Stantec

Noise Study Report

Draft Noise Study Report
for the Harvard Avenue and Michelson Drive Intersection Improvement Project, Irvine, California

October 16, 2019

Prepared for:

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Abbreviations

Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
dB	Decibels
dBA	A-weighted decibel
DHS	Department of Health Services
FTA	Federal Transit Administration
Hz and kHz	Hertz and kilohertz
IBC	Irvine Business Complex
L_{dn}	Day-night average noise level
L_{eq}	Equivalent sound level
L_{max}	Maximum sound level
LOS	Level of Service
μPa	Micro-Pascals
mph	Miles per hour
NEPA	National Environmental Policy Act
NSR	Noise Study Report
PPV	Peak particle velocity
rms	Root mean square
SPL	Sound pressure level
VdB	Vibration decibels

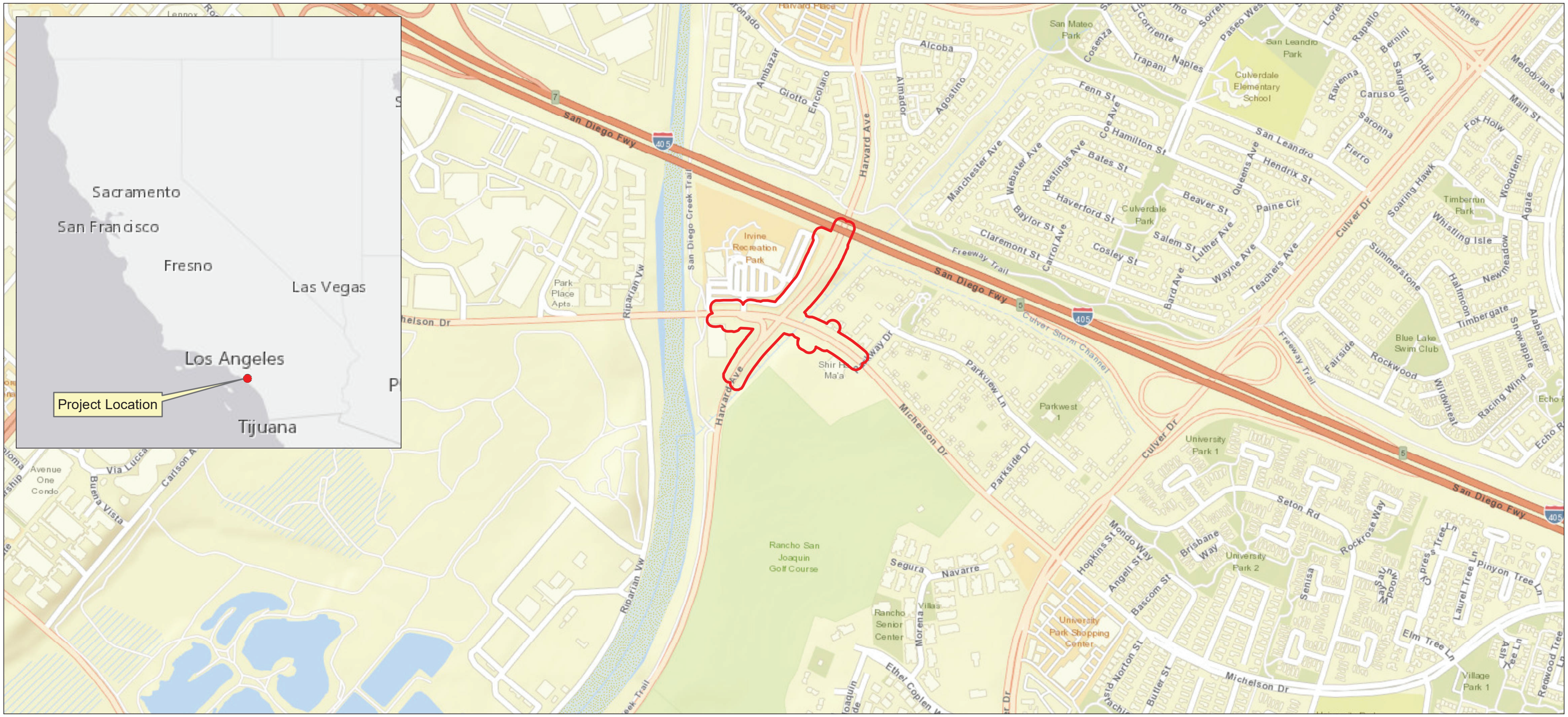
1.0 INTRODUCTION

This Noise Study Report provides an assessment of the potential noise impacts related to the proposed Harvard Avenue and Michelson Drive Intersection Improvement Project (Project). The proposed Project is located in Orange County in the City of Irvine (see Figure 1). It is one of the mitigations identified in both 2010 and 2015 Irvine Business Complex (IBC) Vision Plan Traffic Studies and would improve circulation in the western portion of City of Irvine.

The proposed roadway layout and associated improvements, including revised geometries for the Harvard Avenue and Michelson Drive intersection are summarized below. Each location describes the approach to the intersection and for the purpose of this description, Harvard Avenue is considered going north/south and Michelson Drive going east/west.

- Northbound Harvard Avenue:
  - Existing – One left-turn lane, two through lanes, and a Class II on-street bike lane;
  - Proposed – Re-stripe to lengthen left-turn lane, maintain two through lanes, and restripe to provide a de facto right turn lane.
- Southbound Harvard Avenue:
  - Existing – one left-turn lane, two through lanes, and one right-turn lane;
  - Proposed – Add one left turn lane for a total of two left-turn lanes, maintain two through lanes and one right turn lane, provide a Class II on-street bike lane towards intersection stop line, add 10-foot off-street shared use path for bikes and pedestrians;
- Eastbound Michelson Drive:
  - Existing – Two left-turn lanes, two through lanes and one non-standard free right-turn lane;
  - Proposed – Maintain two left-turn lanes, two through lanes and remove non-standard free right-turn lane and replace with designated right-turn lane, add a 10-foot off-street shared use path for bikes and pedestrians; narrow west end of existing median
- Westbound Michelson Drive:
  - Existing – One left-turn lane and two through lanes.

In order to accommodate the new roadway design and ensure its safe operation, widening of the southwest and northwest quadrants of Harvard Avenue would be needed. The existing “Pork Chop” along the northeast quadrant of Harvard Avenue will be eliminated in order to improve the intersection’s operational characteristics. Additional project components include a shared use path to accommodate the heavy pedestrian and bike traffic, Class II on-street bike lane, reconstructed storm drain/catchment basin, reconstructed and landscaped slope, and other related roadway improvements (e.g., lane restriping, relocation of street lights).



Study Area

0 170 340 metres
(At original document size of 11x17)
1:9,000

N

Project Location
Irvine, California

Prepared by DL on 2019-09-10
TR by RB on 2019-09-10
IR Review by JV on 2019-09-10

Client/Project 2042557300

Harvard Avenue and Michelson Drive
Intersection Improvement Project

Figure No.

1

Title

Project Location

Notes

1. Coordinate System: NAD 1983 2011 StatePlane California VI FIPS 0406 Ft US
2. Data Sources:
3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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1.1 SETTING

1.1.1 Sound, Noise, and Acoustics

Sound is mechanical energy transmitted by pressure waves in a compressible medium (i.e., gaseous, liquid, or the elastic stage of a solid). *Noise* is generally defined as unwanted sound that may be loud, unpleasant, unexpected, or undesired.

For acoustical evaluation, the fundamental model consists of a sound/ noise source, a receptor, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receptor determine the sound level and characteristics of the noise perceived by the receptor. Noise may be generated from a point source, such as a piece of construction equipment, or from a line source, such as moving motor vehicles along a roadway. The field of acoustics deals primarily with the propagation and control of sound.

Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). Low-frequency sounds are low in pitch. Frequency relates to the pressure waves oscillations and is expressed in terms of rate of cycles per second or Hertz (Hz). The human hearing system is not equally sensitive to sound at all frequencies. The audible frequency range for human is generally between 20 Hz and approximately 20,000 Hz (or 20 kilohertz [kHz]).

1.1.2 Sound Pressure Level and Decibels

The amplitude of pressure waves (the difference between ambient air pressure and the peak pressure of the sound wave) generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (μPa), that is, one hundred billionths (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000 μPa. Because of this vast range of values, sound pressure level (SPL) is measured and quantified using a logarithmic scale and is described as decibel (dB). The threshold of hearing for a healthy human ear is about 0 dB, which corresponds to 20 μPa.

Because decibels are logarithmic units, adding and subtracting sound levels cannot be performed through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase in sound level. That is, two identical sources will result in 3 dB higher sound level at any given distance than one source under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB—rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level 5 dB louder than one source.

A-Weighted Decibels

Sound pressure level alone is not a reliable indicator of loudness. The dominant frequency of a sound also has a substantial effect on how humans will respond. The human hearing system is not equally sensitive to sound at all frequencies. Therefore, to approximate this, frequency-dependent human response, the A-weighted system is used to adjust measured sound levels. The A-weighted sound level is expressed as “dBA.” This scale de-emphasizes low frequencies to which human hearing is less sensitive and focuses on mid- to high-range frequencies. In general, the healthy human ear is most sensitive to sound frequencies between 1,000 Hz and 5,000 Hz, and it perceives a sound within that range as being more intense than a sound of higher or lower frequency with the same magnitude. The A-scale weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. Table N-1 shows typical A-weighted noise levels for various noise sources.

Table 1. Typical A-Weighted Sound Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1000 feet		
	— 100 —	
Gas lawn mower at 3 feet		
	— 90 —	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	— 80 —	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	— 70 —	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	— 60 —	
		Large business office
Quiet urban daytime	— 50 —	Dishwasher next room
Quiet urban nighttime	— 40 —	Theater, large conference room (background)
Quiet suburban nighttime		
	— 30 —	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: Caltrans 2013.

Generally, a change of 3 dB in environmental noise is detectible by human ear. A change of 5 dB or greater is readily perceptible, and a change of 10 dB is perceived as being twice or half as loud. Changes of 1 to 3 dB are detectable only under quiet, controlled conditions; and changes of less than 1 dB are usually indiscernible. Noise levels from a particular source generally decline as distance to the receptor increases. Other factors such as the weather and reflecting or shielding, also intensify or reduce the noise level at any given location.

Noise Descriptors

The intensity of environmental noise fluctuates over time, some noise levels fluctuate rapidly, others slowly, some occur in regular patterns, others are random. Several noise descriptors have been developed to incorporate the dependence of the effect of noise on the total acoustical energy content as well as the duration of occurrence. The most commonly used descriptors are:

Equivalent sound level (L_{eq}), is an average of the sound energy occurring over a specified period. In effect, L_{eq} is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period.

Maximum sound level (L_{max}) is the highest instantaneous sound level measured during a specified period.

Day-night average noise level (L_{dn}) is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.

Community noise equivalent level (CNEL). Similar to L_{dn}, CNEL is the energy average of the A-weighted sound levels over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m., and a 5-dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

Sound Propagation and Attenuation

Geometric Spreading. Sound from a localized or point source propagates uniformly outward in a spherical pattern. The sound level decreases (attenuates) at a rate of 6 dB for each doubling of distance from a point source. Noise from a line source such as vehicles moving on a roadway, propagates in a cylindrical pattern and sound level attenuates at a rate of approximately 3 dB per doubling of distance, depending on ground surface characteristics. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water), no excess ground attenuation is assumed. For acoustically soft sites (i.e., sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 dB per doubling of distance is normally assumed. When added to the geometric spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 dB per doubling of distance for a line source and 7.5 dB per doubling of distance for a point source.

Atmospheric Effects. Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound levels can be increased at large distances (e.g., more than 500 feet) from the highway due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. The amount of attenuation provided by shielding depends on the size of the barrier and the frequency content of the noise source.

1.1.3 Ground-borne Vibration

Vibration is sound radiated through the ground. The rumbling sound caused by the vibration of building interior surfaces is called ground-borne noise. Typical sources of ground-borne vibration are construction equipment, steel-wheeled trains, and occasional traffic on rough roads. Problems from ground-borne vibration and noise from these sources are usually localized to areas within 100 feet from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 feet. When roadways are smooth, vibration from traffic, even heavy trucks, is rarely perceptible. The roadway surfaces in the project area are smooth and ground-borne vibration from street traffic would be negligible. Vibration velocity is most often described in terms of peak particle velocity (PPV) for purposes of ground-borne vibration analysis.

1.1.4 Sensitive Receptors

Some land uses are considered more sensitive to intrusive noise than others due to the amount of noise exposure and the types of activities typically involved at the receptor location. Residences, schools, motels and hotels, libraries, religious institutions, hospitals, nursing homes, and parks are generally more sensitive to noise than commercial and industrial land uses. The closest sensitive uses to the project site are residences of the Park West apartment homes to the northeast of the intersection. The closest residence is located about 165 feet from the edge of Harvard Avenue northeast of the intersection across San Joaquin Channel, University Synagogue approximately 300 feet southwest of the intersection, and the closest school/day care center is the Michelson KinderCare located at 3663 Michelson Drive, approximately 590 feet east of the intersection.

1.1.5 Regulatory Setting

Noise Regulations and Standards

The Project would be required to comply with the following regulatory conditions from the City of Irvine and State of California.

City of Irvine

The Noise Element of the City of Irvine General Plan includes strategies to protect the community from harmful and annoying noise and vibration impacts. As such, the City has established regulations regarding allowable increases in noise levels as a result of project implementation.

The following lists the City of Irvine noise and vibration regulations applicable to all projects in the City.

Municipal Code Section 6-8-205(A) — Construction Noise

City of Irvine Municipal Code, Section 6, Title 8, Chapter 2 includes regulations in order to control unnecessary, excessive and annoying noise in the City. The provisions of this chapter are applicable to non-transportation-related, stationary noise sources. Specifically, Section 6-8-205(A) of the City's Municipal Code limits construction noise sources between 7:00 a.m. and 7:00 p.m. Mondays through Fridays, and 9:00 a.m. and 6:00 p.m. on Saturdays. No construction activities shall be permitted outside of these hours or on Sundays and federal holidays.

General Plan Objective F-1: Mobile Noise

Objective F-1 of the Irvine General Plan requires that projects do not generate noise levels that exceed the City's interior and exterior noise standards. The nearby sensitive receptors to the proposed Project include multi-family residential, and church/synagogue land uses. For multi-family residential uses (the City’s most noise restrictive land use), the City provides an interior noise standard of 45 dBA CNEL and an exterior noise standard of 65 dBA CNEL for private balcony areas. For residential balconies that do not meet the 65 dBA CNEL noise standard, the City provides an exemption if an occupancy disclosure notice is provided to all future tenants detailing the potential noise impacts to the balconies. For churches and places of worship, the City provides an interior noise standard of 45 dBA CNEL and no exterior noise standard. Parks have a 65 dBA exterior standard.

State of California Rules

The following lists the State of California rules that are applicable to all industrial projects in the State.

California Vehicle Code Section 27200-27207 — On-Road Vehicle Noise

California Vehicle Code Section 27200-27207 provides noise limits for vehicles operated in California. For vehicles over 10,000 pounds noise is limited to 88 dB for vehicles manufactured before 1973, 86 dB for vehicles manufactured before 1975, 83 dB for vehicles manufactured before 1988, and 80 dB for vehicles manufactured after 1987. All measurements are based at 50 feet from the vehicle.

California Vehicle Section 38365-38380 — Off-Road Vehicle Noise

California Vehicle Code Section 38365-38380 provides noise limits for off-highway motor vehicles operated in California. Code 365 requires that off-highway vehicles be equipped with an adequate muffler in constant operation and properly maintained, and no muffler or exhaust system shall be equipped with a cutout, bypass, or similar device. 92 dBA for vehicles manufactured before 1973, 88 dBA for vehicles manufactured before 1975, 86 dBA for vehicles manufactured before 1986, and 82 dBA for vehicles manufactured after December 31, 1985. All measurements are based at 50 feet from the vehicle. Furthermore, Code 365 requires that off-highway vehicles in constant operation, to be equipped with an adequate muffler and properly maintained. Whereas, no muffler or exhaust system shall be equipped with a cutout, bypass, or similar device.

Vibration Standards/Criteria

Title 14 of the California Administrative Code Section 15000 requires that all state and local agencies implement the CEQA Guidelines, which requires the analysis of exposure of persons to excessive groundborne vibration. However, no statute has been adopted by the state that quantifies the level at which excessive groundborne vibration occurs.

Caltrans published the *Transportation and Construction Vibration Guidance Manual* in 2004, which was updated in 2013. The manual provides guidance to Caltrans engineers, planners, and consultants for addressing vibration issues associated with the construction, operation, and maintenance of Caltrans projects. However, this manual is also used as a reference point by many lead agencies and CEQA practitioners throughout California, as it provides numeric threshold criteria for vibration impacts. The manual includes summary of vibration criteria that have been reported by various researchers, organizations, and governmental agencies. Threshold criteria are developed to be used for evaluating the potential for damage and annoyance from vibration-generating activities.

The City of Irvine has adopted the Federal Transportation Administration (FTA) criteria for: a) Human Annoyance - acceptable levels of groundborne vibration based on the relative perception of a vibration event for vibration sensitive land uses, and b) Structural Damage – the levels at which groundborne vibration is strong enough to cause structural damage. These criteria are also used in Caltrans guidance manual. Tables N-2 and N-3 include these levels.

Table 2. Groundborne Vibration and Noise Impact Criteria – Human Annoyance

Land Use Category	Maximum Lv (VdB)[1]	Description
Workshop	90	Distinctly felt vibration. Appropriate to workshops and nonsensitive areas
Office	84	Felt vibration. Appropriate to offices and nonsensitive areas.
Residential – Day	78	Barely felt vibration. Adequate for computer equipment.
Residential – Night, Operating Rooms	72	Vibration not felt, but groundborne noise may be audible inside quiet rooms.

Notes: VdB = vibration velocity in decibels

Maximum vibration level as measured in 1/3-octave bands of frequency over the frequency ranges of 8 to 80 Hz.

Source: FTA, 2006

Table 3. Groundborne Vibration and Noise Impact Criteria – Structural Damage

Building Category		PPV (inch/sec)[1]	VdB
I.	Reinforced concrete, steel or timber (no plaster)	0.5	102
II.	Engineered concrete and masonry (no plaster)	0.3	98
III.	Nonengineered timber and masonry buildings	0.2	94
IV.	Buildings extremely susceptible to vibration damage	0.12	90

Notes: PPV = peak particle velocity; VdB = vibration velocity in decibels

Root mean square (RMS) calculated from vibration level (VdB) using the reference of one micro inch per second.

Source: FTA, 2006

2.0 IMPACT ANALYSIS

IMPACT N-a) ***Would the Project generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the Project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?***

Less Than Significant Impact. Impacts from construction and operation of the proposed Project are analyzed below.

Construction Impact

During construction of the proposed Project, noise from construction activities may intermittently dominate the noise environment in the nearby area of the construction site. The Project construction activities anticipated to include demolition of the existing sidewalks and curbs, grading and trenching, construction of subgrade and curbs, and paving and restriping. Construction noise levels would fluctuate depending on construction activity, equipment type and duration of use, and the distance between the noise source and receiver. The nearest sensitive receptors to the proposed Project are of the Park West Apartments located northeast of the intersection, along Harvard Avenue. The residence closest to the proposed Project is approximately 165 feet from the edge of Harvard Avenue and about 200 feet from the construction site.

Typical sound emission characteristics of construction equipment are provided in Table N-4 (Typical Construction Equipment Noise Levels).

Table 4. Construction Equipment Noise Levels

Equipment	Maximum Noise Level (dBA at 50 feet)
Scrapers	89
Bulldozers	85
Heavy Trucks	88
Backhoe	80
Pneumatic Tools	85
Concrete Pump	82

Source: FTA, 2006 and FTA, 2018

Construction equipment are expected to generate noise levels ranging from 80 to 90 dB at a distance of 50 feet, and noise produced by construction equipment would be reduced over this distance at a rate of about 6 dB per doubling of distance. Assuming the simultaneous operation of one bulldozer and one large truck at the construction site on Harvard Avenue at the northwest portion of the intersection (both equipment at full power) with no intervening noise barriers, the combined noise level at the nearest sensitive receptor may reach levels of up to 78 dBA L_{max} for intermittent, brief events. However, because equipment moves around the Project site and because most construction equipment is at full power about 40 percent of the time, average noise levels would be less. Based on the above discussion, construction equipment noise would be noticeable intermittently at the nearest sensitive receptors. However, adherence to the City of Irvine noise ordinances regarding construction hours would ensure that noise impacts from the proposed Project's construction activities would be less than significant and no mitigation is required.

Furthermore, construction-related traffic, including delivery trucks and construction workers commute to the worksite would not be substantial due to the small-scale and short-duration nature of the work and there would be no activities or deliveries on Sundays or federal holidays. The impact would be less than significant, and no mitigation is required.

Operation Impact

The proposed Project improvements were previously noted above. Project implementation would improve level of service (LOS) during PM peak hours, however, based on the Project Traffic Analysis Memorandum (Stantec, 2020), traffic volumes and fleet mix along the Harvard Avenue or Michelson Drive would not change compared to the no-build scenario. The additional left turn would not result in bringing traffic closer to the sensitive receptors, as the widening will be on the northwest of the intersection while the nearest residences are located along the northbound Harvard Avenue, northeast of the intersection.

The improved LOS during PM peak hour would result in increased PM peak hour speed; however, the increase in noise (L_{eq}) would be limited to the PM peak hours and would not result in a significant or measurable change in the operational noise level at the receptors. Therefore, noise impact would be less than significant, and no mitigation is required.

IMPACT N-b) ***Would the Project generate excessive groundborne vibration or groundborne noise levels*?**

Less Than Significant Impact. Impacts from construction and operation of the proposed Project are analyzed below.

Construction Impact

Construction activities may generate varying degrees of ground vibration, depending on the construction procedures and the construction equipment used on site. The PPV at 25 feet from construction equipment pieces that are typically used during roadway projects construction are listed in Table N-5 below. Also shown in Table N-5 are the calculated PPV and root mean square (rms) vibration velocities at 100 feet distance from the construction equipment.

For the proposed Project construction, groundborne vibration would be generated primarily during the demolition of the existing sidewalk, curbs and gutters on the southbound segment of Harvard Avenue, and site grading processes when heavy trucks and equipment move within construction site. No pile driving would be used for the proposed Project construction. As shown in Table N-5, vibration velocities from typical heavy construction equipment that would be used during project construction range from

0.003 to 0.089 inch/sec PPV at 25 feet from the source of activity. At 100 feet from the source of activity, vibration velocities range from 0.0004 to 0.011 inch/sec PPV, or 40 to 76 VdB rms.

Table 5. Vibration Levels for Construction Equipment

Equipment	PPV at 25 feet (inch/second)	RMS at 25 ft (VdB)	PPV at 100 feet (inch/second)	RMS at 100 ft (VdB)
Vibratory roller	0.21	94	0.026	76
Large bulldozer	0.089	87	0.011	69
Caisson drilling	0.089	87	0.011	69
Loaded trucks	0.076	86	0.010	68
Jackhammer	0.035	79	0.004	61
Small bulldozer	0.003	58	0.0004	39.5

Source: FTA, 2006 and Caltrans, 2013

For the equipment used in proposed Project construction, the PPV from vibratory roller, bulldozer and heavy truck operations is shown to be 0.21 PPV, 0.089 PPV and 0.076 PPV, respectively, at a distance of 25 feet. The proposed Project construction site would be farther than 100 feet from the nearest sensitive receptor and thus well below the PPV threshold of 0.2 inch per second and even 0.12 inch per second. Therefore, impacts would be less than significant, and no mitigation measures are required.

Operation Impact

As described above, upon completion of construction activities, the proposed Project would not generate any additional traffic, and vehicle trips and fleet mix are expected to remain the same as no-build scenario. Therefore, there would be no Project-related increase in groundborne vibration or noise. Impacts related to vibration would not occur, and no mitigation is required.

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

No Impact. The proposed Project is not within the vicinity of a private airstrip. The Project site is located within the City's Land Use Planning Area 19 and is approximately 1.7 miles west of the John Wayne Airport. The Project site is located outside of the 60-dBA CNEL contour considered for areas potentially affected by noise from the airport operations and thus, not affected by airport noise (see Figure 2). Furthermore, the proposed Project does not involve development of a residential land use or permanent employment that could be subjected to airport noise. Therefore, the proposed Project would not have the potential to expose people residing or working in the Project area to excessive noise levels and no impact would occur.

Project Location

Stantec

Project Location
Irvine, California

Prepared by DL on 2019-09-10
TR by RB on 2019-09-10
IR Review by JY on 2019-09-10

Client/Project
2042567300

Harvard Avenue and Michelson Drive
Intersection Improvement Project

Figure No. 2

Title

Airport Noise Contours

Source: *John Wayne Airport, 2018 Annual CNEL Noise Contours*

3.0 REFERENCES

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