Dos Osos Reservoir Replacement Project

Orinda - California

Noise and Vibration Analysis

East Bay Municipal Utility District
January 2017

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1 Project Description

1.1 Overview

The Dos Osos Pressure Zone provides water service to customers located between elevations of 1,050 feet and 1,250 feet in the Orinda hills above the Caldecott Tunnel in the City of Orinda, California (Figure N-1). The Dos Osos Pumping Plant and Dos Osos Reservoir supply water to the Dos Osos Pressure Zone, which extends along El Toyonal, Camino Del Monte, and Las Piedras from Loma Vista Drive in the south to Chaparral Place in the north.

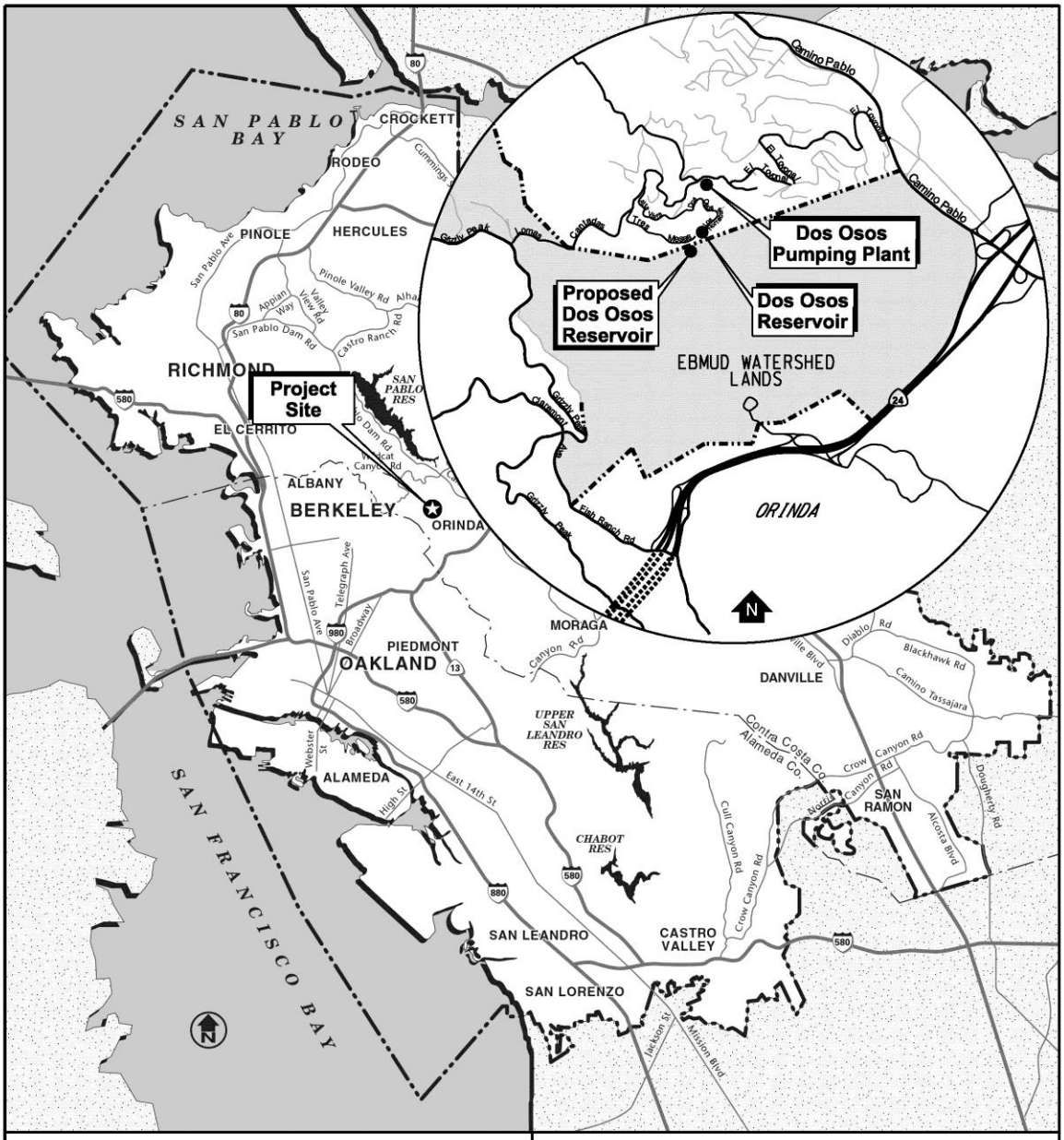
The Dos Osos Pressure Zone is part of the Encinal Cascade which lies within the City of Orinda and consists of single-family residential homes on a hilly terrain with moderate to heavy vegetation. Water is supplied to the Encinal Cascade from the Bryant Pressure Zone where water is pumped to the Encinal Reservoir from the Encinal Pumping Plant and then pumped from the Westside Pumping Plant to the Westside Reservoir and then pumped to the Dos Osos Reservoir from the Dos Osos Pumping Plant. The Dos Osos Pressure Zone is at the top of the Encinal Cascade and encompasses the highest elevations of the cascade.

Located at 8 Los Norrabos in Orinda, the existing steel-welded Dos Osos Reservoir was built in 1955 and has an operating capacity of 0.24 MG. A comprehensive fire flow study for the City of Orinda (EBMUD, 1999) determined that the Dos Osos Reservoir is located too low in elevation resulting in low-pressure areas along Alta Vista and Lomas Cantadas and should be replaced at a higher elevation. In addition, the reservoir interior and exterior require recoating, and the existing wood roof is deteriorating and requires full replacement.

The existing 0.24-MG Dos Osos Reservoir will be replaced with dual 0.12-MG steel-bolted reservoirs to be located on EBMUD-owned watershed property approximately 70 feet higher in elevation, 300 feet southwest of the existing Dos Osos Reservoir site. A new, 12-inch diameter steel inlet-outlet discharge pipeline will be constructed to connect the existing water distribution system to the new dual reservoirs and will be located within an approximately 800-foot-long access road that will be constructed for permanent access from Los Norrabos to the new dual reservoirs. High water age, due to low demand and excess storage, has led to low chlorine residuals in the existing reservoir. Each proposed reservoir will have a remote actuated isolation valve, which will allow for dual-tank operation to improve reservoir turnover while maintaining fire flow storage.

EBMUD's existing Dos Osos Pumping Plant, located at 263 El Toyonal, Orinda, is a 0.3-million-gallons-per-day (MGD) pumping plant. The pumping plant is a critical facility that pumps water from EBMUD's Westside Pressure Zone into the Dos Osos Pressure Zone and is the only source of water for the Dos Osos Pressure Zone. The existing Dos Osos Pumping Plant will be rehabilitated at the same capacity; however, the Dos Osos Pumping Plant will be upgraded with pump units that can pump to a higher elevation to the new dual Dos Osos Reservoirs located approximately 70 feet higher in elevation.

Figure N-1 shows a project vicinity map, including the existing Dos Osos Reservoir, the new dual Dos Osos Reservoirs location, and the existing Dos Osos Pumping Plant. Upon construction completion and successful testing of the new facilities, the existing Dos Osos Reservoir, including the valve pit and foundation, will be demolished.



PROJECT SITE LOCATION MAP

NOT TO SCALE

EAST BAY MUNICIPAL UTILITY DISTRICT

DOS OSOS RESERVOIR REPLACEMENT PROJECT

FIGURE N-1

Figure N-1

1.2 Environmental Setting

The Dos Osos Pressure Zone is located in a hilly region of Orinda above the Caldecott Tunnel at the highest elevation of the El Toyonal neighborhood. It is populated with "semi-rural," low-density, single-family housing and bounded to the south by the open space watershed lands of EBMUD, known as the Siesta Valley Recreation Area. The watershed lands parcel, approximately 980 acres of open space, is roughly bounded by Camino Pablo (east), Grizzly Peak Boulevard and Fish Ranch Road (west), the El Toyonal neighborhood (north) and Highway 24 (south).

The new dual Dos Osos Reservoirs will be located at the northern perimeter of the watershed lands, about 100 feet south of the intersection of two private roads, Los Norrabos and Tres Mesas, which meet just outside the perimeter of the watershed lands. An EBMUD fire access road also exits the watershed lands at this location. The dual reservoirs site will be graded into the hillslopes that face northeast. In contrast to the wooded El Toyonal neighborhood, the watershed lands are open, hilly, grazed annual grassland.

The existing Dos Osos Reservoir is located about 300 feet directly northeast of the proposed reservoirs site on a 0.38-acre parcel at 8 Los Norrabos, roughly 70 feet lower in elevation. The existing reservoir site is surrounded by low-density residential lots and two adjacent vacant irregular shaped parcels situated on steep slopes. The existing reservoir site and neighboring parcels are heavily canopied by native trees, including coastal live oaks and California bay trees. The existing reservoir is located at the margin of the coast live oak woodland and the annual grassland of the watershed lands.

The existing Dos Osos Pumping Plant site is located approximately 0.6 miles from the existing Dos Osos Reservoir on a 0.5-acre parcel at 263 El Toyonal in the El Toyonal neighborhood of the City of Orinda surrounded by low-density, single-family residences. The Dos Osos Pumping Plant building shares the site with EBMUD's Westside Reservoir, a 0.3-MG steel-bolted reservoir constructed in 2005. Access to the Dos Osos Pumping Plant is off of El Toyonal at its intersection with Alta Vista, which is also the only access to the residence at 263 El Toyonal which lies roughly 100 feet beyond the pumping plant along the driveway.

1.3 Key Construction Activities and Equipment Noise Levels

Construction activities associated with the Dos Osos Reservoir Replacement Project (Project) would result in temporary noise increases at sensitive receptors near the three Project sites. Sensitive receptors are defined as population groups more sensitive to noise that are associated with land uses such as residential areas, hospitals, schools, child care facilities, senior facilities, libraries, churches, and parks. The projected construction and operational noise levels at nearby sensitive receptors were compared against specific noise criterion.

Construction noise levels would fluctuate at any given receptor depending on the type of project, construction phasing, equipment type/duration of use, distance between the noise source and receptor, and the presence or absence of barriers between the noise source and receptor. Typical construction equipment generates noise levels ranging from about 76 to 88 dBA at a distance of 50 feet from the

source, with slightly higher levels of about 88 to 91 dBA for certain types of earthmoving and impact equipment. Table N-1 indicates noise levels at 25, 50, and 100 feet from the noise source for typical construction equipment with and without controls. In Table N-1, the "With Controls" columns show noise levels estimates that can be obtained by selecting quieter procedures or machines and implementing noise-control features that do not require major redesign or extreme cost (e.g., improved mufflers, equipment redesign, use of silencers, shields, shrouds, ducts, and engine enclosures).

Table N-1. Noise Levels of Selected Construction Equipment

Equipment	Noise Level at 25 feet		Noise Level at 50 feet		Noise Level at 100 feet	
	Without Controls	With Controls[a]	Without Controls	With Controls[a]	Without Controls	With Controls[a]
Earthmoving						
Front Loaders	85	81	79	75	73	69
Backhoes	91	81	85	75	79	69
Dozers	86	81	80	75	74	69
Tractors	86	81	80	75	74	69
Graders	91	81	85	75	79	69
Trucks[b]	97	81	91	75	85	69
Materials Handling						
Concrete Mixers	91	81	85	75	79	69
Concrete Pumps	88	81	82	75	76	69
Cranes	89	81	83	75	77	69
Derricks	94	81	88	75	82	69
Stationary						
Pumps	82	81	76	75	70	69
Generators	84	81	78	75	72	69
Compressors	87	81	81	75	75	69
Impact						
Pile Drivers	107	101	101	95	95	89
Rock Drills	104	86	98	80	92	74
Jack Hammers	94	81	88	75	82	69
Pneumatic Tols	92	86	86	80	80	74
Other						
Saws	84	81	78	75	72	69
Vibrators	82	81	76	75	70	69

[a] Estimated levels can be obtained by selecting quieter procedures or machines and implementing noise-control features that do not require major redesign or extreme cost (e.g., improved mufflers, equipment redesign, use of silencers, shields, shrouds, ducts, and engine enclosures).

[b] This noise level represents the maximum noise level (Lmax) associated with a single passing truck.

SOURCE: U.S. Environmental Protection Agency, 1971,Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1

A number of EBMUD standard practices and procedures, applicable to all EBMUD projects, have been incorporated into the Project, including Standard Construction Specification 01 35 44, Environmental Requirements. Section 3.6 "Noise Control," of the Environmental Requirements standard specification includes minimization measures for noise control of construction equipment, including:

- Contractor responsibility for taking appropriate measures, including muffling of equipment, selecting quieter equipment, erecting noise barriers, modifying work operations, and other measures as needed to bring construction noise into compliance.
- Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without said muffler.
- Best available noise control techniques (including mufflers, intake silencers, ducts, engine enclosures, and acoustically attenuating shields or shrouds) shall be used for all equipment and trucks, as necessary.
- Material stockpiles as well as maintenance/equipment staging and parking areas (all on-site) shall be located as far as practicable from residential receptors.

Because these construction equipment noise minimization measures will be implemented as part of the Project, the noise levels "With Controls" for construction equipment shown in Table N-1 above can be applied to the Project.

Tables N-2, N-3 and N-4 provide a summary of key construction activities by project phase, and show the highest noise levels associated with different phases of the Project, with and without controls. Estimated durations, lists of major equipment to be used along with associated reference equipment noise levels, and expected loudest construction noise levels by activity are detailed in each project phase table. Tables N-2, N-3, and N-4 also show the greatest vibration levels expected by project phase. The construction equipment per construction phase that has the highest estimated noise levels may not necessarily be the same piece of equipment that has the highest estimated vibration levels.

Table N-2 - New Dual Dos Osos Reservoirs Construction Phase: Major Site Construction Activities

Summary of Key Construction Activities	Estimated Duration (Weeks)[1]	Major Construction Equipment and Reference Noise Levels[2]	Loudest Projected Noise Level at 50 feet (dBA)		Greatest Vibration at 25 feet (in/sec)[4]	
			Without Controls[2]	With Controls[3]	Equipment	PPV
Excavation/Site Work *Remove Trees *Excavate and grade access road *Excavate and grade reservoir pit, foundation and pad	7	Crane (83 dBA), Excavator (85 dBA), Loader (79 dBA), Backhoe (85 dBA), **Haul Trucks (91 dBA)**, Chain Saws (78 dBA)	91	75	Excavator	0.089
Retaining Wall *Shoring *Soil Nails *Shotcrete/Concrete Work *Wall Drainage	5	Crane (83 dBA), Excavator (85 dBA), Loader (79 dBA), Backhoe (85 dBA), **Concrete and Shotcrete Trucks (85 dBA)**, Drill Rig (85 dBA), Forklift (79 dBA)	85	75	Drilling	0.089
Dual Reservoir Construction (Concrete Work) - *Construct Reservoir Foundation and Vault *Construct Reservoir Shell and Roof *Construct Pipelines *Asphalt Paving for Dual Tank Site and Access Road *Backfill	12	Crane (83 dBA), Concrete and Shotcrete Trucks (85 dBA), Excavator (85 dBA), Backhoe (85 dBA), Loader (79 dBA), Forklift (85 dBA), Material Trucks (91 dBA), Soil Compactor (75 dBA), **Asphalt Pavers (89 dBA),** Rollers (75 dBA), Haul Trucks (91 dBA), Street Sweeper (80dBA)	89	80	Roller	0.21
Landscaping/Site Restoration - *Construct Earthen Berms *Landscaping *Install Security Fencing	5	**Excavator (85 dBA),** Backhoe (85 dBA), Loader (79 dBA), Soil Compactor (75 dBA), Forklift (85 dBA)	85	75	Roller	0.21

[1]Estimated duration does not include down time, mobilization/demobilization between project phases, submittal review, equipment/material procurement, reservoir startup/testing, etc. nor reflect total duration.

[2]Reference Noise Levels, shown in parenthesis for each major piece of onsite construction equipment, is from U.S. Environmental Protection Agency, 1971, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1. Equipment in bold typeface is the equipment with the loudest projected noise level at 50 feet with controls.

[3]Estimated levels can be obtained by selecting quieter procedures or machines and implementing noise-control features that do not require major redesign or extreme cost (e.g., improved mufflers, equipment redesign, use of silencers, shields, shrouds, ducts, and engine enclosures). U.S. Environmental Protection Agency, 1971, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1

[4] Equipment with greatest vibration is listed here. Vibration Source Levels for Construction Equipment, Federal Transit Administration. 2006, Transit noise and vibration impact assessment. Table 12-2. FTA-VA-90-1003-06. Office of Planning and Environment, Washington, D.C., Prepared by Harris Miller & Hanson, Inc., Burlington, MA.

Table N-3 - Existing Dos Osos Pumping Plant Rehabilitation: Major Project Site Construction Activities

Summary of Key Construction Activities	Estimated Duration (Weeks)[1]	Major Construction Equipment and Reference Noise Levels[2]	Loudest Projected Noise Level at 50 feet (dBA)[2]	
			Without Controls	With Controls
Pumping Plant Rehabilitation *Removal of existing electrical and mechanical pump equipment inside of existing pumping plant *Installation of replacement electrical and mechanical pump equipment inside of existing pumping plant	4	Electric Portable Pump (40 dBA)	40	40
Total[1]	**4**			

[1]Estimated duration does not include down time, mobilization/demobilization between project phases, submittal review, equipment/material procurement, reservoir startup/testing, etc. nor reflect total duration.

[2]2The noise emitted by the electric portable pump with acoustic enclosure will not exceed 65 dBA, measured at a distance of 3 feet (free field) from any side of the enclosure, with two of the three pumps running at 100% speed and all doors closed. This requirement translates to a Loudest Projected Noise Level at 50 feet of 40 dBA.

[3] Construction activities at the existing pumping plant site will not include equipment that will generate excessive ground-borne noise (vibration) levels.

Table N-4 - Existing Dos Osos Reservoir Demolition Phase: Major Site Construction Activities

Summary of Key Construction Activities	Estimated Duration (Weeks)[1]	Major Construction Equipment and Reference Noise Levels[2]	Loudest Projected Noise Level at 50 feet (dBA)[3]		Greatest Vibration at 25 feet (in/sec)[4]	
			Without Controls	With Controls	Equipment	PPV
Remove/Demo Reservoir Structures *Removal of Reservoir Roof *Removal of Reservoir Shell *Removal of Reservoir Appurtenances	2	Crane (83 dBA), Excavator (85 dBA), Chain Saw (78 dBA), **Haul Trucks (91 dBA)**	91	75	Excavator	0.089
Remove/Demolition of Reservoir Concrete *Removal of Reservoir Foundation *Removal of Reservoir Vault Pit	1	Excavator (85 dBA), Loader (79 dBA), Backhoe (85 dBA), **Hoe Ram (86 dBA),** Jack Hammer (88 dBA), Haul Trucks (91 dBA)	86	80	Hoe Ram	0.089
Backfill - -Backfill removed Reservoir structure foundaton to existing grade -Backfill removed water pipeline trenches to existing grade	2	Excavator (85 dBA), Loader (79 dBA), Compactor (75 dBA), **Haul Trucks (91 dBA),** Rollers (75 dBA)	91	75	Roller	0.21
Site Restoration - *Rough grade site to existing grade *Gravel portion of site	1	Excavator (85 dBA), Loader (79 dBA) , Backhoe (85 dBA), **Material Trucks (91 dBA)**, Rollers (75 dBA), Street Sweeper (80 dBA)	91	75	Roller	0.21

[1]Estimated duration does not include down time, mobilization/demobilization between project phases, submittal review, equipment/material procurement, reservoir startup/testing, etc. nor reflect total duration.

[2]Reference Noise Levels, shown in parenthesis for each major piece of onsite construction equipment, is from U.S. Environmental Protection Agency, 1971, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1. Equipment in bold typeface is the equipment with the loudest projected noise level at 50 feet with controls.

[3]Estimated levels can be obtained by selecting quieter procedures or machines and implementing noise-control features that do not require major redesign or extreme cost (e.g., improved mufflers, equipment redesign, use of silencers, shields, shrouds, ducts, and engine enclosures). U.S. Environmental Protection Agency, 1971, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1

[4] Vibration Source Levels for Construction Equipment, Federal Transit Administration. 2006, Transit noise and vibration impact assessment. Table 12-2. FTA-VA-90-1003-06. Office of Planning and Environment, Washington, D.C., Prepared by Harris Miller & Hanson, Inc., Burlington, MA.

2 Noise and Vibration Analysis

2.1 Short-term Noise Level Analysis by Construction Phase

When typical construction noise levels with controls are applied to each site, worst-case, project-related, temporary noise increases can be estimated based on the minimum distance to the closest sensitive receptor (Figure N-2).

At the new dual reservoirs site, the nearest sensitive receptor is at the residence at 9 Los Norrabos roadway, approximately 340 feet from the site, and approximately 40 feet lower in elevation than the bottom elevation of the new dual reservoirs. At the existing Dos Osos Reservoir site, the nearest sensitive receptor is the residence at 9 Los Norrabos roadway, approximately 160 feet from the existing reservoir, and approximately 30 feet higher in elevation. At the existing Dos Osos Pumping Plant, the nearest sensitive receptor is a residence approximately 100 feet from the pumping plant at approximately the same elevation as the pumping plant.

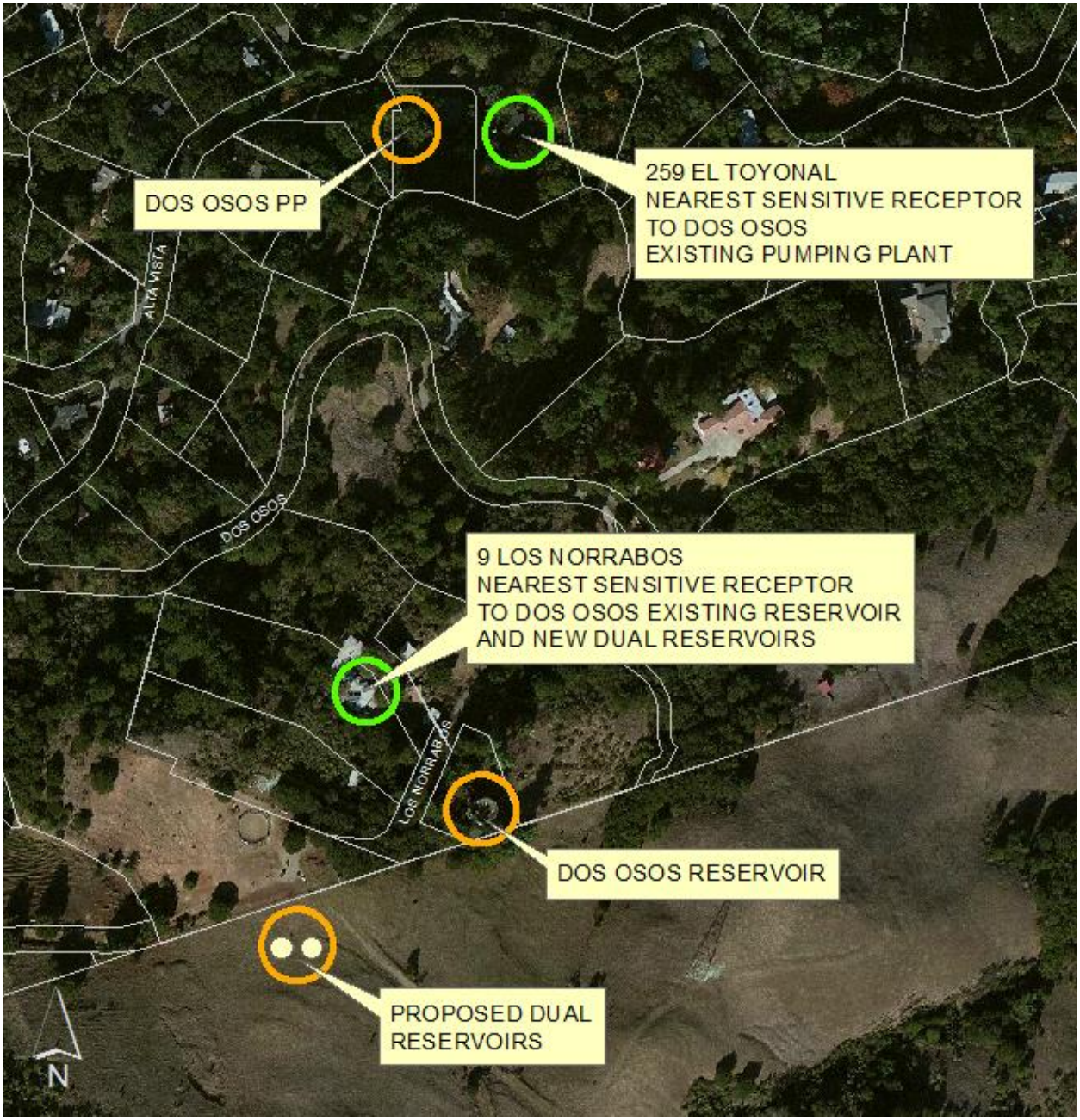


Figure N-2. Dos Osos Reservoir Replacement Project Sensitive Receptors

EBMUD's projected construction noise level analysis was conducted to determine the expected noise level at the nearest sensitive receptors to Project sites during the loudest construction activity for each phase. The significance of temporary increases in noise levels due to construction activities is evaluated by comparing estimated noise levels with the 70-dBA speech interference criterion.

Speech interference is an indicator of impact on typical daytime and evening activities. A speech interference criterion, in the context of impact duration and time of day, was used to identify "substantial" increases in noise from temporary construction activities. Noise peaks generated by construction equipment could result in speech interference in adjacent buildings if the noise level in the interior of the building exceeds 45 to 60 dBA.1 A typical building can reduce noise levels by 25 dBA with the windows closed (U.S. Environmental Protection Agency, 1974). This noise reduction could be maintained only on a temporary basis in some cases, since it assumes windows must remain closed at all times. Since a typical building can reduce noise levels by 25 dBA (with closed windows), an exterior noise level of 70 dBA at receptors would maintain an acceptable interior noise environment of 45 dBA. Thus, noise levels greater than 70 dBA at receptors would constitute a significant impact.

Table N-5 shows the results of the noise level analysis by construction phase. For each phase, the loudest projected noise level at 50 feet "With Controls" for construction equipment (incorporated via EBMUD Standard Specification 01 35 44) is shown. Then the distance adjustment for the distance to the closest sensitive receptor is applied for each phase at both construction sites to calculate the project noise level at the sensitive receptor. This sensitive receptor noise level is then compared to the exterior speech criterion.

[1] Sound is characterized by various parameters that describe the rate of oscillation of sound waves, the distance between successive troughs or crests, the speed of propagation, and the pressure level or energy content of a given sound. The sound pressure level has become the most common descriptor used to characterize the loudness of an ambient sound. The decibel (dB) scale is used to quantify sound intensity. Because sound can vary in intensity by over one million times within the range of human hearing, a logarithmic loudness scale is used to keep sound intensity numbers at a convenient and manageable level. Since the human ear is not equally sensitive to all sound frequencies within the entire spectrum, human response is factored into sound descriptions in a process called "A-weighting," expressed as "dBA." The dBA, or A-weighted decibel, refers to a scale of noise measurement that approximates the range of sensitivity of the human ear to sounds of different frequencies. On this scale, the normal range of human hearing extends from about 0 dBA to about 140 dBA. A 10-dBA increase in the level of a continuous noise represents a perceived doubling of loudness. The noise levels presented herein are expressed in terms of dBA, unless otherwise indicated.

Table N-5 - Noise Level Analysis by Construction Phase

Project Site	Closest Sensitive Receptor	Construction Hours	Major Construction Activities	Duration (Weeks)	Loudest Projected Noise Level at 50 feet (dBA) With controls[1]	Distance to Closest Sensitive Receptor[2]	Noise Level Distance Adjustment[3]	Projected Noise Level at Sensitive Receptor during Key Construction Activities (dBA)	Exterior Speech Interference Criterion	Criterion Exceeded?
Existing Reservoir Demolition	9 Los Norrabos	8 a.m. to 6 p.m.	Demolish Reservoir Structures	2	75	160	-10	65	70	No
			Demolish Reservoir Concrete	1	80		-10	70		No
			Demolish Underground Piping	1	75		-10	65		No
			Backfill	2	75		-10	65		No
			Site Restoration	1	75		-10	65		No
New Dual Reservoir Construction	9 Los Norrabos	8 a.m. to 6 p.m.	Excavation/Site Work	7	75	340	-17	58	70	No
			Retaining Wall Construction	5	75		-17	58		No
			Dual Reservoir Construction	12	80		-17	63		No
			Landscaping/site Restoration	5	75		-17	58		No
Existing Pumping Plant Rehabilitation	263 El Toyonal	8 a.m. to 11 a.m. and 6 p.m. to 8 a.m.	Electric Portable Pump[4]	4	40	100	-6	34	70	No

[1]U.S. Environmental Protection Agency, 1971, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1

[2]Sensitive receptors are defined as population groups more sensitive to noise that are associated with land uses such as residential areas, hospitals, schools, child care facilities, senior facilities, libraries, churches, and parks.

[3]There is a noise level drop of 6dB per doubling of distance. The application of this inverse distance formula calculates the decrease in noise level at a sensitive receptors due to its distance from the noise source.

[4]The noise emitted by the electric portable pump with acoustic enclosure will not exceed 65 dBA, measured at a distance of ***3*** feet (free field) from any side of the enclosure, with two of the three pumps running at 100% speed and all doors closed. This requirement translates to a Loudest Projected Noise Level at 50 feet of 40 dBA.

During the construction of the new dual reservoirs, the loudest project noise levels occur during the concrete work for the new dual reservoirs and the paving of the new access road to the new dual reservoirs. However, for all phases of the new dual reservoir construction, the projected noise levels at the nearest sensitive receptors would be below the speech interference criterion of 70 dBA with implementation of Section 3.6 "Noise Control," of the Environmental Requirements standard specification and the distance from the new dual reservoir construction to the nearest sensitive receptor.

During the rehabilitation of the existing Dos Osos Pumping Plant, existing electrical and mechanical equipment within the existing pumping plant will be removed and replaced with upgraded electrical and mechanical equipment. No heavy construction equipment will be required for this work. However, while pumping plant equipment is being replaced, an electric portable pump with acoustic enclosures will be used to maintain pumping operations for potable water service, as explained in the project description. The projected noise levels from electric portable pump operation at the nearest sensitive receptor would be low, 34 dBA, which is below both the speech interference criterion of 70 dBA and the City ordinance night-time noise limit in single-family residential zones

During the demolition of the existing Dos Osos Reservoir, the loudest project noise levels occur during demolition of existing concrete at the reservoir. However, for all phases of the new dual reservoir construction, the projected noise levels at the nearest sensitive receptors would be below the speech interference criterion of 70 dbA with implementation of Section 3.6 "Noise Control," of the Environmental Requirements standard specification and the distance from the existing reservoir to the nearest sensitive receptor.

There are several factors which EBMUD did not consider quantitatively, but which would likely reduce noise levels associated with the Project below the levels predicted in this analysis. The noise level estimates at nearby sensitive receptors do not account for noise attenuation from existing vegetation, topography or other physical barriers between a site and receptors. The residence at 9 Los Norrabos (the closest sensitive receptor to both the existing Dos Osos Reservoir and the new dual reservoir site) is 30 feet higher in elevation than the existing reservoir and 40 feet lower than the new dual reservoir proposed pad elevation, which would reduce noise levels. Also, vegetation located between a noise source and receptors can act as noise barriers wherever they interrupt direct lines-of-sight, helping to reduce noise levels at sensitive receptors. For the Project, vegetation, including large trees, exists between the existing reservoir and dual reservoir site and nearby sensitive receptors, thereby likely reducing noise levels relative to those predicted in this analysis Finally, at the site of the existing Dos Osos Pumping Plant, the Westside Reservoir, a 0.34-MG, 30-foot high, 45-foot diameter, steel water tank, lies directly between the pumping plant and the nearest sensitive receptor, which would also likely reduce noise levels at that receptor relative to those predicted in this analysis. Thus, noise levels reported herein may be conservatively high.

Because Section 3.6, Noise Control, of EBMUD's Standard Construction Specification 01 35 44, Environmental Requirements, has been incorporated into the Project, and includes measures for noise control of construction equipment such as mufflers and intake silencers, and given the distance of the sensitive receptors from the construction sites, short-term construction noise levels at nearby sensitive receptors would fall below the speech criterion, and impacts due to short-term construction activities would be less than significant.

City of Orinda Noise Ordinance

Local noise issues are addressed by assessing consistency with applicable noise ordinance standards or general plan guidelines (if there is no noise ordinance). Noise ordinances regulate such sources as mechanical equipment and amplified sounds as well as prescribe hours of heavy equipment operation. Pursuant to California Government Code Section 53091, EBMUD, as a local agency and utility district serving a broad regional area, is not subject to building and land use zoning ordinances (such as noise ordinances) for projects involving facilities for the production, generation, storage or transmission of water. It is, however, the practice of EBMUD to work with local jurisdictions and neighboring communities during project planning, and to conform to local environmental protection policies to the extent feasible. Noise standards from the City of Orinda's noise ordinance are shown in Table N-6.

Table N-6 - City of Orinda Ordinance Time Limits and Noise Standards

	Construction Time Limits			**Ordinance Noise Limits for Various Activities in Single-Family Residential Zones (dBA)[b]**	
				Day (L_{eq})	**Night (L_{eq})**
Jurisdiction	**Weekdays**	**Saturdays**	**Sundays**	**7 a.m. to 10 p.m.**	**10 p.m. to 7 a.m.**
Orinda[a]	8 a.m. to 6 p.m.	10 a.m. to 5 p.m.	Not Allowed	60 (Ldn) [c]	55

a. Time Limits: Orinda Municipal Code, Chapter 17.39.3, specifies construction time limits. Operation of heavy construction equipment is not allowed on Saturdays or Sundays. Noise Limits: To account for duration and timing, the Orinda Municipal Code, Chapter 17.15.2 stipulates a noise limit of 60 dBA (Ldn) in residential districts. The ordinance further reduces noise levels by five dB between 10 p.m. and 7 a.m. relative to the 60 Ldn. Noise that is produced for cumulative periods of no more than five minutes and one minute in any hour may exceed the standards by five dB and ten dB, respectively. Presumably, these noise levels would be limited to 65 and 70 dBA, respectively Title 17, Section 17.39.9 of Orinda Municipal Code, specifies a maximum noise level of 45 dBA for mechanical equipment which is permanently affixed to a structure or on the ground (but not limited to air conditioners, pool equipment, spa equipment), except for emergency backup power generators.

b. Time variations in noise exposure are typically expressed in terms of a steady-state energy level (called Leq) that represents the acoustical energy of a given measurement. Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, for planning purposes, an artificial dBA increment is added to "quiet time" noise levels to form a 24-hour noise descriptor called the day-night noise level Ldn). Ldn adds a 10-dBA penalty to all nighttime noise events between 10:00 p.m. and 7:00 a.m.

c. Construction activities are exempt from the daytime noise limits if they occur during the construction time limits specified in the ordinance.

In general, the City of Orinda noise ordinance stipulates a noise limit of 60 dBA (Ldn) during the day, and 55 dBA (Ldn) during nighttime hours. However, construction activities that occur Monday through Friday between the hours of 8 a.m. and 6 p.m. and on Saturdays between 10 a.m. and 5 p.m. are exempt from these noise restrictions.

As detailed in the Project Description, a number of EBMUD standard practices and procedures, applicable to all EBMUD projects, have been incorporated into the Project, including Standard

Construction Specifcation 01 14 00 Work Restrictions. Section 1.4, Work Hours, of this standard specification includes minimization measures for restricting hours of construction equipment, including:

- Limit on-site construction work to daytime hours between 7:00 a.m. and 6:00 p.m. Monday through Friday.
- Truck operations (haul trucks and concrete delivery trucks) will be limited to the daytime hours (9:00 a.m. and 4:00 p.m.).

Section 1.8, Construction Noise, of EBMUD's Standard Construction Specification 01 14 00, Work Restrictions, also includes minimization measures for restricting hours of construction equipment, including:

- Noise-generating activities greater than 90 dBA (impact construction such as concrete breaking, concrete crushing, tree grinding, etc.) shall be limited to the hours of 8:00 a.m. and 4:00 p.m., Monday through Friday.

During construction, critical water service outages, other emergencies, and special situations requiring work outside of the City of Orinda ordinance construction daytime work hour limits would be rare and though EBMUD will comply with the City of Orinda ordinance when feasible, EBMUD is not subject to the ordinance (as explained above). In addition, as described in Section d) below, noise generated by construction activities for the Dos Osos Pumping Plant rehabilitation, new dual Dos Osos Reservoirs construction and existing Dos Osos Reservoir demolition construction phases is not expected to exceed the speech interference criterion. Thus, even at times when construction may occur outside of the construction windows set forth in the City of Orinda ordinance, nearby receptors would not be expected to experience substantial noise-related impacts.

Because Section 1.4, Work Hours, of EBMUD's Standard Construction Specification 01 14 00, Work Restrictions, has been incorporated into the Project, which would limit construction activities work hours, and because construction activities noise levels would fall below the speech interference criterion, impacts would be less than significant.

2.2 Long-term, Operational Noise Level Analysis

No substantial permanent increase in noise is anticipated at the three Project sites. At the new dual reservoirs site, there are no electrical or mechanical (pumping) facilities; therefore, typical reservoir operations would not generate noise above ambient levels. At the existing Dos Osos Pumping Plant, existing electrical and mechanical equipment within the existing pumping plant would be upgraded with new electrical and mechanical equipment, and the upgraded equipment would not increase noise levels above existing pumping plant noise levels; noise levels would likely decrease due to advances in electrical and mechanical design since 1968, when the original pumping plant was constructed. The existing Dos Osos Reservoir will be demolished and removed, so no future long-term operations will occur at the existing reservoir site. There is no impact because the long-term operation of proposed facilities will not change from the current operation and will not produce a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project.

2.3 Vibration Analysis by Construction Phase

Vibrations caused by construction activities can be interpreted as energy transmitted in waves through the soil mass. These energy waves generally dissipate with distance from the vibration source (e.g., pile driving or sheetpile driving). Since energy is lost during the transfer of energy from one particle to another, vibration that is distant from a source is usually less perceptible than vibration closer to the source. However, actual human and structure response to different vibration levels is influenced by a combination of factors, including soil type, distance between source and receptor, duration, and the number of perceived events. If great enough, the energy transmitted through the ground as vibration can result in structural damage. To assess the potential for structural damage associated with vibration, the vibratory ground motion in the vicinity of the affected structure is measured in terms of peak particle velocity (PPV) in the vertical and horizontal directions (vector sum), typically in units of inches per second (in/sec). A freight train passing at 100 feet can cause vibrations of 0.1 in/sec PPV, while a strong earthquake can produce vibration in the range of 10 in/sec PPV.

There are no local, state, or federal vibration impact criteria that are applicable to this Project. The California Department of Transportation uses a vibration limit 0.5 inches per second (in/sec) peak particle velocity (PPV) for buildings designed to modern engineering standards. EBMUD has successfully applied the 0.5 in/sec standard criteria established to evaluate the risk for cosmetic or structural damage to buildings with no known adverse impacts.

Table N-7 provides a summary of key construction activities by project phase for the new dual reservoirs and existing reservoir demolition construction phases, and shows the highest vibration levels associated with different phases of the Project, given the distance between the construction sites and the nearest sensitive receptors. Construction activities at the existing pumping plant site will not include equipment that will generate excessive ground-borne noise levels.

Table N-7 - Vibration Analysis by Construction Phase[3]

Project Site	Closest Sensitive Receptor	Construction Hours	Major Construction Activities	Duration (Weeks)	Greatest Vibration at 25 feet (in/sec)[1]	Distance to Closest Sensitive Receptor	Projected Vibration at Sensitive Receptor during Key Construction Activities (dBA)[2]	Vibration Limit Criterion	Criterion Exceeded?
Existing Reservoir Demolition	9 Los Norrabos	8 a.m. to 6 p.m.	Drain Reservoir	1	NA	160	NA	0.5	No
			Demolish Reservoir Structures	2	0.089		0.005		No
			Demolish Reservoir Concrete	1	0.089		0.005		No
			Demolish Underground Piping	1	0.089		0.005		No
			Backfill	2	0.21		0.013		No
			Site Restoration	1	0.21		0.013		No
New Dual Reservoir Construction	9 Los Norrabos	8 a.m. to 6 p.m.	Mobilization	1	0.089	340	0.002	0.5	No
			Excavation/Site Work	7	0.089		0.002		No
			Retaining Wall Construction	5	0.089		0.002		No
			Dual Reservoir Construction	12	0.21		0.004		No
			Landscaping/site Restoration	5	0.21		0.004		No

[1] Vibration Source Levels for Construction Equipment, Federal Transit Administration. 2006, Transit noise and vibration impact assessment. Table 12-2.2. FTA-VA-90-1003-06. Office of Planning and Environment, Washington, D.C., Prepared by Harris Miller & Hanson, Inc., Burlington, MA.

[2]Federal Transit Administration. 2006, Transit noise and vibration impact assessment. Section 12.2.1 "Quantitative Construction Vibration Assessment Methods. Damage Assessment." FTA-VA-90-1003-06. Office of Planning and Environment, Washington, D.C., Prepared by Harris Miller & Hanson, Inc., Burlington, MA.

[3]Existing Pumping Plant Rehabilitation not listed in table because construction activities at the existing pumping plant site will not include equipment that will generate excessive ground-borne noise (vibration) levels.

The new dual Dos Osos Reservoirs construction and existing Dos Osos Reservoir demolition Project phases would not result in exposure of persons to or generation of excessive ground-borne vibration levels, because each of the above construction phases are at locations far enough away from any nearby structures to not approach the 0.5 in/sec PPV criterion. None of the Project phases would experience excessive ground-borne noise levels at sensitive receptors near each Project site; therefore, impacts from exposure to or generation of excessive ground-borne vibration or ground-borne noise levels are less than significant.

As detailed in the Project Description, a number of EBMUD standard practices and procedures, applicable to all EBMUD projects, have been incorporated into the Project, including Standard Construction Specification 01 35 44, Environmental Requirements. Sections 3.5 and 3.6 of this standard construction specification include the following provisions for vibration control of construction equipment:

- Limit surface vibration to no more than 0.5 in/sec PPV, measured at the nearest residence or other sensitive structure.
- Upon homeowner request, and with homeowner permission, the District will conduct preconstruction surveys of homes, sensitive structures and other areas of concern within 15 feet of continuous vibration-generating activities (i.e., vibratory compaction). Any new cracks or other changes in structures will be compared to preconstruction conditions and a determination made as to whether the proposed Project could have caused such damage. In the event that the Project is demonstrated to have caused the damage, the District will have the damage repaired to the pre-existing condition.
- If impact equipment is used, the Contractor is responsible for taking appropriate measures, including but not limited to the following:
    - Hydraulically or electrically powered equipment shall be used wherever feasible to avoid the noise associated with compressed-air exhaust from pneumatically powered tools. However, where use of pneumatically powered tools is unavoidable, an exhaust muffler on the compressed-air exhaust shall be used (a muffler can lower noise levels from the exhaust by up to about ten dB). External jackets on the tools themselves shall be used, where feasible, which could achieve a reduction of five dB. Quieter procedures, such as drilling rather than impact equipment, will be used whenever feasible.
    - Impact construction, including jackhammers, hydraulic backhoe, concrete crushing/recycling activities, vibratory pile drivers, etc., shall be limited to the daytime hours specified in Standard Construction Specification 01 14 00 (see below for discussion).
    - Erect temporary noise barriers or noise control blankets around the construction site, particularly along areas adjacent to residential buildings.
    - Utilize noise control blankets around the major noise sources to reduce noise emission from the site.
    - Evaluate the feasibility of noise control at the receivers by temporarily improving the noise reduction capability of adjacent buildings by the use of sound blankets for example.
    - Limit the noisiest phases of construction to ten workdays at a time, where feasible.
    - Notify neighbors/occupants within 300 feet of Project construction at least 30 days in advance of extreme noise-generating activities about the estimated duration of the activity.
    - Noise monitoring shall be conducted periodically during noise-generating activities.

> Monitoring shall be conducted using a precision sound-level meter that is in conformance with the American National Standards Institute (ANSI) Standard S1.4, Specification for Sound Level Meters. Monitoring results shall be submitted weekly to the Engineer.

Implementation of Sections 3.5, Vibration Control, and 3.6, Noise Control, of Standard Construction Specification 01 35 44 will require vibration controls for construction equipment and provide for preconstruction surveys if necessary.

Section 1.4 of EBMUD's Standard Construction Specification 01 14 00, Work Restrictions, restricts the hours impact construction equipment can be used on site, including the following provisions:

- Work or activity of any kind shall be limited to the hours from 7:00 a.m. to 6:00 p.m. Monday through Friday.
- Truck operations (haul trucks and concrete delivery trucks) will be limited to the daytime hours (between 9:00 a.m. and 4:00 p.m.).

Section 1.8, Construction Noise, of EBMUD's Standard Construction Specification 01 14 00, Work Restrictions, also includes minimization measures for restricting hours of construction equipment, including:

- Noise-generating activities greater than 90 dBA (impact construction such as concrete breaking, concrete crushing, tree grinding, etc.) shall be limited to the hours of 8:00 a.m. and 4:00 p.m., Monday through Friday.

Implementation of Section 1.4, Work Hours, and Section 1.8, Construction Noise, of EBMUD's Standard Construction Specification 01 14 00 will limit construction activity work hours, including the hours when impact equipment can be used on site.

Because the new dual Dos Osos Reservoirs construction and existing Dos Osos Reservoir demolition Project phases are at locations far enough away from any nearby structures such that vibration levels would not exceed the 0.5 in/sec PPV criterion, and because Sections 3.5, Vibration Control, and 3.6, Noise Control, of EBMUD's Standard Construction Specification 01 35 44, Environmental Requirements, and Section 1.4, Work Hours, and Section 1.8, Construction Noise, of EBMUD's Standard Construction Specification 01 14 00, Work Restrictions, have been incorporated into the Project, and these sections require vibration controls for construction equipment and restrict construction activity work hours, the Project impacts from exposure to or generation of excessive ground-borne vibration or ground-borne noise levels are less than significant.