Appendix K –

Noise Assessment – Sanctuary Residential Subdivision

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TECHNICAL MEMORANDUM

Date:	March 9, 2023
To:	Candice Magnus, Dudek
From:	Jonathan V. Leech, INCE, Dudek
Subject:	Revised Noise Assessment – Sanctuary Residential Subdivision, Encinitas
Date:	February 28, 2023
Attachments:	A – Ambient Noise Measurement Data
	B – Construction Noise Modeling Files
	C – On-Site Operational Noise Modeling Files
	D – Traffic Noise Modeling Files

This report contains Dudek's assessment of the noise environment at the proposed Sanctuary Subdivision project located in the City of Encinitas (City). Dudek evaluated noise from project construction, project-added trips on area roadways, and stationary mechanical equipment (heating, ventilation, and cooling [HVAC] units). The analysis also includes predicted exterior noise exposure at the new residential lots from roadway traffic, for comparison to Noise Element policy limits.

1. Background

1.1 Project Setting

The proposed Sanctuary Subdivision project is located west of Rancho Santa Fe Road, between Ranch View Terrace on the north and Woodwind Drive on the south, in the City of Encinitas. Figure 1 (at the end of this report) illustrates the regional and local vicinity of the project site. The project proposes to construct 9 single-family detached residences on individual lots, with the balance of the parcel maintained as open space. Figure 2 (at the end of this report) provides the site plan. Surrounding uses include single-family residences immediately to the north, east, and south, and within approximately 200 feet west of the western boundary of the project site.

1.2 Acoustical Fundamentals

Although the terms may be used interchangeably in the right context, "sound" is defined as any gas or fluid pressure variation detected by the human ear, and "noise" is unwanted sound. The preferred unit for measuring sound is the decibel (dB), which by way of expressing the ratio of sound pressures to a reference value logarithmically enables a wide range of audible sound to be evaluated and discussed conveniently. On the low end of this range, zero dB is not the absence of sound energy, but instead corresponds approximately to the threshold of average healthy human hearing; and, on the upper end, 120–140 dB corresponds to an average person's threshold of pain.

The human ear is not equally responsive to all frequencies of the audible sound spectrum. An electronic filter is normally used when taking noise measurements that de-emphasizes certain frequencies in a manner that mimics the human ear's response to sound; this method is referred to as A-weighting. Sound levels expressed under the A-weighted system are sometimes designated dBA. All sound levels discussed in this report are A-weighted.

The equivalent continuous sound level (L_{eq}) is a single dB value which, if held constant during the specified time period, would represent the same total acoustical energy of a fluctuating noise level over that same time period; this is also known as the "average" sound level. L_{eq} values are commonly expressed for periods of one hour, but longer or shorter time periods may be specified. Another descriptor is maximum sound level (L_{max}), which is the greatest sound level measured during a designated time interval or event. The minimum sound level (L_{min}) is the lowest measured level and often called the floor of a measurement period.

Unlike the L_{eq}, L_{max}, and L_{min} metrics, L_{dn} and CNEL descriptors always represent 24-hour periods and differ from a 24-hour L_{eq} value because they apply a time-weighted factor designed to emphasize noise events that occur during the non-daytime hours (when speech and sleep disturbance is of more concern). *Time weighted* refers to the fact that L_{dn} and CNEL penalize noise that occurs during certain sensitive periods. In the case of CNEL, noise occurring during the daytime (7:00 a.m. to 7:00 p.m.) receives no penalty. Noise during the evening (7:00 p.m. to 10:00 p.m.) is penalized by adding 5 dB to the actual levels, and nighttime (10:00 p.m. to 7:00 a.m.) noise is penalized by adding 10 dB to the actual levels. L_{dn} differs from CNEL in that the daytime period is longer (defined instead as 7:00 a.m. to 10:00 p.m.), thus eliminating the dB adjustment for the evening period. L_{dn} and CNEL are the predominant criteria used to measure roadway noise affecting residential receptors. These two metrics generally differ from one another by no more than 0.5–1 dB and are often considered or actually defined as being essentially equivalent by many jurisdictions.

1.2.1 Exterior Noise Attenuation

Noise sources are classified in two forms: (1) point sources, such as stationary equipment or a group of construction vehicles and equipment working within a spatially limited area at a given time; and (2) line sources, such as a roadway with a large number of pass-by sources (motor vehicles). Sound generated by a point source typically diminishes (attenuates) at a rate of 6.0 dBA for each doubling of distance from the source to the receptor at acoustically "hard" sites and at a rate of 7.5 dBA for each doubling of distance from source to receptor at acoustically "soft" sites (Caltrans 2009). Sound generated by a line source (i.e., a roadway) typically attenuates at a rate of 3 dBA and 4.5 dBA per doubling distance, for hard and soft sites, respectively (Caltrans 2009). Sound levels can also be attenuated by human-made or natural barriers. For the purpose of a sound attenuation discussion, a hard or reflective site does not provide any excess ground-effect attenuation and is characteristic of asphalt or concrete ground surfaces, as well as very hard-packed soils. An acoustically soft or absorptive site is characteristic of unpaved loose soil or vegetated ground.

With respect to examples of this distance-attenuation relationship for exterior noise, a 65-dBA noise level measured at 25 feet from a roadway centerline with hard-packed shoulder would diminish to 62 dBA at 50 feet from the centerline, and to 59 dBA at 100 feet from the centerline. This scenario is addressed by the line source attenuation for a hard site (3 dBA with each doubling of the distance). For the scenario where soft-site conditions exist between a point source (such as construction equipment) and receptor, represented by open ground between the construction zone and receiver, an attenuation rate of 7.5 dBA per doubling of distance would apply; the construction equipment noise measured as a 85 dBA at 50 feet from the construction equipment would diminish to 77.5 dBA at 100 feet from the source and to 70 dBA at 200 feet from the source, where soft ground with or without vegetation exists between the sound source and the receptor location.

1.3. Vibration Characteristics

Per the Caltrans Transportation and Construction Vibration Guidance Manual (2020), vibration is the periodic oscillation of a medium or object. The rumbling sound caused by the vibration of room surfaces is called structure-borne noise. Sources of ground-borne vibrations include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) or human-made causes (e.g., explosions, machinery, traffic, trains, construction equipment).

Peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal and is expressed in inches/second (in/sec). PPV is most frequently used to describe vibration impacts to buildings but can also be used to quantify vibration annoyance potential for humans. Caltrans has established a human annoyance vibration threshold of 0.24 in/sec PPV (distinctly perceptible level) for construction-related vibration levels (Caltrans 2020). The Caltrans threshold for potential damage to newer residential structures is 0.5 in/sec PPV (Caltrans 2020).

1.4 Noise Regulation in Encinitas

The City of Encinitas has established noise guidelines in its General Plan Noise Element Update Current Conditions Report (City of Encinitas 2010). These guidelines identify compatible exterior noise levels for various land use types. The maximum acceptable exterior noise level for single-family residences is an L_{dn} of 60 dBA. This noise level criterion should be applied where outdoor use is a major consideration (e.g., backyards of single-family residences). The 60 dB criterion serves as a screening threshold, anticipated exterior noise exposure above this level triggers a requirement for a site-specific acoustic evaluation to be performed. The maximum conditionally acceptable noise level for proposed single-family residential developments is 70 dBA L_{dn}., where an acoustic evaluation has been performed and it is demonstrated that exterior noise would not exceed this level. Interior noise levels are not to exceed an L_{dn} of 45 dBA. All sound levels discussed in this report are A-weighted.

The City's noise ordinance limits construction activities to the hours of 7 a.m. to 7 p.m. Mondays through Saturdays, and prohibits construction on Sundays and on legal holidays. Also, construction noise is limited to 75 dBA maximum for no more than 8 hours during any 24-hour period at or within the property lines of any property used for residential purposes (City of Encinitas 2016).

2. Baseline Sound Level Survey

On February 7, 2023, Dudek conducted short-term (e.g., less than one hour in duration) sound pressure level measurements along two roadways adjacent to several residential land uses in the Project vicinity, in order to characterize the existing exterior ambient noise levels at these residences that could be impacted by Project on-site noise sources. The measurement locations are depicted in Figure 3 (at the end of this report). The closest residences to the north of the project site are represented by ST1; the closest residences to the south of the project site are represented by ST2. Residences to the east of the project site have frontage along Rancho Santa Fe Road; traffic noise modeling for Rancho Santa Fe Road was conducted to determine ambient noise levels at these residences. Along the eastern project site boundary.

The measurements were conducted using a SoftdB brand Piccolo II Type 2 Sound Level Meter. Type 2 sound-level meters have precision accuracy that is suitable for all types of environmental noise evaluation. The sound-level meter was calibrated before and after use in the field for these measurements. The sound level meter was configured to record data for 10-second intervals; total duration of measurements at each location ranged from approximately 5 to 10 minutes. Sound level metrics including L_{eq}. L_{max}, L_{min}, were recorded for each 10-second period. Data logs for each of the two measurement locations are included in Attachment A. Table 1 presents the baseline sound level survey results as the average (L_{eq}) across the duration of the measurement at each location for ST1 through ST2. Refer to Attachment A for the complete data logs from the sound level meter over the measurement period.

Table 1: Measured Sound Levels in Project Vicinity

Site	Average Noise Level Across Measure Duration ($dBA\ L_{eq}$)
Measure Location ST1	41
Measure Location ST2	46

The roadways along which ST1 and ST2 were located are residential collector streets serving a small number of residences. As such, measured sound levels were relatively low, compared to a typical urban setting.

3. Project Description

The proposed project consists of nine single-family residences each situated on an individual lot, and the balance of the parcel maintained as open space. A new private driveway would connect to Rancho Santa Fe Road to provide access to each of the new residential lots.

Development of the project would include site preparation and grading to create the driveway alignment and building pads, construction of the homes, paving of the driveway, and installation of landscaping. Once constructed, noise generating components of the project would be limited to exterior components of heating ventilation and cooling (HVAC) systems for each residence, and roadway traffic increases from project-related trips.

4. Construction Noise

One of the most extensive and widely used databases for sound levels from motorized or powered equipment is the FHWA RCNM. While the focus of data compilation was for equipment that would typically be employed for the construction of transportation facilities, the list is comprehensive enough to be useful in assessing sound levels for nearly every activity for which powered equipment is used. Table 2 provides an excerpt from RCNM of the sound levels generated by various powered equipment that could be associated with construction of the project. Note that the equipment noise levels presented in Table 2 are maximum noise levels. Usually, construction equipment operates in alternating cycles of full power and low power, producing average noise levels over time that are less than the maximum noise level. The average sound level of construction activity also depends on the amount of time that the equipment operates and the intensity of construction activities during that time.

Table 2. Selected Powered Equipment Noise Emission Levels from RCNM

Equipment	Maximum Sound Level (dBA L_{max}) – 50 feet from Source
Air Compressor	81
Backhoe	80
Compactor	82
Concrete Mixer	85
Crane, Mobile	83
Dozer	85
Generator	81
Grader	85
Loader	85
Paver	89
Pneumatic Tool	85
Pump	76
Roller	74
Saw	76
Scraper	89
Truck	88

Source: FHWA 2006a, 2006b.
Notes: dBA = decibel (A-weighted).

Noise emissions from the construction phase of the Project were estimated based upon default construction scenario information provided by CalEEMod for the type and size of proposed development, and included phasing, equipment mix, and vehicle trips. The construction equipment mixes used for estimating the Project-generated construction noise emissions are included in Attachment B.

A Microsoft Excel–based noise prediction model emulating and using reference data from the FHWA RCNM was used to estimate construction noise levels at the nearest noise-sensitive land uses (i.e., residences) in each direction from the project site, based upon the distance between the closest project construction boundary and these residences. Aggregate noise emission from project construction activities, broken down by sequential phase of construction, was predicted for the worst-case construction activity occurring along the closest construction boundary to the off-site closest residences. Dudek compared predicted construction noise levels to the adopted Encinitas construction noise exposure standard and to measured ambient noise levels.

4.1 Construction Equipment Inventory

The California Air Resources Board CalEEMod (California Emissions Evaluation Model) was used to identify the construction equipment anticipated for development of the Project, including earthwork, building construction, and paving activities. The equipment list is based upon the detailed project description; CalEEMod (Version: CalEEMod.2016.3.1) identified the following anticipated equipment for each phase of the Project construction.

Table 3. Construction Equipment Per Phase

Construction Activity	Site Preparation
Equipment Needed	Dozer Backhoe Loader
Construction Activity	**Grading**
Equipment Needed	Dozer Front End Loader Grader Excavator
Construction Activity	**Building Construction**
Equipment Needed	Forklift Crane Welder Backhoe Generator
Construction Activity	**Paving**
Equipment Needed	Paver Paving Equipment Backhoe Roller Concrete Mixer Truck
Construction Activity	**Architectural Coating**
Equipment Needed	Air Compressor

4.2 Construction Noise Assessment

With the noise sources identified above, a noise analysis was performed with a Microsoft Excel–based noise prediction model emulating and using reference data from the FHWA RCNM. Input variables consist of the receiver / land use types, the equipment type (i.e., backhoe, crane, truck, etc.), the number of equipment pieces, the duty cycle for each piece of equipment (i.e., percentage of each hour the equipment typically works), and the distance from the sensitive noise. Refer to Attachment B for the inputs used in the RCNM-based model, as well as results.

Noise-sensitive land uses in the vicinity of the Project include residences on properties to the north, west, south, and east of the project site. The closest off-site residence is located approximately 55 feet north from the closest boundary of a future construction zone for one of the residential lots; the closest homes to the east are approximately 65 feet from the closest future construction zone boundary; the homes to the south are approximately 75 feet from the closest future construction zone boundary; and homes to the west. are approximately 590 feet from the closest future construction zone boundary. Using the provided construction information and the distance identified for the closest receivers, the RCNM-based construction noise model was used to predict noise from on-site construction activities. The construction noise was modeled at each of the representative distances to determine construction noise exposure for the existing adjacent homes on each side of the project site. The results are summarized in Table 4 (see Attachment B for complete results).

In reviewing Table 4, maximum construction noise levels would exceed the allowable limit of 75 dBA L_{max} at the closest residences to the north, east, and south of the project site, resulting in a **potentially significant short-term construction noise impact.** As such, a temporary sound wall would need to be constructed along the north, east, and south sides of the project site for the duration of construction activities. Homes west of the project would not experience construction noise levels exceeding the standard, but to avoid extension of the temporary soundwall into proposed open space areas, the soundwall should also follow the western edge of the development envelop. Refer to the Mitigation Section below for mitigation language.

Table 4. Construction Noise Levels Per Phase at Closest Residences

Task/Activity	Nearest Residence North (55 Feet)	Nearest Residence East (65 Feet)	Nearest Residence South (75 Feet)	Nearest Residence West (590 Feet)
	L_{max}	L_{max}	L_{max}	L_{max}
Site Preparation	88	86	85	62
Grading	88	87	85	62
Building Construction	89	87	86	63
Architectural Coating	77	76	74	52
Paving	88	87	85	62
Highest Noise Level All Phases	**89**	**87**	**86**	**63**

Table 4 does not display hourly average construction noise levels at nearby residences, as the Encinitas ordinance is based upon L_{max}. However, hourly average noise levels were also modeled. As illustrated in the construction noise worksheets in Attachment B, unmitigated hourly average ($L_{EQ\ 1\ Hour}$) construction noise levels would range from 70 to 84 dBA. This average noise level would be up to 38 dBA above the documented daytime level at the closest residences. Thus, construction noise would represent a substantial increase over ambient, and would make use of exterior living areas at adjacent residential lots undesirable. Compared to existing ambient noise levels, construction noise would be a **potentially significant short-term construction noise impact.** The same temporary soundwall mitigation would apply to ambient noise increases during construction. With typical outdoor to indoor attenuation of 25 dBA for standard construction residential structures, interior noise levels at the closest residence during construction would peak at approximately 60 dBA, which should not interfere with conversation or other daytime activities indoors.

4.3 Mitigation – Construction Noise Levels

Construction noise is predicted to exceed the allowable limit of 75 dBA L_{max} at the closest residences to the north, east, and west of the project site. The following mitigation measure is required to address this significant impact.

MM-NOI-1 A temporary soundwall shall be erected prior to the commencement of site preparation activities and maintained throughout construction of the project, along the northern, eastern, southern, and western development envelop boundaries, to the extents indicated in Figure 4. A licensed surveyor or registered civil engineer shall ensure the design of the wall installation such that it does not encroach into the proposed open space areas. The soundwall shall be a minimum of 10 feet in height, measured from the ground elevation on the project side of the soundwall. The soundwall shall be of solid material with a minimum STC rating of 25.

4.4 Mitigated Construction Noise Levels

Table 5 presents the construction noise levels at the closest neighbors to the north, east, south and west with the required temporary soundwall in place. It should be noted that the soundwall along the west side of the development envelop is not required in order to mitigate construction noise levels at residences to the west, but rather would mitigate noise levels at residences along the northern and southern property boundaries that are close to future construction zone boundaries.. As illustrated in Table 5, post mitigation sound levels would comply with the Encinitas construction noise limit of 75 dBA L_{max}.

Table 5. Mitigated Construction Noise Levels at Closest Residences

Task/Activity	Nearest Residence North (55 Feet)	Nearest Residence East (65 Feet)	Nearest Residence South (75 Feet)	Nearest Residence West (590 Feet)
	L_{max}	L_{max}	L_{max}	L_{max}
Site Preparation	74	73	71	58
Grading	74	73	71	58
Building Construction	75	73	72	59
Architectural Coating	63	62	60	43
Paving	74	73	71	58
Highest Noise Level All Phases	**75**	**73**	**72**	**58**

Table 5 does not display hourly average construction noise levels at nearby residences; However, hourly average noise levels were also modeled for the mitigate scenario. As illustrated in the construction noise worksheets in Attachment B, hourly average ($L_{EQ\ 1\ Hour}$) construction noise levels would range from 56 to 70 dBA. This average noise level would be up to 25 dBA above the documented daytime level at the closest residences, which would be very clearly noticeable and could lead to annoyance. Nonetheless, the mitigated average noise levels in exterior living areas at adjacent residential lots would not be harmful, nor present a deterrent to use of yard areas. With typical outdoor to indoor attenuation of 25 dBA for standard construction residential structures, mitigated interior noise levels at the closest residence during construction would peak at approximately 45 dBA, which should not interfere with conversation or other daytime activities indoors.

5. Operational Noise Prediction

5.1 Methodology

Prediction of project on-site operation noise (i.e., HVAC equipment use) at neighboring receiver properties involved creation of a sound propagation model using a Dudek proprietary Excel-based software tool. Dudek NoisePro is used for calculation, presentation, assessment, and prediction of environmental noise. Estimated sound emission from one assumed HVAC units per residential lot were entered into the Dudek NoisePro model. The outdoor noise propagation formulas in NoisePro follow the International Organization of Standardization (ISO) Standard 9613-2, “Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation” (ISO 1996).

For the HVAC units, Dudek used a Carrier Infinity 19VS air conditioner with 6-ton capacity. The air conditioner element of the HVAC system is the only exterior component that would generate sound levels outdoors. The Carrier

Infinity 19VS 6-ton version has a sound power rating of 72 L_W which equals a sound pressure level of 64 dBA at 1 meter (3.28 feet) from the unit.

The air conditioning units would not be anticipated to operate continuously, but rather would have cycles of operation separated by periods of no operation. In practice, at any given time, some of the equipment would be in operation mode, while other equipment would be in rest mode. Nonetheless, the model was constructed to address a worst-case scenario where all the equipment is in continuous operation for a full day (for comparison to the Encinitas noise element limits). Five receiver points, representing the closest residences on the north, east, and south of the project site were also entered into the NoisePro model space. Figure 5 indicates the location of these receiver points (designated R1 – R5).

Calculation parameters that establish how the NoisePro model predicts combined noise level from these above-listed Project sources include as follows:

- Sound propagation per International Organization of Standardization (ISO) 9613-2 (ISO 1996);
- Default ground acoustical absorption coefficient = 0.5 (on a scale of 0 = reflective, 1 = absorptive); and.
- Zero order of reflection.

5.2 Operation Noise Assessment Results

Figure 5 depicts the modeled receiver locations for the closest adjacent land uses (R1, R2. R3, R4 and R5) in the NoisePro model space. The receiver points in the NoisePro space are intended to represent Project operational sound levels at these existing nearby residences for comparison to the Encinitas Noise Element limits. Table 6 presents the modeled operational noise level at the five receivers and compares these to the Noise Element exterior limit for residences of 60 dBA L_{dn}. Attachment C provides data inputs and results from the NoisePro model setup.

Table 6: Modeled Project Operation Sound Levels Compared to Noise Element Limits

Model Receiver	Modeled Project Operational Noise Level dBA ($L_{eq\ 1\ hour}$)	Modeled Project Operational Noise Level dBA L_{dn}	Noise Element Limit dBA L_{dn}
R1	35	44	60
R2	37	46	
R3	32	41	
R4	38	47	
R5	37	46	

Table Notes: [1] Ordinance limit based upon the more restrictive nighttime period, to account for potential Project operations at night.

The noise model results are also graphically represented on Figure 5, which provides noise contours extending outward from the proposed project to illustrate the hourly average ($L_{eq\ 1\ Hour}$) noise level from operation of the Project (i.e., the worst-case scenario with all the equipment in operation simultaneously). These hourly noise levels were assumed to occur around the clock, continuously, for calculation of the L_{dn} values displayed in Table 6. As illustrated in Table 6, project operational noise levels at the closest adjacent residences would range from 41 to 47 dBA L_{dn}

which would be well below the noise element limit of 60 dBA L_{dn}. With regard to the noise element limit, the project operational noise would result in a **less than significant noise impact.**

Table 7 compares the modeled project operational noise levels at the five receivers to ambient noise levels at these receivers. Ambient noise levels are based upon the ambient noise levels measured at ST1 (for residences to the north and east), and at ST2 (for residences to the south).

Table 7: Modeled Project Operation Sound Levels Compared to Ambient Noise Levels

Model Receiver	Modeled Project Operational Noise Level dBA (L_{max})	Ambient Noise Level ($L_{eq\ hour}$) [1]
R1	35	**46**
R2	37	**41**
R3	32	**41**
R4	38	**41**
R5	37	**41**

As indicated in Table 7, project operational noise levels would remain between 4 – 11 dBA L_{eq} below the ambient noise levels at adjacent residential properties. Adding the project noise levels to the ambient noise levels would not result in an increase of the ambient noise level values. Therefore, in comparing project operational noise to ambient noise levels, the project would have a **less than significant noise impact.**

6. Offsite Traffic Noise Prediction

6.1 Methodology

LOS Engineering quantified average daily trips (ADTs) on roadways to which the project would contribute trips, including scenarios for existing and existing plus project (Local Transportation Analysis, Sanctuary Residential 9 Homes, Ranch View Terrace, City of Encinitas, December 9, 2021). Roadway segments addressed in the LOS study included Rancho Santa Fe Road, north and south of 7th Street.

Dudek used a Microsoft Excel based model incorporating standard traffic noise assessment equations adapted from the FHWA noise prediction model to quantify traffic noise exposure levels along Santa Fe Road, to which the Project would contribute trips. Traffic noise levels were modeled based upon the calculated ADT for each included roadway segment and for each of the scenarios addressed in the LOS study.

6.2 Traffic Noise Assessment Results

Based upon ADT data provided by LOS, Dudek modelled traffic noise exposure along Rancho Santa Fe Road, the roadway to which the Project would principally add trips. The two studied traffic scenarios allow the direct determination of project-related traffic noise increases, by comparing “existing” to “existing plus project.” Table 8 presents the results of the traffic noise modeling, detailed information is provided in Attachment D.

Table 8: Modeled Project Contributions to Roadway Traffic Noise Levels

Roadway	Existing dBA CNEL	Existing + Project dBA CNEL	Project-Related Increase dBA CNEL	Significant?
Rancho Santa Fe, south of 7th	68.4	68.4	0	No
Rancho Santa Fe, north of 7th	66.0	66.1	0.1	No

Source: Attachment D

As indicated in Table 8, operation of the Project would involve trip generation that would result in traffic noise level increases on each roadway segment of no more than 0.1 dBA CNEL, which would not be discernible to the human ear. According to the traffic modeling results, some residences along Rancho Santa Fe Road may be exposed to exterior noise levels that exceed the Noise Element recommended maximum of 60 dBA L_{dn}. However, the project would increase traffic noise exposure by no more than 0.1 dBA, which is a less than discernible increase. The project would therefore not have a considerable contribution to traffic noise levels that could already exceed recommended levels at vicinity residences. Project traffic noise contributions would therefore be a **less than significant noise impact.**

6.3 Traffic Noise for Future Project Residents (Non-CEQA)

Using the project ADT predictions from the LOS report, Dudek also modeled the traffic noise level that would be associated with the project access driveway, since the homes would be at a large enough distance from Rancho Santa Fe Road (and protected by a row of existing homes along this roadway) that traffic noise from Rancho Santa Fe would not affect the noise levels at project future home sites. Based upon the 90 ADTs that would travel along the project driveway, traffic noise levels at the closest homes on the project site would be 44 dBA L_{dn} which would be well below the noise element limit of 60 dBA L_{dn}. Consequently future homes at the project site would experience traffic noise exposure levels that are easily compliant with the noise element standard.

7. Construction Vibration

7.1 Methodology

Construction activity can result in varying degrees of ground vibration at local receptors, depending on the equipment and methods used, distance to the affected structures, and soil type. Ground-borne vibration levels resulting from typical construction activities occurring within the Project site were estimated by data and methods published by Caltrans (2020). Ground vibration levels associated with various types of construction equipment are summarized in Table 9 (Caltrans 2020).

Table 9: Vibration Source Levels for Construction Equipment

Equipment	PPV (in/sec) at 25 feet
Small bulldozer	0.003
Loaded Trucks	0.076
Large bulldozer	0.089
Vibratory roller	0.21

Source: Caltrans 2020

Groundborne vibration attenuates rapidly, even over short distances. The attenuation of groundborne vibration as it propagates from source to receptor through intervening soils and rock strata can be estimated with expressions found in Caltrans guidance (Caltrans 2020). The following equation is used to calculate Peak Particle Velocity (PPV) at any distance of interest from the operating construction equipment

$$PPV_{rcvr} = PPV_{ref} * (25/D)^\wedge 1.5$$

In the above equation, PPV_{rcvr} is the predicted vibration velocity at the receiver position, PPV_{ref} is the reference value at 25 feet from the vibration source (as listed in Table 8), and D is the actual horizontal distance to the receiver.

7.2 Vibration Assessment Results

Using the vibration source level of construction equipment provided in Table 9, the distance to the closest sensitive receiver (i.e., residence), and the equation supplied in the Caltrans (2020) construction vibration assessment methodology (above), Dudek estimated the Project construction-related vibration impacts at the closest residence. The closest residence is at a distance of approximately 55 feet north from the closest future construction zone boundary. Table 10 presents the results of the construction vibration assessment for the closest residence.

Table 10: Construction Vibration Levels at Closest Residence

Equipment	PPV (in/sec) at Nearest Residence (55 Feet)	Significance Threhold PPV (in/sec)	Significant ?
Small bulldozer	0.0009	0.24	No
Loaded Trucks	0.023		No
Large bulldozer	0.027		No
Vibratory roller	0.064		No

As illustrated in Table 10, Project construction-related vibration levels at the residence closest to the Project would in all cases represent less than 30% of the significance threshold for human annoyance (0.24 PPV in/sec). The threshold for structural damage to typical residential structures is even higher (0.5 PPV in/sec). As such, Project construction would have no potential to cause structural damage to the closest residences, or to result in annoyance for the occupants of such residences. Project construction vibration impacts are therefore **less than significant.**

8. References

Caltrans. 2009. *Technical Noise Supplement.*

Caltrans.2013. *Traffic Noise Analysis Protocol.*

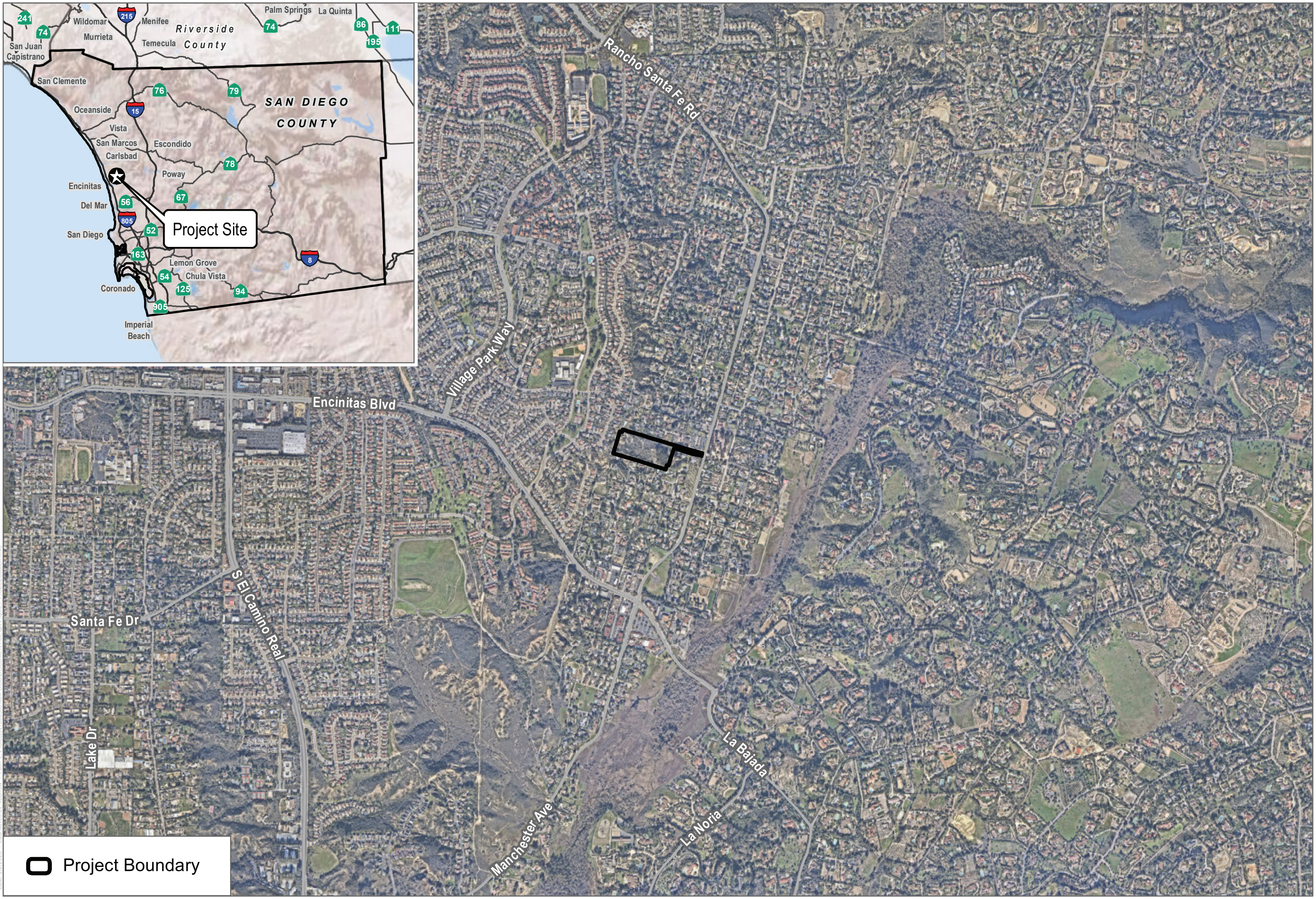
Caltrans. 2020. *Transportation and Construction Vibration Guidance Manual.*

Encinitas, City of. 2011. *General Plan Noise Element*.

FHWA. 2006. *Roadway Construction Noise Model*, Version 1.1

International Organization of Standardization (ISO). 1996. 9613-2: "Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation". December. Accessible at *https://www.iso.org/standard/20649.html*

LOS Engineering Inc. 2021. *Local Transportation Analysis, Sanctuary Residential 9 Homes, Ranch View Terrace, City of Encinitas,* December 9, 2021



SOURCE: SanGIS 2019

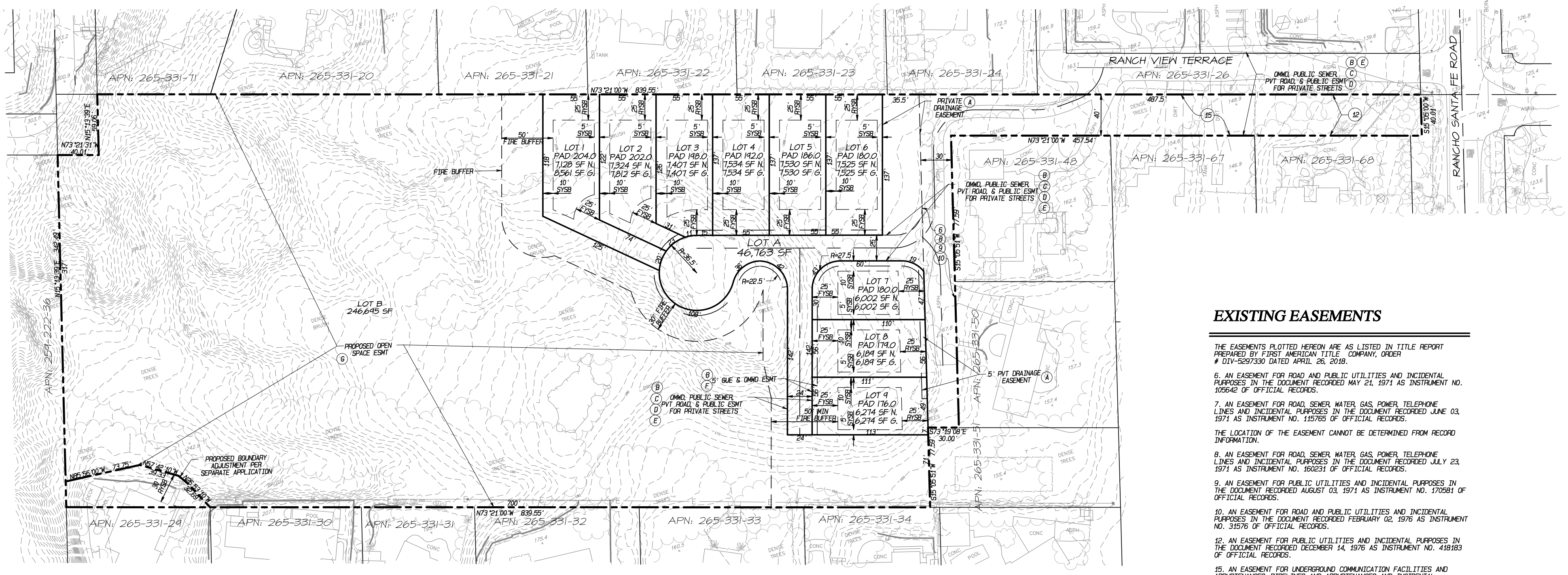
DUDEK

0 1,000 2,000 Feet

FIGURE 1

Project Location

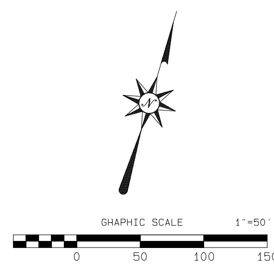
Encinitas Sanctuary Project



LOTS A & B MAY NOT BE FURTHER SUBDIVIDED.

LEGEND

SUBDIVISION BOUNDARY	
LOT LINE	
LOT NUMBER	LOT 4
LOT AREA	5,000 SF
PROPOSED SETBACKS	
CENTERLINE OF RIGHT-OF-WAY	



EXISTING EASEMENTS

THE EASEMENTS PLOTTED HEREON ARE AS LISTED IN TITLE REPORT PREPARED BY FIRST AMERICAN TITLE COMPANY, ORDER # DIV-5297330 DATED APRIL 26, 2018.

6. AN EASEMENT FOR ROAD AND PUBLIC UTILITIES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED MAY 21, 1971 AS INSTRUMENT NO. 105642 OF OFFICIAL RECORDS.

7. AN EASEMENT FOR ROAD, SEWER, WATER, GAS, POWER, TELEPHONE LINES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED JUNE 03, 1971 AS INSTRUMENT NO. 115765 OF OFFICIAL RECORDS.

THE LOCATION OF THE EASEMENT CANNOT BE DETERMINED FROM RECORD INFORMATION.

8. AN EASEMENT FOR ROAD, SEWER, WATER, GAS, POWER, TELEPHONE LINES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED JULY 23, 1971 AS INSTRUMENT NO. 160231 OF OFFICIAL RECORDS.

9. AN EASEMENT FOR PUBLIC UTILITIES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED AUGUST 03, 1971 AS INSTRUMENT NO. 170581 OF OFFICIAL RECORDS.

10. AN EASEMENT FOR ROAD AND PUBLIC UTILITIES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED FEBRUARY 02, 1976 AS INSTRUMENT NO. 31576 OF OFFICIAL RECORDS.

12. AN EASEMENT FOR PUBLIC UTILITIES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED DECEMBER 14, 1976 AS INSTRUMENT NO. 418183 OF OFFICIAL RECORDS.

15. AN EASEMENT FOR UNDERGROUND COMMUNICATION FACILITIES AND APPURTENANCES, PIPELINES AND APPURTENANCES AND INCIDENTAL PURPOSES IN THE DOCUMENT RECORDED MARCH 28, 2001 AS INSTRUMENT NO. 01-182048 OF OFFICIAL RECORDS.

PROPOSED EASEMENTS

- A PRIVATE DRAINAGE EASEMENT
- B OLIVENHAIN MUNICIPAL WATER DISTRICT EASEMENT
- C PUBLIC SEWER EASEMENT
- D PRIVATE ACCESS EASEMENT
- E PUBLIC EASEMENT FOR PRIVATE STREETS
- F GENERAL UTILITY EASEMENT
- G OPEN SPACE EASEMENT

SOURCE: Pasco Laret Suiter & Associates 2021

DUDEK

FIGURE 2

Site Plan

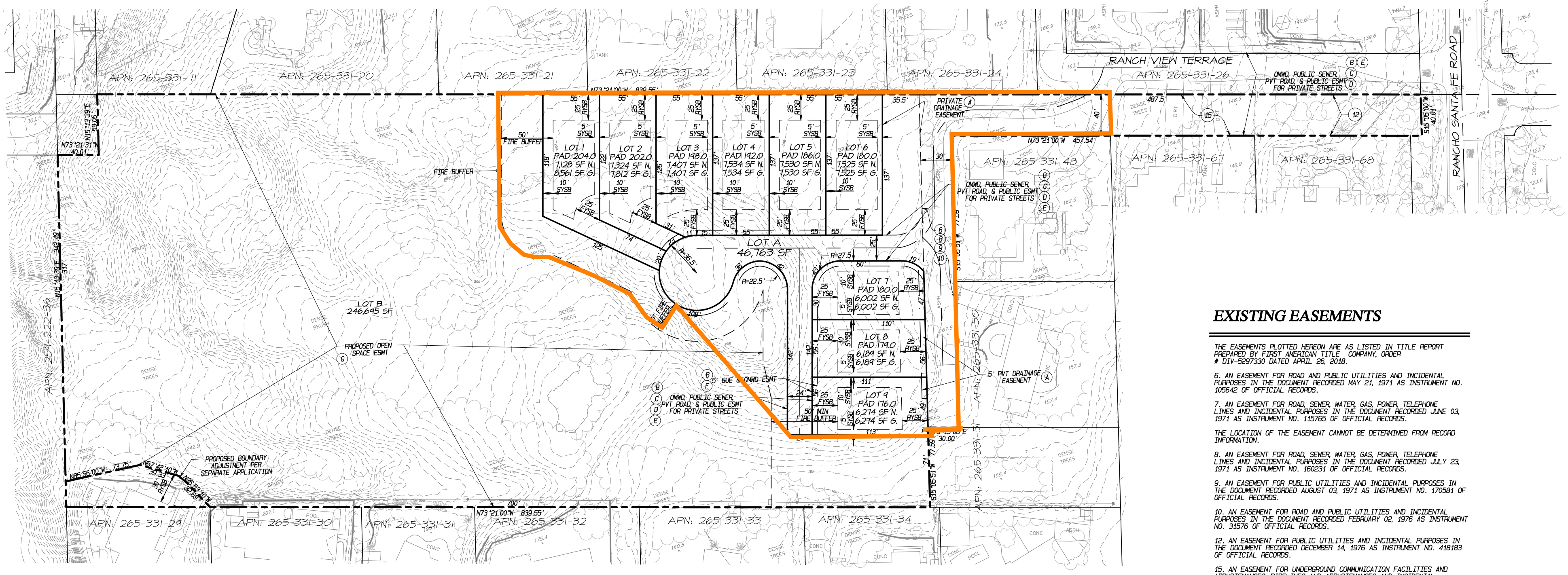
Encinitas Sanctuary Project

FIGURE 3

Ambient Noise Measurement Locations

DUDEK

Encinitas Sanctuary Project



LOTS A & B MAY NOT BE FURTHER SUBDIVIDED.

LEGEND

SUBDIVISION BOUNDARY	
LOT LINE	
LOT NUMBER	LOT 4
LOT AREA	5,000 SF
PROPOSED SETBACKS	
CENTERLINE OF RIGHT-OF-WAY	

GRAPHIC SCALE 1"=50'

0 50 100 150

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- F GENERAL UTILITY EASEMENT
- G OPEN SPACE EASEMENT

LEGEND

Soundwall Location

SOURCE: Pasco Laret Suiter & Associates 2021

FIGURE 4

Required Temporary Construction Noise Soundwall Location

Encinitas Sanctuary Project

DUDEK

SOURCE: Dudek 2023

DUDEK

0 119 238 Feet

FIGURE 5

AVERAGE (LEQ) NOISE LEVELS FOR HVAC OPERATIONS

Encinitas Sanctuary Project

ATTACHMENT A

AMBIENT NOISE MEASUREMENT DATA

MEASUREMENT LOCATION ST1

Start Date	Start Time	End Time	Duration	SPL Rate	Freq Weight	LAeq	LAmax	LAmin	LApk	L10	L25	L50	L90
2/7/2023	4:30:20 PM	4:30:30 PM	0:00:10	Slow	dBA	38.1	39.6	37.2	64	38.5	38.2	37.8	37.3
2/7/2023	4:30:30 PM	4:30:40 PM	0:00:10	Slow	dBA	37.8	38.6	36.7	65.6	38.4	38.2	38	37.2
2/7/2023	4:30:40 PM	4:30:50 PM	0:00:10	Slow	dBA	38.2	39.9	36.7	63.2	39.4	38.4	37.8	37.4
2/7/2023	4:30:50 PM	4:31:00 PM	0:00:10	Slow	dBA	37.9	40.5	36.6	57.4	39.2	38.4	37.7	37.1
2/7/2023	4:31:00 PM	4:31:10 PM	0:00:10	Slow	dBA	36.9	37.9	36.2	51.5	37.6	36.9	36.7	36.5
2/7/2023	4:31:10 PM	4:31:20 PM	0:00:10	Slow	dBA	39.6	45	36.8	63	38.7	38.4	37.4	36.9
2/7/2023	4:31:20 PM	4:31:30 PM	0:00:10	Slow	dBA	46	50	42.7	65.9	48.1	46.2	45.5	43.3
2/7/2023	4:31:30 PM	4:31:40 PM	0:00:10	Slow	dBA	45.8	46.9	44.7	58	46.8	46.2	45.1	44.8
2/7/2023	4:31:40 PM	4:31:50 PM	0:00:10	Slow	dBA	47.1	47.5	46.5	57.6	47.3	47.1	47.1	46.8
2/7/2023	4:31:50 PM	4:32:00 PM	0:00:10	Slow	dBA	46.9	47.5	46.5	59.5	47.3	47.2	46.9	46.7
2/7/2023	4:32:00 PM	4:32:10 PM	0:00:10	Slow	dBA	45.2	51.9	37.7	80.8	50.4	47.1	42.3	38
2/7/2023	4:32:10 PM	4:32:20 PM	0:00:10	Slow	dBA	38.3	39.7	36.8	56.4	39.4	39	38.4	37.1
2/7/2023	4:32:20 PM	4:32:30 PM	0:00:10	Slow	dBA	37.7	38.6	36.8	67.2	38.1	37.9	37.7	37.1
2/7/2023	4:32:30 PM	4:32:40 PM	0:00:10	Slow	dBA	37.8	41.2	35.2	61.6	40.6	39.1	37.2	35.5
2/7/2023	4:32:40 PM	4:32:50 PM	0:00:10	Slow	dBA	38.1	39.8	35.2	55	39.4	39.2	37.9	35.3
2/7/2023	4:32:50 PM	4:33:00 PM	0:00:10	Slow	dBA	38.8	40.8	36.8	56.7	40.1	39.8	38.3	37.3
2/7/2023	4:33:00 PM	4:33:10 PM	0:00:10	Slow	dBA	37.8	39.8	37	56.8	39.1	38.4	37.8	37.1
2/7/2023	4:33:10 PM	4:33:20 PM	0:00:10	Slow	dBA	40.5	44.4	36.5	59.1	43.6	41.3	39.3	36.6
2/7/2023	4:33:20 PM	4:33:30 PM	0:00:10	Slow	dBA	39.1	40.1	37.9	56.9	39.7	39.5	39.1	38.3
2/7/2023	4:33:30 PM	4:33:40 PM	0:00:10	Slow	dBA	43.2	46.4	38.3	57.9	46	44.5	42.8	39.1
2/7/2023	4:33:40 PM	4:33:50 PM	0:00:10	Slow	dBA	38.3	42.9	36.8	52.3	41.1	39.7	38.8	37
2/7/2023	4:33:50 PM	4:34:00 PM	0:00:10	Slow	dBA	36.4	37.1	35.8	51.7	37	36.6	36.3	36
2/7/2023	4:34:00 PM	4:34:10 PM	0:00:10	Slow	dBA	36.4	37	36.2	50	36.7	36.6	36.5	36.3
2/7/2023	4:34:10 PM	4:34:20 PM	0:00:10	Slow	dBA	36.2	36.7	35.7	56.8	36.6	36.4	36.2	35.9
2/7/2023	4:34:20 PM	4:34:30 PM	0:00:10	Slow	dBA	36.6	37.7	35.5	51.4	37.3	37.1	36.6	35.7
2/7/2023	4:34:30 PM	4:34:40 PM	0:00:10	Slow	dBA	35.7	36.5	35	51.9	36.2	35.9	35.6	35.1
2/7/2023	4:34:40 PM	4:34:50 PM	0:00:10	Slow	dBA	36.5	37.7	35.8	59.2	36.9	36.7	36.4	35.9
2/7/2023	4:34:50 PM	4:35:00 PM	0:00:10	Slow	dBA	35.9	36.6	35.6	50.9	36.3	36.1	36	35.7
2/7/2023	4:35:00 PM	4:35:10 PM	0:00:10	Slow	dBA	36.3	36.7	35.9	57	36.5	36.4	36.3	36
2/7/2023	4:35:10 PM	4:35:20 PM	0:00:10	Slow	dBA	36.9	37.5	35.9	50.9	37.4	37.2	36.9	35.9
2/7/2023	4:35:20 PM	4:35:30 PM	0:00:10	Slow	dBA	36.5	37.2	35.9	49.6	36.8	36.6	36.4	36.1

Start Date	Start Time	End Time	Duration	SPL Rate	Freq Weight	LAeq	LAmax	LAmin	LApk	L10	L25	L50	L90
2/7/2023	4:35:30 PM	4:35:40 PM	0:00:10	Slow	dBA	36.6	37.4	36	50.4	37.1	36.9	36.4	36
2/7/2023	4:35:40 PM	4:35:50 PM	0:00:10	Slow	dBA	37.5	38.8	36.8	51.4	38.4	37.6	37.3	37
2/7/2023	4:35:50 PM	4:36:00 PM	0:00:10	Slow	dBA	35.8	37	35.3	50.9	36.6	36	35.8	35.4
2/7/2023	4:36:00 PM	4:36:10 PM	0:00:10	Slow	dBA	35.9	36.2	35.6	49.5	36.1	36	35.8	35.6
2/7/2023	4:36:10 PM	4:36:20 PM	0:00:10	Slow	dBA	36.4	36.8	35.9	50.2	36.6	36.5	36.3	35.9
2/7/2023	4:36:20 PM	4:36:30 PM	0:00:10	Slow	dBA	37.8	39.8	36	54.8	38.9	38.2	37.1	36.1
2/7/2023	4:36:30 PM	4:36:40 PM	0:00:10	Slow	dBA	38.4	41.2	37.1	57.6	39.8	38.9	38.5	37.4
2/7/2023	4:36:40 PM	4:36:50 PM	0:00:10	Slow	dBA	36.9	38.1	36.6	50.2	37.5	37.2	37	36.7
2/7/2023	4:36:50 PM	4:37:00 PM	0:00:10	Slow	dBA	37.1	37.4	36.6	50.5	37.3	37.2	37	36.7
2/7/2023	4:37:00 PM	4:37:10 PM	0:00:10	Slow	dBA	37.8	38.7	36.8	58.8	38.4	38	37.4	37
2/7/2023	4:37:10 PM	4:37:20 PM	0:00:10	Slow	dBA	38.2	39.3	37.6	58.2	38.7	38.3	38.1	37.8
2/7/2023	4:37:20 PM	4:37:30 PM	0:00:10	Slow	dBA	38.6	40.5	37.3	54.8	40.2	39.8	38.1	37.4
2/7/2023	4:37:30 PM	4:37:40 PM	0:00:10	Slow	dBA	37.3	38.1	36.7	60.4	37.8	37.7	37.5	36.8
2/7/2023	4:37:40 PM	4:37:50 PM	0:00:10	Slow	dBA	37.6	38.4	36.6	59.6	38	37.7	37.6	36.9
2/7/2023	4:37:50 PM	4:38:00 PM	0:00:10	Slow	dBA	37.1	37.4	36.8	50.7	37.3	37.3	37.1	36.9
2/7/2023	4:38:00 PM	4:38:10 PM	0:00:10	Slow	dBA	38.5	40.5	37	59.6	39.7	38.6	38.3	37.2
2/7/2023	4:38:10 PM	4:38:20 PM	0:00:10	Slow	dBA	38.4	39.3	37.7	62.4	38.7	38.6	38.3	37.8
2/7/2023	4:38:20 PM	4:38:30 PM	0:00:10	Slow	dBA	39.1	40.2	38.2	53.7	39.7	39.2	39	38.4
2/7/2023	4:38:30 PM	4:38:40 PM	0:00:10	Slow	dBA	39.8	40.5	39.3	53.1	40.4	40.2	39.9	39.4
2/7/2023	4:38:40 PM	4:38:50 PM	0:00:10	Slow	dBA	39.9	40.6	39.3	56.8	40.5	40.4	39.8	39.4
2/7/2023	4:38:50 PM	4:39:00 PM	0:00:10	Slow	dBA	41.2	45.6	39.1	63.2	43.6	41.8	39.9	39.3
2/7/2023	4:39:00 PM	4:39:10 PM	0:00:10	Slow	dBA	40	40.5	39.2	54.4	40.3	40.1	39.9	39.5
2/7/2023	4:39:10 PM	4:39:20 PM	0:00:10	Slow	dBA	39.2	40.1	38.5	53	39.9	39.6	39.3	38.6
2/7/2023	4:39:20 PM	4:39:30 PM	0:00:10	Slow	dBA	39.6	40.4	38.5	61.2	40.2	39.8	39.3	38.8
2/7/2023	4:39:30 PM	4:39:40 PM	0:00:10	Slow	dBA	41.4	44	39.6	55.6	43.1	42	41.3	39.8
2/7/2023	4:39:40 PM	4:39:50 PM	0:00:10	Slow	dBA	38.2	39.6	37.6	52.1	39.1	38.9	38.4	37.7
2/7/2023	4:39:50 PM	4:40:00 PM	0:00:10	Slow	dBA	38.5	40.1	37.5	55.1	39.1	38.5	38	37.6
2/7/2023	4:40:00 PM	4:40:10 PM	0:00:10	Slow	dBA	39.9	41	38.7	53.4	40.8	40.1	39.7	39
2/7/2023	4:40:10 PM	4:40:20 PM	0:00:10	Slow	dBA	40.6	41.2	40.1	54.6	41	40.7	40.5	40.3
2/7/2023	4:40:20 PM	4:40:30 PM	0:00:10	Slow	dBA	41	43.1	39.3	54.8	42.3	41.4	40.9	39.5
2/7/2023	4:40:30 PM	4:40:40 PM	0:00:10	Slow	dBA	42.7	43.8	40.8	56.2	43.2	42.9	42.7	41.7
2/7/2023	4:40:40 PM	4:40:50 PM	0:00:10	Slow	dBA	46.2	49.5	41	60.2	49	48.1	42.3	41.1
2/7/2023	4:40:50 PM	4:41:00 PM	0:00:10	Slow	dBA	47.6	48.5	45.7	59.6	48.3	48.1	47.9	47

Start Date	Start Time	End Time	Duration	SPL Rate	Freq Weight	LAeq	LAmax	LAmin	LApk	L10	L25	L50	L90
2/7/2023	4:41:00 PM	4:41:10 PM	0:00:10	Slow	dBA	45.7	46.7	44.8	58.4	46	45.9	45.6	45.2
2/7/2023	4:41:10 PM	4:41:20 PM	0:00:10	Slow	dBA	44.4	47.5	41.8	58.1	47.1	46.4	44.1	41.9
2/7/2023	4:41:20 PM	4:41:30 PM	0:00:10	Slow	dBA	40.3	41.8	39.2	54.4	41.6	41.3	40.2	39.3
2/7/2023	4:41:30 PM	4:41:40 PM	0:00:10	Slow	dBA	39.6	40.3	39	52.5	40.1	39.8	39.6	39.1
2/7/2023	4:41:40 PM	4:41:50 PM	0:00:10	Slow	dBA	39.8	41	39	55.8	40.4	40.2	39.9	39.2
2/7/2023	4:41:50 PM	4:42:00 PM	0:00:10	Slow	dBA	42.4	44.1	39.3	57.1	43.8	43.5	41.7	39.6
2/7/2023	4:42:00 PM	4:42:10 PM	0:00:10	Slow	dBA	45	48.6	42.3	61.7	45.2	44.8	43.5	42.8
2/7/2023	4:42:10 PM	4:42:20 PM	0:00:10	Slow	dBA	43.4	48.7	42.2	60.5	47.1	44.5	43.5	42.3
2/7/2023	4:42:20 PM	4:42:30 PM	0:00:10	Slow	dBA	45	46.6	42.3	59.2	46.1	45.7	45.1	42.8
2/7/2023	4:42:30 PM	4:42:40 PM	0:00:10	Slow	dBA	45.7	47.6	44.1	58.9	47.1	46.5	45.5	44.4
2/7/2023	4:42:40 PM	4:42:50 PM	0:00:10	Slow	dBA	43.2	44.5	42	56.8	44.3	43.6	43.4	42.5
2/7/2023	4:42:50 PM	4:43:00 PM	0:00:10	Slow	dBA	40.9	42.3	40.3	54.7	42	41.7	40.8	40.6
2/7/2023	4:43:00 PM	4:43:10 PM	0:00:10	Slow	dBA	41.9	44.5	39.6	58.7	44.1	43	41.3	39.8
2/7/2023	4:43:10 PM	4:43:20 PM	0:00:10	Slow	dBA	40.3	40.9	39.6	53.7	40.8	40.7	40.4	40
2/7/2023	4:43:20 PM	4:43:30 PM	0:00:10	Slow	dBA	39.3	44.8	37.3	79.7	38.8	38.1	37.9	37.4
2/7/2023	4:43:30 PM	4:43:40 PM	0:00:10	Slow	dBA	37.5	44.5	37.2	55.5	41.5	38.7	37.7	37.3
2/7/2023	4:43:40 PM	4:43:50 PM	0:00:10	Slow	dBA	37.8	38.8	36.9	54.3	38.1	38	37.7	37.1
2/7/2023	4:43:50 PM	4:44:00 PM	0:00:10	Slow	dBA	37.4	38.4	36.9	51.6	38.2	37.9	37.4	37
2/7/2023	4:44:00 PM	4:44:10 PM	0:00:10	Slow	dBA	37.1	38.2	36.5	52.1	38	37.5	37	36.6
2/7/2023	4:44:10 PM	4:44:20 PM	0:00:10	Slow	dBA	37.6	38.2	36.5	52.6	38.1	37.9	37.4	37
2/7/2023	4:44:20 PM	4:44:30 PM	0:00:10	Slow	dBA	37	37.9	36.6	58.2	37.7	37.2	37	36.7
2/7/2023	4:44:30 PM	4:44:40 PM	0:00:10	Slow	dBA	38	40.1	36.7	74.7	39.4	38.4	37.6	37
2/7/2023	4:44:40 PM	4:44:50 PM	0:00:10	Slow	dBA	36.7	37.1	36.2	50.2	36.9	36.8	36.7	36.3
2/7/2023	4:44:50 PM	4:45:00 PM	0:00:10	Slow	dBA	37.8	39.3	36.5	53.3	38.9	38.1	37.8	36.8
2/7/2023	4:45:01 PM	4:45:10 PM	0:00:09	Slow	dBA	39.3	42.9	36.4	75.1	41.4	39.2	38	36.5

		Laeq				L10	L25	L50	L90
MEASUREMENT LOCATION ST1									
	Values Averaged Across Measurement Period:	40.8				42.3	41.4	40.5	39.6
	Lowest Value Recorded Across Period (Lmin)			0					
	Highest Value Recorded Across Period (Lmax)		51.9						

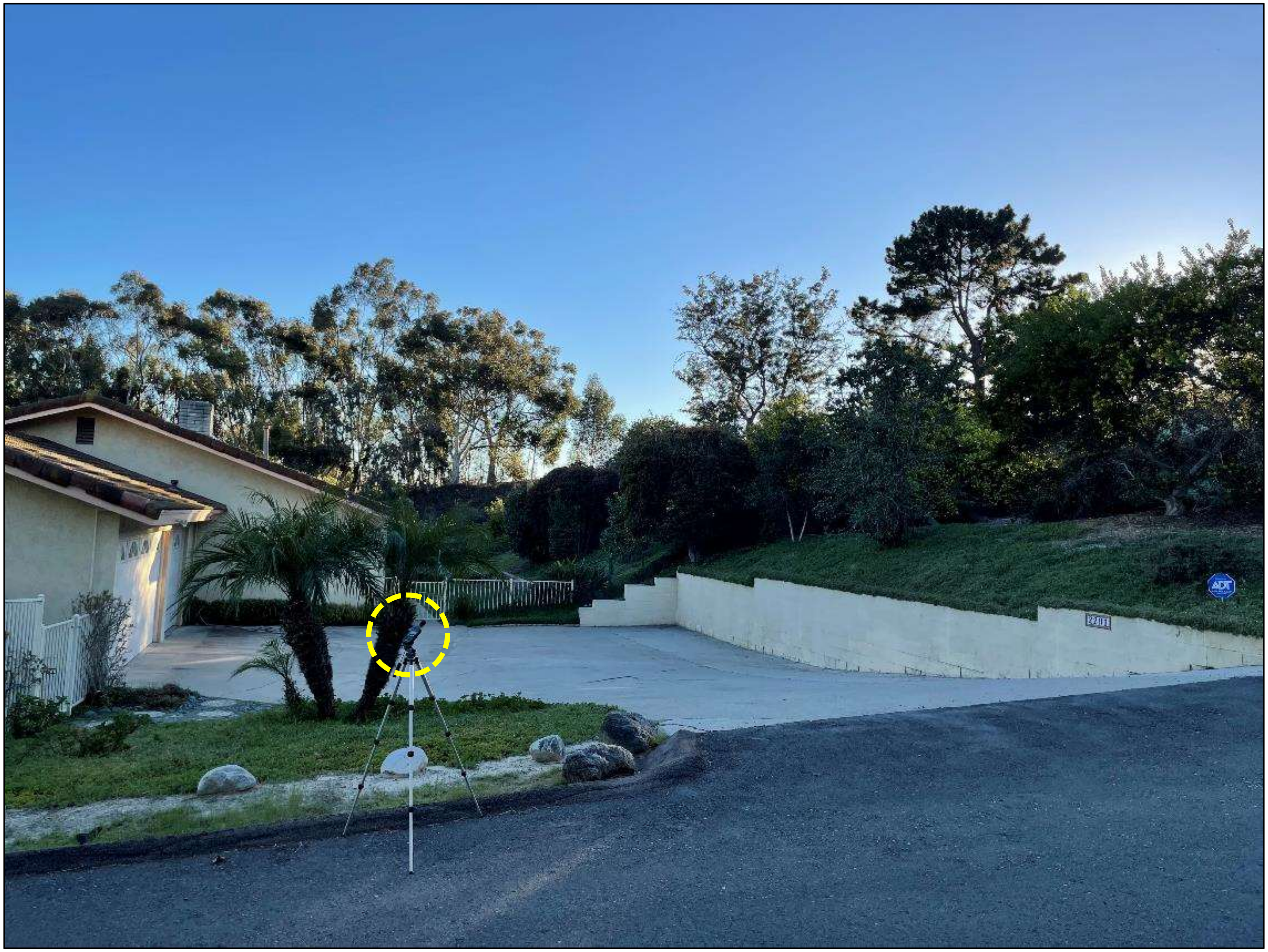
MEASUREMENT LOCATION ST2

Start Date	Start Time	End Time	Duration	SPL Rate	Freq Weight	LAeq	LAmax	LAmin	LApk	L10	L25	L50	L90
2/7/2023	4:53:20 PM	4:53:30 PM	0:00:10	Slow	dBA	39.3	42.2	37	66.6	41	40.3	39	37.6
2/7/2023	4:53:30 PM	4:53:40 PM	0:00:10	Slow	dBA	35.7	37.6	34.4	64.2	36.9	36.2	35.8	34.7
2/7/2023	4:53:40 PM	4:53:50 PM	0:00:10	Slow	dBA	37.6	39.7	34.4	66.1	39.3	38.6	37.8	34.6
2/7/2023	4:53:50 PM	4:54:00 PM	0:00:10	Slow	dBA	38.9	41.9	35.6	68.9	40.9	39.2	37.9	36.2
2/7/2023	4:54:00 PM	4:54:10 PM	0:00:10	Slow	dBA	37.1	41.3	34.6	58.6	40.4	38.9	37.1	35.3
2/7/2023	4:54:10 PM	4:54:20 PM	0:00:10	Slow	dBA	38.7	41.7	34.6	58.5	40.3	39.4	37.8	36.3
2/7/2023	4:54:20 PM	4:54:30 PM	0:00:10	Slow	dBA	39.6	41.5	36.6	63.5	41.2	40.8	38.8	36.9
2/7/2023	4:54:30 PM	4:54:40 PM	0:00:10	Slow	dBA	57.1	62.5	41.5	79.2	61.8	59	53.9	43.4
2/7/2023	4:54:40 PM	4:54:50 PM	0:00:10	Slow	dBA	41.8	53.3	35.5	70.3	50	46.3	42.9	35.8
2/7/2023	4:54:50 PM	4:55:00 PM	0:00:10	Slow	dBA	37.4	39.4	35.3	55.8	38.7	37.9	37	35.8
2/7/2023	4:55:00 PM	4:55:10 PM	0:00:10	Slow	dBA	44	51.2	35.5	67.3	43.4	36.5	36.3	35.6
2/7/2023	4:55:10 PM	4:55:20 PM	0:00:10	Slow	dBA	39.9	50.4	36	63	46.6	44.3	40.7	36.7
2/7/2023	4:55:20 PM	4:55:30 PM	0:00:10	Slow	dBA	44	48.8	36	66.2	47.7	46	41.9	37.7
2/7/2023	4:55:30 PM	4:55:40 PM	0:00:10	Slow	dBA	36.1	37.7	35.3	51	37.1	36.4	36.1	35.6
2/7/2023	4:55:40 PM	4:55:50 PM	0:00:10	Slow	dBA	35.8	36.8	34.8	49.2	36.4	36	35.9	35
2/7/2023	4:55:50 PM	4:56:00 PM	0:00:10	Slow	dBA	37.9	38.9	36.7	57.5	38.8	38.4	37.6	37.2
2/7/2023	4:56:00 PM	4:56:10 PM	0:00:10	Slow	dBA	37.5	39.5	36.6	55.3	38.3	37.7	37.4	36.9
2/7/2023	4:56:10 PM	4:56:20 PM	0:00:10	Slow	dBA	36.2	38	35.3	63.8	37.1	36.8	36	35.5
2/7/2023	4:56:20 PM	4:56:30 PM	0:00:10	Slow	dBA	35.8	39.2	34.1	56.2	37.8	36.8	35.3	34.3
2/7/2023	4:56:30 PM	4:56:40 PM	0:00:10	Slow	dBA	35.6	37.3	34.4	51.3	35.9	35.6	35.3	34.4
2/7/2023	4:56:40 PM	4:56:50 PM	0:00:10	Slow	dBA	37.4	38.5	36.5	51.8	38	37.8	37.4	36.9
2/7/2023	4:56:50 PM	4:57:00 PM	0:00:10	Slow	dBA	40.6	44.4	36.6	60.3	42.9	41.2	39.3	37.9
2/7/2023	4:57:00 PM	4:57:10 PM	0:00:10	Slow	dBA	43.3	45.7	40.5	60.4	44.8	43.9	42.8	40.8
2/7/2023	4:57:10 PM	4:57:20 PM	0:00:10	Slow	dBA	47.5	49.3	44.6	61.6	49.2	48.3	47	45.2
2/7/2023	4:57:20 PM	4:57:30 PM	0:00:10	Slow	dBA	47.5	48.4	46.9	61.7	47.9	47.7	47.6	47.1
2/7/2023	4:57:30 PM	4:57:40 PM	0:00:10	Slow	dBA	47.7	48.7	46	59.6	48.4	48.2	47.7	46.5
2/7/2023	4:57:40 PM	4:57:50 PM	0:00:10	Slow	dBA	48.5	50.2	46.9	61.9	49.5	48.5	48.1	47.4
2/7/2023	4:57:50 PM	4:58:00 PM	0:00:10	Slow	dBA	51	53.2	47.4	64.3	52.8	52.4	50.4	47.7
2/7/2023	4:58:00 PM	4:58:10 PM	0:00:10	Slow	dBA	50.2	52.7	48.4	63.9	51.9	51.2	50.2	48.6
2/7/2023	4:58:10 PM	4:58:20 PM	0:00:10	Slow	dBA	51	52.7	49	63.8	52.5	52	50.5	49.5

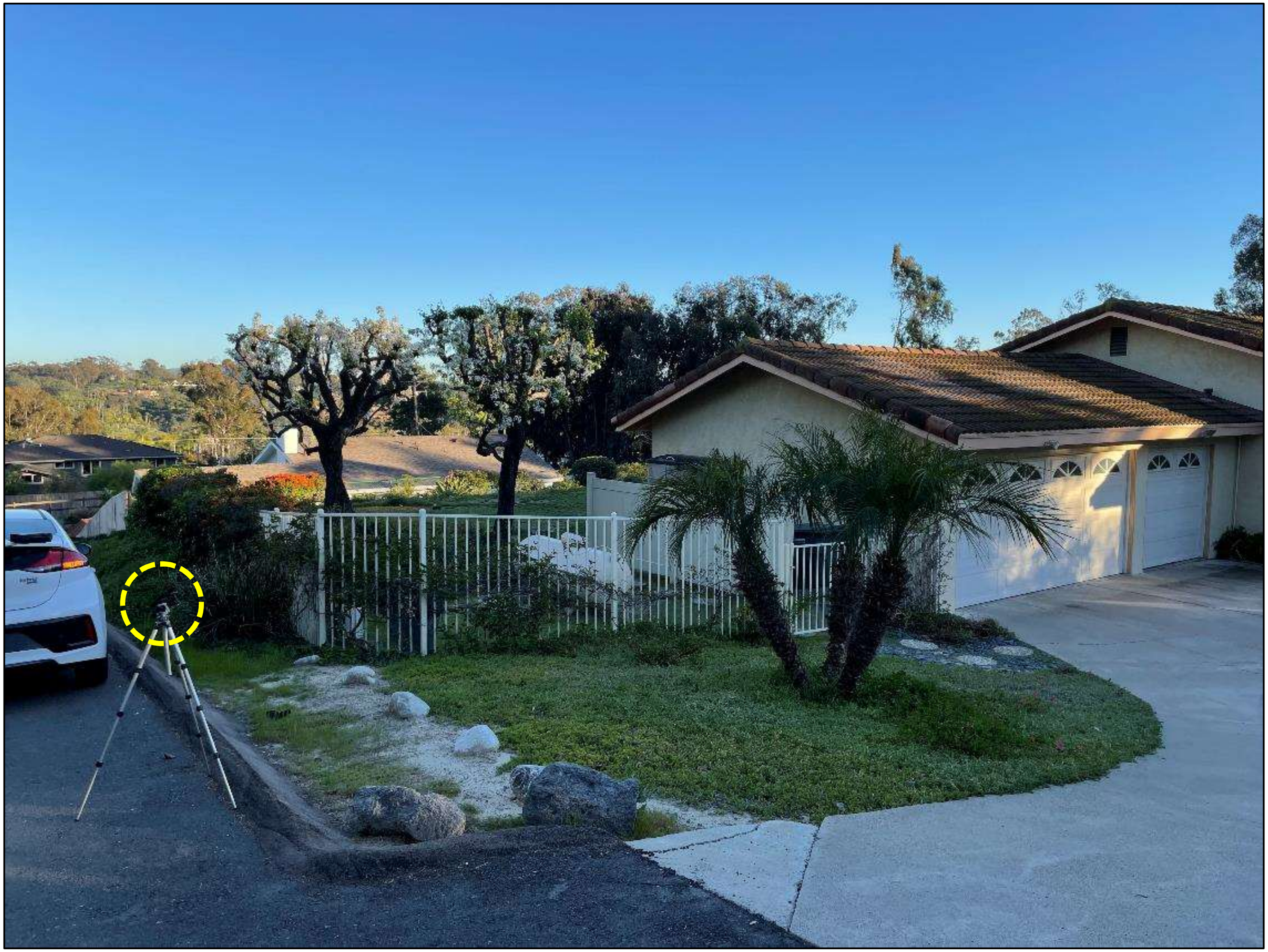
Start Date	Start Time	End Time	Duration	SPL Rate	Freq Weight	LAeq	LAmax	LAmin	LApk	L10	L25	L50	L90
2/7/2023	4:58:20 PM	4:58:30 PM	0:00:10	Slow	dBA	42.7	50.5	38.4	66.5	48.5	46.1	42.1	38.9
2/7/2023	4:58:30 PM	4:58:40 PM	0:00:10	Slow	dBA	39.2	40.7	38	58.6	40.2	39.8	39.3	38.3
2/7/2023	4:58:40 PM	4:58:50 PM	0:00:10	Slow	dBA	41.4	42.8	38.7	59.8	42.4	41.8	41.4	39.7
2/7/2023	4:58:50 PM	4:58:53 PM	0:00:03	Slow	dBA	38.1	40.3	37.4	55.2	39.8	39.6	39.3	37.8

MEASUREMENT LOCATION ST2

	Laeq	Lmax	Lmin	L10	L25	L50	L90
Values Averaged Across Measurement Period:	46.0			49.2	47.4	44.7	42.1
Lowest Value Recorded Across Period (Lmin)			34.1				
Highest Value Recorded Across Period (Lmax)		62.5					



02/07/23 – View of Sound Level Meter (SLM) at Position ST1
(looking southwest; SLM encircled in yellow dashes)



02/07/23 – View of Sound Level Meter (SLM) at Position ST1
(looking south-southeast; SLM encircled in yellow dashes)

02/07/23 – View of Sound Level Meter (SLM) at Position ST2
(looking west-northwest; SLM encircled in yellow dashes)

02/07/23 – View of Sound Level Meter (SLM) at Position ST2
(looking east-southeast; SLM encircled in yellow dashes)

02/07/23 – Screenshots of Field Survey Positions (at blue dots):
ST1 (left) and **ST2** (right)

ATTACHMENT B

CONSTRUCTION NOISE MODELING DATA

To User: bordered cells are inputs, unbordered cells have formulae

Lmax noise level limit for construction phase at residential land use, per Encinitas noise ordinance = **75**
hours over which Leq is to be averaged = 1

0 = temporary barrier (TB) of input height inserted between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq
Site Preparation	dozer	3	40	82	86.8	55	0.1		85.8	1	60	82
	front end loader	2	40	79	82.0	55	0.1		81.1	1	60	77
	backhoe	2	40	78	81.0	55	0.1		80.1	1	60	76
								Total Lmax for Site Preparation Phase:	**87.9**		Total Hourly Leq:	**83.9**
Grading	excavator	1	40	81	81.0	55	0.1		80.1	1	60	76
	grader	1	40	85	85.0	55	0.1		84.1	1	60	80
	dozer	1	40	82	82.0	55	0.1		81.1	1	60	77
	backhoe	3	40	78	82.8	55	0.1		81.8	1	60	78
								Total Lmax for Grading Phase:	**88.0**		Total Hourly Leq:	**84.0**
Building Erection	crane	1	16	81	81.0	55	0.1		80.1	1	60	72
	gradall	3	40	83	87.8	55	0.1		86.8	1	60	83
	generator	1	50	72	72.0	55	0.1		71.1	1	60	68
	backhoe	3	40	78	82.8	55	0.1		81.8	1	60	78
	welder / torch	1	40	73	73.0	55	0.1		72.1	1	60	68
								Total Lmax for Building Erection Phase:	**88.8**		Total Hourly Leq:	**84.5**
Architectural Coating	compressor (air)	1	40	78	78.0	55	0.1		77.1	1	60	73
								Total Lmax for Architectural Coating Phase:	**77.1**			**73.1**
Paving	concrete mixer truck	2	40	79	82.0	55	0.1		81.1	1	60	77
	paver	1	50	77	77.0	55	0.1		76.1	1	60	73
	roller	2	20	80	83.0	55	0.1		82.1	1	60	75
	backhoe	1	40	78	78.0	55	0.1		77.1	1	60	73
	All Other Equipment > 5 HP	1	50	85	85.0	55	0.1		84.1	1	60	81
								Total Lmax for Paving Phase:	**88.0**		Total Hourly Leq:	**84.0**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	dozer	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	front end loader	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Grading	excavator	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	grader	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	dozer	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Building Erection	crane	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	gradall	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	generator	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	welder / torch	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Architectural Coating	compressor (air)	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Paving	concrete mixer truck	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	paver	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	roller	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	All Other Equipment > 5 HP	6	5	0	45	10	55	45.4	11.2	55.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1

To User: bordered cells are inputs, unbordered cells have formulae

Lmax noise level limit for construction phase at residential land use, per Encinitas noise ordinance = **75**

hours over which Leq is to be averaged = 1

10 = temporary barrier (TB) of input height inserted between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq
Site Preparation	dozer	3	40	82	86.8	55	14.2		71.7	1	60	68
	front end loader	2	40	79	82.0	55	14.2		66.9	1	60	63
	backhoe	2	40	78	81.0	55	14.2		65.9	1	60	62
							Total Lmax for Site Preparation Phase:		**73.7**	Total Hourly Leq:		**69.7**
Grading	excavator	1	40	81	81.0	55	14.2		65.9	1	60	62
	grader	1	40	85	85.0	55	14.2		69.9	1	60	66
	dozer	1	40	82	82.0	55	14.2		66.9	1	60	63
	backhoe	3	40	78	82.8	55	14.2		67.7	1	60	64
							Total Lmax for Grading Phase:		**73.9**	Total Hourly Leq:		**69.9**
Building Erection	crane	1	16	81	81.0	55	14.2		65.9	1	60	58
	gradall	3	40	83	87.8	55	14.2		72.7	1	60	69
	generator	1	50	72	72.0	55	14.2		56.9	1	60	54
	backhoe	3	40	78	82.8	55	14.2		67.7	1	60	64
	welder / torch	1	40	73	73.0	55	14.2		57.9	1	60	54
							Total Lmax for Building Erection Phase:		**74.7**	Total Hourly Leq:		**70.4**
Architectural Coating	compressor (air)	1	40	78	78.0	55	14.2		62.9	1	60	59
							Total Lmax for Architectural Coating Phase:		**62.9**			**58.9**
Paving	concrete mixer truck	2	40	79	82.0	55	14.2		66.9	1	60	63
	paver	1	50	77	77.0	55	14.2		61.9	1	60	59
	roller	2	20	80	83.0	55	14.2		67.9	1	60	61
	backhoe	1	40	78	78.0	55	14.2		62.9	1	60	59
	All Other Equipment > 5 HP	1	50	85	85.0	55	14.2		69.9	1	60	67
							Total Lmax for Paving Phase:		**73.9**	Total Hourly Leq:		**69.8**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	dozer	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	front end loader	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	backhoe	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
Grading	excavator	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	grader	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	dozer	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	backhoe	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
Building Erection	crane	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	gradall	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	generator	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	backhoe	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	welder / torch	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
Architectural Coating	compressor (air)	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
Paving	concrete mixer truck	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	paver	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	roller	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	backhoe	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2
	All Other Equipment > 5 HP	6	5	10	45	10	55	45.2	11.2	55.0	1.35	14.3	15.5	5.5	0.5	0.7	14.2

To User: bordered cells are inputs, unbordered cells have formulae

Lmax noise level limit for construction phase at residential land use, per Encinitas noise ordinance = **75**
hours over which Leq is to be averaged = 1

0 = temporary barrier (TB) of input height inserted between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq
Site Preparation	dozer	3	40	82	86.8	65	0.1		84.4	1	60	80
	front end loader	2	40	79	82.0	65	0.1		79.6	1	60	76
	backhoe	2	40	78	81.0	65	0.1		78.6	1	60	75
								Total Lmax for Site Preparation Phase:	**86.4**	Total Hourly Leq:		**82.4**
Grading	excavator	1	40	81	81.0	65	0.1		78.6	1	60	75
	grader	1	40	85	85.0	65	0.1		82.6	1	60	79
	dozer	1	40	82	82.0	65	0.1		79.6	1	60	76
	backhoe	3	40	78	82.8	65	0.1		80.4	1	60	76
								Total Lmax for Grading Phase:	**86.6**	Total Hourly Leq:		**82.6**
Building Erection	crane	1	16	81	81.0	65	0.1		78.6	1	60	71
	gradall	3	40	83	87.8	65	0.1		85.4	1	60	81
	generator	1	50	72	72.0	65	0.1		69.6	1	60	67
	backhoe	3	40	78	82.8	65	0.1		80.4	1	60	76
	welder / torch	1	40	73	73.0	65	0.1		70.6	1	60	67
								Total Lmax for Building Erection Phase:	**87.4**	Total Hourly Leq:		**83.0**
Architectural Coating	compressor (air)	1	40	78	78.0	65	0.1		75.6	1	60	72
								Total Lmax for Architectural Coating Phase:	**75.6**			**71.6**
Paving	concrete mixer truck	2	40	79	82.0	65	0.1		79.6	1	60	76
	paver	1	50	77	77.0	65	0.1		74.6	1	60	72
	roller	2	20	80	83.0	65	0.1		80.6	1	60	74
	backhoe	1	40	78	78.0	65	0.1		75.6	1	60	72
	All Other Equipment > 5 HP	1	50	85	85.0	65	0.1		82.6	1	60	80
								Total Lmax for Paving Phase:	**86.6**	Total Hourly Leq:		**82.5**

Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
dozer	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
front end loader	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
excavator	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
grader	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
dozer	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
crane	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
gradall	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
generator	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
welder / torch	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
compressor (air)	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
concrete mixer truck	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
paver	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
roller	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
All Other Equipment > 5 HP	6	5	0	55	10	65	55.3	11.2	65.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1

To User: bordered cells are inputs, unbordered cells have formulae

Lmax noise level limit for construction phase at residential land use, per Encinitas noise ordinance = **75**
hours over which Leq is to be averaged = 1

10 = temporary barrier (TB) of input height inserted between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq
Site Preparation	dozer	3	40	82	86.8	65	14.0		70.4	1	60	66
	front end loader	2	40	79	82.0	65	14.0		65.7	1	60	62
	backhoe	2	40	78	81.0	65	14.0		64.7	1	60	61
								Total Lmax for Site Preparation Phase:	**72.5**	Total Hourly Leq:		**68.5**
Grading	excavator	1	40	81	81.0	65	14.0		64.7	1	60	61
	grader	1	40	85	85.0	65	14.0		68.7	1	60	65
	dozer	1	40	82	82.0	65	14.0		65.7	1	60	62
	backhoe	3	40	78	82.8	65	14.0		66.4	1	60	62
								Total Lmax for Grading Phase:	**72.6**	Total Hourly Leq:		**68.7**
Building Erection	crane	1	16	81	81.0	65	14.0		64.7	1	60	57
	gradall	3	40	83	87.8	65	14.0		71.4	1	60	67
	generator	1	50	72	72.0	65	14.0		55.7	1	60	53
	backhoe	3	40	78	82.8	65	14.0		66.4	1	60	62
	welder / torch	1	40	73	73.0	65	14.0		56.7	1	60	53
								Total Lmax for Building Erection Phase:	**73.4**	Total Hourly Leq:		**69.1**
Architectural Coating	compressor (air)	1	40	78	78.0	65	14.0		61.7	1	60	58
								Total Lmax for Architectural Coating Phase:	**61.7**			**57.7**
Paving	concrete mixer truck	2	40	79	82.0	65	14.0		65.7	1	60	62
	paver	1	50	77	77.0	65	14.0		60.7	1	60	58
	roller	2	20	80	83.0	65	14.0		66.7	1	60	60
	backhoe	1	40	78	78.0	65	14.0		61.7	1	60	58
	All Other Equipment > 5 HP	1	50	85	85.0	65	14.0		68.7	1	60	66
								Total Lmax for Paving Phase:	**72.6**	Total Hourly Leq:		**68.6**

Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
dozer	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
front end loader	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
backhoe	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
excavator	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
grader	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
dozer	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
backhoe	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
crane	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
gradall	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
generator	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
backhoe	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
welder / torch	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
compressor (air)	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
concrete mixer truck	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
paver	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
roller	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
backhoe	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0
All Other Equipment > 5 HP	6	5	10	55	10	65	55.1	11.2	65.0	1.32	14.2	15.5	5.5	0.5	0.7	14.0

To User: bordered cells are inputs, unbordered cells have formulae

Lmax noise level limit for construction phase at residential land use, per Encinitas noise ordinance = **75**
hours over which Leq is to be averaged = 1

0 = temporary barrier (TB) of input height inserted between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq
Site Preparation	dozer	3	40	82	86.8	75	0.1		82.7	1	60	79
	front end loader	2	40	79	82.0	75	0.1		78.0	1	60	74
	backhoe	2	40	78	81.0	75	0.1		77.0	1	60	73
								Total Lmax for Site Preparation Phase:	84.8		Total Hourly Leq:	**80.8**
Grading	excavator	1	40	81	81.0	75	0.1		77.0	1	60	73
	grader	1	40	85	85.0	75	0.1		81.0	1	60	77
	dozer	1	40	82	82.0	75	0.1		78.0	1	60	74
	backhoe	3	40	78	82.8	75	0.1		78.7	1	60	75
								Total Lmax for Grading Phase:	84.9		Total Hourly Leq:	**81.0**
Building Erection	crane	1	16	81	81.0	75	0.1		77.0	1	60	69
	gradall	3	40	83	87.8	75	0.1		83.7	1	60	80
	generator	1	50	72	72.0	75	0.1		68.0	1	60	65
	backhoe	3	40	78	82.8	75	0.1		78.7	1	60	75
	welder / torch	1	40	73	73.0	75	0.1		69.0	1	60	65
								Total Lmax for Building Erection Phase:	85.7		Total Hourly Leq:	**81.4**
Architectural Coating	compressor (air)	1	40	78	78.0	75	0.1		74.0	1	60	70
								Total Lmax for Architectural Coating Phase:	**74.0**			**70.0**
Paving	concrete mixer truck	2	40	79	82.0	75	0.1		78.0	1	60	74
	paver	1	50	77	77.0	75	0.1		73.0	1	60	70
	roller	2	20	80	83.0	75	0.1		79.0	1	60	72
	backhoe	1	40	78	78.0	75	0.1		74.0	1	60	70
	All Other Equipment > 5 HP	1	50	85	85.0	75	0.1		81.0	1	60	78
								Total Lmax for Paving Phase:	84.9		Total Hourly Leq:	**80.9**

Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
dozer	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
front end loader	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
excavator	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
grader	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
dozer	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
crane	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
gradall	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
generator	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
welder / torch	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
compressor (air)	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
concrete mixer truck	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
paver	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
roller	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
backhoe	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
All Other Equipment > 5 HP	6	5	0	65	10	75	65.3	11.2	75.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1

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Lmax noise level limit for construction phase at residential land use, per Encinitas noise ordinance = **75**

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Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	dozer	3	40	82	86.8	75	13.8		69.0	1	60	65	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	front end loader	2	40	79	82.0	75	13.8		64.2	1	60	60	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	backhoe	2	40	78	81.0	75	13.8		63.2	1	60	59	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
								Total Lmax for Site Preparation Phase:	**71.0**		Total Hourly Leq:	**67.0**																
Grading	excavator	1	40	81	81.0	75	13.8		63.2	1	60	59	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	grader	1	40	85	85.0	75	13.8		67.2	1	60	63	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	dozer	1	40	82	82.0	75	13.8		64.2	1	60	60	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	backhoe	3	40	78	82.8	75	13.8		65.0	1	60	61	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
								Total Lmax for Grading Phase:	**71.2**		Total Hourly Leq:	**67.2**																
Building Erection	crane	1	16	81	81.0	75	13.8		63.2	1	60	55	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	gradall	3	40	83	87.8	75	13.8		70.0	1	60	66	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	generator	1	50	72	72.0	75	13.8		54.2	1	60	51	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	backhoe	3	40	78	82.8	75	13.8		65.0	1	60	61	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	welder / torch	1	40	73	73.0	75	13.8		55.2	1	60	51	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
								Total Lmax for Building Erection Phase:	**72.0**		Total Hourly Leq:	**67.7**																
Architectural Coating	compressor (air)	1	40	78	78.0	75	13.8		60.2	1	60	56	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
								Total Lmax for Architectural Coating Phase:	**60.2**			**56.2**																
Paving	concrete mixer truck	2	40	79	82.0	75	13.8		64.2	1	60	60	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	paver	1	50	77	77.0	75	13.8		59.2	1	60	56	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	roller	2	20	80	83.0	75	13.8		65.2	1	60	58	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	backhoe	1	40	78	78.0	75	13.8		60.2	1	60	56	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
	All Other Equipment > 5 HP	1	50	85	85.0	75	13.8		67.2	1	60	64	6	5	10	65	10	75	65.1	11.2	75.0	1.30	14.1	15.5	5.5	0.5	0.7	13.8
								Total Lmax for Paving Phase:	**71.2**		Total Hourly Leq:	**67.2**																

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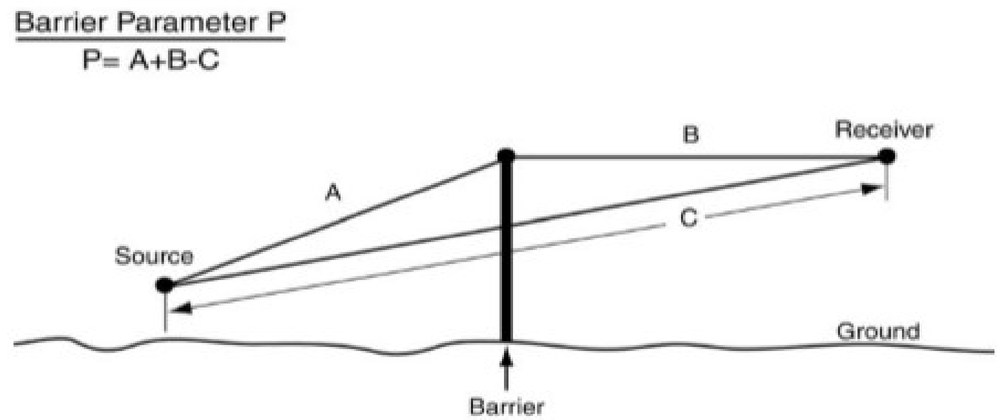
Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Lmax @ 50 ft. for quantify of equipment	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 1-hour Leq
Site Preparation	dozer	3	40	82	86.8	590	0.1		60.2	1	60	56
	front end loader	2	40	79	82.0	590	0.1		55.5	1	60	51
	backhoe	2	40	78	81.0	590	0.1		54.5	1	60	50
							Total Lmax for Site Preparation Phase:		**62.3**	Total Hourly Leq:		**58.3**
Grading	excavator	1	40	81	81.0	590	0.1		54.5	1	60	50
	grader	1	40	85	85.0	590	0.1		58.5	1	60	54
	dozer	1	40	82	82.0	590	0.1		55.5	1	60	51
	backhoe	3	40	78	82.8	590	0.1		56.2	1	60	52
							Total Lmax for Grading Phase:		**62.4**	Total Hourly Leq:		**58.5**
Building Erection	crane	1	16	81	81.0	590	0.1		54.5	1	60	46
	gradall	3	40	83	87.8	590	0.1		61.2	1	60	57
	generator	1	50	72	72.0	590	0.1		45.5	1	60	42
	backhoe	3	40	78	82.8	590	0.1		56.2	1	60	52
	welder / torch	1	40	73	73.0	590	0.1		46.5	1	60	42
							Total Lmax for Building Erection Phase:		**63.2**	Total Hourly Leq:		**58.9**
Architectural Coating	compressor (air)	1	40	78	78.0	590	0.1		51.5	1	60	47
							Total Lmax for Architectural Coating Phase:		**51.5**			**47.5**
Paving	concrete mixer truck	2	40	79	82.0	590	0.1		55.5	1	60	51
	paver	1	50	77	77.0	590	0.1		50.5	1	60	47
	roller	2	20	80	83.0	590	0.1		56.5	1	60	49
	backhoe	1	40	78	78.0	590	0.1		51.5	1	60	47
	All Other Equipment > 5 HP	1	50	85	85.0	590	0.1		58.5	1	60	55
							Total Lmax for Paving Phase:		**62.4**	Total Hourly Leq:		**58.4**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	dozer	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	front end loader	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Grading	excavator	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	grader	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	dozer	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Building Erection	crane	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	gradall	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	generator	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	welder / torch	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Architectural Coating	compressor (air)	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
Paving	concrete mixer truck	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	paver	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	roller	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	backhoe	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1
	All Other Equipment > 5 HP	6	5	0	580	10	590	580.0	11.2	590.0	0.00	0.1	5.5	5.5	0.7	0.7	0.1

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Lesser of or available Lmax	Spec. 721 Lmax	Measured L_{max} @50ft (dBA, slow)
All Other Equipment > 5 HP	No	50	85	85	-- N/A --
Auger Drill Rig	No	20	84	85	84
Backhoe	No	40	78	80	78
Bar Bender	No	20	80	80	-- N/A --
Blasting	Yes	-- N/A --	94	94	-- N/A --
Boring Jack Power Unit	No	50	80	80	83
Chain Saw	No	20	84	85	84
Clam Shovel (dropping)	Yes	20	87	93	87
Compactor (ground)	No	20	80	80	83
Compressor (air)	No	40	78	80	78
Concrete Batch Plant	No	15	83	83	-- N/A --
Concrete Mixer Truck	No	40	79	85	79
Concrete Pump Truck	No	20	81	82	81
Concrete Saw	No	20	90	90	90
Crane	No	16	81	85	81
Dozer	No	40	82	85	82
Drill Rig Truck	No	20	79	84	79
Drum Mixer	No	50	80	80	80
Dump Truck	No	40	76	84	76
Excavator	No	40	81	85	81
Flat Bed Truck	No	40	74	84	74
Front End Loader	No	40	79	80	79
Generator	No	50	72	72	81
Generator (<25KVA, VMS signs)	No	50	70	70	73
Gradall	No	40	83	85	83
Grader	No	40	85	85	-- N/A --
Grapple (on backhoe)	No	40	85	85	87
Horizontal Boring Hydr. Jack	No	25	80	80	82
Hydra Break Ram	Yes	10	90	90	-- N/A --
Impact Pile Driver	Yes	20	95	95	101
Jackhammer	Yes	20	85	85	89
Man Lift	No	20	75	85	75
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	90
Pavement Scarafier	No	20	85	85	90
Paver	No	50	77	85	77
Pickup Truck	No	40	55	55	75
Pneumatic Tools	No	50	85	85	85
Pumps	No	50	77	77	81
Refrigerator Unit	No	100	73	82	73
Rivit Buster/chipping gun	Yes	20	79	85	79
Rock Drill	No	20	81	85	81
Roller	No	20	80	85	80
Sand Blasting (Single Nozzle)	No	20	85	85	96
Scraper	No	40	84	85	84
Shears (on backhoe)	No	40	85	85	96
Slurry Plant	No	100	78	78	78
Slurry Trenching Machine	No	50	80	82	80
Soil Mix Drill Rig	No	50	80	80	-- N/A --
Tractor	No	40	84	84	-- N/A --
Vacuum Excavator (Vac-truck)	No	40	85	85	85
Vacuum Street Sweeper	No	10	80	80	82
Ventilation Fan	No	100	79	85	79
Vibrating Hopper	No	50	85	85	87
Vibratory Concrete Mixer	No	20	80	80	80
Vibratory Pile Driver	No	20	95	95	101
Warning Horn	No	5	83	85	83
Welder / Torch	No	40	73	73	74

$Source_{elev}$	5.0	A_{horiz}	24.0	A	25.0
$Receiver_{elev}$	10.0	B_{horiz}	38.0	B	38.1
C	62.2	C_{horiz}	62.0		
P	0.85				
$Barrier_{elev}$	12				
Abarr	12.3				

The above calculations, refering to inputs from the figure at right, helps a user estimate what barrier attenuation (Abarr) to expect (i.e., up to 15 per formula to right) based upon source height (above grade), barrier height, and receiver height, and the horizontal distances between the source and receiver to the barrier. The FTA-based formula in the worksheets use these path length (P) and Abarr values to determine the barrier's insertion loss.



For all other barriers, and for protrusion of terrain above the line of sight:	$A_{barrier} = \min\left\{15 or \left[20\times\log\left(\frac{2.51\sqrt{P}}{\tanh\left[4.46\sqrt{P}\right]}\right)+5\right]\right\}$
Barrier Insertion Loss	$IL_{barrier} = \max\left\{0 or \left[A_{barrier} - 10(G_{NB}-G_B)\log\left(\frac{D}{50}\right)\right]\right\}$

D = closest distance between the receiver and the source, in feet
P = path length difference, in feet (see figure below)
G_{NB} = Ground factor G computed *without barrier* (see Figure 6-5)
G_B = Ground factor G computed *with barrier* (see Figure 6-5)

† The term "tanh(variable)" stands for hyperbolic tangent, available on many scientific calculators. If "tanh" is not available, then compute E = exp(variable), and set tanh(variable) = (E - 1/E) / (E + 1/E), where exp(variable) is the "exponential" function, also written as e^x on calculator keypads.

Sources: Transit Noise & Vibration Impact Assessment (FTA 2006)

ATTACHMENT C

NOISEPRO MODELING DATA

Technical Basis of Dudek's "NoisePro" Excel-based Outdoor Sound Propagation Prediction Model

In summary, the Microsoft Excel-based **NoisePro** outdoor sound propagation model developed by Dudek calculates the aggregate sound pressure level (SPL) received by each and every cell within a two-dimensional (2D) array (a product of X columns of cells by Y rows of cells). The quantity of this received SPL, in A-weighted decibels (dBA), is the logarithmic sum of acoustical contribution from each of "n" user-input sound emitting point sources located on the same 2D array, which may be written as follows:

$$SPL_{X,Y} = 10 * \log \sum_{i=1}^{n} 10^{0.1[L_i - A_i]}$$

where each individual source sound level (L_i) is attenuated by an algebraic sum of three attenuation factors ($A_i = A_{div} + A_{atm} + A_{gr}$) that are each dependent on the distance between the sound source position on the X by Y array and the receiving $SPL_{X,Y}$ position on a different position in the same 2D array of worksheet cells, where each cell is defined by the user as representing the center of a square area having equal sides of user-defined length in feet. The above expression is based on Equation 5 from the International Organization for Standardization (ISO) 9613-2 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation", and the individual attenuation factors used by **NoisePro** emulate those in Equation 4 and may be summarized as follows:

- $\boldsymbol{A_{div}}$ = attenuation due to *geometrical divergence* (i.e., pure distance), equating to 20*LOG(d/d_{ref}); and where $\boldsymbol{d}$ is the horizontal distance between a source and a receiver position, while $\boldsymbol{d_{ref}}$ is the reference distance at which the sound source L_i is defined.
- $\boldsymbol{A_{atm}}$ = attenuation due to *atmospheric absorption*, which for 1,000 Hz (1 kHz) = 4.16*$\boldsymbol{d}$/3280 and is derived from Equation 5.7 in <u>Noise & Vibration Control Engineering</u> (Beranek and Ver, 1992).
- $\boldsymbol{A_{gr}}$ = attenuation due to *ground effects*, appearing as Equation 10 in ISO 9613-2 and can be expressed with the following Excel formula:

  $\boldsymbol{A_{gr}}$ = MAX(0,4.8-[$\boldsymbol{h_s}$+$\boldsymbol{h_r}$]/$\boldsymbol{d}$*[17+984/$\boldsymbol{d}$])

  where $\boldsymbol{h_s}$ and $\boldsymbol{h_r}$ are the heights (in feet) of the sound source and receiver positions above grade, respectively. This means that for small distances, attenuation from ground effects will be small or essentially zero; and, even at great distances, the attenuation from ground effects is effectively capped at 4.8 dB.

The Excel workbook comprising **NoisePro** calculates $SPL_{X,Y}$ by using a coding loop to evaluate the acoustic contribution from each attenuated sound source ($\boldsymbol{L_i}$ - $\boldsymbol{A_i}$) in sequence, and logarithmically adding the new evaluation to the previous total in a cumulative manner. When all sources have been evaluated, the loop terminates and yields an aggregate or log-summed total $SPL_{X,Y}$ value that is thus unique to a position in the 2D array of cells represented by X and Y, and can thus be "mapped". If the user has defined a particular cell in the X by Y array as a uniquely tagged Receiver, then the corresponding $SPL_{X,Y}$ value can be indexed and displayed accordingly.

The resulting output array of cells, each having an individually calculated $SPL_{X,Y}$ numerical value, is then filled with a color (from a user-defined palette) by application of a Conditional Formatting rules set (an Excel formatting feature) that compares the dB quantity with user-defined "high" and "low" dB ranges for each available color. Each colored cell can thus be likened to a "pixel" within a 2D array that forms a composite image representing—visually—the sound propagation from all modeled sound sources.

GRID CALCULATION WORKSHEET

Example Portion of Concluded Calculations Loop

grid size (ft)		
x	11.9	
y	11.9	
rcvr plane height (ft)		
z	5	
Grid Upper Left (C,R)		
1	1	
Grid Lower Right (C,R)		
120	90	Receiver Location

Source	9
Source TYPE	HVAC09
Source X-coordinate	1023.4
Source Y-coordinate	761.6
Source Z-coordinate	3
Source Reference SPL	64
Source Ref. Distance (ft.)	3.28
Source height above grade (ft.)	3

Column	Row	X-coord	Y-coord	Z-coord	Cumulative SPL
1	1	11.9	11.9	5	10.59
1	2	11.9	23.8	5	10.50
1	3	11.9	35.7	5	10.49
1	4	11.9	47.6	5	10.51
1	5	11.9	59.5	5	10.55
1	6	11.9	71.4	5	10.60
1	7	11.9	83.3	5	10.65
1	8	11.9	95.2	5	10.71
1	9	11.9	107.1	5	10.76
1	10	11.9	119	5	10.82
1	11	11.9	130.9	5	10.88
1	12	11.9	142.8	5	10.93
1	13	11.9	154.7	5	10.99
1	14	11.9	166.6	5	11.04
1	15	11.9	178.5	5	11.10
1	16	11.9	190.4	5	11.15
1	17	11.9	202.3	5	11.20
1	18	11.9	214.2	5	11.25
1	19	11.9	226.1	5	11.30
1	20	11.9	238	5	11.34
1	21	11.9	249.9	5	11.39
1	22	11.9	261.8	5	11.43
1	23	11.9	273.7	5	11.48
1	24	11.9	285.6	5	11.52
1	25	11.9	297.5	5	11.55
1	26	11.9	309.4	5	11.59
1	27	11.9	321.3	5	11.63
1	28	11.9	333.2	5	11.66
1	29	11.9	345.1	5	11.69
1	30	11.9	357	5	11.72
1	31	11.9	368.9	5	11.75

Source Inventory With Model Grid Coordinate Locations and Sound Pressure Reference Levels

Source	1	2	3	4	5	6	7	8	9
Source Tag	HVAC01	HVAC02	HVAC03	HVAC04	HVAC05	HVAC06	HVAC07	HVAC08	HVAC09
Source X-coordinate	725.9	785.4	844.9	892.5	952	999.6	1023.4	1023.4	1023.4
Source Y-coordinate	487.9	487.9	487.9	487.9	487.9	487.9	642.6	714	761.6
Source Z-coordinate	3	3	3	3	3	3	33	3	3
Source Type	HVAC	HVAC	HVAC	HVAC	HVAC	HVAC	HVAC	HVAC	HVAC
Source Ref. SPL	64	64	64	64	64	64	64	64	64
Source Ref. Dist.(ft.)	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28

Receiver Inventory With Model Grid Coordinate Locations and Predicted Operational Sound Level Exposure

Receiver	**R1**	**R2**	**R3**	**R4**	**R5**
Source Tag	R1	R2	R3	R4	R5
X-Coordinate	988	1071	1071	952	809
Y-Coordinate	881	702	559	440	440
Modeled SPL	**34.8**	**36.8**	**31.9**	**37.7**	**37.4**

ATTACHMENT D

TRAFFIC NOISE MODELING DATA

FHWA - HIGHWAY TRAFFIC NOISE PREDICTION MODEL

(modified for CNEL)

DUDEK

PROJECT:	Sanctuary Encinitas	JN:	15009
ROADWAY:	Rancho Santa Fe Road - North of 7th	DATE:	2/21/2023
Scenario:	**Existing**	BY:	J. Leech

ADT	12,579		PK HR VOL	1,258
SPEED	40			
PK HR %	10			
DIST CTL	50			
DIST N/F	36	(M=76,P=52,S=36,C=12)	AUTO SLE DISTANCE	46.9
DIST WALL	0		MED TRUCK SLE DIST	46.7
DIST W/OB	50		HVY TRUCK SLE DIST	46.7
HTH WALL	0.0	********		
HTH OBS	5.0			
AMBIENT	45.0			
ROADWAY VIEW:				
LF ANGLE	-45			
RT ANGLE	45			
DF ANGLE	90			

SITE CONDITIONS: (15=HARD SITE, 10=SOFT SITE)

AUTOM	15.0
MED TR	15.0
HVY TR	15.0
BARRIER	0 (0=WALL,1=BERM)

ELEVATIONS:

PAD	0.0	AUTOMOBILES =	0.00
ROAD	0.0	MEDIUM TRUCKS=	2.30
		HEAVY TRUCKS =	8.01
GRADE:	0.0 %	GRADE ADJUSTM=	0.0 (TO HEAVY TRUCKS)

VEHICLE DISTRIBUTION:

	DAY	EVE	NIGHT	DAILY
AUTOMOBILES	0.770	0.127	0.096	0.9700
MEDIUM TRUCKS	0.874	0.051	0.075	0.0200
HEAVY TRUCKS	0.891	0.028	0.081	0.0100

NOISE IMPACTS WITHOUT TOPO OR BARRIER SHIELDING:

	LEQ PK HR	LEQ DAY	LEQ EVE	LEQ NIGHT	CNEL
AUTOMOBILES	64.3	62.3	60.5	54.5	63.7
MEDIUM TRUCKS	58.6	57.3	50.9	47.9	57.4
HEAVY TRUCKS	60.9	59.6	50.7	50.4	59.6
VEHICULAR NOISE	**66.7**	65.0	61.4	56.6	65.8

FHWA - HIGHWAY TRAFFIC NOISE PREDICTION MODEL

(modified for CNEL)

DUDEK

PROJECT:	Sanctuary Encinitas	JN:	15009
ROADWAY:	Rancho Santa Fe Road - North of 7th	DATE:	2/21/2023
Scenario:	**Existing + Project**	BY:	J. Leech

ADT	12,597		PK HR VOL	1,260
SPEED	40			
PK HR %	10			
DIST CTL	50			
DIST N/F	36	(M=76,P=52,S=36,C=12)	AUTO SLE DISTANCE	46.9
DIST WALL	0		MED TRUCK SLE DIST	46.7
DIST W/OB	50		HVY TRUCK SLE DIST	46.7
HTH WALL	0.0	********		
HTH OBS	5.0			
AMBIENT	45.0			
ROADWAY VIEW:				
LF ANGLE	-45			
RT ANGLE	45			
DF ANGLE	90			

SITE CONDITIONS: (15=HARD SITE, 10=SOFT SITE)

AUTOM	15.0
MED TR	15.0
HVY TR	15.0
BARRIER	0 (0=WALL,1=BERM)

ELEVATIONS:

PAD	0.0	AUTOMOBILES =	0.00
ROAD	0.0	MEDIUM TRUCKS=	2.30
		HEAVY TRUCKS =	8.01
GRADE:	0.0 %	GRADE ADJUSTM=	0.0 (TO HEAVY TRUCKS)

VEHICLE DISTRIBUTION:

	DAY	EVE	NIGHT	DAILY
AUTOMOBILES	0.770	0.127	0.096	0.9700
MEDIUM TRUCKS	0.874	0.051	0.075	0.0200
HEAVY TRUCKS	0.891	0.028	0.081	0.0100

NOISE IMPACTS WITHOUT TOPO OR BARRIER SHIELDING:

	LEQ PK HR	LEQ DAY	LEQ EVE	LEQ NIGHT	CNEL
AUTOMOBILES	64.3	62.3	60.5	54.5	63.8
MEDIUM TRUCKS	58.6	57.3	50.9	47.9	57.4
HEAVY TRUCKS	60.9	59.6	50.7	50.4	59.6
VEHICULAR NOISE	**66.7**	65.0	61.4	56.6	65.8

FHWA - HIGHWAY TRAFFIC NOISE PREDICTION MODEL

(modified for CNEL)

DUDEK

PROJECT:	Sanctuary Encinitas	JN:	15009
ROADWAY:	Rancho Santa Fe Road - South of 7th	DATE:	2/21/2023
Scenario:	**Existing**	BY:	J. Leech

ADT	13,175		PK HR VOL	1,318
SPEED	40			
PK HR %	10			
DIST CTL	50			
DIST N/F	36	(M=76,P=52,S=36,C=12)	AUTO SLE DISTANCE	46.9
DIST WALL	0		MED TRUCK SLE DIST	46.7
DIST W/OB	50		HVY TRUCK SLE DIST	46.7
HTH WALL	0.0	********		
HTH OBS	5.0			
AMBIENT	45.0			
ROADWAY VIEW:				
LF ANGLE	-45			
RT ANGLE	45			
DF ANGLE	90			

SITE CONDITIONS: (15=HARD SITE, 10=SOFT SITE)

AUTOM	15.0
MED TR	15.0
HVY TR	15.0
BARRIER	0 (0=WALL,1=BERM)

ELEVATIONS:

PAD	0.0	AUTOMOBILES =	0.00
ROAD	0.0	MEDIUM TRUCKS=	2.30
		HEAVY TRUCKS =	8.01
GRADE:	0.0 %	GRADE ADJUSTM=	0.0 (TO HEAVY TRUCKS)

VEHICLE DISTRIBUTION:

	DAY	EVE	NIGHT	DAILY
AUTOMOBILES	0.770	0.127	0.096	0.9700
MEDIUM TRUCKS	0.874	0.051	0.075	0.0200
HEAVY TRUCKS	0.891	0.028	0.081	0.0100

NOISE IMPACTS WITHOUT TOPO OR BARRIER SHIELDING:

	LEQ PK HR	LEQ DAY	LEQ EVE	LEQ NIGHT	CNEL
AUTOMOBILES	64.5	62.5	60.7	54.7	63.9
MEDIUM TRUCKS	58.8	57.5	51.1	48.1	57.6
HEAVY TRUCKS	61.1	59.8	50.9	50.6	59.8
VEHICULAR NOISE	**66.9**	65.2	61.6	56.8	66.0

FHWA - HIGHWAY TRAFFIC NOISE PREDICTION MODEL

(modified for CNEL)

DUDEK

PROJECT:	Sanctuary Encinitas	JN:	15009
ROADWAY:	Rancho Santa Fe Road - South of 7th	DATE:	2/21/2023
Scenario:	**Existing + Project**	BY:	J. Leech

ADT	13,247		PK HR VOL	1,325
SPEED	40			
PK HR %	10			
DIST CTL	50			
DIST N/F	36	(M=76,P=52,S=36,C=12)	AUTO SLE DISTANCE	46.9
DIST WALL	0		MED TRUCK SLE DIST	46.7
DIST W/OB	50		HVY TRUCK SLE DIST	46.7
HTH WALL	0.0	********		
HTH OBS	5.0			
AMBIENT	45.0			
ROADWAY VIEW:				
LF ANGLE	-45			
RT ANGLE	45			
DF ANGLE	90			

SITE CONDITIONS:		(15=HARD SITE, 10=SOFT SITE)
AUTOM	15.0	
MED TR	15.0	
HVY TR	15.0	
BARRIER	0	(0=WALL,1=BERM)

ELEVATIONS:				
PAD	0.0	AUTOMOBILES =	0.00	
ROAD	0.0	MEDIUM TRUCKS=	2.30	
		HEAVY TRUCKS =	8.01	
GRADE:	0.0 %	GRADE ADJUSTM=	0.0	(TO HEAVY TRUCKS)

VEHICLE DISTRIBUTION:

	DAY	EVE	NIGHT	DAILY
AUTOMOBILES	0.770	0.127	0.096	0.9700
MEDIUM TRUCKS	0.874	0.051	0.075	0.0200
HEAVY TRUCKS	0.891	0.028	0.081	0.0100

NOISE IMPACTS WITHOUT TOPO OR BARRIER SHIELDING:

	LEQ PK HR	LEQ DAY	LEQ EVE	LEQ NIGHT	CNEL
AUTOMOBILES	64.5	62.6	60.8	54.8	64.0
MEDIUM TRUCKS	58.9	57.5	51.1	48.1	57.6
HEAVY TRUCKS	61.1	59.8	50.9	50.6	59.8
VEHICULAR NOISE	**66.9**	65.2	61.6	56.8	66.1

FHWA - HIGHWAY TRAFFIC NOISE PREDICTION MODEL

(modified for CNEL)

DUDEK

PROJECT:	Sanctuary Encinitas	JN:	15009
ROADWAY:	Project Driveway	DATE:	2/21/2023
Scenario:	**Project Traffic**	BY:	J. Leech

ADT	90		PK HR VOL	9
SPEED	25			
PK HR %	10			
DIST CTL	30			
DIST N/F	36	(M=76,P=52,S=36,C=12)	AUTO SLE DISTANCE	24.5
DIST WALL	0		MED TRUCK SLE DIST	24.2
DIST W/OB	30		HVY TRUCK SLE DIST	24.2
HTH WALL	0.0	********		
HTH OBS	5.0			
AMBIENT	45.0			
ROADWAY VIEW:				
LF ANGLE	-45			
RT ANGLE	45			
DF ANGLE	90			

SITE CONDITIONS:		(15=HARD SITE, 10=SOFT SITE)
AUTOM	15.0	
MED TR	15.0	
HVY TR	15.0	
BARRIER	0	(0=WALL,1=BERM)

ELEVATIONS:				
PAD	0.0	AUTOMOBILES =	0.00	
ROAD	0.0	MEDIUM TRUCKS=	2.30	
		HEAVY TRUCKS =	8.01	
GRADE:	0.0 %	GRADE ADJUSTM=	0.0	(TO HEAVY TRUCKS)

VEHICLE DISTRIBUTION:

	DAY	EVE	NIGHT	DAILY
AUTOMOBILES	0.770	0.127	0.096	0.9700
MEDIUM TRUCKS	0.874	0.051	0.075	0.0200
HEAVY TRUCKS	0.891	0.028	0.081	0.0100

NOISE IMPACTS WITHOUT TOPO OR BARRIER SHIELDING:

	LEQ PK HR	LEQ DAY	LEQ EVE	LEQ NIGHT	CNEL
AUTOMOBILES	41.3	39.4	37.6	31.6	40.8
MEDIUM TRUCKS	36.6	35.2	28.9	25.8	35.3
HEAVY TRUCKS	40.8	39.5	30.5	30.3	39.5
VEHICULAR NOISE	**44.8**	43.2	38.8	34.6	43.8

ATTACHMENT A

AMBIENT NOISE MEASUREMENT DATA

ATTACHMENT B

CONSTRUCTION NOISE MODELING DATA

ATTACHMENT C

NOISEPRO MODELING DATA

ATTACHMENT D

TRAFFIC NOISE MODELING DATA