INDIVIDUAL NOISE ASSESSMENT REPORT

Site Name/Facility:	Mission Bay High School (MBHS) and Pacific Beach Drive/Olney Street (PBO)
Master Program Map No.:	36 & 37
Date:	
Acoustician Name:	

***Instructions**: This form must be completed in its entirety for each target facility identified in the Annual Maintenance Needs Assessment report when the potential exists for sensitive wildlife to occur within 750 feet of a proposed maintenance activity. If no sensitive species are expected within 750 feet of maintenance, only the first two rows under the Existing Conditions section must be completed. Attach additional sheets as needed.*

EXISTING CONDITIONS

The City of San Diego (City) has developed the Master Storm Water System Maintenance Program (MMP, Master Maintenance Program) (City 2011a) to govern channel operation and maintenance activities in an efficient, economic, environmentally and aesthetically acceptable manner to provide flood control for the protection of life and property. This document provides a summary of the Individual Noise Assessment (INA) for proposed maintenance activities within the Mission Bay High School (MBHS) (Map 36) and Pacific Beach Dr./Olney St. (PBO) (Map 37). Channels to comply with the MMP's Programmatic Environmental Impact Report (PEIR) (City 2011b). Map numbers correspond to those contained in the MMP.

INA procedures under the MMP provide the guidelines for a site-specific inspection of the proposed maintenance activity site including access routes, and temporary spoils storage and staging areas. An INA is required whenever a qualified biologist determines that noise from maintenance activities could adversely affect sensitive wildlife in or around the maintenance area.

Project Location and Description

The purpose of the project is to maintain the existing storm water facilities by restoring the original design capacity to provide public safety and protection of property. The City is proposing to routinely maintain the MBHS and PBO channels through periodic removal of trash, debris, vegetation and accumulated sediment.

The MBHS and PBO channels are located west of Interstate 5 in the Pacific Beach community of the City (Figure 1), and are situated adjacent to Pacific Beach Drive and Mission Bay High School just north of Mission Bay (Figure 2). The channels are located in un-sectioned lands in Township 16 South, Range 3 West on the San Bernardino Base and Meridian U.S. Geological Survey (USGS) 7.5-minute La Jolla quadrangle map (Figure 3). Kendall-Frost Mission Bay Marsh Reserve is located southwest of the site, along the northern edge of Mission Bay.

The channels are located within the City and California Coastal Commission's Coastal Overlay Zone (Coastal Appealable and Coastal Permit) and Pacific Beach community. The project area is zoned RS-1-7 (Residential-Single Unit), and designated as School (Senior High) and Single-Family (Residential) in the Pacific Beach Community Plan. According to the Federal Emergency Management Agency (FEMA), the project is located outside of the Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance Flood as well as the 0.2% Annual Chance Flood areas. The channels are within the Peñasquitos Hydrologic Unit. The site is not located within the City's Multiple Species Conservation Program's (MSCP) Multi-Habitat Planning Area (MHPA). The City's MHPA is mapped within the Kendall-Frost Mission Bay Marsh Reserve which is directly downstream and southwest of the project site.

A more detailed discussion of the channels is provided below.

MBHS Channel

The MBHS channel runs in a north-south direction for approximately 1,075 feet from the southwesterly corner of the Mission Bay High School bus loading/unloading zone to Pacific Beach Drive, and discharges into the PBO channel. It is bordered by Mission Bay High School to the east and a military single-family residential housing development and Quincy Street to the west. The MBHS channel is a concrete trapezoidal channel with a 4-foot (ft) bottom width, 10-ft top width, and 2-ft channel depth, with a nearly flat, longitudinal slope (0.25%). The channel receives storm flows from:

- a 27-inch reinforced concrete pipe (RCP) at its upstream end,
- a 36-inch RCP located 250 ft south of its upstream end,
- the adjacent Mission Bay High School baseball field and northerly parking lot areas, and
- the adjacent Mission Bay High School tennis court.

PBO Channel

The PBO channel runs in an east-west direction for approximately 897 ft from the southwesterly corner of Mission Bay High School to Olney Street. The channel is bordered by Pacific Beach Drive and Campland on the Bay to the south and a military single-family residential housing development to the north. The PBO channel is a trapezoidal earthen channel with a bottom width that varies from 3 to 5 ft, a top width that varies from 20 ft to 26 ft, an average channel depth of 5 to 6 ft, and a nearly flat, longitudinal slope (0.25%). The channel receives storm flows from:

- the MBHS channel,
- an 18-inch RCP located 245 ft west of its upstream end,
- Mission Bay High School football/baseball fields, and Lee Street, and
- a portion of the Campland at the Bay parking lot.

The PBO channel discharges into a 42-inch RCP projecting barrel culvert that is located at the intersection of Pacific Beach Drive and Olney Street. The culvert conveys storm flows to the south side of Pacific Beach Drive and discharges into a concrete vault known as the Mission Bay Sewage Interceptor System (MBSIS) box. This box was installed as part of the City's efforts to divert dry weather flows into the sewer system. The MBSIS box discharges into a concrete basin where water then flows out of the basin to a natural channel that conveys storm water to Mission Bay.

Proposed Maintenance

Maintenance will involve removal of sediment and vegetation to restore the original capacity of the two channels to convey storm water. Maintenance will begin by removing standing water in the channel with a vactor at the upstream and downstream ends of the MBHS Channel as well as the upstream end of the PBO Channel. Once the standing water has been removed, the RCP channel discharge locations will be blocked with sandbags to prevent additional channel in-flow. The vactors will continue to capture surface in-flow behind the sandbags during maintenance. In addition, sandbags will be placed across the downstream end of the PBO Channel.

A skid steer or excavator will be used in the channel to remove sediment and vegetation dependent on conditions. This equipment will enter the channel from access points indicated on the Individual Maintenance Plan (IMP). The skid steer/excavator will push sediment and vegetation to central locations where the material will be removed by a gradall stationed outside the channel at areas identified on the IMP. A gradall will scoop up the material/ excavator, and transfer it directly into a dump truck for disposal at an approved landfill.

Upon completion of the maintenance, the sandbags will be removed. The equipment will be transported back to the City yard.

An illustrative IMP and more detailed discussion of the maintenance activities are contained in Appendix A.

Survey Methods and Date:

All noise level or sound level values presented herein are expressed in terms of decibels (dB), with A weighting (abbreviated "dBA") used to approximate the hearing sensitivity of humans. Time averaged noise levels are expressed by the symbol "L_{EQ}" unless a different period is specified (with "L_{EQ}" implied to mean a period of one hour).

Ambient noise measurements were taken in the proposed maintenance area to establish baseline conditions. The following equipment was used to measure existing noise levels:

- Larson Davis System 831 Integrating Sound Level Meter
- Larson Davis Model CA250 Calibrator
- Windscreen and tripod for the sound level meter
- Digital camera

The sound level meter was field-calibrated immediately prior to the noise measurements to ensure accuracy. All sound level measurements conducted and presented in this report were made with a sound level meter that conforms to the American National Standards Institute specifications for sound level meters (ANSI SI.4-1983 R2001). All instruments were maintained with National Bureau of Standards traceable calibration per the manufacturers' standards.

Meteorological conditions during the measurement period were seasonally typical and appropriate for conducting ambient outdoor SPL measurements. Air temperatures at the measurement locations was approximately 77 °F, with 40 percent relative humidity (RH). Winds ranged from zero miles-per-hour to five miles-per-hour from the west.

Ambient noise levels were measured at three locations: near the north end of the MBHS channel (#1); at the south end of Quincy Street off Grand Avenue, near the north end of the PBO channel (#2); and at the western end of the PBO channel (#3). The locations of the measurements are illustrated on Figure 4. The results are included in Table 1.

Table 1. Ambient Noise Levels

Location	Sound Level (dBA $L_{EQ)}$	Primary Noise Source
1	53.5	Traffic on Grand Avenue and minor construction noise from Mission Bay High School.
2	54.4	Traffic on North Mission Bay Drive turning into Campland on the Bay and a Front End Loader at Mission Bay High School for construction.
3	54.7	Traffic on North Mission Bay Drive.

Are there sensitive wildlife species within 750 feet of proposed maintenance?
Yes ☒ No ☐
If not, no further assessment of noise impacts from maintenance is required.
If yes, the rest of this form must be completed.

Sensitive Wildlife Observed/Detected:
Describe sensitive wildlife anticipated to occur within 750 feet of maintenance that were observed and the closest distance to proposed maintenance.

As discussed below, sensitive or protected bird species may occur within 750 feet of the proposed maintenance activities.

Light-footed Clapper Rail

The light-footed clapper rail is known to occur in the Kendall-Frost Mission Bay Marsh Reserve, located southwest of the PBO channel. The nearest suitable nesting locations are located in salt marsh in the northern portion of the Kendall-Frost Mission Bay Reserve,

located approximately 300 feet south of the western end of the PBO maintenance area (see Figure 4).

Nesting Raptors

Potential habitat for nesting raptors exists in adjacent and nearby eucalyptus trees and other large ornamental trees primarily located along the southern edge of the PBO channel. These areas have the potential to support nesting raptors such as Cooper's hawk (see Figure 4).

Migratory Bird Treaty Act Protected Birds

Potential habitat for birds protected by the Migratory Bird Treaty Act (MBTA) also exists in adjacent and nearby eucalyptus trees and other large ornamental trees.

MAINTENANCE IMPACTS

List the equipment to be used during maintenance and anticipated noise levels associated with each. Calculate the combined maximum hourly noise level associated with simultaneous operation of equipment during maintenance. Estimate the distance to the 60 dBA Leq including existing ambient noise sources affecting the maintenance area.

Channel Maintenance Activity

Based on the maintenance methodology included in Appendix A, the noise levels associated with the maintenance equipment are estimated in Table 2. For purposes of this analysis, the expected noise levels produced by maintenance equipment are based on data obtained from previous on-site noise measurements taken at other similar operations and construction noise levels estimated by the Federal Highway Administration (Appendix B). This analytical method provides a known basis for determining noise levels associated with channel maintenance. The noise levels are based on dBA, L_{max} at 50 feet, Acoustical usage factors (% of an hour) are based on Federal Highway Administration (FHWA) Road Construction Noise Model (RCNM) User's Guide Table 1 (FHWA, 2006).

Table 2. Equipment Noise Levels

Equipment	Noise Level at 50 feet (dBA, L_{max})	Percentage Operation During Average Hour (%)
Dump Truck	76	40
Gradall	72.5	40
Mini-Excavator	68	40
Skid Steer	68	50
Vactor Truck	85	40

Calculate the combined maximum hourly noise level associated with simultaneous operation of equipment during maintenance. Estimate the distance to the 60 dBA L_{EQ} including existing ambient noise sources affecting the maintenance area.

Channel Maintenance Activity

In order to conservatively estimate the potential impact of maintenance on the ligh-footed clapper rail, this analysis assumed that a gradall, skidsteer/excavator, and dump truck would be operating simultaneously from a single point at the western end of the PBO channel. Based on the maintenance methodology in Appendix A, the nearest vactor truck operation would be approximately 700 ft east of the other three pieces at the east end of the PBO Channel. The noise model calculated the aggregate noise level (i.e., the logarithmic sum of the equipment noise sources along with the estimated percentage of operation within a one-hour period. The estimate was then adjusted to the actual distance from the 50-feet reference distance to account for geometric divergence of 6 dBA per doubling of distance.

Based on the noise model, the 60 dBA_{LEQ} when the gradall, skid steer/excavator and dump truck operate together would occur 300 feet away from the equipment. When the vactor truck is added to the other three pieces of equipment, the 60 dBA_{LEQ} would extend 430 feet away from the equipment location. Figure 4 identifies the estimated location of the 60 dBA contour based on these two scenarios. The bulges in the contour lines correspond with the anticipated locations of the vactors where all four pieces of equipment could operate simultaneously. As illustrated, maintenance noise is not expected to exceed 60 dBA L_{EQ} within the nearest suitable nesting habitat for the clapper rail. However, the 60 dBA L_{EQ} contour would affect nearby eucalyptus trees along the PBO Channel which could be used for nesting by raptors and/or birds protected by the MBTA.

Would sensitive wildlife receptors be affected by maintenance noise in excess of 60 dBA L_{EQ}?
Yes ☑ No ☐
If yes, identify the wildlife species and discuss their sensitivity to maintenance noise.

While light-footed clapper rail habitat would not be impacted by maintenance noise, equipment noise would impact nesting raptors or other birds protected by the MBTA should maintenance occur between January 15 and August 31 and active nests occur within the 60dBA contour created by maintenance activities.

MITIGATION

What mitigation measures would be required to avoid adverse impacts to sensitive wildlife (e.g. barriers or limitations on hours of operation)?

Nesting Raptors

Impacts to nesting raptors would be avoided by conducting maintenance outside of the raptor breeding season (January 15 through August 31). If maintenance is planned during the raptor nesting season, pre-construction nesting surveys would be conducted within 3 days of initiating maintenance activities (PEIR MM 4.3-13). If active nests are identified, equipment would be set back from the nests in accordance with the setbacks identified in PEIR MM 4.3.16, 21, and 22).

Nesting Birds Protected Under the Migratory Bird Treaty Act

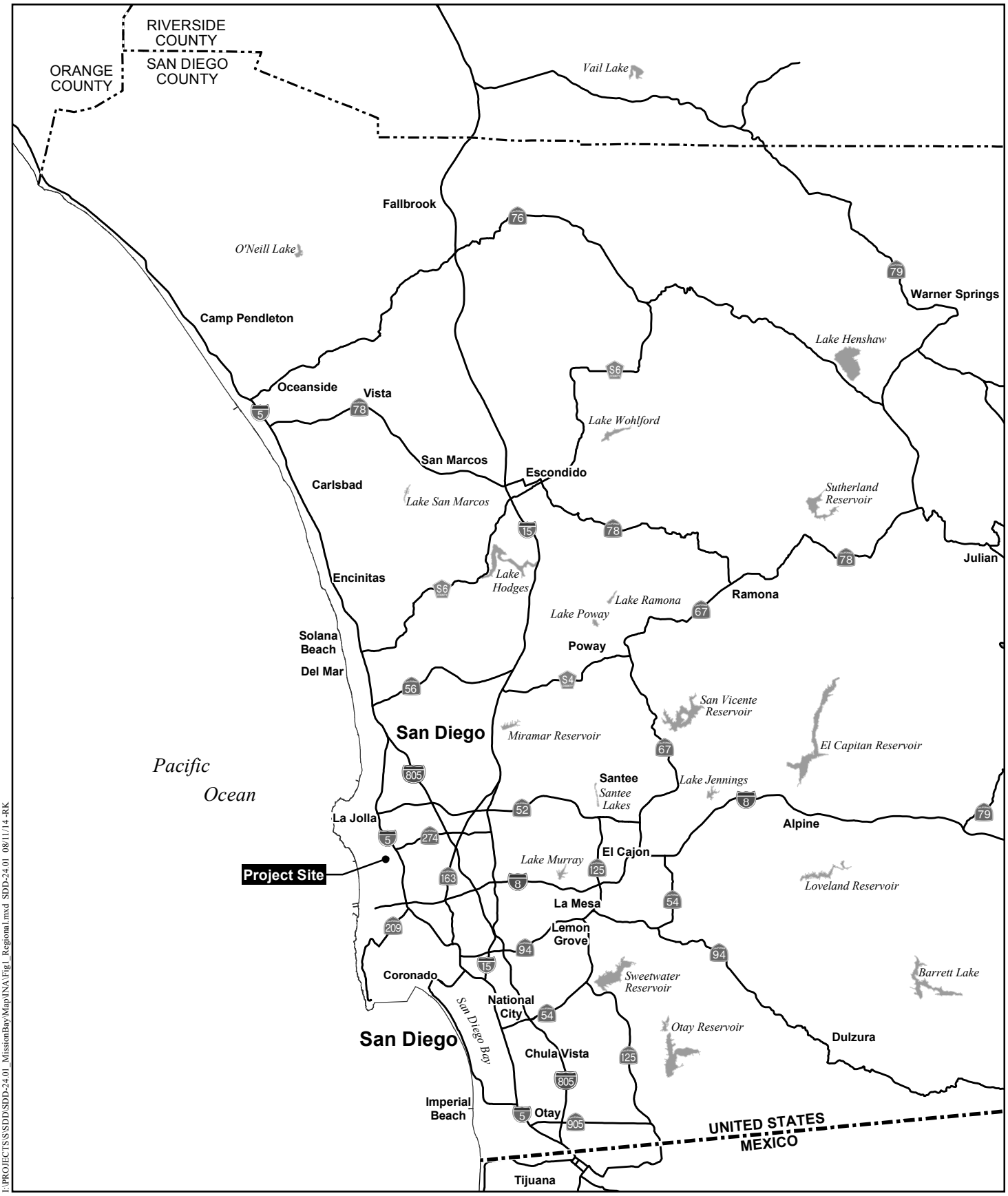
Impacts to nesting birds protected by the MBTA would be avoided by conducting maintenance outside of the avian breeding season (January 15 through August 31) in areas within or adjacent to avian nesting habitat. If maintenance is planned during the raptor nesting season, pre-construction nesting surveys would be conducted within 3 days of initiating maintenance activities (PEIR MM 4.3-13). If active nests are identified, equipment would be set back from the nests in accordance with the setbacks identified in PEIR MM 4.3.16, 21, and 22).

In addition, the following protocols from the MMP would serve to reduce impacts to sensitive birds near the maintenance activities.

BIO-3 Conduct a pre-maintenance meeting on-site prior to the start of any maintenance activity that occurs within or adjacent to sensitive biological resources. The pre-maintenance meeting shall include the qualified biologist, field engineer/planner, equipment operators/superintendent and any other key personnel conducting or involved with the channel maintenance activities. The qualified biologist shall point out or identify sensitive biological resources to be avoided during maintenance, flag/delineate sensitive resources to be avoided, review specific measures to be implemented to minimize direct/indirect impacts, and direct crews or other personnel to protect sensitive biological resources as necessary. The biologist shall also review the proposed erosion control methods to confirm that they would not pose a risk to wildlife (e.g., non-biodegradable blankets which may entangle wildlife).

BIO-5 Conduct appropriate pre-maintenance protocol surveys if maintenance is proposed during the breeding season of a sensitive animal species. If sensitive animal species covered by the PEIR are identified, then applicable measures from the MMRP shall be implemented under the direction of a qualified biologist to avoid significant direct and/or indirect impacts to identified sensitive animal species. If sensitive animal species are identified during pre-maintenance surveys that are not covered by the PEIR, SWD shall contact the appropriate wildlife agencies and additional environmental review under CEQA will be required.

BIO-7 Avoid mechanized maintenance within 300 feet of a Cooper's hawk nest, 900 feet of a northern harrier's nest, or 500 feet of any other raptor's nest until any fledglings have left the nest.
ADDITIONAL COMMENTS OR RECOMMENDATIONS



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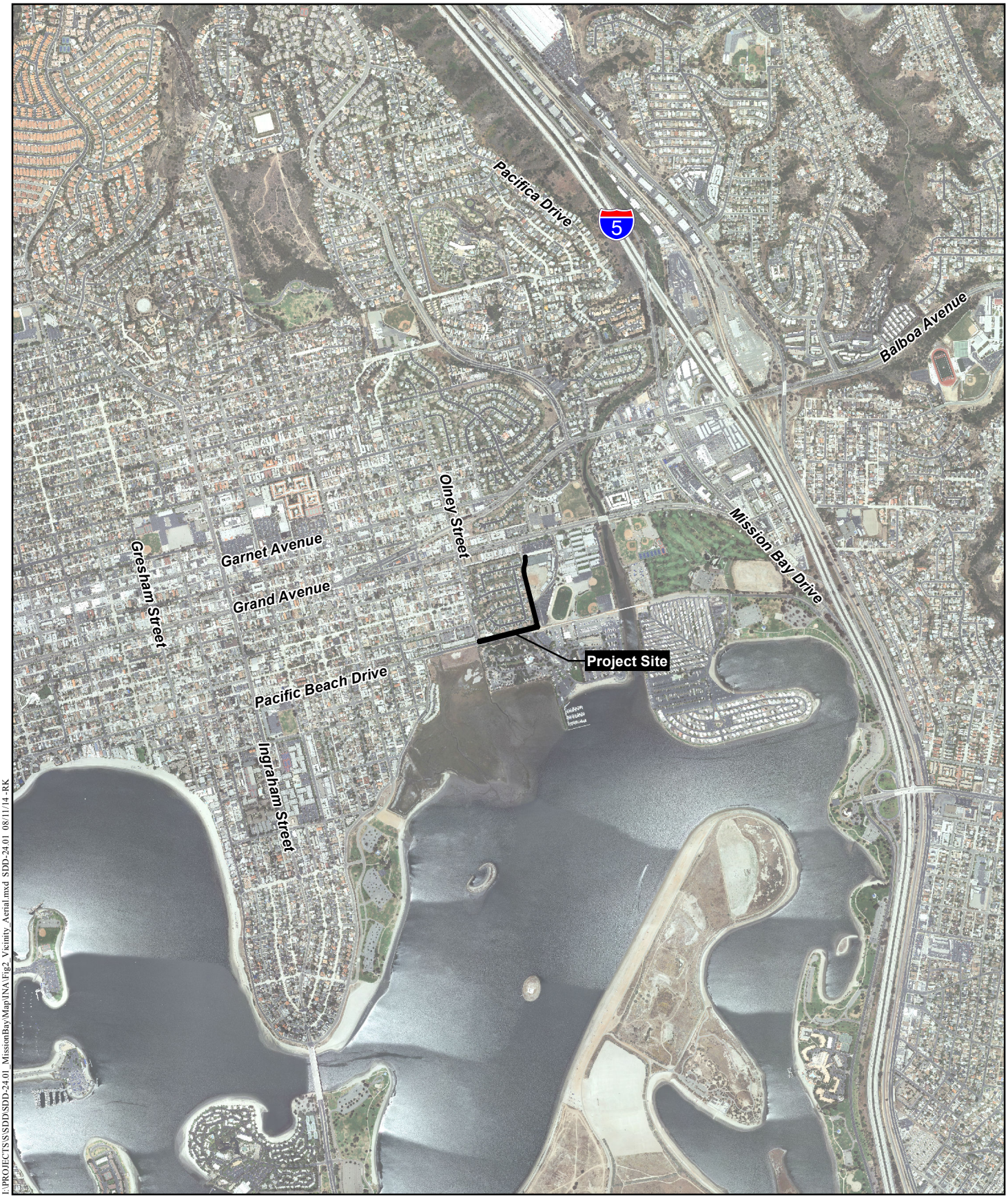
Regional Location Map

STORM WATER FACILITY MAPS 36 & 37 (MISSION BAY HIGH SCHOOL AND PACIFIC BEACH DRIVE/OLNEY STREET CHANNELS)

HELIX Environmental Planning

N 0 8 Miles

Figure 1



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Project Vicinity Map (Aerial Photograph)

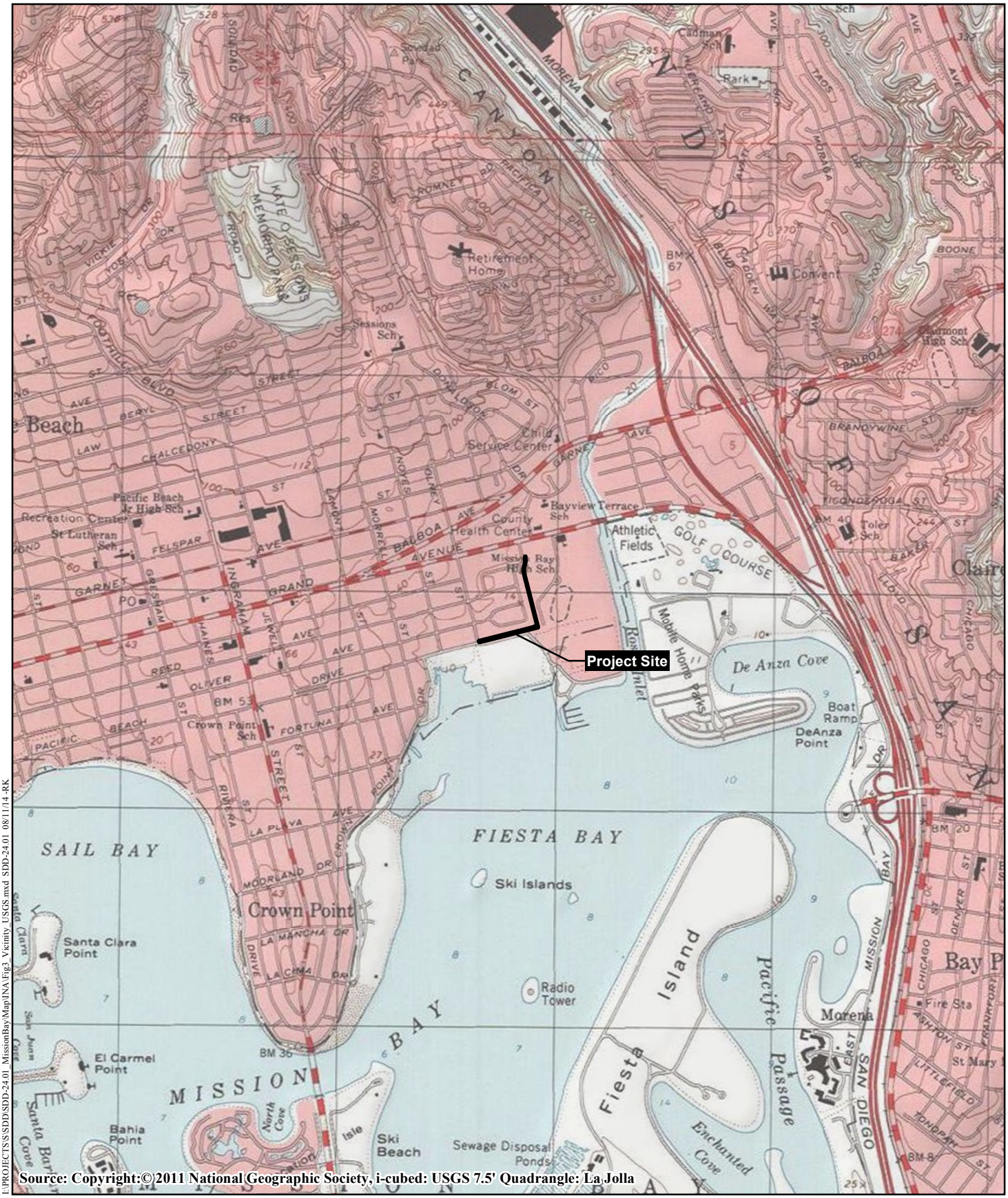
STORM WATER FACILITY MAPS 36 & 37 (MISSION BAY HIGH SCHOOL AND PACIFIC BEACH DRIVE/OLNEY STREET CHANNELS)

HELIX Environmental Planning

N

0 2,000 Feet

Figure 2



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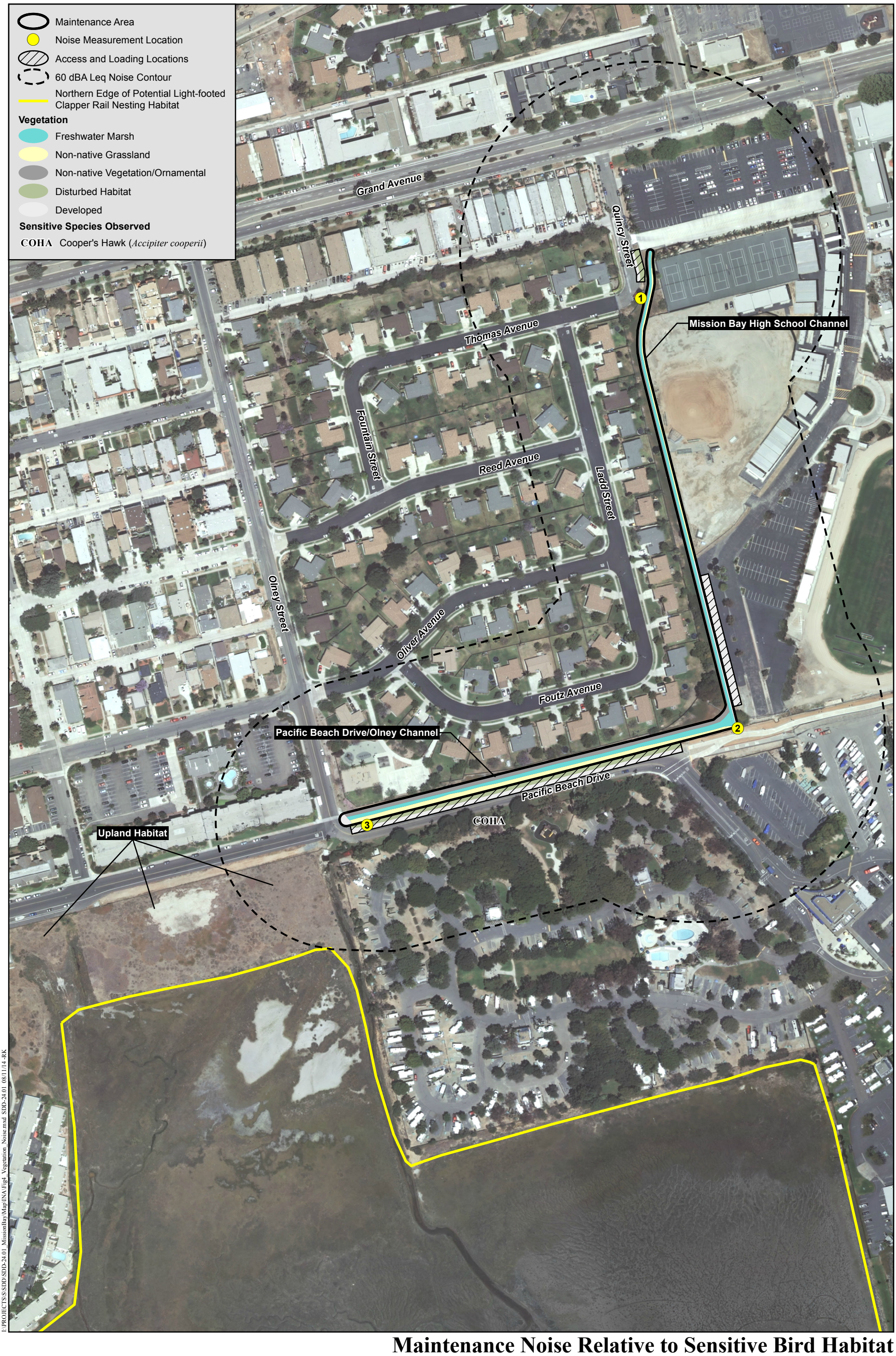
Project Vicinity Map (USGS Topography)

STORM WATER FACILITY MAPS 36 & 37 (MISSION BAY HIGH SCHOOL AND PACIFIC BEACH DRIVE/OLNEY STREET CHANNELS)

HELIX Environmental Planning

N 0 2,000 Feet

Figure 3



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Maintenance Noise Relative to Sensitive Bird Habitat

STORM WATER FACILITY MAPS 36 AND 37 (MISSION BAY HIGH SCHOOL AND PACIFIC BEACH DRIVE/OLNEY STREET CHANNELS)

HELIX Environmental Planning

0 200 Feet

Figure 4

Appendix A

MAINTENANCE METHODOLOGY AND PLAN

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Individual Maintenance Plan

STORM WATER FACILITY MAPS 36 & 37 (MISSION BAY HIGH SCHOOL AND PACIFIC BEACH DRIVE/OLNEY STREET CHANNELS)

N

0 200 Feet

Mission Bay High School and Pacific Beach Drive/Olney Channels –
MMP MAP No. 36 & 37
IMP Maintenance Methodology Table

<table>
<tr><td>FACILITY/CHANNEL</td><td colspan="2">MISSION BAY HIGH SCHOOL (MBHS) AND PACIFIC BEACH/OLNEY (PB/OLNEY) CHANNELS</td></tr>
<tr><td>DIMENSIONS</td><td>MBHS CHANNEL
TRAPAZOIDAL, CONCRETE-LINED
1,075’ LENGTH
APPROX. 10’ TOP WIDTH
4’ BOTTOM WIDTH
2’ IN DEPTH
1/2-1’ OF SEDIMENT
40-70 CUBIC YARDS
MAXIMUM CUBIC YARDS: 150</td><td>PB/OLNEYCHANNEL
EARTHEN
897’ LENGTH
APPROX. 20-26’ TOP WIDTH
3-5’ BOTTOM WIDTH
5-6’ IN DEPTH
1/2-1’ OF SEDIMENT
80-140 CUBIC YARDS
MAXIMUM CUBIC YARDS: 250</td></tr>
<tr><td>MAINTENANCE METHOD</td><td colspan="2">MECHANIZED SEDIMENT & VEGETATION REMOVAL</td></tr>
<tr><td>EQUIPMENT
(EQUIPMENT WILL BE EQUIVALENT OR SMALLER IN SIZE/TYPE)</td><td colspan="2">• GRADALL
• SKID STEER (BOBCAT S650)
• RUBBER TRACKED SKIDSTEER (JOHN DEERE 333E)
• EXCAVATOR (JOHN DEERE 50D)
• DUMP TRUCKS(S) (10/12 YD)
• BACKHOE (JOHN DEERE 410K)
• VACTOR (2100 PLUS PD)</td></tr>
<tr><td>SCHEDULE</td><td colspan="2">IN CHANNEL WORK WILL TAKE 1-2 WEEKS – 7 DAYS A WEEK; 7:00 AM TO 7:00 PM.</td></tr>
<tr><td>STAFFING</td><td colspan="2">MON-FRI – 6 TO 8 PEOPLE
SA-SUN – 6 TO 10 PEOPLE (ADDITIONAL TRUCK DRIVERS MAY BE AVAILABLE)</td></tr>
<tr><td colspan="3">MAINTENANCE PROCEDURE</td></tr>
<tr><td>CHANNEL SEQUENCE</td><td colspan="2">1. MBHS CHANNEL
STATION 9+97 TO 20+72
2. PB/OLNEY CHANNEL
PB 1 (STATION 8+58 TO 9+97)
PB 2 (STATION 1+00 TO 8+58)</td></tr>
<tr><td>ACCESS & LOADING AREA(S)</td><td colspan="2">MBHS CHANNEL
ACCESS & LOADING AREA – MB1: STATION 10+04 TO 13+09, (305’ X 20’) - EXCAVATOR & SKID STEER ENTER/EXIT(S) CHANNEL FROM PARKING LOT
LOADING AREA – MB2: STATION 20+00 TO 20.72 (72’ X 20’) – VACTOR TO REMOVE STANDING, INCOMING, OR CONTAINED WATER FROM CHANNEL
PB/OLNEY CHANNEL
ACCESS & LOADING AREA – PB1: STATION 8+58 TO 8+73, (15’ X 20’) - RUBBER TRACKED SKID - STEER ENTER/EXIT(S) CHANNEL FROM PACIFIC BEACH DRIVE
LOADING AREA – PB2: STATION 1+08 TO 8+58, (750’ X 20’) - GRADALL LOADS TRUCKS</td></tr>
</table>

Mission Bay High School and Pacific Beach Drive/Olney Channels –
MMP MAP No. 36 & 37
IMP Maintenance Methodology Table

STAGING & STOCKPILE AREA	N/A – NO EQUIPMENT WILL BE STAGED ON SITE. ALL MATERIALS WILL BE HAULED IMMEDIATELY TO A LEGAL DISPOSAL SITE (MIRAMAR LANDIFLL).
METHODOLOGY	<u>MBHS CHANNEL</u> 1. VACTOR(S) TO REMOVE STANDING WATER FROM CHANNEL AT STA 20+72 & THEN POSITION VACTORS AT STA 20+72 & STA 10+04 TO CAPTURE ANY INCOMING OR CONTAINED FLOWS. 2. CREWS INSTALL TEMPORARY SANDBAG BERM ACROSS CHANNEL AT DOWNSTREAM END OF MBHS CHANNEL. 3. SKID-STEER(S) AND/OR EXCAVATOR ENTER/EXIT(S) CHANNEL AT ACCESS & LOADING AREA-MB1. 4. EXCAVATOR MAY BE UTILIZED IN THE CHANNEL IF NECESSARY TO MOVE VEGETATION TO GRADALL, DUE TO CHANNEL GEOMETRY 5. SKID-STEER(S) PUSH VEGETATION & SEDIMENT TO GRADALL STATIONED OUTISDE OF CHANNEL WITHIN ACCESS & LOADING AREA-MB1. 6. GRADALL STATIONED AT ACCESS & LOADING AREA-MB1 SCOOPS MATERIAL FROM CENTRAL LOCATION WITHIN CHANNEL & LOADS MATERIAL INTO WAITING DUMP TRUCK LOCATED IN EXISTING PAVED PARKING LOT. 7. DUMP TRUCKS HAUL MATERIAL TO LEGAL DISPOSAL SITE. 8. SKID-STEER & EXCAVATOR EXITS CHANNEL. <u>PB/OLNEY CHANNEL (PB 1)</u> 1. VACTOR(S) TO REMOVE STANDING WATER FROM CHANNEL AND CAPTURE ANY INCOMING OR CONTAINED FLOWS AT STA 8+73. 2. CREWS INSTALL TEMPORARY SANDBAG BERM ACROSS PIPE INLET AT DOWNSTREAM END OF PB/OLNEY CHANNEL. 3. RUBBER TRACKED SKID - STEER ENTER/EXIT(S) CHANNEL AT ACCESS POINT WITHIN ACCESS & LOADING AREA-PB1. 4. RUBBER TRACKED SKID - STEER PUSHS MATERIAL TO GRADALL STATIONED ALONG ACCESS & LOADING AREA-PB1 UNTIL IT REACHES EASTERN LIMIT OF WORK (STATION 9+97). 5. GRADALL LOADS MATERIALS FROM PB/ONLEY CHANNEL DIRECTLY INTO DUMP TRUCKS. 6. DUMP TRUCK HAULS MATERIAL TO LEGAL DISPOSAL SITE. <u>PB/OLNEY CHANNEL (PB 2)</u> 1. GRADALL POSITIONS ITSELF ALONG LOADING AREA-PB2 ABOVE CHANNEL BANK & SCOOPS VEGETATION & SEDIMENT FROM CHANNEL INTO DUMP TRUCKS.

Mission Bay High School and Pacific Beach Drive/Olney Channels –
MMP MAP No. 36 & 37
IMP Maintenance Methodology Table

	2. DUMP TRUCK HAULS MATERIAL TO LEGAL DISPOSAL SITE. 3. REMOVE SANDBAG BERM FROM DOWNSTREAM END OF CHANNEL.
POST-MAINTENANCE	1. DEMOBILIZE EQUIPMENT. 2. REMOVE TEMPORARY CONSTRUCTION BMPS.
OTHER NOTES	1. SWEEPERS WILL SWEEP ADJACENT PUBLIC RIGHTS-OF-WAY AND IMMEDIATE TRUCK LOADING SITES NIGHTLY. 2. REMOVE STANDING WATER (IF ANY) WITHIN DRAINAGE FACILITY WITH VACTOR. 3. EQUIPMENT FUELED OUTSIDE CHANNEL & LOCATED AT LEAST 150' FROM WATERS OF US/STATE. 4. BICYCLE/PEDESTRIAN PATH TO BE CLOSED DURING MAINTENANCE ACTIVITIES.

Appendix B

FHWA CONSTRUCTION EQUIPMENT NOISE LEVELS

9.0 CONSTRUCTION EQUIPMENT NOISE LEVELS AND RANGES

9.1 Equipment Type Inventory and Related Emission Levels

Noise levels generated by individual pieces of construction equipment and specific construction operations form the basis for the prediction of construction-related noise levels. A variety of information exists related to sound emissions related to such equipment and operations. This data transcends the period beginning in the 1970s thru 2006. This information exists for both stationary and mobile sources and for steady, intermittent, and impulse type generators of noise.

9.1.1 Stationary Equipment

Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, blasting operations, etc., produce variable and sporadic noise levels and often produce impact-type noises. Impact equipment is equipment that generates impulsive noise, where impulsive noise is defined as noise of short duration (generally less than one second), high intensity, abrupt onset, rapid decay, and often rapidly changing spectral composition. For impact equipment, the noise is produced by the impact of a mass on a surface, typically repeating over time.

9.1.2 Mobile Equipment

Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

9.2 Sources of Information

Construction-related equipment and operation noise level data may be provided by numerous sources, including suppliers, manufacturers, agencies, organizations, etc. Some information is included in this document, and many web-based links are given for equipment manufacturers.

9.3 Specifics of Construction Equipment and Operation Noise Inventories

Details included in each specific inventory of construction equipment and operation noise emission levels are often variable in terms of how data is represented. Some inventories include ranges of noise levels while others present single numbers for each equipment type. Others provide levels for specific models of each type of construction equipment. Often, different noise descriptors are used, such as L_{Aeq}, L_{max}, L_{10}, sound power level, etc. As such, the array of data does not readily lend itself to being combined into a single table or easily compared. As such, this Handbook attempts to summarize a variety of such inventories and provide links to each, thereby providing the reader with a variety of sources from which to choose the appropriate levels for use in his or her respective analysis.

9.4 Summaries of Referenced Inventories

Included below are examples of several inventories of construction-related noise emission values. These and additional inventories are included on the companion CD-ROM.

9.4.1 RCNM Inventory

Equipment and operation noise levels in this inventory are expressed in terms of L_{max} noise levels and are accompanied by a usage factor value. They have been recently updated and are based on extensive measurements taken in conjunction with the Central Artery/Tunnel (CA/T) Project. Table 9.1 summarizes the equipment noise emissions database used by the CA/T Project. While these values represent the "default" values for use in the RCNM, user-defined equipment and corresponding noise levels can be added.

Table 9.1 RCNM Default Noise Emission Reference Levels and Usage Factors.

Equipment Description	Impact Device?	Acoustical Usage Factor (%)	Spec. 721.560 L_{max} @ 50 feet (dBA, slow)	Actual Measured L_{max} @ 50 feet (dBA, slow) (Samples Averaged)	Number of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	N/A	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	N/A	0
Blasting	Yes	N/A	94	N/A	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	N/A	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS Signs)	No	50	70	73	74
Gradall	No	40	85	83	70

Grader	No	40	85	N/A	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydraulic Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	N/A	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarifier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/Chipping Gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (single nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Sheers (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	N/A	0
Tractor	No	40	84	N/A	0
Vacuum Excavator (Vac-Truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44

Warning Horn	No	5	85	83	12
Welder/Torch	No	40	73	74	5

For each generic type of equipment listed in Table 9.1, the following information is provided:

- an indication as to whether or not the equipment is an impact device;
- the acoustical usage factor to assume for modeling purposes;
- the specification "Spec" limit for each piece of equipment expressed as an L_{max} level in dBA "slow" at a reference distance of 50 foot from the loudest side of the equipment;
- the measured "Actual" emission level at 50 feet for each piece of equipment based on hundreds of emission measurements performed on CA/T work sites; and
- the number of samples that were averaged together to compute the "Actual" emission level.

A comparison of the "Spec" emission limits against the "Actual" emission levels reveals that the Spec limits were set, in general, to realistically obtainable noise levels based on the equipment used by contractors on the CA/T Project. When measured in the field, some equipment such as pile drivers, sand blasting, demolition shears, and pumps tended to exceed their applicable emission limit. As such, these noisy devices needed to have some form of noise mitigation in place in order to comply with the Spec emission limits. Other equipment, such as clamshell shovels, concrete mixer trucks, truck-mounted drill rigs, man-lifts, chipping guns, ventilation fans, pavers, dump trucks, and flatbed trucks, easily complied. Therefore, the Spec emission limits for these devices could have been reduced somewhat further. It is recommended that the user review the RCNM User's Guide contained in Appendix A for detailed guidance regarding application of values contained in Table 9.1.

9.4.2 FHWA Special Report Inventories

Appendix A of the 1977 Handbook provides tables of construction equipment noise levels and ranges. The majority of the data were provided by the American Road Builders Association. These data were taken during a 1973 survey in which member contractors were asked to secure readings of noise exposure to operators of various types of equipment. Additionally, the contractors were asked to take readings at 50 feet from the machinery. These 50-foot peak readings are provided in Tables 9.2 through 9.8. Though the data were produced under varying conditions and degrees of expertise, the values are relatively consistent.

Table 9.2 Construction Equipment Noise Levels Based on Limited Data Samples - Cranes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Northwestern	80D	77	Within 15m 1958 mod
Northwestern	8	84	Within 15m 1940 mod
Northwestern	6	72	Within 15m 1965 mod
American	7260	82	Within 15m 1967 mod
American	599	76	Within 15m 1969 mod
American	5299	70	Within 15m 1972 mod
American	4210	82	Within 15m 1968 mod
Buck Eye	45C	79	Within 15m 1972 mod
Buck Eye	308	74	Within 15m 1968 mod
Buck Eye	30B	73	Within 15m 1965 mod
Buck Eye	30B	70	Within 15m 1959 mod
Link Belt	LS98	76	Within 15m 1956 mod
Manitowoc	4000	94	Within 15m 1956 mod

Grove	RF59	82	Within 15m 1973 mod
Koehr	605	76	Within 15m 1967 mod
Koehr	435	86	Within 15m 1969 mod
Koehr	405	84	Within 15m 1969 mod

Table 9.3 Construction Equipment Noise Levels Based on Limited Data Samples - Backhoes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Link Belt	4000	92	Within 15m 1971 mod
John Deere	609A	85	Within 15m 1971 mod
Case	680C	74	Within 15m 1973 mod
Drott	40 yr.	82	Within 15m 1971 mod
Koehr	1066	81 & 84	Within 15m 2 tested

Table 9.4 Construction Equipment Noise Levels Based on Limited Data Samples - Front Loaders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	980	84	Within 15m 1972 mod
Caterpillar	977K	79	Within 15m 1969 mod
Caterpillar	977	87	Within 15m 1971 mod
Caterpillar	977	94	Within 15m 1967 mod
Caterpillar	966C	84	Within 15m 1973 mod
Caterpillar	966C	85	Within 15m 1972 mod
Caterpillar	966	81	Within 15m 1972 mod
Caterpillar	966	77	Within 15m 1972 mod
Caterpillar	966	85	Within 15m 1966 mod
Caterpillar	955L	90	Within 15m ;1973 mod
Caterpillar	955K	79	Within 15m 1969 mod
Caterpillar	955H	94	Within 15m 1963 mod
Caterpillar	950	78 & 80	Within 15m 1972 mod
Caterpillar	950	75	Within 15m 1968 mod
Caterpillar	950	88	Within 15m 1967 mod
Caterpillar	950	86	Within 15m 1965 mod
Caterpillar	944A	80	Within 15m 1965 mod
Caterpillar	850	82	Within 15m 1968 mod
Michigan	75B	90	Within 15m 1969 mod
Michigan	475A	96	Within 15m 1967 mod
Michigan	275	85	Within 15m 1971 mod

Michigan	125	87	Within 15m 1967 mod
Hough	65	82	Within 15m 1971 mod
Hough	60	91	Within 15m 1961 mod
Hough	400B	94	Within 15m 1961 mod
Hough	H90	86	Within 15m 1961 mod
Trojan	3000	85	Within 15m 1956 mod
Trojan	RT	82	Within 15m 1965 mod
Payloader	H50	85	Within 15m 1963 mod

Table 9.5 Construction Equipment Noise Levels Based on Limited Data Samples - Dozers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	D5	83	Within 15m 1967 mod
Caterpillar	D6	85	Within 15m 1967 mod
Caterpillar	D6	86	Within 15m 1964 mod
Caterpillar	D6	81	Within 15m 1967 mod
Caterpillar	D6B	83	Within 15m 1967 mod
Caterpillar	D6C	82	Within 15m 1962 mod
Caterpillar	D7	85	Within 15m 1956 mod
Caterpillar	D7	86	Within 15m 1969 mod
Caterpillar	D7	84	Within 15m 1969 mod
Caterpillar	D7	78	Within 15m 1970 mod
Caterpillar	D7	78	Within 15m 1972 mod
Caterpillar	D7E	86	Within 15m 1965 mod
Caterpillar	D7E	78	Within 15m 1970 mod
Caterpillar	D7E	84	Within 15m 1973 mod
Caterpillar	D7F	80	Within 15m 1972 mod
Caterpillar	D8	92	Within 15m 1954 mod
Caterpillar	D8	95	Within 15m 1968 mod
Caterpillar	D8	86	Within 15m 1972 mod
Caterpillar	D8H	88	Within 15m 1966 mod
Caterpillar	D8H	82	Within 15m 1972 mod
Caterpillar	D9	85	Within 15m 1972 mod
Caterpillar	D9	94	Within 15m 1972 mod
Caterpillar	D9	90	Within 15m 1963 mod
Caterpillar	D9	87	Within 15m 1965 mod
Caterpillar	D9	90	Within 15m 1965 mod

Caterpillar	D9	88	Within 15m 1968 mod
Caterpillar	D9	92	Within 15m 1972 mod
Caterpillar	D9G	85	Within 15m 1965 mod
Allis Chambers	HD41	93	Within 15m 1970 mod
International	TD15	79	Within 15m 1970 mod
International	TD20	87	Within 15m 1970 mod
International	TD25	90	Within 15m 1972 mod
International	TD8	83	Within 15m 1970 mod
Case	1150	82	Within 15m 1972 mod
John Deer	350B	77	Within 15m 1971 mod
John Deer	450B	65	Within 15m 1972 mod
Terex	8230	70	Within 15m 1972 mod
Terex	8240	93	Within 15m 1969 mod
Michigan	280	85	Within 15m 1961 mod
Michigan	280	90	Within 15m 1962 mod
Caterpillar	824	90	Within 15m 1968 mod

Table 9.6 Construction Equipment Noise Levels Based on Limited Data Samples - Graders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	16	91	Within 15m 1969 mod
Caterpillar	16	86	Within 15m 1968 mod
Caterpillar	140	83	Within 15m 1970 mod
Caterpillar	14E	84	Within 15m 1972 mod
Caterpillar	14E	85	Within 15m 1971 mod
Caterpillar	14C	85	Within 15m 1971 mod
Caterpillar	14B	84	Within 15m 1967 mod
Caterpillar	12F	82	Within 15m 1961-72 mod
Caterpillar	12F	72-92	Within 15m 1961-72 mod
Caterpillar	12E	81.3	Within 15m 1959-67 mod
Caterpillar	12E	80-83	Within 15m 1959-67 mod
Caterpillar	12	84.7	Within 15m 1960-67 mod
Caterpillar	12	82-88	Within 15m 1960-67 mod
Gallon	T500	84	Within 15m 1964 mod
Allis Chambers		87	Within 15m 1964 mod

Table 9.7 Construction Equipment Noise Levels Based on Limited Data Samples - Scrapers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	660	92	Within 15m
Caterpillar	641B	85	Within 15m 1972 mod
Caterpillar	641B	86	Within 15m 1972 mod
Caterpillar	641	80 & 84	Within 15m 1972 mod
Caterpillar	641	83 & 89	Within 15m 1965 mod
Caterpillar	637	87	Within 15m 1971 mod
Caterpillar	633	87	Within 15m 1972 mod
Caterpillar	631C	89	Within 15m 1973 mod
Caterpillar	631C	83	Within 15m 1972 mod
Caterpillar	631B	94	Within 15m 1969 mod
Caterpillar	631B	84-87	Within 15m 1968 mod
Caterpillar		85 avg.	Within 15m 1968 mod
Caterpillar	621	90	Within 15m 1970 mod
Caterpillar	621	86	Within 15m 1967 mod
Caterpillar	613	76	Within 15m 1972 mod
Terex	TS24	87	Within 15m 1972 mod
Terex	TS24	84-91	
Terex	TS24	82	Within 15m 1971 mod
Terex	TS24	81-83	Within 15m 1971 mod
Terex	TS24	94	Within 15m 1966 mod
Terex	TS24	92-98	Within 15m 1966 mod
Terex	TS24	94.7	Within 15m 1963 mod
Terex	TS24	94-95	Within 15m 1963 mod
Terex	TS14	82	Within 15m 1969 mod
Terex	S35E	84	Within 15m 1971 mod

Table 9.8 Noise Levels of Standard Compressors.

Manufacturer	Model	Silenced or Standard	Type Eng.	Type Comp.	Test Avg. Cond. (cfm.psi)	Avg. Cond. Noise Lev. (cfm.psi) (dBA) at 7m*
Atlas	ST-48	Standard	Diesel	Reciprocal	160,100	83.6
Atlas	ST-95	Standard	Diesel	Reciprocal	330,105	80.2
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,850	70.2
Atlas	VT-85M	Standard	Gas	Reciprocal	85,100	81.4
Atlas	VS-85Dd	Silenced	Gas	Reciprocal	85,100	75.5
Atlas	VSS-125Dd	Silenced	Diesel	Reciprocal	125,100	70.1

Atlas	STS-35Dd	Silenced	Diesel	Reciprocal	125,100	73.5
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,100	
Gardner-Denver	SPWDA/2	Silenced	Diesel	Rotary-Screw	1200,000	73.3
Gardner-Denver	SPQDA/2	Silenced	Diesel	Rotary-Screw	750,000	78.2
Gardner-Denver	SPHGC	Silenced	Gas	Rotary-Screw	185,000	77.1
Ingersoll-Rand	DXL 1200	Standard	Diesel	Rotary-Screw	1200,125	92.6
Ingersoll-Rand	DXL 1200 (doors open)	Standard	Diesel	Rotary-Screw	1200,125	
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	76.0
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.1
Ingersoll-Rand	DXLCU1050	Standard	Diesel	Rotary-Screw	1050,125	90.2
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.3
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.0
Ingersoll-Rand	DXL 900	Standard	Diesel	Rotary-Screw	900,125	89.9
Ingersoll-Rand	DXL 750	Standard	Diesel	Rotary-Screw	750,125	87.7
Jaeger	A	Standard	Gas	Rotary-Screw	175,100	88.2
Jaeger	A(doors open)	Standard	Gas	Rotary-Screw	175,100	
Jaeger	E	Standard	Gas	Vane	85,100	81.5
Jaeger	E(doors open)	Standard	Gas	Vane	85,100	
Worthington	60 G/2Qt	Silenced	Gas	Vane	160,100	74.2
Worthington	750-QTEX	Silenced	Diesel	Rotary-Screw	750,100	74.7

*Data taken from EPA Report - EPA 550/9-76-004.

9.4.3 FTA Noise and Vibration Assessment Procedure

Chapter 12 of the FTA Transit Noise and Vibration Guidance Handbook discusses construction noise evaluation methodology and contains the noise emission levels for construction equipment displayed in Table 9.9.

Table 9.9 FTA Construction Equipment Noise Emission Levels.

Equipment	Typical Noise Level (dBA) 50 ft from Source*
Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane Derrick	88
Crane Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	88

*Table based on EPA Report, measured data from railroad construction equipment taken during Northeast Corridor improvement project and other measured data.

9.5 Links to Equipment Manufacturers

Table 9.10 contains web-based links to manufacturers of construction equipment. While few of these links contain noise-related data associated with the equipment, they provide descriptions and/or specifications related to the equipment, as well as sources for possibly obtaining additional information related to the equipment. Information in this table is by no means all-inclusive and does not represent any type of endorsement of the manufacturers, suppliers, or equipment. Users are hereby advised that the referenced websites may have certain restrictions, copyrights, etc., associated with any use of data contained therein.

Table 9.10 Equipment Manufacturers and Websites.

Equipment	Manufacturer	Website Address
Arrow Boards		
	North Star	http://northstar-traffic.com/index.cfm?SC=14&PT=1
	Trafcom	http://www.trafcon.com
	Allmand	http://www.allmand.com/MB%20AB%20page.htm
Articulated Trucks		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=196
	Hitachi	http://www.hitachi-c-m.com/global/products/articulate/index.html
	Terex	http://www.terex.com/main.php
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/articulatedhaulers/
Asphalt Saws		
	Allied	http://www.alliedcp.com/products/rotocut.asp
Augers - See Drills / Augers		
Backhoes - See Loaders/Backhoes		
Boring Equipment - See Pile Drivers/Boring Equipment		
Compaction Equipment		
	Allied	http://www.alliedcp.com/products/compactor.asp
Compressors		
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Compair	http://www.compair.com/Products/Portable_Compressors.aspx
Concrete and Asphalt Batch/Mixing Plants and Equipment		
	Con-E-Co	http://www.con-e-co.com/products.cfm
	Terex	http://www.terex.com/main.php
	Gunter & Zimmerman	http://www.guntert.com/concrete_mobilebatching.asp
	Rex Con	http://www.rexcon.com
Concrete Breakers/ Hydraulic Hammers/Hydraulic Breakers		
	Drillman	http://www.drillmanindia.com/concrete-breaker.html
	Hydro Khan	http:/www.sangi.co.kr/english/e_product1_2.php
	Stanley	http://www.stanley-hydraulic-tools.com/Hand%20Held/NoAmbreakers.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/breakers.htm
Concrete Chain Saws		
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/concrete-saws.htm
Concrete Core Drilling Machines		
	Multiquip	http://www.multiquip.com/multiquip/318_ENU_HTML.htm
Concrete Cutters		

	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/Line.jsp?PrdlnID=3618
Concrete/Material Pumps		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Reed	http://www.reedpumps.com/
Concrete Mixer Trucks		
	Oshkosh	http://www.oshkoshtruck.com/concrete/products~overview~home.cfm
	London	http://www.lmi.ca/mixers.cfm
	Terex/Advance	http://www.advancemixer.com
Concrete Saws		
	Multiquip	http://www.multiquip.com/multiquip/315_ENU_HTML.htm
	Diamond Core Cut	http://www.diamondproducts.com/dp_home.htm
Concrete Screeds		
	Multiquip	http://www.multiquip.com/multiquip/317_ENU_HTML.htm
Concrete Vibrators		
	Multiquip	http://www.multiquip.com/multiquip/313_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5722,00.html
Cranes		
	Malcolm Drilling	www.malcolmdrilling.com
	Link-Belt	http://www.linkbelt.com/lit/products/frameproducthome.htm
	Casagrande	http://www.casagrandegroup.com
	Liebherr	http://www.liebherr.com/em/en/35381.asp
	Terex	http://www.terex.com/main.php
Crawler Tractors - See Dozers/Crawler Tractors		
Crushing and Screening Equipment		
	Cedarapids	http://www.cedarapids.com/crushscr.htm
	Hitachi	http://www.hitachi-c-m.com/
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
Crushers/Pulverizers		
	Hydro Khan	http://www.sangi.co.kr/english/e_product3.php
Cutoff Saws		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/cutoff%20saw.htm
Dozers/CrawlerTractors		
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/crawlers/deere_dozer_sele
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=2
	Komatsu	http://www.komatsu.com/ce/products/crawler_dozers.html
Dewatering Pumps		
	Multiquip	http://www.multiquip.com/multiquip/371_ENU_HTML.htm
Drills / Augers		
	Malcolm Drilling	www.malcolmdrilling.com
	Casagrande	www.casagrandegroup.com
	Soilmec	http://www.soilmec.com/_vti_g1_techno.aspx?rpstry=4_

	Terex	http://www.terex.com/main.php
Excavators		
	Hitachi	http://www.hitachi-c-m.com/global/products/excavator/index.html
	Caterpiller	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/compactexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/wheeledexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/crawlerexcavators/
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/excavators/deere_excavat
	Liebherr	http://www.liebherr.com/em/en/18891.asp
	Soilmec	http://www.soilmec.com/_vti_g1_t02.aspx?rpstry=29_
	Gehl	http://www.gehl.com
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=216
	Komatsu	http://www.komatsu.com/ce/products/crawler_excavators.html
		http://www.komatsu.com/ce/products/wheel_excavators.html
	Terex	http://www.terex.com/main.php
	Link-Belt	http://www.lbxco.com/lx_series.asp
	Gradall	http://www.gradall.com/
	Badger Daylighting	http://www.badgerinc.com/
Fork Lifts - See Lifts / Variable Reach Fork Lifts/ Material Handlers		
Generators		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/212_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Baldor	http://www.baldor.com/products/generators/ts.asp
Graders		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=190
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/MotorGraders/
	Komatsu	http://www.komatsu.com/ce/products/motor_graders.html
	Terex	http://www.terex.com/main.php
Hand Compaction Equipment		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Hydraulic Hammers/Hydraulic Breakers - See Concrete Breakers/ HydraulicHammers/Hydraulic Breakers		
Jackhammers - See Rock Drilling Equipment/Jackhammers		
Lifts / Variable Reach Fork Lifts/ Material Handlers		
	Genie Lift	www.genielift.com
	Sky Track	www.kirby-smith.com/
	Ingersol-Rand	www.ingersollrand.com
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/www/docs/102/mtv-material-transfer-vehicle/
LightTowers		
	Baldor	http://www.baldor.com/products/generators/mlt.asp
	Multiquip	http://www.multiquip.com/multiquip/293_ENU_HTML.htm
	Allmand	http://www.allmand.com/Night%20Lite%20Pro%20page.htm
Loaders/Backhoes		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=54

	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/backhoeloaders/
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/backhoes/deere_backhoe_
	Komatsu	http://www.komatsu.com/ce/products/backhoe_loaders.html
Material Handlers - See Lifts / Variable Reach Fork Lifts/ Material Handlers		
Milling Machines		
	Wirtgen	https://www.wirtgenamerica.com/noflash.html
Mining Trucks - See Rigid Dump Trucks/Mining Trucks		
Pans - See Scrapers/Pans		
Pavers/Paving Equipment		
	Caterpillar/ Barber Greene	http://www.cat.com/cda/layout?m=37840&x=7
	Rosco	http://www.leeboy.com/rosco/
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Gehl	http://www.gehl.com/const/prodpg_ap.html
	Leeboy	http://www.leeboy.com/leeboy/
	Terex	http://www.terex.com/main.php
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=12
	Vogele	http://www.vogeleamerica.com/noflash.html
	GOMACO	http://www.gomaco.com/index.html
	Roadtec	http://www.roadtec.com
Pile Drivers/Boring Equipment		
	Soilmec	http://www.soilmec.com/_vti_g1_t09.aspx?rpstry=29_
	Leffer	http://www.leffer.com/hme.html
	Bauer	http://www.bauer.de/en/maschinenbau/produkte/drehbohrgeraete/bg_reihe/usbg15h.ht
Pipelayers/Trenchers		
	Liebherr	http://www.liebherr.com/em/en/18908.asp
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=28&archived=1
	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/trenching-equipment.htm
	Ditchwitch	http://www.ditchwitch.com/dwcom/Product/ProductView/115
	Eagle	http://www.guntert.com/trenchers_home.asp
Profilers - See Roadway Planers/Profilers		
Rammers		
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Rebar Benders/Cutters		
	Multiquip	http://www.multiquip.com/multiquip/1316_ENU_HTML.htm
Recyclers - See Stabilizers/Recyclers		
Rigid Dump Trucks/Mining Trucks		
	Hitachi	http://www.hitachi-c-m.com/global/products/rigid/index.html
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Liebherr	http://www.liebherr.com/em/en/18898.asp
	Komatsu	http://www.komatsu.com/ce/products/dump_trucks.html
	Terex	http://www.terex.com/main.php
Roadway Planers/Profilers		
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/products/cold_planers/default.htm

Rock Drilling Equipment/Jackhammers		
	Drillman	http://www.drillmanindia.com/rock-drilling-machine.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5721,00.html
	Allied	http://www.alliedcp.com/products/hammers.asp
Rollers - See Tampers/Rollers		
Scrapers/Pans		
	Terex	http://www.terex.com/main.php
Screening Equipment - See Crushing and Screening Equipment		
Slabbuster		
	Allied	http://www.alliedcp.com/products/slabbuster.asp
Slip Form Pavers		
	Huron	http://www.huronmanufacturing.com/
	Guntert & Zimmerman	http://www.guntert.com/concreteSlipformPavers.asp
Stabilizers/Recyclers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
	Wirtgen	https://www.wirtgenamerica.com/noflash.html
	Roadtec	http://www.roadtec.com
Sweepers		
	Elgin	http://www.elginsweeper.com
	Johnston	http://www.johnstonsweepers.com/
Tampers/ Rollers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/vibratory_rollers.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/tamper.htm
	Multiquip	http://www.multiquip.com/multiquip/181_ENU_HTML.htm
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=15
Trenchers - See Pipelayers/Trenchers		
Trucks - See Articulated Trucks, Concrete Mixer Trucks, Rigid Dump Trucks/Mining Trucks		
Vacuum Units		
	Advanced Recycling Systems	www.arsrecycling.com/
	Vacmasters	http://www.vacmasters.com/airsystm.htm
	Vector	http://www.vector-vacuums.com/
Variable Message Signs		
	Allmand	http://www.allmand.com/MB%20only%20page.htm
	North Star	http://northstar-traffic.com/index.cfm?SC=13&PT=1
	Trafcom	http://www.trafcon.com
	Daktronics	http://www.daktronics.com/vms_prod/dak_vms_products.cfm
Vibratory Rammers		
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
Welders/Welding Equipment		

	Airgas	www.airgas.com
	Multiquip	http://www.multiquip.com/multiquip/408_ENU_HTML.htm
	Miller	http://www.millerwelds.com/products/
	Lincoln	http://www.mylincolnelectric.com/Catalog/equipmentseries.asp?browse=101|400|
Wheel Loaders		
	Hitachi	http://www.hitachi-c-m.com/global/products/loader/index.html
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=30
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/wheelloaders/
	Terex	http://www.terex.com/main.php
	Komatsu	http://www.komatsu.com/ce/products/wheel_loaders.html
	TCM	http://www.tcmglobal.net/products/main02.html

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