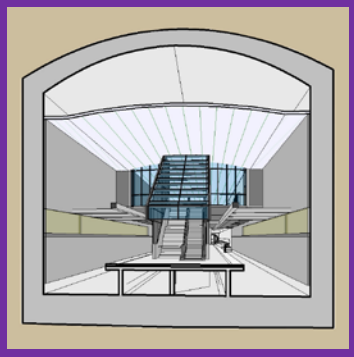
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

WESTSIDE PURPLE LINE EXTENSION PROJECT, SECTION 2

ADVANCED PRELIMINARY ENGINEERING

Contract No. PS-4350-2000


Section 2 Construction Noise and Vibration Evaluation – Revision 1

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Table of Contents

List of Figures

List of Tables

List of Appendices

PREFACE

This Section 2 Construction Noise and Vibration Evaluation incorporates and supersedes three memoranda that were previously stand-alone documents:

- *Westside Purple Line Extension, Section 2, Construction Noise/Vibration Mitigation and Monitoring Plan*
- *Westside Purple Line Extension Century City Rehabilitation Facility Nighttime Construction Noise Assessment Memorandum*
- *Westside Purple Line Extension Beverly Hills High School Temporary Classrooms Construction Noise Assessment*

These three memoranda were shared with the City of Beverly Hills and the Beverly Hills Unified School District in February 2017 as part of the Section 4(f) consultation process for the publicly used recreational facilities at Beverly Hills High School. This revised and consolidated version of the memo addresses comments and concerns received in letters from the City of Beverly Hills on April 4, 2017 and Beverly Hills Unified School District on April 7, 2017.

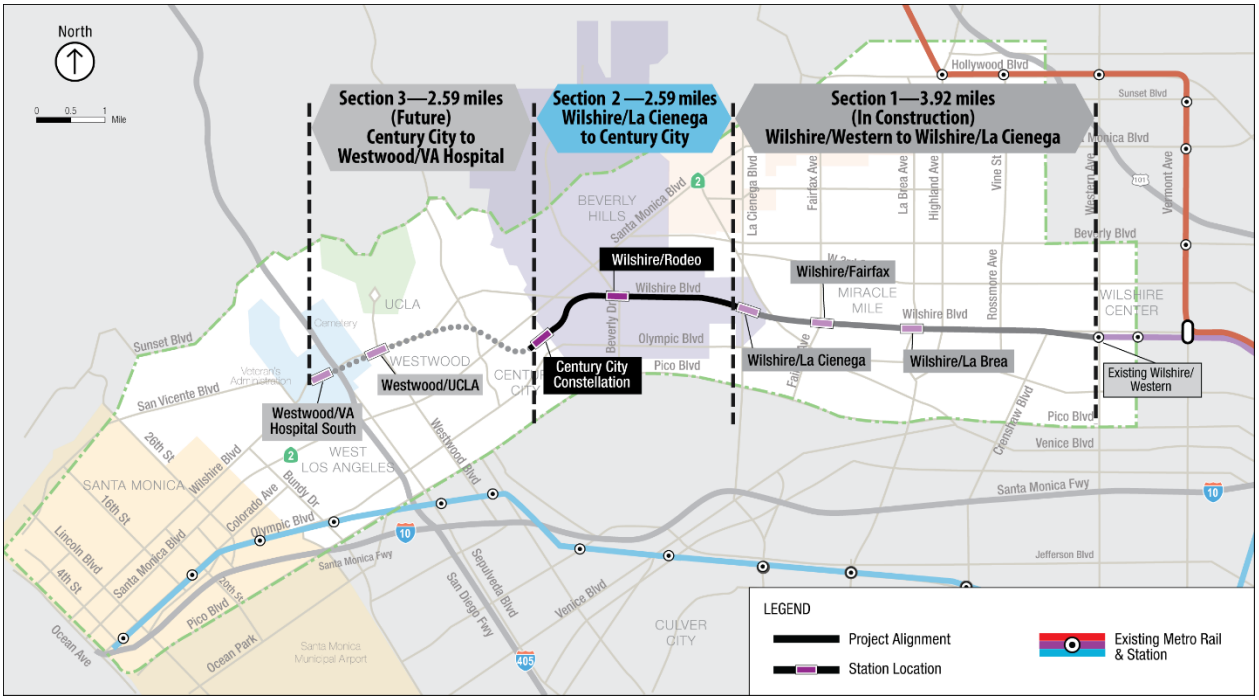
1.0 INTRODUCTION

The Westside Purple Line Extension Project (formerly the Westside Subway Extension Project) (the Project) is an approximately 9-mile heavy rail transit subway that will operate as an extension of the Metro Purple Line from its current western terminus at the Wilshire/Western Station to a new western terminus near the West Los Angeles Veterans Affairs (VA) Hospital (Figure 1-1). The Project lies within the Cities of Los Angeles and Beverly Hills and a part of unincorporated Los Angeles County in the vicinity of the Federal Building and the VA Hospital area.

The Project was planned to be constructed in three phases:

- Section 1: 3.92-mile section from the existing Wilshire/Western Station to Wilshire/La Cienega with three new stations: Wilshire/La Brea, Wilshire/Fairfax, and Wilshire/La Cienega
- Section 2: 2.59-mile section from Wilshire/La Cienega to Century City with two new stations: Wilshire/Rodeo and Century City Constellation
- Section 3: 2.59-mile section from Century City to Westwood/VA Hospital with two new stations: Westwood/University of California, Los Angeles and Westwood/VA Hospital

Figure 1-1: Project Sections



In November 2014, construction began for Section 1 of the Project, which is anticipated to be completed in 2024. Major construction activities for Section 2 of the Project, which is the subject of this limited scope Draft SEIS, could begin as early as January 2018 with expected completion in 2026. Construction for Section 3 is scheduled to begin in 2025 with project completion anticipated in 2035.

On November 8, 2016, Los Angeles County residents voted to approve a half-cent sales tax measure (Measure M—the Los Angeles County Traffic Improvement Plan), which is expected to provide funding to expedite construction of Section 3 of the Project.

The construction of the Project involves activities which generate high noise and vibration levels. This Construction Noise and Vibration Plan (the Plan) discloses the predicted noise and vibration effects of construction activities related to Section 2 of the Project based on possible construction methods, though the actual means and methods employed during construction will be determined by the construction contractors and may differ from those described in this document.

The Plan was prepared to meet the criteria, standards, and mitigation commitments in the *Westside Subway Extension Final Environmental Impact Statement/ Environmental Impact Report* (Final EIS/EIR) (March 2012). The Plan identifies receivers where noise or vibration impact may occur as a result of construction activities, provides additional information on the noise and vibration limits for the planned means and methods of construction, and recommends mitigation measures and monitoring locations where necessary.

2.0 CONSTRUCTION ACTIVITIES

The Project's plans call for lay down and staging areas to support the station construction and tunneling activities. A brief description of each of the construction area and the noise- and vibration-generating construction activities modeled in this Plan follow below. The locations of the construction areas discussed below are shown in Figure 2-1 through Figure 2-4.

2.1 Wilshire/Rodeo

A station box will be constructed below Wilshire Boulevard between S. Crescent Drive and S. Beverly Drive as shown on Figure 2-3. The lay down and staging areas supporting the construction of the Wilshire/Rodeo Station are:

Wilshire/Rodeo Station Box: Construction of the Wilshire/Rodeo Station box includes installation of piling and lagging, excavation below street level, and installation of main deck beams and street decking. The installation of the main deck beams and street decking occurs over the 56-hour weekend closure (approximately 16 weekend closures). The remaining excavation is done under the street decking system. Spoils are hoisted to the surface by crane and temporarily stockpiled in the adjacent laydown and staging areas. The spoils are then loaded onto trucks for transportation to a disposal site. Once excavation is complete, station concreting occurs which includes concreting of station appendages and entrance structure. Concreting is followed by backfilling and compaction of the station, appendages and entrance structure. Concurrent with the backfilling and compaction operation is installation of station mechanical and electrical in the various ancillary spaces/rooms and the entrance structure. Station finishes follow including those in the station entrance. Concurrent with the installation of the station finishes, site restoration occurs including AC pavement, concrete sidewalks, curbs, gutters, street lighting, signal systems, landscaping, signing, pavement striping, and installation of street furniture.

Wilshire South Staging Area (Site 9447 Wilshire Boulevard): This site is utilized for materials staging to support construction of the Wilshire/Rodeo Station. The site includes an open shaft which allows access to the main station box, storage containers, air scrubbers, and a water treatment plant. This staging area is shown on Figure 2-1 labeled as Parcel 4. This staging site will be used during station excavation to stockpile, load, and haul out excavated materials.

Wilshire North Staging Area (Site 9384 thru 9440 Wilshire Boulevard): This site is utilized for muck handling for excavation down to 12 feet below street level. Once the main deck beams and street decking are in place, this site will revert over to support construction of Wilshire/Rodeo Station. The site includes an open shaft which allows access to the main station box, temporary power, and a water treatment plant. This staging site will be used during station excavation to stockpile, loadi, and haul out excavated materials. This staging area is shown on Figure 2-1 labeled as Parcels 1, 2, and 3.

Figure 2-1: Lay down and Staging Areas at Wilshire/Rodeo Station

2.2 Century City Constellation

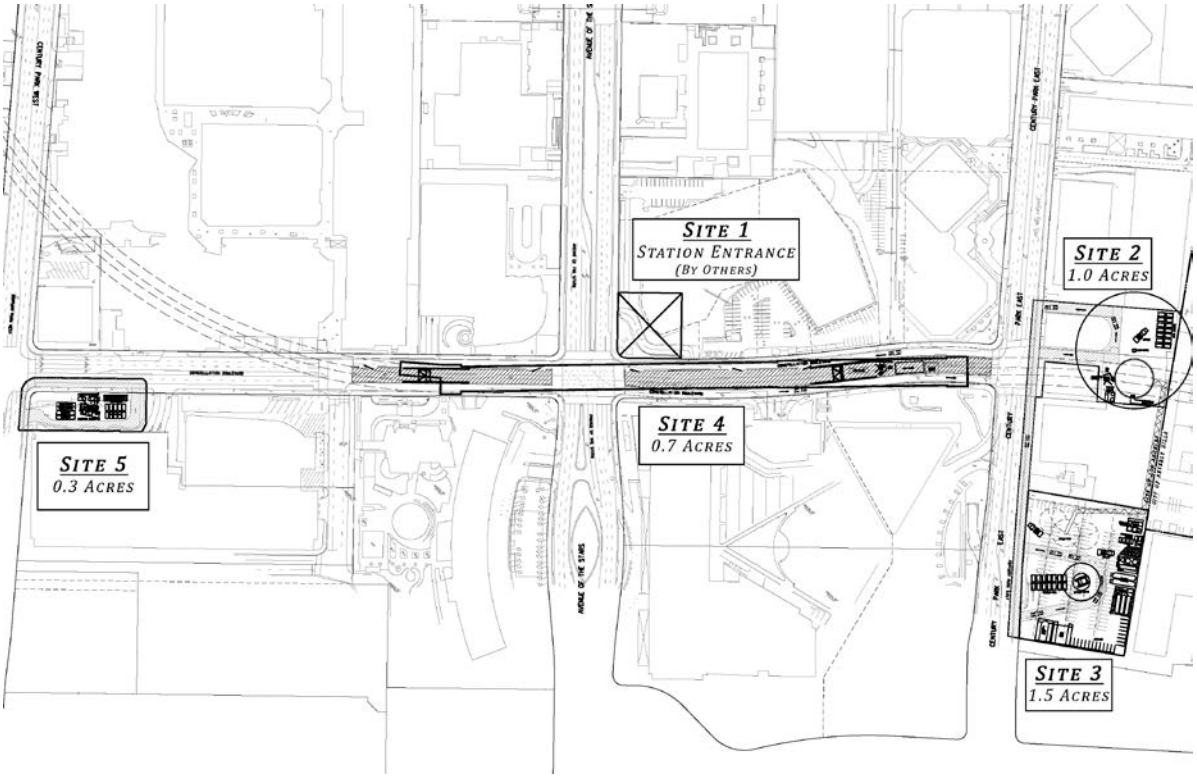
A station box will be constructed below Constellation Boulevard between Century Park East (CPE) and Solar Way (Figure 2-4). The lay down and staging areas supporting the construction of the Century City Constellation Station are:

Median of Constellation Boulevard: Main construction staging to support all construction operations necessary to construct Century City Constellation station with the exception of installing main deck beams and street decking, which occurs continuously over the 56-hour weekend closures (approximately 21 weekend closures). As there are no spoils storage areas available, all spoils are immediately loaded onto trucks and taken to disposal sites. This site is to be utilized for both day and night work shifts. This area is shown on Figure 2-2 labeled as Site 4 and Site 1.

Construction Site 1940 (CPE): Primary use is to support tunneling operations for day and night shifts. This site also is to receive materials such as pre-cast concrete segments which constitute the tunnel lining. This site will also support the mining of cross-passages and concreting of tunnels and cross-passages, mechanical, electrical, and finishes for day shifts. This area is shown on Figure 2-2 labeled as Site 2. Tunnel ventilation and air scrubbing equipment will be located on this site, together with a temporary substation providing power for tunneling equipment.

Construction Site 1950 CPE: Access shaft to support tunneling operations for day and night shifts during tunneling. The access shaft facilitates removal of tunnel muck as well as for deliveries of precast segments to rail mounted cars below which will be taken to the tunnel boring machine's (TBM) rear trailing gear for installation as the tunnel liner. Other miscellaneous material appurtenances will also be delivered in this manner. This site also supports concreting of tunnels (invert & walkway) and cross-passages, mechanical, electrical, and finishes for day shifts. This area is shown on Figure 2-2 labeled as Site 2. During construction of the access shaft, the site will also be used by excavating and hoisting equipment required for shaft construction. At the completion of tunnel construction, the shaft will be

Figure 2-2: Lay down and Staging Areas at Century City Constellation Station



used to support rail welding. Stock rail will be delivered to the site by trucks. The rail will be lowered down to track level through the shaft and placed in stockpiles. A portable rail welding plant will be set up at the bottom of the shaft to weld stock rail into continuous welded rail (CWR) strings approximately 500 feet long. The CWR strings will also be stockpiled within the tunnels.

Construction Site 2040 CPE: Main construction staging site to support tunneling operations for day and night shifts during tunneling. This site also supports the drying and storage of tunnel muck until it is loaded onto trucks and taken to disposal sites. This site houses the compressor plant, ventilation plant, grout plant, foam plant, conveyor system, machine shop, and electrical shop. Upon completion of tunneling, this site reverts to daytime use to support concreting of tunnels and cross-passages, mechanical, electrical and finishes. This area is shown on Figure 2-2 labeled as Site 3.

Construction Site at Constellation Boulevard and Century Park West (Parcel W3901): Primary use of this site is for miscellaneous tool storage as well as limited materials storage to support Century City Constellation Station construction operations. This site is to be for both day and night work shifts. This area is shown on Figure 2-2 labeled as Site 5.

Once tunnels have been completed, the tunneling operation will demobilize, thereby leaving construction sites 1940 CPE, 1950 CPE, and 2040 CPE to support construction of the Century City Constellation Station and systems installation (Trackwork, Traction Power, Automatic Train Control and Communications).

Figure 2-3: Wilshire/Rodeo Station Construction Sites and Noise Receivers

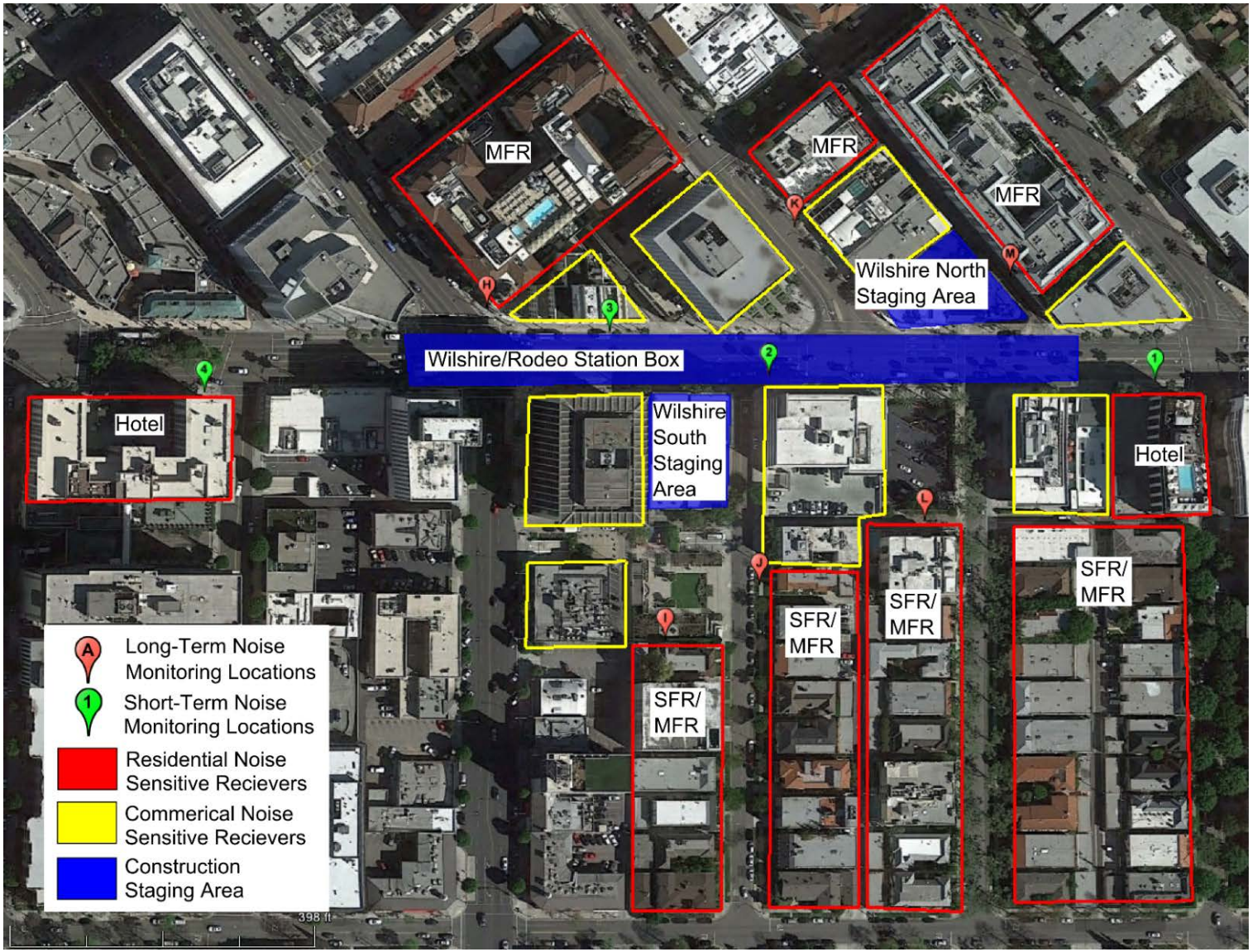
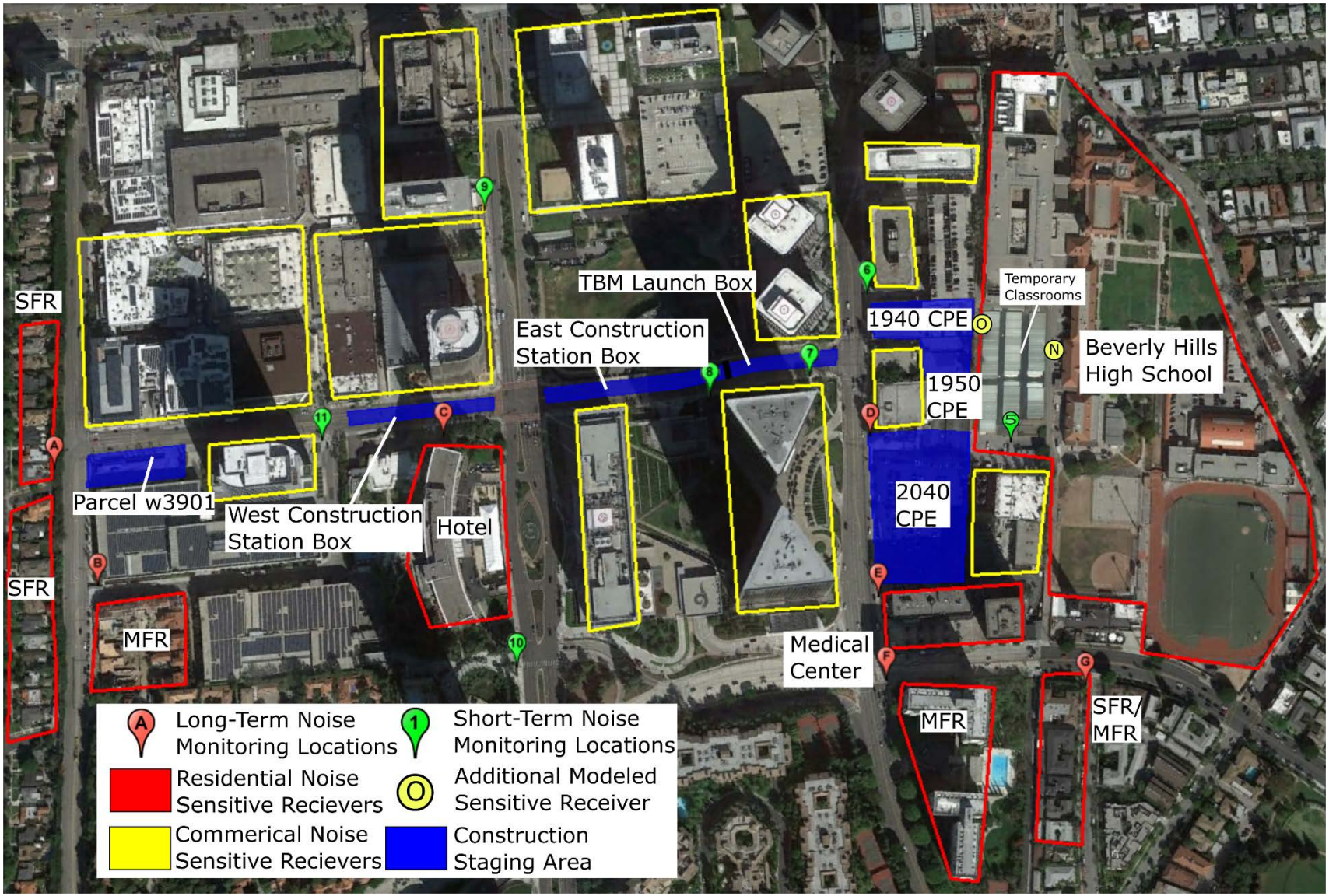


Figure 2-4: Century City Constellation Station Construction Sites and Noise Receivers



3.0 PRE-CONSTRUCTION NOISE MEASUREMENTS

Existing noise conditions were documented at sensitive receivers closest to the construction areas to determine the baseline ambient noise levels before construction activities. The location of the noise sensitive receivers is shown in Figure 2-3 and Figure 2-4. These existing noise measurements are used as the initial basis to establish the noise level limits for:

- A noise variance from the City of Los Angeles for construction during the nighttime hours 9:00 P.M. to 7:00 A.M.
- A noise variance from the City of Beverly Hills for construction during the evening hours of 6:00 P.M. to 9:00 P.M. and nighttime hours of 9:00 P.M. to 8:00 A.M.
- Establish City of Beverly Hills daytime construction noise limits during the hours of 8:00 A.M. to 6:00 P.M.

Existing daytime noise, from 7:00 A.M. to 9:00 P.M., at receivers in the City of Los Angeles was not measured because the City has a construction noise limit of 75 dBA for these hours.

The results of the noise measurements are presented in Table 3-1 and Table 3-2. The table presents the average of the measured daytime, evening, and nighttime noise levels (Leq) for receivers in the jurisdiction of the City of Beverly Hills and the nighttime Leq for receivers within the jurisdiction of the City of Los Angeles. Detailed measurement results are presented in Appendix B.

Prior to construction, Metro shall review and update the noise sensitive locations listed in Table 3-1 and Table 3-2, adding and deleting locations to reflect any changes. The Contractor shall take pre-construction 24-hour noise level measurements at each of the noise sensitive locations listed in Table 3-1 and Table 3-2. Where nighttime work within the City of Los Angeles is planned for any project sites, pre-construction measurements shall be taken at these locations during nighttime hours. Where daytime, evening, and nighttime work within the City of Beverly Hills is planned for any project sites, pre-construction measurements shall be taken at these locations during daytime, evening, and nighttime hours. Preconstruction noise level measurements shall be provided to Metro. The selection of the measurement sites shall be subject to Metro approval. Pre-construction noise levels shall be measured continuously over a 14-day period, 30 days prior to the beginning of construction

After completion of Contractor's pre-construction ambient noise measurements, the daytime, evening, and nighttime noise limits for construction will be updated for each receiver site.

Table 3-1: Pre-Construction Noise Measurement Results Wilshire/Rodeo Station

Receiver	Measurement Location	Daytime Leq[b]	Evening Leq[b]	Nighttime Leq[b]
H	210 N. Beverly Drive (MFR)	72 dBA	70 dBA	69 dBA
I	133-153 S. Reeves Drive (SFR/MFR)	59 dBA	56 dBA	54 dBA
J	Sitaj Hotel, 120 S. Reeves Drive	58 dBA	56 dBA	52 dBA
K	192 N. Canon Drive (Offices)	68 dBA	65 dBA	65 dBA
L	121-157 S. Canon Drive (SFR/MFR)	61 dBA	61 dBA	57 dBA
M	AKA Beverly Hills Hotel, 155 N. Crescent Drive	62 dBA	60 dBA	62 dBA
1	Beverly Sixty Hotel, 9360 Wilshire Boulevard[a]	76 dBA	74 dBA	72 dBA
2	The Rolex Building, 9420 Wilshire Boulevard (Offices) [a]	74 dBA	72 dBA	70 dBA
3	Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Offices) [a]	74 dBA	72 dBA	71 dBA
4	Beverly Wilshire Hotel, 9500 Wilshire Boulevard[a]	73 dBA	72 dBA	70 dBA

Notes:
[a] 1-hour measurements were taken at Receivers 1 through 4. The daytime Leq, evening Leq, and nighttime Leq were estimated by comparing the 1-hour measurement to the same hour of the nearest 24-hour measurement location.
[b]Daytime is from 8:00 A.M. to 6:00 P.M., evening is from 6:00 P.M. to 9:00 P.M. and nighttime is from 9:00 P.M. to 8:00 A.M.
MFR – Multi-Family Residences
SFR – Single-Family Residences

Table 3-2: Pre-Construction Noise Measurement Results Century City Constellation Station

Receiver	Measurement Location	Nighttime Leq[b]		
A	1918-1952 Fox Hills Drive (MFR)	58 dBA		
B	2050 Century Park West (MFR)	59 dBA		
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars	56 dBA		
D	2010 Century Park East (Offices)	63 dBA		
E	California Rehabilitation Institute, 2080 Century Park East	63 dBA		
F	2160 Century Park East (MFR)	65 dBA		
6	1888 Century Park East (Offices)[a]	63 dBA		
7	Century Park Towers, 2049 Century Park East (Offices)[a]	59 dBA		
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Blvd[a]	56 dBA		
9	Bain & Company Building, 1901 Avenue of the Stars[a]	61 dBA		
10	The Century, 10 West Century Drive (Offices)[a]	57 dBA		
11	Constellation Place, 10250 Constellation Boulevard (Offices)[a]	64 dBA		
Sites G, 5, N and O are in the City of Beverly Hills and subject to the Beverly Hills Noise Code				
		Daytime	Evening	Nighttime
G	401 Shirley Place, Beverly Hills (SFR)	68 dBA	68 dBA	63 dBA
5	Beverly Hills High School Lacrosse Field[a,c]	56 dBA	53 dBA	51 dBA
N	Beverly Hills High School Façade[d]	53 dBA	50 dBA	48 dBA
O	Beverly Hills High School Temporary Classroom Buildings Closest to the 1940 CPE Construction Site[e]	59 dBA	56 dBA	54 dBA

Notes:
[a] 1-hour measurements were taken at Receivers 5 through 11. At these locations, the daytime Leq, evening Leq, and nighttime Leq were estimated by comparing the 1-hour measurement to the same hour of the nearest 24-hour measurement location.
[b] Nighttime is from 9:00 P.M. to 7:00 A.M as defined by the City of Los Angles Municipal Code.
[c] The measurements at Receiver 5 were taken before the temporary classrooms were located in the Lacrosse Field.
[d] A distance adjustment was made between Receiver 5 and the closest building façade at Beverly Hills High School.
[e] A distance adjustment was made between Receiver O and Receiver 5.

4.0 CONSTRUCTION NOISE LIMITS

The Project is subject to the local noise limits set forth in the City of Los Angeles Municipal Code (LAMC) and the City of Beverly Hills Municipal Code (BHMC). The Wilshire/Rodeo construction areas are located in the City of Beverly Hills and are subject to the BHMC. The Century City Constellation construction areas are in the City of Los Angeles and are subject to the LAMC. The exception are those noise sensitive receivers within the City of Beverly Hills limits are affected by the activities at Century City Constellation construction sites on Century Park East. These receivers, single-family residences on Shirley Place (Site G), and Beverly Hills High School (BHHS) (Site 5) are subject to the BHMC.

4.1 City of Los Angeles Noise Limits

Section 112.05 of the LAMC sets a maximum noise level for powered equipment of 75 dBA at a distance of 50 feet when operated within 500 feet of a residential zone. However, compliance with this standard is not required where "technically infeasible." Technically infeasible means that the established noise limits cannot be met with at the project site despite the use of mufflers, shields, sound barriers, and/or other noise reduction devices or techniques employed during the operation of equipment.

Section 111.02 of the LAMC provides procedures and criteria for the measurement and impact assessment of noise sources. Specifically, the procedures provide for a penalty of 5 dBA for steady high-pitched noise or repeated impulsive noises. Conversely, the procedures provide a credit of 5 dBA for noise occurring less than 15 minutes in a period of 60 consecutive minutes during the day because short-term noise events are typically less annoying than continuous noise sources.

The LAMC also restricts the hours of construction activities. Section 41.40 prohibits construction between the hours of 9:00 P.M. and 7:00 A.M. Monday through Friday, 6:00 P.M and 8:00 A.M on Saturday, and at any time on Sunday. Construction during nighttime hours or on Sunday requires a noise variance. If a noise variance is obtained, construction can be conducted during nighttime hours with a noise limit of 5 dBA above the measured ambient.

Pre-construction noise measurements were conducted at the sensitive receivers adjacent to the construction areas to determine the pre-construction ambient noise levels and nighttime construction noise limits. The noise measurement results are presented in Section 3.0. More detailed information on the ambient measurement results are shown in Appendix B.

4.2 City of Beverly Hills Noise Limits

Section 5-1-202 of the BHMC limits the noise level of any machinery, equipment, pump, fan, air conditioning apparatus, or similar mechanical device in any manner so as to create any noise which would cause the noise level at the property line of any property to exceed the ambient noise level by more than 5 dBa.

Section 5-1-205 of the BHMC restricts the hours of construction activity during the hours of 6:00 P.M. and 8:00 A.M. Monday through Saturday and at any time on Sunday or public holidays. The Project may be granted an after hours construction permit authorizing work during restricted hours if the city building official determines that the public interest will be served by such a permit.

The BHMC does not mention the nighttime noise limit that is applied if a nighttime noise permit is obtained. In this Plan, we assume that the nighttime noise limit will be 5 dBA above the ambient noise level. This is consistent with the limit applied during the nighttime hours in the City of Los Angeles and with the limit applied during the daytime in the City of Beverly Hills.

4.3 Summary of Noise Limits

A summary of the noise limits is presented in Table 4-1.-The table presents the different noise limits for City of Los Angeles and the City of Beverly Hills. Additionally, there are different limits for different times of day. For the noise impact analysis in this Plan, the limits are applied at the facade of the nearest sensitive receivers. Residential land uses (where people sleep) or institutional land uses such as theatres, churches, or schools are considered sensitive receivers. Commercial and industrial land uses are not considered sensitive and are not assessed for impact in this Plan.

Table 4-1: Summary of Construction Noise Limits

Construction Activity	Noise Limit[1], dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), general activities	75 dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), steady high-pitch noise or repeated impulsive noises	70 dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), less than 15 minute duration in a period of 60 consecutive minutes	80 dBA
City of Los Angeles Nighttime (9:00 P.M.-7:00 A.M.), all activities	Nighttime Ambient + 5dB
City of Beverly Hills Daytime (8:00 A.M.-6:00 P.M.), all activities	Daytime Ambient +5 dB
City of Beverly Hills Evening (6:00 P.M.-9:00 P.M.), all activities	Evening Ambient + 5dB
City of Beverly Hills Nighttime (9:00 P.M.-8:00 A.M.), all activities	Nighttime Ambient + 5 dB

Notes:
[1]Noise limit applies to the facade of the closest noise sensitive property.

5.0 CONSTRUCTION VIBRATION LIMITS

The primary concern regarding construction vibration relates to risk of damage. Vibration is generally assessed in terms of peak particle velocity (PPV) for risk of building damage. PPV is the appropriate metric for evaluating the potential of building damage and is often used when monitoring construction vibration because it relates to the stresses that are experienced by the buildings.

Vibration damage risk thresholds from the *Westside Subway Extension Final EIS/EIR* are presented in Table 5-1. The table presents PPV thresholds for different building categories. The 'Structural Building Damage' category is the level above which there is a risk that structural damage may occur. The 'Architectural Building Damage' category is the level above which there is a risk that superficial building damage, such as small cracks, may occur. The third category, 'Damage Risk to Historic Buildings and Cultural Resource Structures' is meant to apply to historic buildings that are particularly susceptible to damage. In this Plan, the 'Architectural Building Damage' threshold of 0.5 PPV is used for all non-historic structures. Where the PPV exceeds 0.5, monitoring or other appropriate mitigation measures such as using alternative construction approaches are considered.

Table 5-1: Construction Vibration Damage Risk Thresholds

Building Category	Peak Particle Velocity (in/sec)
Structural Building Damage	2.0
Architectural Building Damage	0.5
Damage Risk to Historic Buildings and Cultural Resource Structures	0.12 to 0.2

Source: Westside Subway Extension Final EIS/EIR, (Metro, March 2012)

A survey of the cultural resources and historic properties within the project area were completed as part of the EIS/EIR.

Table 5-2 lists the properties identified in the survey which are eligible for the National Register of Historic Places (NRHP) and the California Register of Historic Places (CHRP) and are within 500 feet of any of the construction laydown areas or other major construction activities. Based on the existing condition of these properties identified as being potentially eligible for NRHP and CHRP these building will be assessed with the upper limit of the damage risk threshold of 0.2 PPV in/sec in this Plan. This is a conservative threshold to prevent any architectural damage to the buildings.

Table 5-2: Properties Listed and Eligible as NRHP

Property	Status
Sterling Plaza/Bank of California, 9441 Wilshire Boulevard	Potentially Eligible NRHP, CRHP
Ace Gallery, 9430 Wilshire Boulevard	Potentially Eligible NRHP, CRHP
Union Bank Building, 9460 Wilshire Boulevard	Potentially Eligible NRHP, CRHP
AAA Building, 1950 Century Park East	Potentially Eligible NRHP, CRHP
Beverly Hills High School, 241 S. Moreno Drive	Potentially Eligible NRHP, CRHP
Century Park Towers, 2029 Century Park East	Potentially Eligible NRHP, CRHP
Century Plaza Hotel, 2025 Avenue of the Stars	Potentially Eligible NRHP, CRHP

Source: Historic Properties Supplemental Survey Technical Report (Metro, March 2012)

5.1 Groundborne Noise

During tunnel excavation, the operation of the tunnel train will result in groundborne noise levels that could affect receivers above the tunnel such as residences, hotels, theaters, churches, and schools. Metro has adopted groundborne noise criteria for tunneling that are based on adding 5 dBA to the Federal Transit Administration (FTA) groundborne noise criteria. Table 5-3 lists the criteria which are also included in Metro's Contract Specification Section 01565, Construction Noise and Vibration Control, which will be included as part of the contract documents for this Project.

Table 5-3: Allowable Maximum Interior Groundborne Noise from Underground Construction Activities (Lmax)

Land Use Activity	Groundborne Noise Level Limits – L_{max} (dBA)
Single-Family Dwellings	40
Multi-Family Dwellings	45
Hotel/Motel	45
Offices	50
Commercial Buildings	55
Concert Halls, Recording and TV Studios	30
Auditoriums and Music Rooms	35
Churches and Theaters	40
Hospital Sleeping Rooms	45
Schools and Libraries	50

Note: Maximum groundborne noise is as measured in the inside of the affected noise sensitive structure.

6.0 CONSTRUCTION NOISE PREDICTIONS

6.1 Noise Prediction Methodology

The projected daytime and nighttime construction noise levels were modeled using CadnaA version 4.0, a three-dimensional graphics-oriented noise modeling program that uses the International Organization for Standardization (ISO) 9613, a general purpose standard for outdoor noise propagation. CadnaA incorporates the following elements:

- An emission model that determines the noise generated by the equipment at a reference distance.
- A propagation model that calculates how the noise level varies with distance.
- A prediction model that sums the noise of each source at sensitive locations.

The noise modeling includes the effects of ground cover, the shielding of building structures, and the reduction provided by a noise barrier wall (if one is specified in the construction plans). The construction noise levels were estimated at each of the receivers within close proximity to the construction sites. The source noise levels used in the model for different pieces of construction equipment are based on the actual measured noise level data presented in Table 6-1. This data is from the Federal Highway Administration (FHWA) Roadway Construction Noise Model.

6.2 Noise Prediction Results and Impact Assessment

Noise prediction models were developed for each construction site based on the project plan drawings and the current means and methods planned for the construction phases. Each of the construction sites where nighttime activities will occur is assumed to have a noise barrier wall of a different height erected around the perimeter of the site, and construction at that site would use low noise emission equipment as specified by Metro's Specification Section 01 56 19, Construction Noise and Vibration Control. The following sections present predictions of noise levels at sensitive receivers near the laydown areas and other areas where construction activity is scheduled to take place. The hourly Leq from the proposed construction activities and the applicable noise limits at the nearest receivers are presented in Table 6-2 and Table 6-3.

6.2.1 Wilshire/Rodeo Station

Activities at the Wilshire/Rodeo site consist of construction of the station box and support of underground mining activities. There are three construction areas, all of which will support construction activities during nighttime hours from 6:00 P.M. to 8:00 A.M. During these nighttime hours, the following equipment is expected to be used at each of these areas:

- **Wilshire/Rodeo Station Box Area**: boom crane, rough terrain crane, fork lift truck, and pickup truck.
- **Wilshire South Staging Area**: rough terrain crane, excavator, dump trucks, fork lift truck, and pickup truck.
- **Wilshire North Staging Area**: hydraulic crane, excavator, dump trucks, fork lift truck, and pickup truck.

Table 6-1: Construction Equipment Noise Emission Levels

Equipment Description	Lmax Noise Limit at 50 ft, dB Slow	Is Equipment an Impact Device?
Auger Drill Rig	85 dBA	No
Backhoe	80 dBA	No
Boring Jack Power Unit	80 dBA	No
Chain Saw	85 dBA	No
Clam Shovel	93 dBA	Yes
Compactor (ground)	80 dBA	No
Compressor (air)	80 dBA	No
Concrete Mixer Truck	85 dBA	No
Concrete Pump Truck	82 dBA	No
Concrete Saw	90 dBA	No
Crane (mobile or stationary)	85 dBA	No
Dozer	85 dBA	No
Dump Truck	84 dBA	No
Excavator	85 dBA	No
Flat Bed Truck	84 dBA	No
Front End Loader	80 dBA	No
Generator (25 KVA or less)	70 dBA	No
Generator (more than 25 KVA)	82 dBA	No
Gradall	85 dBA	No
Horizontal Boring Hydraulic Jack	80 dBA	No
Impact Pile Driver (diesel or drop)	95 dBA	Yes
Jackhammer	85 dBA	Yes
Mounted Impact Hammer (hoe ram)	90 dBA	Yes
Paver	85 dBA	No
Pickup Truck	55 dBA	No
Pneumatic Tools	85 dBA	No
Pumps	77 dBA	No
Rock Drill	85 dBA	No
Scraper	85 dBA	No
Slurry Plant	78 dBA	No
Slurry Trenching Machine	82 dBA	No
Soil Mix Drill Rig	80 dBA	No
Tractor	84 dBA	No
Vacuum Excavator (Vac-Truck)	85 dBA	No
Vacuum Street Sweeper	80 dBA	No
Vibratory Concrete Mixer	80 dBA	No
Vibratory Pile Driver	95 dBA	No
Welder	73 dBA	No

Source: Federal Highway Administration (FHWA) Roadway Construction Noise Model (2006)

Moveable noise barriers, as shown in Figure 9-3, shall be used to mitigate noise at surface work sites within the perimeter of the Wilshire/Rodeo Station Box Area. 20-foot high noise barrier walls shall be constructed at the perimeters of the Wilshire South Staging Area and the Wilshire North Staging Area. The noise barrier walls will be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control. Equipment used during nighttime hours at these construction areas shall comply with the low noise equipment emission limits also specified in Section 01 56 19. Wilshire/Rodeo noise receivers are presented below. The predicted construction noise at the noise sensitive receivers near these construction areas during the daytime, evening, and nighttime hours compared with the BHMC noise levels limits of the existing ambient noise plus 5 dBa are presented in Table 6-2. The predicted construction noise levels at all the receiver sites analyzed do not exceed the daytime, evening, or nighttime BHMC noise limits.

Table 6-2: Wilshire/Rodeo Nighttime Construction Noise – Leq (dBA)

Receiver[1]	Location	Daytime Construction Noise	Daytime Noise Limit[2]	Evening Construction Noise	Evening Noise Limit	Nighttime Construction Noise	Nighttime Noise Limit
H	210 N. Beverly Drive (MFR)	69	77	54	75	54	74
I	133-153 S. Reeves Drive (SFR/MFR)	59	64	55	61	55	59
J	Sirtaj Hotel 120 S. Reeves Drive	60	63	57	61	57	57
K	192 N. Canon Drive (Offices)	64	73	54	70	54	70
L	121-157 S. Canon Drive (SFR/MFR)	63	66	52	66	52	62
M	AKA Beverly Hills Hotel, 155 N. Crescent Drive	62	67	59	65	59	67
1	Beverly Sixty Hotel, 9360 Wilshire Boulevard	65	81	54	79	54	77
2	The Rolex Building, 9420 Wilshire Boulevard (Offices)	70	79	62	77	62	75
3	Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Offices)	72	79	62	77	62	76
4	Beverly Wilshire Hotel, 9500 Wilshire Boulevard	63	78	52	77	52	75

Notes:
[1]The location of the modeled receivers is shown on Figure 2-3.

6.2.2 Century City Constellation Station

Activities at the Century City Constellation site consist of launching of the TBM, construction of the station box, removal of the tunnel spoils, and support of station and tunnel underground mining activities. There are five construction areas, all of which will support construction activities during nighttime hours from 9:00 P.M. to 7:00 A.M for most of the noise receivers that are within the jurisdiction of the City of Los Angeles and from 6:00 P.M. to 8:00 A.M. for those two receivers that are within the jurisdiction of the City of Beverly Hills. During these nighttime hours, the following equipment is expected to be used at each of these areas:

- **2040 CPE Construction Area**: front end loader, boom crane, haul trucks, excavator, concrete pumps, shotcrete machine, lift hoist, water treatment plant, ventilation plant, compressor plant, foam plant, grout plant, conveyor system, mechanical shop, electrical shop.

- **1940-1950 CPE Construction Area**: tower crane, boom crane, pile rig drill, front end loader, Bob Cat, drilling polymer plant, concrete pumps, generator, ready mix trucks, pick-up trucks, haul trucks, ventilations fans, street sweepers, telehandler, water treatment plant, conveyor system, segment carrier, roller compactor.
- **TBM Launch Site**: boom crane, rough terrain crane, pile drill rig, front end loader, Bob Cat, drilling polymer plant, concrete pumps, generator, ready mix trucks, pick-up trucks, street sweeper, light plants, welding plants, fork lifts, excavator, haul trucks, dozer, ventilation fans, telehandler.
- **Century City Constellation Station Box**: boom crane, rough terrain crane, pile drill rig, front end loader, Bob Cat, drilling polymer plant, concrete pumps, generator, ready mix trucks, pick-up trucks, street sweeper, light plants, welding plants, fork lifts, excavator, haul trucks, dozer, ventilation fans, telehandler.
- **Construction Site at Constellation Boulevard and CPW (Parcel W3901)**: telehandler, hydraulic crane, pickup truck

Noise barrier walls shall be constructed at the perimeter of the following construction areas:

- 2040 CPE Construction Area – 20-foot high noise barrier
- 1940-1950 CPE Construction Area - 20-foot high noise barrier
- Construction Site at Constellation Boulevard and Century Park West (Parcel W3901) – 20-foot high noise barrier

At the Century City Constellation Station Box and the TBM launch site areas, a 14-foot high moveable noise barrier, as shown in Figure 9-3, shall be used at the perimeter of the construction sites.

The noise barrier wall and moveable noise barrier shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control. Equipment used during nighttime hours at these construction areas shall comply with the low noise equipment emission limits also specified in Section 01 56 19.

Table 6-3 presents the predicted construction noise during the daytime, evening, and nighttime hours for Receivers G, 5, N, and O, which are in the City of Beverly Hills, compared with the BHMC noise levels limits of the existing ambient noise plus 5 dB. The remaining receiver sites which are within the City of Los Angeles are presented showing the predicted daytime construction noise is compared to the LAMC noise limit of 75 dBA and the nighttime construction noise to the existing ambient noise plus 5 dB.

As shown in Table 6-3, the construction noise level at Site O, BHHS temporary classroom buildings closest to the 1940 CPE construction site, would exceed the noise limit by 1 dB for daytime and 2 dB for nighttime hours. At all the other Beverly Hill sites analyzed the daytime, evening, and nighttime noise limits are not exceeded.

At Site 7, Century Park Towers, the nighttime noise limit is exceeded by 1 dB. At Site 8, Annenberg Space for Photography and Skylight Studios, the nighttime noise limit would be exceeded by 1 dB. At all the other Los Angeles sites analyzed the nighttime noise limits are not exceeded.

Table 6-3: Century City Constellation Nighttime Construction Noise – Leq (dBA)

Receiver[1]	Location	Daytime Construction Noise	Daytime Noise Limit[2]	Evening Construction Noise	Evening Noise Limit[3]	Nighttime Construction Noise	Nighttime Noise Limit[4]
The following receivers are within the jurisdiction of the City of Beverly Hills							
G	401 Shirley Place (SFR)	48	73	42	73	42	68
5	Beverly Hills High School Lacrosse Field	58	61	54	58	54	56
N	Beverly Hills High School Facade	56	58	50	55	50	53
O	Beverly Hills High School Temporary Classroom Buildings Closest to the 1940 CPE Construction Site	65	64	61	61	61	59
The following receivers are within the jurisdiction of the City of Los Angles							
A	1918-1952 Fox Hills Drive (MFR)	56	75			47	63
B	2050 Century Park West (MFR)	44	75			31	64
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars	68	75			59	61
D	2010 Century Park East (Offices)	67	75			61	68
E[5]	California Rehabilitation Institute, 2080 Century Park East	57	75			51	61
F	2160 Century Park East (MFR)	55	75			48	70
6	1888 Century Park East (Offices)	67	75 65			61	68
7	Century Park Towers, 2049 Century Park East (Offices)	71	75			65	64
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard	68	75			62	61
9	Bain & Company Building, 1901 Avenue of the Stars	61	75			55	66
10	The Century, 10 West Century Drive (Offices)	55	75			51	62
11	Constellation Place, 10250 Constellation Boulevard (Offices)	60	75			53	69

Notes:
[1] The location of the modeled receivers is shown on Figure 2-4.
[2] Daytime is defined as 8:00 A.M. to 6:00 P.M. by the City of Beverly Hills and 7:00 A.M. to 9:00 P.M. by the City of Los Angeles.
[3] Evening is defined as 6:00 P.M. to 9:00 P.M. by the City of Beverly Hills. The City of Los Angeles Municipal Code does not include evening hour.
[4] Nighttime is defined as 9:00 P.M. to 8:00 A.M. by the City of Beverly Hills and 9:00 P.M to 7:00 A.M. by the City of Los Angeles.
[5] Construction noise at Site E was modeled at street level. A more detailed assessment of the construction noise at the upper floors of the rehabilitation facility is presented in Section 0.
(XX) – Noise levels in red indicate an exceedance of the noise level limits.

The Contractor will be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to be used at the Century City Constellation Launch Box Area to meet the LAMC nighttime noise limit at Sites 7 and 8, and at the 1940-1950 CPE Construction Area to meet the BHMC daytime and nighttime noise limits at Site O.

6.2.3 California Rehabilitation Institute Facility

The California Rehabilitation Institute facility is adjoining to the 2040 CPE Construction Area. The 20-foot high noise barrier wall at the perimeter of this site and the 16-foot high noise barrier around the mucking operations will shield the construction noise activities at the street level of the rehabilitation facility resulting in an average nighttime noise level of 51 dBA, which is 10 dB less than the noise limit of 61 dBA (see Table 6-3). Since the patient rooms of the rehabilitation facility overlooking the construction site are on the upper floors of the facility, a more detailed noise assessment was prepared for this receiver.

The primary use of the 2040 CPE construction site is for the main construction staging to support tunneling operations for day and night shifts during tunneling. This site also supports the drying and storage of tunnel muck until it is loaded onto trucks and taken to disposal sites. It is expected that removal of muck from this site by truck will occur during nighttime hours. This site houses the compressor plant, ventilation plant, grout plant, foam plant, conveyor system, machine shop, and electrical shop. A long boom crane and a front end loader will also operate during both day and night shifts. Upon completion of tunneling, this site reverts to daytime use to support concreting of tunnels and cross-passages, mechanical, electrical, and finishes.

The assessment is based on the expected construction activities at the 2040 CPE construction site between the hours of 9:00 P.M. and 7:00 A.M. Patient rooms at the rehabilitation facility facing the construction site are on the 3rd through the 8th floors of the facility. The assessment includes the predicted construction noise at these floors and adjusted ambient noise levels measured at ground level at these different building heights.

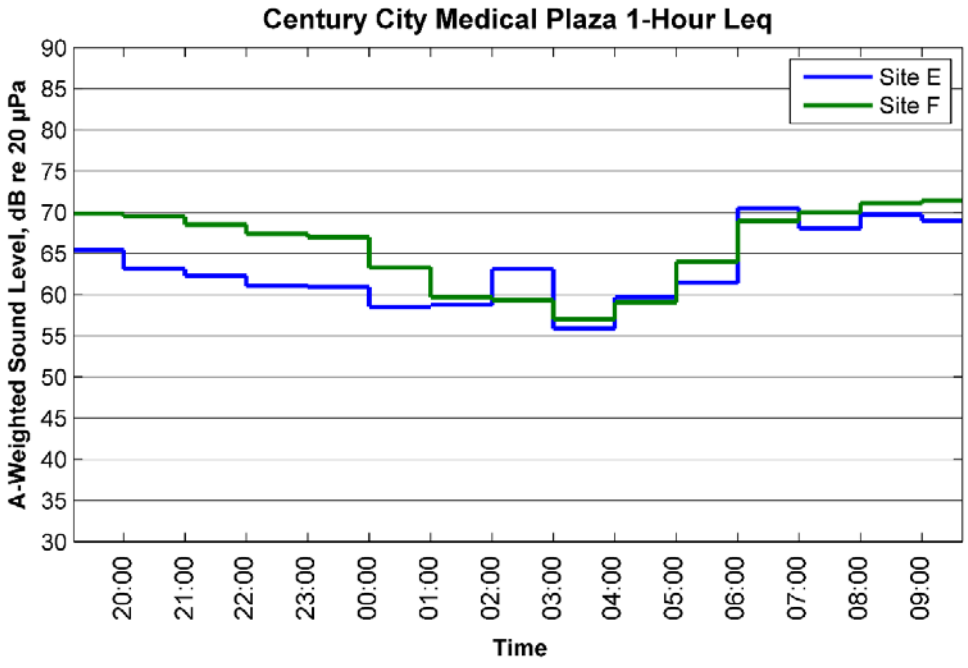
Existing Ambient Noise Levels

Ambient noise measurements were conducted at the California Rehabilitation Institution facility at 2080 CPE, 180 feet from Olympic Boulevard (Site E) setback 4 feet from the street curb (Figure 6-1). The measured noise levels were then adjusted to account for the additional setback distance of the rehabilitation facility. The adjusted 24 one-hour Leq ambient noise levels at the face of the rehabilitation facility are graphically shown in Figure 6-2.

The measurements were conducted from 7:00 P.M. to 10:00 A.M. This time period was chosen to characterize the nighttime noise levels at the rehabilitation facility. Section 41.40 of the LAMC requires a variance for nighttime construction from 9:00 P.M. to 7:00 A.M. The variance is based on not exceeding a noise limit of the ambient level plus 5 dB. Ambient noise measurements were not conducted during daytime hours because the City of Los Angeles has a maximum construction noise level limit of 75 dBA for daytime construction regardless of the ambient level.

Figure 6-1: Noise Measurement Site

Figure 6-2: California Rehabilitation Institute Facility Measured Noise Levels



As a worst case scenario, the ambient noise of Leq=56 dBA measured from 3:00 A.M. and 4:00 A.M. was used as the nighttime noise impact threshold for the rehabilitation facility. The ambient was measured at ground level and adjusted for additional height of the 3rd through the 8th floor patient levels. The adjusted ambient along with the nighttime noise impact threshold are presented in Table 6-4 along with the predicted noise levels from nighttime construction activities. The predicted nighttime construction noise is based on a 20-foot noise barrier wall around the perimeter of the site and the use of low noise emission equipment.

Table 6-4: Nighttime (3:00 A.M. to 4:00 A.M.) Construction Noise Impact Thresholds at the Rehabilitation Facility

Rehabilitation Facility Floor	Ambient Noise Level, Leq (dBA)	Los Angles Nighttime Construction Noise Limit, Leq (dBA)	Nighttime Construction Noise, Leq (dBA)	Exceeds the Nighttime Noise Limit (Y/N)
Ground Level	56	61	51	N
Patient Floor 3	52	57	65	Y
Patient Floor 4	51	56	66	Y
Patient Floor 5	51	56	66	Y
Patient Floor 6	51	56	66	Y
Patient Floor 7	51	56	66	Y
Patient Floor 8	51	56	66	Y

Note: Ambient noise levels were measured from 3:00 A.M. to 4:00 A.M.

The predicted construction noise at the patient floors exceed the nighttime noise limits of existing ambient plus 5 dB. Additional noise control measures recommended for the 2040 CPE Construction Area to meet the nighttime noise limits are presented in Section 9.0 of this report.

6.2.4 Haul Routes

As described in Section 3.8.2 of the Final EIS/EIR, anticipated truck haul routes related to the construction of Section 2 would include arterial and local streets within City of Los Angeles and Beverly Hills. The location of the haul routes identified for the construction of the Wilshire/Rodeo and the Century City Constellation Stations have not changed from what was described in Section 3.8.2 of the Final EIS/EIR.

The haul routes identified for construction of the Century City Constellation Station and the Section 2 tunnel would be located to the west of the BHHS campus and would not overlap with BHHS construction activities. The construction haul truck routes for the Century City Constellation Station and the Section 2 tunnel include Santa Monica Boulevard, Constellation Boulevard, Century Park East, Century Park West, and Avenue of the Stars. The haul trucks would use these routes to transport spoils, muck, material, and equipment between construction laydown site locations, station entrance locations, and the off-site disposal location using the nearest freeway interchange. To minimize peak period traffic disruptions, haul truck activity is anticipated to take place during off-peak and nighttime periods. Land use along the haul routes is mainly commercial, with the exception of residential areas to the west side of Century Park West. The estimated daily haul truck trips differ depending on the type of construction activity.

Table 6-5 summarizes the daily haul truck trips generated for the construction of the Century City Constellation station and Section 2 tunneling activities.

Table 6-5: Estimated Daily Haul Truck Trips

Location	Station Box Construction	Tunnel Boring Machine Activity	Station and Other Related Construction
Century City Constellation Station and TMB launch locations	80-120	90-130	80-120

Source: Westside Purple Line Extension Century City Constellation Station Air Quality Technical Memorandum (Metro 2017)

Even with the relocation of construction staging activities for the Century City Constellation Station as described in Chapter 2, haul truck routes to support construction staging would be along street segments that were identified in Section 3.8.2 of the Final EIS/EIR. However, the haul truck routes immediate to the construction site are modified based on the relocation of the construction staging activities.

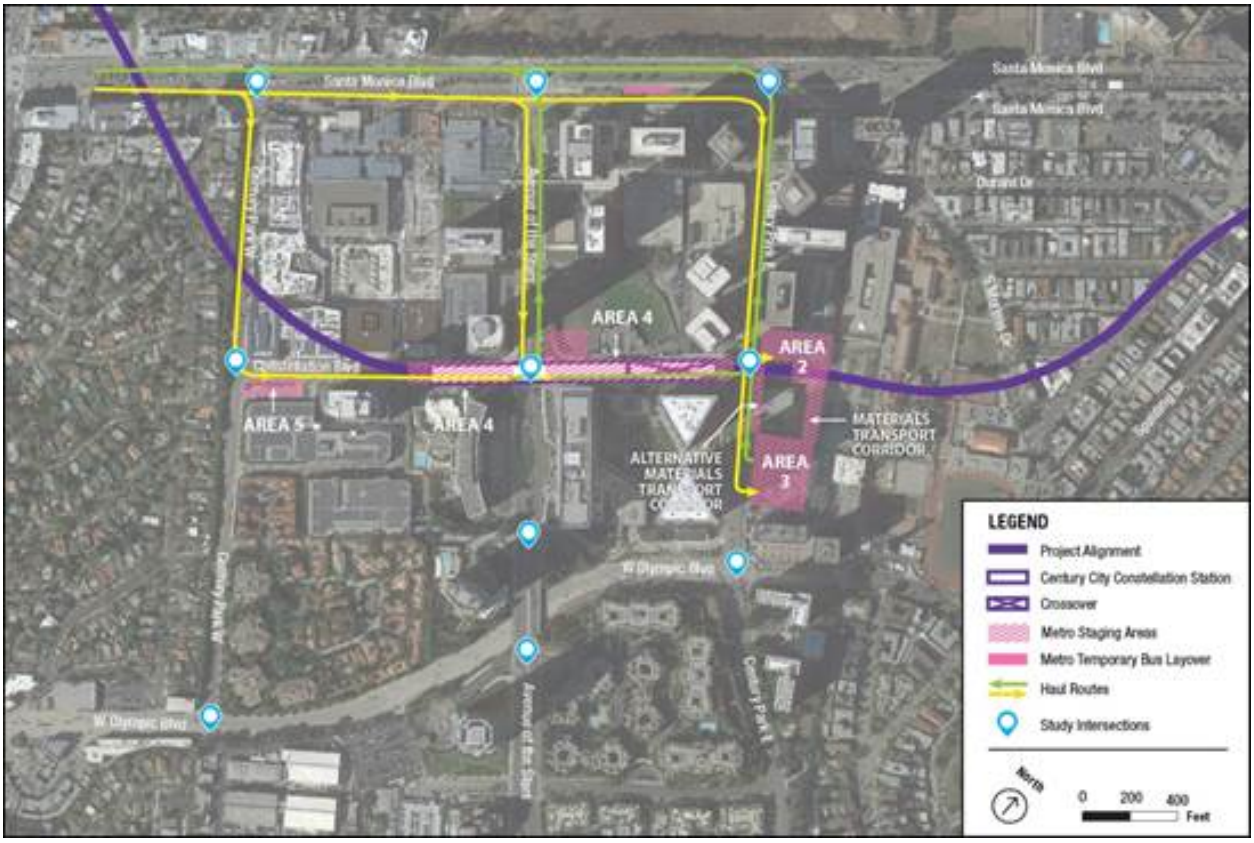
The haul routes along Santa Monica Boulevard between I-405 and Century Park West identified in Section 3.8.2 of the Final EIS/EIR are not expected to change based on the relocation of the construction staging and laydown areas described in Chapter 2 of this SEIS.

Figure 6-3 illustrates the proposed new haul routes. For the proposed new haul routes, inbound trips would split to three different routes from Santa Monica Boulevard. The first route would turn right at Century Park West and left at Constellation Boulevard to access Area 5 before exiting via Avenue of the Stars and Santa Monica Boulevard. This route would be adjacent to residential areas west of Century Park West, between Santa Monica Boulevard and Constellation Boulevard. As noted, the haul trucks would operate during off-peak hours and therefore would not increase traffic impact at this segment.

The second route would turn right at Avenue of the Stars and left on Constellation Boulevard to access Area 4 before exiting via Century Park East and Santa Monica Boulevard. The third route would turn right at Century Park East to access Area 2 and Area 3 before exiting via Century Park East in reverse direction.

Traffic noise at the residential areas to the west side of Century Park West would increase during nighttime operations of the haul trucks. Haul trucks operating between the hours of 12:00 midnight and 5:00 AM must have lower emission limits (80 dBA at 50 feet) than normally required by the California Vehicle Code. All trucks used for these nighttime hours must be certified in accordance with these specifications. Necessary steps shall be taken by the Contractor to comply with this limit, which may include fitting the equipment with high grade engine exhaust silencers and engine casing sound insulation.

Figure 6-3: Proposed Construction Truck Haul Routes



7.0 CONSTRUCTION VIBRATION PREDICTIONS

7.1 Prediction Methodology

For this study, the FTA analytical/empirical construction vibration prediction model was used to estimate vibration levels propagate from construction equipment to vibration sensitive locations. The vibration model is based on a combination of previous works including measured equipment vibration emission data from the FTA and the Central Artery/Tunnel project in Boston and ground transmissibility relationships found in Charles Dowding's reference textbook Construction Vibrations[1]. The fundamental equation used in the model is based on propagation relationships of vibration through average soil conditions and distance, as follows:

$$PPV_{receiver} = PPV_{ref} * \left(100 / Dist_{receiver} \right)^{n},$$

where:

$PPV_{receiver}$ = predicted PPV at the receiver,

PPV_{ref} = reference PPV of equipment at 100 feet,

$Dist_{receiver}$ = distance from the receiver to the equipment in feet, and

n = 1.5 (the vibration attenuation rate through the soil).

The suggested value for n in the FTA Manual is 1.5. The value for n can lie between 1.0 and 2.0 and a value of 1.5 is commonly used in general models. The value of 1.1 is considered appropriate for this model because the project area has stiff soils which generally have a higher value of n.

Equipment vibration emission levels used for the predictions are shown in Table 7-1. The levels were gathered from measurements performed and published in several projects including the FTA Manual, Central Artery/Tunnel Project in Boston, and Dowding's textbook. The equipment with a reference PPV of N/A implies the equipment does not generate vibration levels significantly above normal ambient levels. Therefore, equipment such as generators and compressors that may require noise modeling and assessment are not assessed for vibration impact. The vibration-generating equipment that is likely to be used during the Project is shown as highlighted in Table 7-1.

[1] Dowding, Charles, Construction Vibrations, Prentice Hall, Upper Saddle River, NJ, 1996.

Table 7-1: Equipment Vibration Emission Levels

Equipment Description	Vibration Type (Steady or Transient)	Ref PPV at 100 ft
Auger Drill Rig	Steady	0.011125
Backhoe	Steady	0.011
Compactor	Steady	0.03
Concrete Mixer	Steady	0.01
Concrete Pump	Steady	0.01
Crane	Steady	0.001
Large Dozer	Steady	0.07
Small Dozer	Steady	0.04
Dump Truck	Steady	0.01
Excavator	Steady	0.011
Flat Bed Truck	Steady	0.01
Front End Loader	Steady	0.011
Gradall	Steady	0.011
Grader	Steady	0.011
Horizontal Boring Hydraulic Jack	Steady	0.003
Hydra Break Ram	Transient	0.05
Impact Pile Driver	Transient	0.2
Insitu Soil Sampling Rig	Steady	0.011125
Jackhammer	Steady	0.030
Paver	Steady	0.01
Pickup Truck	Steady	0.01
Scraper	Steady	0.000375
Slurry Trenching Machine	Steady	0.002125
Soil Mix Drill Rig	Steady	0.011125
Tractor	Steady	0.01
Vibratory Pile Driver	Steady	0.15
Vibratory Roller (large)	Steady	0.059
Vibratory Roller (small)	Steady	0.022
Blasting	Transient	0.75
Clam Shovel	Transient	0.02525
Rock Drill	Steady	0.011125
3-ton truck at 35 mph	Steady	0.0002

7.2 Prediction Results and Impact Assessment

Table 7-2 presents the distance beyond which the damage risk criteria would not be exceeded for the major vibration-generating pieces of equipment likely to be used for the Project. Most of the equipment can be operated without risk of damage at distances of 35 feet or greater from historic buildings or at distances of 20 feet or greater from non-historic buildings.

Table 7-2: Distance to Construction Vibration Impact Thresholds

Equipment	PPV Ref Level at 100 ft (in/sec)	Distance to Impact Threshold of 0.5 in/sec PPV[(a)]	Distance to Impact Threshold of 0.2 in/sec PPV[(a)]
Compactor	0.030 in/sec	10 ft	20 ft
Cranes	0.001 in/sec	2 ft	3 ft
Dozer	0.040 in/sec	15 ft	25 ft
Dump Truck	0.01 in/sec	3 ft	8 ft
Front End Loader	0.011 in/sec	4ft	8 ft
Jackhammer	0.035 in/sec	12 ft	22 ft

Notes:
[(a)]The impact threshold for non-historic buildings is 0.5in/sec PPV and the impact threshold for historic buildings is 0.2 in/sec PPV.

7.2.1 Wilshire/Rodeo Station

The Sterling Plaza/Bank of California building and Union Bank Building (see Table 5-2) are within 25 feet of the Wilshire/Rodeo Station Box Construction Area. At this distance, there is the potential risk of exceeding the damage risk criteria of 0.20 inches/second during jackhammering, compacting, and operation of a dozer.

7.2.2 Century City Constellation Station

The closest building of the Century Plaza Hotel to the station box construction is more than 40 feet from the edge of the construction. BHHS is over 200 feet from 2040 CPE and 1940-1950 CPE Construction Areas. At these distances, it is not expected that the equipment assumed to be used for construction will exceed the damage risk criteria of 0.20 inches/second.

7.3 Tunnel Trains

Previous measurements conducted of tunnel trains operating during the construction of the Metro Red Line Segment 2 tunnel shows a predominance of high frequency energy, up to 125 Hz. This contrasts with the groundborne vibration from rail trains in subways where vibration levels usually peak below 60 Hz. The high frequency energy of the tunnel trains means the community intrusion is more likely to be caused by groundborne noise rather than perceptible vibration.

Tunnel trains are expected to operate for the duration of the tunnel construction, typically 24 to 36 months until the final trackwork is installed. The vibration from the tunnel train operations is transmitted directly into the tunnel invert through the rails. Providing a resilient support under the track in the form of rubber rail pad will reduce the high frequency vibration and in most cases either eliminate or minimize the perception of the groundborne noise in the buildings above the tunnel.

7.4 Sensitive Receivers

There are several vibration sensitive receivers that may be affected during the tunnel excavation including:

- Montage Hotel and Condominiums
- Beverly Wilshire Hotel
- Apartment Buildings

- Hotels
- Medical Offices
- BHHS Offices and Classrooms

As discussed above, the effects of the TBM would be limited to a few days when its operations would be perceptible at these receivers. In terms of a tunnel train operating in the tunnel, mitigation measures to control train vibrations would need to be included for the entire length of the running tunnel from the Wilshire/Rodeo Station to the Century City Constellation Station due to the close proximity of these receivers above the tunnel.

8.0 GROUNDBORNE VIBRATION DURING TUNNELING

The primary sources of vibration during tunneling are generated by the TBM and the tunnel train used to carry muck, pre-cast concrete tunnel segments, and materials. The TBM will be used to excavate the running tunnel between the Wilshire/Rodeo and Century City Constellation station boxes. The TBMs will be pressurized closed-face tunnel boring machines. The tunnel trains run 24 hours a day in the underground tunnels if used to take out the muck disposed of by the TBMs. These trains have open gondolier cars which are pulled by a diesel locomotive and run at speed of about 5 to 10 mph. Tunnel trains follow the TBMs as they move ahead boring the tunnel. A conveyor connected to the center of the cutter head of the TBM delivers the muck to these trains. The trains carry the muck outside from the TBM area, where the cars are lifted to the surface through a shaft by gantry cranes and the muck is deposited in muck piles before being loaded onto dump trucks and carried away from the construction site. These same tunnel trains are used to transport material and the precast tunnel lining segments. The tunnel trains run on temporary rails that are usually directly fixed to the invert of the tunnel. These trains are also used to carry tunnel segments and materials.

8.1 Tunnel Boring Machines

The main source of vibration during tunneling is when the TBM pushes the shield forward against the earth using a hydraulic ram. The vibration generated by this action would be perceptible above the tunnel at distances of 100 feet from the tunnel centerline and would approach human annoyance levels at closer distances. Most of the energy from the TBM operation is at low frequencies (30 Hz and lower). This would mean that if the TBM vibration is perceived in buildings above the tunnel, it will be perceived as feelable vibration rather than groundborne noise.

Based on previous measurements conducted of the Metro Red Line Section 2 construction in 1993 made near the Wilshire/Western Station, the vibration levels from TBMs were below damage risk levels, either for structural damage or minor cosmetic damage such as hairline fractions in plaster or drywall. This is an important point since whenever groundborne vibration is perceptible, most people's first response is "this must be damaging my house."

There is the potential for community intrusion during the passing of the TBM. The advance rate of the TBM is expected to be approximately 40 feet per day. The presence of the TBM beneath any one residential structure where it would be perceptible as either feelable vibration or groundborne noise would be approximately three to four days. The intrusion would not be continuous but would occur only at times when the shield is pushed against the earth using the hydraulic ram, approximately four to six times a day. There are no measures that can be used to mitigate the effects of the TBM other than keeping residents informed when the tunneling will occur in their area and that some vibration may be perceptible, but not damaging.

9.0 MITIGATION

A perimeter noise barrier wall has been incorporated into the design of the construction sites at the Wilshire/Rodeo and Century City Constellation Stations where nighttime construction will occur. The noise barrier wall shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control. The noise and vibration predictions presented in this report identified exceedances of the BHMC and LAMC noise levels limits at the construction sites that require additional mitigation measures.

This section identifies noise control measures to be used in addition to the 20-foot noise barrier wall and low noise emission equipment to meet the BHMC and LAMC noise limits if the Contractor exceeds these limits. Also included are general noise control measures that shall be implemented by the Contractor at all sites.

9.1 Wilshire/Rodeo Station

Based on the means and methods of construction presented in Section 2.0, the potential for construction noise exceeding the noise limits at sensitive receivers during daytime, evening, and nighttime was predicted not to exceed the BHMC and LAMC noise level limits using a 20-foot high noise barrier wall, moveable noise barriers, and low noise emission equipment. If the Contractor exceeds the noise level limits, they shall be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to meet the BHMC and LAMC noise limits.

9.2 Century City Constellation Station

If needed to comply with the LAMC noise level limits for nighttime construction at the California Rehabilitation Institute Facility (Site E) patient floors, levels 3 through 8, the following noise control measures or similar approaches will be required in addition to the 20-foot high noise barrier wall constructed around the perimeter of the 2040 CPE construction site (Figure 9-1) and the use of low noise emission equipment.

- The compressor plant, ventilation plant, grout plant, foam plant, machine shop, and electrical shop are to be fully enclosed.
- The conveyor system is to be enclosed.
- The boom crane and front end loader used during the night shift are to be retrofitted with a hospital grade muffler and additional damping and insulation added to the engine compartments.
- A supplemental 16-foot noise barrier wall shall be built, as shown in Figure 9-1, to further shield the noise from the front end loader and crane operations.

Based on the means and methods of construction presented in Section 2.0, and the implementation of these noise control measures, the nighttime construction noise at the patient floors of the rehabilitation facility is predicted not to exceed the LAMC nighttime construction noise limits as shown in Table 6-4. If the Contractor exceeds the noise level limits they shall be responsible for providing additional noise control measures and/or limiting the equipment and construction activities. The nighttime construction noise contours at the face of the rehabilitation facility are shown graphically in Figure 9-2.

Figure 9-1: 2040 CPE and 1940-1950 CPE Construction Site Noise Barrier Walls

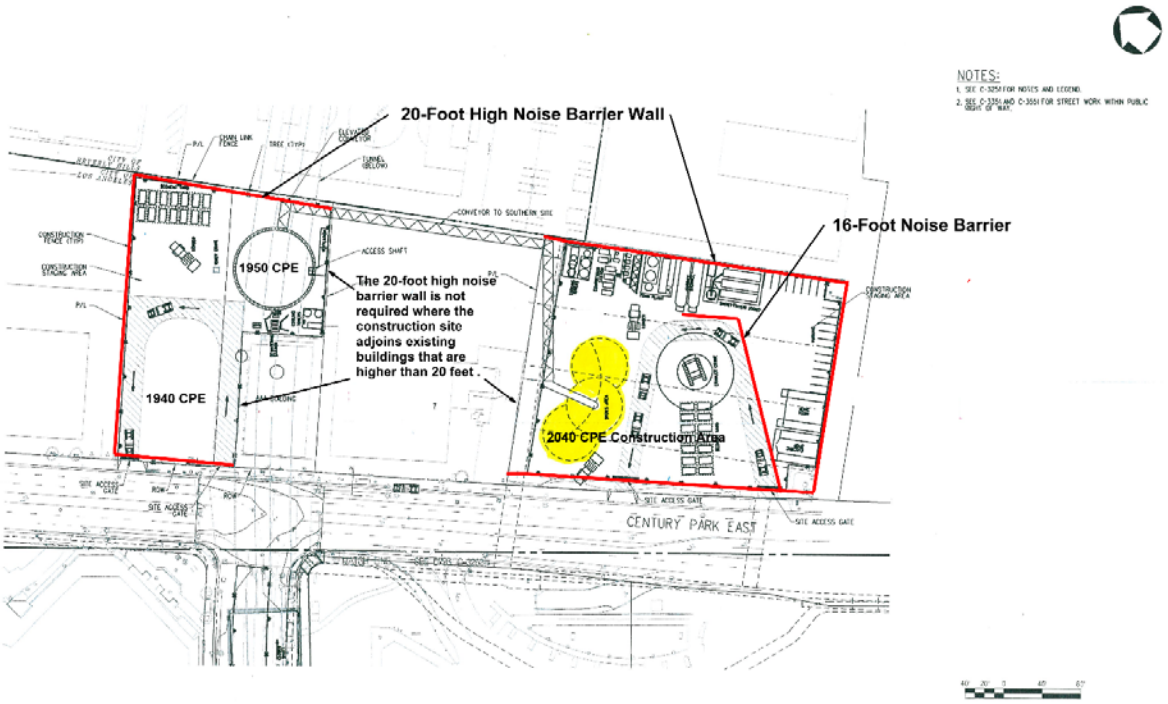
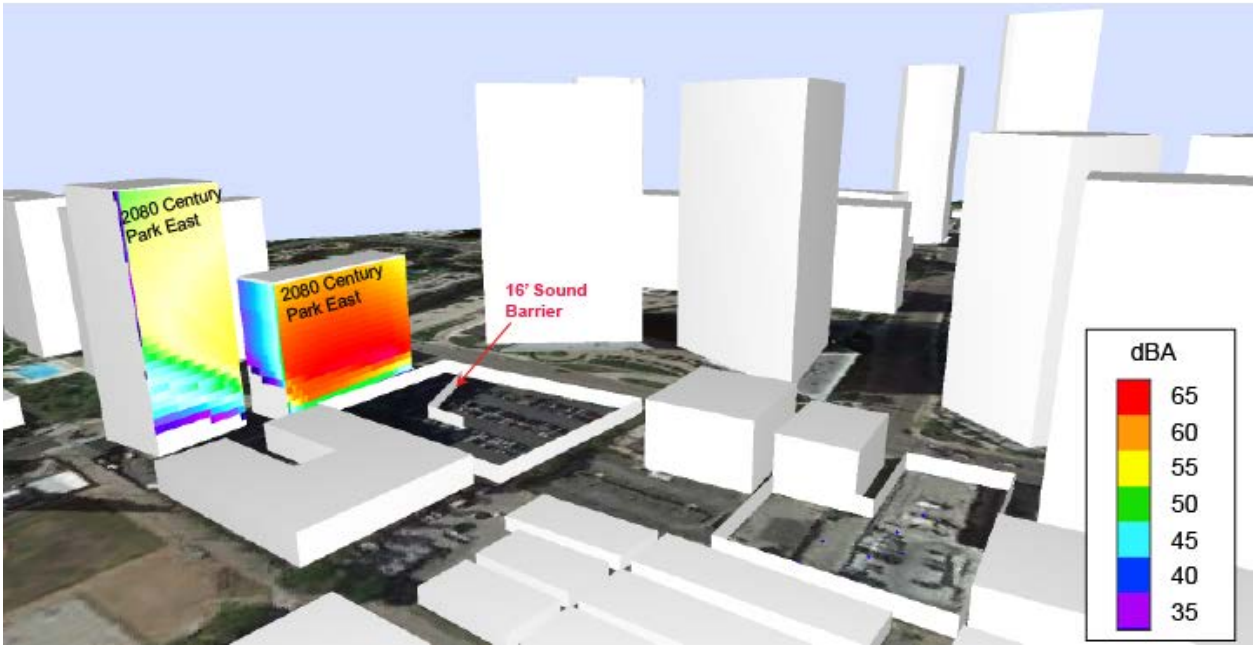


Figure 9-2: Nighttime Noise Level Contours at California Rehabilitation Institute Facility



Based on the means and methods of construction presented in Section 2.0, and the mitigation measures described in Section 6.2.2, the BHMC noise limits are predicted to be exceeded at the BHHS temporary classroom buildings closest to the 1940 CPE construction site (Site O) by 1 dBA during the daytime and 2 dBA during the nighttime. The LAMC nighttime noise levels are predicted to be exceeded by 1 dBA at the Century Plaza Towers (Site 7) and the Annenberg Space for Photography (Site 8). The Contractor shall be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to reduce the construction noise at these sites to comply with the noise level limits.

9.3 Backup Alarms

All equipment operating during nighttime hours at all construction sites shall use low-impact backup alarms. The low-impact back-up alarms shall comply with California Code of Regulations (CCR) Title 8, Section 1592, Warning Methods. For equipment that must comply with CCR Title 8, Section 1592(a), equip these vehicles with compliant white sound, broadband and multi-frequency type back-up alarm devices. For equipment subject to the requirements of CCR Title 8, Section 1592(b) the Contractor may choose to equip with automatic back-up audible alarms. Such alarms shall only be of a compliant white sound, broadband, or multi-frequency back-up alarm type device.

The compliant white sound, broadband, or multi-frequency type back-up alarm device shall be a self-adjusting, "smart" reversing alarm that continually adjusts to 5 dB above ambient. Acceptable manufacturers are Brigade, ECCO, or approved equal. The compliant white sound, broadband, or multi-frequency type back-up alarm device shall be rated as medium duty or heavy duty, as the field conditions and/or usage would dictate.

9.4 Haul Trucks

Trucks operating off-site between the hours of 12:00 midnight and 5:00 AM must have lower emission limits (80 dBA at 50 feet) than normally required by the California Vehicle Code. All trucks used for these nighttime hours must be certified in accordance with these specifications. Take necessary steps to comply with this limit, which may include fitting the equipment with high grade engine exhaust silencers and engine casing sound insulation.

9.5 Tunnel from Wilshire/Rodeo and Century City Constellation Stations

To reduce the vibration generated by a tunnel train the Contractor shall be required to use a durable resilient system to support the tunnel train tracks. Such a system would include a resilient mat under the tracks and a resilient grommet or bushing under the heads of any track fasteners. The hardness of the resilient mat should be in the 40- to 50-durometer range and the mat should be about 1" to 2" thick, depending on how heavily loaded the cars would be. The Contractor would need to select the mat thickness so that the rail doesn't bottom out during a train passby.

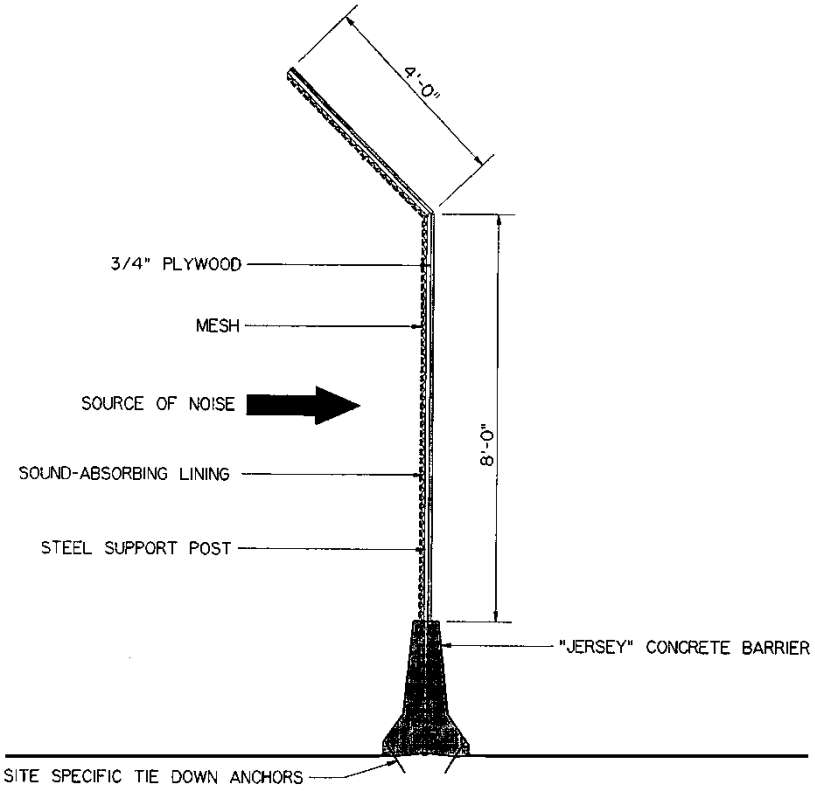
If the Metro groundborne noise limits presented in Table 5-3 are exceeded, the Contractor shall be required to take action to reduce vibrations to acceptable levels. Such action could include reducing the train speed, adding additional rail and tie isolation, and maintaining the tunnel train track and train wheels in good order to reduce potential vibration impacts, including keeping gaps between track sections to a minimum and more frequent maintenance to avoid wheel flats.

9.6 Additional Mitigation Measures

The following are additional noise control measures that can be used to at the construction site to shield noise generating equipment.

- Moveable noise barriers that can be located within the construction site in close proximity to the equipment and activities that are exceeded the impact thresholds. The moveable noise barriers shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control, Article 2.03, Moveable Noise Barriers. The height of the moveable noise barrier shall be a minimum of 14 feet. A representative design of a moveable noise barrier used for other construction projects is shown in Figure 9-3.
- Noise control curtains that can be tented over the area where the noisy equipment is operating. The noise curtain shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control, Article 2.04, Noise Control Curtains.
- Replacing the standard engine exhaust muffler with a hospital grade engine silencer for stationary cranes, front end loaders, dozers, and any other diesel powered equipment operating during nighttime hours.

Figure 9-3: Representative Moveable Noise Barrier Design



9.7 General Noise and Vibration Control Measures

The following general noise and vibration control measures shall be implemented by the Contractor at all construction sites:

- Readily visible signs indicating “Noise Control Zone” would be prepared.
- Noise-control devices that meet original specifications and performance would be used.
- Fixed noise-producing equipment would be used to comply with regulations during project activity.
- Mobile or fixed noise-producing equipment that is equipped to mitigate noise to the extent practical would be used.
- Electrically-powered equipment would be used to the extent practical.
- Temporary noise barriers and sound-control curtains would be erected where project activity is unavoidably close to noise-sensitive receivers.
- Designated haul routes would be used based on the least overall noise impact. Heavily-loaded trucks would be routed away from residential streets, if possible. Identification of haul routes would consider streets with the fewest noise sensitive receivers if no alternatives are available.
- Non-noise sensitive, designated parking areas for project-related vehicles would be used.
- Earth-moving equipment, fixed noise-generating equipment, stockpiles, staging areas, and other noise-producing operations would be located as far as practicable from noise-sensitive receivers.
- The use of air horn type devices, including but not limited to vehicle mounted or hand held, shall not be used to communicate signals from one area of the project site to another. Compliance with the requirements of the Tunnel Safety Orders for signaling systems shall be obtained through the use of other auditory or visual systems other than the use of air horn type devices.
- Use of horns, whistles, alarms, and bells would be limited.
- All noise-producing project equipment and vehicles would be required to use internal combustion engines equipped with mufflers and air-inlet silencers, where appropriate, and kept in good operating condition that meets or exceeds original factory specifications. Mobile or fixed “package” equipment (e.g., arc welders, air compressors) would be equipped with shrouds and noise control features that are readily available for that type of equipment.
- Any project-related public address or music system would not be audible at any adjacent receiver.
- Demolition, earth moving, and ground-impacting operations would be phased so as not to occur in the same time period.
- Impact pile driving would be avoided. Drilled piles drivers would be used where the geological conditions permit their use.
- Demolition methods would be selected to minimize noise and vibration impact where possible.
- Use of vibratory rollers and packers would be avoided near vibration sensitive areas.
- An elastomer isolator would be installed between the floor of the tunnel and the rails and ties on which the tunnel train carrying excavated materials operates. If the Metro groundborne noise limits or groundborne vibration limits are exceeded, the Contractor shall be required to take action to

reduce vibrations to acceptable levels. Such actions could include reducing the tunnel train speed, adding additional rail and tie isolation, and performing more frequent rail and wheel maintenance.

- Enclosures for fixed equipment such as TBM slurry processing plants would be required to reduce noise.

Metro Baseline Specifications Section 01565, Construction Noise and Vibration Control requires that the Contractor shall, among other provisions

- Hire or retain the services of an Acoustical Engineer to be responsible for preparing and overseeing the implementation of the Noise Control and Monitoring Plans.
- Prepare a Noise Control Plan that includes an inventory of construction equipment used during daytime and nighttime hours, estimate of projected construction noise levels, and locations and types of noise abatement measures that may be required to meet the specified noise limits.
- In the case of nighttime construction, the Contractor shall comply with the provisions of the nighttime noise variance issued by the local jurisdictions.
- Conduct periodic noise measurement in accordance with an approved Noise Monitoring Plan, specifying monitoring locations, equipment, procedures, and schedule of measurements and reporting methods to be used.
- During nighttime hours, use equipment at the surface of the construction site that, operating under full load, is certified to meet specified lower noise level limits than standard equipment.
- For nighttime construction activities, erect Metro-designed noise barrier walls at each construction site prior to the start of any construction activities.

10.0 MONITORING

The Contractor is required to submit a Noise and Vibration Monitoring Plan prepared, stamped, and administered by the Contractor's Acoustical Engineer. Noise and vibration monitoring shall be performed at locations in the vicinity of all the construction sites.

10.1 Noise Monitoring

There are two types of noise monitoring that shall be performed, depending on the location and the expected level of impact. The first type is continuous noise monitoring, which is to be performed in areas where nighttime work is anticipated from 6:00 P.M. to 8:00 A.M. in the City of Beverly Hills and from 9:00 P.M. to 7:00 A.M. in the City of Los Angeles. The second type is short-term noise monitoring, which consists of weekly short-duration (1 hour or more) measurements to verify that noise levels during construction do not exceed the predicted noise levels or relevant impact criteria.

Continuous noise monitoring will require the installation of permanent monitoring stations that include microphones, sound level meters, power sources, and associated ancillary equipment. Each continuous noise monitoring station should also include data transmission capabilities to make remote access possible. Monitors should be installed in locations that provide a direct line of sight to construction activities and are representative of residential (or otherwise noise-sensitive) receivers.

In all measurement sites the continuous noise monitor shall be located at the side of the building closest to the construction activities, no closer than 3 feet from the building façade. If this is not possible and another site is selected, the measured data shall be adjusted to the building setback distance from the construction activities.

Weekly short-term noise measurements may be performed using a sound level meter and associated ancillary equipment. Short-term measurements should be conducted at a height of approximately 5 feet above ground level.

Contractor must initiate short-term noise monitoring when performing a new activity or as requested by Metro.

10.1.1 Wilshire/Rodeo

Continuous noise levels shall be monitored at the following locations:

- 210 N. Beverly Drive (Site H)
- Sirtaj Hotel, 120 S. Reeves Drive (Site J)
- AKA Beverly Hills Hotel, 155 N. Crescent Drive (Site M)
- Beverly Sixty Hotel (Site 1)

Short-term noise measurements shall be conducted on a weekly basis during daytime and nighttime hours at the following locations:

- 133-153 S. Reeves Drive (Site I)
- 192 N. Canon Drive (Site K)

- 121-157 S. Canon Drive (Site L)
- The Rolex Building, 9420 Wilshire Boulevard (Site 2)
- Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Site 3)

If the measured levels exceed the noise limits specified in Table 4-1, reduce the noise levels by appropriate abatement measures, or modify the construction activity responsible for the noise limit exceedance.

10.1.2 Century City Constellation

Continuous noise levels shall be monitored at the following locations:

- Hyatt Regency Century Plaza Hotel (Site C)
- California Rehabilitation Institute (Site E)

Short-term noise measurements will be conducted on a weekly basis during daytime and nighttime hours at the following locations:

- BHHS (Site 5)
- 401 Shirley Place (Site G)
- 1918-1952 Fox Hills Drive (Site A)
- 2050 Century Park West (Site B)
- 2010 Century Park East (Site D)
- 2160 Century Park East (Site F)
- 1888 Century Park East (Site 6)
- Century Park Towers, 2049 Century Park East (Site 7)
- Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard (Site 8)
- Bain & Company Building, 1901 Avenue of the Stars (Site 9)
- The Century, 10 West Century Drive (Site 10)
- Constellation Place, 10250 Constellation Boulevard (Site 11)

If the measured levels exceed the noise limits specified in Table 4-1, reduce the noise levels by appropriate abatement measures, or modify the construction activity responsible for the noise limit exceedance.

10.2 Vibration Monitoring

Vibration monitoring for this project shall consist of continuous measurements of vibration at the closest building façade to the construction activities of the following historic buildings using a permanent vibration monitor:

- Sterling Plaza/Bank of California, 9441 Wilshire Boulevard
- Union Bank Building, 9460 Wilshire Boulevard

Short-term vibration measurements shall also be conducted at buildings closest to the construction activities during periods of construction when equipment that generates a substantial amount of groundborne vibration (such as jack hammer or compactor) are in use. All vibration monitors used for either permanent monitoring or short term measurements should be equipped with an alarm feature to provide notification that vibration impact criteria have been approached or exceeded.

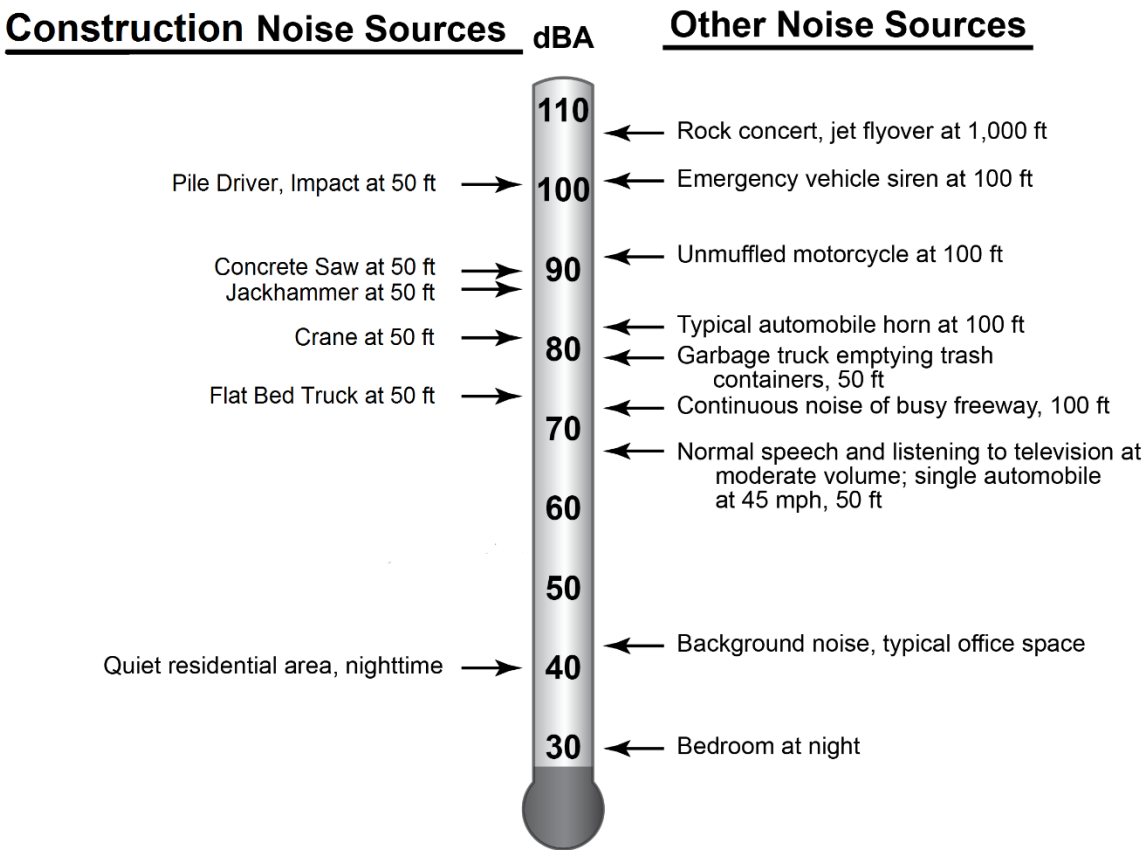
APPENDIX A FUNDAMENTALS OF NOISE AND VIBRATION

APPENDIX A FUNDAMENTALS OF NOISE AND VIBRATION

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally defined as unwanted or excessive sound. Sound can vary in intensity by over one million times within the range of human hearing. Therefore, a logarithmic scale, known as the decibel scale (dB), is used to quantify sound intensity and compress the scale to a more manageable range.

Sound is characterized by both its amplitude and frequency (or pitch). The human ear does not hear all frequencies equally. In particular, the ear deemphasizes low and very high frequencies. To better approximate the sensitivity of human hearing, the A-weighted decibel scale has been developed. A-weighted decibels are abbreviated as "dBA." On this scale, the human range of hearing extends from approximately 3 dBA to around 140 dBA. As a point of reference, Figure A-1 includes examples of A-weighted sound levels from common indoor and outdoor sounds.

Figure A-1: Typical Outdoor and Indoor Noise Levels



Using the decibel scale, sound levels from two or more sources cannot be directly added together to determine the overall sound level. Rather, the combination of two sounds at the same level yields an increase of 3 dBA. The smallest recognizable change in sound level is approximately 1 dBA. A 3 dBA increase is generally considered perceptible, whereas a 5 dBA increase is readily perceptible. A 10 dBA increase is judged by most people as an approximate doubling of the perceived loudness.

Two of the primary factors that reduce levels of environmental sounds are increasing the distance between the sound source and the receiver and having intervening obstacles such as walls, buildings, or terrain features that block the direct path between the sound source and the receiver. Factors that act to increase the loudness of environmental sounds include the proximity of the sound source to the receiver, sound enhancements caused by reflections, and focusing caused by various meteorological conditions.

Brief definitions of the measures of environmental noise used in this report are:

- **Equivalent Sound Level (Leq)**: Environmental sound fluctuates constantly. The equivalent sound level (Leq), sometimes referred to as the energy-average sound level, is the most common means of characterizing community noise. Leq represents a constant sound that, over the specified period, has the same sound energy as the time-varying sound.
- **Day-Night Sound Level (Ldn)**: Ldn is basically a 24-hour Leq with an adjustment to reflect the greater sensitivity of most people to nighttime noise. The adjustment is a 10 dB penalty for all sound that occurs between the hours of 10:00 P.M. and 7:00 A.M. The effect of the penalty is that, when calculating Ldn, any event that occurs during the nighttime is equivalent to 10 of the same event during the daytime. Ldn is the most common measure of total community noise over a 24-hour period.
- **Maximum Sound Level (Lmax)**: The maximum sound level over a period of time or for a specific event can also be a useful parameter for characterizing specific noise sources. Standard sound level meters have two settings, fast and slow, which represent different time constants. Lmax using the fast setting will typically be 1 to 3 dB greater than Lmax using the slow setting.
- **Percent Exceedance Level (Lxx)**: This is the sound level that is exceeded for xx percent of the measurement period. For example, L99 is the sound level exceeded 99 percent of the measurement period. For a one hour period, the sound level is less than L99 for 36 seconds of the hour and the sound level is greater than L1 for 36 seconds of the hour. L1 represents typical maximum sound levels, L33 is approximately equal to Leq when free-flowing traffic is the dominant noise source, L50 is the median sound level, and L99 is close to the minimum sound level.
- **Sound Exposure Level (SEL)**: SEL is a measure of the total sound energy of an event. In essence, all sound from the event is compressed into a one-second period. This means that SEL increases as the event duration increases and as the event sound level increases. SEL is useful for estimating the Ldn that would be caused by individual events such as train passbys.

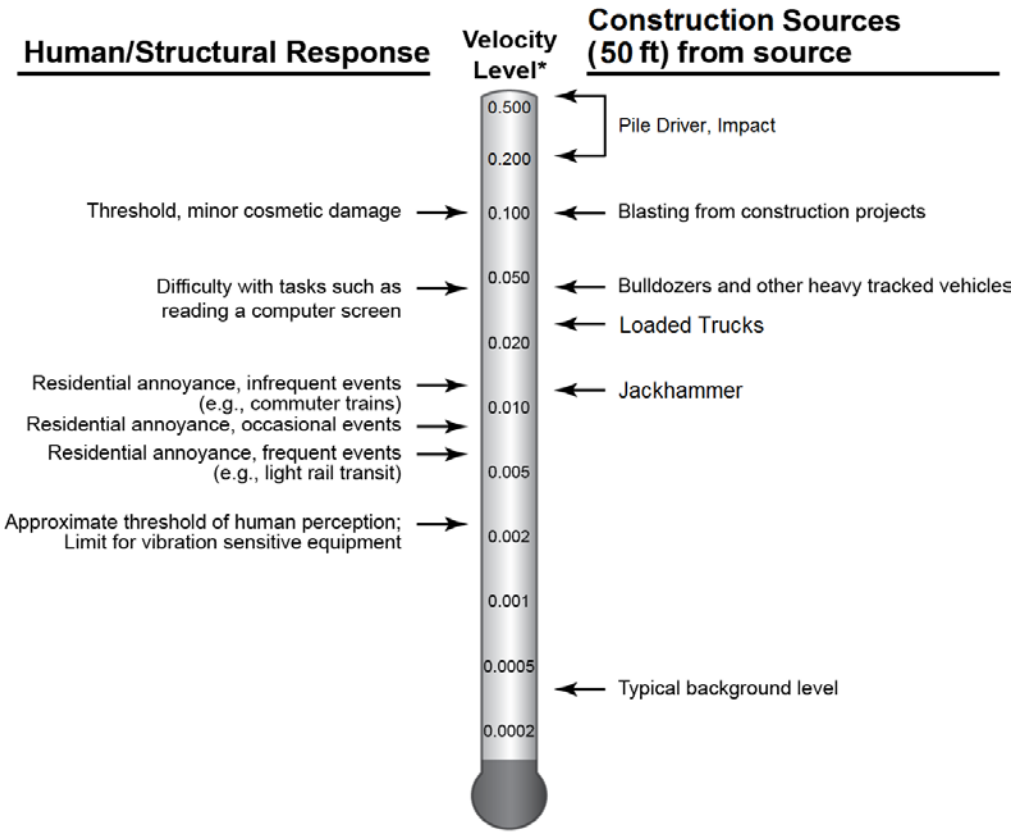
Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration of the motion. One potential effect from the Project is an increase in vibration that is transmitted from the tracks through the ground into adjacent houses. When evaluating human response, groundborne vibration is usually expressed in terms of decibels using the RMS vibration velocity. RMS is defined as the average of the squared amplitude of the vibration signal. To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels. All vibration decibels in this report use a decibel reference of 1 µin/sec. Vibration can also be expressed as the peak particle velocity (PPV), which is generally used to evaluate whether vibration has potential to cause damage to fragile building structures. PPV is normally expressed in inches per second.

The potential adverse effects of rail transit groundborne vibration are as follows:

- **Perceptible Building Vibration**: This is when building occupants feel the vibration of the floor or other building surfaces. Experience has shown that the threshold of human perception is around 65 VdB and that vibration that exceeds 75 to 80 VdB may be intrusive and annoying to building occupants.
- **Rattle**: The building vibration can cause rattling of items on shelves and hanging on walls and various different rattle and buzzing noises from windows and doors.
- **Reradiated Noise**: The vibration of room surfaces radiates sound waves that may be audible to humans. This is referred to as groundborne noise. When audible groundborne noise occurs it sounds like a low-frequency rumble. For surface rail systems, the groundborne noise is usually masked by the normal airborne noise radiated from the transit vehicle and the rails.
- **Damage to Building Structures**: Vibration from rail systems is usually one to two orders of magnitude below the most restrictive thresholds for preventing building damage. However, fragile and extremely fragile structures may be susceptible to damage if the tracks are in sufficient proximity to the structure.

Figure A-2 shows typical RMS vibration velocity levels from rail and non-rail sources as well as the human and structure response to such levels.

Figure A-2: Typical RMS Vibration Velocity Levels



Often it is necessary to determine the contribution at different frequencies when evaluating vibration or noise signals. The 1/3-octave band spectrum is the most common procedure used to evaluate frequency components of acoustic signals. The term “octave” has been borrowed from music where it refers to a span of eight notes. The ratio of the highest frequency to the lowest frequency in an octave is 2:1. For a 1/3-octave band spectrum, each octave is divided into three bands where the ratio of the lowest frequency to the highest frequency in each 1/3-octave band is 21/3:1 (1.26:1). An octave consists of three 1/3 octaves.

The 1/3-octave band spectrum of a signal is obtained by passing the signal through a bank of filters. Each filter excludes all components except those that are between the upper and lower range of one 1/3-octave band. The FTA Guidance Manual is a good reference for additional information on transit noise and vibration and the technical terms used in this section.

Construction equipment can produce high levels of vibration, and many pieces of equipment will incite vibration levels greater than expected from train operations. Vibration from construction equipment is generally expressed as a peak particle velocity (PPV) in units of inches per second. The PPV is an instantaneous linear peak value and is more appropriate for assessing vibration when damage is a concern.

APPENDIX B NOISE MEASUREMENT RESULTS

APPENDIX B NOISE MEASUREMENT RESULTS

Noise measurements were conducted at sensitive receivers near the construction laydown areas to document the pre-construction ambient noise levels. This section includes brief descriptions of the measurement sites and tables of the hourly sound levels.

B.1 WILSHIRE/RODEO STATION

Six long-term (24-hour) measurements and four short-term (1-hour) measurement were conducted near the Wilshire/Rodeo laydown, staging, and construction areas to document the pre-construction ambient noise levels. The hourly results of the measurements are presented in Table B-1 and Table B-2. Brief descriptions of the measurement sites follow below:

- Site H - 210 North Beverly Drive: A long-term noise measurement was conducted from 10:19 A.M. on August 10th 2015 to 10:19 A.M. on August 11th 2015. The building is an apartment complex with ground floor retail. The microphone was located on the sidewalk in front of Beverly Drive, about 10 feet from the building façade, 20 feet from Wilshire Boulevard, the main source of traffic noise at this site. The microphone was 5 feet above street level.
- Site I - 133-153 South Reeves Drive: A long-term noise measurement was conducted from 9:04 A.M. on August 11th 2015 to 9:42 A.M. on August 12th 2015. The building is an apartment complex at the south end of Reeves Park. The microphone was located within this park, about 10 feet from the southern end of the park, 20 feet from the western end, and 100 feet from Reeves Drive. The main noise source at this site was traffic on Reeves Drive. The microphone was 5 feet above street level.
- Site J - 120 South Reeves Drive: A long-term noise measurement was conducted from 9:32 A.M. on August 11th 2015 to 10:32 A.M. on August 12th 2015. The microphone was located on the sidewalk in front of the Sirtaj Hotel. It was 13 feet from the building façade. It was 4 feet from Reeves Drive, the main source of traffic noise at this site. The microphone was 5 feet above street level.
- Site K - 192 North Canon Drive: A long-term noise measurement was conducted from 10:37 A.M. on August 10th 2015 to 11:02 A.M. on August 11th 2015. The building is an apartment/office complex with ground floor retail. The microphone was located on the sidewalk in front of Canon Drive, 6 feet from the building façade, 220 feet from Wilshire Boulevard, and 4 feet from Canon Drive. The main source of traffic noise at this site was from Canon Drive. The microphone was 5 feet above street level.
- Site L - 121-157 South Canon Drive: A long-term noise measurement was conducted from 9:04 A.M. on August 11th 2015 to 9:42 A.M. on August 12th 2015. The building is an apartment complex on Canon Drive directly south of a small parking lot. The microphone was located in an alley between the apartment complex and the parking lot at the southern end of the alley, 190 feet from Wilshire Boulevard and 90 feet from Canon Drive. The main source of traffic noise at this site was from Canon Drive. The microphone was 5 feet above street level and 5 feet from the building wall.
- Site M – 155 North Crescent Drive: A long-term noise measurement was conducted from 8:35 A.M. on August 10th 2015 to 9:14 A.M. on August 11th 2015. The building is the AKA Beverly Hills Hotel located on Crescent Drive with one end of the building on Crescent Drive and the other on an alley between and Crescent Drive and Canon Drive. The microphone was located in this alley 3 feet from

the building façade and 265 feet from Wilshire Boulevard. The main noise source at this site was from trucks coming through the alley. The microphone was 5 feet above street level.

- Site 1 – Beverly Sixty Hotel, 9360 Wilshire Boulevard: A short-term noise measurement was conducted from 8:57 A.M. on August 11th 2015 to 9:57 A.M. on August 11th 2015. The microphone was located on the sidewalk in front of the hotel on Wilshire Boulevard, the main traffic noise source at this site. The microphone was 3 feet from the building façade, 12 feet from Wilshire Boulevard, and 5 feet above street level.
- Site 2 – The Rolex Building, 9420 Wilshire Boulevard: A short-term noise measurement was conducted from 7:34 A.M. on August 11th 2015 to 8:37 A.M. on August 11th 2015. The microphone was located on the sidewalk in front of the building on Wilshire Boulevard, the main traffic noise source at this site. The microphone was 12 feet from the building façade, 3 feet from Wilshire Boulevard, and 5 feet above street level.
- Site 3 – Sterling Plaza/Bank of California, 9441 Wilshire Boulevard: A short-term noise measurement was conducted from 7:35 on August 11th 2015 to 8:39 on August 11th 2015. The microphone was located on the sidewalk in front of the building on Wilshire Boulevard, the main traffic noise source at this site. The microphone was 8 feet from the building façade, 5 feet from Wilshire Boulevard, and 5 feet above street level.
- Site 4 – Beverly Wilshire Hotel, 9500 Wilshire Boulevard: A short-term noise measurement was conducted from 7:25 A.M. on August 11th 2015 to 8:25 A.M. on August 11th 2015. The microphone was located on the sidewalk in front of the hotel building on South El Camino Drive, 7 feet from the building façade, 18 feet from Wilshire Boulevard, and 5 feet above street level. Traffic on Wilshire Boulevard was the main source of noise at this site.

Table B-1: Long-Term Noise Measurement Results at Wilshire/Rodeo

Hour Start	Site H	Site I	Site J	Site K	Site L	Site M
11:00	70.4	57.9	58.3	68.5	61.4	61.8
12:00	73.7	58.6	55.5	66.0	60.8	65.9
13:00	71.3	57.9	57.2	68.2	60.0	72.3
14:00	71.4	59.2	58.1	71.2	59.8	59.5
15:00	70.8	58.2	58.5	67.6	60.8	62.4
16:00	70.1	59.0	57.1	66.2	59.1	59.7
17:00	74.4	59.3	58.5	67.0	64.4	59.4
18:00	71.1	57.4	56.9	67.1	59.3	59.8
19:00	70.2	55.7	55.5	64.8	62.5	60.9
20:00	70.0	54.4	55.0	63.7	59.8	59.0
21:00	68.8	53.6	54.2	68.9	60.4	60.9
22:00	69.2	53.7	53.2	65.3	55.6	64.3
23:00	67.8	54.9	52.6	65.3	56.5	57.5
00:00	67.6	51.5	53.6	65.4	56.6	59.1
01:00	67.1	51.5	49.1	59.0	53.7	56.0
02:00	65.7	50.4	48.6	64.3	51.8	54.4
03:00	64.0	50.9	47.4	58.7	52.7	54.5
04:00	63.2	52.4	49.8	55.1	54.8	60.2
05:00	67.1	53.5	50.6	62.6	54.6	64.7
06:00	70.9	57.8	53.1	65.5	56.9	66.2
07:00	73.3	57.5	56.0	66.5	60.6	64.5
08:00	71.8	61.6	56.3	69.2	61.0	63.2
09:00	71.2	59.6	57.4	71.6	58.8	63.2
10:00	70.9	58.0	57.8	66.3	62.4	63.9
Daytime (8 am-6.pm)	72	59	60	64	63	62
Evening (6pm-9pm)	70	56	56	65	61	60
Nighttime (9pm-8am)	69	54	52	65	57	62

Table B-2: Short-Term Noise Measurement Results at Wilshire/Rodeo

Hour Start	Site 1	Site 2	Site 3	Site 4
11:00	74.1	72.2	72.3	71.5
12:00	77.5	75.5	75.6	74.8
13:00	75.1	73.1	73.2	72.4
14:00	75.1	73.2	73.2	72.4
15:00	74.5	72.6	72.7	71.8
16:00	73.9	71.9	72.0	71.2
17:00	78.2	76.2	76.3	75.5
18:00	74.8	72.9	73.0	72.2
19:00	73.9	71.9	72.0	71.2
20:00	73.7	71.8	71.9	71.1
21:00	72.5	70.6	70.7	69.9
22:00	72.9	71.0	71.1	70.2
23:00	71.5	69.6	69.7	68.9
00:00	71.3	69.3	69.4	68.6
01:00	70.8	68.9	69.0	68.2
02:00	69.4	67.5	67.6	66.8
03:00	67.7	65.8	65.9	65.0
04:00	66.9	64.9	65.0	64.2
05:00	70.8	68.8	68.9	68.1
06:00	74.6	72.6	72.7	71.9
07:00	77.1	75.1	75.2	74.4
08:00	75.5	73.6	73.7	72.9
09:00	74.9	73.0	73.0	72.2
10:00	74.6	72.6	72.7	71.9
Daytime (8 am-6.pm)	76	74	74	73
Evening (6pm-9pm)	74	72	72	72
Nighttime (9pm-8am)	72	70	71	70

B.2 Century City Constellation Station

Six long-term nighttime measurements, from 9:00 P.M. to 7:00 A.M. (minimum 10-hour), one long-term 24-hour noise measurement, and seven short-term (1-hour) measurements were conducted near the Century City Constellation laydown, staging, and construction areas to document the pre-construction ambient noise levels. The hourly results of the measurements are presented in Table B-3 and Table B-4. Brief descriptions of the measurement sites follow below:

- Site A – 1918-1952 Fox Hills Drive: A nighttime noise measurement was conducted from 7:55 P.M. on August 17th 2015 to 8:00 A.M. on August 18th 2015. The buildings are a row of single-family residences across from the trees on the western side of Century Park West. The microphone was located within this tree area, 10 feet from the curb of Century Park West, the main traffic noise source at this site. The microphone was 5 feet above street level.

- Site B – 2050 Century Park West: A nighttime noise measurement was conducted from 7:21 P.M. on August 13th 2015 to 8:02 A.M. on August 14th 2015. The site is an under-construction apartment complex on the SE corner of Solar Way and Century Park West. The microphone was located 3 feet from the north side of Solar Way, 30 feet from the east curb of Century Park West, and 5 feet above street level. Traffic on Century Park West was the main source of noise at this site.
- Site C – Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars: A nighttime noise measurement was conducted from 7:35 P.M. on August 13th 2015 to 8:11 A.M. on August 14th 2015. The microphone was located in the slightly hilly landscaped area between the hotel and Constellation Boulevard, 25 feet from Constellation Boulevard and 70 feet from the hotel. The microphone was 8 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.
- Site D – 2019 Century Park East: A nighttime noise measurement was conducted from 7:45 P.M. on August 12th 2015 to 8:11 A.M. on August 13th 2015. The microphone was located on the sidewalk in front office building at this location, 12 feet from Century Park East, 32 feet from the south side of the building, and 5 feet above street level. Daytime data was also taken from 9:30 A.M. on August 13th 2015 to 8:03 P.M. on August 13th 2015. The second location was 2 feet from Century Park East, 22 feet from the west side of the building, and 5 feet above street level. Traffic on Century Park East was the main source of noise at this site.
- Site E – California Institute Rehabilitation Facility, 2080 Century Park East: A nighttime noise measurement was conducted from 7:11 P.M. on August 13th 2015 to 9:39 A.M. on August 14th 2015. The microphone was located on the sidewalk of Century Park East, 4 feet from the curb and 40 feet from the building façade. The microphone was 5 feet above street level. Traffic on Century Park East was the main source of noise at this site.
- Site F – 2160 Century Park East: A nighttime noise measurement was conducted from 7:11 P.M. on August 13th 2015 to 9:39 A.M. on August 14th 2015. The site is a high-rise apartment complex. The microphone was located on the sidewalk of Olympic Boulevard in front of the building, 4 feet from the curb and 20 feet from the façade. The microphone was 5 feet above street level. Traffic on Olympic Boulevard was the main noise source at this site.
- Site G – 401 Shirley Place, Beverly Hills: A long-term noise measurement was conducted from 10:28 A.M. on August 11th 2015 to 8:54 A.M. on August 12th 2015. The site is a row of single-family residences on Shirley Place. The microphone was located on the sidewalk of Shirley place, 3 feet from the curb, 15 feet from the façade, and 40 feet from Olympic Boulevard, the main source of traffic noise at this site. The microphone was 5 feet above street level.
- Site 5 – Beverly Hills High School: Short-term noise measurements were conducted from 8:36 P.M. on August 12th 2015 to 8:57 P.M. on August 12th 2015 at one location and from 8:59 P.M. on August 12th 2015 to 9:30 P.M. on August 12th 2015 at another location. At the first location, the microphone was located in the back of the high school parking lot, closest to Century Park East. The main noise source at this location was the HVAC of the building located on Heath Ave behind the high school parking lot. The other measurement location was at the corner of the high school soccer field and Heath Avenue. Both microphones were 5 feet above street level.
- Site 6 – 1888 Century Park East: A short-term noise measurement was conducted from 9:01 P.M. on August 12th 2015 to 10:01 P.M. on August 12th 2015. The microphone was located on the sidewalk of Century Park East in front of the office building. The microphone was 5 feet from the curb, 14 feet

from the building façade, and 5 feet above street level. The traffic on Century Park East was the main source of noise at this site.

- Site 7 – Century Park Towers, 2049 Century Park East: A short-term noise measurement was conducted from 10:03 P.M. on August 12th 2015 to 11:03 P.M. on August 12th 2015. The microphone was located on the sidewalk of Constellation Boulevard, 5 feet from the curb, 100 feet from the building façade, and 5 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.
- Site 8 - Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard: A short-term noise measurement was conducted from 9:29 P.M. on August 12th 2015 to 10:45 P.M. on August 12th 2015. The microphone was located on the sidewalk of Constellation Boulevard in front of the art studio, 22 feet from the curb, 23 feet from the building façade, and 5 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.
- Site 9 - Bain & Company Building, 1901 Avenue of the Stars: A short-term noise measurement was conducted from 9:29 P.M. on August 13th 2015 to 10:45 P.M. on August 13th 2015. The microphone was located on the sidewalk of Avenue of the Stars in front of the office building. It was 8 feet from the curb, 32 feet from the building façade, and 7.5 feet above street level. Traffic on Avenue of the Stars was the main source of noise at this site.
- Site 10 - The Century, 10 West Century Drive: A short-term noise measurement was conducted from 9:43 P.M. on August 13th 2015 to 10:44 P.M. on August 13th 2015. The microphone was located on the sidewalk of Avenue of the Stars in front of the apartment complex, 13 feet from the curb, 200 feet from the building façade, and 5 feet above street level. Traffic on Avenue of the Stars was the main source of noise at this site.
- Site 11 - Constellation Place, 10250 Constellation Boulevard: A short-term noise measurement was conducted from 9:43 P.M. on August 13th 2015 to 10:44 P.M. on August 13th 2015. The microphone was located in front of the office building on the sidewalk of Constellation Boulevard, 10 feet from the curb, 40 feet from the building façade, and 5 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.

Table B-3: Long-Term Noise Measurement Results at Century City Constellation

Hour Start	Site A	Site B	Site C	Site D	Site E	Site F	Site G
11:00							67.6
12:00							67.3
13:00							67.5
14:00							67.9
15:00							67.6
16:00							68.4
17:00							68.9
18:00							67.0
19:00							66.8
20:00							68.7
21:00	61.9	63.2	57.6	62.2	62.3	68.5	67.7
22:00	60.9	59.2	57.6	61.8	61.0	67.4	66.9
23:00	58.2	58.5	56.0	60.8	60.9	67.0	65.1
00:00	54.1	54.6	57.1	61.0	58.5	63.3	64.1
01:00	51.3	58.5	51.9	58.5	58.7	59.7	61.4
02:00	49.5	53.8	54.1	58.9	63.1	59.3	58.2
03:00	55.5	53.7	49.4	58.3	55.8	57.0	58.2
04:00	51.9	56.6	54.9	59.6	59.7	59.1	56.6
05:00	58.2	61.5	55.8	61.1	61.5	64.0	59.2
06:00	60.6	60.6	59.8	69.0	70.5	68.9	62.4
07:00							66.1
08:00							68.3
09:00							68.3
10:00							65.6
Daytime (8 am-6.pm)							69
Evening (6pm-9pm)							68
Nighttime (9pm-8am for Site G and 9pm-7am for Sites A through F)	58	59	56	63	63	65	63

Table B-4: Short-Term Noise Measurement Results at Century City Constellation

Hour Start	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
11:00	54.8						
12:00	56.1						
13:00	55.6						
14:00	54.9						
15:00	55.1						
16:00	54.6						
17:00	54.8						
18:00	53.7						
19:00	53.4						
20:00	51.5						
21:00	50.2	62.2	59.7	57.2	62.4	58.5	65.2
22:00	49.7	61.8	58.3	57.2	62.4	58.5	65.2
23:00	48.7	60.8	57.9	55.6	60.8	56.9	63.6
00:00	48.9	61.0	56.9	56.7	61.9	58.0	64.7
01:00	46.4	58.5	57.1	51.5	56.7	52.8	59.5
02:00	46.8	58.9	54.6	53.7	58.9	55.0	61.6
03:00	46.3	58.3	55.0	49.1	54.3	50.4	57.0
04:00	47.6	59.6	54.4	54.5	59.7	55.8	62.5
05:00	49.1	61.1	55.7	55.4	60.6	56.8	63.4
06:00	56.9	69.0	57.3	59.4	64.6	60.7	67.3
07:00	54.4						
08:00	56.3						
09:00	57.4						
10:00	55.7						
Daytime (8 am-6.pm)	56						
Evening (6pm-9pm)	53						
Nighttime (9pm-8am for Site 5 and 9pm-7am for Sites 6 through 11)	51	63	59	56	61	57	64