Oakland Alameda Access Project

Noise Study Report

Interstate 880 (PM ALA 30.47 to PM 31.61) and State Route 260 (PM ALA R0.78 to R1.90)

OAKLAND AND ALAMEDA, CALIFORNIA

EA 04-0G360

April 2020

Caltrans

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APRIL 2020

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Summary

The Oakland Alameda Access Project (Project) would improve access along Interstate-880 (I-880) and the Posey and Webster Tubes, within downtown Oakland, and within the City of Alameda. Within the approximately 1-mile-long project extent, I-880 (PM ALA 30.47 to PM 31.61) and State Route 260 (SR-260) (PM ALA R0.78 to R1.90) are major transportation corridors. Moreover, the I-880 freeway viaduct is a physical barrier, limiting bicycle and pedestrian connectivity between downtown Oakland and Chinatown to the north and the Jack London District and Oakland Estuary to the south. Existing local street patterns across I-880 are intertwined with freeway entrance and exit ramps and the Posey and Webster tubes (Tubes) through downtown Oakland and to and from the City of Alameda, affecting the cross-freeway circulation of motorists, bicyclists, and pedestrians. The project footprint includes all of the improvements located within the project study area boundaries.

The purpose of the Project is to; 1) improve mobility and accessibility for travelers between I-880, SR-260 (Tubes), City of Oakland downtown neighborhoods, and the City of Alameda; 2) reduce freeway-bound regional traffic and congestion on local roadways and in area neighborhoods; 3) reduce conflicts between regional and local traffic; and 4) improve bicycle and pedestrian connectivity within the project study area.

The purpose of this Noise Study Report (NSR) is to evaluate noise impacts and abatement under the requirements of Title 23, Part 772 of the Code of Federal Regulations (23 CFR 772) “Procedures for Abatement of Highway Traffic Noise.” According to 23 CFR 772, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with Federal Highway Administration (FHWA) noise standards.

The Project is a Type I project because it would involve the physical alteration of an existing highway where there is either a substantial horizontal or substantial vertical change to the alignment of the highway and the relocation of interchange lanes or ramps. Therefore, the project requires noise abatement to be considered for impacted receptors. Compliance with 23 CFR 772 provides compliance with the noise impact assessment requirements of the National Environmental Policy Act (NEPA).

Activity Category B (residential), Category C (schools, day care centers, parks, places of worship, playgrounds, and sports areas), Category D (interior areas of schools, day care centers, and places of worship), Category E (offices, restaurants, and hotels), and Category F (storage and industrial) land uses were identified in the vicinity of the project. Vehicles

traveling along I-880, ramps, and local roads are the primary source of noise for receptors located along the project alignment. The study included noise measurements, calculations of existing noise levels, calculations of future noise levels with the construction and operation of the project, and identification of measures to reduce construction noise levels and to abate traffic noise levels at adjacent receptors. The Federal Highway Administration's Traffic Noise Model, TNM 2.5, was used to calculate existing and future traffic noise levels and analyze traffic noise impacts. The model was validated based on measured noise and traffic conditions documented during the field survey. Following validation, noise levels were assessed in TNM 2.5 based on future traffic conditions. One Build Alternative was assessed.

The Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects (Protocol) defines a noise increase as substantial when the predicted noise levels with project implementation exceed existing noise levels by 12 dBA or more. Noise levels are calculated to increase by up to 2 dBA over existing conditions assuming 2045 No Build conditions. The Build Alternative would increase noise levels by up to 1 dBA over existing conditions and would not result in measurable increases over No Build conditions. These predicted noise level increases are not considered substantial.

The worst-hour noise levels resulting from 2045 Build conditions would range from 36 to 73 dBA $L_{eq[h]}$ at existing Category B and C land uses along the project alignment. Under Build conditions, traffic noise levels are predicted to approach or exceed the Noise Abatement Criteria (NAC) at Category B and C receptors located to the north and south of I-880 in Oakland, to the north and south of 7th Street in Oakland, and east of Mariner Square Drive in Alameda. Many of the receptor locations along I-880 are upper story balconies or rooftop patios, reducing the effectiveness of noise abatement that could be constructed at the I-880 edge of shoulder. Noise levels inside Category D uses along the project alignment would not be anticipated to approach or exceed the interior NAC.

In accordance with 23 CFR 772, noise abatement is considered where noise impacts are predicted in areas of frequent human use that would benefit from a lowered noise level. Noise abatement, in the form of new noise barriers, was assessed for receptors where noise levels would approach or exceed the NAC. A total of eight potential barriers were evaluated for feasibility and acoustical reasonableness (i.e., would achieve the Caltrans noise reduction goal). Of the eight barriers evaluated, three (Barriers 3, 7, and 8) were found to be feasible and to achieve the Caltrans noise reduction design goal (minimum 7 dB reduction for at least one receptor). As shown in Table ES-1, the total reasonable allowance for Barriers 3, 7, and 8 ranged from $107,000 to $214,000.

This study does not include an analysis of noise barrier cost-effectiveness. Noise barrier cost-effectiveness will be assessed and documented in the Noise Abatement Decision Report (NADR). The final decision to include noise barriers in the proposed project design must consider reasonableness factors, such as cost-effectiveness, as well as other feasibility considerations including topography, access requirements, other noise sources, safety, and information developed during the design and public review process. Table ES-1 lists the reasonableness allowance calculated for all barriers that were calculated to be acoustically feasible and meet the Caltrans noise reduction design goal.

Construction activities would result in temporary increases to noise and vibration levels at adjacent noise-sensitive receptors. Construction activities would be conducted following applicable local regulations and would be short-term and intermittent. Measures to reduce construction noise and vibration are included in this report.

Table ES-1. Summary of Acoustically Feasible and Resonable Noise Barriers

Barrier ID	Approximate Stationing/ Location[a]	Noise Level w/o Barrier at Benefited Receptors ($L_{eq[h]}$)	Barrier Height (feet)	Insertion Loss (dBA)	Number of Benefited Receptors	Total Reasonable Monetary Allowance
3	NB I-880 Edge of Shoulder (EOS) (1490 ft)	66	14	7	1	$107,000
			16	7	1	$107,000
7	North side of 7th Street between Harrison Street and Alice Street (100 ft)	69	6	7	2	$214,000
			8	9	2	$214,000
			10	11	2	$214,000
			12	12	2	$214,000
			14	12	2	$214,000
			16	12	2	$214,000
8	East side of Mariner Square Drive (305 ft)	69	8	8	1	$107,000
			10	9	1	$107,000
			12	11	1	$107,000
			14	12	1	$107,000
			16	13	1	$107,000

[a] Barrier lengths are based on linear approximations used for purposes of noise modeling in TNM 2.5. Actual lengths may differ slightly due to barrier curvature, etc.

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List of Abbreviated Terms

23CFR772	Title 23, Part 772 of the Code of Federal Regulations
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CNEL	Community Noise Equivalent Level
dB	Decibel
dBA	A-Weighted Decibel
FHWA	Federal Highway Administration
Hz	Hertz
I-880	Interstate 880
I-980	Interstate 980
kHz	Kilohertz
L_{dn}	Day-Night Level
L_{eq}	Equivalent Sound Level
$L_{eq[h]}$	Equivalent Sound Level over one hour
L_{xx}	Percentile-Exceeded Sound Level
LT	Long-Term Reference Noise Measurement
L_{max}	Maximum Instantaneous Sound Level
mPa	micro-Pascals
mph	miles per hour
NAC	Noise Abatement Criteria
NADR	Nosie Abatement Decision Report
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NSR	Noise Study Report
OAAP	Oakland Alameda Access Project
Protocol	Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects
RCNM	FHWA Roadway Construction Noise Model v.1.0
ROW	Right of Way
SLM	Sound Level Meter
SPL	Sound Pressure Level
SR 260	State Route 260
ST	Short-Term Noise Measurement
TeNS	Caltrans’ Technical Noise Supplement
TOAR	Traffic Operations Analysis Report
TNAP	Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects
TNM 2.5	FHWA Traffic Noise Model Version 2.5

Chapter 1. Introduction

1.1. Purpose of the Noise Study Report

The purpose of this Noise Study Report (NSR) is to evaluate noise impacts and abatement under the requirements of Title 23, Part 772 of the Code of Federal Regulations (23 CFR 772) "Procedures for Abatement of Highway Traffic Noise." 23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for Federal and Federal-aid highway projects. According to 23 CFR 772.3, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with Federal Highway Administration (FHWA) noise standards. Compliance with 23 CFR 772 provides compliance with the noise impact assessment requirements of the National Environmental Policy Act (NEPA).

The Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects (Protocol) (Caltrans 2011) provides Caltrans policy for implementing 23 CFR 772 in California. The Protocol outlines the requirements for preparing NSRs. The primary objective of the NSR is to identify noise-sensitive receptors where noise levels would approach or exceed the Noise Abatement Criteria (NAC) with the project or receptors that would experience a substantial increase in noise levels as a result of the project. Noise impacts associated with this project under the California Environmental Quality Act (CEQA) are not evaluated in the NSR. The determination of CEQA and NEPA noise impacts are determined by the Project Development Team and will be disclosed in the project's Environmental Impact Report/Environmental Assessment (EIR/EA).

This NSR documents the assessment of existing and future traffic noise levels at noise sensitive receptors in the vicinity of the proposed project and identifies whether or not preliminary noise abatement measures are necessary for the project to comply with State and Federal noise abatement/mitigation requirements. The primary objective of this study is to identify noise sensitive receptors where noise levels would approach or exceed the NAC with the project or receptors that would experience a substantial increase in noise levels as a result of the project.

1.2. Project Purpose and Need

The purpose of the project is to:

- Improve multimodal safety and reduce conflicts between regional and local traffic;
- Enhance bicycle and pedestrian accessibility and connectivity within the project study area;
- Improve mobility and accessibility between I-880, SR-260 (Tubes), City of Oakland downtown neighborhoods, and the City of Alameda;
- Reduce freeway-bound regional traffic and congestion on local roadways and in area neighborhoods.

The proposed project is needed to address existing and projected safety issues, traffic congestion, geometric deficiencies, and improve bicycle and pedestrian connectivity within and between the cities of Oakland and Alameda. I-880 and SR-260 within the project area serve as major transportation corridors. The I-880 freeway viaduct (the series of elevated bridge spans that run east to west between 5th and 6th Streets) is a physical barrier that limits bicycle and pedestrian connectivity between downtown Oakland and Chinatown to the north and the Jack London District and Oakland Estuary to the south.

Local streets in the project study area are congested during morning and evening peak commute hours. Under current conditions, motorists traveling between I-880 and I-980 freeways and the Tubes must take circuitous routes along Oakland city streets, which causes local arterial congestion, bottlenecks (a localized disruption of vehicular traffic), and long travel delays. Several of the local intersections are operating at deficient levels of service because of the high traffic volumes. The streets in and around the Oakland Chinatown area have a high traffic volume of pedestrian activity and experience substantial vehicle-pedestrian conflicts. In addition, I-880 is a physical barrier to the implementation of bicycle and pedestrian connectivity between downtown Oakland and the Jack London District.

Under the Build Alternative, Caltrans and ACTC propose to remove and modify the existing freeway ramps and to modify the Posey Tube exit in Oakland. In addition, the proposed project would include the addition of Class IV bicycle tracks within the project area. This would improve connectivity to existing and future planned bicycle paths in the City of Oakland and implement various "complete streets" improvements to create additional opportunities for non-motorized vehicles and pedestrians across I-880 between downtown Oakland and the Jack London District. Bicycle and pedestrian improvements would be constructed at the Posey and Webster Tubes approach in Alameda and Oakland. The Webster Tube westside walkway would also be opened to bicycles and pedestrians.

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Chapter 2. Project Description

The proposed project is located in the cities of Oakland and Alameda in Alameda County, California. The project proposes to improve access along I-880 and in and around the Tubes, downtown Oakland, and the City of Alameda. Within the approximately 1-mile-long project, I-880 (PM ALA 30.47 to PM 31.61) and SR-260 (PM ALA R0.78 to R1.90) are major transportation corridors. Also, the I-880 freeway viaduct is a physical barrier, limiting bicycle and pedestrian connectivity between downtown Oakland and Chinatown to the north and the Jack London District and Oakland Estuary to the south. Existing local street patterns across I-880 are intertwined with on- and off-ramps and the Tubes connecting Oakland and Alameda affecting the cross-freeway circulation of motorists, bicyclists, and pedestrians.

2.1. Purpose and Need

2.1.1. Purpose

The purpose of the project is to:

- Improve multimodal safety and reduce conflicts between regional and local traffic;
- Enhance bicycle and pedestrian accessibility and connectivity within the project study area;
- Improve mobility and accessibility between I-880, SR-260 (Tubes), City of Oakland downtown neighborhoods, and City of Alameda;
- Reduce freeway-bound regional traffic and congestion on local roadways and in area neighborhoods.

2.1.2. Need

Access between the freeway and the roadway networks between I-880 and the Tubes is limited and indirect, and access to/from the cities of Oakland and Alameda is circuitous. Existing access to I-880 from Alameda and the Jack London District requires loops through several local streets and intersections, routing vehicles through the downtown Oakland Chinatown neighborhood, which has the following operational impacts on local streets:

- Streets in and around the downtown Oakland Chinatown area have a high volume of pedestrian activity and experience substantial vehicle-pedestrian conflicts, and the I-880 viaduct limits bicycle and pedestrian connectivity between downtown Oakland and the Jack London District.

- SB I-880 traffic heading to Alameda must exit at the Broadway/Alameda off-ramp, then travel south along 5th Street for more than a mile — through nine signalized and unsignalized intersections — before reaching the Webster Tube at 5th Street/Broadway.

- WB I-980 traffic heading to Alameda must exit at the Jackson Street off-ramp and circle back through Chinatown through seven signalized and unsignalized intersections to reach the Webster Tube.

- NB I-880 traffic heading to Alameda must exit at the Broadway off-ramp and form a queue on Broadway between 5th and 6th streets, which backs up onto the ramp. Alternatively, drivers may loop through Chinatown to access the Webster Tube.

2.2. Project Alternatives

2.2.1. No-Build (No-Action) Alternative

Under the No-Build Alternative, there would be no improvements to bicycle or pedestrian connectivity or safety. Freeway traffic to/from the cities of Oakland and Alameda would continue to use city streets through Oakland and Chinatown, which are areas with a high volume of pedestrian activity. Vehicle-pedestrian or -bicycle conflicts from traffic traveling through city streets would continue. The I-880 viaduct would continue to impede connectivity between downtown Oakland and the Jack London District, and access would not be improved for bicycles and pedestrians traveling between Oakland and Alameda.

2.2.2. Build Alternative

Under the Build Alternative, Caltrans and ACTC propose to remove and modify the existing freeway ramps and to modify the Posey Tube exit in Oakland. The Build Alternative would improve access to NB and SB

I-880 from the Posey Tube via a right turn-only lane from the Posey Tube to 5th Street and a new horseshoe connector at Jackson Street below the I-880 viaduct that would connect to the existing NB I-880/Jackson Street on ramp. The existing WB I-980/Jackson Street off ramp would be reconstructed and shifted to the south.

The Webster Tube entrance at 5th Street and Broadway would be shifted to the east to create more space for trucks to make the turn from Broadway into the Webster Tube. A bulb-out would be constructed to extend the sidewalk, reducing the crossing distance and allowing improved visibility of pedestrians on the southeast corner.

The NB I-880/Broadway off-ramp would be removed and the NB I-880/ Oak Street off-ramp to 6th Street would be widened. The NB I-880/Oak Street intersection would become the main NB I-880 off-ramp to downtown Oakland and to Alameda. 6th Street would become a one-way through street from Oak Street to Harrison Street and a two-way street from Harrison Street to Broadway.

The proposed project would include the addition of a Class IV two-way cycle track on 6th Street between Oak and Washington streets and on Oak Street between 3rd and 9th streets. Bicycle and pedestrian improvements would be constructed at the Tubes' approaches in Oakland and Alameda, and the Webster Tube westside walkway would be opened to pedestrians. This would improve connectivity to existing and future planned bicycle paths in the City of Oakland and implement various "complete streets" improvements to create additional opportunities for non-motorized vehicles and pedestrians to cross under I-880 between downtown Oakland, the Jack London District, and Alameda. See Figure 1, Figure 2, Figure 3, and Figure 4 for proposed elements of the Build Alternative.

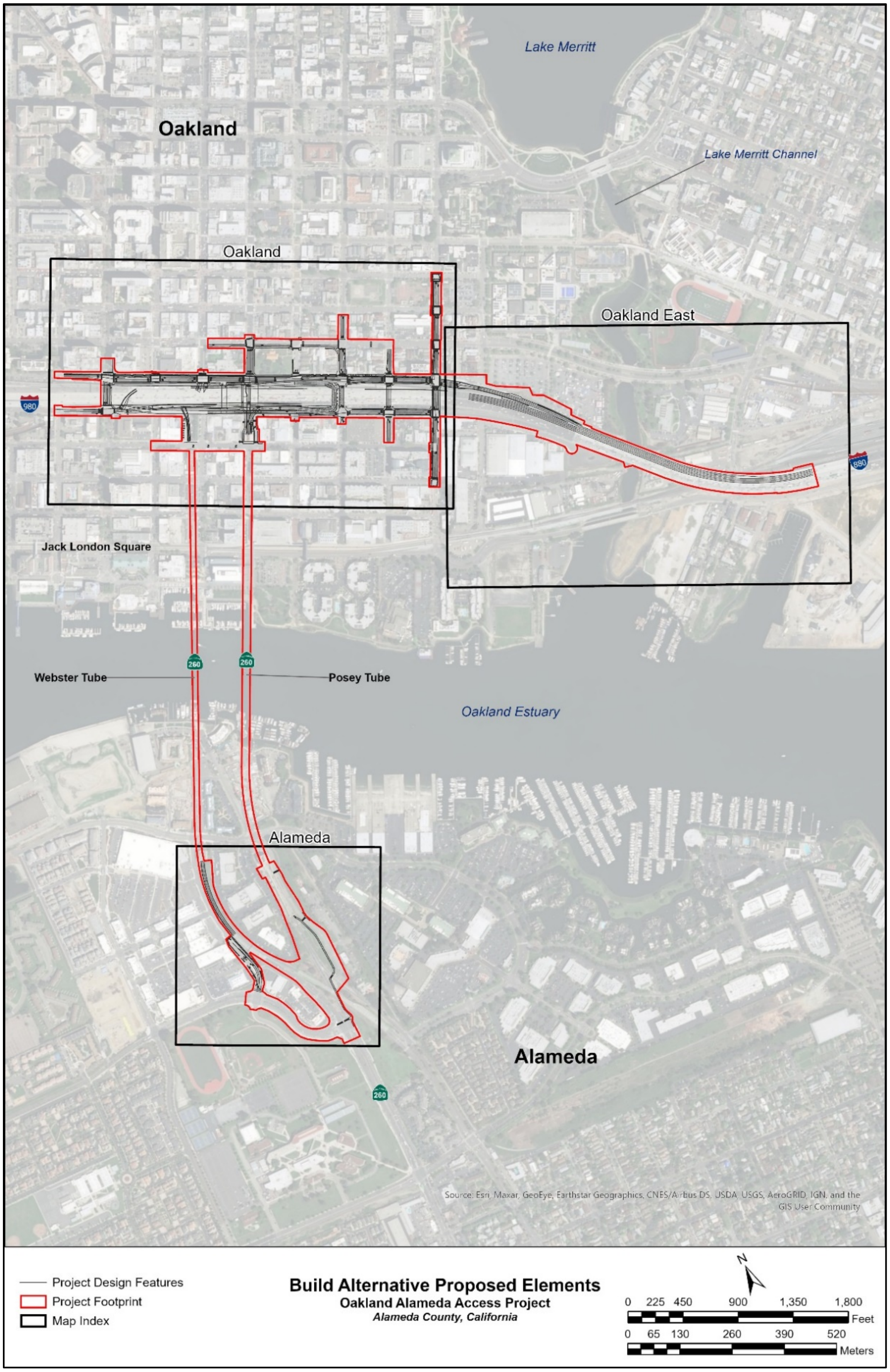

Figure 1. Build Alternative Proposed Elements, Project Overview

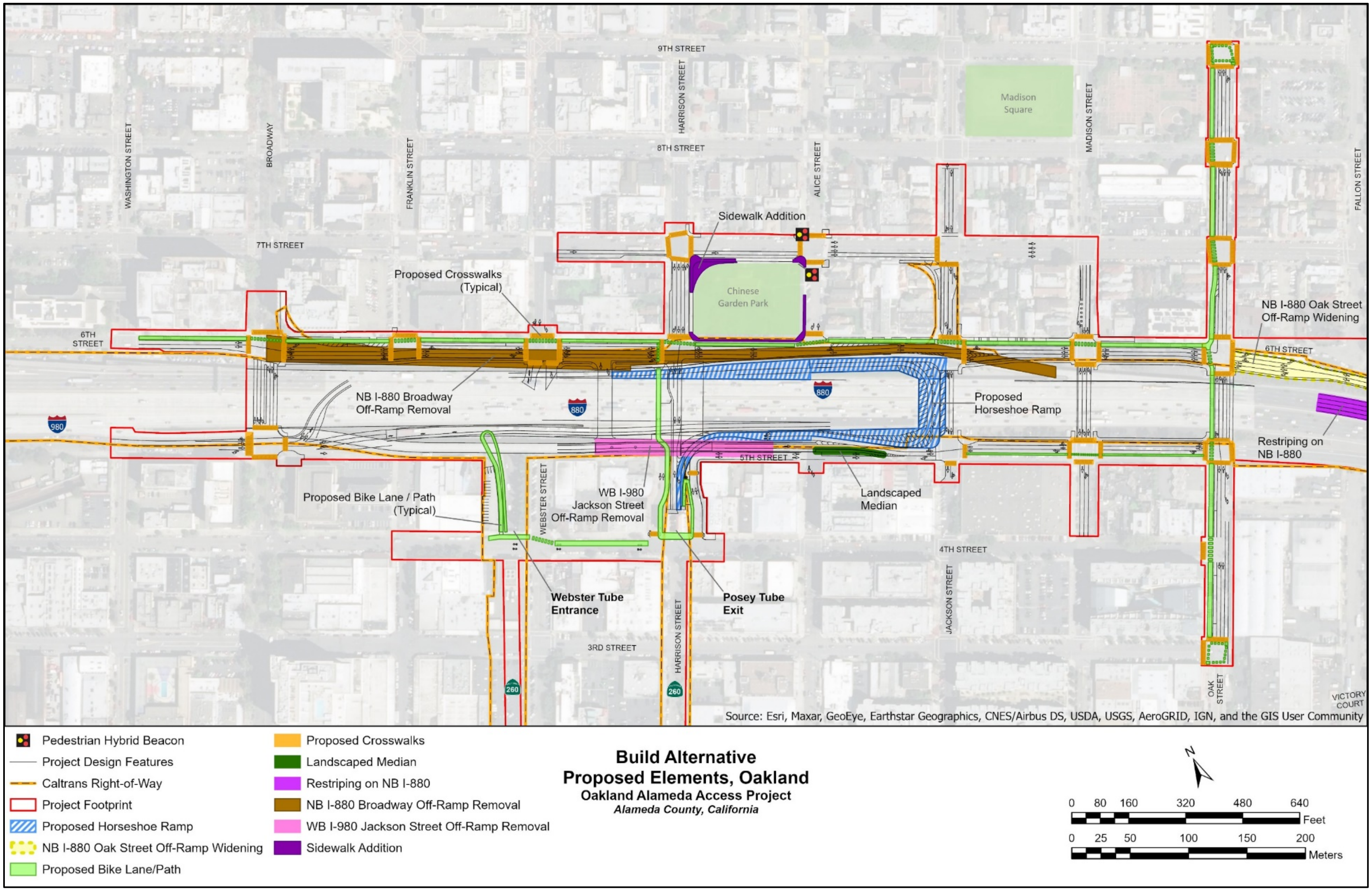

Figure 2. Build Alternative Proposed Elements, Oakland

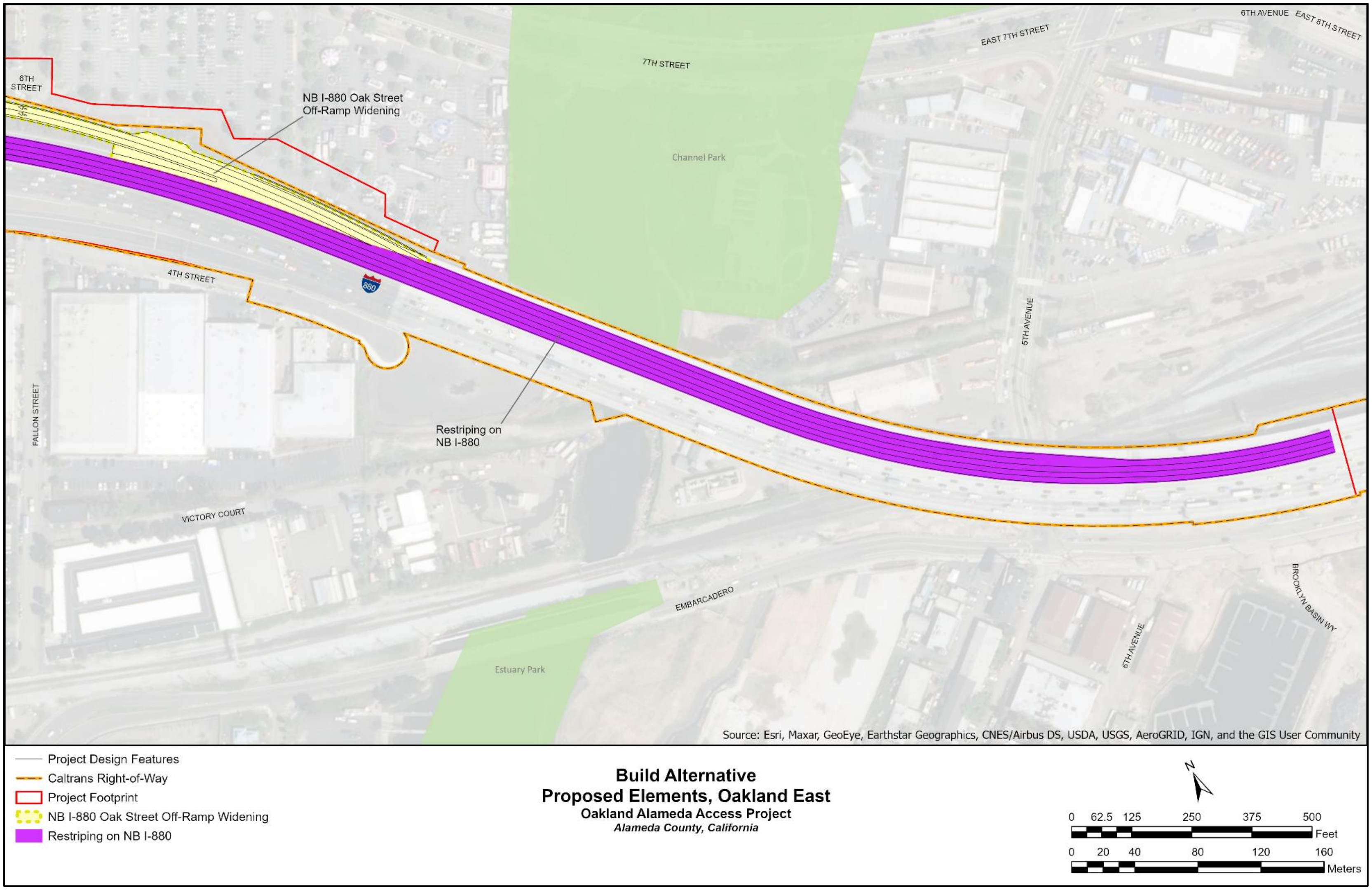

Figure 3. Build Alternative Proposed Elements, Oakland East

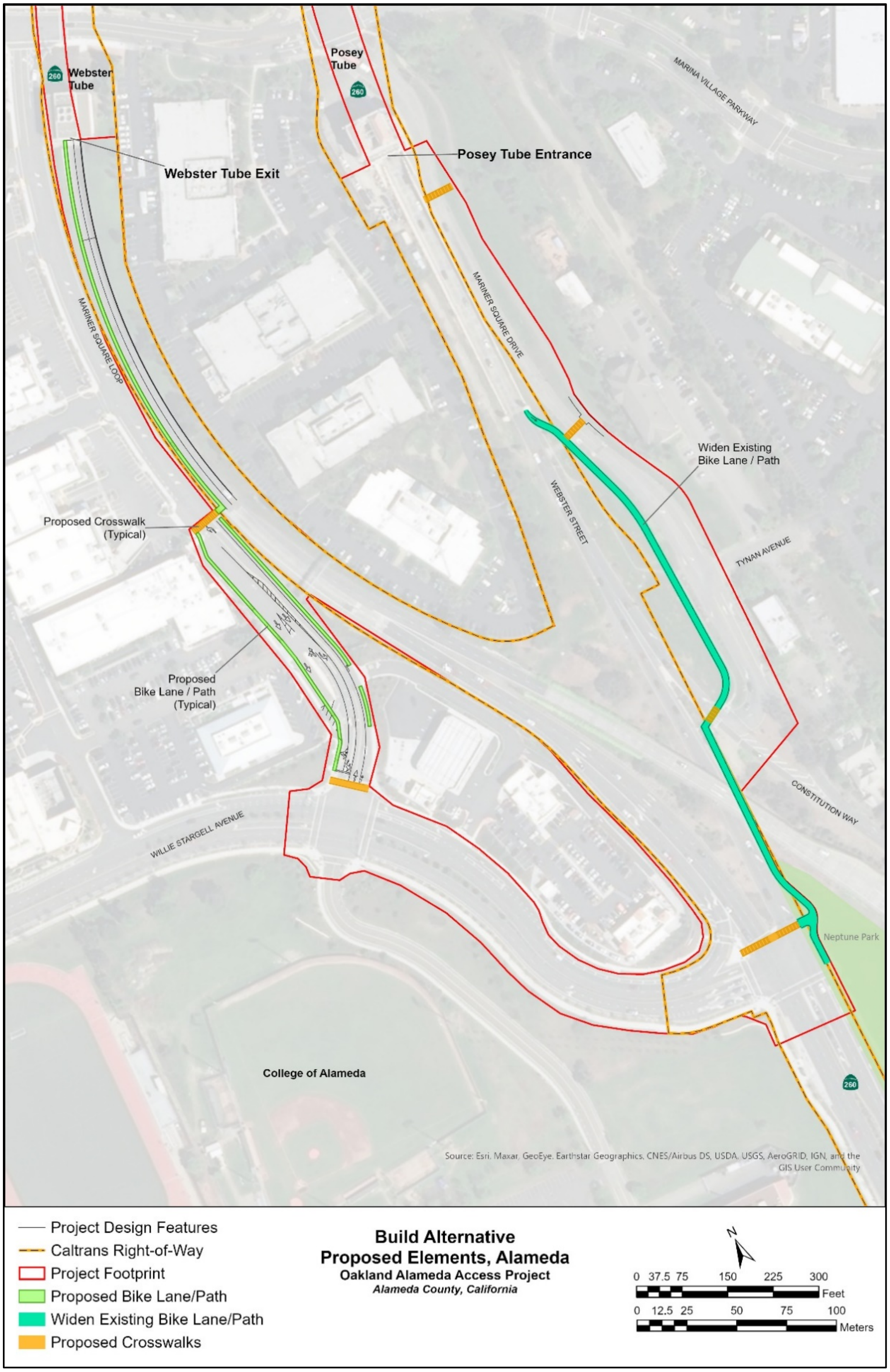

Figure 4. Build Alternative Elements, Alameda

Additional details on the Build Alternative improvements:

1. Construction of a new horseshoe connector under I-880 at Jackson Street.

Vehicles exiting the Posey Tube would have direct access to NB I-880 via the proposed horseshoe connector. Vehicles heading to NB and SB I-880 would use the right-turn-only lane at the Posey Tube exit to turn onto eastbound 5th Street. Access to a new horseshoe connector would be provided from the left side of 5th Street and would loop below the I-880 viaduct to connect to the existing NB I-880/Jackson Street on-ramp. Traffic heading to SB I-880 would continue eastbound on 5th Street to the SB I-880/Oak Street on-ramp. Figure 2 shows the new horseshoe connector under I-880 at Jackson Street.

Construction of the new right-turn-only lane onto 5th Street would require new retaining walls along the right side of the Posey Tube exit replacing the historic Posey Tube wall. The horseshoe connector would provide a direct route between the Posey Tube and NB I-880/EB I-980 and SB I-880, substantially improving connectivity and minimizing the need for freeway-bound vehicles to travel through Chinatown to access the ramps. This configuration would also reduce intersection and bicycle-pedestrian conflicts.

Posey Tube traffic heading to Chinatown and downtown Oakland would remain in the left lane and continue onto Harrison Street or turn left onto 6th Street to reach downtown via Broadway. A new left-turn pocket to accommodate the turn onto 6th Street would be constructed requiring removal of a section of the historic Posey Tube western exit wall.

2. Reconstruction of the existing WB I-980/Jackson Street off-ramp.

To provide space for unimpeded movement from the Posey Tube to the new horseshoe connector, the WB I-980/Jackson Street off-ramp would be realigned to the south. Figure 2 shows the relocated Jackson Street off-ramp. The realigned off-ramp would touch down at grade on 5th Street at the Alice Street intersection. Off-ramp and 5th Street traffic would continue to be separated by a landscaped median past the condominium building at 428 Alice Street. 5th Street would be converted to a two-way street to accommodate condominium residents allowing vehicles to turn left or right onto 5th Street.

3. Removal of the existing NB I-880/Broadway off-ramp viaduct structure including the bridge deck and supporting columns.

Removing the NB I-880/Broadway off-ramp structure would provide the space for complete street improvements on 6th Street. It would also restore an element of the City of Oakland's street grid system by providing a continuous 6th Street between Oak Street and Broadway. Figure 2 shows where the existing NB I-880/Broadway off-ramp would be removed. This would provide for a more efficient street network, and it would allow traffic to be more evenly distributed on Oakland city streets. Also, it would improve traffic operations at the Broadway/6th Street and Broadway/5th Street intersections by eliminating the stream of traffic exiting the Broadway off-ramp and heading to the Webster Tube entrance. Instead, this traffic would use 6th Street and turn left at Webster Street to access the Webster Tube.

4. Widening of the NB I-880/Oak Street off-ramp.

The existing Oak Street off-ramp would be widened from a one- to a two-lane exit by restriping the NB I-880 mainline and reconfiguring the ramp terminus. Figure 3 shows the proposed widening at the NB I-880/Oak Street off-ramp and restriping on NB I-880. At the Oak Street intersection, the ramp would be further widened from one left-turn-only pocket lane, one through and left-turn lane, and one through and right-turn lane to provide one left-turn-only (SB) pocket lane, one through westbound (WB) lane, one through (WB) and right-turn (NB) lane, and one right-turn-only (NB) lane. Two new retaining walls would be constructed along the widened ramp's new edge of the shoulder. In advance of the Oak Street exit, NB I-880 would be restriped from four to five lanes, including a standard 1,400-foot-long auxiliary lane to accommodate the additional traffic resulting from the Broadway off-ramp removal.

5. Modification of 5th Street/Broadway access to the Webster Tube.

The 5th Street/Broadway entrance to the Webster Tube would be moved slightly east (refer to Figure 2. Also, the 5th Street crosswalk on the east side of Broadway would be shifted east and considerably shortened, and the signal phasing would be modified to include a pedestrian-led signal phase for eastbound pedestrian traffic. This would improve safety by giving pedestrians priority over turning traffic. Also, this would improve truck access to the Webster Tube and minimize conflicts with other vehicular traffic.

6. Construction of a new through 6th Street connecting Oak Street to Broadway.

Improvements to 6th Street would be accomplished by turning the street into a one-way street in the westbound direction from Oak Street to Harrison Street and a two-way street from Harrison Street to Broadway (refer to Figure 2). The lanes would be a minimum of 11 feet wide. There would be a minimum of two through lanes with additional turn pockets at intersections in the westbound direction. There would be one lane in the eastbound direction from Harrison Street to Broadway.

A new sidewalk would be constructed along the south side between Broadway and Oak Street. Segments of the existing sidewalk along the north side between Oak Street and Broadway would be reconstructed to a minimum of 10 feet wide between Harrison and Alice streets to provide continuity for pedestrians. A continuous Class IV two-way cycle track would also be provided between Oak and Washington streets. Parking spaces would be provided along portions of this roadway.

7. Construction of a two-way bicycle/pedestrian path and walkway from Webster Street in Alameda to 6th Street in Oakland through the Posey Tube and from 4th Street in Oakland through the Webster Tube to Mariner Square Loop in Alameda.

The path would begin at Webster Street and Constitution Way in Alameda, would continue through the Posey Tube on the existing eastside walkway, and would exit the Tube via a new ramp with a hairpin turn at 5th Street. Figure 4 shows the proposed bicycle and pedestrian improvements. The path in Alameda connecting to the Posey Tube would be realigned and widened. The path in Oakland would wrap around the back of the Portal building on 4th Street and continue onto Harrison Street. It would continue onto a Class I two-way bicycle/pedestrian path under I-880 just west of Harrison Street and connect to the Class IV two-way cycle track on 6th Street between Oak and Washington streets. The new bicycle and pedestrian ramp exit from the Posey Tube would require removal of the existing historic Posey Tube staircase to provide street level ADA-compliant access from the Tube.

The proposed project would improve access between Oakland and Alameda by opening the Webster Tube maintenance walkway to bicycle and pedestrian travel. The walkway would connect to the proposed path under I-880 at 4th Street (near the Posey Tube Portal building).It would continue onto 4th Street to Webster Street, and it would turn north through the existing parking lot on the west side of the Webster Tube entrance before making a hairpin turn to connect to the westside walkway inside the Tube.

On the Alameda side, the walkway would connect to existing bicycle and pedestrian facilities at Mariner Square Loop and Willie Stargell Avenue. The existing sidewalk within Neptune Park would be widened to match the proposed sidewalk to the north. Improvements inside the Tube would include widening the existing walkway, upgrading the existing railings, and relocating call boxes and fire extinguishers.

8. Modification of 5th, 7th, Madison, Jackson, Harrison, Webster, Oak, and Franklin streets.

The street modifications (refer to Figure 2) would include replacing the dual right turns at the 7th Street/Harrison Street intersection with a single right-turn-only lane and removing the free right turn (where the island allows cars to turn right without stopping) at the 7th Street/ Jackson Street intersection. These would no longer be needed because Alameda traffic bound for NB/SB I 880 would be better served by the right turns from the Posey Tube to 5th Street. With the removal of the free right turns, vehicles would observe the traffic signal before turning right. With the curb extension proposed at this location, the pedestrian crossing distance would be shortened, which would decrease vehicle-pedestrian conflicts. In addition, a PHB beacon would be installed on 7th Street across the street from the Chinese Garden Park. There would also be restrictive right-turn movements to reduce bicycle and vehicle conflicts at the 5th/Broadway, 6th/Webster, 6th/Harrison, 6th/Jackson, 6th/Madison, 5th/Jackson, 8th/Oak, and 7th/Oak intersections.

A continuous sidewalk would be installed along the perimeter of Chinese Garden Park. Additional improvements, including landscaping modifications, could occur adjacent to the southern boundary of the park and would be coordinated through the City of Oakland.

Jackson Street between 5th and 6th streets would be converted from two- to one-way travel lanes in the northbound direction, and it would provide an emergency-only access lane.

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Chapter 3. Fundamentals of Traffic Noise

The following is a brief discussion of fundamental traffic noise concepts. For a detailed discussion, please refer to Caltrans' Technical Noise Supplement (TeNS) (Caltrans 2013), a technical supplement to the Protocol that is available on Caltrans' Web site (http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013B.pdf). Technical terms are defined in Appendix A.

3.1. Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receptor, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting noise propagation to the receptor determines sound level and characteristics of the noise perceived by the receptor. The field of acoustics deals primarily with the propagation and control of sound.

3.1. Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or Hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz (kHz), or thousands of Hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

3.2. Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (mPa). One mPa is approximately one hundred billionth (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 mPa. Because of this huge range of values, sound is rarely expressed in terms of mPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB). The threshold of hearing for young people is about 0 dB, which corresponds to 20 mPa.

3.3. Addition of Decibels

Because decibels are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher 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.

3.4. A-Weighted Decibels

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an "A-weighted" sound level (expressed in units of dBA) can be computed based on this information.

The A-weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make a judgment of the relative loudness or annoyance of a sound, their judgment correlates well with the A-scale sound levels of those sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with highway-traffic noise. Noise levels for traffic noise reports are typically reported in terms of A-weighted decibels or dBA. Table 3-1 describes typical A-weighted noise levels for various noise sources.

Table 3-1. Typical A-Weighted Noise 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.

3.5. Human Response to Changes in Noise Levels

As discussed above, doubling sound energy results in a 3-dB increase in sound. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different than what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1-dB changes in sound levels, when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000 Hz–8,000 Hz) range. In typical noisy environments, changes in noise of 1 to 2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3-dB increase in sound, would generally be perceived as barely detectable.

3.6. Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors most commonly used in traffic noise analysis.

- **Equivalent Sound Level (L_{eq}):** L_{eq} represents 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. The 1-hour A-weighted equivalent sound level (L_{eq}[h]) is the energy average of A-weighted sound levels occurring during a one-hour period, and is the basis for noise abatement criteria (NAC) used by Caltrans and FHWA.

- **Percentile-Exceeded Sound Level (L_{xx}):** L_{xx} represents the sound level exceeded for a given percentage of a specified period (e.g., L_{10} is the sound level exceeded 10% of the time, and L_{90} is the sound level exceeded 90% of the time).

- **Maximum Sound Level (L_{max}):** L_{max} is the highest instantaneous sound level measured during a specified period.

- **Day-Night Level (L_{dn}):** 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 occurring 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.

3.7. Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the following factors.

3.7.1. Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 decibels for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 decibels for each doubling of distance from a line source.

3.7.2. Ground Absorption

The propagation path of noise from a highway to a receptor is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receptor, such as a parking lot or body of water,), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receptor, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 decibels per doubling of distance.

3.7.3. 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.

3.7.4. Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receptor can substantially attenuate noise levels at the receptor. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receptor specifically to reduce noise. A barrier that breaks the line of sight between a source and a receptor will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the highway and receptor is rarely effective in reducing noise because it does not create a solid barrier.

Chapter 4. Federal Regulations and State Policies

This report focuses on the requirements of 23 CFR 772, as discussed below.

4.1. Federal Regulations

4.1.1. 23 CFR 772

23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for Federal and Federal-aid projects. Under 23 CFR 772.7, projects are categorized as Type I, Type II, or Type III projects.

FHWA defines a Type I project as a proposed Federal or Federal-aid project for the construction of a highway or roadway on a new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment of the highway. The following projects are also considered to be Type I projects:

- The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a high-occupancy vehicle (HOV) lane, high-occupancy toll (HOT) lane, bus lane, or truck climbing lane,
- The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane,
- The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange,
- Restriping existing pavement for the purpose of adding a through traffic lane or an auxiliary lane,
- The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.

If a project is determined to be a Type I project under this definition, the entire project area as defined in the environmental document is a Type I project.

A Type II project is a noise barrier retrofit project that involves no changes to highway capacity or alignment. A Type III project is a project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

Under 23 CFR 772.11, noise abatement must be considered for Type I projects if the project is predicted to result in a traffic noise impact. In such cases, 23 CFR 772 requires that the project sponsor "consider" noise abatement before adoption of the final NEPA document. This process involves identification of noise abatement measures that are reasonable, feasible, and likely to be incorporated into the project, and of noise impacts for which no apparent solution is available.

Traffic noise impacts, as defined in 23 CFR 772.5, occur when the predicted noise level in the design-year approaches or exceeds the NAC specified in 23 CFR 772, or a predicted noise level substantially exceeds the existing noise level (a "substantial" noise increase). 23 CFR 772 does not specifically define the terms "substantial increase" or "approach"; these criteria are defined in the Protocol, as described below.

Table 4-1 summarizes NAC corresponding to various land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual or permitted land use in a given area.

In identifying noise impacts, primary consideration is given to exterior areas of frequent human use. In situations where there are no exterior activities, or where the exterior activities are far from the roadway or physically shielded in a manner that prevents an impact on exterior activities, the interior criterion (Activity Category D) is used as the basis for determining a noise impact. Indoor analysis is conducted at Activity Category D land uses only after all outdoor analysis options have been exhausted and after a determination has been made that exterior abatement measures would not be feasible and reasonable.

4.1.2. Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects

The Protocol specifies the policies, procedures, and practices to be used by agencies that sponsor new construction or reconstruction of Federal or Federal-aid highway projects. The Protocol defines a noise increase as substantial when the predicted noise levels with project implementation exceed existing noise levels by 12 dBA or more. The Protocol also states that a sound level is considered to approach a NAC level when the sound level is within 1 dB of the NAC identified in 23 CFR 772 (e.g., 66 dBA is considered to approach the NAC of 67 dBA, but 65 dBA is not).

The Technical Noise Supplement to the Protocol provides detailed technical guidance for the evaluation of highway traffic noise. This includes field measurement methods, noise modeling methods, and report preparation guidance.

Table 4-1. Activity Categories and Noise Abatement Criteria (23 CFR 772)

Activity Category	Activity $L_{eq}[h]$[1]	Evaluation Location	Description of Activities
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	Exterior	Residential.
C[2]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A–D or F.
F			Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G			Undeveloped lands that are not permitted.

[1] The $L_{eq[h]}$ activity criteria values are for impact determination only and are not design standards for noise abatement measures. All values are A-weighted decibels (dBA).

[2] Includes undeveloped lands permitted for this activity category.

4.2. State Regulations and Policies

4.2.1. California Environmental Quality Act (CEQA)

Noise analysis under the California Environmental Quality Act (CEQA) may be required regardless of whether or not the project is a Type I project. The CEQA noise analysis is completely independent of the 23 CFR 772 analysis done for NEPA. Under CEQA, the baseline noise level is compared to the build noise level. The assessment entails looking at the setting of the noise impact and then how large or perceptible any noise increase would be in the given area. Key considerations include: the uniqueness of the setting, the sensitive nature of the noise receptors, the magnitude of the noise increase, the number of residences affected, and the absolute noise level.

The significance of noise impacts under CEQA are addressed in the environmental document rather than the NSR. Even though the NSR (or noise technical memorandum) does not specifically evaluate the significance of noise impacts under CEQA, it must contain the technical information that is needed to make that determination in the environmental document.

4.2.2. Section 216 of the California Streets and Highways Code

Section 216 of the California Streets and Highways Code relates to the noise effects of a proposed freeway project on public and private elementary and secondary schools. Under this code, a noise impact occurs if, as a result of a proposed freeway project, noise levels exceed 52 dBA $L_{eq[h]}$ in the interior of public or private elementary or secondary classrooms, libraries, multipurpose rooms, or spaces. This requirement does not replace the "approach or exceed" NAC criterion for FHWA Activity Category D for classroom interiors, but it is a requirement that must be addressed in addition to the requirements of 23 CFR 772.

If a project results in a noise impact under this code, noise abatement must be provided to reduce classroom noise to a level that is at or below 52 dBA $L_{eq[h]}$. If the noise levels generated from freeway and roadway sources exceed 52 dBA $L_{eq[h]}$ prior to the construction of the proposed freeway project, then noise abatement must be provided to reduce the noise to the level that existed prior to construction of the project.

Chapter 5. Study Methods and Procedures

This chapter describes the methodology used to measure and evaluate noise levels in the Project area.

5.1. Methods for Identifying Land Uses and Selecting Noise Measurement and Modeling Receptor Locations

A field investigation was conducted from July 16th to July 18th, 2018, to identify land uses that could be subject to traffic and construction noise impacts from the proposed Project. Existing land uses in the Project area were categorized by land use type and Activity Category (see Table 4-1) and the extent of frequent human use. Noise receptor locations exposed to potential traffic noise impacts, including construction noise impacts, were identified along the Project corridor through a review of project mapping, aerial photos, and field reconnaissance. Activity Category B, C, D, E, and F land uses are located within the Project study area, as described in Section 6.1.

As stated in the Protocol, noise abatement is only considered where frequent human use occurs and where a lowered noise level would be of benefit. Although all land uses are evaluated in this analysis, the focus is on locations of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and common use areas at multi-family residences.

Long-term measurement sites were selected to capture the diurnal traffic noise level pattern in the Project area and to identify the loudest traffic noise hour (worst-hour traffic noise). Short-term measurement locations were selected to represent each major developed and potential development area within the Project area. Short-term measurement locations were selected to serve as representative modeling locations.

Photographs of the measurement sites are provided in Appendix B. Receptor locations selected for the Project area are illustrated in Appendix C.

5.2. Field Measurement Procedures

A field noise study was conducted in accordance with recommended procedures in the Technical Noise Supplement (TeNS) to the Traffic Noise Analysis Protocol (Protocol). Noise measurements were made with Larson Davis Model 820 Integrating Sound Level Meters (SLMs) set at “slow” response (serial numbers 1474, 1939, 1905, 0826, 1211, 1460, and 1938). The sound level meters were equipped with G.R.A.S. Type 40AQ ½-inch random incidence microphones fitted with windscreens. The sound level meters were calibrated prior to the noise measurements using a Larson Davis Model CA200 acoustical calibrators (serial numbers 3702 and 2383). The response of the system was checked after each measurement session and was always found to be within 0.2 dBA. No calibration adjustments were made to the measured sound levels. At the completion of each monitoring event, the measured interval noise level data were obtained from the SLM using the Larson Davis SLM utility software program.

5.2.1. Long-Term Measurements

Long-term (LT) reference noise measurements were made at two (2) locations in the Project area and vicinity to quantify the diurnal trend in noise levels and to establish the worst-hour traffic noise hour. These reference noise measurements included one located at a childcare facility in Oakland (L1), approximately 220 feet from the edge of I-880, and one 75 feet from the center of Webster Street in Alameda (L2). The noise measurements were made over an approximate 48-hour period, from midday on Monday, July 16th, 2018 to midday on Wednesday, July 18th, 2018. Measurements were taken at heights of about 12 feet above ground level. Care was taken to select sites that were primarily affected by traffic noise and to avoid those sites where extraneous noise sources, such as barking dogs or mechanical equipment could contaminate the noise data. After the data was downloaded from the sound level meter, the data was reviewed to identify any time periods possibly contaminated by local noise sources. Data points were excluded from the dataset where significant contamination was noted. The trends in ambient noise levels measured at long-term locations are summarized graphically in Appendix D.

5.2.2. Short-Term Measurements

Short-term noise measurements were made at fifteen (15) locations in Oakland (S1 to S15) and four locations in Alameda, including the entranceways to both the Webster and Posey Tubes (S16 to S19). Short-term measurements were made in concurrent time intervals with the data collected at the long-term reference measurement sites. This method facilitates a direct comparison between both the short-term and long-term noise measurements and allows for the identification of the worst-hour noise levels at land uses in the Project vicinity where long-term noise measurements were not made, but where both short-term and long-term measurements are exposed to the same primary noise source. Two or more consecutive 10-minute measurements were made at each noise measurement site. At all locations, noise levels were measured five feet above the ground surface and at least 10 feet from structures or barriers. Noise measurement locations were used as noise modeling receptors for the prediction of existing and future worst-hour traffic noise levels.

Traffic counts and speed observations were also made during the short-term noise measurements for model calibration purposes. Traffic volumes were classified into five vehicle types: (1) light-duty autos and trucks, (2) medium-duty trucks (typically trucks with two axles and more than four wheels), (3) heavy-duty trucks (typically trucks with more than two axles), (4) buses, and (5) motorcycles.

5.2.3. Meteorology

Meteorological conditions were observed during the long-term and short-term noise measurements and generally consisted of clear to partly cloudy skies, calm to moderate winds (1 to 5 mph), and seasonable temperatures (65 to 80°F during midday). Noise monitoring did not occur if weather conditions consisted of rain or high winds (i.e., greater than 11 mph).

5.3. Traffic Noise Levels Prediction Methods

Traffic noise levels were predicted using the FHWA Traffic Noise Model Version 2.5 (TNM 2.5). TNM 2.5 is a computer model based on two FHWA reports: FHWA-PD-96-009 and FHWA-PD-96-010 (FHWA 1998a, 1998b). TNM 2.5 has been validated at distances within 500 feet of the highway. Receptors that are located beyond 500 feet from the project area do not need to be considered for analysis unless there is a reasonable expectation that noise impacts would extend beyond that boundary. For this project, first row receptors located more than 500 feet from the highway, but along local roads affected by the project, were included in the analysis.

TNM 2.5 calculates traffic noise levels based on the geometry of the sites, which includes the positioning of travel lanes, receptors, barriers, terrain, ground type, buildings, etc. The noise source is the traffic flow, as defined by the user, in terms of hourly volumes of automobiles, medium-duty trucks, heavy-duty trucks, buses, and motorcycles. Existing traffic and Design Year (2045) peak hour traffic volume data and speed estimates provided by *DKS* were used as model inputs for local roads and ramps. *HNTB* provided the geometric plans used to create the base traffic noise model. The proposed roadway, existing and future receptors, structures, ground zones, and noise barriers were digitized and input into the traffic noise model.

5.3.1. Validation of the Traffic Noise Model

TNM 2.5 cannot accurately account for pavement types and conditions, atypical vehicle noise populations, transparent shielding (such as wood fences with shrinkage gaps), reflections from nearby buildings and structures, or meteorological conditions. For these reasons, noise measurements are conducted, and traffic noise model adjustments and validation factors are developed. For each measured condition, the corresponding observed traffic conditions are used in the model to calculate the noise level. The calculated and measured noise levels are compared to assess differences and validate the traffic noise model.

Traffic noise modeling of the effects of reflections near tunnel portals was conducted and validated in accordance with Caltrans recommended procedures and based on recommendations made in NCHRP Report 791, entitled “Supplemental Guidance on the Application of FHWA’s Traffic Noise Model (TNM)”.

Traffic counts made during the noise monitoring survey were adjusted to reflect one-hour conditions, assuming the traffic volumes during the noise measurement interval (10 minutes) were equal during the six 10-minute intervals of an hour. These adjusted one-hour volumes were input into the model for validation.

Calibration factors or model adjustments developed from this process are used to modify the model to more closely represent measured conditions. Modeled results that vary from measurements by more than 3 dB are adjusted after a careful review of all measurement and modeled data. The adjustments are calculated as follows:

- Where modeled levels are more than 3 dB lower than measured levels, the modeled results are adjusted to measured conditions: Adjustment = Measured – Modeled.
- Where the modeled result is 0 to +3 dB lower than the measured level, no adjustment is made: Adjustment = 0.
- Where the modeled result is 0 to +3 dB higher than the measured level, no adjustment is made: Adjustment = 0.
- Where the modeled result is more than +3 dB higher than the measured level, an adjustment is made to bring the modeled result to within 3 dB of measured conditions: Adjustment = (Measured + 3) – Modeled.

5.3.2. Traffic Inputs used for Noise Modeling

Once the TNM 2.5 was validated, the worst-hour traffic noise levels were calculated for Existing, 2045 No Build, and 2045 Build cases. The worst-hour traffic noise hour is not necessarily the hour with peak traffic volumes. Congestion results in slower speeds, which substantially reduces traffic noise levels. The worst-hour traffic noise hour is generally characterized by free-flowing traffic at the roadway design speed (i.e., Level of Service [LOS] C/D or better).

Traffic volumes, speeds, and mix information used in the TNM 2.5 model are given in Appendix E.

5.4. Methods for Identifying Traffic Noise Impacts and Consideration of Abatement

Traffic noise impacts are considered to occur at receptor locations where predicted design-year noise levels are 12 dB or greater than existing noise levels, or where predicted design-year noise levels approach or exceed the NAC for the applicable activity category, as shown in Table 4-1. Caltrans has defined the meaning of approaching the NAC to be 1 dBA below the NAC (e.g., 66 dBA is considered approaching the NAC for Activity Category B activity areas). Where traffic noise impacts are identified, noise abatement must be considered for reasonableness and feasibility as required by 23 CFR 772 and the Protocol.

Noise abatement is only considered where frequent human usage occurs and where a lowered noise level would be of benefit. Areas of frequent human usage are considered to occur at exterior locations where people are exposed to traffic noise for an extended period of time on a regular basis. Therefore, impacts are typically assessed at locations with defined outdoor activity areas, such as residential backyards, common exterior use areas, trails, pools, patios, and parks (e.g., playfields, playgrounds, or picnic tables). Other examples are outdoor seating areas at restaurants or outdoor use areas at hotels.

Caltrans policies and procedures for traffic noise analysis are contained in the Protocol and TeNS. The feasibility of noise abatement is an engineering consideration. According to the Protocol, abatement measures are considered acoustically feasible if a minimum noise reduction of 5 dB at impacted receptor locations is predicted with implementation of the abatement measures. Other factors that affect feasibility include topography, utility conflicts, and safety considerations.

Once all feasible noise abatement is identified, a procedure is conducted to assess the reasonableness of noise abatement. The determination of the reasonableness of noise abatement is more subjective than the determination of its feasibility. As defined in Section 772.5 of the regulation, reasonableness is the combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure. NSRs calculate the reasonable cost allowance for feasible noise barriers, but do not determine whether a feasible barrier would be reasonable.

The overall reasonableness of noise abatement is determined by the following three factors:

- The noise reduction design goal (a barrier must be predicted to provide at least 7 dB of noise reduction at one or more benefited receptors).
- The cost of noise abatement (2019 allowance of $107,000 per benefited receptor).
- The viewpoints of benefited receptors (including property owners and residents of the benefited receptors).

The Caltrans' acoustical design goal is that a barrier must be predicted to provide at least 7 dB of noise reduction at one benefited receptor. This design goal applies to any receptor and is not limited to impacted receptors.

The Protocol defines the procedure for assessing reasonableness of noise barriers from a cost perspective. Cost considerations for determining noise abatement reasonableness are based on an allowance per benefitted receptor. This reasonable allowance maybe adjusted based on the most recent annual Construction Price Index. The annual price index for the fourth quarter of any year is usually posted by February of the following year. The base cost allowance for any 2019 reasonable/feasible analysis is $107,000 for each benefited receptor (i.e., receptors that receive at least 5 dB of noise reduction from a noise barrier). The total allowance for each barrier is calculated by multiplying the number of benefited receptors by $107,000.

The noise study report identifies traffic noise impacts and evaluates noise abatement for acoustical feasibility. It also reports information that will be used in the reasonableness analysis, including if the 7 dB design goal reduction in noise can be achieved and the abatement allowances. The noise study report does not make any conclusions regarding reasonableness. The feasibility and reasonableness of noise abatement is reported in the Noise Abatement Decision Report (NADR).

Chapter 6. Existing Noise Environment

The following is a discussion of existing noise levels in the Project area.

6.1. Existing Land Uses

Existing land uses in the Project area were categorized by Activity Category, as outlined in Section 4.1 (see Table 4-1 for land use descriptions). A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed Project. No Activity Category A land uses (lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose) were identified in the Project area. The following noise-sensitive land uses were identified in the Project area:

- Activity Category B - Residential;
- Activity Category C – Day care centers, schools, parks, picnic areas, places of worship, active sports areas, institutional structures;
- Activity Category D (Interior) - Day care centers, schools, places of worship; and
- Activity Category E – Restaurants/bars, offices.

Activity Category F land uses located in the Project area are not noise-sensitive. Although all developed land uses are evaluated in this analysis, noise abatement is only considered for areas of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards, common exterior use areas for multi-family development, sports areas, and outdoor commercial use areas. The noise-sensitive uses identified in the Project area are described in further detail in Chapter 7.

6.2. Noise Measurement Results

The existing noise environment throughout the Project area varies by location, depending on site characteristics such as proximity of receptors to I-880, local roadways, or other significant sources of noise in the area, the relative base elevations of roadways and receptors, and the presence of any intervening structures or barriers.

Two long-term noise measurements were made to quantify the diurnal trend in noise levels and establish the worst-hour traffic noise (L1 and L2). For security purposes, these locations were measured at heights of 12 feet above ground and were not representative of areas of frequent human use. The noise levels measured at these positions were used as a reference only.

Nineteen (19) short-term noise measurements (S1a, S1b, and S2 to S18) were made at land uses in the vicinity of the Project area. Short-term noise measurements were made at heights of 5 feet above ground level. With the exception of the reference measurements made at the entranceways to the Webster and Posey Tubes, short-term measurements were made in locations representative of noise sensitive exterior areas of frequent human use.

The results of the long- and short-term field measurements are summarized in Table 6-1 and Table 6-2. The calculated existing modeled worst-hour noise levels at short-term noise measurement locations are based on TNM modeling using free-flow existing traffic volumes provided in the traffic analysis; where demand volumes exceeded the capacity of the highway, free-flowing capacity traffic conditions were used.

Table 6-1. Summary of Long-Term Noise Measurements[a]

Receptor ID	Location (See Appendix B for Photos)	Date	Measured Worst Hour(s)	Worst Hour $L_{eq[h]}$, dBA
L1	Childcare facility, 220 feet from the edge of I-880	7/17/2018	5:00 a.m., 6:00 a.m., 9:00 a.m., 10:00 a.m.	71
L2	75 feet from the center of Webster Street	7/17/2018	7:00 a.m., 8:00 a.m.	71

a Long-term receptors were used to identify the worst traffic noise hour and to compare to short-term data for purposes of model validation and were not used in modeling of Existing and Future conditions.

Table 6-2. Summary of Short-Term Noise Measurements

Receptor ID	Location (See Appendix C)	Date	Start Time	10- minute L_{eq}, dBA	Calculated Worst-Hour $L_{eq[h]}$, dBA
S1a	Apartment Complex, Center of 2nd Floor Courtyard, 423 7th Street, Oakland	7/17/18	12:10 p.m.	65	66
			12:20 p.m.	65	
S1b	Apartment Complex, Center of Rooftop Patio, 423 7th Street, Oakland	7/18/18	12:00 p.m.	61	61
			12:10 p.m.	61	
S2	Front porch of 613 Harrison Street, Oakland	7/17/18	11:40 a.m.	70	73
			11:50 a.m.	69	

Receptor ID	Location (See Appendix C)	Date	Start Time	10- minute L_{eq}, dBA	Calculated Worst-Hour $L_{eq[h]}$, dBA
S3	Childcare facility, 275 7th Street, Oakland	7/17/18	10:40 a.m.	67	72
			10:50 a.m.	68	
S4	Chinese Garden Park, Oakland	7/17/18	10:40 a.m.	71	71
			10:50 a.m.	72	
S5	Front area of 272 7th Street, Oakland	7/17/18	11:10 a.m.	68	69
			11:20 a.m.	67	
S6	Equivalent setback of Baptist church, 280 8th Street, Oakland	7/17/18	11:20 a.m.	64	n/a[c]
			11:30 a.m.	64	
S7	Courtyard of 428 Alice Street, Oakland	7/17/18	11:10 a.m.	58	59
			11:20 a.m.	59	
S8	Equivalent setback of 600 Alice Street, Oakland	7/18/18	1:20 p.m.	71	72[a]
			1:30 p.m.	71	
S9	Backyard of 230 7th Street, Oakland	7/18/18	12:50 p.m.	55[d]	48
			1:00 p.m.	56[d]	
S10	Outdoor area of 186 6th Street, Oakland	7/17/18	12:10 p.m.	60	60
			12:20 p.m.	59	
S11	Backyard of 129 7th Street, Oakland	7/17/18	12:50 p.m.	63	64
			1:00 p.m.	64	
S12	Equivalent setback of Buddhist temple, 623 Oak Street, Oakland	7/17/18	11:20 a.m.	68[d]	66
			11:30 a.m.	65	
S13	Peralta Community College, 333 East 8th Street, Oakland	7/17/18	10:20 a.m.	67	66
			10:30 a.m.	66	
S14	Laney College, 900 Fallon Street, Oakland	7/17/18	10:30 a.m.	60	62
			10:40 a.m.	61	
S15	Equivalent setback of baseball field of Alameda College, 555 Ralph Appezzato Memorial Parkway, Alameda	7/18/18	1:30 p.m.	56	58[a]
			1:40 p.m.	62 (56)[b]	
S16	Equivalent setback of play area of school, 2100 Mariner Square, Alameda	7/18/18	1:20 p.m.	67	69
			1:30 p.m.	68	
S17a	Webster Tube, tunnel entrance, Alameda	7/18/18	10:00 a.m.	79	80[a]
			10:10 a.m.	79	

Receptor ID	Location (See Appendix C)	Date	Start Time	10- minute L_{eq}, dBA	Calculated Worst-Hour $L_{eq[h]}$, dBA
S17b	Webster Tube, setback 45 feet from tunnel entrance, Alameda	7/18/18	10:00 a.m.	80	81[a]
			10:10 a.m.	80	
S17c	Webster Tube, setback 90 feet from tunnel entrance, Alameda	7/18/18	10:00 a.m.	80	81[a]
			10:10 a.m.	80	
S18a	Posey Tube, setback 10 feet from tunnel entrance, Alameda	7/18/18	11:00 a.m.	81	81[a]
			11:10 a.m.	81	
S18b	Posey Tube, setback 60 feet from tunnel entrance, Alameda	7/18/18	11:00 a.m.	81	81[a]
			11:10 a.m.	81	
S18c	Posey Tube, setback 120 feet from tunnel entrance, Alameda	7/18/18	11:00 a.m.	80	80[a]
			11:10 a.m.	80	

[a] Measurement location used for model validation only.
[b] Emergency vehicle sirens resulted in elevated L_{eq} levels. The level indicated in parentheses, which was calculated based on the L_{50}, was used for validation of the TNM model.
[c] Outside Project study area. Provided for informational purposes only.
[d] Measured noise level elevated due to local noise sources.

6.3. Model Validation to Existing Conditions

TNM 2.5 was used to calculate existing noise levels at field measurement locations during periods when the measurements were made, and traffic was counted. Adjustments or “K factors” were then developed where the traffic noise model and the measured levels varied by 3 dBA or greater. The development of each K factor followed the methodology detailed in Section 5.3. The adjustment is added to modeled results for existing and future worst-hour traffic noise conditions. The K factor for each receptor can be found in Table 6-3. As a conservative measure, when modeled traffic noise levels exceeded corresponding measured levels by 3 dBA or more, a K factor was developed to bring modeled noise level predictions 3 dBA higher (e.g., if the measured noise level was 60 dBA and the modeled noise level was 64 dBA, K factor = -1 dBA; whereas, if the measured noise level was 60 dBA and the modeled noise level was 56 dBA, K factor = 4 dBA).

Table 6-3. TNM 2.5 Adjustment Factors

Receptor ID	10-min L_{eq} Noise Level, dBA			K Factor, dBA
	Measured Level	TNM 2.5 Validation	Difference	
S1a	64.5	65.6	-1.1	0
	64.5	65.6	-1.1	
S1b	61.4	61.2	0.2	0
	60.7	61	-0.3	
S2	69.5	70.8	-1.3	0
	68.5	70.9	-2.4	
S3	66.9	70.5	-3.6	-0.1
	67.9	70.5	-2.6	
S4	70.9	69.7	1.2	0
	71.7	69.7	2	
S5	67.5	67.6	-0.1	0
	66.9	67.5	-0.6	
S7	59.7	58.9	0.8	0
	58.9	58.4	0.5	
S8	70.9	69	1.9	0
	71.4	69.3	2.1	
S9	55.4 [a]	48	7.4	0
	55.7 [a]	48.2	7.5	
S10	59.5	60.6	-1.1	0
	59.1	60.2	-1.1	
S11	63.1	63.3	-0.2	0
	63.5	63.6	-0.1	
S12	67.5 [a]	66.1	1.4	0
	64.9	66.1	-1.2	
S13	66.9	66.8	0.1	0
	65.5	66.7	-1.2	
S14	60.3	62.3	-2	0
	61	62.4	-1.4	
S15	56.2	58.2	-2	0
	55.5 [b]	57.4	-1.9	
S16	67.4	64.1	3.3	3.6
	67.5	63.6	3.9	
S17b	80.4	80.1	0.3	0
	80.4	80.1	0.3	
S17c	79.6	80	-0.4	0
	79.6	80	-0.4	
S18b	81.3	80.1	1.2	0
	81.3	80.1	1.2	
S18c	79.2	80.1	-0.9	0
	79.2	80.1	-0.9	

[a] Measured noise level elevated due to local noise sources.
[b] Emergency vehicle sirens resulted in elevated L_{eq} levels. The level used for validation was calculated based on L_{50}.

6.4. Future Undeveloped Land Uses

The Protocol requires that the NSR discuss the development of future land uses in the vicinity of the Project. The Project is located in a primarily built-out area. Lists of planned and approved projects in the Cities of Oakland and Alameda were reviewed to identify undeveloped lands for which development is planned, designed, and programmed so that it may be considered approved prior to Project approval. According to the Protocol, future development would be considered planned, designed, and programmed once it has received final development approval. The review focused on projects within approximately 500 feet of the roadway alignments within the Project limits, where traffic noise levels from the highway or other improved Project roadways could dominate the noise environment. Projects located beyond this distance were excluded from further analysis.

6.4.1. Oakland

Review of the City of Oakland's Development Project Status Map, dated April 2019, identified three approved projects and one project currently under construction. The three approved projects include a 27-story mixed-use building with 380 residential units and 8,195 ft^2 of retail at 325 7^{th} Street, an 8-story mixed-use building with 58 residential units and 1,399 ft^2 for other use at 925 Fallon Street (outside project study area), and a 7-story mixed-use building with 157 residential units and 3,000 ft^2 of retail at 412 Madison Street. Additionally, a mixed-use residential community comprised of two buildings with ground level retail and 330 residential units is under construction at 150 and 155 4^{th} Street. Noise modeling receptors were placed at locations representative of these future uses for calculation of Future No Build and Build traffic noise levels.

6.4.2. Alameda

There are no planned or approved projects located in Alameda within the Project area.

Chapter 7. Future Noise Environment, Impacts, and Considered Abatement

This chapter discusses the future noise environment and potential noise impacts, and then presents a preliminary analysis of noise abatement measures for impacted receptors.

7.1. Future Noise Environment and Impacts

Traffic noise modeling results and predicted traffic noise impacts for existing and design year conditions are shown in Table 7-1. The modeling results are discussed in detail following Table 7-1. In this table, 2045 Build traffic noise levels are compared to Existing conditions and to 2045 No Build conditions. The comparison to Existing conditions is included in the analysis to identify traffic noise impacts as defined under 23 CFR 772. The comparison between 2045 Build and 2045 No Build conditions indicates the direct effect of the Project.

As stated in the TeNS, modeling results are rounded to the nearest decibel before comparisons are made. In some cases, this can result in relative changes that may not appear intuitive. An example would be a comparison between calculated sound levels of 64.4 and 64.5 dBA. The difference between these two values is 0.1 dB. However, after rounding, the difference is reported as 1 dB.

Impacted receptors were identified by Activity Category and the number of impacted receptors is summarized to calculate reasonableness monetary allowances for feasible noise barriers that also meet the 7 dB noise reduction design goal. Noise levels discussed in this section are based on the adjusted model results, using the worst-hour traffic conditions (in terms of noise generation) for the Existing, 2045 No Build, and 2045 Build scenarios.

Thirteen short-term measurement positions (S1 through S5, S7, S9 through S14, and S16) were used as modeling receptors in the vicinity of the Project alignment. In addition, there are twenty-two modeled receptor locations (R1 through R22). Measurement location S6 is outside of the Project study area and is not included as a representative receptor location. Measurement locations S8 and S15 were used for model validation and are better represented by modeled receptors M9 and M22. Measurement locations S17 and S18 were used to validate the tunnel modeling methodology, are not representative of areas of common outdoor usage, and are not included as receptors in the analysis.

There are no existing noise barriers in the Project area. However, most of the receptors in Oakland are shielded by intervening structures and/or the I-880 bridge structure and ramps. Many of the Oakland receptors are located at upper story balconies or rooftop patio areas, reducing the effectiveness of noise barriers placed along the highway edge of shoulder as noise abatement.

Table 7-1. Calculated Noise Levels

Receptor ID	Worst-Hour Noise Levels, $L_{eq[h]}$ dBA			Increase Over Existing, dBA		Increase Over No Build, dBA	Activity Category (NAC)	Impact[1]
	Existing	2045 No Build	2045 Build	2045 No Build	2045 Build			
S1a	66	66	66	0	0	0	B(67)	A/E
S1b	61	62	61	1	0	-1	B(67)	None
S2	73	73	73	0	0	0	B(67)	A/E
S3	72	71	71	-1	-1	0	C(67)	A/E
S4	71	70	70	-1	-1	0	C(67)	A/E
S5	69	68	69	-1	0	1	B(67)	A/E
S7	59	59	59	0	0	0	B(67)	None
S9	48	48	48	0	0	0	B(67)	None
S10	60	61	60	1	0	-1	E(72)	None
S11	64	64	64	0	0	0	C(67)	None
S12	66	67	66	1	0	-1	C(67)	A/E
S13	66	67	66	1	0	-1	C(67)	A/E
S14	62	63	62	1	0	-1	C(67)	None
M1	60	61	60	1	0	-1	E(72)	None
M2	61	62	61	1	0	-1	B(67)	None
M3	48	49	48	1	0	-1	B(67)	None
M4	73	73	73	0	0	0	B(67)	A/E
M5	52	53	52	1	0	-1	E(72)	None
M6	63	63	63	0	0	0	B(67)	None
M7	68	69	68	1	0	-1	B(67)	A/E
M8	54	54	54	0	0	0	B(67)	None
M9	68	68	68	0	0	0	B(67)	A/E
M10	57	58	57	1	0	-1	B(67)	None
M11	43	43	43	0	0	0	B(67)	None
M12	36	36	35	0	-1	-1	B(67)	None

Receptor ID	Worst-Hour Noise Levels, $L_{eq[h]}$ dBA			Increase Over Existing, dBA		Increase Over No Build, dBA	Activity Category (NAC)	Impact[1]
	Existing	2045 No Build	2045 Build	2045 No Build	2045 Build			
M13	67	67	67	0	0	0	C(67)	A/E
M14	48	49	48	1	0	-1	B(67)	None
M15	37	38	37	1	0	-1	B(67)	None
M16	64	65	64	1	0	-1	B(67)	None
M17	57	59	57	2	0	-2	E(72)	None
M18	43	44	43	1	0	-1	B(67)	None
M19	42	42	42	0	0	0	B(67)	None
M20	55	56	55	1	0	-1	B(67)	None
S16	69	69	69	0	0	0	C(67)	A/E
M21	57	58	58	1	1	0	C(67)	None
M22	51	52	52	1	1	0	C(67)	None

1 Impact Type: S = Substantial Increase (12 dBA or more), A/E = Approach or Exceed NAC, None = Increase is less than 12 decibels and noise levels do not approach or exceed the NAC.

7.1.1. Oakland

The worst-hour noise levels at Category B land uses in Oakland are calculated to range from 36 to 73 dBA $L_{eq[h]}$ under Existing and 2045 No Build conditions and from 35 to 73 dBA $L_{eq[h]}$ under 2045 Build conditions. The worst-hour noise levels at Category C land uses are calculated to range from 62 to 71 dBA $L_{eq[h]}$ under Existing conditions, from 63 to 70 dBA $L_{eq[h]}$ under 2045 No Build conditions, and from 62 to 70 dBA $L_{eq[h]}$ under 2045 Build conditions. 2045 Build traffic noise levels are predicted to approach or exceed the Noise Abatement Criteria (NAC) at first row Category B and C receptors located to the north and south of I-880 (S1a, S2, S3, S13, M4, M7, M9, M13) and at first row Category B and C receptors to the north and south of 7th Street (S4, S5, S12). Many of the receptors along I-880 are located at upper story balconies or rooftop patios; these include S1a, S1b, S7, M1, M2, M10, and M13. Although there are no existing noise barriers within the Project area, most ground level and some upper story receptors are in areas shielded behind existing structures or within building courtyard areas. Noise abatement in the form of new sound walls was considered for impacted receptors.

Noise levels would increase by up to 2 dBA over Existing conditions under 2045 No Build conditions and would not be anticipated to increase measurably over Existing conditions (increase is less than 1 dBA) under 2045 Build conditions. This noise level increase is not considered substantial.

7.1.2. Alameda

There are no Category B land uses within the Project area in Alameda. The worst-hour noise levels at Category C land uses in Alameda are calculated to range from 51 to 69 dBA $L_{eq[h]}$ under Existing conditions and from 52 to 69 dBA $L_{eq[h]}$ under 2045 No Build and 2045 Build conditions. 2045 Build traffic noise levels are predicted to approach or exceed the Noise Abatement Criteria (NAC) at a school (S16), located east of Mariner Square Drive. Noise abatement in the form of a new sound wall was considered for impacted receptors.

Noise levels would increase by up to 1 dBA over Existing conditions under 2045 No Build and 2045 Build conditions. This noise level increase is not considered substantial.

7.1.3. Interior Noise Levels in Category D Uses

Under Section 216 of the California Streets and Highways Code, a noise impact occurs if, as a result of a proposed freeway project, noise levels approach or exceed 52 dBA-$L_{eq[h]}$ in the interior of auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. Based on Federal Highway Administration Guidance, a typical Category D use structure would be anticipated to provide about 10 dBA of noise reduction from exterior noise sources with windows open and 20 to 30 dBA of noise reduction with windows in the closed position, depending on the window and exterior wall construction. Therefore, Category D use structures that do not have forced air mechanical ventilation, to allow occupants to keep windows closed to control noise, could be anticipated to have interior noise levels approaching or exceeding 52 dBA-$L_{eq[h]}$ with exterior exposures of 62 dBA-$L_{eq[h]}$ or more. For structures with windows in the closed position, exterior noise levels of 72 to 82 dBA-$L_{eq[h]}$ or less, depending on the acoustical construction of the structure, would result in acceptable interior noise levels.

Three daycare centers (S3, a facility approximately 350 feet southeast of the Posey Tube in Alameda, and S16), three schools (S14 Laney College, S13 Peralta Community College, and M22 Alameda College), and one place of worship (S12 Buddhist temple) have been identified along the alignment. Noise levels at the worst-case exterior façades of these land uses range from 58 to 71 dBA $L_{eq[h]}$ under 2045 Build conditions. Interior noise levels at childcare facility (S3), a school (S16), Peralta Community College (S13), and a Buddhist temple (S12) could potentially approach or exceed 52 dBA-$L_{eq[h]}$ with windows open. Assuming standard building construction with windows in the closed position, noise levels inside these structures are not anticipated to approach or exceed 52 dBA-$L_{eq[h]}$. Noise barriers evaluated to reduce exterior noise levels would also reduce noise levels inside ground level interior spaces.

7.2. Preliminary Noise Abatement Analysis

Noise abatement is considered where noise impacts are predicted in areas of frequent human use that would benefit from a lowered noise level. Noise abatement must be predicted to provide at least a 5 dB minimum reduction at an impacted receptor to be considered feasible by Caltrans (i.e., the barrier would provide a noticeable noise reduction). Additionally, the Protocol’s acoustical design goal states that the noise barrier must provide at least 7 dB of noise reduction at one or more benefited receptors. Noise abatement measures that provide noise reduction of more than 5 dB are encouraged, as long as they meet the reasonableness guidelines. According to 23 CFR 772(13)(c) and 772(15)(c), federal funding may be used for the following abatement measures:

- Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way.

- Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
- Alteration of horizontal and vertical alignments.
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development, which would be adversely impacted by traffic noise.
- Noise insulation of Activity Category D land use facilities listed in Table 4-1. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Concrete safety barriers will be incorporated along I-880 to the extent possible, which may provide some noise reduction.

Bridge deck tining (longitudinal instead of transverse tining) is a Caltrans standard measure to attenuate noise. Tining will be evaluated during the design phase and incorporated, if feasible.

The type of bridge joints incorporated into the project's bridge design (plate bridge joints instead of accordion joints) to potentially reduce noise levels will also be evaluated during the design phase due to the additional maintenance needs associated with plate bridge joints.

Noise barriers were considered as noise abatement for exterior land uses in the Project area. Noise abatement in the form of forced-air ventilation is considered as noise abatement for interior uses of Category D land uses that do not already have it installed.

Each noise barrier has been evaluated for feasibility based on achievable noise reduction. The noise barriers within the State right-of-way are typically constructed to meet the criteria in Chapter 1100 of the Highway Design Manual. The manual states that noise barriers should not be higher than 14 feet above the pavement when located within 15 feet of the edge of traveled way and 16 feet above ground when located more than 15 feet from the edge of traveled way.

A height consideration in the acoustical design of noise barriers is Caltrans guidance to break the line-of-sight between an 11.5-foot-high truck exhaust stack and a 5-foot-high receiver in the first row of houses. This guideline, detailed in Highway Design Manual

Chapter 1100, is intended to reduce the visual and noise intrusiveness of truck exhaust stacks at the first-line receivers. Barrier heights determined by TNM 2.5 often satisfy the acoustical requirements without shielding high truck exhaust stacks. Although such barriers may reduce noise levels sufficiently to meet feasibility and design goal requirements, they have generated complaints from the public in the past when truck stacks were visible. As such, the barrier height at which the line-of-sight to a truck stack is broken is indicated for each evaluated barrier.

The design of noise barriers presented in this report is preliminary and has been conducted at a level appropriate for environmental review but not for final design of the Project. Preliminary information on the physical location, length, and height of noise barriers is provided in this report. If pertinent parameters change substantially during the final Project design, preliminary noise barrier designs may be modified or eliminated from the final Project. A final decision on the construction of noise barriers will be made upon completion of the Project design.

Preliminary noise barriers were evaluated at the most acoustically effective locations within the state right-of-way (ROW). I-880 is elevated above receptors throughout the majority of the Project area. Where the roadway is at grade, or elevated above receptors, the most acoustically effective location for a barrier is near the edge of the shoulder, either on the structure or at the top of the slope. Where the roadway is located in a cut-section, the most acoustically effective location for a barrier is typically at the right-of-way. There are no existing noise barriers along the Project alignment.

Degradation of noise barrier performance is a possibility when the ratio of the spacing between parallel barriers or retaining walls constructed with noise-reflecting materials and the average height of the barriers or walls is 15:1 or less. For these barriers, reflective noise and the use of acoustically absorptive surfaces should be considered. The cost of implementing an absorptive surface would not be included in the construction cost for comparison to the reasonable allowance.

Eight noise barriers were studied as potential noise abatement. Potential noise barriers are discussed in detail below. Once a noise barrier achieved the minimum of a 5 dB reduction at a given receptor and achieved the 7 dB noise reduction design goal for at least one receptor, the reasonable allowance was determined. Tables 7-2 through 7-11 show the predicted 2045 worst-hour noise levels and insertion loss for each barrier at various design heights under the Build Alternative. Table 7-12 summarizes the insertion loss, benefited receptors, and reasonable allowances for each feasible barrier that also met the 7 dB noise reduction design goal. Evaluated barrier locations, as well as measured and modeled receptor locations, are depicted in Appendix C.

7.2.1. Oakland

Outdoor areas of first row Category B and C receptors located to the north and south of I-880 (S1a, S2, S3, S13, M4, M7, M9, M13) and at first row Category B and C receptors to the north and south of 7th Street (S4, S5, S12) have been identified for noise abatement because 2045 Build noise levels would approach or exceed the NAC and these land uses are not shielded by existing noise barriers. Receptors S1a and M13 are located on rooftop patios; reducing the effectiveness of noise abatement. The Buddhist temple (S12) does not include a Category C outdoor use area, but would be considered for interior noise abatement under Category D.

Tables 7-2 through 7-10 show the predicted 2045 Build worst-hour noise levels and insertion loss for Barriers 1 through 7 at various design heights. Barriers located along the I-880 edge of pavement were analyzed for barrier heights of 8 to 16 feet. Barriers located on local roadways were analyzed at heights of 6 to 16 feet.

7.2.1.1. Evaluated Barriers 1, 2, and 3: North of I-880

With implementation of the Project, Barriers 1 and 2 would not feasibly abate traffic noise or meet the 7 dB noise reduction goal. Therefore, reasonable allowances were not calculated for Barriers 1 or 2.

Barrier 3 would feasibly abate traffic noise, meet the 7 dB noise reduction goal, and break the line-of-sight between truck stacks and receptors at a minimum height of 14 feet. The reasonable allowance calculated for barrier heights of 14 to 16 feet is $107,000.

Table 7-2. Evaluated Barrier 1

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S1a	1	66	64	2	64	2	63	3	63	3	63	3
S1b	1	61	61	0	61	0	61	0	60	1	60	1
S2	1	73	71	2	71	2	71	2	71	2	71	2
S3	1	71	71	0	71	0	71	0	71	0	71	0
S4	1	70	70	0	70	0	70	0	70	0	70	0
M2	1	61	61	0	61	0	61	0	61	0	61	0
M3	1	48	48	0	48	0	48	0	48	0	48	0
M6	1	63	62	1	62	1	62	1	62	1	62	1

Table 7-3. Evaluated Barrier 2

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S3	1	71	71	0	71	0	71	0	71	0	71	0
S4	1	70	70	0	69	1	69	1	69	1	69	1
S10	1	60	59	1	59	1	58	2	58	2	58	2
M9	3	68	67	1	67	1	66	2	66	2	66	2

Table 7-4. Evaluated Barriers 1 and 2

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S2	1	73	70	3	70	3	70	3	70	3	70	3
S3	1	71	71	0	70	1	70	1	70	1	70	1
S4	1	70	69	1	69	1	69	1	69	1	69	1

Table 7-5. Evaluated Barrier 3

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S13	1	66	63	3	62	4	60	6	59	7	59	7
S14	1	62	61	1	61	1	59	3	59	3	58	4

7.2.1.2. Evaluated Barriers 4 and 5: South of I-880

With implementation of the Project, Barriers 4 and 5 would not feasibly abate traffic noise or meet the 7 dB noise reduction goal. Therefore, reasonable allowances were not calculated for Barriers 4 or 5.

Table 7-6. Evaluated Barrier 4

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
M4	1	73	71	2	71	2	70	3	70	3	70	3
M7	1	68	67	1	67	1	66	2	66	2	66	2

Table 7-7. Evaluated Barrier 5

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
M7	1	68	65	3	65	3	65	3	65	3	65	3
M13	1	67	66	1	66	1	66	1	66	1	66	1

Table 7-8. Evaluated Barriers 4 and 5

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
M7	1	68	65	3	65	3	64	4	64	4	64	4

7.2.1.3. Evaluated Barriers 6 and 7: North and South of 7th Street

With implementation of the Project, Barrier 6 would not feasibly abate traffic noise or meet the 7 dB noise reduction goal. Therefore, a reasonable allowance was not calculated for Barrier 6.

Barrier 7 would feasibly abate traffic noise, meet the 7 dB noise reduction goal, and break the line-of-sight between truck stacks and receptors at a minimum height of 6 feet. The reasonable allowance calculated for barrier heights of 6 to 16 feet is $214,000.

Table 7-9. Evaluated Barrier 6

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=6 feet		With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S4	1	70	68	2	68	2	67	3	67	3	67	3	67	3

Table 7-10. Evaluated Barrier 7

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=6 feet		With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S5	2	69	62	7	60	9	58	11	57	12	57	12	57	12

7.2.1.4. Interior Noise Levels in Category D Uses

Interior noise levels at three Category D uses; childcare facility (S3), Peralta Community College (S13), and Buddhist temple (S12) could potentially approach or exceed 52 dBA-$L_{eq[h]}$ with windows open. Assuming standard building construction with windows in the closed position, noise levels inside these structures are not anticipated to approach or exceed 52 dBA-$L_{eq[h]}$. The childcare facility (S3), Peralta Community College, and Buddhist temple (S12) have all been confirmed to have a ventilation system, allowing occupants to keep windows closed to control noise. No further noise abatement is considered for these interior uses.

7.2.2. Alameda

2045 Build traffic noise levels are predicted to approach or exceed the Noise Abatement Criteria (NAC) at a school (S16), located east of Mariner Square Drive. Noise abatement in the form of a new sound wall was considered for impacted receptors.

Table 7-11 shows the predicted 2045 Build worst-hour noise levels and insertion loss for Barrier 8 at various design heights.

7.2.2.1. Evaluated Barrier 8: Mariner Square Drive

Barrier 8 would feasibly abate traffic noise, meet the 7 dB noise reduction goal, and break the line-of-sight between truck stacks and receptors at a minimum height of 8 feet. The reasonable allowance calculated for barrier heights of 8 to 16 feet is $107,000.

A school (S16) was confirmed to have forced air ventilation, allowing occupants the option of closing windows to control noise. Assuming standard building construction with windows in the closed position, noise levels inside this structure is not anticipated to approach or exceed 52 dBA-$L_{eq[h]}$ with or without the construction of Barrier 8. The construction of Barrier 8 would further reduce interior levels for indoor school uses.

Table 7-11. Evaluated Barrier 8

Receptor ID	Units Represented	Noise Level w/o Wall	With Wall H=6 feet		With Wall H=8 feet		With Wall H=10 feet		With Wall H=12 feet		With Wall H=14 feet		With Wall H=16 feet	
			$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.	$L_{eq[h]}$	I.L.
S16	1	69	64	5	62	8	60	9	59	11	58	12	57	13

7.3. Preliminary Reasonableness Analysis

The determination of the reasonableness of noise abatement is more subjective than the determination of its feasibility. As defined in Section 772.5 of the regulation, reasonableness is the combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

The overall reasonableness of noise abatement is determined by the following three factors:

- The noise reduction design goal (a barrier must be predicted to provide at least 7 dB of noise reduction at one or more benefited receptors).
- The cost of noise abatement (reasonable allowance of $107,000 per benefited receptor).
- The viewpoints of benefited receptors (including property owners and residents of the benefited receptors).

For any noise barrier to be considered reasonable from a cost perspective, the estimated cost of the barrier should be equal to or less than the total cost allowance calculated for the barrier. The cost calculations of the noise barrier must include all items appropriate and necessary for construction of the barrier, such as traffic control, drainage modification, retaining walls, landscaping for graffiti abatement, and right-of-way costs. Construction cost estimates are not provided in this NSR but are presented in the NADR. The NADR is prepared to compile information from the NSR, other relevant environmental studies, and design considerations into a single, comprehensive document before public review of the Project. The NADR is prepared by the Project Development Team after completion of the NSR and prior to publication of the draft environmental document. The NADR includes noise abatement construction cost estimates that have been prepared and signed by the

Project Development Team based on site-specific conditions. Construction cost estimates are compared to reasonable allowances in the NADR to identify which wall configurations are reasonable from a cost perspective.

Table 7-12 lists the reasonableness allowance calculated for all barriers that were calculated to be acoustically feasible and to meet the Caltrans noise reduction design goal. For each noise barrier found to be acoustically feasible, reasonable cost allowances were calculated by multiplying the number of benefited receptors by $107,000.

Table 7-12. Summary of Acoustically Feasible and Resonable Noise Barriers

Barrier ID	Approximate Stationing/ Location[a]	Noise Level w/o Barrier at Benefited Receptors ($L_{eq[h]}$)	Barrier Height (feet)	Insertion Loss (dBA)	Number of Benefited Receptors	Total Reasonable Monetary Allowance
3	NB I-880 EOS (1490 ft)	66	14	7	1	$107,000
			16	7	1	$107,000
7	North side of 7th Street between Harrison Street and Alice Street (100 ft)	69	6	7	2	$214,000
			8	9	2	$214,000
			10	11	2	$214,000
			12	12	2	$214,000
			14	12	2	$214,000
			16	12	2	$214,000
8	East side of Mariner Square Drive (305 ft)	69	8	8	1	$107,000
			10	9	1	$107,000
			12	11	1	$107,000
			14	12	1	$107,000
			16	13	1	$107,000

a Barrier lengths are based on linear approximations used for purposes of noise modeling in TNM 2.5. Actual lengths may differ slightly due to barrier curvature, etc.

Chapter 8. Construction Noise

Components of the Project are described in detail in Chapter 2. Noise generated by Project-related construction activities would be a function of the noise levels generated by individual pieces of construction equipment, the type and amount of equipment operating at any given time, the timing and duration of construction activities, the proximity of nearby sensitive land uses, and the presence or lack of shielding at these sensitive land uses. Construction noise levels would vary on a day-to-day basis during each phase of construction depending on the specific task being completed.

8.1. Regulatory Criteria

8.1.1. State Policy

Noise associated with construction is controlled by Caltrans Standard Specification Section 14-8.02, "Noise Control," which states the following:

- Control and monitor noise resulting from work activities.
- Do not exceed 86 dBA L_{max} at 50 feet from the job site activities from 9:00 p.m. to 6:00 a.m.

8.1.2. Local Regulations

Typically, work taking place within the Caltrans ROW is not subject to local noise ordinances; however, Caltrans will work with the contractor to meet local requirements, where feasible. The following discussions detail relevant local regulatory criteria established by cities along the Project corridor:

City of Oakland

The City of Oakland's Construction (or Demolition) Noise Performance Standards for activities that occur for more than 10 days, or any repetitively scheduled and relatively long-term construction or demolition operation, is 70 dBA at commercial uses and 65 dBA at residential uses during weekday daytime hours. To ensure compliance with the City's Municipal Code noise control requirements, the City requires implementation of "Standard Conditions of Approval" (COA) for proposed projects involving noise-generating construction and demolition activities. The following COA would be applicable to construction of the Project:

- Construction activities are limited to between 7:00 a.m. and 7:00 p.m. Monday through Friday. Pier drilling and/or other extreme noise generating activities greater than 90 dBA shall be limited to between 8:00 a.m. and 4:00 p.m. Monday through Friday. No exterior construction is allowed on Saturdays, Sunday or federal holidays within 300 feet of a residential zone.

- Equipment and trucks used for Project construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically-attenuating shields or shrouds) wherever feasible.

- Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for Project construction shall be hydraulically or electrically powered to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used. External jackets on the tools themselves shall be used. Quieter procedures shall be used, such as drills rather than impact equipment, whenever such procedures are available and consistent with construction procedures.

- Use temporary power poles instead of generators where feasible.

- Stationary noise sources shall be located as far from adjacent properties as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures to provide equivalent noise reduction.

- The noisiest phases of construction shall be limited to less than 10 days at a time.

- The Project applicant shall notify property owners and occupants located within 300 feet of the construction activities at least 14 calendar days prior to commencing extreme noise generating activities.

City of Alameda

Construction is exempt from the noise limits specified in the City of Alameda's Municipal Code, provided that construction activities are limited to the hours between 7:00 am to 7:00 pm, Mondays through Fridays, and 8:00 am to 5:00 pm on Saturdays.

8.2. Construction Phasing and Noise Levels

The Project would be constructed through a dense urban and developed area in the Cities of Oakland and Alameda. Construction activities would last approximately 3 years. There would be two major stages of construction with several phases in each. The first stage will construct the Jackson horseshoe and associated improvements on the southside of I-880 as well as widen the walkway in the Webster Tube. The second stage will widen the NB I-880/Oak Street off-ramp, remove the Broadway NB I-880 off-ramp, construct 6th Street improvements with associated elements on the northside of I-880. Construction equipment would be staged at areas underneath the I-880 structure owned by Caltrans. Construction activities would primarily be in the daytime, however, nighttime work will be necessary to minimize traffic impacts. Caltrans would continue to coordinate with the cities of Oakland and Alameda to develop and implement a Traffic Management Plan, and other measures to minimize construction impacts on the human and natural environment. As part of the Traffic Management Plan, a shuttle would be in operation during construction to transport bicyclists and pedestrians between Alameda and Oakland.

Construction noise would primarily result from the operation of heavy construction equipment and arrival and departure of heavy-duty trucks. Cast-in-Drilled-Hole (CIDH) Concrete Piles will be used for bridge construction. Additionally, temporary sheet piles will be driven by vibratory pile driver during the construction of retaining walls 3, 5, and 7. Impact pile driving will not be used as a method of construction.

Table 8-1 presents construction noise levels calculated for each major phase of the Project at a distance of 50 feet, based on calculations conducted in FHWA's Roadway Construction Noise Model (RCNM) using Project specific construction information. Ranges are given to identify variation in anticipated noise levels by subphases within each phase. The RCNM construction noise model includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). In some instances, maximum instantaneous noise levels are calculated to be slightly lower than hourly average noise levels. This occurs because the model reports the maximum instantaneous noise level generated by the loudest single piece of construction equipment, while reporting the hourly average noise levels resulting from the additive effect of multiple pieces of construction equipment operating simultaneously. Noise generated by construction equipment drops off at a rate of 6 dB per doubling of distance.

Table 8-1. Noise Levels by Construction Phase at 50 feet

Construction Stage	Subphase	Maximum Noise Level (L_{max}, dBA)	Hourly Average Noise Level ($L_{eq[h]}$, dBA)
Stage 1: South of I-880	(1A) Construct Webster Tube Bike/Pedestrian Walkway (180 Days)	85 to 90	88 to 91
	(1B) Construct Horseshoe (295 Days)	90	87 to 92
	(1C) Construct 5th Street Curb/Gutter, SW, and Pavement (20 Days)	90	90
	(1D) Posey Tube / Harrison Street (80 Days)	90	88 to 92
Stage 2: North of I-880	(2A) Widen Oak Street Off-Ramp and Prepare 6th Street (280 Days)	85 to 90	88 to 90
	(2B) Remove Broadway Off-Ramp Structure and Approach (140 Days)	90	91
	(2C) Construct 6th Street (120 Days)	85 to 90	84 to 90
	(2D) Construct Bike Paths and Tracks on Local Streets (80 Days)	90	89 to 90
	(2E) Landscaping (60 Days)	85	83

8.3. Construction Noise Impacts

Although the overall construction schedule for the entire project area is anticipated to occur over a period of 3 years, roadway construction activities in any specific location would typically occur over a period of time much less than three years, as construction proceeds to other Project elements. Construction noise would mostly be of concern in areas where heavy construction would be concentrated for extended periods of time in areas adjacent to noise sensitive receptors, where noise levels from individual pieces of equipment are substantially higher than ambient conditions, or when construction activities would occur during noise-sensitive early morning, evening, or nighttime hours.

As indicated through comparison of Table 8-1, most construction phases would generate average noise levels that would exceed ambient daytime noise levels at adjacent land uses by 15 to 25 dBA $L_{eq[h]}$. Maximum instantaneous noise levels generated by typical construction activities would generally be at or below existing maximum noise levels generated by highway traffic, but would be considerably higher than levels generated by local traffic and other local noise sources. Receptors shielded by noise barriers would be exposed to a similar increase in noise, albeit at lower overall noise levels because the shielding provided by the existing noise barriers would attenuate construction noise at a similar rate to traffic noise.

With the exception of short periods of heavy demolition and site preparation, construction noise levels would not be expected to exceed the quantitative noise limits established by Caltrans. Construction noise levels are anticipated during unshielded heavy construction located within 500 feet of commercial uses and/or 800 feet of residential uses. Due to the dense urban location of the Project, this would include most components of the Project construction.

8.4. Construction Noise Minimization Measures

To reduce the potential for noise impacts resulting from Project construction, the following measures should be implemented during Project construction.

- All construction equipment should conform to Section 14-8.02, Noise Control, of the latest Standard Specifications.

- The construction activities generating excessive noise should be limited to the hours specified in the appropriate local ordinance, where feasible. If work is necessary outside of these hours, Caltrans should require the contractor to implement a construction noise monitoring program and provide additional mitigation where practical and feasible.

- Equip all internal combustion engine driven equipment with manufacturer recommended intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Unnecessary idling of internal combustion engines within 100 feet of residences should be strictly prohibited.

- Locate stationary noise generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near the construction Project area.

- Utilize "quiet" air compressors and other "quiet" equipment where such technology exists.

- Prohibit unnecessary idling of internal combustion engines within 100 feet of residences.
- Avoid staging of construction equipment within 200 feet of residences and locate all stationary noise-generating construction equipment, such as air compressors, portable power generators, or self-powered lighting systems as far as practicable from noise sensitive receptors.
- Notify property owners and occupants located within 300 feet of the construction activities at least 14 calendar days prior to commencing extreme noise generating activities.

Chapter 9. Construction Vibration

Construction activities are described in detail in Chapter 8 and would generally include demolition, earthwork, paving, concrete/rebar/formwork, utility trenching, and roadway striping. Demolition activity, blasting, and crack-and-seat operations are the primary sources of vibration addressed by Caltrans. Impact pile driving will not be used as a method of construction. Traffic, including heavy trucks traveling on a highway, rarely generates vibration amplitudes high enough to cause structural or cosmetic damage.

Due to the short-term nature of construction, the primary concern is the potential to damage a structure. Demolition and construction activities required for construction often generate perceptible vibration levels and levels that could affect nearby structures when heavy equipment or impact tools (e.g. jackhammers, hoe rams) are used in the vicinity of nearby sensitive land uses. Building damage generally falls into three categories. Cosmetic damage (also known as threshold damage) is defined as hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. Minor damage is defined as hairline cracking in masonry or the loosening of plaster. Major structural damage is defined as wide cracking or the shifting of foundation or bearing walls. Critical factors pertaining to the impact of construction vibration on sensitive receptors include the proximity of the existing structures to the Project site, soil conditions, the soundness of the structures, and the methods of construction used.

9.1. Regulatory Criteria

9.1.1. State Policy

The California Department of Transportation identifies a vibration limit of 0.5 in/sec Peak Particle Velocity (PPV) as the threshold at which there is a potential risk of damage to new residential and modern commercial/industrial structures, 0.3 in/sec PPV for older residential structures, and a conservative limit of 0.25 in/sec PPV for historic and some old buildings (see Table 9-1, below).

Table 9-1. Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

9.1.2. Local Regulations

Typically, work taking place within the Caltrans right-of-way is not subject to local ordinances; however, Caltrans will work with the contractor to meet local requirements, where feasible. The following discussions detail relevant local regulatory criteria established by cities along the Project corridor:

Cities of Oakland and Alameda

The City of Oakland does not specify a construction vibration limit. However, to ensure compliance with the City's Municipal Code noise control requirements, the City requires implementation of "Standard Conditions of Approval" (COA) for proposed projects involving noise-generating construction and demolition activities. The following vibration related COA would be relevant to construction of the Project:

- The Project applicant shall retain a structural engineer or other appropriate professional to determine threshold levels of vibration and cracking that could damage nearby historic structures, and design means and methods of construction that shall be utilized to not exceed the thresholds. The engineer’s analysis shall be submitted to the City of Oakland for review and approval. The applicant shall implement the approved plan.

The City of Alameda does not specify a construction vibration limit.

9.2. Construction Vibration Levels

Construction activities with the greatest potential of generating perceptible vibration levels would include vibratory pile driving, the removal of pavement and soil, the movement of heavy tracked equipment, and vibratory compacting of roadway base materials by use of a roller. Table 9-2 presents typical vibration levels that could be expected from representative construction equipment at a reference distance of 25 feet and at distances of 10, 50, and 100 feet, representative of typical setbacks of structures to Project construction. Vibration levels are highest close to the source, and then attenuate with increasing distance depending on soil conditions. Assuming normal propagation, construction vibration would attenuate at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet.

Table 9-2. Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Representative of Setbacks of Nearest Structures (in/sec PPV)[1]		
			10 feet	50 feet	100 feet
Pile Driver (Sonic)	upper range	0.734	2.011	0.342	0.160
	typical	0.17	0.466	0.079	0.037
Clam shovel drop		0.202	0.553	0.094	0.044
Hydromill (slurry wall)	in soil	0.022	0.022	0.004	0.002
	in rock	0.047	0.047	0.008	0.004
Vibratory Roller		0.210	0.575	0.098	0.046
Hoe Ram		0.089	0.244	0.042	0.019
Large bulldozer		0.089	0.244	0.042	0.019
Caisson drilling		0.089	0.244	0.042	0.019
Loaded trucks		0.076	0.208	0.035	0.017
Jackhammer		0.035	0.096	0.016	0.008
Small bulldozer		0.003	0.008	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, September 2018 as modified by Illingworth & Rodkin, Inc., November 2019.

[1]These levels calculated assuming normal propagation conditions, using a standard equation of $PPVeqmt\text{-}PPVref * (25/D)^{1.1}$, from Caltrans, September 2013.

9.3. Construction Vibration Impacts

As shown in Table 9-1, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for new residential and modern commercial/industrial structures, 0.3 in/sec PPV for older residential structures, and 0.25 in/sec PPV for historic and some old buildings. The Project is located in a dense urban area with a variety of structures and land uses, including many historic properties. The following properties are designated as historic:

- George A. Posey Tube (including Oakland and Alameda Portals and Approaches)
- 601–609 Jackson Street
- 640 Harrison Street
- 318-322 Harrison Street
- 220 4th Street
- 228 Harrison Street
- Oakland Waterfront Warehouse District
- Seventh Street/Harrison Square Residential District

Heavy construction located within 25 feet and vibratory pile driving located within 75 feet of historic buildings would have the potential to exceed the 0.25 in/sec PPV threshold. The 0.3 in/sec PPV threshold would be exceeded for heavy construction located within 20 feet and vibratory pile driving located within 60 feet of older residential structures. For new residential and modern commercial/industrial structures, the 0.5 in/sec PPV threshold for heavy construction located within 12 feet and vibratory pile driving located within 40 feet. Distances to exceedances of the vibration limits for various structure types are shown in Table 9-3.

Table 9-3. Distance to Exceedance of Vibration Limit by Structure Type

Structure Type (Threshold)	Distance to Exceedance of Threshold, feet[1]	
	Vibratory Pile Driving	Other Heavy Construction
Historic Buildings (0.25 in/sec PPV)	75 feet	25 feet
Older Residences (0.3 in/sec PPV)	60 feet	20 feet
New Residential and Commercial/Industrial Buildings (0.5 in/sec PPV)	40 feet	12 feet

[1]These levels calculated assuming normal propagation conditions, using a standard equation of $PPVeqmt\text{-}PPVref * (25/D)^{1.1}$, from Caltrans, September 2013.

Due to the proximity of heavy construction and vibratory pile driving to structures and the density of historic structures in Oakland adjacent to Project construction, vibration limits are anticipated to be exceeded during vibratory pile driving and heavy construction located adjacent to historic structures. Construction vibration limits are not anticipated to be exceeded in Alameda.

A desktop review conducted for the project area and adjacent areas did not identify any vibration sensitive business operations that would be impacted by construction. Additionally, no comments regarding vibration concerns were received in response to the public outreach notice and scoping meeting.

9.4. Construction Vibration Minimization Measures

To reduce the potential for vibration impacts resulting from Project construction, the following measures should be implemented during Project construction.

- Where hydraulic breakers are proposed within 25 feet of historic structures, consider alternative construction methods such as use of hydraulic crushers or hydraulic splitters to break up material and use of saws or rotary rock-cutting heads to cut bridge decks or concrete slabs into small sections that can be loaded onto trucks for disposal.

- Structural conditions at all buildings located within 25 feet of heavy construction and 75 feet of vibratory pile driving prior to, during, and after vibration generating construction activities should be documented, including the following tasks:

    - Identification of sensitivity to ground-borne vibration of structures and operations located within 25 feet of heavy construction and 75 feet of vibratory pile driving.

    - Performance of a pre and post-condition assessment through observation and measurements, plans, photos and any other data the qualified preparer may deem appropriate for all structures located within the exceedance distances given in Table 9-3, based on the determination made as the sensitivity of the structure to damage due to construction vibration.

- Conduct a post-survey on structures where complaints of damage occur. Make appropriate repairs in accordance with the Secretary of the Interior's Standards where damage has occurred as a result of construction activities.

- Designate a person responsible for registering and investigating claims of excessive vibration. The contact information of such person shall be clearly posted on the construction site.

Chapter 10. References

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Chapter 11. List of Preparers

The following individuals had substantial roles in the preparation of this report:

- Dana Lodico, PE, INCE Bd. Cert. (Illingworth & Rodkin, Inc. — Senior Consultant) – Project Manager, noise measurements, data analysis, traffic noise modeling, report preparation, and quality assurance review.
- Michael Thill (Illingworth & Rodkin, Inc. — Principal Consultant) – Noise Measurements and quality assurance review.
- Richard Rodkin (Illingworth & Rodkin, Inc. — Senior Consultant) - Noise measurements.
- Carrie Janello (Illingworth & Rodkin, Inc. — Senior Consultant) - Noise measurements.
- Steve Deines (Illingworth & Rodkin, Inc. — Staff Consultant) – Traffic noise modeling.
- Manasi Biwalkar (Illingworth & Rodkin, Inc. — Staff Consultant) - Noise measurements.
- Micah Black (Illingworth & Rodkin, Inc. — Staff Consultant) – Report graphics preparation.

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Appendix A Definition of Technical Terms

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro-Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn}	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 p.m. and 7:00 a.m.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 p.m. to 10:00 p.m. and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

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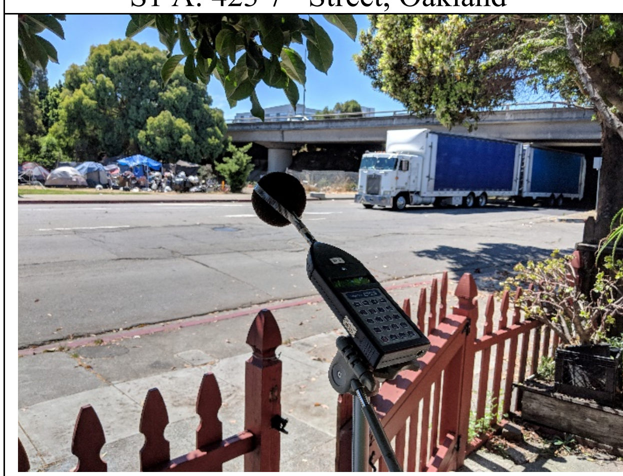
Appendix B Site Photographs

L1: Childcare Facility, Oakland

L2: 75 feet from center of Webster Street, Alameda

S1 A: 423 7th Street, Oakland

S1 B - D: 423 7th Street, Oakland



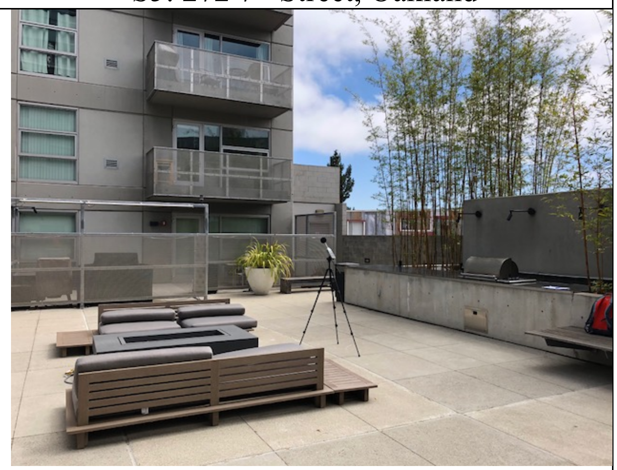
S2: 613 Harrison Street, Oakland

S3: 275 7th Street, Oakland

S4: Chinese Garden Park, Oakland

S5: 272 7th Street, Oakland

S6: 280 8th Street, Oakland



S7: 428 Alice Street, Oakland

S8: 600 Alice Street, Oakland

S9: 230 7st Street, Oakland

S10: 186 6th Street, Oakland

S11: 129 7th Street, Oakland

S12: 632 Oak Street, Oakland

S13: 333 8th Street, Oakland

No Photo Available

S14: Laney College, Oakland

S15: 555 Ralph Appezzato Memorial Parkway, Alameda

 S16: 2100 Mariner Square Drive, Alameda	 S17 A - C: Webster Tube Alameda
 S18 A: Posey Tube, Alameda	 S18 B: Posey Tube, Alameda

Appendix C Receptor Locations and Noise Barriers

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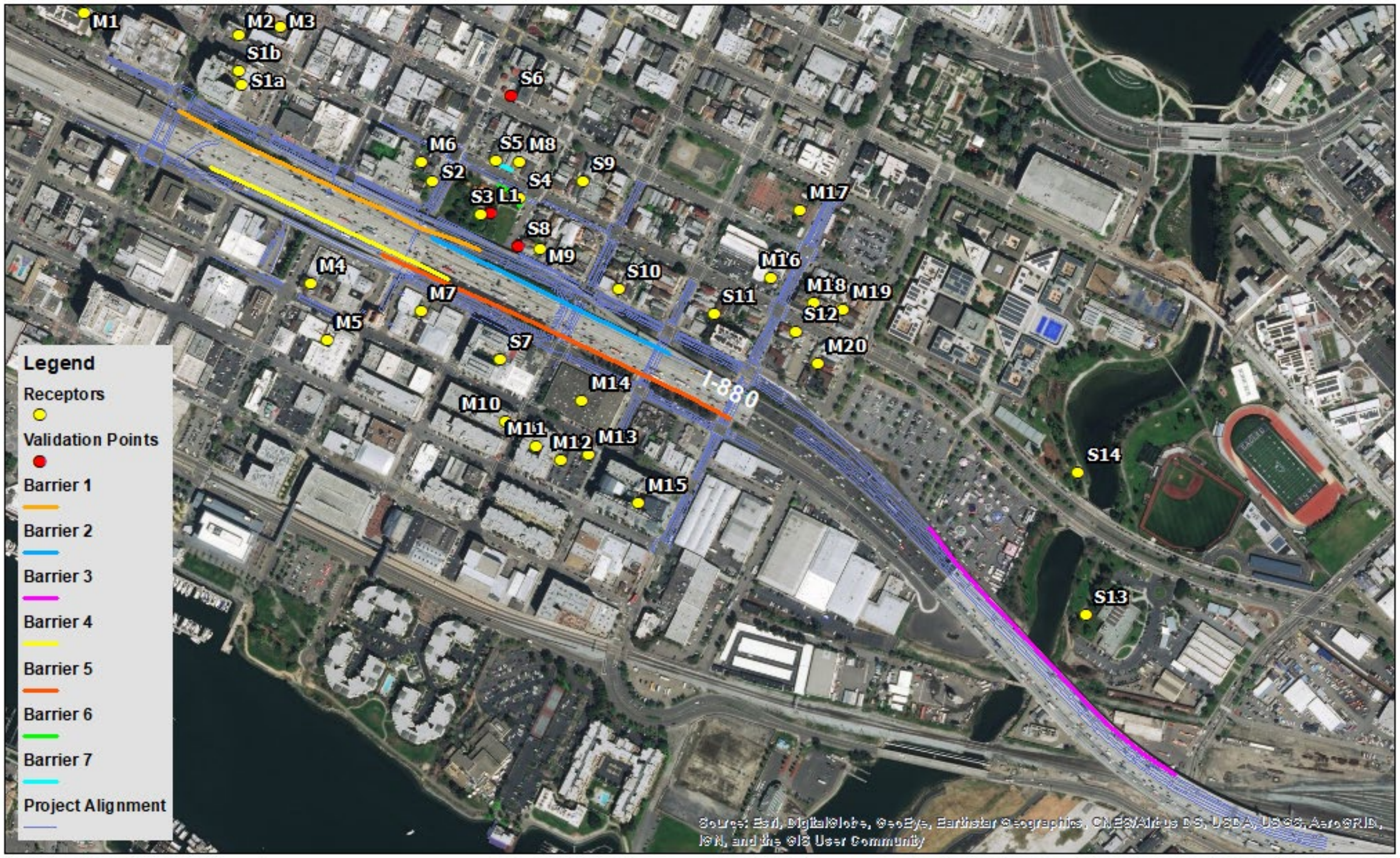


Figure C-1:
Receptor Locations and Noise Barriers
I-880, Oakland, CA

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

N

0 250 500 1,000 1,500 2,000 Feet

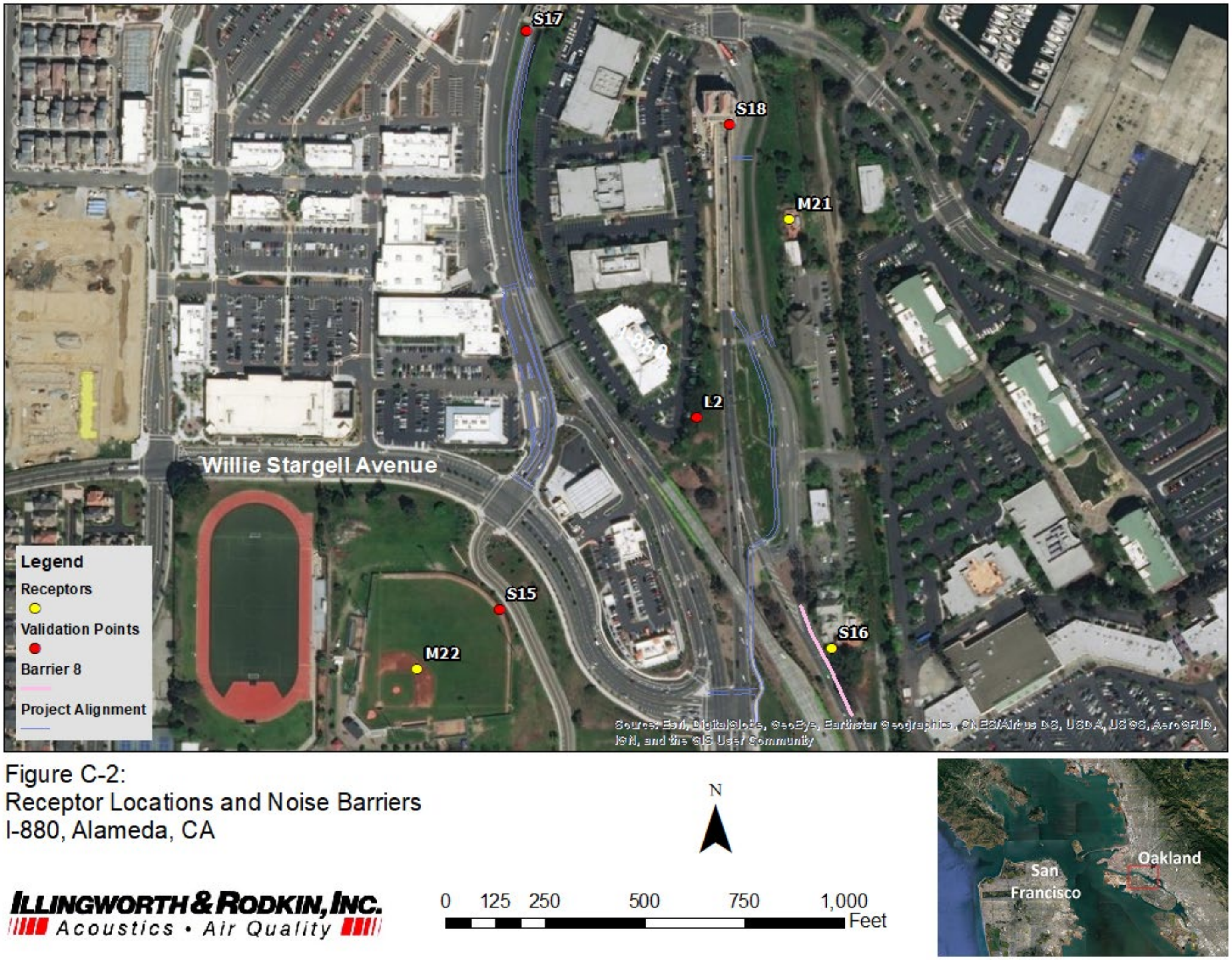


Figure C-2:
Receptor Locations and Noise Barriers
I-880, Alameda, CA

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

Appendix D Long-Term Noise Data

Figure D1. Daily Noise Trends at L1, Childcare Facility, Oakland, Tuesday, July 17th, 2018

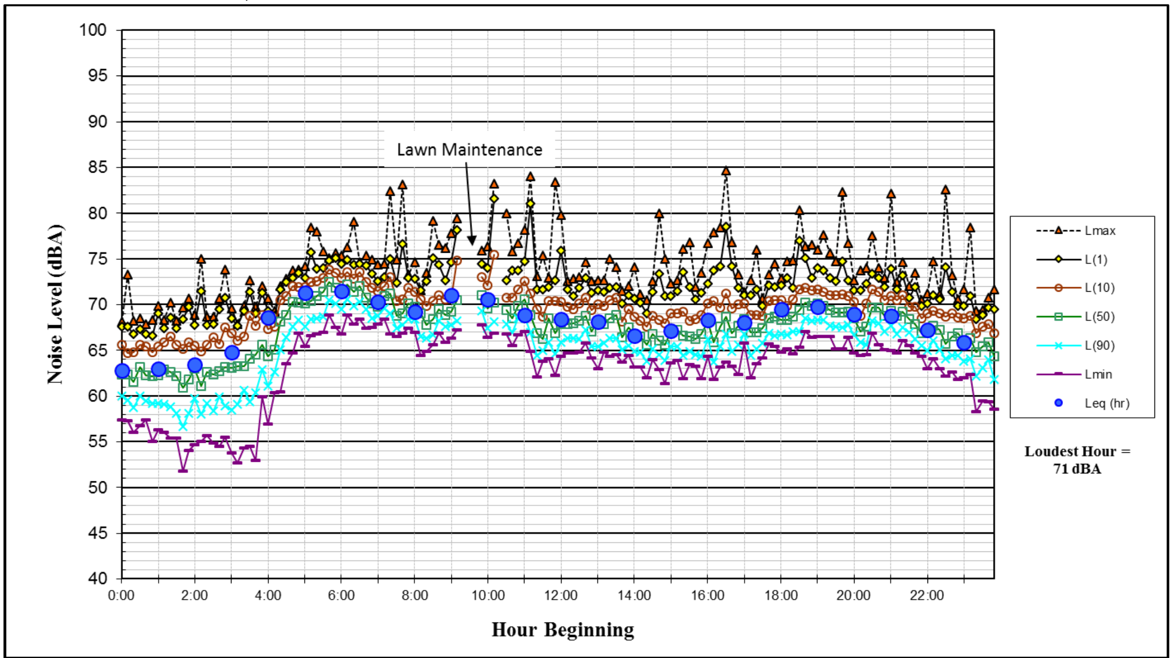
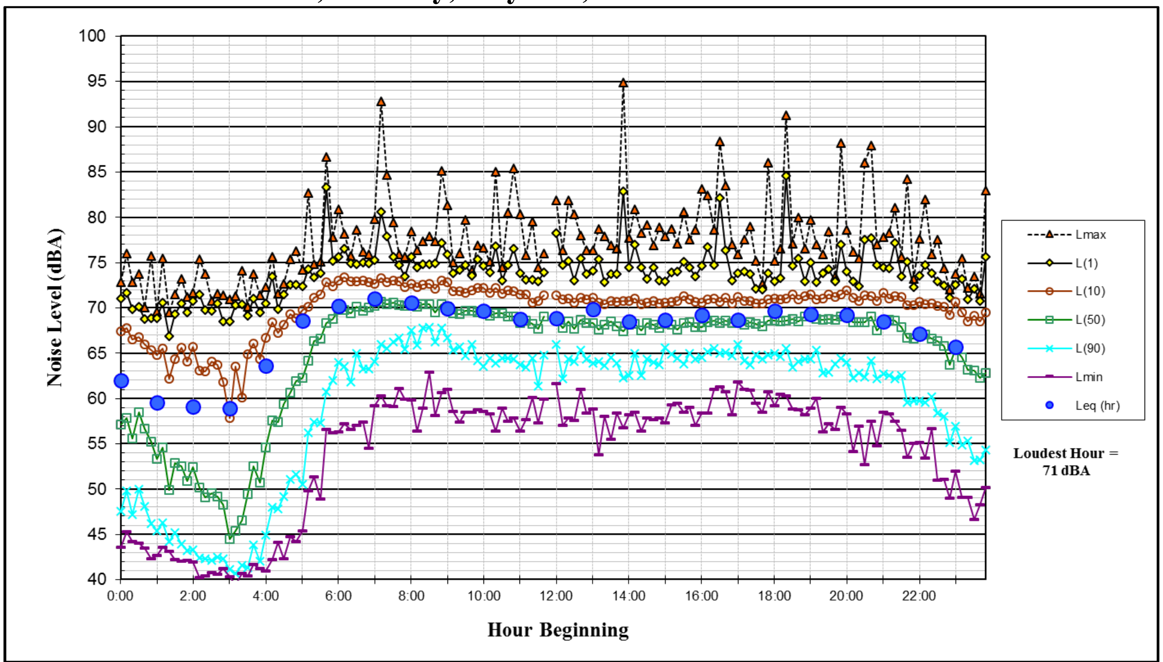


Figure D2. Daily Noise Trends at L1, 75 feet from center of Webster Street, Alameda, Tuesday, July 17th, 2018



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Appendix E Traffic Data

Table E-1. Traffic Data for Existing Conditions

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
5th Street, Washington Street to Broadway	3	1,464	95%	1,391	3%	44	2%	29	30
5th Street, Broadway to Jackson Street	2	657	95%	624	3%	20	2%	13	30
5th Street, Jackson Street to Madison Street	3	649	95%	617	3%	19	2%	13	30
5th Street, Madison Street to Oak Street	3	1,254	95%	1,191	3%	38	2%	25	30
6th Street, Oak Street to Madison Street	3	263	95%	250	3%	8	2%	5	30
6th Street. Madison Street to Jackson Street	3	393	95%	373	3%	12	2%	8	30
6th Street, Jackson Street to Broadway	3	1,994	95%	1,894	3%	60	2%	40	30
6th Street, Broadway to Washington Street	2	213	95%	202	3%	6	2%	4	30
7th Street, Washington Street to Broadway	4	1,503	95%	1,428	3%	45	2%	30	30
7th Street, Broadway to Webster Street	4	1,856	95%	1,763	3%	56	2%	37	30

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
7th Street, Webster Street to Harrison Street	4	1,105	95%	1,050	3%	33	2%	22	30
7th Street, Harrison Street to Jackson Street	4	2,336	95%	2,219	3%	70	2%	47	30
7th Street, Jackson Street to Madison Street	4	1,571	95%	1,492	3%	47	2%	31	30
7th Street, Madison Street to Oak	4	1,572	95%	1,493	3%	47	2%	31	30
Oak Street, 5th Street to 6th Street	2	857	95%	814	3%	26	2%	17	30
Oak Street, 6th Street to 7th Street	3	1,214	95%	1,153	3%	36	2%	24	30
Oak Street, 7th Street to 8th Street	3	790	95%	751	3%	24	2%	16	30
Madison Street, 7th Street to 6th Street	3	982	95%	933	3%	29	2%	20	30
Madison Street, 6th Street to 5th Street	2	802	95%	762	3%	24	2%	16	30
Jackson Street, 5th Street to 6th Street	2	934	95%	887	3%	28	2%	19	30
Jackson Street, 6th Street to 7th Street	2	1,930	95%	1,834	3%	58	2%	39	30

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
Broadway, 4th Street to 5th Street	5	1,066	95%	1,013	3%	32	2%	21	30
Broadway, 5th Street to 6th Street	5	1,248	95%	1,186	3%	37	2%	25	30
Broadway, 6th Street to 7th Street	5	1,376	95%	270	3%	9	2%	6	30
Washington Street, 5th Street to 6th Street	2	320	95%	304	3%	10	2%	6	30
Washington Street, 6th Street to 7th Street	2	284	95%	270	3%	9	2%	6	30
I-880, Northbound Mainline	4	7081	89.3%	6323	3.4%	241	7.3%	517	55
I-880, Southbound Mainline	4	5606	89.3%	5006	3.4%	191	7.3%	409	55
NB I-880 Off Ramp to Oak Street	1	950	89.3%	848	3.4%	32	7.3%	69	35
NB I-880 Off Ramp to Broadway	1	989	89.3%	883	3.4%	34	7.3%	72	35
NB I-880 On-Ramp from Jackson Street	1	1894	89.3%	1691	3.4%	64	7.3%	138	35
NB I-880 Off Ramp to I-980	2	3581	89.3%	2665	3.4%	101	7.3%	218	45
SB I-880 On Ramp from I-980	2	2774	89.3%	2477	3.4%	94	7.3%	203	45
SB I-980 Off Ramp to Jackson Street	1	1180	89.3%	1054	3.4%	40	7.3%	86	35

SB I-880 On Ramp from Broadway	1	540	89.3%	482	3.4%	18	7.3%	39	35
SB I-880 On Ramp from Oak Street/5th Street	2	1008	89.3%	900	3.4%	34	7.3%	74	35
Constitution Way, Alameda	2	2827	99%	2799	1%	28	0%	0	30
Marina Square Drive, Alameda	2	390	99%	386	1%	4	0%	0	30
Willie Stargell Way, Alameda	4	1500	99%	1485	1%	15	0%	0	30
Webster Street, Alameda	2	2615	95%	2484	3%	78	2%	52	30

Table E-2. Traffic Data for 2045 No Build

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
5th Street, Washington Street to Broadway	3	1496	95%	1421	3%	45	2%	30	30
5th Street, Broadway to Jackson Street	2	617	95%	586	3%	19	2%	12	30
5th Street, Jackson Street to Madison Street	3	965	95%	917	3%	29	2%	19	30
5th Street, Madison Street to Oak Street	3	1352	95%	1284	3%	41	2%	27	30
6th Street, Oak Street to Madison Street	3	439	95%	417	3%	13	2%	9	30
6th Street. Madison Street to Jackson Street	3	647	95%	615	3%	19	2%	13	30
6th Street, Jackson Street to Broadway	3	1362	95%	1294	3%	41	2%	27	30
6th Street, Broadway to Washington Street	2	362	95%	344	3%	11	2%	7	30
7th Street, Washington Street to Broadway	4	1669	95%	1586	3%	50	2%	33	30
7th Street, Broadway to Webster Street	4	2246	95%	2134	3%	67	2%	45	30

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
7th Street, Webster Street to Harrison Street	4	1384	95%	1315	3%	42	2%	28	30
7th Street, Harrison Street to Jackson Street	4	1950	95%	1853	3%	59	2%	39	30
7th Street, Jackson Street to Madison Street	4	1890	95%	1796	3%	57	2%	38	30
7th Street, Madison Street to Oak	4	2294	95%	2179	3%	69	2%	46	30
Oak Street, 5th Street to 6th Street	2	1136	95%	1079	3%	34	2%	23	30
Oak Street, 6th Street to 7th Street	3	1265	95%	1202	3%	38	2%	25	30
Oak Street, 7th Street to 8th Street	3	1067	95%	1014	3%	32	2%	21	30
Madison Street, 7th Street to 6th Street	3	1254	95%	1191	3%	38	2%	25	30
Madison Street, 6th Street to 5th Street	2	926	95%	880	3%	28	2%	19	30
Jackson Street, 5th Street to 6th Street	2	973	95%	924	3%	29	2%	19	30
Jackson Street, 6th Street to 7th Street	2	1149	95%	1092	3%	34	2%	23	30

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
Broadway, 4th Street to 5th Street	5	1428	95%	1357	3%	43	2%	29	30
Broadway, 5th Street to 6th Street	5	1856	95%	1763	3%	56	2%	37	30
Broadway, 6th Street to 7th Street	5	1769	95%	1681	3%	53	2%	35	30
Washington Street, 5th Street to 6th Street	2	322	95%	306	3%	10	2%	6	30
Washington Street, 6th Street to 7th Street	2	284	95%	270	3%	9	2%	6	30
I-880, Northbound Mainline	4	7767	89.3%	6939	3.4%	264	7.3%	567	55
I-880, Southbound Mainline	4	7041	89.3%	6288	3.4%	239	7.3%	514	55
NB I-880 Off Ramp to Oak Street	1	1024	89.3%	914	3.4%	35	7.3%	75	35
NB I-880 Off Ramp to Broadway	1	944	89.3%	843	3.4%	32	7.3%	69	35
NB I-880 On-Ramp from Jackson Street	1	2050	89.3%	1831	3.4%	70	7.3%	150	35
NB I-880 Off Ramp to I-980	2	4168	89.3%	3722	3.4%	142	7.3%	304	45
SB I-880 On Ramp from I-980	2	3137	89.3%	2801	3.4%	107	7.3%	229	45
SB I-980 Off Ramp to Jackson Street	1	1580	89.3%	1411	3.4%	54	7.3%	115	35

SB I-880 On Ramp from Broadway	1	540	89.3%	482	3.4%	18	7.3%	39	35
SB I-880 On Ramp from Oak Street/5th Street	2	1013	89.3%	905	3.4%	34	7.3%	74	35
Constitution Way, Alameda	2	2860	99%	2831	1%	29	0%	0	30
Marina Square Drive, Alameda	2	626	99%	620	1%	6	0%	0	30
Willie Stargell Way, Alameda	4	1904	99%	1885	1%	19	0%	0	30
Webster Street, Alameda	2	2759	95%	2621	3%	83	2%	55	30

Table E-3. Traffic Data for 2045 Build

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
5th Street, Washington Street to Broadway	3	1541	95%	1464	3%	46	2%	31	30
5th Street, Broadway to Jackson Street	2	1965	95%	1867	3%	59	2%	39	30
5th Street, Jackson Street to Madison Street	3	1209	95%	1149	3%	36	2%	24	30
5th Street, Madison Street to Oak Street	3	1411	95%	1340	3%	42	2%	28	30
6th Street, Oak Street to Madison Street	3	1227	95%	1166	3%	37	2%	25	30
6th Street. Madison Street to Jackson Street	3	2101	95%	1996	3%	63	2%	42	30
6th Street, Jackson Street to Broadway	3	1102	95%	1047	3%	33	2%	22	30
6th Street, Broadway to Washington Street	2	496	95%	471	3%	15	2%	10	30
7th Street, Washington Street to Broadway	4	1616	95%	1535	3%	48	2%	32	30
7th Street, Broadway to Webster Street	4	1498	95%	1423	3%	45	2%	30	30

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
7th Street, Webster Street to Harrison Street	4	1242	95%	1180	3%	37	2%	25	30
7th Street, Harrison Street to Jackson Street	4	1609	95%	1529	3%	48	2%	32	30
7th Street, Jackson Street to Madison Street	4	1877	95%	1783	3%	56	2%	38	30
7th Street, Madison Street to Oak	4	2191	95%	2081	3%	66	2%	44	30
Oak Street, 5th Street to 6th Street	2	1104	95%	1049	3%	33	2%	22	30
Oak Street, 6th Street to 7th Street	3	1033	95%	981	3%	31	2%	21	30
Oak Street, 7th Street to 8th Street	3	754	95%	716	3%	23	2%	15	30
Madison Street, 7th Street to 6th Street	3	1286	95%	1222	3%	39	2%	26	30
Madison Street, 6th Street to 5th Street	2	713	95%	677	3%	21	2%	14	30
Jackson Street, 5th Street to 6th Street	2	683	95%	649	3%	20	2%	14	30
Jackson Street, 6th Street to 7th Street	2	611	95%	580	3%	18	2%	12	30

Roadway	Number of Lanes	Worst Hour Traffic Volume	Auto		Medium Trucks		Heavy Trucks		Speed, mph
			%	Volume	%	Volume	%	Volume	
Broadway, 4th Street to 5th Street	5	1289	95%	1225	3%	39	2%	26	30
Broadway, 5th Street to 6th Street	5	1501	95%	1426	3%	45	2%	30	30
Broadway, 6th Street to 7th Street	5	1276	95%	1212	3%	38	2%	26	30
Washington Street, 5th Street to 6th Street	2	321	95%	305	3%	10	2%	6	30
Washington Street, 6th Street to 7th Street	2	294	95%	279	3%	9	2%	6	30
I-880, Northbound Mainline	4	7173	89.3%	6095	3.4%	232	7.3%	498	55
I-880, Southbound Mainline	4	7041	89.3%	6288	3.4%	239	7.3%	514	55
NB I-880 Off Ramp to Oak Street	2	1929	89.3%	1723	3.4%	66	7.3%	141	35
NB I-880 Off Ramp to Broadway	Removed with the Project								
NB I-880 On-Ramp from Jackson Street	1	2020	89.3%	1804	3.4%	69	7.3%	147	35
NB I-880 Off Ramp to I-980	2	4310	89.3%	2757	3.4%	105	7.3%	225	45
SB I-880 On Ramp from I-980	2	3137	89.3%	2801	3.4%	107	7.3%	229	45
SB I-980 Off Ramp to Jackson Street	1	1567	89.3%	1399	3.4%	53	7.3%	114	35

SB I-880 On Ramp from Broadway	1	540	89.3%	482	3.4%	18	7.3%	39	35
SB I-880 On Ramp from Oak Street/5th Street	2	994	89.3%	888	3.4%	34	7.3%	73	35
Constitution Way, Alameda	2	2860	99%	2831	1%	29	0%	0	30
Marina Square Drive, Alameda	2	626	99%	620	1%	6	0%	0	30
Willie Stargell Way, Alameda	4	1904	99%	1885	1%	19	0%	0	30
Webster Street, Alameda	2	2759	95%	2621	3%	83	2%	55	30

Appendix F RCNM Output Files

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Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Aa Mobilization Clear and Grubb

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Generator	No	50		80.6	50.0	0.0
All Other Equipment > 5 HP	No	50	85.0		50.0	0.0
All Other Equipment > 5 HP	No	50	85.0		50.0	0.0
Generator	No	50		80.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
All Other Equipment > 5 HP	85.0	82.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
All Other Equipment > 5 HP	85.0	82.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85.0	88.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Ac 6th Street Entrance to Webster

**** Receptor #1 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Gradall	No	40		83.4	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Jackhammer	Yes	20		88.9	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Gradall	83.4	79.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jackhammer	88.9	81.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Ad Construct Webster Tube Bike/Ped Wakway

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
All Other Equipment > 5 HP	No	50	85.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Man Lift	No	20		74.7	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Gradall	No	40		83.4	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

													N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
All Other Equipment > 5 HP	85.0	82.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Gradall	83.4	79.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Ba

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Man Lift	No	20		74.7	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Man Lift	No	20		74.7	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	88.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Ba

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Man Lift	No	20		74.7	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Man Lift	No	20		74.7	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.5	87.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Bb

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Spec Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Man Lift	No	20		74.7	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Crane	No	16		80.6	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Jackhammer	Yes	20		88.9	50.0	0.0
Hydra Break Ram	Yes	10	90.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jackhammer	88.9	81.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydra Break Ram	90.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	90.0	91.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Bd

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Man Lift	No	20		74.7	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Roller	No	20		80.0	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	89.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1C

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Scraper	No	40		83.6	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Roller	No	20		80.0	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1C

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	88.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Dc

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Scraper	No	40		83.6	50.0	0.0
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Crane	No	16		80.6	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Jackhammer	Yes	20		88.9	50.0	0.0
Hydra Break Ram	Yes	10	90.0		50.0	0.0
Roller	No	20		80.0	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

													N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jackhammer	88.9	81.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydra Break Ram	90.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	90.0	91.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2B

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Roller	No	20		80.0	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Aa

**** Receptor #1 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Roller	No	20		80.0	50.0	0.0
All Other Equipment > 5 HP	No	50	85.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

													N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
All Other Equipment > 5 HP	85.0	82.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85.0	87.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Ac

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Hydra Break Ram	Yes	10	90.0		50.0	0.0
Generator	No	50		80.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydra Break Ram	90.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

														N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	90.0	87.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2B

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Pavement Scarafier	No	20		89.5	50.0	0.0
Jackhammer	Yes	20		88.9	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Hydra Break Ram	Yes	10	90.0		50.0	0.0
Generator	No	50		80.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jackhammer	88.9	81.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydra Break Ram	90.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	90.0	90.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Ca

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Hydra Break Ram	Yes	10	90.0		50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydra Break Ram	90.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	90.0	90.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Cb

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Scraper	No	40		83.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	89.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Cb

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Cd

**** Receptor #1 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Ce

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
All Other Equipment > 5 HP	No	50	85.0		50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
All Other Equipment > 5 HP	85.0	82.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total	85.0	83.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Ce

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Da

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	88.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 2Ce

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Slurry Trenching Machine	No	50		80.4	50.0	0.0
Concrete Saw	No	20		89.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Compactor (ground)	No	20		83.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Vacuum Street Sweeper	No	10		81.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slurry Trenching Machine	80.4	77.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compactor (ground)	83.2	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Street Sweeper	81.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	90.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2020
Case Description: 1Dc

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
50 ft receptor	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
All Other Equipment > 5 HP	No	50	85.0		50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0
Dump Truck	No	40		76.5	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
All Other Equipment > 5 HP	85.0	82.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85.0	82.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A