# APPENDIX F

# NOISE AND VIBRATION IMPACT ANALYSIS

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PALM SPRINGS
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# MEMORANDUM

**DATE:** November 22, 2024

**TO:** Erik Peterson, Architect, CEDG

**FROM:** J.T. Stephens, Principal / Noise and Vibration
Moe Abushanab, Noise Engineer

**SUBJECT:** Noise and Vibration Impact Analysis for the Proposed San Antonio Water Headquarters in Upland, California (LSA Project No. 20241723)

## INTRODUCTION AND PROJECT DESCRIPTION

This noise and vibration impact analysis has been prepared to evaluate the potential impacts associated with the proposed San Antonio Water Headquarters (project) in Upland, California. This memorandum is intended to satisfy the City of Upland (City) requirement for a project-specific noise and vibration impact analysis and examines the impacts to the surrounding noise-sensitive uses with the incorporation of project design features and standard conditions. Future noise level impacts are based on the noise measurement data gathered in the vicinity of the project site (from July 16, 2024, to July 17, 2024), modeled traffic volumes from the *Traffic Impact Analysis for the San Antonio Water Headquarters* (LSA 2024), and calculated stationary source noise levels to properly account for the impacts associated with the proposed project.

### Location and Description

The approximately 4.92-acre project site is located at 400 East 20th Street in the City of Upland in San Bernardino County (Assessor's Parcel Number 1044-091-22). The project site is located in northwest Upland in an area primarily consisting of residential, commercial, and industrial uses. The project site is bound by East 20th Street to the north, undeveloped open space to the east, State Route 210 (SR 210) to the south, and Flower Court to the west. Figure 1 shows the proposed project location, and Figure 2 shows the site plan. All figures are presented in Attachment B.

The project would result in the construction of a new 3,698-square-foot SAWCO headquarters and associated improvements including a 4,066-square-foot maintenance building, maintenance yard, driveway, parking, solar cover, landscaping, and utility improvements. The headquarters building would feature office space, meeting and conference rooms, a lobby, an archive room, a break room, two Americans with Disabilities Act (ADA) restrooms, a quiet room, a copy room, and a work area. The maintenance building would include storage space, an outdoor welding area, a motor repair room, electrical rooms, an ADA restroom, a locker room, and a maintenance office/break room. The existing water storage tank, pump station, and signal buildings and tower would remain in place.

The buildings would be a maximum height of 23 feet and have a FAR of 0.07. Approximately ten people are expected to be employed on site.

## METHODOLOGY

The evaluation of noise impacts associated with the proposed project includes the following:

- A determination of the short-term construction noise and vibration levels at off-site noise-sensitive uses and a comparison to the City's General Plan noise standards and Noise Ordinances within the Municipal Code
- A determination of the long-term noise levels at off-site, noise-sensitive uses as well as the proposed project and comparison of those levels to the City's pertinent noise standards
- If necessary, a determination of required mitigation measures, such as noise barriers and upgraded windows, to reduce long-term noise impacts from all sources

## CHARACTERISTICS OF SOUND

Noise is usually defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep.

To the human ear, sound has two significant characteristics: pitch and loudness. Pitch is generally an annoyance, while loudness can affect the ability to hear. Pitch is the number of complete vibrations, or cycles per second, of a wave resulting in the tone's range from high to low. Loudness is the strength of a sound that describes a noisy or quiet environment and is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves combined with the reception characteristics of the human ear. Sound intensity refers to how hard the sound wave strikes an object, which in turn produces the sound's effect. This characteristic of sound can be precisely measured with instruments. The analysis of a project defines the noise environment of the project area in terms of sound intensity and its effect on adjacent sensitive land uses.

### Measurement of Sound

Sound intensity is measured through the A-weighted scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound similar to the human ear's de-emphasis of these frequencies. Unlike linear units (e.g., inches or pounds), decibels are measured on a logarithmic scale representing points on a sharply rising curve.

For example, 10 decibels (dB) is 10 times more intense than 1 dB, 20 dB is 100 times more intense than 1 dB, and 30 dB is 1,000 times more intense than 1 dB. Thirty decibels (30 dB) represents 1,000 times as much acoustic energy as 1 dB. The decibel scale increases as the square of the change, representing the sound pressure energy. A sound as soft as human breathing is about 10 times greater than 0 dB. The decibel system of measuring sound gives a rough connection between the physical intensity of sound and its perceived loudness to the human ear. A 10 dB

increase in sound level is perceived by the human ear as only a doubling of the loudness of the sound. Ambient sounds generally range from 30 dB (very quiet) to 100 dB (very loud).

Sound levels are generated from a source, and their decibel level decreases as the distance from that source increases. Sound dissipates exponentially with distance from the noise source. For a single-point source, sound levels decrease approximately 6 dB for each doubling of distance from the source. This drop-off rate is appropriate for noise generated by stationary equipment. If noise is produced by a line source (e.g., highway traffic or railroad operations), the sound decreases 3 dB for each doubling of distance in a hard site environment. Similarly, line sources with intervening absorptive vegetation or line sources that are located at a great distance to the receptor would decrease 4.5 dB for each doubling of distance.

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. The equivalent continuous sound level ($L_{eq}$) is the total sound energy of time-varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the $L_{eq}$ and Community Noise Equivalent Level (CNEL) or the day-night average noise level ($L_{dn}$) based on A-weighted decibels (dBA). CNEL is the time-varying noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly $L_{eq}$ for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and a 10 dBA weighting factor applied to noises occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). $L_{dn}$ is similar to the CNEL scale but without the adjustment for events occurring during the evening hours. CNEL and $L_{dn}$ are within 1 dBA of each other and are normally interchangeable. The City uses the $L_{dn}$ noise scale for long-term noise impact assessment.

Other noise rating scales of importance when assessing the annoyance factor include the maximum instantaneous noise level ($L_{max}$), which is the highest exponential time-averaged sound level that occurs during a stated time period. The noise environments discussed in this analysis for short-term noise impacts are specified in terms of maximum levels denoted by $L_{max}$, which reflects peak operating conditions and addresses the annoying aspects of intermittent noise. It is often used together with another noise scale or noise standards in terms of percentile noise levels in noise ordinances for enforcement purposes. For example, the $L_{10}$ noise level represents the noise level exceeded 10 percent of the time during a stated period. The $L_{50}$ noise level represents the median noise level (i.e., half the time the noise level exceeds this level, and half the time it is less than this level). The $L_{90}$ noise level represents the noise level exceeded 90 percent of the time and is considered the background noise level during a monitoring period. For a relatively constant noise source, the $L_{eq}$ and $L_{50}$ are approximately the same.

Noise impacts can be described in three categories. The first category is audible impacts that refer to increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3 dB or greater because this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1 and 3 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category is changes in noise levels of less than 1 dB, which are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

## Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects the entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. In comparison, extended periods of noise exposure above 90 dBA would result in permanent cell damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by the feeling of pain in the ear. This is called the threshold of pain. A sound level of 160–165 dBA will result in dizziness or loss of equilibrium. The ambient or background noise problem is widespread and generally more concentrated in urban areas than in outlying less developed areas.

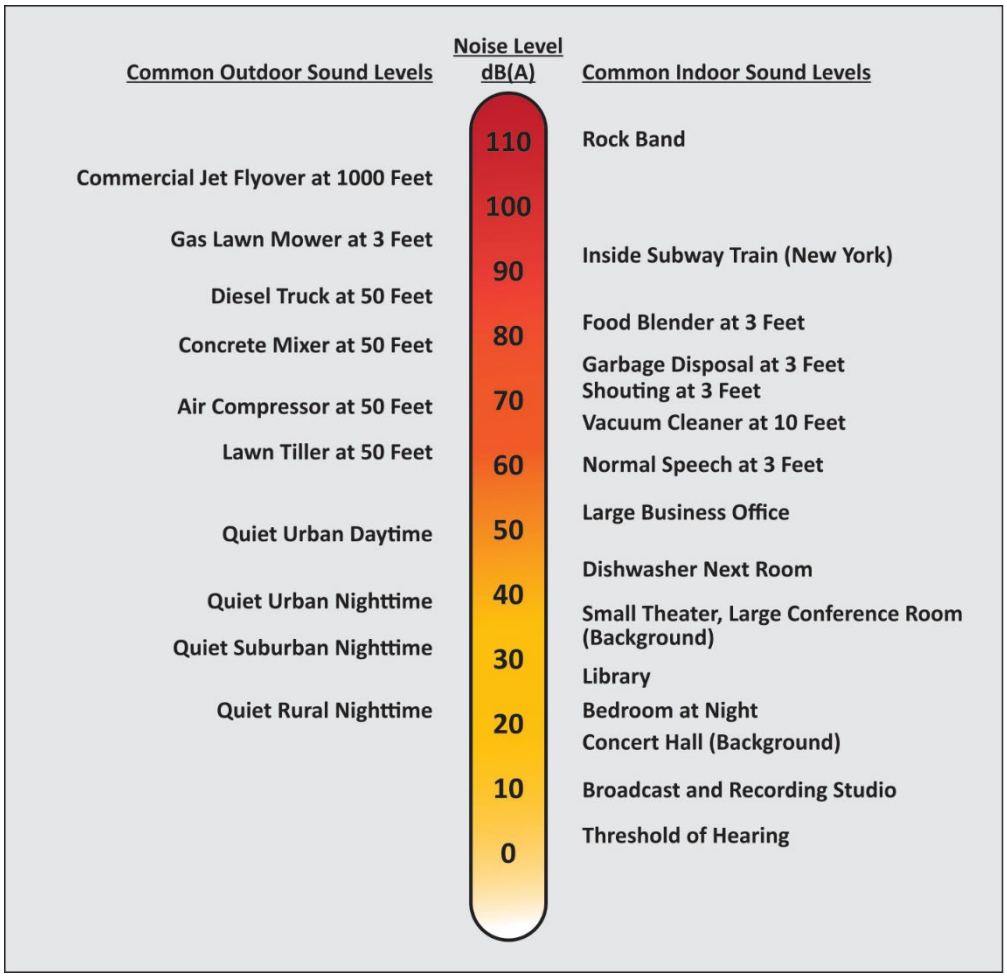
Table A lists full definitions of acoustical terms, and Table B shows common sound levels and their sources.

### Table A: Definitions of Acoustical Terms

| Term | Definition |
|---|---|
| Decibel, dB | A unit of level that denotes the ratio between two quantities proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio. |
| Frequency, Hz | Of a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., number of cycles per second). |
| 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 components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this assessment are A-weighted, unless reported otherwise. |
| $L_{01}$, $L_{10}$, $L_{50}$, $L_{90}$ | The fast A-weighted noise levels equaled or exceeded by a fluctuating sound level for 1 percent, 10 percent, 50 percent, and 90 percent of a stated time period. |
| Equivalent Continuous Noise Level, $L_{eq}$ | The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time-varying sound. |
| Community Noise Equivalent Level, CNEL | The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 5 dB to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 dB to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m. |
| Day/Night Noise Level, $L_{dn}$ | The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 dB to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m. |
| $L_{max}$, $L_{min}$ | The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging. |
| Ambient Noise Level | The all-encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources at many directions, near and far; no particular sound is dominant. |
| Intrusive | The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content, as well as the prevailing ambient noise level. |

Source 1: *Technical Noise Supplement* (California Department of Transportation 2013).
Source 2: *Transit Noise and Vibration Impact Assessment Manual* (Federal Transit Administration 2018).

## Table B: Common Sound Levels and Noise Sources




Source: LSA (2016).
dBA = A-weighted decibel

## CHARACTERISTICS OF VIBRATION

Vibration refers to ground-borne noise and perceptible motion. Ground-borne vibration is almost exclusively a concern inside buildings and is rarely perceived as a problem outdoors, where the motion may not be discernible. Typically, there is more adverse reaction to effects associated with the shaking of a building. Vibration energy propagates from a source through intervening soil and rock layers to the foundations of nearby buildings. The vibration then propagates from the foundation throughout the remainder of the structure. Building vibration may be perceived by occupants as the motion of building surfaces, the rattling of items on shelves or hanging on walls, or a low-frequency rumbling noise. The rumbling noise is caused by the vibration of walls, floors, and ceilings that radiate sound waves. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by 10 dB or less. This is an order of magnitude below the damage threshold for normal buildings.

Typical sources of ground-borne vibration are construction activities (e.g., blasting, pile driving, and operating heavy-duty earthmoving equipment), steel-wheeled trains, and occasional traffic on rough roads. Problems with both ground-borne vibration and noise from these sources are usually localized to areas within approximately 100 feet of the vibration source, although there are examples of ground-borne vibration causing interference to distances greater than 200 feet (Federal Transit Administration [FTA] 2018). When roadways are smooth, vibration from traffic, even heavy trucks, is rarely perceptible. It is assumed for most projects that the roadway surface will be smooth enough that ground-borne vibration from street traffic will not exceed the impact criteria; however, the construction of a project could result in ground-borne vibration that may be perceptible and annoying.

Ground-borne vibration has the potential to disturb people and damage buildings. Although it is very rare for typical construction activities to cause even cosmetic building damage, it is not uncommon for construction processes such as blasting and pile driving to cause vibration of sufficient amplitudes to damage nearby buildings (FTA 2018). Ground-borne vibration is usually measured in terms of vibration velocity, either the root-mean-square (RMS) velocity or peak particle velocity (PPV). The RMS is best for characterizing human response to building vibration, and PPV is used to characterize potential for damage. Decibel notation acts to compress the range of numbers required to describe vibration. Vibration velocity level in decibels is defined as:

$$L_v = 20 \log_{10} [V/V_{ref}]$$

where $L_v$ is the vibration velocity in decibels (VdB), V is the RMS velocity amplitude, and $V_{ref}$ is the reference velocity amplitude, or $1 \times 10^{-6}$ inches/second (in/sec) used in the United States.

## APPLICABLE NOISE STANDARDS

The following information provides standards to which potential noise impacts will be compared. Where exceedances have been identified, impacts are described, and mitigation recommended.

### City of Upland General Plan

The Safety Element of the City's General Plan is intended to identify sources of noise and provide goals and policies that ensure that noise from various sources does not create an unacceptable noise environment. Overall, the City's Safety Element describes the noise environment (including noise sources) in the city; addresses noise mitigation regulations, strategies, and programs; and delineates federal, State, and City jurisdiction relative to rail, automotive, aircraft, and nuisance noise.

The City's noise standards correlate with land use zoning classifications to maintain identified ambient noise levels and to limit, mitigate, or eliminate intrusive noise that exceeds the ambient noise levels within a specified zone. As shown in Table C, the City has adopted local guidelines based, in part, on the community noise compatibility guidelines established by the Governor's Office of Planning and Research for use in assessing the compatibility of various land use types with a range of noise levels.

## Table C: City of Upland Exterior Noise Compatibility Standards

| Land Use Type | Highest Level of Noise Exposure that is Regarded as "Normally Acceptable" (Ldn of CNEL) |
|---|---|
| Residential – Low Density Single-Family, Duplex, Mobile Homes | 60 dBA |
| Residential – Multi-Family | 65 dBA |
| Mixed-Use | 70 dBA |
| Transient Lodging – Hotels, Motels | 65 dBA |
| Schools, Libraries, Churches, Hospitals, Nursing Homes | 70 dBA |
| Auditoriums, Concert Halls, Amphitheaters | Mitigation based on site-specific study |
| Sports Arena, Outdoors Spectator Sports | Mitigation based on site-specific study |
| Playgrounds, Neighborhood Parks | 70 dBA |
| Golf Courses, Riding Stables, Water Recreation, Cemeteries | 75 dBA |
| Office Buildings – Commercial, Office/Professional | 70 dBA |
| Industrial, Manufacturing, Utilities, Agriculture | 75 dBA |

Source: Governor's Office of Planning and Research, State of California General Plan Guidelines 2003, 2003, pages 244-254.

Source: *General Plan, Safety Element* (City of Upland 2015).
CNEL = Community Noise Equivalent Level
$L_{dn}$ = Day-Night Noise Level
dBA = A-weighted decibel

### City of Upland Municipal Code

The City of Upland Municipal Code Chapter 9.40, Unnecessary Noise, limits the noise level generated on a property that can cross to a neighboring property. The City's noise ordinance limits are presented in terms of a 1-hour average sound level and apply to residential uses only. As prescribed in Section 9.40.040, the exterior noise standards for sensitive residential uses are 55 dBA between 7:00 a.m. and 10:00 p.m. (daytime) and 45 dBA between 10:00 p.m. and 7:00 a.m. (nighttime). Ordinance limits generally apply to "stationary" sources such as mechanical equipment, manufacturing activities, or vehicles operating on private property (City of Upland 2024).

Additionally, section 9.40.100 (M) limits construction activities to the hours between 7:00 a.m. and 6:00 p.m. on weekdays (City of Upland 2024).

### Federal Transit Administration

Although the City does not have daytime construction noise level limits for activities that occur within the specified hours of the City's Municipal Code, to determine potential California Environmental Quality Act (CEQA) noise impacts, construction noise was assessed using criteria from the *Transit Noise and Vibration Impact Assessment Manual* (FTA Manual) (FTA 2018).

Table D shows the FTA's Detailed Assessment Construction Noise Criteria based on the composite noise levels per construction phase.

### Table D: Detailed Assessment Daytime Construction Noise Criteria

| Land Use | Daytime 1-hour $L_{eq}$ (dBA) |
|---|---|
| Residential | 80 |
| Commercial | 85 |
| Industrial | 90 |

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
dBA = A-weighted decibels
$L_{eq}$ = equivalent continuous sound level

## APPLICABLE VIBRATION STANDARDS

The following information provides standards to which potential vibration impacts will be compared. Where exceedances have been identified, impacts are discussed, and mitigation recommended.

### Federal Transit Administration

Vibration standards included in the FTA Manual are used in this analysis for ground-borne vibration impacts on human annoyance (FTA 2018). Table E provides the criteria for assessing the potential for interference or annoyance from vibration levels in a building.

### Table E: Criteria for Potential Vibration Annoyance

| Land Use | Max $L_v$ (VdB)[1] | Description of Use |
|---|---|---|
| Workshop | 90 | Distinctly feelable vibration. Appropriate to workshops and non-sensitive areas. |
| Office | 84 | Feelable vibration. Appropriate to offices and non-sensitive areas. |
| Residential Day | 78 | Feelable vibration. Appropriate for computer equipment and low-power optical microscopes (up to 20X). |
| Residential Night and Operating Rooms | 72 | Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power microscopes (100X) and other equipment of low sensitivity. |

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] As measured in 1/3-octave bands of frequency over the frequency range 8 to 80 Hz.
FTA = Federal Transit Administration
Hz = hertz
$L_V$ = velocity in decibels
Max = maximum
VdB = vibration velocity decibels

The criteria for environmental impacts resulting from ground-borne vibration and noise are based on the maximum levels for a single event. The City's Municipal Code does not include specific criteria for assessing vibration impacts associated with damage. Therefore, for the purpose of determining the significance of vibration impacts experienced at sensitive uses surrounding the project site, the guidelines within the 2018 FTA Manual have been used to determine vibration impacts (refer to Table F, below).

### Table F: Construction Vibration Damage Criteria

| Building Category | PPV (in/sec) |
|---|---|
| Reinforced concrete, steel, or timber (no plaster) | 0.50 |
| Engineered concrete and masonry (no plaster) | 0.30 |
| Non-engineered timber and masonry buildings | 0.20 |
| Buildings extremely susceptible to vibration damage | 0.12 |

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
FTA = Federal Transit Administration
in/sec = inches per second
PPV = peak particle velocity

The FTA Manual (2018) guidelines show that a vibration level of up to 0.2 in/sec in PPV is considered safe for non-engineered timber and masonry buildings and would not result in any construction vibration damage. Therefore, in order to be conservative, the 0.2 in/sec in the PPV threshold has been used when evaluating vibration impacts at the nearest structures to the site.

## THRESHOLDS OF SIGNIFICANCE

Based on *Guidelines for the Implementation of the California Environmental Quality Act* (*State CEQA Guidelines*), Appendix G, Public Resources Code, Sections 15000–15387, a project will normally have a significant effect on the environment related to noise if it will substantially increase the ambient noise levels for adjoining areas or conflict with adopted environmental plans and the goals of the community in which it is located.

The *State CEQA Guidelines* indicate that a project would have a significant impact on noise if it would result in:

- Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Generation of excessive ground-borne vibration or ground-borne noise levels; or
- For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels.

## OVERVIEW OF THE EXISTING NOISE ENVIRONMENT

The primary existing noise sources in the project area are transportation facilities, including SR 210 to the south. To assess the existing noise conditions in the area, long-term noise measurements were conducted at the project site. Two long-term, 24-hour measurements were taken from July 16, 2024, to July 17, 2024. The locations of the noise measurements are shown on Figure 3, and the results are summarized in Table G. Noise measurement data information is provided in Attachment C of this analysis.

## Table G: Existing Noise Level Measurements

| Location Number | Location Description | Daytime Noise Levels[1] (dBA $L_{eq}$) | Evening Noise Levels[2] (dBA $L_{eq}$) | Nighttime Noise Levels[3] (dBA $L_{eq}$) | Average Daily Noise Levels (dBA CNEL) |
|---|---|---|---|---|---|
| LT-1 | On a light pole at the end of 20th Street across from the northeastern corner of the project site, approximately 490 feet away from the SR 210 centerline and 355 feet away from the North Campus Avenue centerline | 59.8–67.4 | 60.6–61.9 | 57.9–64.9 | 68.1 |
| LT-2 | On a light pole across from the southwestern corner of the project site, approximately 175 feet away from the SR 210 centerline. | 63.4–68.9 | 63.6–64.4 | 61.1–65.0 | 70.1 |

Source: Compiled by LSA (2024).
[1] Daytime Noise Levels = noise levels during the hours of 7:00 a.m. to 7:00 p.m.
[2] Evening Noise Levels = noise levels during the hours of 7:00 p.m. to 10:00 p.m.
[3] Nighttime Noise Levels = noise levels during the hours of 10:00 p.m. to 7:00 a.m.
CNEL = Community Noise Equivalent Level
dBA = A-weighted decibels
ft = foot/feet
$L_{eq}$ = equivalent continuous sound level

### Sensitive Land Uses in the Project Vicinity

Certain land uses are considered more sensitive to noise than others. Examples of these include residential areas, educational facilities, hospitals, childcare facilities, and senior housing. The project site is surrounded primarily by residential uses to the west. Land uses adjacent to the project site include the following:

- **North:** Existing single-family homes opposite East 20th Street, approximately 95 feet from the project site property line.
- **East:** Undeveloped open space.
- **South:** SR 210.
- **West:** Existing single-family homes opposite Flower Court, approximately 60 feet from the project site property line.

### Aircraft Noise

The project site is approximately 2.6 miles northeast of Cable Airport. Noise impacts related to aircraft operations may contribute to the aircraft noise in the project area; however, the project site is located well outside of the 60 dBA CNEL contour. Because the project site and surrounding

sensitive uses are all outside of the 60 dBA CNEL contours of airports in the vicinity, no further analysis is necessary.

## PROJECT IMPACT ANALYSIS

The proposed project would result in short-term construction noise and vibration impacts and long-term mobile source noise and vibration impacts, as described below.

### Short-Term Construction-Related Impacts

Project construction would result in short-term noise and vibration impacts on adjacent land uses. Maximum construction impacts would be short-term, generally intermittent depending on the construction phase and variable depending on receiver distance from the active construction zone. The duration of impacts generally would be from 1 day to several weeks depending on the phase of construction. The following describes the level and types of impacts that would occur during construction.

#### *Construction Noise Impacts*

Two types of short-term noise impacts could occur during the construction of the proposed project. First, construction crew commutes and the transport of construction equipment and materials to the site for the proposed project would incrementally increase noise levels on access roads leading to the site. Although there would be a relatively high single-event noise-exposure potential causing intermittent noise nuisance (passing trucks at 50 feet would generate up to 84 dBA $L_{max}$), the effect on longer-term ambient noise levels would be small compared to existing daily traffic volumes on East 20$^{th}$ Street. The results of the California Emissions Estimator Model (CalEEMod) for the proposed project indicate during the paving phase an additional 39 passenger car equivalent (PCE) vehicles, composed of worker and hauling trips, would be added to the adjacent roadway to the project site. Based on the *Traffic Impact Analysis* (LSA 2024) the existing traffic volume on East 20$^{th}$ Street, assumed to be the main construction access, is 80 vehicles. The expected traffic noise level increase would be approximately 1.7 dBA. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, short-term, construction-related impacts associated with worker commute and equipment transport to the project site would be less than significant.

The second type of short-term noise impact is related to noise generated during construction, which includes site preparation, grading, building construction, paving, and architectural coating on the project site. Construction is completed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on the site and, therefore, the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase. Table H lists typical construction equipment noise levels recommended for noise impact assessments, based on a distance of 50 feet between the equipment and a noise receptor, taken from the Federal Highway Administration (FHWA) *Roadway Construction Noise Model* (FHWA 2006).

In addition to the reference maximum noise level, the usage factor provided in Table H is used to calculate the hourly noise level impact for each piece of equipment based on the following equation:

$$L_{eq}(equip) = E.L. + 10\log(U.F.) - 20\log\left(\frac{D}{50}\right)$$

where: $L_{eq}(equip)$ = $L_{eq}$ at a receiver resulting from the operation of a single piece of equipment over a specified time period.

E.L. = noise emission level of the particular piece of equipment at a reference distance of 50 feet.

U.F. = usage factor that accounts for the fraction of time that the equipment is in use over the specified period of time.

D = distance from the receiver to the piece of equipment.

## Table H: Typical Construction Equipment Noise Levels

| Equipment Description | Acoustical Usage Factor (%)[1] | Maximum Noise Level ($L_{max}$) at 50 Feet[2] |
|---|---|---|
| Auger Drill Rig | 20 | 84 |
| Backhoes | 40 | 80 |
| Compactor (ground) | 20 | 80 |
| Compressor | 40 | 80 |
| Cranes | 16 | 85 |
| Dozers | 40 | 85 |
| Dump Trucks | 40 | 84 |
| Excavators | 40 | 85 |
| Flat Bed Trucks | 40 | 84 |
| Forklift | 20 | 85 |
| Front-end Loaders | 40 | 80 |
| Graders | 40 | 85 |
| Impact Pile Drivers | 20 | 95 |
| Jackhammers | 20 | 85 |
| Paver | 50 | 77 |
| Pickup Truck | 40 | 55 |
| Pneumatic Tools | 50 | 85 |
| Pumps | 50 | 77 |
| Rollers | 20 | 85 |
| Scrapers | 40 | 85 |
| Tractors | 40 | 84 |
| Trencher | 50 | 80 |
| Welder | 40 | 73 |

Source: FHWA Roadway Construction Noise Model User's Guide, Table 1 (FHWA 2006).
Note: Noise levels reported in this table are rounded to the nearest whole number.

[1] Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.

[2] Maximum noise levels were developed based on Specification 721.560 from the Central Artery/Tunnel program to be consistent with the City of Boston's Noise Code for the "Big Dig" project.

FHWA = Federal Highway Administration
$L_{max}$ = maximum instantaneous sound level

Each piece of construction equipment operates as an individual point source. Using the following equation, a composite noise level can be calculated when multiple sources of noise operate simultaneously:

$$Leq\ (composite) = 10 * \log_{10}\left(\sum_{1}^{n} 10^{\frac{Ln}{10}}\right)$$

Using the equations from the methodology above, the reference information in Table H, and the construction equipment list provided, the composite noise level of each construction phase was calculated. The project construction composite noise levels at a distance of 50 feet would range from 74 dBA $L_{eq}$ to 86 dBA $L_{eq}$, with the highest noise levels occurring during the grading phase.

Once composite noise levels are calculated, reference noise levels can then be adjusted for distance using the following equation:

$$Leq\ (at\ distance\ X) = Leq\ (at\ 50\ feet) - 20 * \log_{10}\left(\frac{X}{50}\right)$$

In general, this equation shows that doubling the distance would decrease noise levels by 6 dBA while halving the distance would increase noise levels by 6 dBA.

Table I shows the nearest sensitive uses to the project site, their distance from the center of construction activities, and composite noise levels expected during construction. These noise level projections do not consider intervening topography or barriers. Construction equipment calculations are provided in Attachment D.

### Table I: Potential Construction Noise Impacts at Nearest Receptor

| Receptor (Location) | Composite Noise Level (dBA $L_{eq}$) at 50 feet[1] | Distance (feet) | Composite Noise Level (dBA $L_{eq}$) |
|---|---|---|---|
| Residential (North) | 86 | 250 | 72 |
| Residential (West) | | 405 | 68 |

Source: Compiled by LSA (2024).

[1] The composite construction noise level represents the grading phase which is expected to result in the greatest noise level as compared to other phases.

dBA $L_{eq}$ = average A-weighted hourly noise level

While construction noise will vary, it is expected that composite noise levels during construction at the nearest sensitive residential uses to the north and west would approach 72 dBA $L_{eq}$ and 68 dBA $L_{eq}$, respectively, during daytime hours. These predicted noise levels would only occur when all construction equipment is operating simultaneously and, therefore, are assumed to be rather conservative in nature. While construction-related short-term noise levels have the potential to be higher than existing ambient noise levels in the project area under existing conditions, the noise impacts would no longer occur once project construction is completed.

As stated above, the City's Noise Ordinance regulates noise impacts associated with construction activities. The proposed project would comply with the construction hours specified in the City's

Noise Ordinance, which states that construction activities are allowed between the hours of 7:00 a.m. and 6:00 p.m. on weekdays (City of Upland 2024).

As it relates to off-site uses, construction-related noise impacts would remain below the 80 dBA $L_{eq}$ 1-hour construction noise level criteria for daytime construction noise level criteria as established by the FTA for residential land uses; therefore, the impact would be considered less than significant.

### *Construction Vibration Building Damage Potential*

Ground-borne noise and vibration from construction activity would be mostly low. Table J provides reference PPV values and vibration levels (in terms of VdB) from typical construction vibration sources at 25 feet. Although the specific pieces of equipment that would be used on the site are unknown at this time, to provide an analysis of potential vibration levels expected for a project of this size, a large bulldozer would generate 0.089 PPV (in/sec) of ground-borne vibration when measured at 25 feet, based on the FTA Manual (FTA 2018). As shown in Table F, it would take a minimum of 0.2 PPV (in/sec) to cause any potential building damage to non-engineered timber and masonry buildings.

### Table J: Vibration Source Amplitudes for Construction Equipment

| Equipment | Reference PPV/$L_V$ at 25 ft | |
|---|---|---|
| | PPV (in/sec) | $L_V$ (VdB)[1] |
| 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: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).

[1] RMS VdB re 1 µin/sec.

µin/sec = micro-inches per second
ft = foot/feet
FTA = Federal Transit Administration
in/sec = inches per second
$L_V$ = velocity in decibels
PPV = peak particle velocity
RMS = root-mean-square
VdB = vibration velocity in decibels

The distance to the nearest buildings for vibration impact analysis is measured between the nearest off-site buildings and the project construction boundary (assuming the construction equipment would be used at or near the project setback line). The formula for vibration transmission is provided below:

$$L_vdB\ (D) = L_vdB\ (25\ feet) - 30\ Log\ (D/25)$$

$$PPV_{equip} = PPV_{ref} \times (25/D)^{1.5}$$

The closest structures, which are associated with the residential uses to the west, are approximately 60 feet from the western project construction boundary. Using the reference data from Table J and the equation above, it is expected that vibration levels generated by dump trucks and other large equipment would generate ground-borne vibration levels of up to 0.024 PPV (in/sec) at the closest

structure to the project site. This vibration level would not exceed the 0.2 in/sec PPV threshold considered safe for non-engineered timber and masonry buildings. Therefore, construction would not result in any vibration damage, impacts would be less than significant, and no mitigation is required.

#### *Construction Vibration Human Annoyance Potential*

As stated above, the existing residences, located approximately 250 feet to the north from the center of the project site, is the nearest sensitive receptor and would experience vibration levels approaching 57 VdB based on the following equation:

$$L_vdB\ (D) = L_vdB\ (25\ feet) - 30\ Log\ (D/25)$$

Based on the standards provided in Table E, this level of ground-borne vibration is below the threshold of distinctly perceptible, which is approximately 72 VdB for frequent events at uses where people sleep and would not exceed the FTA vibration threshold for human annoyance at the nearest sensitive use, and project construction would not result in vibration levels that would typically result in human annoyance. Therefore, this level of ground-borne vibration would be less than significant for human annoyance. No mitigation is required.

### Long-Term Off-Site Traffic Noise Impacts

The guidelines included in the FHWA Highway Traffic Noise Prediction Model (FHWA-RD-77 108) were used to evaluate highway traffic-related noise conditions along roadway segments in the project vicinity. This model requires various parameters, including traffic volumes, vehicle mix, vehicle speed, and roadway geometry to compute typical equivalent noise levels during daytime, evening, and nighttime hours. The resultant noise levels are weighted and summed over 24-hour periods to determine the CNEL values. Table K provides the traffic noise levels for the opening year and horizon year with and without project scenarios. These noise levels represent the worst-case scenario, which assumes no shielding is provided between the traffic and the location where the noise contours are drawn.

The without and with project scenario traffic volumes were obtained from *Traffic Impact Analysis for the San Antonio Water Headquarters* (LSA 2024). Attachment E provides the specific assumptions used in developing these noise levels and model printouts. Although Table K shows that the increase in project-related traffic noise would be greater than 3 dBA, which is perceptible to the human ear in an outdoor environment, the generated CNEL noise levels would be below 60 dBA CNEL, which is acceptable for low-density residential uses as specified in the City's General Plan. Therefore, traffic noise impacts from project-related traffic on off-site sensitive receptors would be less than significant, and no mitigation measures are required.

### Long-Term Ground-Borne Noise and Vibration from Vehicular Traffic

The proposed project would not generate noticeable vibration levels related to on-site operations. Trucks traveling to and from the project site as well as loading and unloading activities may generate vibration levels. However, the closest off-site uses are greater than 25 feet away and vibration levels generated from trucks would not be perceptible. In addition, vibration levels generated from

project-related traffic on the adjacent roadways are unusual for on-road vehicles because the rubber tires and suspension systems of on-road vehicles provide vibration isolation. Based on a reference vibration level of 0.089 in/sec PPV, structures greater than 25 feet from the roadways that contain project trips would experience vibration levels below the most conservative standard of 0.12 in/sec PPV; therefore, vibration levels generated from project-related traffic on the adjacent roadways would be less than significant, and no mitigation measures are required.

## Table K: Traffic Noise Levels Without and With Proposed Project

| Roadway Segment | Existing | | Existing – With Project | | | Opening Year (2027) | | Opening Year (2027) – With Project | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ADT | CNEL (dBA) 50 ft from Centerline of Outermost Lane | ADT | CNEL (dBA) 50 ft from Centerline of Outermost Lane | Increase from Baseline Conditions (dBA) | ADT | CNEL (dBA) 50 ft from Centerline of Outermost Lane | ADT | CNEL (dBA) 50 ft from Centerline of Outermost Lane | Increase from Baseline Conditions (dBA) |
| 20th Street West of Winston Court | 80 | 42.4 | 190 | 46.1 | 3.7 | 100 | 43.4 | 210 | 46.6 | 3.2 |
| 20th Street East of Winston Court | 0 | 23.4 | 30 | 38.1 | 14.7 | 0 | 23.4 | 30 | 38.1 | 14.7 |
| 20th Street East of Campus Avenue | 7,910 | 62.0 | 8,070 | 62.0 | 0.0 | 8,570 | 62.3 | 8,730 | 62.4 | 0.1 |
| Campus Avenue North of 20th Street | 7,910 | 63.8 | 7,910 | 63.8 | 0.0 | 8,540 | 64.1 | 8,540 | 64.1 | 0.0 |

Source: Compiled by LSA (2024).
Note: Shaded cells indicate roadway segments adjacent to the project site.
ADT = average daily traffic dBA = A-weighted decibels
CNEL = Community Noise Equivalent Level ft= foot/feet

## Table K: Traffic Noise Levels Without and With Proposed Project (Continued)

| Roadway Segment | Horizon Year (2050) | | Horizon Year (2050) – With Project | | |
|---|---|---|---|---|---|
| | ADT | CNEL (dBA) 50 ft from Centerline of Outermost Lane | ADT | CNEL (dBA) 50 ft from Centerline of Outermost Lane | Increase from Baseline Conditions (dBA) |
| 20th Street West of Winston Court | 100 | 43.4 | 210 | 46.6 | 3.2 |
| 20th Street East of Winston Court | 0 | 23.4 | 30 | 38.1 | 14.7 |
| 20th Street East of Campus Avenue | 9,290 | 62.6 | 9,450 | 62.7 | 0.1 |
| Campus Avenue North of 20th Street | 9,260 | 64.4 | 9,260 | 64.4 | 0.0 |

Source: Compiled by LSA (2024).
Note: Shaded cells indicate roadway segments adjacent to the project site.
ADT = average daily traffic dBA = A-weighted decibels
CNEL = Community Noise Equivalent Level ft= foot/feet

### Long-Term Off-Site Operational Noise Impacts

Adjacent off-site land uses would be potentially exposed to stationary-source noise impacts from rooftop heating, ventilation, and air conditioning (HVAC) equipment and proposed truck arrival and departure activities. The potential noise impacts to off-site sensitive land uses from the proposed operations are discussed below.

### Heating, Ventilation, and Air Conditioning Equipment

The project would have various rooftop mechanical equipment, including HVAC units, atop the proposed buildings. Based on the project site plan, the project is assumed to have two rooftop HVAC units atop each proposed building (Main Building and Maintenance Building) and assumed to operate 24 hours per day. The HVAC equipment could operate 24 hours per day and would generate sound power levels ($L_w$) of up to 87 dBA $L_w$ or 72 dBA $L_{eq}$ at 5 feet, based on manufacturer data (Trane n.d.).

### Truck Arrival and Departure Activities

Noise levels generated by delivery trucks would be similar to noise readings from truck loading and unloading activities, which generate a noise level of 75 dBA $L_{eq}$ at 20 feet based on measurements taken by LSA (*Operational Noise Impact Analysis for Richmond Wholesale Meat Distribution Center* [LSA 2016]). Shorter term noise levels that occur during the docking process taken by LSA for the *Operational Noise Impact Analysis for Richmond Wholesale Meat Distribution Center* were measured to be 76.3 dBA $L_8$ at 20 feet. These noise level measurements are relevant to the project because delivery trucks are anticipated during operation of the project. Delivery trucks would arrive on site and maneuver their trailers so that trailers would be parked within the loading docks. During this process, noise levels are associated with the truck engine noise, air brakes, and back-up alarms while the truck is backing into the dock. These noise levels would occur for a shorter period of time (less than 5 minutes). After a truck enters the loading dock, the doors would be closed, and the remainder of the truck loading activities would be enclosed and therefore much less perceptible. Consistent with the *Traffic Impact Analysis for the San Antonio Water Company Headquarters Project* (LSA 2024), it is assumed that truck arrivals and departure activities could occur at 6 parking spaces during peak hour for a period of less than 5 minutes each.

### Cumulative Operations Noise Assessment

Tables L and M below show the combined hourly noise levels generated by HVAC equipment and truck delivery activities at the closest off-site land uses. The results indicated that operational noise levels would be below the daytime hourly noise level standards of 55 dBA $L_{eq}$ for residential uses. Although the operational noise levels may exceed the nighttime hourly noise level standards of 45 dBA $L_{eq}$, ambient noise levels would not increase by 5 dBA or more. Therefore, operations of the proposed project would be less than significant. No mitigation is required. Attachment F presents the operational noise source calculations.

## Table L: Daytime Exterior Noise Level Impacts

| Receptor | Direction | Existing Quietest Daytime Noise Level (dBA $L_{eq}$) | Project Generated Noise Levels (dBA $L_{eq}$) | Potential Operational Noise Impact?[1] |
|---|---|---|---|---|
| Residential | North | 59.8 | 47.0 | No |
| Residential | West | 63.4 | 46.7 | No |

Source: Compiled by LSA (2024).

[1] A potential operational noise impact would occur if (1) the quietest daytime ambient hour is less 55 dBA $L_{eq}$ at the nearest residential uses and project noise impacts are greater 55 dBA $L_{eq}$ at the nearest residential uses, or (2) the quietest daytime ambient hour is greater than 55 dBA $L_{eq}$ at the nearest residential uses and project noise impacts are 3 dBA greater than the quietest daytime ambient hour.

dBA $L_{eq}$ = average A-weighted hourly noise level

## Table M: Nighttime Exterior Noise Level Impacts

| Receptor | Direction | Existing Quietest Nighttime Noise Level (dBA $L_{eq}$) | Project Generated Noise Levels (dBA $L_{eq}$) | Potential Operational Noise Impact?[1] |
|---|---|---|---|---|
| Residential | North | 57.9 | 47.0 | No |
| Residential | West | 61.1 | 46.7 | No |

Source: Compiled by LSA (2024).

[1] A potential operational noise impact would occur if (1) the quietest nighttime ambient hour is less 45 dBA $L_{eq}$ at the nearest residential uses and project noise impacts are greater than 45 dBA $L_{eq}$ at the nearest residential uses, or (2) the quietest nighttime ambient hour is greater than 45 dBA $L_{eq}$ at the nearest residential uses and project noise impacts are 3 dBA greater than the quietest nighttime ambient hour.

dBA $L_{eq}$ = average A-weighted hourly noise level

In conclusion, the proposed project would not generate noise levels from operations above the quietest ambient noise levels during daytime and nighttime hours. Furthermore, due to the relatively high ambient noise levels, the project would not contribute to the overall ambient noise levels. The project is also not anticipated to generate vibration levels above the FTA limits to off-site receptors with the implementation of project design features that limit the location of heavy equipment operations. Therefore, the proposed project would comply with the City's noise and vibration standards, and no noise reduction features are required.

Attachments:
- A: References
- B: Figures
- C: Noise Measurement Data
- D: Construction Noise Calculations
- E: FHWA Traffic Noise Printouts
- F: Operational Noise Level Calculations

# ATTACHMENT A

# REFERENCES

City of Upland. 2015. *General Plan, Safety Element.* September.

_____. 2024. *Municipal Code, Noise Ordinances.* March 13.

Federal Highway Administration (FHWA). 2006. *Roadway Construction Noise Model User's Guide.* January. Washington, D.C. Website: https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf (accessed November 2024).

Federal Transit Administration (FTA). 2018. *Transit Noise and Vibration Impact Assessment Manual* (FTA Manual). FTA Report 0123. Office of Planning and Environment. September.

LSA Associates, Inc. (LSA). 2016. *Operational Noise Impact Analysis for Richmond Wholesale Meat Distribution Center.*

_____. 2024. *Traffic Impact Analysis for the San Antonio Water Headquarters.*

Trane. n.d. *Fan Performance - Product Specifications RT-PRC023AU-EN.*

# ATTACHMENT B

# FIGURES

Figure 1: Project Location

Figure 2: Conceptual Site Plan

Figure 3: Noise Monitoring Locations

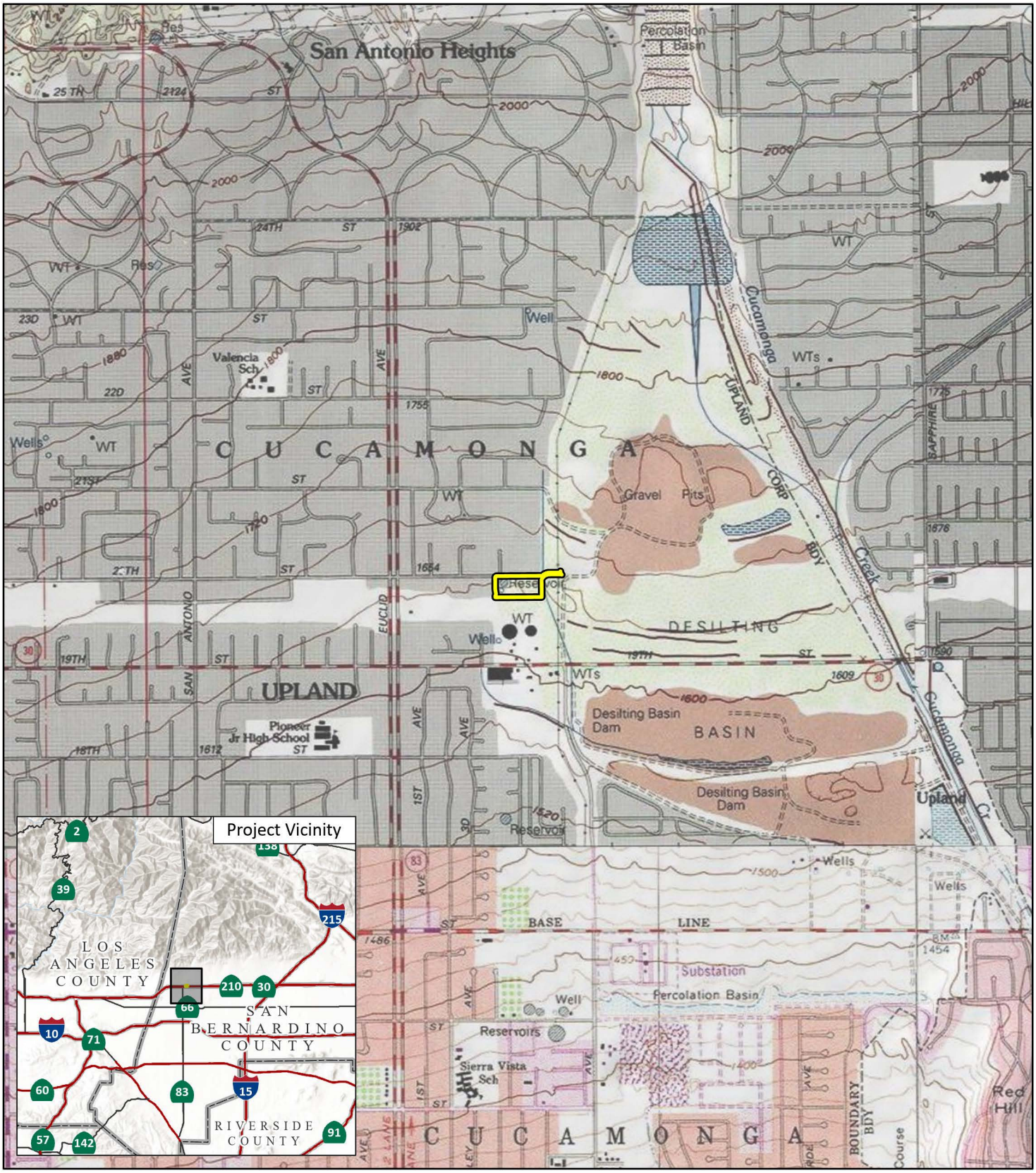



FIGURE 1

0 1000 2000
FEET

SOURCE: *Mt. Baldy CA*, 7.5' Quad (USGS 1988)

*San Antonio Water Company Headquarters*

Project Location and Vicinity

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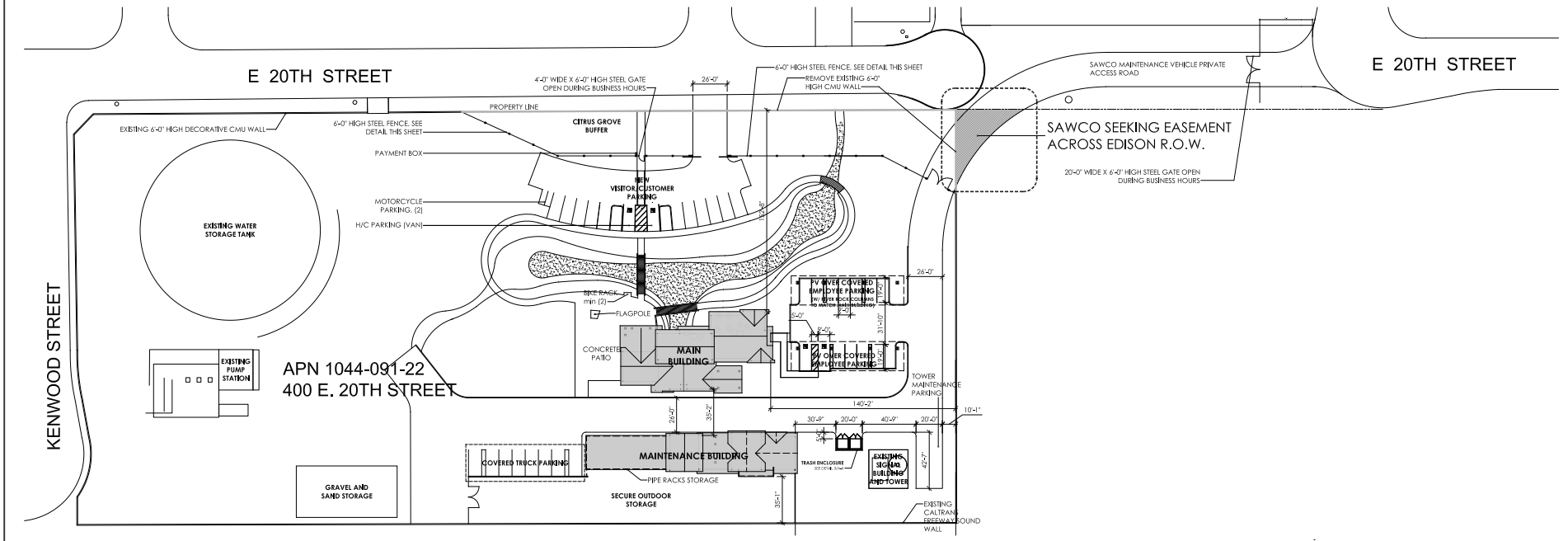


LSA

FIGURE 2

N

0 60 120

FEET

SOURCE: CEDG, Inc.

*San Antonio Water Company Headquarters*

Conceptual Site Plan

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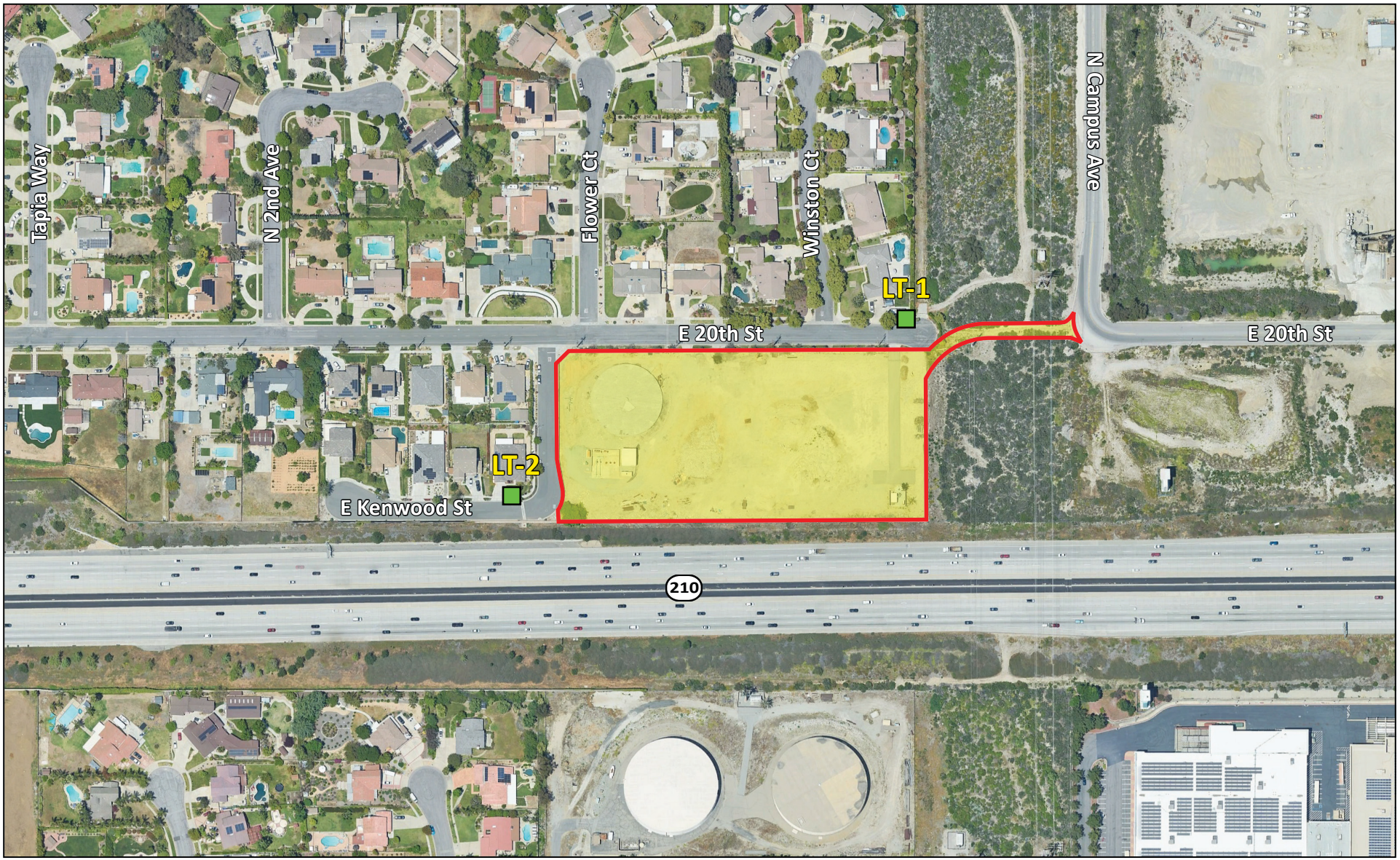


LSA

LEGEND

Project Site Boundary

LT-1 Long-term Noise Monitoring Location

FIGURE 3

0 125 250

FEET

SOURCE: Google Earth 2024

*San Antonio Water Company Headquarters*

Noise Monitoring Locations

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# ATTACHMENT C

# NOISE MEASUREMENT DATA

# Noise Measurement Survey – 24 HR

Project Number: 20241723
Project Name: San Antonio

Test Personnel: Amber Hazelrigg
Equipment: Spark 706RC (SN: 18517)

Site Number: LT-1 Date: 7/16/24

Time: From 12pm To 12pm

Site Location: The monitor was hung on a light pole at the end of 20th street across from the northeastern side of the project site. It is approximately 490 feet to the 210 Freeway centerline and 355 feet to North Campus Avenue centerline.

Primary Noise Sources: The primary noise would be residential.

Comments:

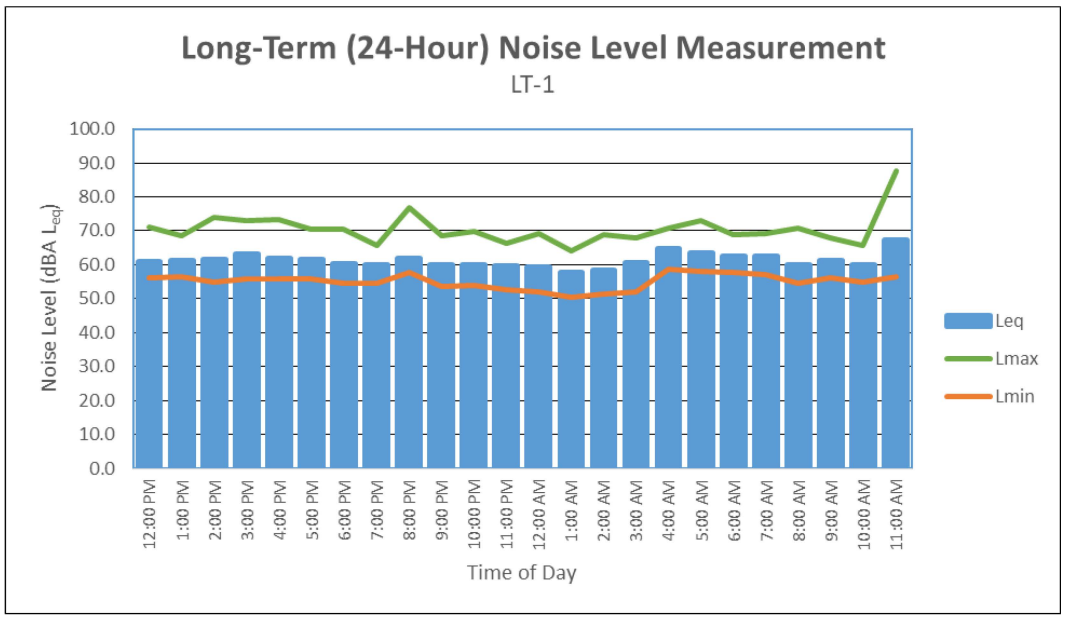
Photo:

## Long-Term (24-Hour) Noise Level Measurement Results at LT-1

| Start Time | Date | Noise Level (dBA) | | |
|---|---|---|---|---|
| | | $L_{eq}$ | $L_{max}$ | $L_{min}$ |
| 12:00 PM | 7/16/24 | 60.8 | 71.0 | 56.1 |
| 1:00 PM | 7/16/24 | 61.3 | 68.4 | 56.4 |
| 2:00 PM | 7/16/24 | 61.5 | 74.0 | 55.0 |
| 3:00 PM | 7/16/24 | 63.1 | 73.0 | 55.7 |
| 4:00 PM | 7/16/24 | 61.8 | 73.4 | 55.9 |
| 5:00 PM | 7/16/24 | 61.6 | 70.4 | 55.8 |
| 6:00 PM | 7/16/24 | 60.3 | 70.3 | 54.5 |
| 7:00 PM | 7/16/24 | 60.1 | 65.8 | 54.4 |
| 8:00 PM | 7/16/24 | 61.9 | 76.9 | 57.8 |
| 9:00 PM | 7/16/24 | 60.0 | 68.4 | 53.7 |
| 10:00 PM | 7/16/24 | 59.9 | 69.8 | 53.8 |
| 11:00 PM | 7/16/24 | 59.6 | 66.2 | 52.7 |
| 12:00 AM | 7/17/24 | 59.3 | 69.1 | 51.9 |
| 1:00 AM | 7/17/24 | 57.9 | 64.0 | 50.5 |
| 2:00 AM | 7/17/24 | 58.5 | 69.0 | 51.5 |
| 3:00 AM | 7/17/24 | 60.8 | 67.8 | 51.9 |
| 4:00 AM | 7/17/24 | 64.9 | 70.7 | 58.6 |
| 5:00 AM | 7/17/24 | 63.3 | 73.1 | 57.9 |
| 6:00 AM | 7/17/24 | 62.6 | 68.9 | 57.8 |
| 7:00 AM | 7/17/24 | 62.3 | 69.3 | 57.1 |
| 8:00 AM | 7/17/24 | 59.8 | 70.7 | 54.7 |
| 9:00 AM | 7/17/24 | 61.3 | 68.0 | 56.1 |
| 10:00 AM | 7/17/24 | 59.8 | 65.7 | 54.9 |
| 11:00 AM | 7/17/24 | 67.4 | 87.7 | 56.5 |

Source: Compiled by LSA Associates, Inc. (2024).

dBA = A-weighted decibel
$L_{eq}$ = equivalent continuous sound level
$L_{max}$ = maximum instantaneous noise level
$L_{min}$ = minimum measured sound level



# Noise Measurement Survey – 24 HR

Project Number: 20241723
Project Name: San Antonio

Test Personnel: Amber Hazelrigg
Equipment: Spark 706RC (SN: 17206)

Site Number: LT-2 Date: 7/16/24

Time: From 1 pm To 1 pm

Site Location: The monitor was hung on a light pole on the across from the southwestern side of the project site. It is approximately 175 feet to the 210 freeway centerline and 72 feet from Flower Court.

Primary Noise Sources: The primary noise source is the 210 freeway.

Comments:

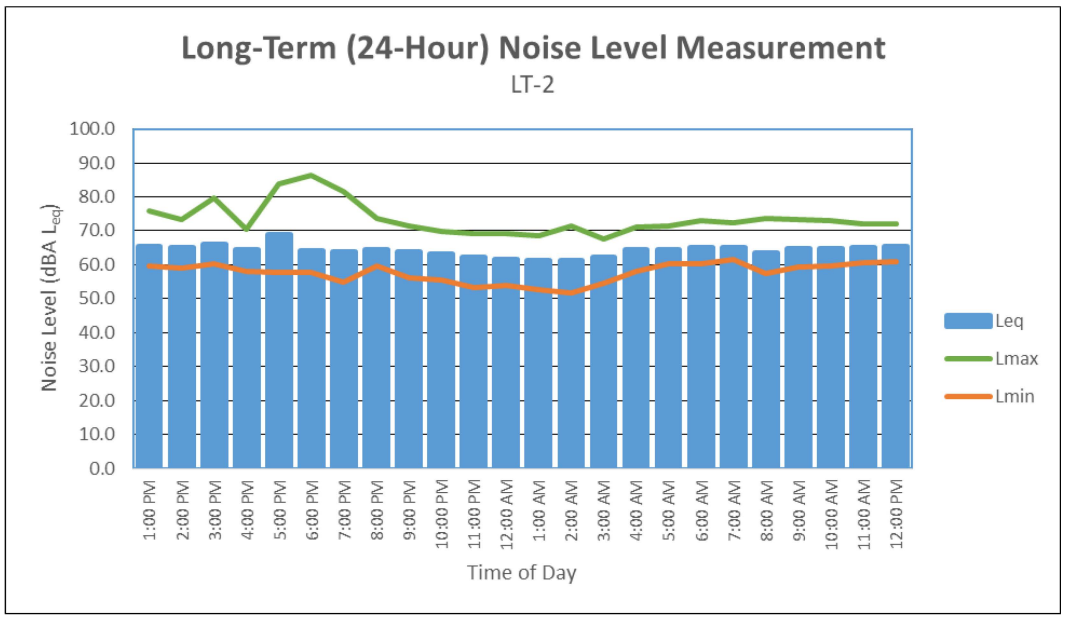
Photo:

## Long-Term (24-Hour) Noise Level Measurement Results at LT-2

| Start Time | Date | Noise Level (dBA) | | |
|---|---|---|---|---|
| | | $L_{eq}$ | $L_{max}$ | $L_{min}$ |
| 1:00 PM | 7/16/11 | 65.4 | 75.8 | 59.7 |
| 2:00 PM | 7/16/11 | 65.0 | 73.4 | 59.1 |
| 3:00 PM | 7/16/11 | 66.0 | 79.6 | 60.3 |
| 4:00 PM | 7/16/11 | 64.5 | 70.4 | 58.0 |
| 5:00 PM | 7/16/11 | 68.9 | 83.7 | 57.6 |
| 6:00 PM | 7/16/11 | 64.1 | 86.5 | 57.7 |
| 7:00 PM | 7/16/11 | 63.7 | 81.7 | 54.9 |
| 8:00 PM | 7/16/11 | 64.4 | 73.7 | 59.8 |
| 9:00 PM | 7/16/11 | 63.6 | 71.3 | 56.3 |
| 10:00 PM | 7/16/11 | 63.1 | 69.7 | 55.6 |
| 11:00 PM | 7/16/11 | 62.2 | 69.3 | 53.3 |
| 12:00 AM | 7/17/11 | 61.6 | 69.1 | 53.8 |
| 1:00 AM | 7/17/11 | 61.1 | 68.4 | 52.5 |
| 2:00 AM | 7/17/11 | 61.1 | 71.3 | 51.6 |
| 3:00 AM | 7/17/11 | 62.2 | 67.7 | 54.4 |
| 4:00 AM | 7/17/11 | 64.6 | 71.1 | 58.1 |
| 5:00 AM | 7/17/11 | 64.5 | 71.3 | 60.2 |
| 6:00 AM | 7/17/11 | 65.0 | 73.1 | 60.4 |
| 7:00 AM | 7/17/11 | 65.0 | 72.5 | 61.6 |
| 8:00 AM | 7/17/11 | 63.4 | 73.7 | 57.3 |
| 9:00 AM | 7/17/11 | 64.7 | 73.2 | 59.4 |
| 10:00 AM | 7/17/11 | 64.6 | 72.9 | 59.7 |
| 11:00 AM | 7/17/11 | 65.1 | 72.2 | 60.7 |
| 12:00 PM | 7/17/11 | 65.4 | 72.1 | 60.8 |

Source: Compiled by LSA Associates, Inc. (2024).

dBA = A-weighted decibel
$L_{eq}$ = equivalent continuous sound level
$L_{max}$ = maximum instantaneous noise level
$L_{min}$ = minimum measured sound level



# ATTACHMENT D

# CONSTRUCTION NOISE CALCULATIONS

# Construction Calculations

Phase: Site Preparation

| Equipment | Quantity | Reference (dBA) 50 ft Lmax | Usage Factor[1] | Distance to Receptor (ft) | Ground Effects | Noise Level (dBA) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lmax | Leq |
| Grader | 1 | 85 | 40 | 50 | 0.5 | 85 | 81 |
| Scraper | 1 | 84 | 40 | 50 | 0.5 | 84 | 80 |
| Tractor | 1 | 84 | 40 | 50 | 0.5 | 84 | 80 |
| | | | | | **Combined at 50 feet** | **89** | **85** |
| | | | | | **Combined at Receptor 250 feet** | **75** | **71** |

Phase: Grading

| Equipment | Quantity | Reference (dBA) 50 ft Lmax | Usage Factor[1] | Distance to Receptor (ft) | Ground Effects | Noise Level (dBA) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lmax | Leq |
| Grader | 1 | 85 | 40 | 50 | 0.5 | 85 | 81 |
| Dozer | 1 | 82 | 40 | 50 | 0.5 | 82 | 78 |
| Tractor | 2 | 84 | 40 | 50 | 0.5 | 84 | 83 |
| | | | | | **Combined at 50 feet** | **89** | **86** |
| | | | | | **Combined at Receptor 250 feet** | **75** | **72** |
| | | | | | **Combined at Receptor 405 feet** | **70** | **68** |

Phase:Building Construstion

| Equipment | Quantity | Reference (dBA) 50 ft Lmax | Usage Factor[1] | Distance to Receptor (ft) | Ground Effects | Noise Level (dBA) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lmax | Leq |
| Crane | 1 | 81 | 16 | 50 | 0.5 | 81 | 73 |
| Man Lift | 1 | 75 | 20 | 50 | 0.5 | 75 | 68 |
| Tractor | 1 | 84 | 40 | 50 | 0.5 | 84 | 80 |
| Generator | 1 | 81 | 50 | 50 | 0.5 | 81 | 78 |
| Welder / Torch | 3 | 74 | 40 | 50 | 0.5 | 74 | 75 |
| | | | | | **Combined at 50 feet** | **87** | **83** |
| | | | | | **Combined at Receptor 250 feet** | **74** | **69** |

Phase:Paving

| Equipment | Quantity | Reference (dBA) 50 ft Lmax | Usage Factor[1] | Distance to Receptor (ft) | Ground Effects | Noise Level (dBA) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lmax | Leq |
| Drum Mixer | 1 | 80 | 50 | 50 | 0.5 | 80 | 77 |
| Paver | 1 | 77 | 50 | 50 | 0.5 | 77 | 74 |
| Tractor | 1 | 84 | 40 | 50 | 0.5 | 84 | 80 |
| Roller | 1 | 80 | 20 | 50 | 0.5 | 80 | 73 |
| All Other Equipment > 5 hp | 1 | 85 | 50 | 50 | 0.5 | 85 | 82 |
| | | | | | **Combined at 50 feet** | **89** | **85** |
| | | | | | **Combined at Receptor 250 feet** | **75** | **72** |

Phase:Architectural Coating

| Equipment | Quantity | Reference (dBA) 50 ft Lmax | Usage Factor[1] | Distance to Receptor (ft) | Ground Effects | Noise Level (dBA) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lmax | Leq |
| Compressor (air) | 1 | 78 | 40 | 50 | 0.5 | 78 | 74 |
| | | | | | **Combined at 50 feet** | **78** | **74** |
| | | | | | **Combined at Receptor 250 feet** | **64** | **60** |

*Sources: RCNM*

[1]- Percentage of time that a piece of equipment is operating at full power.
dBA – A-weighted Decibels
Lmax- Maximum Level
Leq- Equivalent Level

# ATTACHMENT E

# FHWA TRAFFIC NOISE PRINTOUTS

TABLE Existing -01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street West of Winston Court
NOTES: San Antonio Water Headquarters Project - Existing

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 80  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 42.39

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Existing -02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Winston Court
NOTES: San Antonio Water Headquarters Project - Existing

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 0  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 23.36

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Existing -03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Campus Avenue
NOTES: San Antonio Water Headquarters Project - Existing

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 7910  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 20  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 61.95

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 92.7 | 195.9 |

---

TABLE Existing -04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: Campus Avenue North of 20th Street
NOTES: San Antonio Water Headquarters Project - Existing

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 7910  SPEED (MPH): 40  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 63.76

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 54.4 | 113.6 | 242.9 |

---

TABLE Existing With Project -01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street West of Winston Court
NOTES: San Antonio Water Headquarters Project - Existing With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 190  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 46.14

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Existing With Project -02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Winston Court
NOTES: San Antonio Water Headquarters Project - Existing With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 30  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 38.13

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Existing With Project -03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Campus Avenue
NOTES: San Antonio Water Headquarters Project - Existing With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 8070  SPEED (MPH): 35  GRADE: .5

| | TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|---|
| | DAY | EVENING | NIGHT |
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 20  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.04

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| 0.0 | 0.0 | 93.9 | 198.5 |

---

TABLE Existing With Project -04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: Campus Avenue North of 20th Street
NOTES: San Antonio Water Headquarters Project - Existing With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 7910  SPEED (MPH): 40  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 63.76

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 54.4 | 113.6 | 242.9 |

---

TABLE Opening Year (2027) Without Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street West of Winston Court
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) Without Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 100  SPEED (MPH): 35  GRADE: .5

| TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|
| DAY | EVENING | NIGHT |
| --- | --- | --- |
| AUTOS | | |
| 75.51 | 12.57 | 9.34 |
| M-TRUCKS | | |
| 1.56 | 0.09 | 0.19 |
| H-TRUCKS | | |
| 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 43.36

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| --- | --- | --- | --- |
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Opening Year (2027) Without Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Winston Court
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) Without Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 0 SPEED (MPH): 35 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 23.36

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Opening Year (2027) Without Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Campus Avenue
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) Without Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 8570  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 20  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.30

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 97.5 | 206.6 |

---

TABLE Opening Year (2027) Without Project-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: Campus Avenue North of 20th Street
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) Without Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 8540  SPEED (MPH): 40  GRADE: .5

| TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|
| DAY | EVENING | NIGHT |
| --- | --- | --- |
| AUTOS | | |
| 75.51 | 12.57 | 9.34 |
| M-TRUCKS | | |
| 1.56 | 0.09 | 0.19 |
| H-TRUCKS | | |
| 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.09

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| --- | --- | --- | --- |
| 0.0 | 57.0 | 119.4 | 255.6 |

---

TABLE Opening Year (2027) With Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street West of Winston Court
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 210  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 46.58

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Opening Year (2027) With Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Winston Court
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 30 SPEED (MPH): 35 GRADE: .5

| TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|
| DAY | EVENING | NIGHT |
| --- | --- | --- |
| AUTOS | | |
| 75.51 | 12.57 | 9.34 |
| M-TRUCKS | | |
| 1.56 | 0.09 | 0.19 |
| H-TRUCKS | | |
| 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 38.13

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| --- | --- | --- | --- |
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Opening Year (2027) With Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Campus Avenue
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 8730  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 20  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.38

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 98.7 | 209.1 |

---

TABLE Opening Year (2027) With Project-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: Campus Avenue North of 20th Street
NOTES: San Antonio Water Headquarters Project - Opening Year (2027) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 8540  SPEED (MPH): 40  GRADE: .5

| TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|
| DAY | EVENING | NIGHT |
| --- | --- | --- |
| AUTOS | | |
| 75.51 | 12.57 | 9.34 |
| M-TRUCKS | | |
| 1.56 | 0.09 | 0.19 |
| H-TRUCKS | | |
| 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.09

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| --- | --- | --- | --- |
| 0.0 | 57.0 | 119.4 | 255.6 |

---

TABLE Horizon 2050 (Without) Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street West of Winston Court
NOTES: San Antonio Water Headquarters Project - Horizon 2050 (Without) Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 100  SPEED (MPH): 35  GRADE: .5

| TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|
| DAY | EVENING | NIGHT |
| --- | --- | --- |
| AUTOS | | |
| 75.51 | 12.57 | 9.34 |
| M-TRUCKS | | |
| 1.56 | 0.09 | 0.19 |
| H-TRUCKS | | |
| 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 43.36

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| --- | --- | --- | --- |
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Horizon 2050 (Without) Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Winston Court
NOTES: San Antonio Water Headquarters Project - Horizon 2050 (Without) Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 0 SPEED (MPH): 35 GRADE: .5

| TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|
| DAY | EVENING | NIGHT |
| --- | --- | --- |
| AUTOS | | |
| 75.51 | 12.57 | 9.34 |
| M-TRUCKS | | |
| 1.56 | 0.09 | 0.19 |
| H-TRUCKS | | |
| 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 23.36

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| --- | --- | --- | --- |
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Horizon 2050 (Without) Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Campus Avenue
NOTES: San Antonio Water Headquarters Project - Horizon 2050 (Without) Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 9290  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 20  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.65

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 102.7 | 217.9 |

---

TABLE Horizon 2050 (Without) Project-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: Campus Avenue North of 20th Street
NOTES: San Antonio Water Headquarters Project - Horizon 2050 (Without) Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 9260  SPEED (MPH): 40  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.44

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 60.0 | 125.9 | 269.7 |

---

TABLE Horizon (2050) With Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street West of Winston Court
NOTES: San Antonio Water Headquarters Project - Horizon (2050) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 210  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 46.58

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Horizon (2050) With Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Winston Court
NOTES: San Antonio Water Headquarters Project - Horizon (2050) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 30  SPEED (MPH): 35  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 38.13

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 |

---

TABLE Horizon (2050) With Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: 20th Street East of Campus Avenue
NOTES: San Antonio Water Headquarters Project - Horizon (2050) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 9450  SPEED (MPH): 35  GRADE: .5

| | TRAFFIC DISTRIBUTION PERCENTAGES | | |
|---|---|---|---|
| | DAY | EVENING | NIGHT |
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 20  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.72

| DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL | | | |
|---|---|---|---|
| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
| 0.0 | 0.0 | 103.8 | 220.4 |

---

TABLE Horizon (2050) With Project-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 10/31/2024
ROADWAY SEGMENT: Campus Avenue North of 20th Street
NOTES: San Antonio Water Headquarters Project - Horizon (2050) With Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 9260  SPEED (MPH): 40  GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

| | DAY | EVENING | NIGHT |
|---|---|---|---|
| AUTOS | 75.51 | 12.57 | 9.34 |
| M-TRUCKS | 1.56 | 0.09 | 0.19 |
| H-TRUCKS | 0.64 | 0.02 | 0.08 |

ACTIVE HALF-WIDTH (FT): 15  SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.44

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

| 70 CNEL | 65 CNEL | 60 CNEL | 55 CNEL |
|---|---|---|---|
| 0.0 | 60.0 | 125.9 | 269.7 |

---

# ATTACHMENT F

# OPERATIONAL NOISE LEVEL CALCULATIONS

**Stationary Noise**

| | Land Use | Direction | Noise Source | Peak Hour Daytime Reference Noise Level at 50 ft (dBA Leq) | Off-Peak Nighttime Reference Noise Level at 50 ft (dBA Leq) | Reference Distance (ft) | Distance (ft) | Distance Attenuation (dBA) | Peak Hour Daytime Reference Noise Level at Receptor (dBA Leq) | Off-Peak Nighttime Reference Noise Level at Receptor (dBA Leq) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Residential | West | Truck Load/Unload Activity | 72.0 | 72.0 | 20 | 395 | 25.9 | 46.1 | 46.1 |
| | | | HVAC 1 | 75.0 | 75.0 | 5 | 520 | 40.3 | 34.7 | 34.7 |
| | | | HVAC 2 | 75.0 | 75.0 | 5 | 525 | 40.4 | 34.6 | 34.6 |
| | | | | | | | | **Combined** | **46.7** | **46.7** |
| 1 | Residential | North | Truck Load/Unload Activity | 72.0 | 72.0 | 20 | 410 | 26.2 | 45.8 | 45.8 |
| | | | HVAC 1 | 75.0 | 75.0 | 5 | 335 | 36.5 | 38.5 | 38.5 |
| | | | HVAC 2 | 75.0 | 75.0 | 5 | 410 | 38.3 | 36.7 | 36.7 |