as the significant impact level for non-engineered timber and masonry buildings. Furthermore, structures or buildings constructed of reinforced-concrete, steel, or timber, have vibration damage criteria of 0.50 inch per second pursuant to the FTA guidelines.

Table 3 - Federal Transit Administration Construction Vibration Impact Criteria for Building Damage

Building Category	Peak Particle Velocity (inch per second)
I. Reinforced-concrete, steel or timber (no plaster)	0.5
II. Engineered concrete and masonry (no plaster)	0.3
III. Non-engineered timber and masonry buildings	0.2
IV. Buildings extremely susceptible to vibration damage	0.12
Source: Federal Transit Administration, 2006.	

Impacts for the human response to vibration levels are given in VdB by the FTA in Table 8-1 of the *Transit Noise and Vibration Impact Assessment* manual[5], as shown in Table 4 below. The FTA Land Use Category 1 impact criteria is intended for vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations. These Category 1 impact criteria vibration levels are well below those associated with human annoyance but are equal to the threshold of perceptibility. The FTA vibration criteria for Category 2, residential impact, indicate impacts occur at a 72 VdB vibration level for frequent events occurring more than 70 times per day, at 75 VdB for occasional events occurring between 30 and 70 times per day, and at 80 VdB for infrequent events occurring less than 30 times per day.

Table 4 - Federal Transit Administration Ground-Borne Vibration Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch /sec)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB

Notes:
1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have these many operations.
3. "Infrequent Events" is 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.

Source: Federal Transit Administration, 2006.

5 U.S. Department of Transportation, Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, (Washington, DC: U.S. Department of Transportation, Federal Transit Administration, May 2006), p. 8-3

2.5 Project Requirements

The above requirements are summarized in the following Table 5.

Table 5 - Project Requirements

Activity	Standard
Residential (General Plan)	Zone A – 50-60 CNEL (Normally Acceptable) Zone B – 60-70 CNEL (Conditionally Acceptable)
Exterior Noise at Rural & Single-Family Residential Zones (General plan Table N-2)	60 dBA (Outdoor - One hour average)
Multi- Family Residential Zone (General plan Table N-2)	65 dBA (Outdoor - One hour average)
Interior Noise at Multi-Family Residences	45 CNEL
Construction Noise	Prohibited between 7:00 P.M. and 7:00 A.M. Monday thru Saturday, and anytime Sunday and public holidays
Operational Noise	At Single-family residential property, one-hour average sound level: 55 dBA from 7:00 a.m. to 10:00 p.m. 45 dBA from 10:00 p.m. to 7:00 a.m.
	At multi-family residential property, one-hour average sound level: 55 dBA from 7:00 a.m. to 10:00 p.m. 50 dBA from 10:00 p.m. to 7:00 a.m.
	At commercial, civic and limited use zone property, one-hour average sound level: 60 dBA from 7:00 a.m. to 10:00 p.m. 55 dBA from 10:00 p.m. to 7:00 a.m.
Vibration	At residences where people normally sleep: 72 VdB – greater than 70 events per day. 75 VdB – between 30-70 events per day. 80 VdB – less than 30 events per day.

3.0 ENVIRONMENTAL IMPACTS AND SIGNIFICANCE

3.1 Significance Thresholds

The following significance thresholds are used in this report to evaluate the significance of the project noise impacts:

- Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Generation of excessive ground borne vibration or ground born noise levels.
- For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels.

3.2 Impact 1. Noise levels in excess of standards

Would the project result in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

3.2.1 Methodology

Analysis of the existing and future noise environments presented in this section is based on technical reports, noise monitoring, and noise prediction modeling. CNEL predictions are based on the measured ambient sound levels and the number of traffic events in a 24-hour period. This was accomplished using the Federal Highway Administration Highway Noise Prediction Model (TNM Version 2.5). The California Department of Transportation (Caltrans) published the "Technical Noise Supplement (TeNS)" in October of 1998 which defines how to predict traffic noise for projects in California. The TeNS, Section N-5520 requires that any traffic noise study conducted after March 30, 2000 utilize the calculation methods used by Federal Highway Administration (FHWA) TNM. This model calculates the average noise level at specific locations based on traffic volumes, average speeds, roadway geometry, and site conditions. The off-site traffic noise is analyzed on an increase in CNEL basis to determine the project's impact.

3.2.2 Existing Ambient Monitored Noise Levels

Traffic on Wake Avenue and 4th Street is the primary noise source around the project site. The land uses surrounding the project are single-family residential, commercial land uses, and parking lots.

According to the Transportation Impact Analysis Report (Ref 3-21-3498) the existing Average Daily Traffic (ADT) count on 4th Street is 14,090 and Wake Avenue reported a total of 9,610.

To establish existing ambient noise levels in areas surrounding the project site, a field monitoring study was conducted. Measurements were performed in and around the project site to document the ambient conditions. Bruel & Kjaer Model 2270 Sound Level Meters, which satisfy the American National Standards Institute (ANSI) for general environmental noise measurement instrumentation, were used for this purpose. Measurements were performed at several locations, as shown on Figure 4. The measurements occurred on November 16, 2022. Noise readings were measured over 1-second intervals with "A" frequency fast time weighting. The weather conditions were normal, and no anomalies were present during the survey periods.

Table 6, Existing Ambient Monitored Noise Levels, provides the noise level data associated with each monitoring period for each location. As shown, noise levels ranged from 53 dBA to 59 dBA, dependent on the road traffic activity and the relative distance between the noise source and the measurement positions.

Figure 4 – Wake Avenue Affordable Housing Development Site and Noise Monitoring Locations

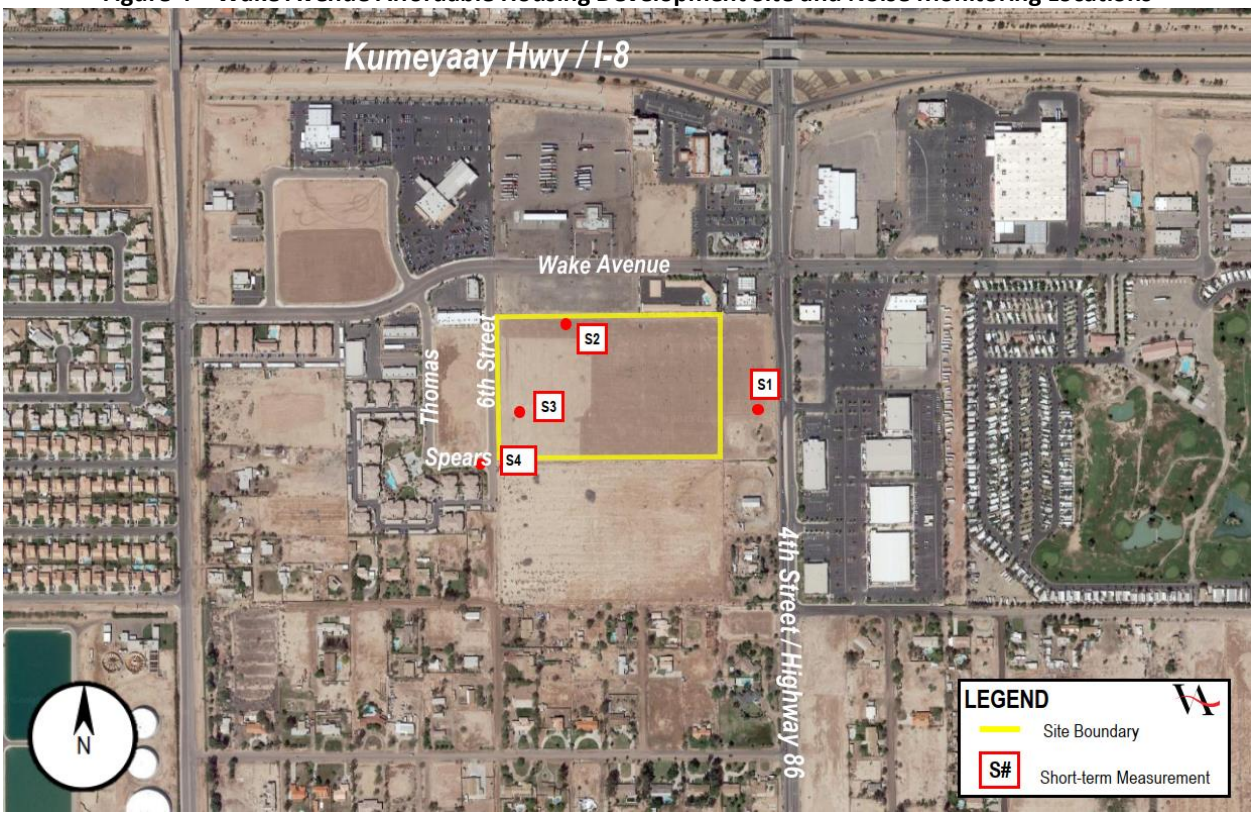


Table 6 – Existing Ambient Monitored Noise Levels

Position	Average Sound Level, L_{eq} dBA	Predicted CNEL
Pos S1	59	62
Pos S2	58	58
Pos S3	53	--
Pos S4	56	--

Notes:
Noise measurements taken on November 16, 2022.
Source: Veneklasen Associates, 2022.

Veneklasen also utilized FHWA noise prediction model to predict the existing noise levels at the receivers shown in Figure 4. According to the transportation Impact analysis report dated Feb 24, 2022, the ADT traffic count on 4th Street is 14,090 ADT, and Wake Avenue is 9,610 ADT. Per the Caltrans website the I-8 traffic count in 2020 was 33,000 ADT. Using the above information, the predicted noise levels at S1 location is 62 CNEL, and S2 location is 58 CNEL.

3.2.3 Future Exterior Project Noise Levels

The future traffic conditions for the local roads were not available in the City of El Centro or in the provided Transportation Impact Analysis Report for the project.

Therefore, Veneklasen assumes the yearly traffic increment is 1% and the predicted future traffic count for the Year 2037 on Wake Avenue and 4th Street based on the year 2022 levels are predicted to be 12,318 ADT and 16,811 ADT, respectively. The I-8 predicted future traffic count is approximately 38,637 ADT.

Based on the computer model, the noise level at the S1 (4th Street) and S2 (Wake Avenue) will be 63 CNEL and 59 CNEL, respectively.

The predicted exterior noise levels exceed the General Plan Zone A, Normally Acceptable criteria level for residential zones of CNEL 60, and therefore requires detailed noise analysis and noise reduction measures to be identified and included in the project design as needed. The project should therefore incorporate noise attenuation features such as sound-rated windows into the design.

Mitigation 1. A detailed acoustical analysis of the project should be completed by a qualified acoustical consultant to define the mitigation required such that the exterior and interior noise level requirements are satisfied.

This impact is less than significant with mitigation.

3.2.4 Permanent Increase in Ambient Noise Levels

Increase due to project traffic

A substantial permanent increase in traffic noise would occur if the project would result in an increase of 3 dBA CNEL or more. According to the Traffic Analysis Report, the trip generation due to the project is 1,214 ADT. The report also indicates the project traffic contribution and the total increase of the traffic due to the project contribution plus existing traffic.

The cumulative traffic count on Wake Avenue and 4th Street is 14,480 ADT and 10,610 ADT, respectively. The existing predicted noise level at location S1 is 62 CNEL, and 58 CNEL at location S2.

Based on the computer model, the existing plus project contribution noise levels are predicted to be between 0.1 and 0.4 decibels higher than the existing CNEL level. Therefore, the project traffic contribution is insignificant on 4th Street and Wake Avenue. The summary of the levels for each road is shown in Table 7 below.

Table 7 – Increase in Ambient Sound Level due to Site-Generated Traffic

Road Segment	Existing Ambient Noise Levels, CNEL	Traffic Model existing plus Project contribution Noise Levels, CNEL	Increase in CNEL	Impact
Wake Avenue	58	58	0.1	Less than Significant
4th Street	62	62	0.4	Less than Significant

The noise levels generated by the site due to traffic causes less than a 3 CNEL increase in the existing ambient levels at the site, and therefore the impact due to project traffic is less than significant.

3.2.5 Operational Noise

The project will include outdoor mechanical equipment, such as split-system outdoor condensing units. Based on published sound power data for units of typical residential size, the noise level will be less than 50 dBA at a distance of 30 feet from the equipment.

The outdoor condensing units for the project will be located on the rooftop of the buildings. A parapet will surround the units with a height that is, at minimum, the height of the units. The residences surrounding the property are one and two-story single or multi-family homes. The nearest residence is approximately 500 feet away, and a motel located north of the site is 85 feet away from the proposed buildings. The predicted mechanical equipment noise level at the nearest receiver, the motel north of the project site, taking into account building elevation and shielding from the parapet, the noise levels due to mechanical equipment has been calculated to be 41 dBA at the nearest residential location. This is significantly below the measured ambient noise level of 58 dBA. These levels are below the operational noise criteria status in Table 6.

This impact is less than significant.

3.2.6 Temporary Increase in Ambient Noise Levels

The construction of the proposed project would increase noise levels in the area. The construction noise impacts were analyzed for long-term noise exposure due to all anticipated construction equipment operating during each phase of construction, as well as for short-term noise exposure from equipment operating along the project site perimeter. Typical construction equipment utilized for each type of activity is indicated in Appendix B. The equipment noise level for all equipment listed for each activity was predicted for each phase in the proposed construction schedule. The equipment used in each construction phase are shown in Table 8.

Table 8 – Proposed Equipment used in Construction Phases

Phase Name	Equipment Type	Amount	Usage Power	Horsepower	Load Factor
Architectural Coating	Air Compressors	1	6	78	0.48
Demolition Concrete	Industrial Saws	1	8	81	0.73
Building Construction	Cranes	1	7	231	0.29
Demolition	Excavators	3	8	158	0.38
Grading	Excavators	2	8	158	0.38
Building Construction	Forklifts	3	8	89	0.20
Building Construction	Generator Sets	1	8	84	0.74
Grading	Graders	1	8	187	0.41
Paving	Pavers	2	8	130	0.42
Paving	Paving Equipment	2	8	132	0.36
Paving	Paving Rollers	2	8	80	0.38
Demolition	Rubber Tired Dozers	2	8	247	0.40
Grading	Rubber Tired Dozers	1	8	247	0.40
Site Preparation	Rubber Tired Dozers	3	8	247	0.40
Grading	Scrapers	2	8	367	0.48
Building Construction	Tractors/Loaders/Backhoes	3	7	97	0.37
Grading	Tractors/Loaders/Backhoes	2	8	97	0.37
Site Preparation	Tractors/Loaders/Backhoes	4	8	97	0.37
Building Construction	Welders	1	8	46	0.45

It was assumed that all the equipment is located at the center of the project site and used simultaneously in each phase to represent.

The nearest off-site residential sensitive receivers are located to the west, southwest, and south of the project site. The distance to the property lines of the nearest sensitive receivers from the perimeter of the project site are shown in Table 9.

Table 9 – Distance to the Sensitive Receivers from the Center of Project Site and Property Line

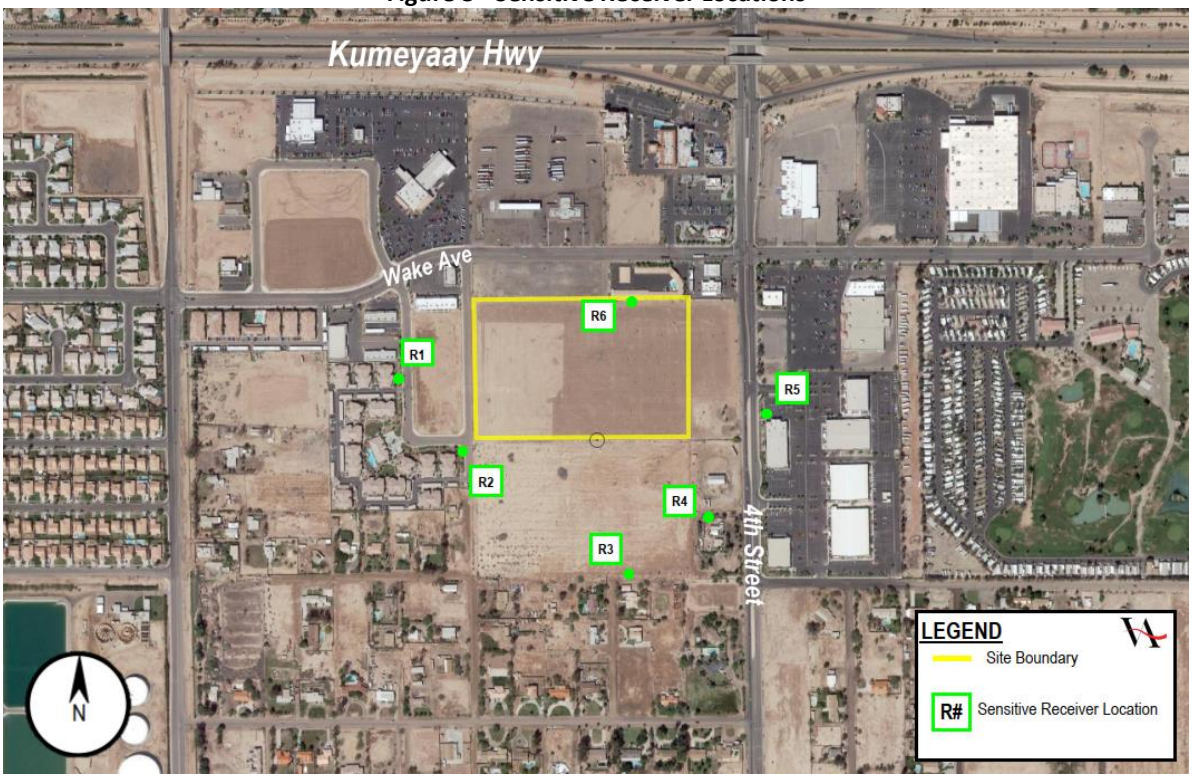
Receiver	Distance from the Center of the Project Site (feet)	Distance from the Project Property line (feet)
Receiver 1	882	375
Receiver 2	769	115
Receiver 3	1073	710
Receiver 4	852	554
Receiver 5	719	405
Receiver 6	393	25

The maximum predicted hourly average noise levels at these sensitive receptors due to construction operations are shown in Table 10 below. Figure 5 shows the location of sensitive receivers adjacent to the site. Appendix B shows the detailed calculation results for the construction equipment noise level at each receiver location.

Table 10 - Construction Noise Levels at the Boundary of Receiver Locations

Receptor	Existing Noise Level at Project Site Boundaries, Leq dBA	Construction Noise Level at the Boundaries of Sensitive Receivers, Leq dBA					
		Rec 1	Rec 2	Rec 3	Rec 4	Rec 5	Rec 6
Demolition	53-59	56	57	54	56	58	63
Site Preparation		64	66	63	65	67	72
Grading		64	65	63	65	66	71
Building Construction		61	62	59	61	63	68
Architectural Coating		-					
Paving		71	73	70	72	73	79

Figure 5 - Sensitive Receiver Locations



According to the provided equipment list, the construction maximum noise level at Receiver 6 during the paving phase is 79 dBA. According to the City Noise Regulation, there is no decibel criterion for construction noise, and the activities are controlled by limiting the hours of the day for construction. Therefore, for the general compatibility of surrounding sensitive receivers, these activities should be scheduled to limit the number of heavy construction machines operating simultaneously. Additionally, a temporary construction noise barrier is recommended along the north and southwest corner property line of the project site in order to reduce the noise impact to the nearest residential areas.

The barrier is recommended to have a minimum height of 8 feet or more. In order block the line of sight from the noise source to the receiver, the barrier height may be increased. The minimum density of the barrier should be 2 lbs./sq. ft with no holes or gaps.

Mitigation 2. The impact is less than significant with mitigation. The following measures are identified to reduce the potential effects of construction noise on adjacent properties.

- Limit construction activity to the hours listed in Table 5 (6:00 am to 7:00 pm).
- Schedule highest noise-generating activity and construction activity away from noise-sensitive land uses.
- Equip internal combustion engine-driven equipment with original factory (or equivalent) intake and exhaust mufflers which are maintained in good condition.

- Prohibit and post signs prohibiting unnecessary idling of internal combustion engines.
- Locate all stationary noise-generating equipment such as air compressors and portable generators as far as practicable from noise-sensitive land uses.
- Utilize "quiet" air compressors and other stationary equipment where feasible and available.
- Designate a noise disturbance coordinator who would respond to neighborhood complaints about construction noise by determining the cause of the noise complaints and require implementation of reasonable measures to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site.
- A temporary noise barrier along the north and southwest property line of the project site is recommended. The barrier should have a minimum height of 8 feet or more at some location in order to block the line of sight between the neighbor receptors and the project's construction activities. The noise barrier shall be solid with no gaps or holes and have a minimum density of 2 lbs./sq. ft.

3.3 Impact 2. Excessive ground-borne vibration

Would the project result in exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels?

Construction equipment associated with building the project would be the only vibration-generating source introduced by the project, as there are no vibration sources from operations that will introduce vibration into the environment. Vibration generated by construction equipment, unless specified otherwise through permitting, would only occur during approved work hours per the City of El Centro, 6:00 am – 7:00 pm, six days a week, excluding holidays. Table 8 shows the equipment used in each construction phase.

Table 11 below, shows the construction equipment proposed by the project planning group and the typical vibration levels generated during operation. It is understood that for this project, pile drivers will not be used. The vibration levels for some of the equipment used in the construction phase are unavailable, and Veneklasen utilized the vibration levels of similar equipment for the analysis.

Table 11 –Vibration Levels (Lv, VdB) of Typical Construction Equipment at 25 ft

Equipment	Reference RMS Velocity (Lv) at 25 ft. (VdB)
Vibratory roller	94
Large bulldozer	87
Caisson drilling	87
Loaded trucks	86
Jackhammer	79

Equipment	Reference RMS Velocity (Lv) at 25 ft. (VdB)
Small bulldozer	58
Source: Federal Transit Administration (except Hanson 2001 for Vibratory rollers), 1995.	

Based on the reference vibration levels generated by typical construction equipment and analysis carried out by the Veneklasen, construction equipment vibration levels at the project site boundary will not exceed the criteria per FTA guidelines shown in Table 3.. Therefore, the impact is less than significant, and no mitigation is required. The predicted vibration levels of the proposed construction equipment at the boundary of the project site are shown in Table 12. Appendix B shows the detailed calculation results for the construction equipment vibration level at project boundary.

Table 12 – Construction Vibration Levels at the Boundary of Project Site

Receptor	Construction Vibration Level at Project Site Boundaries, Lv VdB					
	Rec 1	Rec 2	Rec 3	Rec 4	Rec 5	Rec 6
Demolition	19	16	23	26	25	23
Site Preparation	25	22	29	32	31	29
Grading	51	48	55	58	57	55
Building Construction	47	44	51	54	53	51
Architectural Coating	-					
Paving	60	56	64	67	66	64

3.4 Impact 3. Airport noise exposure

For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

The project is not within two miles of a public airport or public use airport. Therefore, there is no impact.

4.0 SUMMARY

4.1 Summary of Mitigation Measures

Mitigation 1. A detailed acoustical analysis of the project should be completed by a qualified acoustical consultant to define the mitigation required such that the exterior and interior noise level requirements are satisfied.

Mitigation 2. The impact is less than significant with mitigation. The following measures are identified to reduce the potential effects of construction noise on adjacent properties.

- Limit construction activity to the hours listed in Table 4 (6:00 am to 7:00 pm).
- Schedule highest noise-generating activity and construction activity away from noise-sensitive land uses.
- Equip internal combustion engine-driven equipment with original factory (or equivalent) intake and exhaust mufflers which are maintained in good condition.
- Prohibit and post signs prohibiting unnecessary idling of internal combustion engines.
- Locate all stationary noise-generating equipment such as air compressors and portable generators as far as practicable from noise-sensitive land uses.
- Utilize “quiet” air compressors and other stationary equipment where feasible and available.
- Designate a noise disturbance coordinator who would respond to neighborhood complaints about construction noise by determining the cause of the noise complaints and require implementation of reasonable measures to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site.
- A temporary noise barrier along the southwest and north property line of the project site is recommended. The barrier should have a minimum height of 8 feet or more at some locations in order to block the line of sight between the neighbor receptors and the project’s construction activities. The noise barrier shall be solid with no gaps or holes and have a minimum density of 2 lbs./sq. ft.

4.2 Summary of significance of impacts

CEQA Noise Impact Question		No Impact	Less Than Significant	Less Than Significant with Mitigation	Potentially Significant
1	Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.			**X**	
2	Generation of excessive ground borne vibration or ground born noise levels.	**X**			
3	For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels	**X**			

APPENDIX A

Table A.1 – Definitions of Noise-Related Terms

Term	Definition
Decibel, dB	A unit describing the amplitude of sound equivalent to 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound to the reference pressure of 20 μPa.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured in an A-weighting filter network. The A-weighting de-emphasizes the very low frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are in the A-weighted scale.
L_0 (L_{max}), L_2, L_8, L_{25}, L_{50}	The A-weighted noise levels that are exceeded 0 percent (maximum noise level), 2 percent, 8 percent, 25 percent, and 50 percent of the time during the measurement period.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the stated measurement period.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 P.M. to 10:00 P.M., and after addition of 10 decibels to noise levels in the night between 10:00 P.M. and 7:00 A.M.
Day-Night Noise Level, DNL, Ldn	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 P.M. and 7:00 A.M.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Impulsive Noise	Sound of short duration. Typically associated with an abrupt onset and rapid decay (i.e., gun-shots, etc.).
Pure Tones	A sound wave, residing over a small range of frequencies, which has a sinusoidal behavior over time.
VdB	Unit of measurement used by FHWA to describe ground-borne vibration. Equivalent to 20 times the logarithm, to the base 10, of the ratio of the root mean square ground-borne velocity to the reference of reference of $1x10^{-6}$ in/sec.

APPENDIX B

Table B.1 - Typical Construction Equipment Noise

Equipment Type	FHWA Lmax @ 50 ft.	Usage Factor (%)
Excavator	81	40
Loader	79	40
Grinder	80	40
Rubber Tired Dozer	82	40
Tractor/Loader/Backhoe	84	40
Grader	85	40
Forklifts	84	40
Generator Sets	81	50
Welder	74	40
Paver	77	50
Paving Equipment	82	20
Rollers	80	20
Air Compressors	78	40

Table B.2 – Calculated Construction Noise Impacts by Phase

Phase	Equipment Type	Unit Amount	Hours/Day	Receiver	Calculated Noise Level at Nearest Sensitive Receptors (Hourly Leq, dBA
Building Demolition	Rubber Tired Dozer	2	8	Receiver 1	56
				Receiver 2	57
				Receiver 3	54
				Receiver 4	56
				Receiver 5	58
				Receiver 6	63
Site Preparation	Rubber Tired Dozer	3	8	Receiver 1	64
				Receiver 2	66
				Receiver 3	63
	Tractor/Loader/Backhoe	4	8	Receiver 4	65
				Receiver 5	67
				Receiver 6	72
Grading	Scrapers	2	8	Receiver 1	64
	Grade	1	8	Receiver 2	65
	Rubber Tired Dozer	1	8	Receiver 3	63
	Tractor/Loader/Backhoe	2	8	Receiver 4	65
				Receiver 5	66
				Receiver 6	71
Building Construction	Forklifts	3	8	Receiver 1	61
				Receiver 2	62
	Generator Sets	1	8	Receiver 3	59
	Tractor/Loader/Backhoe	3	7	Receiver 4	61
	Welder	1	8	Receiver 5	63
				Receiver 6	68
Asphalt Paving	Paver	2	8	Receiver 1	71
				Receiver 2	73
	Paving Equipment	2	8	Receiver 3	70
				Receiver 4	72
	Rollers	2	8	Receiver 5	73
				Receiver 6	79

Construction Noise Assessment Results

Phase 1 - Demolition

Equipment	Qty	Reference Sound Pressure Level @ 50 ft (dBA re: 20µPa)						Reference Utilization (%)			Receptor R1		Receptor R2		Receptor R3		Receptor R4		Receptor R5		Receptor R6	
		Client	FTA	FHWA (Predicted)	FHWA (Measured)	VA	Used	Client	FHWA	Used	Distance to R1 (ft)	Sound Pressure Level @ R1 (dBA re: 20µPa)	Distance to R2 (ft)	Sound Pressure Level @ R2 (dBA re: 20µPa)	Distance to R3 (ft)	Sound Pressure Level @ R3 (dBA re: 20µPa)	Distance to R4 (ft)	Sound Pressure Level @ R4 (dBA re: 20µPa)	Distance to R5 (ft)	Sound Pressure Level @ R5 (dBA re: 20µPa)	Distance to R6 (ft)	Sound Pressure Level @ R6 (dBA re: 20µPa)
Dozer	1	0	85	85	82	0	85	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
						Total Sound Pressure Level at Receiver NO Barrier						56		57		54		56		58		63
						Total Sound Pressure Level at Receiver WITH Barrier						50		50		48		50		51		52

Phase 2 – Site Preparation

Equipment	Qty	Reference Sound Pressure Level @ 50 ft (dBA re: 20µPa)						Reference Utilization (%)			Receptor R1		Receptor R2		Receptor R3		Receptor R4		Receptor R5		Receptor R6	
		Client	FTA	FHWA (Predicted)	FHWA (Measured)	VA	Used	Client	FHWA	Used	Distance to R1 (ft)	Sound Pressure Level @ R1 (dBA re: 20µPa)	Distance to R2 (ft)	Sound Pressure Level @ R2 (dBA re: 20µPa)	Distance to R3 (ft)	Sound Pressure Level @ R3 (dBA re: 20µPa)	Distance to R4 (ft)	Sound Pressure Level @ R4 (dBA re: 20µPa)	Distance to R5 (ft)	Sound Pressure Level @ R5 (dBA re: 20µPa)	Distance to R6 (ft)	Sound Pressure Level @ R6 (dBA re: 20µPa)
Dozer	2	0	85	85	82	0	85	N/A	40%	40%	882	59	769	60	1073	57	852	59	719	61	393	66
Grader	1	0	85	85	0	0	85	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
Scraper	2	0	85	85	84	87	87	N/A	40%	40%	882	62	769	63	1073	60	852	62	719	63	393	69
Backhoe	2	0	80	80	78	82	82	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
						Total Sound Pressure Level at Receiver NO Barrier						65		66		63		65		67		72
						Total Sound Pressure Level at Receiver WITH Barrier						57		57		55		57		58		57

Phase 3 – Grading

Equipment	Qty	Reference Sound Pressure Level @ 50 ft (dBA re: 20µPa)						Reference Utilization (%)			Receptor R1		Receptor R2		Receptor R3		Receptor R4		Receptor R5		Receptor R6	
		Client	FTA	FHWA (Predicted)	FHWA (Measured)	VA	Used	Client	FHWA	Used	Distance to R1 (ft)	Sound Pressure Level @ R1 (dBA re: 20µPa)	Distance to R2 (ft)	Sound Pressure Level @ R2 (dBA re: 20µPa)	Distance to R3 (ft)	Sound Pressure Level @ R3 (dBA re: 20µPa)	Distance to R4 (ft)	Sound Pressure Level @ R4 (dBA re: 20µPa)	Distance to R5 (ft)	Sound Pressure Level @ R5 (dBA re: 20µPa)	Distance to R6 (ft)	Sound Pressure Level @ R6 (dBA re: 20µPa)
Grader	1	0	85	85	0	0	85	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
Dozer	1	0	85	85	82	0	85	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
Scraper	2	0	85	85	84	87	87	N/A	40%	40%	882	62	769	63	1073	60	852	62	719	63	393	69
Backhoe	2	0	80	80	78	82	82	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
						Total Sound Pressure Level at Receiver NO Barrier						64		65		63		65		66		71
						Total Sound Pressure Level at Receiver WITH Barrier						56		56		54		57		57		57

Phase 4 – Building Construction

Equipment	Qty	Reference Sound Pressure Level @ 50 ft (dBA re: 20µPa)						Reference Utilization (%)			Receptor R1		Receptor R2		Receptor R3		Receptor R4		Receptor R5		Receptor R6	
		Client	FTA	FHWA (Predicted)	FHWA (Measured)	VA	Used	Client	FHWA	Used	Distance to R1 (ft)	Sound Pressure Level @ R1 (dBA re: 20µPa)	Distance to R2 (ft)	Sound Pressure Level @ R2 (dBA re: 20µPa)	Distance to R3 (ft)	Sound Pressure Level @ R3 (dBA re: 20µPa)	Distance to R4 (ft)	Sound Pressure Level @ R4 (dBA re: 20µPa)	Distance to R5 (ft)	Sound Pressure Level @ R5 (dBA re: 20µPa)	Distance to R6 (ft)	Sound Pressure Level @ R6 (dBA re: 20µPa)
Front End Loader	3	0	80	80	79	78	80	N/A	40%	40%	882	56	769	57	1073	54	852	56	719	58	393	63
Generator	1	0	82	82	81	76	82	N/A	50%	50%	882	54	769	55	1073	52	852	54	719	56	393	61
Backhoe	3	0	80	80	78	82	82	N/A	40%	40%	882	58	769	59	1073	56	852	58	719	60	393	65
Welder / Torch	1	0	0	73	74	0	74	N/A	40%	40%	882	45	769	46	1073	43	852	45	719	47	393	52
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
						Total Sound Pressure Level at Receiver NO Barrier						61		62		59		61		63		68
						Total Sound Pressure Level at Receiver WITH Barrier						53		53		51		53		54		54

Phase 6 – Paving

Equipment	Qty	Reference Sound Pressure Level @ 50 ft (dBA re: 20μPa)						Reference Utilization (%)			Receptor R1		Receptor R2		Receptor R3		Receptor R4		Receptor R5		Receptor R6	
		Client	FTA	FHWA (Predicted)	FHWA (Measured)	VA	Used	Client	FHWA	Used	Distance to R1 (ft)	Sound Pressure Level @ R1 (dBA re: 20μPa)	Distance to R2 (ft)	Sound Pressure Level @ R2 (dBA re: 20μPa)	Distance to R3 (ft)	Sound Pressure Level @ R3 (dBA re: 20μPa)	Distance to R4 (ft)	Sound Pressure Level @ R4 (dBA re: 20μPa)	Distance to R5 (ft)	Sound Pressure Level @ R5 (dBA re: 20μPa)	Distance to R6 (ft)	Sound Pressure Level @ R6 (dBA re: 20μPa)
Paver	2	0	85	85	77	88	88	N/A	50%	50%	882	63	769	64	1073	61	852	63	719	65	393	70
Paver	2	0	85	85	77	88	88	N/A	50%	50%	882	63	769	64	1073	61	852	63	719	65	393	70
Roller	1	0	85	85	80	74	85	N/A	20%	20%	882	53	769	54	1073	51	852	53	719	55	393	60
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
Pile-driver (Sonic)	1	0	95	0	0	0	95	N/A	N/A	100%	882	70	769	71	1073	68	852	70	719	72	393	77
No equipment	1	0	0	0	0	0	N/A	N/A	N/A	N/A	882	0	769	0	1073	0	852	0	719	0	393	0
						Total Sound Pressure Level at Receiver NO Barrier						72		73		70		72		73		79
						Total Sound Pressure Level at Receiver WITH Barrier						64		64		62		64		64		64

Phase 1 - Demolition

Annoyance Criteria	Equipment type			Receptor R1			Receptor R2			Receptor R3			Receptor R4			Receptor R5			Receptor R6		
				Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)
			Damage C	I. Reinforced-concrete,		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5
			Annoyanc	Category III:Institutional land uses			Category III:Institutional land u			Category I: Buildings where vib			Category III:Institutional land u			Category III:Institutional land u			stitutional land uses with primarl		
		PPVref at	Lv at 25ft	Distance (	PPVequip at	Lv at R1	Distance (	PPVequip	Lv at R2	Distance (	PPVequip	Lv at R3	Distance (	PPVequip	Lv at R4	Distance (	PPVequip	Lv at R5	Distance (	PPVequip	Lv at R6
Occasional Events: 30-70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0

Phase 2 – Site Preparation

Annoyance Criteria	Equipment type			Receptor R1			Receptor R2			Receptor R3			Receptor R4			Receptor R5			Receptor R6		
				Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)
			Damage C	I. Reinforced-concrete,		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5
			Annoyanc	Category III:Institutional land uses			Category III:Institutional land u			Category I: Buildings where vib			Category III:Institutional land u			Category III:Institutional land u			stitutional land uses with primarl		
		PPVref at	Lv at 25ft	Distance (	PPVequip at	Lv at R1	Distance (	PPVequip	Lv at R2	Distance (	PPVequip	Lv at R3	Distance (	PPVequip	Lv at R4	Distance (	PPVequip	Lv at R5	Distance (	PPVequip	Lv at R6
Occasional Events: 30-70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0

Phase 3 – Grading

				Receptor R1			Receptor R2			Receptor R3			Receptor R4			Receptor R5			Receptor R6		
				Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)
			Damage C	I. Reinforced-concrete,		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5
			Annoyanc	Category III:Institutional land uses			Category III:Institutional land u			Category I: Buildings where vib			Category III:Institutional land u			Category III:Institutional land u			stitutional land uses with primarl		
Annoyance Criteria	Equipment type	PPVref at	Lv at 25ft	Distance (	PPVequip at	Lv at R1	Distance (	PPVequip	Lv at R2	Distance (	PPVequip	Lv at R3	Distance (	PPVequip	Lv at R4	Distance (	PPVequip	Lv at R5	Distance (	PPVequip	Lv at R6
Occasional Events: 30-70 events per day	Large Bulldozer	0.089	87	507	0.000974514	48	654	0.000665	44	363	0.001609	52	298	0.002163	55	314	0.001999	54	368	0.001576	52
Frequent Events: >70 events per day	Large Bulldozer	0.089	87	507	0.000974514	48	654	0.000665	44	363	0.001609	52	298	0.002163	55	314	0.001999	54	368	0.001576	52
Frequent Events: >70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0

Phase 4 – Building Construction

				Receptor R1			Receptor R2			Receptor R3			Receptor R4			Receptor R5			Receptor R6		
				Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)
			Damage C	I. Reinforced-concrete,		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5
			Annoyanc	Category III:Institutional land uses			Category III:Institutional land u			Category I: Buildings where vib			Category III:Institutional land u			Category III:Institutional land u			stitutional land uses with primarl		
Annoyance Criteria	Equipment type	PPVref at	Lv at 25ft	Distance (	PPVequip at	Lv at R1	Distance (	PPVequip	Lv at R2	Distance (	PPVequip	Lv at R3	Distance (	PPVequip	Lv at R4	Distance (	PPVequip	Lv at R5	Distance (	PPVequip	Lv at R6
Occasional Events: 30-70 events per day	Small bulldozer	0.003	58	507	3.28488E-05	19	654	2.24E-05	15	363	5.42E-05	23	298	7.29E-05	26	314	6.74E-05	25	368	5.31E-05	23
Frequent Events: >70 events per day	Loaded trucks	0.076	86	507	0.000832169	47	654	0.000568	43	363	0.001374	51	298	0.001847	54	314	0.001707	53	368	0.001346	51
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0

Phase 6 – Paving

				Receptor R1			Receptor R2			Receptor R3			Receptor R4			Receptor R5			Receptor R6		
				Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)	Building category		Criteria PPV (in/sec)
			Damage C	I. Reinforced-concrete,		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5	I. Reinforced-concre		0.5
			Annoyanc	Category III:Institutional land uses			Category III:Institutional land u			Category I: Buildings where vib			Category III:Institutional land u			Category III:Institutional land u			stitutional land uses with primarl		
Annoyance Criteria	Equipment type	PPVref at	Lv at 25ft	Distance (	PPVequip at	Lv at R1	Distance (	PPVequip	Lv at R2	Distance (	PPVequip	Lv at R3	Distance (	PPVequip	Lv at R4	Distance (	PPVequip	Lv at R5	Distance (	PPVequip	Lv at R6
Occasional Events: 30-70 events per day	Vibratory Roller	0.21	94	507	0.002299415	55	654	0.00157	51	363	0.003796	59	298	0.005103	62	314	0.004718	61	368	0.003718	59
Frequent Events: >70 events per day	Vibratory Roller	0.21	94	507	0.002299415	55	654	0.00157	51	363	0.003796	59	298	0.005103	62	314	0.004718	61	368	0.003718	59
Frequent Events: >70 events per day	Vibratory Roller	0.21	94	507	0.002299415	55	654	0.00157	51	363	0.003796	59	298	0.005103	62	314	0.004718	61	368	0.003718	59
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Infrequent Events: <30 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0
Frequent Events: >70 events per day	No Equipment	N/A	N/A	507	0	0	654	0	0	363	0	0	298	0	0	314	0	0	368	0	0