MEMORANDUM

DATE: April 3, 2025

TO: Priit Kaskla, Associate Planner

FROM: Jason Lui, Associate/Senior Noise Specialist

SUBJECT: Noise and Vibration Impact Analysis for the Warehouse Project at 12821 Knott Street, Garden Grove, California

INTRODUCTION

This Noise and Vibration Impact Analysis has been prepared to evaluate the potential noise and vibration impacts associated with the proposed 12821 Knott Street Warehouse Project (project) in Garden Grove, California. This memorandum has been prepared in compliance with the requirements of the City of Garden Grove (City) and the California Environmental Quality Act (CEQA). All references cited in this memorandum are included in Attachment A.

PROJECT LOCATION

The proposed project is located within a highly urbanized area at 12821 Knott Street (Assessor's Parcel Number [APN] 215-014-01) in Garden Grove, California. Regional access to the project site is provided by State Route 22 (SR-22), located immediately south of the project site, and Knott Street, located immediately east of the project site. Figure 1 (all figures are provided in Attachment B) shows the project location.

PROJECT DESCRIPTION

The proposed project includes the construction of an additional approximately 10,338 square feet (sf) of mezzanine office space within the existing 173,000 sf building. Construction is anticipated to begin in 2025 and last for approximately 7 months. No exterior construction or revisions to the existing parking lot are proposed. All construction staging would be contained within the existing building, and all construction equipment would access the site from Knott Street on the east side of the project site. The project site's zoning (PUD 104-70 (REV. 2019)) allows for the current use, and the current use would not change with implementation of the proposed project. Figure 2 shows the proposed site plan.

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. Decibels (dB), unlike the linear scale (e.g., inches or pounds), are measured on a logarithmic scale, which is a scale based on powers of 10.

For example, 10 dB is 10 times more intense than 0 dB, 20 dB is 100 times more intense than 0 dB, and 30 dB is 1,000 times more intense than 0 dB. Thirty decibels (30 dB) represents 1,000 times as much acoustic energy as 0 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; however, line source noise in a relatively flat environment with absorptive vegetation decreases 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 CNEL noise scale for long-term noise impact assessment.

Other noise rating scales of importance when assessing the annoyance factor include the maximum 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. L_{max} 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. 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 includes 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 dB and 3 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category includes 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 (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 definitions of acoustical terms, and Table B shows common sound levels and their sources.

Table A: Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of measurement that denotes the ratio between two quantities that are 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 1 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 deemphasizes the very low- and very high-frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. (All sound levels in this report are A-weighted unless reported otherwise.)
L_{01}, L_{10}, L_{50}, L_{90}	The fast A-weighted noise levels that are equaled or exceeded by a fluctuating sound level 1%, 10%, 50%, and 90% 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 dBA to sound levels occurring in the evening from 7:00 PM to 10:00 PM and after the addition of 10 dBA to sound levels occurring in the night between 10:00 PM and 7:00 AM.
Day/Night Noise Level, L_{dn}	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 dBA to sound levels occurring in the night between 10:00 PM and 7:00 AM.
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: *Handbook of Acoustical Measurements and Noise Control* (Harris 1991).

Table B: Common Sound Levels and Their Noise Sources

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Evaluations
Near Jet Engine	140	Deafening	128 times as loud
Civil Defense Siren	130	Threshold of Pain	64 times as loud
Hard Rock Band	120	Threshold of Feeling	32 times as loud
Accelerating Motorcycle at a Few Feet Away	110	Very Loud	16 times as loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very Loud	8 times as loud
Ambulance Siren; Food Blender	95	Very Loud	—
Garbage Disposal	90	Very Loud	4 times as loud
Freight Cars; Living Room Music	85	Loud	—
Pneumatic Drill; Vacuum Cleaner	80	Loud	2 times as loud
Busy Restaurant	75	Moderately Loud	—
Near Freeway Auto Traffic	70	Moderately Loud	—
Average Office	60	Quiet	One-half as loud
Suburban Street	55	Quiet	—
Light Traffic; Soft Radio Music in Apartment	50	Quiet	One-quarter as loud
Large Transformer	45	Quiet	—
Average Residence without Stereo Playing	40	Faint	One-eighth as loud
Soft Whisper	30	Faint	—
Rustling Leaves	20	Very Faint	—
Human Breathing	10	Very Faint	Threshold of Hearing
—	0	Very Faint	—

Source: Compiled by LSA (2015).

FUNDAMENTALS 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 be discernible, but without the effects associated with the shaking of a building there is less adverse reaction. 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 vibration velocity decibels (VdB) 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. Ground-borne vibration and noise from these sources are usually localized to areas within approximately 100 feet (ft) from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 ft (see the Federal Transit Administration's [FTA] 2018 *Transit Noise and Vibration Impact Assessment Manual*). 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, both construction of a project and freight train operations on railroad tracks could result in ground-borne vibration that may be perceptible and annoying.

Ground-borne noise is not likely to be a problem because noise arriving via the normal airborne path will usually be greater than ground-borne noise. Ground-borne vibration has the potential to disturb people and damage buildings. Although it is very rare for train-induced ground-borne vibration to cause cosmetic building damage, it is not uncommon for heavy duty construction processes (e.g., 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 VdB, "V" is the RMS velocity amplitude, and "V_{ref}" is the reference velocity amplitude, or 1×10^{-6} inches/second (in/sec) used in the United States.

REGULATORY SETTING

Federal Guidelines

Federal Transit Administration

Noise. The construction noise criteria included in the *Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual* (2018) were used to evaluate potential construction noise impacts because the City does not have construction noise level limits. Table C shows the FTA's Detailed Assessment Daytime Construction Noise Criteria based on the composite noise levels for each construction phase.

Table C: 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

Vibration. Vibration standards included in the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018) were used to evaluate vibration impacts because the City does not have vibration standards. Table D provides the criteria for assessing the potential for interference or annoyance from vibration levels in a building, while Table E lists the potential vibration building damage criteria associated with construction activities.

Table D: Interpretation of Vibration Criteria for Detailed Analysis

Land Use	Maximum L_v (VdB)[1]	Description of Use
Workshop	90	Vibration that is distinctly felt. Appropriate for workshops and similar areas not as sensitive to vibration.
Office	84	Vibration that can be felt. Appropriate for offices and similar areas not as sensitive to vibration.
Residential Day	78	Vibration that is barely felt. Adequate for computer equipment and low-power optical microscopes (up to 20×).
Residential Night and Operating Rooms	72	Vibration is not felt, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power microscopes (100×) and other equipment of low sensitivity.

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] As measured in ⅓-octave bands of frequency over the frequency range 8 to 80 Hertz.
FTA = Federal Transit Administration
VdB = vibration velocity decibels
L_V = velocity in decibels

Table E: 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
Nonengineered-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
PPV = peak particle velocity
in/sec = inches per second

Local Regulations

City of Garden Grove

General Plan. The City's General Plan Noise Element (City of Garden Grove 2008) has established noise and land use compatibility guidelines for various land uses (shown in Table F), as well as policies and implementation programs to meet the City's noise-related goals. As shown in Table F, a noise level of up to 70 dBA CNEL is the upper limit of what is considered a "normally acceptable" noise environment, and a noise level of up to 77.5 dBA CNEL is the upper limit of what is considered a "conditionally acceptable" noise environment for office, business, and commercial uses. Also, a noise level of up to 75 dBA CNEL is the upper limit of what is considered a "normally acceptable" noise environment, and a noise level of up to 80 dBA CNEL is the upper limit of what is considered a "conditionally acceptable" noise environment for industrial uses. The applicable General Plan Noise Element goals, policies, and implementation programs for the proposed project are listed below.

Table F: Noise and Land Use Compatibility Matrix

Land Use Category	Community Noise Exposure (dBA L_{dn} or CNEL)			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Residential—Low-Density, Single-Family, Duplex, Mobile Homes	50–60	55–70	70–75	75–85
Residential—Multiple-Family	50–65	60–70	70–75	70–85
Transient Lodging—Motels, Hotels	50–65	60–70	70–80	80–85
Schools, Libraries, Churches, Hospitals, Nursing Homes	50–70	60–70	70–80	80–85
Auditoriums, Concert Halls, Amphitheaters	N/A	50–70	N/A	65–85
Sports Arenas, Outdoor Spectator Sports	N/A	50–75	N/A	70–85
Playgrounds, Neighborhood Parks	50–70	N/A	67.5–75	72.5–85
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50–70	N/A	70–80	80–85
Office Buildings, Business Commercial and Professional	50–70	67.5–77.5	75–85	N/A
Industrial, Manufacturing, Utilities, Agriculture	50–75	70–80	75–85	N/A

Source: City of Garden Grove General Plan Noise Element (City of Garden Grove 2008).
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.
Normally Unacceptable—New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
Clearly Unacceptable—New construction or development should generally not be undertaken.
N/A = Not Applicable

Goal N-1: Noise consideration must be incorporated into land use planning decisions.

Policy N-1.2: Incorporate a noise assessment study into the environmental review process, when needed for a specific project for the purposed of identifying potential noise impacts and noise abatement procedures

Policy N-1.3: Require noise reduction techniques in site planning, architectural design, and construction, where noise reduction is necessary consistent with the standards in Tables 7-1 (Table F) and 7-2 (Table G), Title 24 of the California Code of Regulations, and Section 8.47 of the Municipal Code.

N-IMP-1B Require that new commercial, industrial, any redevelopment project, or any proposed development near existing residential land use demonstrate compliance with the City's Noise Ordinance prior to approval of the project.

N-IMP-1D Require construction activity to comply with the limits established in the City's Noise Ordinance.

N-IMP-1E Require buffers or appropriate mitigation of potential noise sources on noise sensitive areas.

N-IMP-1F Require that vehicle access to commercial properties that are located adjacent to residential parcels or other noise sensitive uses be located at the maximum practical distance from these uses.

N-IMP-1G Encourage truck deliveries to commercial or industrial properties abutting residential or noise sensitive uses after 7:00 a.m. and before 10:00 p.m.

Goal N-2: Maximized efficiency in noise abatement efforts through clear and effective policies and ordinances.

Policy N-2.3 Incorporate noise reduction features for items such as but not limited to parking and loading areas, ingress/egress point, and refuse collection areas, during site planning to mitigate anticipated noise impacts on affected noise sensitive land uses.

N-IMP-2A Require a noise impact evaluation for projects, if determined necessary through the environmental review process. Should noise abatement be necessary, the City shall require the implementation of mitigation measures based on a technical study prepared by a qualified acoustical professional.

Municipal Code. Section 8.47.050 of the City's Municipal Code limits excessive exterior noise levels from stationary noise sources at the property line of various land uses shown in Table G.

Table G: Noise Ordinance Standards

Use Categories	Use Designations	Time of Day	Ambient Base Noise Levels (dBA)	Noise Level (dBA)				
				L_{50}	L_{25}	L_{8}	L_{2}	L_{max}
Sensitive	Residential Use	7:00 a.m. to 10:00 p.m.	55	55	60	65	70	75
		10:00 p.m. to 7:00 a.m.	50	50	55	60	65	70
Conditionally Sensitive	Institutional Use	Anytime	65	65	70	75	80	85
	Office-Professional Use	Anytime	65	65	70	75	80	85
	Hotels and Motels	Anytime	65	65	70	75	80	85
Non-Sensitive	Commercial Uses	Anytime	70	70	75	80	85	90
	Commercial/Industrial Uses within 150 feet of Residential	7:00 a.m. to 10:00 p.m.	65	65	70	75	80	85
		10:00 p.m. to 7:00 a.m.	50	50	55	60	65	70
	Industrial Use	Anytime	70	70	75	80	85	90

Source: City of Garden Grove Municipal Code (City of Garden Grove 2024).

Note: When the actual measured ambient noise level exceeds the ambient base noise level, the actual measured ambient noise level shall be utilized. In situations where two adjoining properties exist within two different use designations, the most restrictive ambient base noise level will apply. This section permits any noise level that does not exceed either the ambient base noise level or the actual measured ambient noise level by 5 dBA, as measured at the property line of the noise generation property. In the event the ambient noise level exceeds any of the first four noise limit categories above, the cumulative period applicable to said category shall be increased to reflect said ambient noise level. In the event the ambient noise level exceeds the 5th noise limit category, the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level. The following criteria shall be used whenever the noise level exceeds:

L_{50} = The noise standard for a cumulative period of more than 30 minutes in any hour.
L_{25} = The noise standard plus 5 dBA for a cumulative period of more than 15 minutes in any hour.
L_{8} = The noise standard plus 10 dBA for a cumulative period of more than 5 minutes in any hour.
L_{2} = The noise standard plus 15 dBA for a cumulative period of more than 1 minute in any hour.
L_{max} = The noise standard plus 20 dBA for any period of time.

dBA = A-weighted decibel(s)

Section 8.47.060(C) of the City's Municipal Code limits noise generated from machinery, equipment, pump, fan, air conditioning, or similar mechanical equipment from creating noise that would cause the noise level at the property line of any property to exceed either the ambient base noise level or the actual measured ambient noise level by more than 5 dBA.

Section 8.47.060(D) of the City's Municipal Code prohibits construction activities that cause discomfort or annoyance to a person of normal sensitivity within a residential area or within a radius of 500 ft between the hours of 10:00 p.m. and 7:00 a.m.

THRESHOLDS OF SIGNIFICANCE

Based on the *Guidelines for the Implementation of the California Environmental Quality Act* (*State CEQA Guidelines*), Appendix G, 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.

EXISTING SETTING

Overview of the Existing Noise Environment

The primary existing noise sources in the project area are transportation facilities. Traffic on SR-22, Knott Street, and other roadways in the project area contributes to the ambient noise levels in the project vicinity. Also, office, commercial, and industrial activities contribute to the noise environment in the project area.

Land Uses in the Project Vicinity

Existing land uses within the project area include the Garden Room Banquet Facility and Wedding Chapel to the north, industrial uses and Calvary Chapel Westgrove across Knott Street to the east, office uses to the southeast, the Garden Grove Freeway (SR-22) and the city of Westminster to the south, and a residential community to the west.

Existing Aircraft Noise

The closest airport to the project site is the Joint Forces Training Base in Los Alamitos, which is 2 miles northwest of the project site. Based on the *Airport Environs Land Use Plan for Joint Forces Training Base Los Alamitos* (ALUC 2017), the project site is well beyond the 60 dBA CNEL noise contour. Also, there are no private airstrips within 2 miles of the project site. Therefore, the project would not expose people working in the project vicinity to aviation-related excessive noise levels, and this topic is not further discussed.

IMPACTS

Short-Term Construction Noise Impacts

Two types of short-term noise impacts would occur during project construction. The first type would be from construction crew commutes and the transport of construction equipment and materials to the project site, and would incrementally raise noise levels on roadways leading to the site. The pieces of construction equipment for construction activities would move on site, would remain for the duration of each construction phase, and would not add to the daily traffic volume in the project vicinity. Although there would be a relatively high single-event noise exposure potential causing intermittent noise nuisance (passing trucks at 50 ft would generate up to a maximum of 84 dBA), the effect on longer-term ambient noise levels would be small because the number of daily construction-related vehicle trips is small compared to existing daily traffic volume on Knott Street. The building construction phase and architectural coating phase are the only phases of construction for this project and would overlap, which would have an acoustical equivalent traffic volume of 90 passenger car equivalent based on the California Emissions Estimator Model (CalEEMod) (Version 2022.1) results contained in Attachment B of the *Air Quality and Greenhouse Gas Technical Memorandum for* *the 12821 Knott Street Project* (LSA 2025a). Knott Street and Garden Grove Boulevard would be used to access the project site, and the existing average daily traffic (ADT) volumes are 33,000 and 17,000, respectively, based on the 2024 Traffic Flow Map (OCTA 2024). Based on the information above, construction-related traffic would increase noise by up to 0.02 dBA. A noise level increase of less than 1 dBA would not be perceptible to the human ear. Therefore, short-term construction-related noise impacts associated with worker commutes and equipment transport to the project site would be less than significant. No mitigation measures are required.

The second type of short-term noise impact is related noise generated from construction activities. Construction is performed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. The proposed project anticipates only building construction and architectural coating phases of construction. These various sequential phases change the character of the noise generated on a project site. Therefore, the noise levels vary 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 the L_{max} recommended for noise impact assessments for typical construction equipment included in the Federal Highway Administration (FHWA) *Highway Construction Noise Handbook* (2006), based on a distance of 50 ft between the equipment and a noise receptor.

Table I lists the anticipated construction equipment for each construction phase based on the CalEEMod (Version 2022.1) results contained in Attachment B of the *Air Quality and Greenhouse Gas Technical Memorandum for the 12821 Knott Street Project* (LSA 2025a). Table I shows the combined noise level at 50 ft from all of the equipment in each phase and the L_{eq} noise level for each equipment type at 50 ft based on the quantity, reference instantaneous maximum (L_{max}) noise level at 50 ft, and acoustical usage factor. Although the construction of the proposed project is primarily inside the existing warehouse building, the anticipated construction equipment would operate at the exterior of existing warehouse building at the west side of the project site near the truck loading dock. As shown in Table I, construction noise levels would reach up to 85.1 L_{eq} at a distance of 50 ft.

The closest residential property line is approximately 100 ft from where construction equipment would operate near the existing warehouse building and may be subject to short-term construction noise reaching 79.1 dBA L_{eq} generated by construction activities in the project area. Construction noise is temporary and would stop once project construction is completed. Project construction activities shall be limited to between the hours of 7:00 a.m. and 10:00 p.m. as specified in Section 8.47.060(D) of the City's Municipal Code and would ensure construction-related noise would not be generated during the more sensitive nighttime hours. Furthermore, construction-related noise levels would be below the FTA noise level standard of 80 dBA L_{eq} for residential uses. Therefore, noise levels generated from project construction would be less than significant. No mitigation measures are required.

Table H: Typical Construction Equipment Noise Levels

Equipment Description	Acoustical Usage Factor (%)[1]	Maximum Noise Level (L_{max}) at 50 ft[2]
Backhoes	40	80
Compactor (ground)	20	80
Compressor (air)	40	80
Concrete Mixer Truck	40	85
Cranes	16	85
Dozers	40	85
Dump Trucks	40	84
Excavators	40	85
Flat Bed Trucks	40	84
Manlift (Forklift)	20	85
Front-end Loaders	40	80
Generator	50	82
Graders	40	85
Jackhammers	20	85
Pavement Scarifier	20	85
Paver	50	77
Pickup Truck	40	55
Pneumatic Tools	50	85
Pumps	50	77
Rock Drills	20	85
Rollers	20	85
Scrapers	40	85
Tractors	40	84
Welder/Torch	40	73

Source: Table 1, *FHWA Roadway Construction Noise Model User's Guide* (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
ft = foot/feet

Table I: Summary of Construction Phase, Equipment, and Noise Levels

Construction Phase	Construction Equipment	Quantity	Reference Noise Level at 50 ft (dBA L_{max})	Acoustical Usage Factor[1] (%)	Noise Level at 50 ft (dBA L_{eq})	Combined Noise Level at 50 ft (dBA L_{eq})
Building Construction	Forklifts	2	85	20	81.0	85.1
	Backhoe	2	80	40	79.0	
	Front-End Loaders	3	80	40	80.8	
Architectural Coating	Air Compressors	1	80	40	76.0	76.0

Source: Compiled by LSA (2025).
[1] The acoustical usage factor is the percentage of time during a construction noise operation that a piece of construction equipment operates at full power.
dBA = A-weighted decibel(s)
L_{eq} = equivalent continuous sound level
ft = foot/feet
L_{max} = maximum instantaneous noise level

Short-Term Construction Vibration Impacts

This construction vibration impact analysis discusses the level of human annoyance using vibration levels in RMS (VdB) and assesses the potential for building damage using vibration levels in PPV (in/sec). Vibration levels calculated in RMS velocity are best for characterizing human response to building vibration, whereas vibration levels in PPV are best for characterizing damage potential.

Table J shows the reference vibration levels at a distance of 25 ft for each type of standard construction equipment from the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018). Project construction is expected to require the use of loaded trucks, which would generate ground-borne vibration levels of up to 0.076 PPV (in/sec) when measured at 25 ft. Jackhammers, bulldozers, and other vibration-generating construction equipment would not be used because the proposed project primarily consists of tenant improvements as described above.

Table J: Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV (in/sec) at 25 ft
Pile Driver (Impact), Typical	0.644
Pile Driver (Sonic), Typical	0.170
Vibratory Roller	0.210
Hoe Ram	0.089
Large Bulldozer	0.089
Caisson Drilling	0.089
Loaded Trucks[1]	**0.076**
Jackhammer	0.035
Small Bulldozer	0.003

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).

[1] The equipment shown in **bold** is expected to be used on site.

ft = foot/feet
in/sec = inches per second
FTA = Federal Transit Administration
PPV = peak particle velocity

The distance to the nearest buildings for vibration impact analysis is measured between the nearest off-site buildings and the project boundary (assuming the construction equipment would be used at or near the project boundary) because vibration impacts normally occur within the buildings.

The formula for vibration transmission is provided below:

$$L_v dB\ (D) = L_v dB\ (25\ ft) - 30\ Log\ (D/25)$$

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

Table K lists the projected vibration levels from loaded trucks on the project site to the nearest buildings in the project vicinity. Areas where loaded trucks would operate on the project site include the truck loading dock area west of the warehouse building and on-site access routes north and south of the warehouse building leading to the loading dock area. As shown in Table K, the closest buildings from where loaded trucks would operate on the project site are residential buildings approximately 80 ft away and would experience a vibration level of up to 71 VdB. This vibration level would not have the potential to result in community annoyance because vibration levels would not exceed the FTA community annoyance threshold of 78 VdB for daytime residences. Other building structures that surround the project site would experience lower vibration levels because they are farther away.

Table K: Potential Construction Vibration Annoyance

Land Use	Direction	Equipment/ Activity	Reference Vibration Level (VdB) at 25 ft	Distance to Structure (ft)[1]	Vibration Level (VdB)
Commercial	North	Loaded trucks	86	125	65
Industrial	East	Loaded trucks	86	170	61
Office	Southeast	Loaded trucks	86	145	63
Residential	West	Loaded trucks	86	80	71

Source: Compiled by LSA (2025).
Note: The FTA threshold perception is 65 VdB.
[1] Distance from where loaded trucks operate on the project site to the building structure.
ft = foot/feet
VdB = vibration velocity decibel(s)
FTA = Federal Transit Administration

Table L lists the projected vibration levels from loaded trucks on the project site at the project construction boundary to the nearest buildings in the project vicinity. As shown in Table L, the closest buildings from the property line are residential buildings approximately 15 ft away and would experience a vibration level of up to 0.164 PPV (in/sec). This vibration level would not have the potential to result in building damage because these residential buildings are conservatively assumed to have been built using nonengineered timber and/or masonry construction, and the anticipated project-related vibration levels would not exceed the FTA vibration damage threshold of 0.20 PPV (in/sec). Other building structures that surround the project site would experience lower vibration levels because they are farther away and are also conservatively assumed to have been built using nonengineered timber and/or masonry construction. Therefore, construction vibration impacts during project construction would be less than significant. No mitigation measures are required.

Table L: Potential Construction Vibration Damage

Land Use	Direction	Equipment/Activity	Reference Vibration Level at 25 ft	Distance to Structure (ft)[1]	Vibration Level
			PPV (in/sec)		PPV (in/sec)
Commercial	North	Loaded trucks	0.076	100	0.010
Industrial	East	Loaded trucks	0.076	130	0.006
Office	Southeast	Loaded trucks	0.076	100	0.010
Residential	West	Loaded trucks	0.076	15	0.164

Source: Compiled by LSA (2025).
Note: The FTA-recommended building damage threshold is 0.20 PPV (in/sec) at the receiving nonengineered timber and masonry building.
[1] Distance from the project construction boundary to the building structure.
ft = foot/feet
in/sec = inches per second
FTA = Federal Transit Administration
PPV = peak particle velocity

Long-Term Traffic Noise Impacts

The project is estimated to generate a net new ADT volume of 112, which would consist of automobiles from the additional office space based on the *Transportation Memorandum for the 12821 Knott Street Project* (LSA 2025b). The existing ADT volumes of 33,000 and 17,000 along Knott Street and Garden Grove Boulevard in the project area, respectively, were obtained from the 2024 Traffic Flow Map (OCTA 2024). It takes a doubling of traffic to increase traffic noise levels by 3 dBA. Based on the information above, project-related traffic on Knott Street and Garden Grove Boulevard would increase traffic noise levels by up to 0.03 dBA. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, traffic noise impacts from project-related traffic on off-site sensitive receptors would be less than significant. No mitigation measures are required.

Long-Term Stationary Source Noise Impacts

Operations of the proposed project would include truck delivery and truck loading and unloading activities, parking lot activities; and heating, ventilation, and air conditioning (HVAC) equipment. The following provides a detailed noise analysis, discussion of each stationary noise source, and the potential operational noise increase.

Truck Delivery and Truck Loading and Unloading Activities

Truck delivery and truck unloading activities would occur at the west side of the existing warehouse building during the hours of operation from 8:00 a.m. to 6:00 p.m., which is same as the existing condition. Also, the number of trucks and the intensity of truck unloading activities would remain the same because the existing warehouse capacity would remain the same as the existing warehouse under the proposed project. Given this, noise generated from truck delivery and truck unloading activities would be similar to the existing condition, and a project-related noise increase is not anticipated. Therefore, noise generated from truck delivery and truck unloading activities would be less than significant. No mitigation measures are required.

Parking Activities

The proposed project would not modify the existing parking lot because the existing 198 parking spaces is more than the required parking spaces under the existing and proposed warehouse project. The required number of parking spaces under the existing and proposed project is 173 and 183 parking spaces, respectively. Based on the increase of required parking spaces, the increase in parking activities and associated noise would be minimal because the increase in parking activities would not double. It takes a doubling of sound energy to increase noise levels by 3 dBA. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, noise generated from parking activities on the project site would be less than significant. No mitigation measures are required.

Heating, Ventilation, and Air Conditioning Noise

The existing warehouse building has approximately 12 rooftop HVAC units based on an aerial photo survey. The proposed project may include additional rooftop HVAC equipment for the proposed mezzanine office space. The additional HVAC equipment would operate during the hours of operation from 8:00 a.m. to 6:00 p.m. along with the existing rooftop HVAC equipment. Also, it is assumed that the number of additional rooftop HVAC units, if any, would be minimal. It takes a doubling of sound energy to increase noise levels by 3 dBA. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, noise generated from the additional HVAC equipment would be less than significant. No mitigation measures are required.

Long-Term Vibration Impacts

The proposed project would not generate vibration. In addition, vibration levels generated from project-related traffic on the roadways (Knott Street and Garden Grove Boulevard) leading to the project site are unusual for on-road vehicles because the rubber tires and suspension systems of on-road vehicles provide vibration isolation. Vibration generated from operations of the project would be minimal to negligible. Therefore, vibration impacts from project-related operations would be less than significant. No mitigation measures are required.

REGULATORY COMPLIANCE MEASURES

Compliance with the following measure would ensure that construction noise would be generated only during allowable times:

- The construction contractor shall limit construction activities to between the hours of 7:00 a.m. and 10:00 p.m. to avoid the City's prohibited hours of construction specified in Section 8.47.060(D) of the City's Municipal Code (City of Garden Grove 2024).

Attachments: A: References
B: Figures

ATTACHMENT A

REFERENCES

Airport Land Use Commission (ALUC). 2017. *Airport Environs Land Use Plan for Joint Forces Training Base Los Alamitos*. August 17. Website: https://files.ocair.com/media/2021-02/JFTB,Los Alamitos-AELUP2017.pdf (accessed January 2025).

City of Garden Grove. 2008. General Plan Noise Element. May. Website: https://ggcity.org/internet/pdf/planning/chapter07_noiseelement.pdf (accessed January 2025).

_____. 2024. Municipal Code. September 10.

Federal Highway Administration (FHWA). 2006. *Highway Construction Noise Handbook*. Roadway Construction Noise Model, FHWA-HEP-06-015. DOT-VNTSC-FHWA-06-02. NTIS No. PB2006-109012. August.

Federal Transit Administration (FTA). 2018. *Transit Noise and Vibration Impact Assessment Manual*. FTA Report No. 0123. September. Website: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf (accessed January 2025).

Harris, Cyril M., Editor. 1991. *Handbook of Acoustical Measurements and Noise Control*. Third Edition.

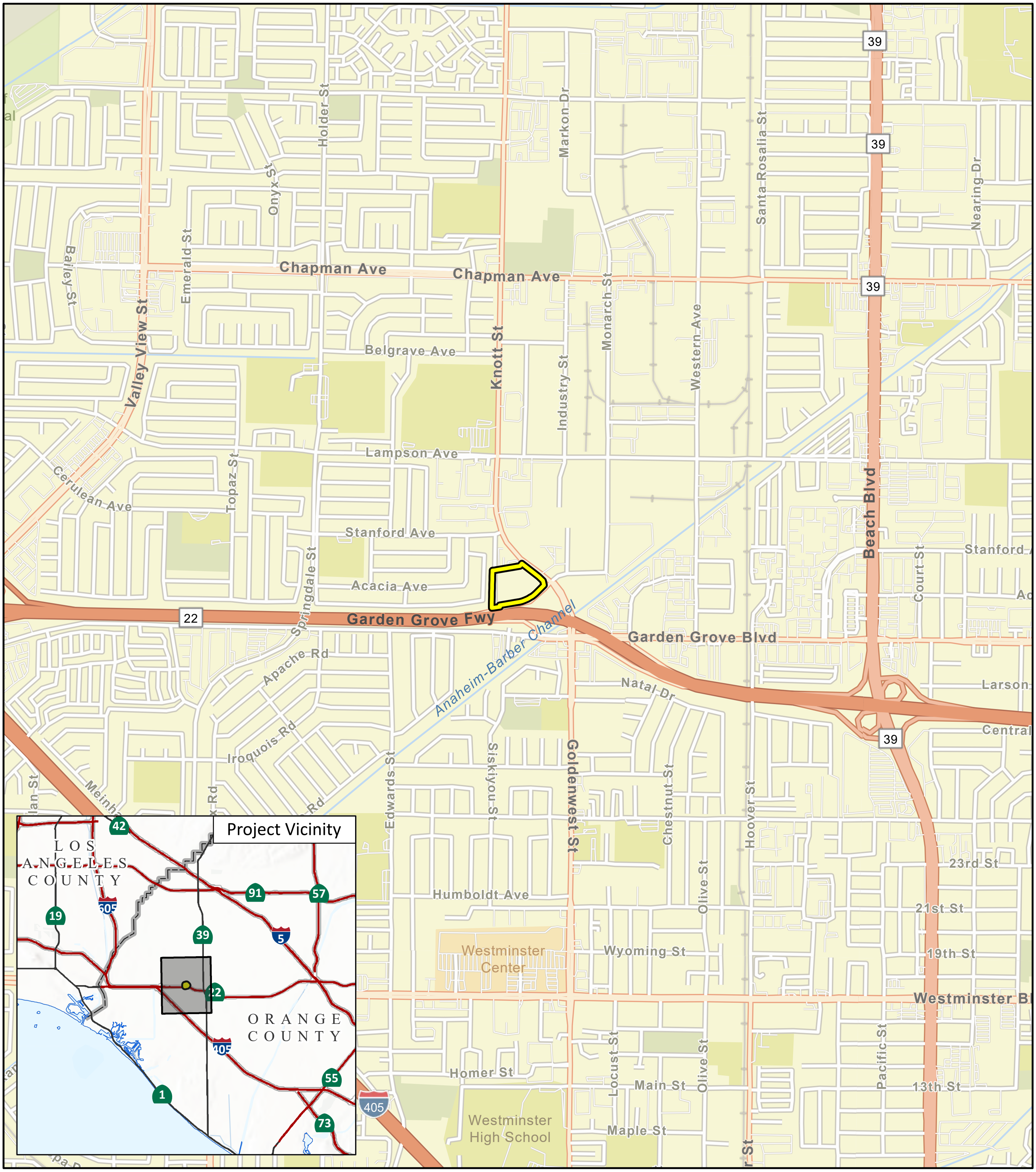
LSA Associates, Inc. (LSA). 2025a. *Air Quality and Greenhouse Gas Technical Memorandum for the 12821 Knott Street Project*. January 31.

_____. 2025b. *Transportation Memorandum for the 12821 Knott Street Project*. January 20.

Orange County Transportation Authority (OCTA). 2024. *2024 Traffic Flow Map*. September. Website: https://www.octa.net/pdf/TrafficFlow-ADT-2024.pdf (accessed January 2025).

ATTACHMENT B

FIGURES



Project Site

FIGURE 1

LSA

N

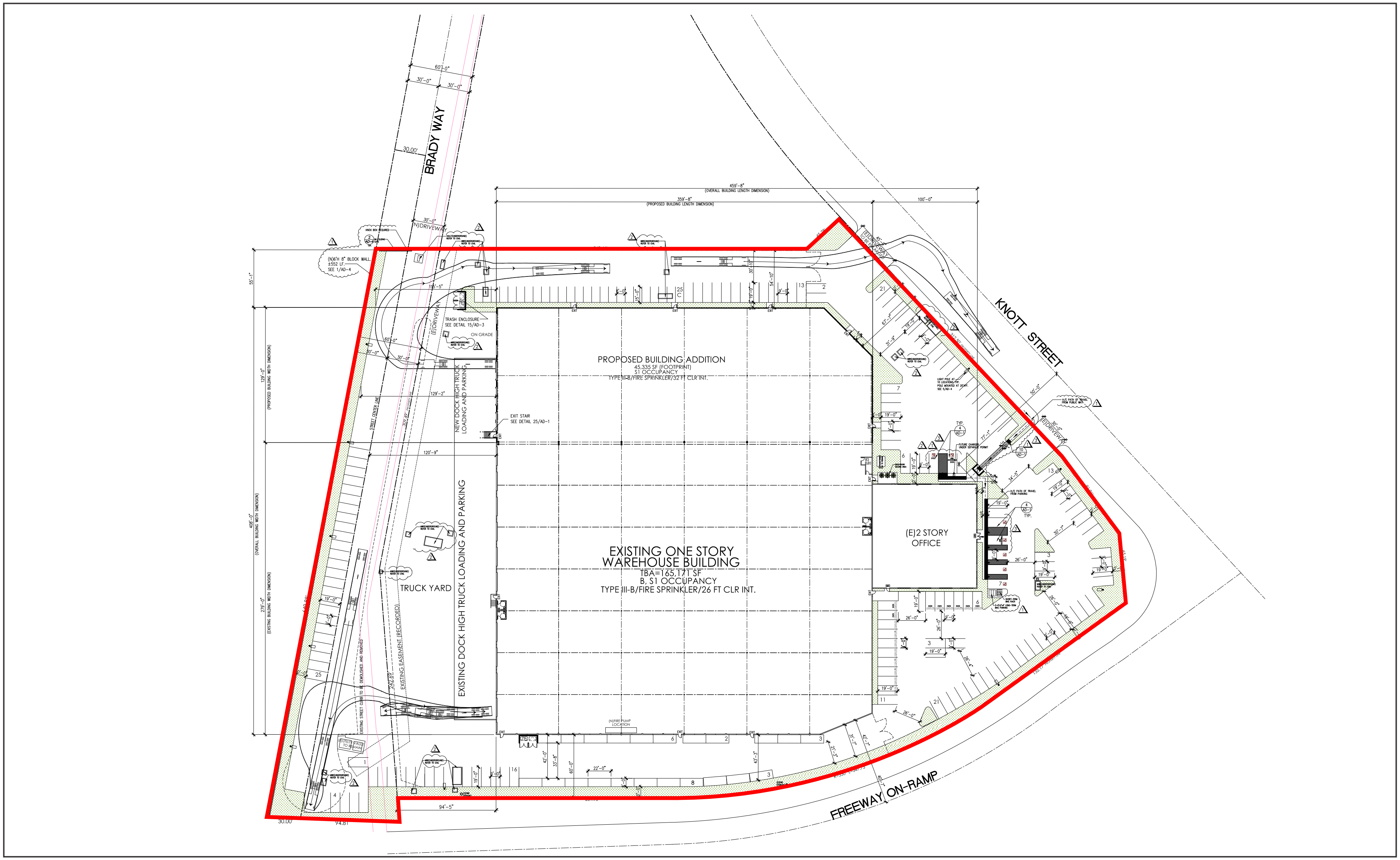
0 1000 2000
FEET

SOURCE: Esri Street Map 2024

12821 Knott Street Project

Project Location

I:\2024\20241951\GIS\Pro\12821 Knott Street Project\12821 Knott Street Project.aprx (10/17/2024)



LEGEND

Project Site

FIGURE 2

0 60 120
FEET

SOURCE: JGC Architecture

12821 Knott Street Project

Site Plan