CITY OF ANAHEIM CALIFORNIA
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Lincoln Colony Apartments Project

Appendix H

Noise Impact Analysis, Revised June 2021

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LINCOLN COLONY APARTMENTS NOISE IMPACT ANALYSIS

City of Anaheim

April 2, 2021 (Revised June 14, 2021)

ganddini

Traffic Engineering ● Transportation Planning ● Parking ● Noise & Vibration
Air Quality ● Global Climate Change ● Health Risk Assessment

LINCOLN COLONY APARTMENTS
NOISE IMPACT ANALYSIS

City of Anaheim

April 2, 2021 (Revised June 14, 2021)

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Project No. 19326

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EXECUTIVE SUMMARY

The purpose of this report is to provide an assessment of the noise impacts associated with development and operation of the proposed Lincoln Colony Apartments project and to identify mitigation measures that may be necessary to reduce those impacts. The noise issues related to the proposed land use and development have been evaluated in light of applicable federal, state and local policies, including those of the City of Anaheim.

Although this is a technical report, effort has been made to write the report clearly and concisely. A list of acronyms and glossary are provided in Appendix A and Appendix B of this report to assist the reader with technical terms related to noise analysis.

PROJECT LOCATION

The proposed project is located at the southwest corner of the intersection of Lincoln Avenue and Ohio Street, addressed at 898, 900, and 914 West Lincoln Avenue, in the City of Anaheim. The project site was developed with a vacated car wash which has already been demolished.

PROJECT DESCRIPTION

The project involves the construction of a four-story apartment building with 43 residential dwelling units and 102 parking spaces.

PROJECT IMPACTS

Construction Impacts

Modeled unmitigated construction noise levels reached up to 71.9 dBA L_{eq} at the nearest school property line to the northeast, 74.4 dBA L_{eq} at the nearest multi-family residential property line to the southeast, up to 79.6 dBA L_{eq} at the nearest multi-family residential property line to the south, and up to 78 dBA L_{eq} at the nearest single-family residential property line to the southeast of the project site.

Construction noise sources are regulated within the City of Anaheim under Section 6.70.010 of the City's Municipal Code which exempts construction activities from the noise standards between the hours of 7:00 AM and 7:00 PM.

The City of Anaheim has not adopted a numerical threshold that identifies what a substantial increase would be. For purposes of this analysis, the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment (2018) criteria will be used to establish significance thresholds. For residential uses, the daytime noise threshold is 80 dBA L_{eq} averaged over an 8-hour period ($L_{eq\ (8\text{-}hr)}$; and the nighttime noise threshold is 70 dBA $L_{eq\ (8\text{-}hr)}$. For commercial uses, the daytime and nighttime noise threshold is 85 dBA $L_{eq\ (8\text{-}hr)}$. In compliance with the City's Code, construction would not occur during the noise-sensitive nighttime hours.

Impacts would be less than significant and no mitigation is required. However, impacts related to construction noise will be further minimized with adherence to applicable Municipal Ordinances and implementation of the recommended measures presented in Section 7 of this report.

Noise Impacts to Off-Site Receptors Due to Project Generated Trips

The roadway noise level increases from project generated vehicular traffic were modeled utilizing a computer program that replicates the FHWA Traffic Noise Prediction Model FHWA-RD-77-108.

According to the City of Anaheim General Plan/Zoning Code Update EIR's Noise Section 5.10.3, Thresholds of Significance: Mobile-source noise (i.e., vehicle noise) is preempted from local regulation, but is still subject to CEQA. A change of 5 dBA would denote a significant impact if their resultant noise level were to remain within the objectives of the General Plan (e.g., 65 dBA (CNEL) at a residential location), or 3 dBA if the resultant level were to meet or exceed the objectives of the General Plan.

Per the noise modeling, projected generated vehicle traffic is anticipated to change roadway noise by approximately 0.03 dBA CNEL. Therefore, a change in noise level would not be audible and would be considered less than significant.

Groundborne Vibration Impacts

Use of vibratory equipment could cause annoyance and potential architectural damage at nearby sensitive receptors. A mitigation measure restricting the use of vibratory rollers within 20 feet and large bulldozers within twelve feet of any commercial structure to the west of the project site and vibratory rollers within 136 feet and large bulldozers within 80 feet of any residential structures to the south and/or southwest of the project site would reduce temporary vibration levels associated with project construction to less than significant. Mitigation measures to reduce potential vibration impacts related to construction activities are presented below and in Section 7 of this report.

As the proposed project consists of a four-story apartment building with 43 residential dwelling units, the project does not include any sources of operational vibration; no impacts are anticipated.

Impacts to Project from Airports

The closest airport to the project site is the Fullerton Municipal Airport, which is located approximately 3.92 miles to the northwest of the project site. Per the Fullerton Municipal Airport Master Plan Update (August 2020), the project site is well outside the 60 CNEL noise contour for this airport.[1] Therefore, as the project is not within two miles of a public airport or in the vicinity of a private airstrip, the project would not expose people residing or working in the project area to excessive noise levels associated with airports.

MEASURES TO REDUCE IMPACTS

Construction Noise Reduction Measures

In addition to adherence to the City of Anaheim Municipal Code which limits the construction hours of operation, the following measures are recommended to further reduce construction noise, emanating from the proposed project:

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from the noise sensitive receptors nearest the project site.

3. As applicable, all equipment shall be shut off and not left to idle when not in use.

4. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

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[1] Fullerton Municipal Airport Master Plan Update Figure 9-3 Fullerton Municipal Airport 2023 CNEL Noise Contours, May 2004.

5. Jackhammers, pneumatic equipment and all other portable stationary noise sources shall be shielded and noise shall be directed away from sensitive receptors.

6. The project proponent shall mandate that the construction contractor prohibit the use of music or sound amplification on the project site during construction.

7. The construction contractor shall limit haul truck deliveries to the same hours specified for construction equipment.

Vibration Mitigation Measures

1. The Project Applicant shall require that all construction contractors prohibit the use of vibratory rollers, or other similar vibratory equipment, within 20 feet and large bulldozers within twelve feet of any commercial structure to the west of the project site. In addition, vibratory rollers are prohibited within 136 feet and large bulldozers within 80 feet of any residential structures to the south and/or southwest of the project site. If construction activity must occur within these distances, it would need to be performed with smaller equipment types that do not exceed the vibration thresholds applied herein.

1. INTRODUCTION

This section describes the purpose of this noise impact analysis, project location, proposed development, and study area. Figure 1 shows the project location map and Figure 2 illustrates the project site plan.

PURPOSE AND OBJECTIVES

The purpose of this report is to provide an assessment of the noise impacts resulting from development of the proposed Lincoln Colony Apartments project and to identify mitigation measures that may be necessary to reduce those impacts. The noise issues related to the proposed land use and development have been evaluated in light of applicable federal, state and local policies, including those of the City of Anaheim.

Although this is a technical report, effort has been made to write the report clearly and concisely. A list of acronyms and glossary are provided in Appendix A and Appendix B of this report to assist the reader with technical terms related to noise analysis.

PROJECT LOCATION

The proposed project is located at the southwest corner of the intersection of Lincoln Avenue and Ohio Street, addressed at 898, 900, and 914 West Lincoln Avenue, in the City of Anaheim. The project site was developed with a vacated car wash which has already been demolished. A vicinity map showing the project location is provided on Figure 1.

PROJECT DESCRIPTION

The project involves the construction of a four-story apartment building with 43 residential dwelling units and 102 parking spaces. Figure 2 illustrates the project site plan.

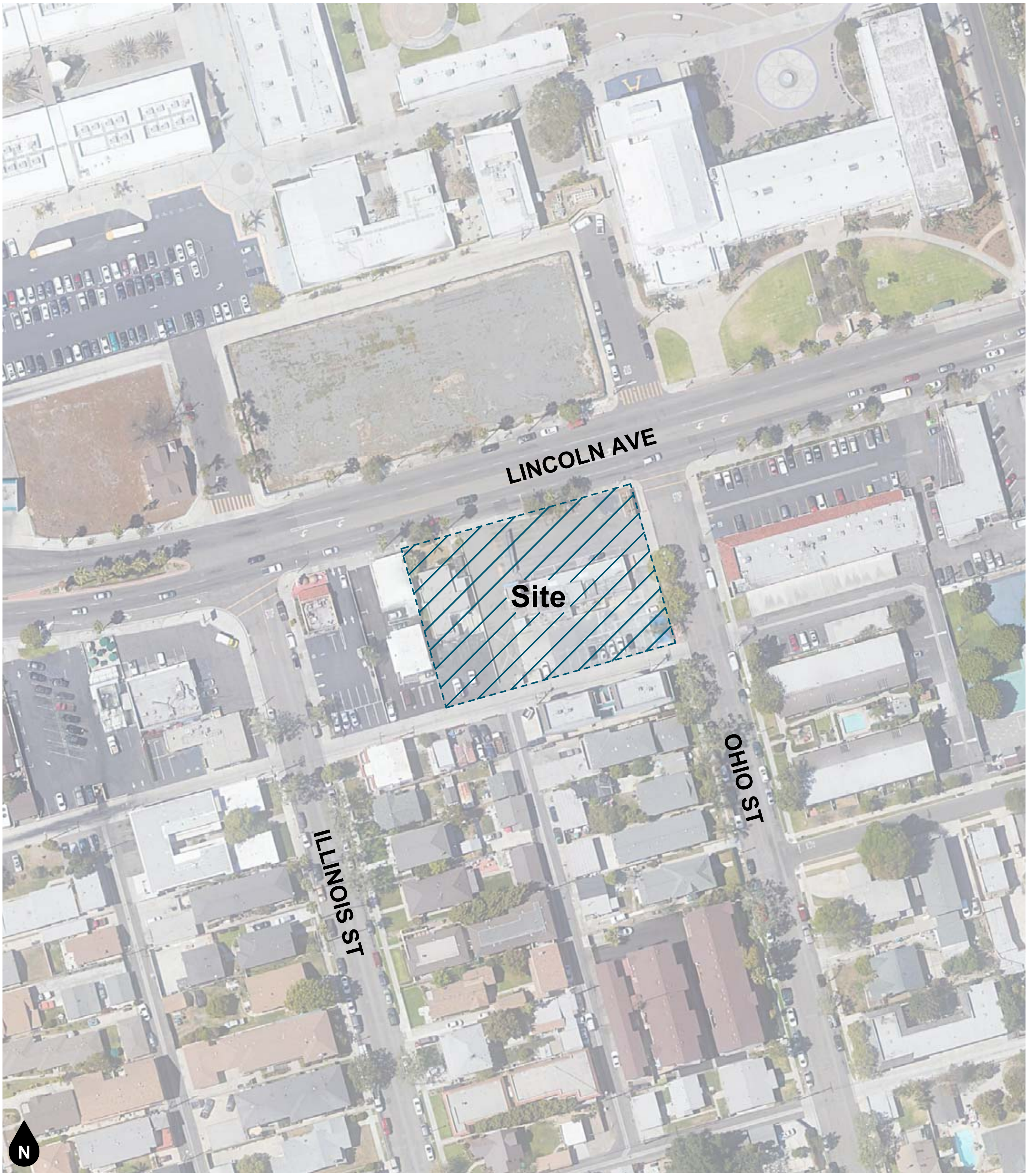


Figure 1
Project Location Map

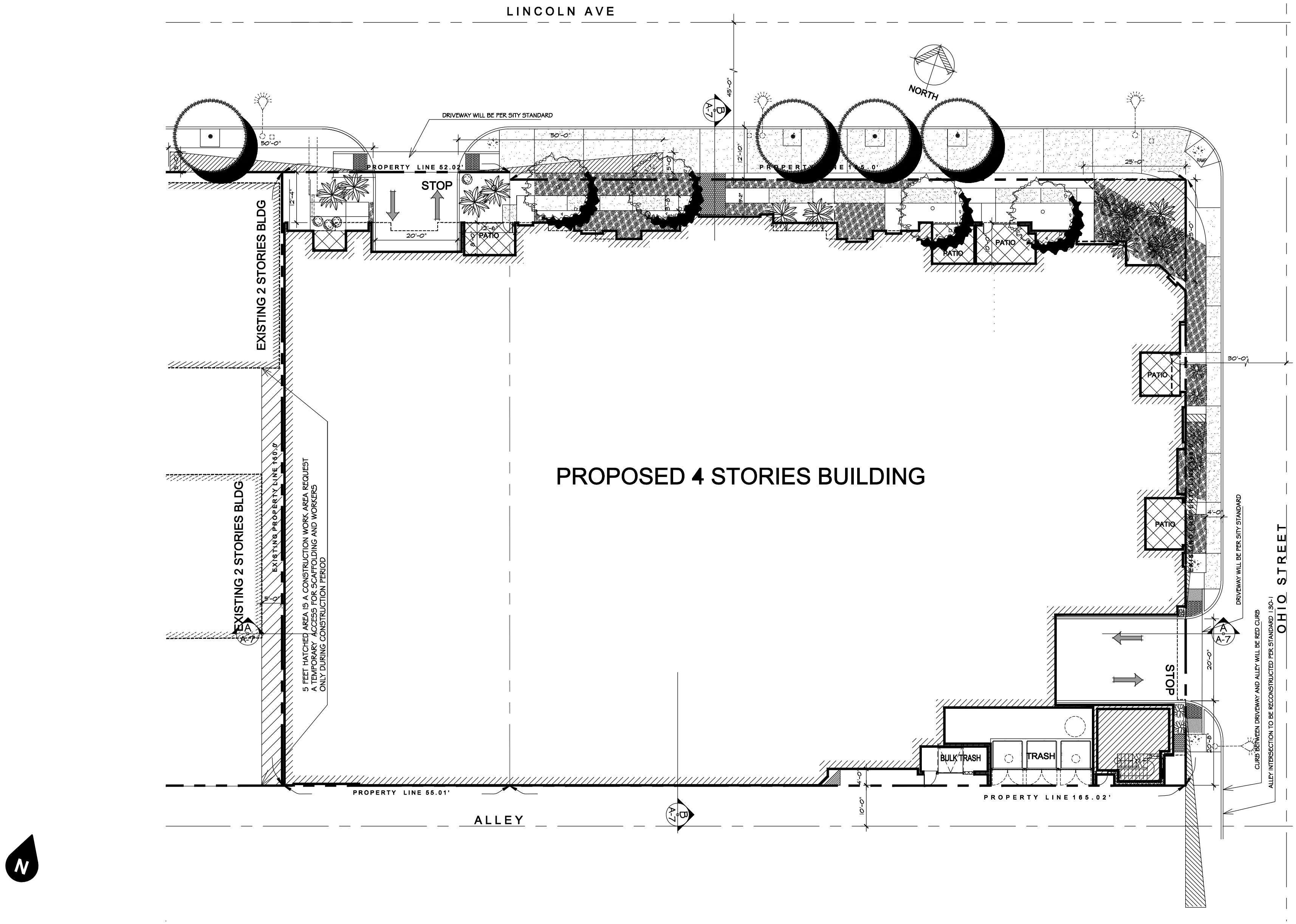


Figure 2
Site Plan

2. NOISE AND VIBRATION FUNDAMENTALS

NOISE FUNDAMENTALS

Sound is a pressure wave created by a moving or vibrating source that travels through an elastic medium such as air. Noise is defined as unwanted or objectionable sound. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and in extreme circumstances, hearing impairment.

Commonly used noise terms are presented in Appendix B. The unit of measurement used to describe a noise level is the decibel (dB). The human ear is not equally sensitive to all frequencies within the sound spectrum. Therefore, the "A-weighted" noise scale, which weights the frequencies to which humans are sensitive, is used for measurements. Noise levels using A-weighted measurements are written dB(A) or dBA.

From the noise source to the receiver, noise changes both in level and frequency spectrum. The most obvious is the decrease in noise as the distance from the source increases. The manner in which noise reduces with distance depends on whether the source is a point or line source as well as ground absorption, atmospheric effects and refraction, and shielding by natural and manmade features. Sound from point sources, such as air conditioning condensers, radiates uniformly outward as it travels away from the source in a spherical pattern. The noise drop-off rate associated with this geometric spreading is 6 dBA per each doubling of the distance (dBA/DD). Transportation noise sources such as roadways are typically analyzed as line sources, since at any given moment the receiver may be impacted by noise from multiple vehicles at various locations along the roadway. Because of the geometry of a line source, the noise drop-off rate associated with the geometric spreading of a line source is 3 dBA/DD.

Decibels are measured on a logarithmic scale, which quantifies sound intensity in a manner similar to the Richter scale used for earthquake magnitudes. Thus, a doubling of the energy of a noise source, such as a doubled traffic volume, would increase the noise levels by 3 dBA; halving of the energy would result in a 3 dBA decrease. Figure 3 shows the relationship of various noise levels to commonly experienced noise events.

Average noise levels over a period of minutes or hours are usually expressed as dBA L_{eq}, or the equivalent noise level for that period of time. For example, $L_{eq(3\text{-}hr)}$ would represent a 3-hour average. When no period is specified, a one-hour average is assumed.

Noise standards for land use compatibility are stated in terms of the Community Noise Equivalent Level (CNEL) and the Day-Night Average Noise Level (DNL). CNEL is a 24-hour weighted average measure of community noise. CNEL is obtained by adding five decibels to sound levels in the evening (7:00 PM to 10:00 PM), and by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the evening and nighttime hours. DNL is a very similar 24-hour average measure that weights only the nighttime hours.

It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA; that a change of 5 dBA is readily perceptible, and that an increase (decrease) of 10 dBA sounds twice (half) as loud. This definition is recommended by the California Department of Transportation's Technical Noise Supplement to the Traffic Noise Analysis Protocol (2013).

VIBRATION FUNDAMENTALS

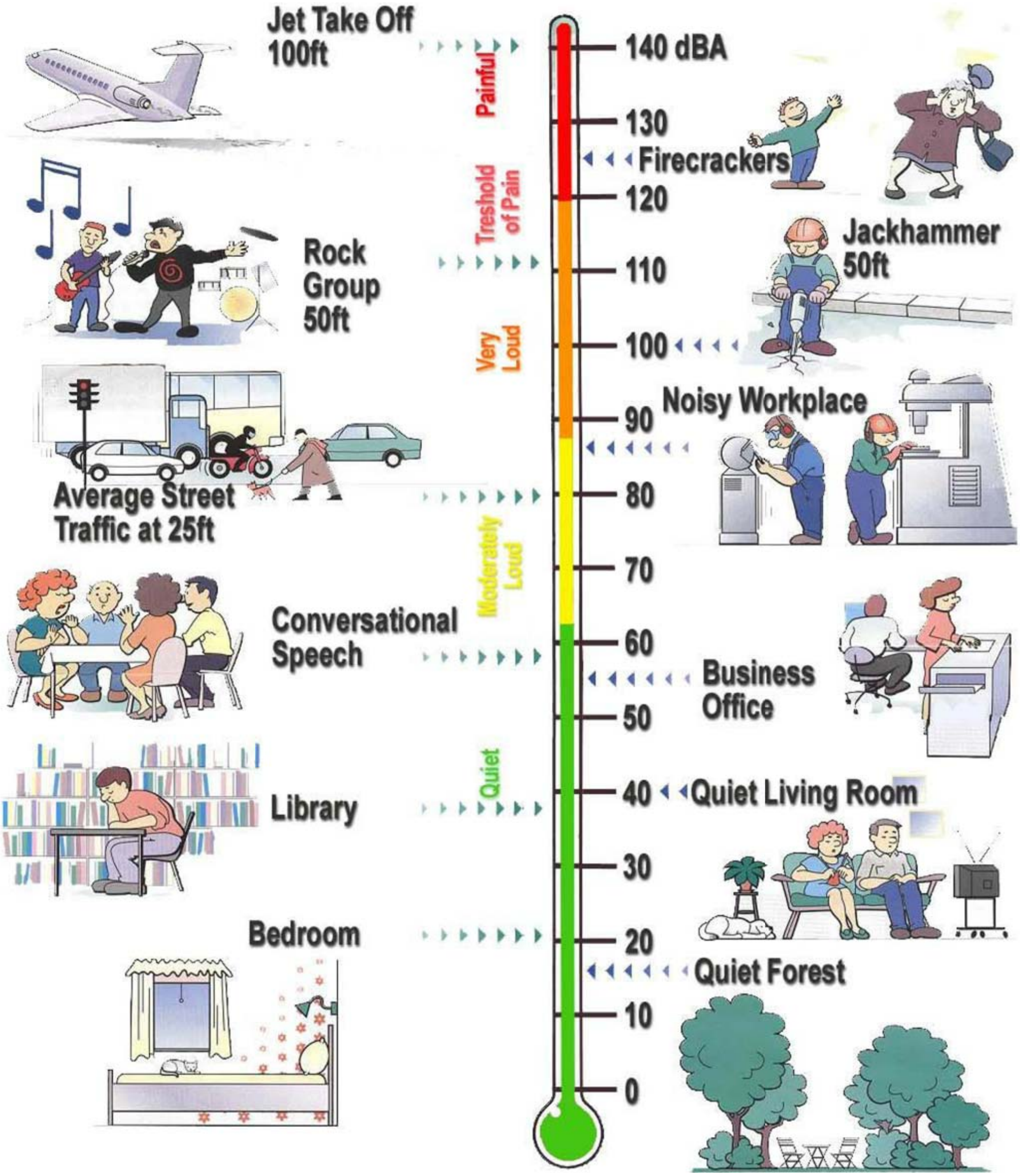
The way in which vibration is transmitted through the earth is called propagation. Propagation of earthborn vibrations is complicated and difficult to predict because of the endless variations in the soil through which waves travel. There are three main types of vibration propagation: surface, compression and shear waves. Surface waves, or Raleigh 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 throwing a rock into a pool of water.

Compression waves, or P-waves, are body waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal (i.e., in a “push-pull” fashion). P-waves are analogous to airborne sound waves. Shear waves, or S-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 striking a given point 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 void spaces. The amount of attenuation provided by material damping varies with soil type and condition as well as the frequency of the wave.

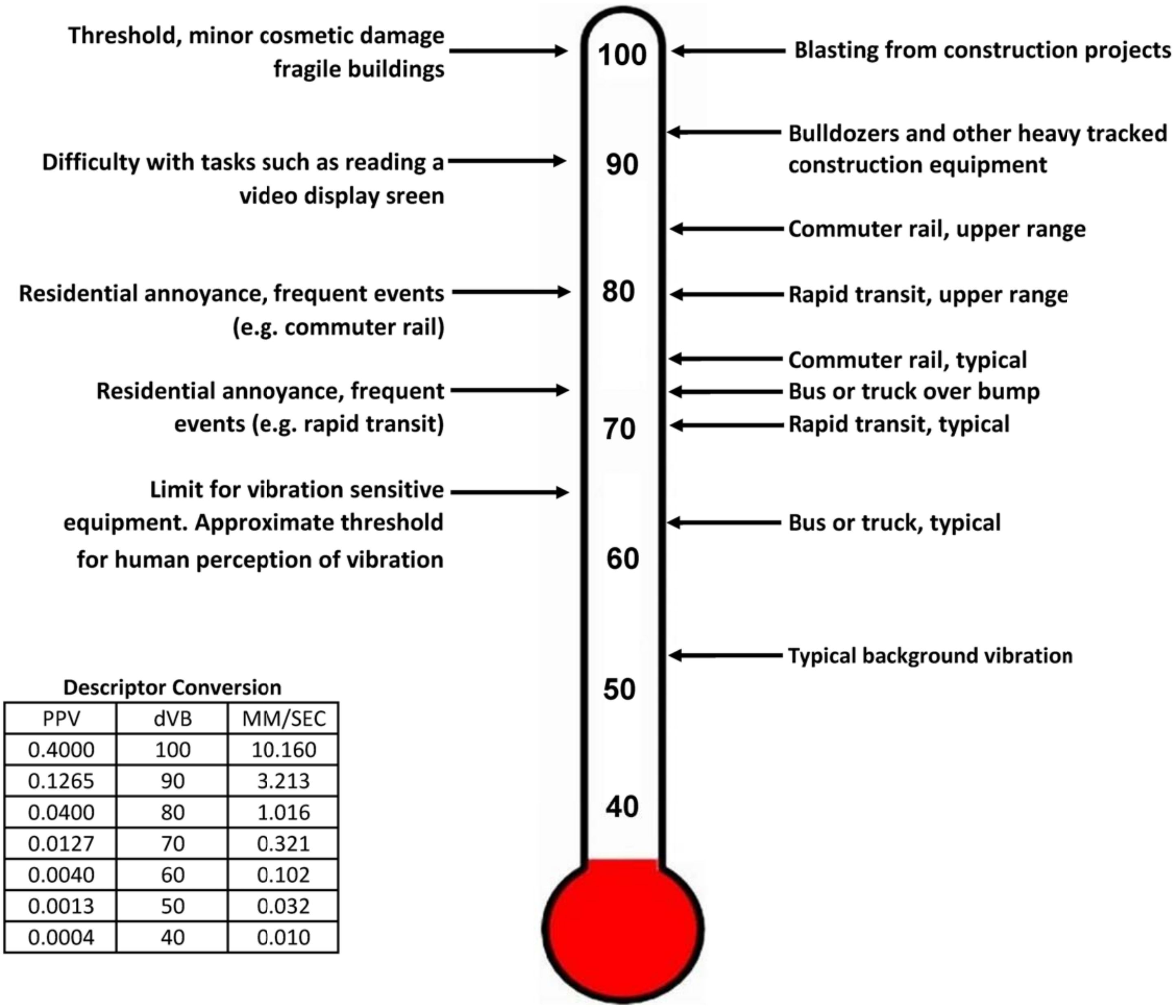
Vibration amplitudes are usually expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous peak of the vibration signal in inches per second. The RMS of a signal is the average of the squared amplitude of the signal in vibration decibels (VdB), ref one micro-inch per second. The Federal Railroad Administration uses the abbreviation “VdB” for vibration decibels to reduce the potential for confusion with sound decibel.

PPV is appropriate for evaluating the potential of building damage and VdB is commonly used to evaluate human response. Decibel notation acts to compress the range of numbers required in measuring vibration. Similar to the noise descriptors, L_{eq} and L_{max} can be used to describe the average vibration and the maximum vibration level observed during a single vibration measurement interval. Figure 4 illustrates common vibration sources and the human and structural responses to ground-borne vibration. As shown in the figure, the threshold of perception for human response is approximately 65 VdB; however, human response to vibration is not usually substantial unless the vibration exceeds 70 VdB. Vibration tolerance limits for sensitive instruments such as magnetic resonance imaging (MRI) or electron microscopes could be much lower than the human vibration perception threshold.



Source: Bruel & Kjaer 2001

Figure 3
Weighted Sound Levels and Human Response



Descriptor Conversion

PPV	dVB	MM/SEC
0.4000	100	10.160
0.1265	90	3.213
0.0400	80	1.016
0.0127	70	0.321
0.0040	60	0.102
0.0013	50	0.032
0.0004	40	0.010

Source: FRA, 2012. Federal Railroad Administration High-Speed Ground Transportation Noise and Vibration Impact Assessment. Office of Railroad Policy Development, Washington, D.C. DOT/FRA/ORD-12/15. September.

Figure 4
Typical Levels of Groundborne Vibration

3. EXISTING NOISE ENVIRONMENT

EXISTING LAND USES AND SENSITIVE RECEPTORS

The project site is bordered by Lincoln Avenue to the north, Ohio Street to the east, an alley way to the south, and commercial uses to the west.

The State of California defines sensitive receptors as those land uses that require serenity or are otherwise adversely affected by noise events or conditions. Schools, libraries, churches, hospitals, single and multiple-family residential, including transient lodging, motels and hotel uses make up the majority of these areas. Sensitive land uses that may be affected by project noise include the existing multi-family residential dwelling units located approximately 20 feet to the south and 60 feet to the southeast and the single-family residential dwelling units located approximately 20 feet to the southwest of the project site. School uses are located approximately 100 feet northeast (across Lincoln Avenue) and 245 feet southeast (along Citron Street) of the project site.

AMBIENT NOISE MEASUREMENTS

An American National Standards Institute (ANSI Section SI.4 2014, Class 1) Larson Davis model LxT sound level meter was used to document existing ambient noise levels. To document existing ambient noise levels in the project area, four (4) 15-minute daytime noise measurements were taken between 1:54 PM and 3:34 PM on February 1, 2021. Field worksheets and noise measurement output data are included in Appendix C.

As shown on Figure 5, the noise measurements were taken near the school use located to the northeast (across the intersection of Lincoln Avenue and Ohio Street) (NM1), near the multi-family residential dwelling units to the south and southeast of the project site (along Ohio Street) (NM2), near the single-family residential uses located to the southwest of the project site (NM3), and near the commercial uses to the west of the project site (NM4). Table 1 provides a summary of the short-term ambient noise data. Short-term ambient noise levels were measured between 55.5 and 71.5 dBA L_{eq}. The dominant noise sources were vehicles traveling along Lincoln Avenue, Ohio Street, Illinois Street, and other surrounding roadways.

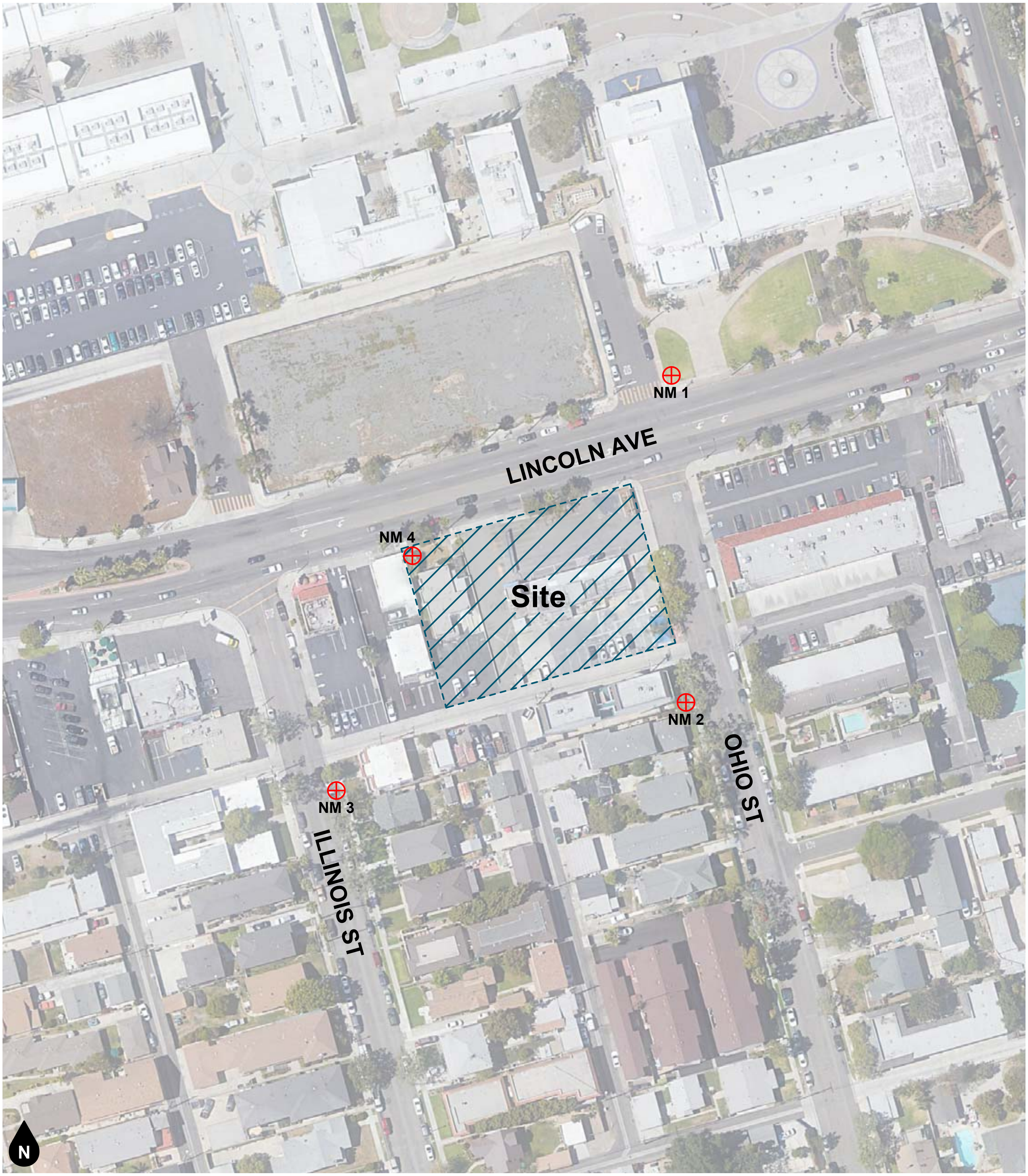
Table 1
Short-Term Noise Measurement Summary (dBA)

Daytime Measurements[1,2]								
Site Location	Time Started	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(50)
NM1	1:54 PM	71.5	79.8	52.9	77.1	75.5	73.5	69.9
NM2	2:21 PM	55.5	66.9	47.3	60.8	58.2	56.5	54.5
NM3	2:47 PM	57.6	75.2	47.2	63.2	60.2	58.3	55.8
NM4	3:19 PM	73.5	83.5	52.4	79.0	77.3	75.0	72.3

Notes:

(1) See Figure 5 for noise measurement locations. Each noise measurement was performed over a 15-minute duration.

(2) Noise measurements performed on February 1, 2021.



Legend

⊕ Noise Measurement Location

NM 1

Figure 5

Noise Measurement Location Map

4. REGULATORY SETTING

FEDERAL REGULATION

Federal Noise Control Act of 1972

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control was originally established to coordinate federal noise control activities. After its inception, EPA's Office of Noise Abatement and Control issued the Federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In response, the EPA published Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (Levels of Environmental Noise). The Levels of Environmental Noise recommended that the Ldn should not exceed 55 dBA outdoors or 45 dBA indoors to prevent significant activity interference and annoyance in noise-sensitive areas.

In addition, the Levels of Environmental Noise identified five (5) dBA as an "adequate margin of safety" for a noise level increase relative to a baseline noise exposure level of 55 dBA Ldn (i.e., there would not be a noticeable increase in adverse community reaction with an increase of five dBA or less from this baseline level). The EPA did not promote these findings as universal standards or regulatory goals with mandatory applicability to all communities, but rather as advisory exposure levels below which there would be no risk to a community from any health or welfare effect of noise.

In 1981, EPA administrators determined that subjective issues such as noise would be better addressed at lower levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to State and local governments. However, noise control guidelines and regulations contained in EPA rulings in prior years remain in place by designated Federal agencies, allowing more individualized control for specific issues by designated Federal, State, and local government agencies.

STATE REGULATIONS

State of California General Plan Guidelines 2017

Though not adopted by law, the State of California General Plan Guidelines 2017, published by the California Governor's Office of Planning and Research (OPR) (OPR Guidelines), provides guidance for the compatibility of projects within areas of specific noise exposure. The OPR Guidelines identify the suitability of various types of construction relative to a range of outdoor noise levels and provide each local community some flexibility in setting local noise standards that allow for the variability in community preferences. Findings presented in the Levels of Environmental Noise Document (EPA 1974) influenced the recommendations of the OPR Guidelines, most importantly in the choice of noise exposure metrics (i.e., Ldn or CNEL) and in the upper limits for the normally acceptable outdoor exposure of noise-sensitive uses.

The OPR Guidelines include a Noise and Land Use Compatibility Matrix which identifies acceptable and unacceptable community noise exposure limits for various land use categories. Where the "normally acceptable" range is used, it is defined as the highest noise level that should be considered for the construction of the buildings which do not incorporate any special acoustical treatment or noise mitigation. The "conditionally acceptable" or "normally unacceptable" ranges include conditions calling for detailed acoustical study prior to the construction or operation of the proposed project.

California Environmental Quality Act

The California Environmental Quality Act Guidelines (Appendix G) establishes thresholds for noise impact analysis. This noise study includes analysis of noise and vibration impacts necessary to assess the project in light of the following Appendix G Checklist Thresholds.

Would the project result in:

a) 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?

Substantial increases in ambient noise levels are usually associated with project construction noise (temporary) and project operational noise (permanent).

Project Construction Noise: Construction noise sources are regulated within the City of Anaheim under Section 6.70.010 of the City's Municipal Code which exempts construction activities from the noise standards between the hours of 7:00 AM and 7:00 PM.

Although construction activity may be exempt from the noise standards in the City's Municipal Code, CEQA requires that potential noise impacts still be evaluated for significance.

The City of Anaheim has not adopted a numerical threshold that identifies what a substantial increase would be. For purposes of this analysis, the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment (2018) criteria will be used to establish significance thresholds. The FTA provides reasonable criteria for assessing construction noise impacts based on the potential for adverse community reaction. For residential uses, the daytime noise threshold is 80 dBA L_{eq} averaged over an 8-hour period ($L_{eq\ (8\text{-hr})}$; and the nighttime noise threshold is 70 dBA $L_{eq\ (8\text{-hr})}$. For commercial uses, the daytime and nighttime noise threshold is 85 dBA $L_{eq\ (8\text{-hr})}$. In compliance with the City's Code, construction would not occur during the noise-sensitive nighttime hours.

Project Operational Noise (permanent): On-site operational noise is usually only evaluated for commercial and industrial projects. Quantitative analysis of on-site operational noise is typically not conducted for residential projects as they usually do not include stationary noise sources that could result in substantial increases in ambient noise levels resulting in violations of established standards. Depending upon how many units are proposed and the existing noise environment, project generated vehicle trips could result in substantial increases in noise levels. Therefore, the evaluation of project operational noise in this study is limited to the potential impacts associated with project generated vehicle traffic (off-site noise).

According to the City of Anaheim General Plan/Zoning Code Update EIR's Noise Section 5.10.3, Thresholds of Significance: Mobile-source noise (i.e., vehicle noise) is preempted from local regulation, but is still subject to CEQA. A change of 5 dBA would denote a significant impact if their resultant noise level were to remain within the objectives of the General Plan (e.g., 65 dBA (CNEL) at a residential location), or 3 dBA if the resultant level were to meet or exceed the objectives of the General Plan. Also note that an impact is only potentially significant if it affects a receptor. An increase in noise in an uninhabited location would not denote a significant impact.

b) Generate excessive groundborne vibration or groundborne noise levels?

The City currently does not have any adopted standards, guidelines, or thresholds relative to ground-borne vibration. Ground-borne noise refers to the noise generated by ground-borne vibration. Ground-borne noise that accompanies the building vibration is usually perceptible only inside buildings and typically is only an issue at locations with subway or tunnel operations where there is no airborne noise path or for buildings with substantial sound insulation such as a recording studio.[1] As such, available guidelines from the Federal Transit Administration (FTA) are utilized to assess impacts due to ground-borne vibration. The FTA has adopted vibration standards that are used to evaluate potential building damage impacts related to construction activities. As shown in Table 2, the threshold at which there is a risk to "architectural" damage to reinforced-

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[1] Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2018, pp 108, 112.

concrete, steel or timber (no plaster) buildings is a peak particle velocity (PPV) of 0.5, at engineered concrete and masonry (no plaster) buildings a PPV of 0.3, at non-engineered timber and masonry buildings a PPV of 0.2 and at buildings extremely susceptible to vibration damage a PPV of 0.1. The FTA has also adopted standards associated with human annoyance for groundborne vibration impacts for the following three land-use categories:

(1) Vibration Category 1 – High Sensitivity,
(2) Vibration Category 2 – Residential, and
(3) Vibration Category 3 – Institutional.

The FTA defines Category 1 as buildings where vibration would interfere with operations within the building, including vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations. Vibration-sensitive equipment includes, but is not limited to, electron microscopes, high-resolution lithographic equipment, and normal optical microscopes. Category 2 refers to all residential land uses and any buildings where people sleep, such as hotels and hospitals. Category 3 refers to institutional land uses such as schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. The vibration criteria associated with human annoyance for these three land-use categories are shown in Table 3. Table 3 shows that 72 VdB is the threshold for annoyance from groundborne vibration at sensitive receptors.

Therefore, impacts related to building damage would be significant if construction activities result in groundborne vibration of 0.2 PPV or higher at residential structures and/or a PPV of 0.3 or higher at commercial structures. Impacts related to human annoyance would be significant if they result in groundborne vibration levels that exceed 72 VdB at sensitive receptor locations.

LOCAL REGULATIONS

City of Anaheim General Plan

The City has adopted the State of California's exterior noise and land use compatibility standards for land use development in the Noise Element of its General Plan, as shown in Table 4. These Guidelines establish standards for outdoor noise levels that are acceptable, conditionally acceptable, and unacceptable for a variety of land uses. For multi-family residential uses noise levels of up to 65 dBA CNEL are considered "normally acceptable." Noise environments with noise levels up to 70 dBA CNEL are considered "conditionally acceptable"; under this circumstance, development may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features are included in the project design. Conventional construction, but with closed windows and a fresh air supply system or air conditioning, will normally suffice as a noise insulation feature for these conditionally acceptable environments. These standards apply to the proposed project itself.

The City of Anaheim General Plan contains goals and policies that address noise. The following goals and policies are presented in the City's General Plan Noise Element and are applicable to the proposed project:

Goal 1.1 Protect sensitive land uses from excessive noise through diligent planning and regulation.

Policy 1 Update City regulations to adopt Land Use Compatibility for Community Noise Exposure and California Interior and Exterior Noise Standards as appropriate.

Policy 5 Encourage proper site planning and architecture to reduce noise impacts.

Policy 6 Discourage the siting of sensitive uses in areas in excess of 65 dBA CNEL without appropriate mitigation.

Policy 7	Require that site-specific noise studies be conducted by a qualified acoustic consultant utilizing acceptable methodologies while reviewing the development of sensitive land uses or development that has the potential to impact sensitive land uses.
Goal 2.1	Encourage the reduction of noise from transportation-related noise sources such as motor vehicles, aircraft operations, and railroad movements.
Policy 3	Require that development generating increased traffic and subsequent increases in the ambient noise level adjacent to noise-sensitive land uses provide appropriate mitigation measures.
Goal 3.1	Protect residents from the effects of “spill over” or nuisance noise emanating from the City’s activity centers.
Policy 1	Discourage new projects located in commercial or entertainment areas from exceeding stationary-source noise standards at the property line of proximate residential or commercial uses, as appropriate.
Policy 2	Prohibit new industrial uses from exceeding commercial or residential stationary-source noise standards at the most proximate land uses, as appropriate. (Industrial noise may spill over to proximate industrial uses so long as the combined noise does not exceed the appropriate industrial standards.)
Policy 3	Enforce standards to regulate noise from construction activities. Particular emphasis shall be placed on the restriction of the hours in which work other than emergency work may occur. Discourage construction on weekends or holidays except in the case of construction proximate to schools where these operations could disturb the classroom environment.
Policy 4	Require that construction equipment operate with mufflers and intake silencers no less effective than originally equipped.
Policy 3	Encourage the use of portable noise barriers for heavy equipment operations performed within 100 feet of existing residences or make applicant provide evidence as to why the use of such barriers is infeasible.

City of Anaheim Municipal Code

The City addresses noise in the noise ordinances of its Municipal Code. These ordinances are summarized below.

Section 6.70.010 Established

Sound produced in excess of the sound pressure levels permitted herein are hereby determined to be objectionable and constitute an infringement upon the right and quiet enjoyment of property in this City.

No person shall within the City create any sound radiated for extended periods from any premises which produces a sound pressure level at any point on the property line in excess of sixty decibels (Re 0.0002 Microbar) read on the A-scale of a sound level meter. Readings shall be taken in accordance with the instrument manufacturer’s instructions, using the slowest meter response.

The sound level measuring microphone shall be placed at any point on the property line, but not closer than three (3) feet from any wall and not less than three (3) feet above the ground, where the above listed maximum sound pressure level shall apply. At any point the measured level shall be the average of not less than three

(3) readings taken at two (2) minute intervals. To have valid readings, the levels must be five (5) decibels or more above the levels prevailing at the same point when the sources of the alleged objectionable sound are not operating.

Sound pressure levels shall be measured with a sound level meter manufactured according to American Standard S1.4-1961 published by the American Standards Association, Inc., New York City, New York.

Traffic sounds created by emergency activities and sound created by governmental units or their contractors shall be exempt from the applications of this chapter. Sound created by construction or building repair of any premises within the City shall be exempt from the applications of this chapter during the hours of 7:00 AM to 7:00 PM Additional work hours may be permitted if deemed necessary by the Director of Public Works or Building Official.

Section 18.40.090 Sound Attenuation for Residential Developments

Section 18.40.090 of the City's Municipal Code addresses noise levels for new residential developments involving the construction of two or more dwelling units and located within six hundred feet of any railroad, freeway, expressway, major arterial, primary arterial or secondary arterial, as designated by the Circulation Element of the General Plan. According to the Circulation Element of the General Plan, Lincoln Avenue is identified as a Primary Arterial and because the project site fronts this roadway, the provisions of Section 18.40.090 are applicable to the proposed project. Per Section 18.40.090, exterior noise within common recreation areas of any single family attached or multiple family dwelling project shall be attenuated to a maximum of sixty-five (65) dB CNEL. Interior noise levels shall be attenuated to a maximum of forty-five (45) dB CNEL, or to a level designated by the Uniform Building Code, as adopted by the City. Additionally, the Planning Commission may grant a deviation from the requirements, provided the evidence presented shows that all of the following conditions exist:

- The deviation from prescribed levels does not pertain to interior noise levels;
- The deviation does not exceed five (5) dB CNEL above the prescribed levels for exterior noise; and
- Measures to attenuate noise to the prescribed levels would compromise or conflict with the aesthetic value of the project.

Table 2
Construction Vibration Damage Criteria

Building/Structural Category	PPV, in/sec	Approximate L_v[1]
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 extremelly susceptible to vibration damage	0.1	90

Notes:

Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment Manual (September 2018).

(1) RMS velocity in decibels, VdB re 1 micro-in/sec.

Table 3
Ground-Borne Vibration (GBV) Impact Criteria for General Vibration Assessment

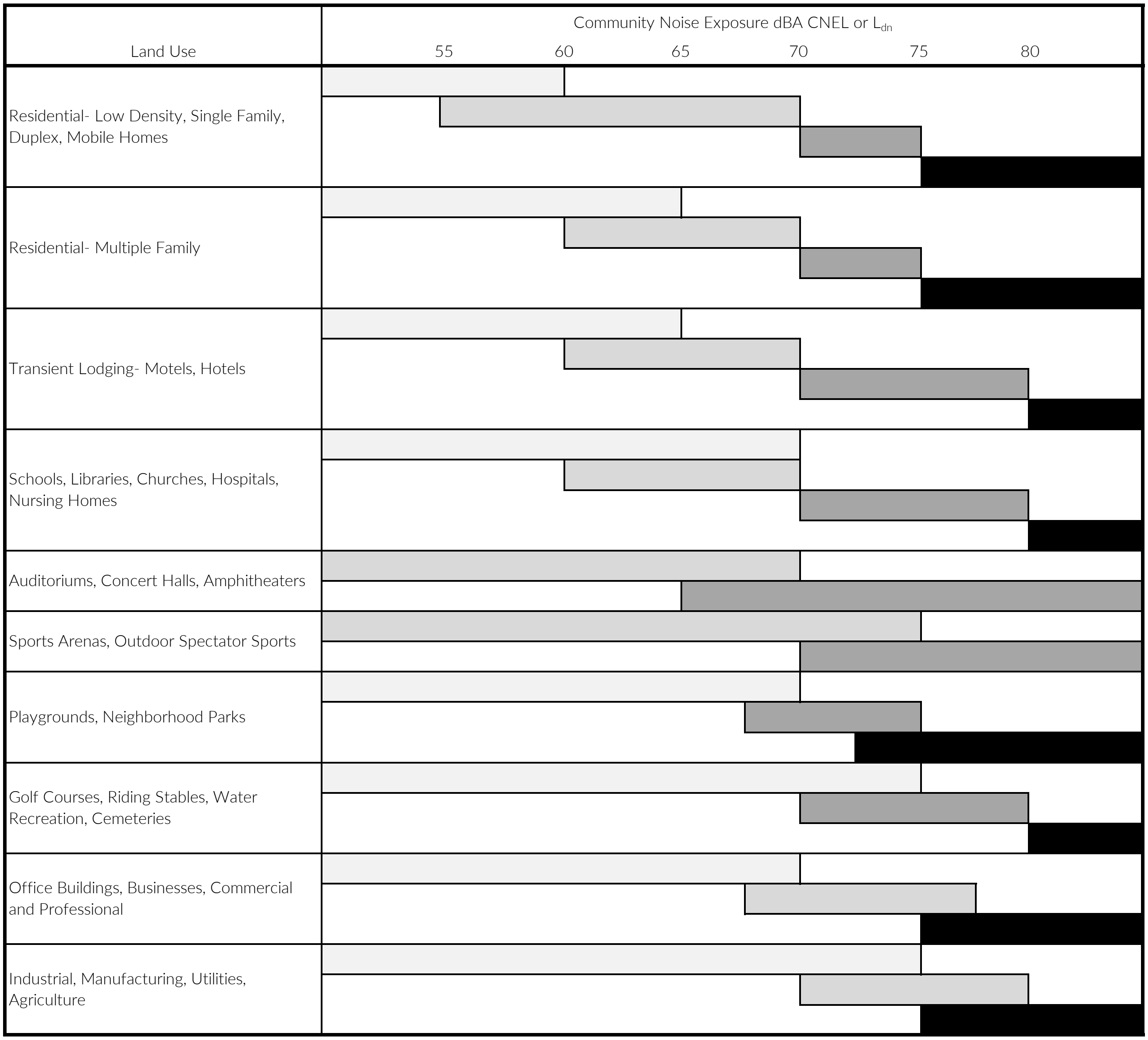
Land Use Category	GBV Impact Levels (VdB re 1 micro-inch/sec)		
	Frequent Events	Occasional Events	Infrequent Events
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB*	65 VdB*	65 VdB*
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB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

Notes:

Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment Manual (September 2018).

*This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical

Table 4
City of Anaheim Land Use Compatibility for Community Noise Exposure (Exterior)



⬜	**Normally Acceptable:**	Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
▒	**Conditionally Acceptable:**	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice. Outdoor environment will seem noisy.
▓	**Normally Unacceptable:**	New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made with needed noise insulation features included in the design. Outdoor areas must be shielded.
■	**Clearly Unacceptable:**	New construction or development should generally not be undertaken. Construction cost to make the indoor environment acceptable would be prohibitive and the outdoor environment would not be usable.

Notes:

(1) Source: City of Anaheim General Plan Noise Element, Figure N-2, May 2004.

5. ANALYTICAL METHODOLOGY AND MODEL PARAMETERS

This section discusses the analysis methodologies used to assess noise impacts.

CONSTRUCTION NOISE MODELING

Construction noise associated with the proposed project was calculated at the sensitive receptor locations, utilizing methodology presented in the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (2018) together with several key construction parameters including: distance to each sensitive receiver, equipment usage, percent usage factor, and baseline parameters for the project site. Distances to receptors were based on the acoustical center of the project site. The equipment used to calculate the construction noise levels for each phase were based on the assumptions provided in the CalEEMod modeling in the Air Quality, Global Climate Change, and Energy Impact Analysis prepared for the proposed project (Ganddini Group, Inc., 2021). For construction noise purposes, the distance measured from the project site to sensitive receptors was assumed to be the acoustical center of the project site to the property line of residential properties with existing residential buildings. Construction noise worksheets are provided in Appendix D.

FEDERAL HIGHWAY ADMINISTRATION (FHWA) TRAFFIC NOISE PREDICTION MODEL

The roadway noise level increases from project generated vehicular traffic were modeled utilizing a computer program that replicates the FHWA Traffic Noise Prediction Model FHWA-RD-77-108.

The FHWA Traffic Noise Prediction Model arrives at a predicted noise level through a series of adjustments to the Reference Energy Mean Emission Level (REMEL). In California the national REMELs are substituted with the California Vehicle Noise (Calveno) Emissions Levels.[3] Adjustments are then made to the REMEL to account for: total average daily traffic volumes, roadway classification (i.e., collector, secondary, major or arterial), the roadway active width (i.e., distance between the center of the outermost travel lanes on each side of the roadway), travel speed, truck mix (i.e., percentage of automobiles, medium trucks, and heavy trucks in the traffic volume), roadway grade and site conditions (hard or soft ground surface relating to the absorption of the ground, pavement, or landscaping). Research conducted by Caltrans identifies that the use of soft site conditions is appropriate for the application of the FHWA traffic noise prediction model.[4] Therefore, surfaces adjacent to all modeled roadways were assumed to have a “soft site”. Possible reductions in noise levels due to intervening topography and buildings were not accounted for in this analysis.

Existing traffic volumes were obtained from a traffic impact analysis completed for a nearby study as well as existing ambient noise levels. Project traffic volumes were obtained from the project's trip generation memorandum (Integrated Engineering Group 2021).[5] No vehicle mix data for use in noise studies has been published for these roadways by the County of Orange or the City of Anaheim, so published Riverside County vehicle mix requirements were utilized for modeling purposes.[6] Existing Plus Project vehicle mixes were calculated by adding the proposed project trips to existing conditions. FHWA spreadsheets are included in Appendix E.

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[3] California Department of Transportation Environmental Program, Office of Environmental Engineering. Use of California Vehicle Noise Reference Energy Mean Emission Levels (Calveno REMELs) in FHWA Highway Traffic Noise Prediction. September 1995. TAN 95-03.

[4] California Department of Transportation. Traffic Noise Attenuation as a Function of Ground and Vegetation Final Report. June 1995. FHWA/CA/TL-95/23.

[5] The existing average daily traffic volume for Lincoln Avenue was obtained from the 1600 W. Lincoln Avenue Apartments Traffic Impact Analysis City of Anaheim, Dudek (January 2020). The existing average daily traffic volume for Ohio Street was calculated by use of the existing ambient noise levels. Project average daily traffic volumes obtained from the Lincoln Colony Apartments Trip Generation Memorandum, Integrated Engineering Group (February 12, 2021).

[6] Riverside, County Department of Public Health, Requirements for Determining and Mitigating Traffic Noise Impacts to Residential Structures, Steven Hinde, REHS, CIH, Senior Industrial Hygienist, November 23, 2009.

6. IMPACT ANALYSIS

This impact discussion analyzes the potential for noise and/or groundborne vibration impacts to cause the exposure of a person to, or generation of, noise levels in excess of established City of Anaheim standards related to: construction and transportation noise related impacts to, or from, the proposed project.

IMPACTS RELATED TO CONSTRUCTION NOISE

The existing multi-family residential dwelling units located to the south and southeast, the single-family residential dwelling units located to the southwest, and the school use located to the northeast of the project site may be affected by short-term noise impacts associated with construction noise. Construction noise will vary depending on the construction process, type of equipment involved, location of the construction site with respect to sensitive receptors, the schedule proposed to carry out each task (e.g., hours and days of the week) and the duration of the construction work.

The construction phases for the proposed project are anticipated to include grading, building construction, paving and architectural coating. Construction activities are anticipated to begin September 2021 and be completed by September 2023. A summary of noise level data for a variety of construction equipment compiled by the U.S. Department of Transportation is presented in Table 5. Typical operating cycles for these types of construction equipment may involve one or two minutes of full power operation followed by three to four minutes at lower power settings.

Construction noise associated with the proposed project was calculated utilizing methodology presented in the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (2018) together with several key construction parameters including: distance to each sensitive receiver, equipment usage, percent usage factor, and baseline parameters for the project site. Distances to receptors were based on the acoustical center of the proposed construction activity. Construction noise levels were calculated for each phase. Anticipated noise levels during each construction phase are presented in Table 6. Worksheets for each phase are included as Appendix D.

A comparison of existing noise levels and project construction noise levels are presented in Table 6. NM1 was chosen to represent noise levels at the property line of the school use to the northeast, NM2 was chosen to represent noise levels at the residential property lines of the multi-family residential properties to the south and southeast of the project site, and NM3 was chosen to represent the residential property line of the single-family residential property to the southwest of the project site.

Modeled unmitigated construction noise levels reached up to 71.9 dBA L_{eq} at the nearest school property line to the northeast, 74.4 dBA L_{eq} at the nearest multi-family residential property line to the southeast, up to 79.6 dBA L_{eq} at the nearest multi-family residential property line to the south, and up to 78 dBA L_{eq} at the nearest single-family residential property line to the southeast of the project site.

As discussed earlier, construction noise sources are regulated within the City of Anaheim under Section 6.70.010 of the City's Municipal Code which exempts construction activities from the noise standards between the hours of 7:00 AM and 7:00 PM.

As stated previously, per FTA daytime construction noise levels should not exceed 80 dBA L_{eq} for an 8-hour period at residential uses and 85 dBA L_{eq} for an 8-hour period at commercial uses. Therefore, project construction would not be anticipated to exceed the FTA thresholds for either residential or commercial uses. Further, with compliance with the City's Municipal Code Section 6.70.010, construction would not occur during the noise-sensitive nighttime hours.

Impacts would be less than significant, and no mitigation is required. However, impacts related to construction noise will be further minimized with adherence to the above Municipal Ordinances and implementation of the recommended measures presented in Section 7 of this report.

Off-Site Construction Activity

Construction truck trips would occur throughout the construction period. According to the FHWA, the traffic volumes need to be doubled in order to increase noise levels by 3 dBA CNEL.[7] The estimated existing average daily trips along Foothill Boulevard are 28,594 average daily vehicle trips and for Ohio Street are 673 average daily vehicle trips per day.[8] As shown in the CalEEMod output files provided in the Air Quality, Global Climate Change, and Energy Impact Analysis prepared for the proposed project (Ganddini Group, Inc., 2021) including the greatest number of vehicle trips per day would be during grading at up to 310 vehicle trips per day (10 for worker trips and 300 for hauling trips). Given the project site's proximity to the Interstate 5 Freeway, it is anticipated that haul truck traffic would take the most direct route to the appropriate freeway ramps. Therefore, the addition of project haul trucks and worker vehicles per day along off-site roadway segments would not be anticipated to result in a doubling of traffic volumes. Off-site project generated construction vehicle trips would result in a negligible noise level increase and would not result in a substantial increase in ambient noise levels. Impacts would be less than significant. No mitigation measures are required.

NOISE IMPACTS TO OFF-SITE RECEPTORS DUE TO PROJECT GENERATED TRIPS

During operation, the proposed project is expected to generate approximately 234 average daily trips with 15 trips during the AM peak-hour and 19 trips during the PM peak-hour. Project generated traffic noise levels were modeled utilizing the FHWA Traffic Noise Prediction Model - FHWA-RD-77-108. As the Trip Generation Memorandum (Integrated Engineering Group 2021) provided for the proposed project does not include project trip distribution and in order to provide a conservative analysis for each affected roadway, all project generated vehicle trips were assumed to travel along both Lincoln Avenue and Ohio Street. Traffic noise levels were calculated at the right of way from the centerline of the analyzed roadway. The modeling is theoretical and does not take into account any existing barriers, structures, and/or topographical features that may further reduce noise levels. Therefore, the levels are shown for comparative purposes only to show the difference in with and without project conditions. Roadway input parameters including average daily traffic volumes (ADTs), speeds, and vehicle distribution data is shown in Table 7. The potential off-site noise impacts caused by an increase of traffic from operation of the proposed project on the nearby roadways were calculated for the following scenarios:

Existing Year (without Project): This scenario refers to existing year traffic noise conditions and is demonstrated in Table 8.

Existing Year (With Project): This scenario refers to existing year plus project traffic noise conditions and is demonstrated in Table 8.

As shown in Table 8, modeled Existing traffic noise levels range between 58.5 and 75.7 dBA CNEL at the right-of-way of the modeled roadway segments; and the modeled Existing Plus Project traffic noise levels range between 59.8 and 75.7 dBA CNEL at the right-of-way of the modeled roadway segments.

As stated previously, a change of 5 dBA would denote a significant impact if the resultant noise level were to remain within the objectives of the General Plan (e.g., 65 dBA (CNEL) at a residential location), or 3 dBA if the resultant level were to meet or exceed the objectives of the General Plan.

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[7] Federal Highway Administration, Highway Noise Prediction Model, December 1978.

[8] The existing average daily traffic volume for Lincoln Avenue was obtained from the 1600 W. Lincoln Avenue Apartments Traffic Impact Analysis City of Anaheim, Dudek (January 2020). The existing average daily traffic volume for Ohio Street was calculated by use of the existing ambient noise levels. See Table 7.

Project generated vehicle trips are anticipated to change noise levels between approximately 0.03 to 1.3 dBA CNEL. Therefore, a change in noise level would not be audible, is less than 3 dBA, and would be considered less than significant. No mitigation is required.

GROUNDBORNE VIBRATION IMPACTS

Construction Vibration

There are several types of construction equipment that can cause vibration levels high enough to annoy persons in the vicinity and/or result in architectural or structural damage to nearby structures and improvements. For example, as shown in Table 9, a vibratory roller could generate up to 0.21 PPV at a distance of 25 feet; and operation of a large bulldozer (0.089 PPV) at a distance of 25 feet (two of the most vibratory pieces of construction equipment). Groundborne vibration at sensitive receptors associated with this equipment would drop off as the equipment moves away. For example, as the vibratory roller moves further than 100 feet from the sensitive receptors, the vibration associated with it would drop below 0.0026 PPV. It should be noted that these vibration levels are reference levels and may vary slightly depending upon soil type and specific usage of each piece of equipment.

Architectural Damage

Vibration generated by construction activity generally has the potential to damage structures. This damage could be structural damage, such as cracking of floor slabs, foundations, columns, beams, or wells, or cosmetic architectural damage, such as cracked plaster, stucco, or tile. (California Department of Transportation, 2020).

Table 5 identifies the threshold at which there is a risk to "architectural" damage to reinforced-concrete, steel or timber (no plaster) buildings as a peak particle velocity (PPV) of 0.5, at engineered concrete and masonry (no plaster) buildings as a PPV of 0.3, at non-engineered timber and masonry buildings as a PPV of 0.2 and at buildings extremely susceptible to vibration damage as a PPV of 0.1. Therefore, impacts would be significant if construction activities result in groundborne vibration of 0.2 PPV or higher at residential structures and/or a PPV of 0.3 or higher at commercial structures. Calculated project generated construction vibration levels are shown in Table 10.

The commercial use adjacent to the west of the project site includes two buildings. The northernmost building is located approximately one foot from the project's western property line, while the southernmost building is located approximately 5 feet from the project's western property line. As shown in Table 10, at one foot, use of a vibratory roller would be expected to generate a PPV of 26.25 and a bulldozer would be expected to generate a PPV of 11.125, while at five feet use of a vibratory roller would be expected to generate a PPV of 2.348 and a bulldozer would be expected to generate a PPV of 0.995. Therefore, use of either a vibratory roller or a bulldozer could result in architectural damage to the receptors to the west. In order to reduce potential vibration levels at adjacent commercial structures to the west, vibratory rollers, or other similar vibratory equipment, are to be prohibited within twenty feet and large bulldozers within twelve feet of any commercial structures to the west. Mitigation measures to reduce potential impacts related to vibration are presented in Section 7 of this report.

The next nearest off-site buildings are the multi-family residential dwelling units located approximately 20 feet from the southern project property line. As shown in Table 10, at 20 feet, use of a vibratory roller would be expected to generate a PPV of 0.293 in/sec and a bulldozer would be expected to generate a PPV of 0.124 in/sec. Therefore, use of a vibratory roller could result in architectural damage to the receptors to the south. In order to reduce potential vibration levels at residential structures to the south, vibratory rollers, or other similar vibratory equipment, are to be prohibited within twenty-six feet of any residential structure to the south. Mitigation measures to reduce potential impacts related to vibration are presented in Section 7 of this report.

Buildings associated with the single-family residential dwelling unit to the southwest of the project site are located as close as approximately 30 feet from the southern project property line. As shown in Table 10, at 30 feet, use of a vibratory roller would be expected to generate a PPV of 0.16 in/sec and a bulldozer would be expected to generate a PPV of 0.068 in/sec. Therefore, use of a vibratory roller or large bulldozer would not cause architectural damage to the receptors to the southwest.

Furthermore, a commercial building is located approximately 60 feet from the eastern project property line. As shown in Table 10, at 60 feet, the commercial building to the west, use of a vibratory roller would be expected to generate a PPV of 0.056 in/sec and a bulldozer would be expected to generate a PPV of 0.024 in/sec. Therefore, use of a vibratory roller or large bulldozer would not cause architectural damage to the receptors to the east.

Therefore, temporary vibration levels associated with project construction could cause architectural damage to the nearest commercial receptors to the west and residential structures to the south and mitigation is required. In order to reduce potential vibration levels at adjacent commercial structures to the west, vibratory rollers, or other similar vibratory equipment, are to be prohibited within twenty feet and large bulldozers within twelve feet of the any commercial structure to the west and vibratory rollers within twenty-six feet of any residential structure to the south. With incorporation of mitigation, as shown in Table 10, impacts from vibration generated damage would be reduced to less than significant. Vibration worksheets are provided in Appendix F.

Annoyance to Persons

The primary effect of perceptible vibration is often a concern. However, secondary effects, such as the rattling of a china cabinet, can also occur, even when vibration levels are well below perception. Any effect (primary perceptible vibration, secondary effects, or a combination of the two) can lead to annoyance. The degree to which a person is annoyed depends on the activity in which they are participating at the time of the disturbance. For example, someone sleeping or reading will be more sensitive than someone who is running on a treadmill. Reoccurring primary and secondary vibration effects often lead people to believe that the vibration is damaging their home, although vibration levels are well below minimum thresholds for damage potential. (California Department of Transportation, 2020).

As shown in Table 6, vibration becomes strongly perceptible to sensitive receptors at a level of 72 VdB. A vibratory roller could generate up to 72 VdB at a distance of 136 feet from the source and a large bulldozer could generate 72 VdB at a distance of 80 feet from the source. Calculated project generated construction vibration levels are shown in Table 10.

The closest buildings to the project site are the commercial buildings located between one and five feet from the western project property line. The FTA adopted standards associated with human annoyance for groundborne vibration impacts for three land-use categories: Vibration Category 1 – High Sensitivity, Vibration Category 2 – Residential, and Vibration Category 3 – Institutional. The FTA defines Category 1 as buildings where vibration would interfere with operations within the building, including vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations. Vibration-sensitive equipment includes, but is not limited to, electron microscopes, high-resolution lithographic equipment, and normal optical microscopes. Category 2 refers to all residential land uses and any buildings where people sleep, such as hotels and hospitals. Category 3 refers to institutional land uses such as schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Therefore, as commercial uses are not considered a vibration-sensitive land use, no further analysis in regard to annoyance is necessary.

The next closest buildings to the project site are the multi-family residential dwelling units located approximately 20 feet and the single-family residential buildings located as close as approximately 30 feet from the southern project property line. As shown in Table 10, potential annoyance from vibration could occur at these sensitive receptors if large bulldozers are used within 136 feet and vibratory rollers within 80 feet of any residential structure to the south or southwest. Annoyance is expected to be short-term, occurring only during site grading; however, mitigation measures to reduce potential impacts related to annoyance have been presented in Section 7 of this report.

With incorporation of mitigation, as shown in Table 10, impacts from vibration related annoyance would be reduced to less than significant. Vibration worksheets are provided in Appendix F.

Operational Vibration

As the proposed project consists of a four-story apartment building with 43 residential dwelling units, the project does not include any sources of operational vibration; no impacts are anticipated.

IMPACTS TO PROJECT FROM AIRPORTS

The closest airport to the project site is the Fullerton Municipal Airport, which is located approximately 3.92 miles to the northwest of the project site. Per the Fullerton Municipal Airport Master Plan Update (August 2020), the project site is well outside the 60 CNEL noise contour for this airport.[9] Therefore, as the project is not within two miles of a public airport or in the vicinity of a private airstrip, the project would not expose people residing or working in the project area to excessive noise levels associated with airports.

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[9] Fullerton Municipal Airport Master Plan Update Figure 9-3 Fullerton Municipal Airport 2023 CNEL Noise Contours, May 2004.

Table 5
CA/T Equipment Noise Emissions and Acoustical Usage Factor Database

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Spec. Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow)	No. of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	-N/A-	0
Backhoe	No	40	80	78	372
Compressor (air)	No	40	80	78	18
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Forklift[2,3]	No	50	n/a	61	n/a
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS signs)	No	50	70	73	74
Grader	No	40	85	-N/A-	0
Jackhammer	Yes	20	85	89	133
Paver	No	50	85	77	9
Pickup Truck	No	50	85	77	9
Paving Equipment	No	50	85	77	9
Pneumatic Tools	No	50	85	85	90
Roller	No	20	85	80	16
Scraper	No	40	85	84	12
Tractor	No	40	84	-N/A-	0
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44

Notes:

(1) Source: FHWA Roadway Construction Noise Model User's Guide January 2006.

(2) Warehouse & Forklift Noise Exposure - NoiseTesting.info Carl Stautins, November 4, 2014
http://www.noisetesting.info/blog/carl-strautins/page-3/

(3) Data provided Leq as measured at the operator. Sound Level at 50 feet is calculated using Inverse Square Law.

Table 6
Construction Noise Levels (L_{eq})

Phase	Receptor Location	Existing Ambient Noise Levels (dBA Leq)[2]	Construction Noise Levels (dBA Leq)
Grading	School to Northeast (NM1)	71.5	71.9
	Residential to Southeast (NM2)	55.5	74.4
	Residential to South (NM2)	55.5	79.6
	Residential to Southwest (NM3)	57.6	78.0
Building Construction	School to Northeast (NM1)	71.5	70.4
	Residential to Southeast (NM2)	55.5	72.9
	Residential to South (NM2)	55.5	78.1
	Residential to Southwest (NM3)	57.6	76.5
Paving	School to Northeast (NM1)	71.5	71.1
	Residential to Southeast (NM2)	55.5	73.6
	Residential to South (NM2)	55.5	78.8
	Residential to Southwest (NM3)	57.6	77.2
Architectural Coating	School to Northeast (NM1)	71.5	62.8
	Residential to Southeast (NM2)	55.5	65.3
	Residential to South (NM2)	55.5	70.4
	Residential to Southwest (NM3)	57.6	68.9

Notes:

(1) Construction noise worksheets are provided in Appendix D.

(2) Per measured existing ambient noise levels. NM1 used for school receptors to the northeast, NM2 for residential receptors to the south and southeast, and NM3 for residential receptors to the southwest.

Table 7
Project Average Daily Traffic Volumes and Roadway Parameters

Roadway	Segment	Average Daily Traffic Volume[1]		Posted Travel Speeds (MPH)	Site Conditions
		Existing	Existing Plus Project[2]		
Lincoln Avenue	West Street to Harbor Boulevard	28,594	28,828	35	Soft
Ohio Street	South of Lincoln Avenue	673	907	25	Soft

Vehicle Distribution (Light Mix)[3]			
Motor-Vehicle Type	Daytime % (7 AM-7 PM)	Evening % (7 PM-10 PM)	Night % (10 PM-7 AM)
Automobiles	75.56	13.96	10.49
Medium Trucks	48.91	2.17	48.91
Heavy Trucks	47.30	5.41	47.30

Vehicle Distribution (Heavy Mix)[3]			
Motor-Vehicle Type	Daytime % (7 AM-7 PM)	Evening % (7 PM-10 PM)	Night % (10 PM-7 AM)
Automobiles	75.54	14.02	10.43
Medium Trucks	48.00	2.00	50.00
Heavy Trucks	48.00	2.00	50.00

Notes:

(1) The existing average daily traffic volume for Lincoln Avenue was obtained from the 1600 W. Lincoln Avenue Apartments Traffic Impact Analysis City of Anaheim, Dudek (January 2020). The existing average daily traffic volume for Ohio Street was calculated by use of the existing ambient noise levels. Project average daily traffic volumes obtained from the Lincoln Colony Apartments Trip Generation Memorandum, Integrated Engineering Group (February 12, 2021).

(2) The Trip Generation Memoradum provided for the proposed project did not include trip distribution. In order to provide a worst-case analysis, it was assumed that all project generated vehicle trips could potentially travel along either Lincoln Avenue and/or Ohio Street. Therefore, both Lincoln Avenue and Ohio Street have been modeled with all 234 of the daily project generated vehicle trips identified in the Trip Generation Memoradum.

(3) Existing vehicle percentages are based on the Riverside County Industrial Hygiene Letter for Traffic Noise.

Table 8
Change in Existing Noise Levels Along Roadways as a Result of Project (dBA CNEL)

			Modeled Noise Levels (dBA CNEL)[1]				
Roadway	Segment	Distance from roadway centerline to right-of-way (feet)[2]	Existing Without Project at right-of-way	Existing Plus Project at right-of-way	Change in Noise Level	Exceeds Standards[3]	Increase of 3 dB or More?
Lincoln Avenue	West Street to Harbor Boulevard	53	75.69	75.72	0.03	Yes	No
Ohio Street	South of Lincoln Avenue	30	58.53	59.83	1.30	No	No

Notes:

(1) Exterior noise levels calculated 5 feet above pad elevation, perpendicular to subject roadway.

(2) Right of way per the City of Anaheim General Plan Circulation Element.

(3) Per the City of Anahiem normally acceptable standard for residential dwelling units (see Table 4).

Table 9
Construction Equipment Vibration Source Levels

Equipment		PPV at 25 ft, in/sec	Approximate Lv* at 25 ft
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (sonic)	upper range	0.734	105
	typical	0.170	93
clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large Bulldozer		0.089	87
Caisson Drilling		0.089	87
Loaded Trucks		0.076	86
Jackhammer		0.035	79
Small Bulldozer		0.003	58

Source: Federal Transit Administration: Transit Noise and Vibration Impact Assessment Manual, 2018.

*RMS velocity in decibels, VdB re 1 micro-in/sec

Table 10
Construction Vibration Levels at the Nearest Receptors

Receptor Location	Distance from Property Line to Nearest Structure (feet)	Equipment	Vibration Level[1]	Vibration Level with Mitigation[1,2]	Threshold Exceeded With Mitigation?[3]
Architectural Damage Analysis					
Commercial to West	1	Vibratory Roller	26.250	0.293	No
	1	Large Bulldozer	11.125	0.268	No
	5	Vibratory Roller	2.348	0.293	No
	5	Large Bulldozer	0.995	0.268	No
Multi-Family Residential to South	20	Vibratory Roller	0.293	0.198	No
	20	Large Bulldozer	0.124	-	No
Single-Family Residential to Southwest	30	Vibratory Roller	0.160	-	No
	30	Large Bulldozer	0.068	-	No
Commercial to East	60	Vibratory Roller	0.056	-	No
	60	Large Bulldozer	0.024	-	No
Annoyance Analysis					
Commercial to West	1	Vibratory Roller	135.94	-	-
	1	Large Bulldozer	128.94	-	-
	5	Vibratory Roller	114.97	-	-
	5	Large Bulldozer	107.97	-	-
Multi-Family Residential to South	20	Vibratory Roller	96.91	71.930	No
	20	Large Bulldozer	89.91	71.850	No
Single-Family Residential to Southwest	30	Vibratory Roller	91.62	71.930	No
	30	Large Bulldozer	84.62	71.850	No
Commercial to East	60	Vibratory Roller	82.59	-	-
	60	Large Bulldozer	75.60	-	-

Notes:

(1) Vibration levels are provided in PPV in/sec for architectural damage and VdB for annoyance.

(2) Mitigation for architectural damage includes prohibiting the use of vibratory rollers, or other similar vibratory equipment, within 26 feet of residential structures to the south and 20 feet of commerial structures to the west and large bulldozers within 12 feet of commercial structures to the west of the project property lines. In addition, mitgation for vibratory annoyance includes prohibiting vibratory rollers, or other similar vibratory equipment, within 136 feet and large bulldozers within 80 feet of residential structures to the south and southwest of the project's northern property line.

(3) The FTA identifies the threshold at which there is a risk to "architectural" damage to reinforced-concrete, steel or timber (no plaster) buildings as a peak particle velocity (PPV) of 0.5 in/sec, at engineered concrete and masonry (no plaster) buildings as a PPV of 0.3 in/sec, at non-engineered timber and masonry buildings as a PPV of 0.2 in/sec and at buildings extremely susceptible to vibration damage as a PPV of 0.1 in/sec. Therefore, vibration impacts related to architectural damage would be significant if construction activities result in groundborne vibration of 0.2 PPV or higher at residential structures and/or a PPV of 0.3 or higher at commercial structures (see Table 2). In addition, the FTA identifies a vibration annoyance threshold of 72 VdB for residential uses (see Table 3). Per the FTA Transit Noise and VIbration Impact Assessment Manual (September 2018), commercial uses are not considered vibration-sensitive land uses; therefore, the annoyance threshold does not apply to commercial uses.

7. MEASURES TO REDUCE IMPACTS

CONSTRUCTION NOISE REDUCTION MEASURES

In addition to adherence to the City of Anaheim Municipal Code which limits the construction hours of operation, the following measures are recommended to reduce construction noise, emanating from the proposed project:

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from the noise sensitive receptors nearest the project site.

3. Equipment shall be shut off and not left to idle when not in use.

4. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

5. Jackhammers, pneumatic equipment and all other portable stationary noise sources shall be shielded and noise shall be directed away from sensitive receptors.

6. The project proponent shall mandate that the construction contractor prohibit the use of music or sound amplification on the project site during construction.

7. The construction contractor shall limit haul truck deliveries to the same hours specified for construction equipment.

VIBRATION MITIGATION MEASURES

1. The Project Applicant shall require that all construction contractors prohibit the use of vibratory rollers, or other similar vibratory equipment, within 20 feet and large bulldozers within twelve feet of any commercial structure to the west of the project site. In addition, vibratory rollers are prohibited within 136 feet and large bulldozers within 80 feet of any residential structures to the south and/or southwest of the project site. If construction activity must occur within these distances, it would need to be performed with smaller equipment types that do not exceed the vibration thresholds applied herein.

8. REFERENCES

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APPENDICES

APPENDIX A

LIST OF ACRONYMS

Term	Definition
ADT	Average Daily Traffic
ANSI	American National Standard Institute
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
D/E/N	Day / Evening / Night
dB	Decibel
dBA or dB(A)	Decibel "A-Weighted"
dBA/DD	Decibel per Double Distance
dBA L_{eq}	Average Noise Level over a Period of Time
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
L_{02},L_{08},L_{50},L_{90}	A-weighted Noise Levels at 2 percent, 8 percent, 50 percent, and 90 percent, respectively, of the time period
DNL	Day-Night Average Noise Level
$L_{eq(x)}$	Equivalent Noise Level for '"x" period of time
L_{eq}	Equivalent Noise Level
L_{max}	Maximum Level of Noise (measured using a sound level meter)
L_{min}	Minimum Level of Noise (measured using a sound level meter)
LOS C	Level of Service C
OPR	California Governor's Office of Planning and Research
PPV	Peak Particle Velocities
RCNM	Road Construction Noise Model
REMEL	Reference Energy Mean Emission Level
RMS	Root Mean Square

APPENDIX B

DEFINITIONS OF ACOUSTICAL TERMS

Term	Definition
Ambient Noise Level	The all-encompassing noise environment associated with a given environment, at a specified time, usually a composite of sound from many sources, at many directions, near and far, in which usually no particular sound is dominant.
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear.
CNEL	Community Noise Equivalent Level. CNEL is a weighted 24-hour noise level that is obtained by adding five decibels to sound levels in the evening (7:00 PM to 10:00 PM), and by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the evening and nighttime hours.
Decibel, dB	A logarithmic unit of noise level measurement that relates the energy of a noise source to that of a constant reference level; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
DNL, Ldn	Day Night Level. The DNL, or Ldn is a weighted 24-hour noise level that is obtained by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the nighttime hours.
Equivalent Continuous Noise Level, L_{eq}	A level of steady state sound that in a stated time period, and a stated location, has the same A-weighted sound energy as the time-varying sound.
Fast/Slow Meter Response	The fast and slow meter responses are different settings on a sound level meter. The fast response setting takes a measurement every 100 milliseconds, while a slow setting takes one every second.
Frequency, Hertz	In a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., the number of cycles per second).
L_{02}, L_{08}, L_{50}, L_{90}	The A-weighted noise levels that are equaled or exceeded by a fluctuating sound level, 2 percent, 8 percent, 50 percent, and 90 percent of a stated time period, respectively.
L_{max}, L_{min}	Lmax is the RMS (root mean squared) maximum level of a noise source or environment measured on a sound level meter, during a designated time interval, using fast meter response. Lmin is the minimum level.
Offensive/ Offending/Intrusive Noise	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of sound depends on its amplitude, duration, frequency, and time of occurrence, and tonal information content as well as the prevailing ambient noise level.
Root Mean Square (RMS)	A measure of the magnitude of a varying noise source quantity. The name derives from the calculation of the square root of the mean of the squares of the values. It can be calculated from either a series of lone values or a continuous varying function.

APPENDIX C

NOISE MEASUREMENT FIELD WORKSHEET

Noise Measurement
Field Data

Project Name: Lincoln Colony Apartments, City of Anaheim. **Date:** February 1, 2021

Project #: JN 19326

Noise Measurement #: NM1 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: North Ohio Street & West Lincoln Avenue

Site Description (Type of Existing Land Use and any other notable features): Project site: Recently demolished/cleared area with Lincoln Ave to north, Ohio St to east, alley way and residential uses to south, & commercial uses to east. Noise Measurement Site: Lincoln Ave to south, high school/auditorium to north and northeast, Ohio Street to west.

Weather: Overcast, thinning cloud, filtered sunshine. **Settings:** [✓ SLOW] FAST

Temperature: 68 deg F **Wind:** 2-5mph **Humidity:** 37% **Terrain:** Flat

Start Time: 1:54 PM **End Time:** 2:09 PM **Run Time:**

Leq: 71.5 dB

Lmax 79.8 dB

L2 77.1 dB

L8 75.5 dB

L25 73.5 dB

L50 69.9 dB

Primary Noise Source: Traffic noise from 402 vehicles traveling along West Lincoln Avenue

Traffic ambiance from other surrounding roads.

Secondary Noise Sources: Bird song, palm leaves rustling in gentle breeze, overhead air traffic.

Pedestrian traffic.

NOISE METER: SoundTrack LXT Class 1

MAKE: Larson Davis

MODEL: LXT1

SERIAL NUMBER: 3099

FACTORY CALIBRATION DATE: 4/9/2020

FIELD CALIBRATION DATE: 2/1/2021

CALIBRATOR: Larson Davis CAL250

MAKE: Larson Davis

MODEL: Cal 250

SERIAL NUMBER: 2733

FACTORY CALIBRATION DATE: 4/2/2020

Noise Measurement
Field Data

PHOTOS:

NM1 looking NE towards Auditorium and High School 811 W Lincoln Ave, Anaheim.

NM1 looking S across W Lincoln Ave & S Ohio St intersection.

Summary

File Name on Meter	LxT_Data.055
File Name on PC	SLM_File_LxT_Data_055.00.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.402
User	Ian Edward Gallagher
Location	NM1 JN 19326 33°49'59.44"N 117°55'28.30"W
Job Description	15 minute noise measurement (1 x 15 minutes)

Measurement

Start	2021-02-01 13:54:54
Stop	2021-02-01 14:09:54
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre Calibration	2021-02-01 13:54:38
Post Calibration	None

Overall Settings

RMS Weight	A Weighting
Peak Weight	Z Weighting
Detector	Slow
Preamp	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Low
OBA Bandwidth	1/1 and 1/3
OBA Freq. Weighting	Z Weighting
OBA Max Spectrum	Bin Max
Overload	122.9 dB

Results

LAeq	71.5	
LAE	101.1	
EA	1.426 mPa²h	
EA8	45.643 mPa²h	
EA40	228.213 mPa²h	
LZpeak (max)	2021-02-01 13:57:44	102.2 dB
LASmax	2021-02-01 14:05:29	79.8 dB
LASmin	2021-02-01 14:01:21	52.9 dB
SEA	-99.94 dB	

		Statistics	
LCeq	76.1 dB	**LAI2.00**	77.1 dB
LAeq	71.5 dB	**LAI8.00**	75.5 dB
LCeq - LAeq	4.6 dB	**LAI25.00**	73.5 dB
LAIeq	72.4 dB	**LAI50.00**	69.9 dB
LAeq	71.5 dB	**LAI66.60**	66.8 dB
LAIeq - LAeq	0.8 dB	**LAI90.00**	60.4 dB
# Overloads	0		

Noise Measurement
Field Data

Project Name: Lincoln Colony Apartments, City of Anaheim.

Date: February 1, 2021

Project #: JN 19326

Noise Measurement #: NM2 Run Time: 15 minutes (1 x 15 minutes)

Technician: Ian Gallagher

Nearest Address or Cross Street: 119 S Ohio Street, Anaheim, California.

Site Description (Type of Existing Land Use and any other notable features): Project site: Recently demolished/cleared area with Lincoln Ave to north, Ohio St to east, alley way and residential uses to south, & commercial uses to east. Noise Measurement Site: Ohio Street to east/northeast, alley way and project site to north,uses to west.

Weather: Overcast, thinning cloud, filtered sunshine.

Settings: [✓ SLOW] FAST

Temperature: 68 deg F

Wind: 2-5mph

Humidity: 37%

Terrain: Flat

Start Time: 2:21 PM

End Time: 2:36 PM

Run Time:

Leq: 55.5 dB

Lmax 66.9 dB

L2 60.8 dB

L8 58.2 dB

L25 56.5 dB

L50 54.5 dB

Primary Noise Source: Traffic noise from 429 vehicles traveling along West Lincoln Avenue and 4 vehicles traveling along S Ohio Street during 15 minute measurement.

Secondary Noise Sources: Bird song, palm leaves rustling in gentle breeze, overhead air traffic. Pedestrian traffic.

NOISE METER: SoundTrack LXT Class 1

MAKE: Larson Davis

MODEL: LXT1

SERIAL NUMBER: 3099

FACTORY CALIBRATION DATE: 4/9/2020

FIELD CALIBRATION DATE: 2/1/2021

CALIBRATOR: Larson Davis CAL250

MAKE: Larson Davis

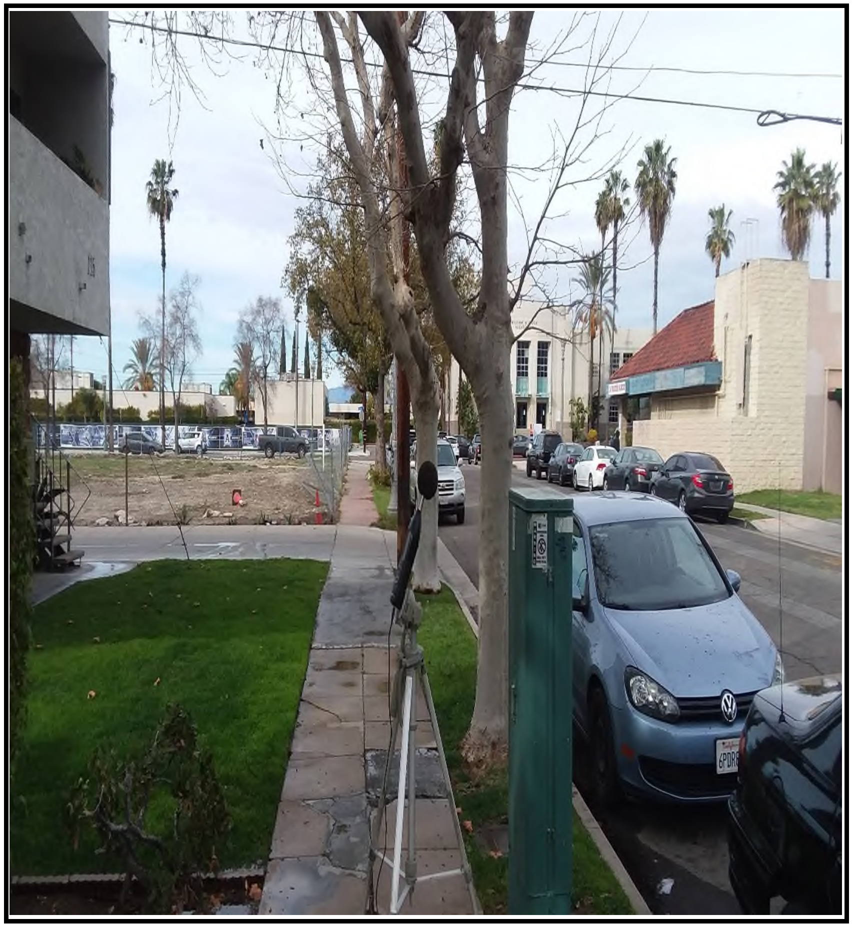
MODEL: Cal 250

SERIAL NUMBER: 2733

FACTORY CALIBRATION DATE: 4/2/2020

Noise Measurement
Field Data

PHOTOS:



NM2 looking NW up S Ohio Street towards W Lincoln Ave.

NM2 looking SSW towards residence 119 S Ohio Street, Anaheim.

Summary

File Name on Meter	LxT_Data.056
File Name on PC	SLM_File_LxT_Data_056.00.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.402
User	Ian Edward Gallagher
Location	NM2 JN 19326 33°49'56.47"N 117°55'28.13"W
Job Description	15 minute noise measurement (1 x 15 minutes)

Measurement

Start	2021-02-01 14:21:41
Stop	2021-02-01 14:36:41
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre Calibration	2021-02-01 14:21:30
Post Calibration	None

Overall Settings

RMS Weight	A Weighting
Peak Weight	Z Weighting
Detector	Slow
Preamp	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Low
OBA Bandwidth	1/1 and 1/3
OBA Freq. Weighting	Z Weighting
OBA Max Spectrum	Bin Max
Overload	122.6 dB

Results

LAeq	55.5	
LAE	85.0	
EA	35.162 µPa^{2}h	
EA8	1.125 mPa^{2}h	
EA40	5.626 mPa^{2}h	
LZpeak (max)	2021-02-01 14:36:32	93.4 dB
LASmax	2021-02-01 14:28:17	66.9 dB
LASmin	2021-02-01 14:24:27	47.3 dB
SEA	-99.94 dB	

LCeq	66.6 dB
LAeq	55.5 dB
LCeq - LAeq	11.1 dB
LAIeq	57.9 dB
LAeq	55.5 dB
LAIeq - LAeq	2.4 dB
# Overloads	0

Statistics

LAI2.00	60.8 dB
LAI8.00	58.2 dB
LAI25.00	56.5 dB
LAI50.00	54.5 dB
LAI66.60	53.1 dB
LAI90.00	50.6 dB

Noise Measurement
Field Data

Project Name: Lincoln Colony Apartments, City of Anaheim. **Date:** February 1, 2021

Project #: JN 19326

Noise Measurement #: NM3 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 114 S Illinois Street, Anaheim, California.

Site Description (Type of Existing Land Use and any other notable features): Project site: Recently demolished/cleared area with Lincoln Ave to north, Ohio St to east, alley way and residential uses to south, & commercial uses to east. Noise Measurement Site: Illinois St to west, residential to east, and alley way and commercial parking lots to north.

Weather: Overcast, thinning cloud, filtered sunshine. **Settings:** [✓ SLOW] FAST

Temperature: 68 deg F **Wind:** 2-5mph **Humidity:** 37% **Terrain:** Flat

Start Time: 2:47 PM **End Time:** 3:02 PM **Run Time:**

Leq: 57.6 dB

Lmax 75.2 dB

L2 63.2 dB

L8 60.2 dB

L25 58.3 dB

L50 55.8 dB

Primary Noise Source: Traffic noise from vehicles traveling along West Lincoln Avenue and 5 vehicles traveling along S Illinois St during 15 minute measurement.

Secondary Noise Sources: Bird song, palm leaves rustling in gentle breeze, overhead air traffic. Pedestrian traffic, parakeet in a cage outside nearby residemce.

NOISE METER: SoundTrack LXT Class 1

MAKE: Larson Davis

MODEL: LXT1

SERIAL NUMBER: 3099

FACTORY CALIBRATION DATE: 4/9/2020

FIELD CALIBRATION DATE: 2/1/2021

CALIBRATOR: Larson Davis CAL250

MAKE: Larson Davis

MODEL: Cal 250

SERIAL NUMBER: 2733

FACTORY CALIBRATION DATE: 4/2/2020

Noise Measurement
Field Data

PHOTOS:

NM3 looking NW up S Illinois Street towards W Lincoln Ave intersection.

NM3 looking NE towards residence 114 S Illinois St, Anaheim.

Summary

File Name on Meter	LxT_Data.057
File Name on PC	SLM_File_LxT_Data_057.00.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.402
User	Ian Edward Gallagher
Location	NM3 JN 19326 33°49'55.65"N 117°55'31.89"W
Job Description	15 minute noise measurement (1 x 15 minutes)

Measurement

Start	2021-02-01 14:47:50
Stop	2021-02-01 15:02:50
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre Calibration	2021-02-01 14:47:32
Post Calibration	None

Overall Settings

RMS Weight	A Weighting
Peak Weight	Z Weighting
Detector	Slow
Preamp	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Low
OBA Bandwidth	1/1 and 1/3
OBA Freq. Weighting	Z Weighting
OBA Max Spectrum	Bin Max
Overload	123.0 dB

Results

LAeq	57.6	
LAE	87.1	
EA	57.487 µPa²h	
EA8	1.840 mPa²h	
EA40	9.198 mPa²h	
LZpeak (max)	2021-02-01 14:53:47	96.2 dB
LASmax	2021-02-01 14:53:48	75.2 dB
LASmin	2021-02-01 14:54:33	47.2 dB
SEA	-99.94 dB	

LCeq	67.7 dB
LAeq	57.6 dB
LCeq - LAeq	10.1 dB
LAIeq	60.2 dB
LAeq	57.6 dB
LAIeq - LAeq	2.6 dB
# Overloads	0

Statistics

LAI2.00	63.2 dB
LAI8.00	60.2 dB
LAI25.00	58.3 dB
LAI50.00	55.8 dB
LAI66.60	54.0 dB
LAI90.00	51.0 dB

Noise Measurement
Field Data

Project Name: Lincoln Colony Apartments, City of Anaheim. **Date:** February 1, 2021

Project #: JN 19326

Noise Measurement #: NM4 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 922 W Lincoln Avenue, Anaheim, California.

Site Description (Type of Existing Land Use and any other notable features): Project site: Recently demolished/cleared area with Lincoln Ave to north, Ohio St to east, alley way and residential uses to south, & commercial uses to east. Noise Measurement Site: Lincoln Ave to north, project site to east and south, and commercial uses to west and south.

Weather: Overcast, thinning cloud, filtered sunshine. **Settings:** [✓ SLOW] FAST

Temperature: 68 deg F **Wind:** 2-5mph **Humidity:** 37% **Terrain:** Flat

Start Time: 3:19 PM **End Time:** 3:34 PM **Run Time:**

Leq: 73.5 dB

Lmax 83.5 dB

L2 79.0 dB

L8 77.3 dB

L25 75.0 dB

L50 72.3 dB

Primary Noise Source: Traffic noise from the 436 vehicles traveling along West Lincoln Avenue during 15 minute measurement.

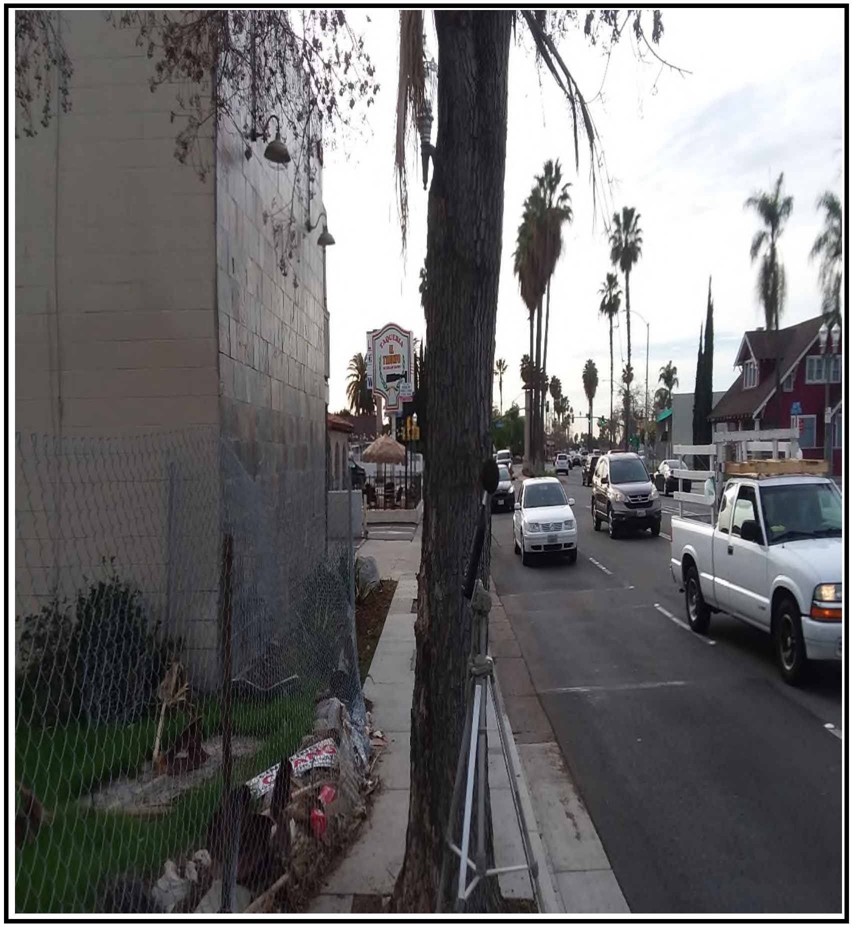
Secondary Noise Sources: Bird song, palm leaves rustling in gentle breeze, overhead air traffic. Pedestrian traffic.

NOISE METER: SoundTrack LXT Class 1
MAKE: Larson Davis
MODEL: LXT1
SERIAL NUMBER: 3099
FACTORY CALIBRATION DATE: 4/9/2020
FIELD CALIBRATION DATE: 2/1/2021

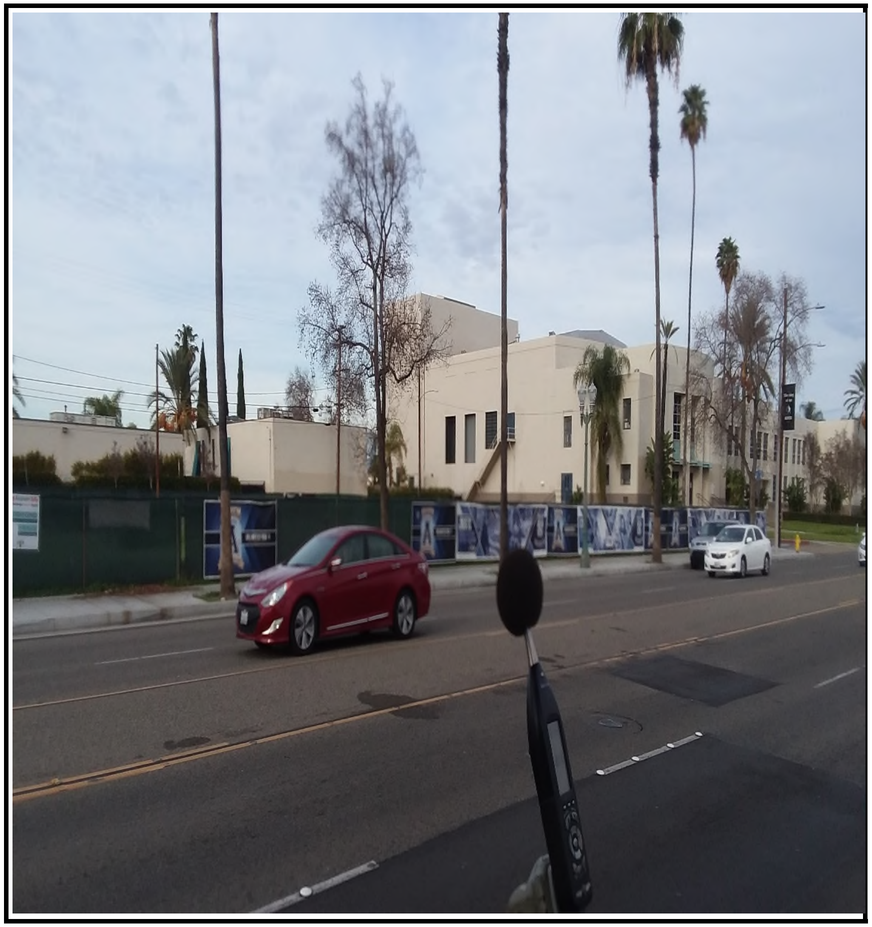
CALIBRATOR: Larson Davis CAL250
MAKE: Larson Davis
MODEL: Cal 250
SERIAL NUMBER: 2733
FACTORY CALIBRATION DATE: 4/2/2020

Noise Measurement
Field Data

PHOTOS:



NM4 looking SW down Lincoln Ave towards restaurant 922 W Lincoln Ave, Anaheim at the S Illinois St intersection.



NM4 looking NE across W Lincoln Ave towards Anaheim High School, 811 W Lincoln Ave, Anaheim.

Summary

File Name on Meter	LxT_Data.058
File Name on PC	SLM_File_LxT_Data_058.00.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.402
User	Ian Edward Gallagher
Location	NM4 JN 19328 33°49'57.87"N 117°55'31.13"W
Job Description	15 minute noise measurement (1 x 15 minutes)

Measurement

Start	2021-02-01 15:19:50
Stop	2021-02-01 15:34:50
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre Calibration	2021-02-01 15:19:13
Post Calibration	None

Overall Settings

RMS Weight	A Weighting
Peak Weight	Z Weighting
Detector	Slow
Preamp	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Low
OBA Bandwidth	1/1 and 1/3
OBA Freq. Weighting	Z Weighting
OBA Max Spectrum	Bin Max
Overload	123.0 dB

Results

LAeq	73.5	
LAE	103.0	
EA	2.239 mPa²h	
EA8	71.636 mPa²h	
EA40	358.181 mPa²h	
LZpeak (max)	2021-02-01 15:24:22	105.9 dB
LASmax	2021-02-01 15:20:19	83.5 dB
LASmin	2021-02-01 15:27:29	52.4 dB
SEA	-99.94 dB	

LCeq	79.0 dB
LAeq	73.5 dB
LCeq - LAeq	5.5 dB
LAIeq	74.9 dB
LAeq	73.5 dB
LAIeq - LAeq	1.4 dB
# Overloads	0

Statistics

LAI2.00	79.0 dB
LAI8.00	77.3 dB
LAI25.00	75.0 dB
LAI50.00	72.3 dB
LAI66.60	70.2 dB
LAI90.00	61.6 dB

APPENDIX D

CONSTRUCTION NOISE MODELING

Receptor - Residential to South

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading							
Rubber Tired Dozers	1	85	95	40	0.40	79.4	75.4
Tractors/Loaders/Backhoes	2	84	95	40	0.80	78.4	77.5
						Log Sum	79.6
Building Construction							
Cranes	1	83	95	16	0.16	77.4	69.5
Forklifts [2]	2	48	95	40	0.80	42.4	41.5
Tractors/Loaders/Backhoes	2	84	95	40	0.80	78.4	77.5
						Log Sum	78.1
Paving							
Cement and Mortar Mixers	4	79	95	40	1.60	73.4	75.5
Pavers	1	77	95	50	0.50	71.4	68.4
Rollers	1	80	95	20	0.20	74.4	67.4
Tractors/Loaders/Backhoes	1	84	95	40	0.40	78.4	74.4
						Log Sum	78.8
Architectural Coating							
Air Compressors	1	80	95	40	0.40	74.4	70.4
						Log Sum	70.4

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construciton Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (structure).

Receptor - Residential to Southeast

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading							
Rubber Tired Dozers	1	85	172	40	0.40	74.3	70.3
Tractors/Loaders/Backhoes	2	84	172	40	0.80	73.3	72.3
						Log Sum	74.4
Building Construction							
Cranes	1	83	172	16	0.16	72.3	64.3
Forklifts [2]	2	48	172	40	0.80	37.3	36.3
Tractors/Loaders/Backhoes	2	84	172	40	0.80	73.3	72.3
						Log Sum	72.9
Paving							
Cement and Mortar Mixers	4	79	172	40	1.60	68.3	70.3
Pavers	1	77	172	50	0.50	66.3	63.3
Rollers	1	80	172	20	0.20	69.3	62.3
Tractors/Loaders/Backhoes	1	84	172	40	0.40	73.3	69.3
						Log Sum	73.6
Architectural Coating							
Air Compressors	1	80	172	40	0.40	69.3	65.3
						Log Sum	65.3

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construciton Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (structure).

Receptor - Residential to Southwest

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading							
Rubber Tired Dozers	1	85	114	40	0.40	77.8	73.9
Tractors/Loaders/Backhoes	2	84	114	40	0.80	76.8	75.9
						Log Sum	78.0
Building Construction							
Cranes	1	83	114	16	0.16	75.8	67.9
Forklifts [2]	2	48	114	40	0.80	40.8	39.9
Tractors/Loaders/Backhoes	2	84	114	40	0.80	76.8	75.9
						Log Sum	76.5
Paving							
Cement and Mortar Mixers	4	79	114	40	1.60	71.8	73.9
Pavers	1	77	114	50	0.50	69.8	66.8
Rollers	1	80	114	20	0.20	72.8	65.9
Tractors/Loaders/Backhoes	1	84	114	40	0.40	76.8	72.9
						Log Sum	77.2
Architectural Coating							
Air Compressors	1	80	114	40	0.40	72.8	68.9
						Log Sum	68.9

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construciton Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (structure).

Receptor - School to Northeast

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading							
Rubber Tired Dozers	1	85	230	40	0.40	71.7	67.8
Tractors/Loaders/Backhoes	2	84	230	40	0.80	70.7	69.8
						Log Sum	71.9
Building Construction							
Cranes	1	83	230	16	0.16	69.7	61.8
Forklifts [2]	2	48	230	40	0.80	34.7	33.8
Tractors/Loaders/Backhoes	2	84	230	40	0.80	70.7	69.8
						Log Sum	70.4
Paving							
Cement and Mortar Mixers	4	79	230	40	1.60	65.7	67.8
Pavers	1	77	230	50	0.50	63.7	60.7
Rollers	1	80	230	20	0.20	66.7	59.8
Tractors/Loaders/Backhoes	1	84	230	40	0.40	70.7	66.8
						Log Sum	71.1
Architectural Coating							
Air Compressors	1	80	230	40	0.40	66.7	62.8
						Log Sum	62.8

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construciton Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (structure).

APPENDIX E

PROJECT GENERATED TRIPS FHWA WORKSHEETS

Existing Traffic Noise

1	:Id
Lincoln Avenue	:Road
West Street to Harbor Boulevard	:Segment

Vehicle Distribution (Heavy Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.54	14.02	10.43	92.00
Medium Trucks	48.00	2.00	50.00	3.00
Heavy Trucks	48.00	2.00	50.00	5.00

ADT	28594
Speed	35
Distance	53
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	1655.99	34.31	57.19	1229.39	5.72	9.53	304.86	47.66	79.43
Speed in MPH	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	65.11	74.83	80.05	65.11	74.83	80.05	65.11	74.83	80.05
ADJUSTMENTS									
Flow	26.44	9.61	11.83	25.15	1.83	4.05	19.09	11.03	13.25
Distance	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	66.23	59.11	66.55	64.94	51.33	58.77	58.88	60.54	67.98
	DAY LEQ	69.79		EVENING LEQ	66.03		NIGHT LEQ	69.13	

F	CNEL	75.69	Day hour	89.00
	DAY LEQ	69.79	Absorptive?	no
			Use hour?	no
			GRADE dB	0.00

Notes:

(1) FHWA Traffic Noise Prediction Model FHWA-RD-77-108

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Plus Project Traffic Noise

1	:Id
Lincoln Avenue	:Road
West Street to Harbor Boulevard	:Segment

Vehicle Distribution (Heavy Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.54	14.02	10.43	92.00
Medium Trucks	48.00	2.00	50.00	3.00
Heavy Trucks	48.00	2.00	50.00	5.00

ADT	28828
Speed	35
Distance	53
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	1669.54	34.59	57.66	1239.45	5.77	9.61	307.36	48.05	80.08
Speed in MPH	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	65.11	74.83	80.05	65.11	74.83	80.05	65.11	74.83	80.05
ADJUSTMENTS									
Flow	26.48	9.64	11.86	25.19	1.86	4.08	19.13	11.07	13.29
Distance	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	66.27	59.15	66.58	64.97	51.37	58.80	58.92	60.58	68.01
	DAY LEQ	69.83		EVENING LEQ	66.06		NIGHT LEQ	69.16	

CNEL	75.72
DAY LEQ	69.83

Day hour	89.00
Absorptive?	no
Use hour?	no
GRADE dB	0.00

Notes:

(1) FHWA Traffic Noise Prediction Model FHWA-RD-77-108

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Traffic Noise

2	:Id
Ohio Street	:Road
South of Lincoln Avenue	:Segment

Vehicle Distribution (Light Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.56	13.96	10.49	97.40
Medium Trucks	48.91	2.17	48.91	1.84
Heavy Trucks	47.30	5.41	47.30	0.74

ADT	673
Speed	25
Distance	30
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	41.27	0.50	0.20	30.50	0.09	0.09	7.64	0.67	0.26
Speed in MPH	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	59.44	71.09	77.24	59.44	71.09	77.24	59.44	71.09	77.24
ADJUSTMENTS									
Flow	11.87	-7.25	-11.36	10.56	-14.76	-14.75	4.55	-6.01	-10.11
Distance	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	48.46	40.98	43.03	47.15	33.47	39.64	41.13	42.23	44.28
	DAY LEQ	50.12		EVENING LEQ	48.01		NIGHT LEQ	47.52	

CNEL	54.60
DAY LEQ	50.12

Day hour	90.00
Absorptive?	no
Use hour?	no
GRADE dB	1.00

Notes:

(1) FHWA Traffic Noise Prediction Model FHWA-RD-77-108

(2) Vehicle percentages based on County of Riverside light truck mix.

Existing Plus Project Traffic Noise

2	:Id
Ohio Street	:Road
South of Lincoln Avenue	:Segment

Vehicle Distribution (Light Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.56	13.96	10.49	97.40
Medium Trucks	48.91	2.17	48.91	1.84
Heavy Trucks	47.30	5.41	47.30	0.74

ADT	907
Speed	25
Distance	30
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	55.63	0.68	0.26	41.11	0.12	0.12	10.30	0.91	0.35
Speed in MPH	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	59.44	71.09	77.24	59.44	71.09	77.24	59.44	71.09	77.24
ADJUSTMENTS									
Flow	13.17	-5.96	-10.06	11.85	-13.47	-13.46	5.84	-4.71	-8.81
Distance	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	49.76	42.28	44.33	48.44	34.77	40.93	42.43	43.53	45.58
	DAY LEQ	51.42		EVENING LEQ	49.31		NIGHT LEQ	48.82	

CNEL	55.89
DAY LEQ	51.42

Day hour	90.00
Absorptive?	no
Use hour?	no
GRADE dB	1.00

Notes:

(1) FHWA Traffic Noise Prediction Model FHWA-RD-77-108

(2) Vehicle percentages based on County of Riverside light truck mix.

APPENDIX F

VIBRATION WORKSHEETS

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments
Date: 6/7/21
Source: Large Bulldozer
Scenario: Unmitigated
Location: Commercial to East
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

INPUT SECTION IN GREEN

Equipment = Type	2	Large Bulldozer
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.
D =	60.00	Distance from Equipment to Receiver (ft)
n =	1.50	Vibration attenuation rate through the ground

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.024	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19326 Lincoln Colony Apartments	Date:	6/7/21
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Commercial to East		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	60.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.056	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments Date: 6/7/21
Source: Large Bulldozer
Scenario: Unmitigated
Location: Commercial to West (Northern Building)
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	1.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	11.125	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19326 Lincoln Colony Apartments	Date:	6/7/21
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Commercial to West (North Building)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	1.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	26.250	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19326 Lincoln Colony Apartments	Date:	6/7/21
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Commercial to West (Southern Building)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	5.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.995	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments Date: 6/7/21
Source: Vibratory Roller
Scenario: Unmitigated
Location: Commercial to West (Southern Building)
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

INPUT SECTION IN GREEN

Equipment = Type	1	Vibratory Roller
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.
D =	5.00	Distance from Equipment to Receiver (ft)
n =	1.50	Vibration attenuation rate through the ground

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

OUTPUT IN BLUE

PPV =	2.348	IN/SEC

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments Date: 6/7/21
Source: Large Bulldozer
Scenario: Unmitigated
Location: Damage Mitigation - Commercial Buildings to West
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	12.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.268	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19326 Lincoln Colony Apartments	Date:	6/7/21
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Damage Mitigation - Commercial to West		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	20.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.293	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments Date: 6/7/21
Source: Large Bulldozer
Scenario: Unmitigated
Location: Residential to South
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	20.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.124	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments
Date: 6/7/21
Source: Vibratory Roller
Scenario: Unmitigated
Location: Residential to South
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

INPUT SECTION IN GREEN

Equipment = Type	1	Vibratory Roller
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.
D =	20.00	Distance from Equipment to Receiver (ft)
n =	1.50	Vibration attenuation rate through the ground

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.293	IN/SEC

OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19326 Lincoln Colony Apartments	Date:	6/7/21
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Damage Mitigation - Residential to South		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment = Type	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	26.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.198	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments　Date: 6/7/21
Source: Large Bulldozer
Scenario: Unmitigated
Location: Residential to Southwest
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

INPUT SECTION IN GREEN

Equipment = Type	2	Large Bulldozer
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.
D =	30.00	Distance from Equipment to Receiver (ft)
n =	1.50	Vibration attenuation rate through the ground

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.068	IN/SEC

OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project: 19326 Lincoln Colony Apartments Date: 6/7/21
Source: Vibratory Roller
Scenario: Unmitigated
Location: Residential to Southwest
Address:
PPV = PPVref(25/D)^n (in/sec)

INPUT

INPUT SECTION IN GREEN

Equipment = Type	1	Vibratory Roller
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.
D =	30.00	Distance from Equipment to Receiver (ft)
n =	1.50	Vibration attenuation rate through the ground

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.160	IN/SEC	OUTPUT IN BLUE

Construction Annoyance Vibration Calculations

Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment Manual (September 2018).

Eq. 7-3: Lvdistance = Lvref - 30log (D/25)

Lvdistance = the rms velocity level adjsuted for distance, VdB
Lvref = the source reference vibration level at 25 feet, VdB
D = distance from the equipment to th receiver, ft.

Large Bulldozer:

Lvdistance = 87 - 30 log (1/25) = 128.94 VdB

Lvdistance = 87 - 30 log (5/25) = 107.97 VdB

Lvdistance = 87 - 30 log (20/25) = 89.91 VdB

Lvdistance = 87 - 30 log (30/25) = 84.62 VdB

Lvdistance = 87 - 30 log (60/25) = 75.60 VdB

Vibratory Roller:

Lvdistance = 94 - 30 log (1/25) = 135.94 VdB

Lvdistance = 94 - 30 log (5/25) = 114.97 VdB

Lvdistance = 94 - 30 log (20/25) = 96.91 VdB

Lvdistance = 94 - 30 log (30/25) = 91.62 VdB

Lvdistance = 94 - 30 log (60/25) = 82.59 VdB

72 VdB

Large Bulldozer: 87 - 30 log (80/25) = 71.85 VdB

Vibratory Roller: Lvdistance = 94 - 30 log (136/25) = 71.93 VdB

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