Chapter 12. Noise

This chapter evaluates the potential noise impacts caused by construction and operation of the two CWP alternatives. The chapter summarizes the relevant existing setting and regulatory framework, identifies the thresholds of significance, and identifies impacts and mitigation measures related to potential noise generation.

12.1 Fundamentals of Acoustics

Acoustics is the study of sound, and noise is defined as unwanted sound. Airborne sound is a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure creating a sound wave. Acoustical terms used in this section are summarized in Table 12-1.

TABLE 12-1
Definitions of Acoustical Terms
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Term	Definition
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise or sound at a given location. The ambient noise level is typically defined by the L_{eq} level.
Background Noise Level	The underlying ever-present lower level noise that remains in the absence of intrusive or intermittent sounds. Distant sources, such as traffic, typically make up the background. The background level is generally defined by the L_{90} percentile noise level.
Intrusive	Noise that intrudes over and above the existing ambient noise level at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, time of occurrence, tonal content, the prevailing ambient noise level as well as the sensitivity of the receiver. The intrusive level is generally defined by the L_{10} percentile noise level.
Sound Pressure (Noise) Level Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).
A-Weighted Sound Pressure (Noise) Level (dBA)	The sound level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighted filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound (noise) levels in this report are A-weighted.
Equivalent Noise Level (L_{eq})	The average A-weighted noise level, on an equal energy basis, during the measurement period.
Percentile Noise Level (L_n)	The noise level exceeded during n percent of the measurement period, where n is a number between 0 and 100 (for example, L_{90})
Day-Night Noise Level (L_{dn} or DNL)	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels from 10:00 p.m. to 7:00 a.m.

The most common metric is the overall A-weighted sound level measurement adopted by regulatory bodies worldwide. The A-weighting network measures sound to the way in which a person perceives or hears sound. There is consensus that A-weighting is appropriate for estimating the hazard of noise-induced hearing loss. With respect to other effects, such as annoyance, A-weighting is acceptable if largely if middle- and high-frequency noise is present; however, if the noise is unusually high at low frequencies or contains prominent low-frequency tones, the A-weighting may not give a valid measure.

A-weighted sound levels are typically measured or presented as equivalent noise level (L_{eq}), which is defined as the average noise level, on an equal energy basis for a stated period of time, and is commonly used to measure steady-state sound or noise that is usually dominant. Statistical methods are used to capture the

dynamics of a changing acoustical environment. Statistical measurements are typically denoted by $L_{xx,}$ where xx represents the percentile of time the sound level is exceeded. The L_{90} measurement represents the noise level that is exceeded during 90 percent of the measurement period. Similarly, L_{10} represents the noise level exceeded for 10 percent of the measurement period.

Some metrics used in determining the impact of environmental noise consider the different response that people have to daytime and nighttime noise levels. During the nighttime, exterior background noises are generally lower than the daytime levels. However, most household noise also decreases at night and exterior noise becomes more noticeable. Furthermore, most people sleep at night and are sensitive to intrusive noises. To account for human sensitivity to nighttime noise levels, the day-night sound level (L_{dn} or DNL) was developed. L_{dn} is a noise index that accounts for the greater annoyance of noise during the nighttime hours.

L_{dn} values are calculated by averaging hourly L_{eq} sound levels for a 24-hour period, and apply a weighting factor to nighttime L_{eq} values. The weighting factor, which reflects the increased sensitivity to noise during nighttime hours, is added to each hourly L_{eq} sound level before the 24-hour L_{dn} is calculated. For the purposes of assessing noise, the 24-hour day is divided into two time periods, with the following weightings:

- Daytime: 7:00 a.m. to 10:00 p.m. (15 hours) weighting factor of 0 dB
- Nighttime: 10:00 p.m. to 7:00 a.m. (9 hours) weighting factor of 10 dB

The two time periods are averaged to compute the overall L_{dn} value. For a continuous noise source, the L_{dn} value is easily computed by adding 6.4 dBA to the overall 24-hour noise level (L_{eq}). For example, if the expected continuous noise level from a facility was 60.0 dBA, the resulting L_{dn} from the facility would be 66.4 dBA.

The effects of noise on people can be listed in three general categories:

1. Subjective effects of annoyance, nuisance, and dissatisfaction
2. Interference with activities such as speech, sleep, and learning
3. Physiological effects such as startling and hearing loss

In most cases, environmental noise produces effects in the first two categories only. However, workers in industrial plants may experience noise effects in the third category. No completely satisfactory way exists to measure the subjective effects of noise or to measure the corresponding reactions of annoyance and dissatisfaction. This lack of a common standard is primarily due to the wide variation in individual thresholds of annoyance and habituation to noise. Thus, one way of determining a person's subjective reaction to a new noise is by comparing it to the existing, ambient environment to which that person has adapted. In general, the more the level or the tonal (frequency) variations of a noise exceed the previously existing ambient noise level or tonal quality, the less acceptable the new noise will be, as judged by the exposed individual.

Table 12-2 shows the relative A-weighted noise levels of common sounds measured in the environment and in industry for various sound levels.

TABLE 12-2
Typical Sound Levels Measures in the Environment and Industry
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Noise Source at a Given Distance	A-Weighted Noise Level (dB)	Noise Environments	Subjective Impression
Shotgun (at shooter's ear)	140	Carrier flight deck	Painfully loud
Civil defense siren (at 100 feet)	130		
Jet takeoff (at 200 feet)	120		Threshold of pain
Loud rock music	110	Rock music concert	
Pile driver (at 50 feet)	100		Very loud
Ambulance siren (at 100 feet)	90	Boiler room	
Pneumatic drill (at 50 feet)	80	Noisy restaurant	
Busy traffic; hair dryer	70		Moderately loud
Normal conversation (at 5 feet)	60	Data processing center	
Light traffic (at 100 feet); rainfall	50	Private business office	
Bird calls (distant)	40	Average living room, library	Quiet
Soft whisper (at 5 feet); rustling leaves	30	Quiet bedroom	
	20	Recording studio	
Normal breathing	10		Threshold of hearing

Source: Beranek, 1998.

12.2 Existing Setting

12.2.1 Existing Noise Levels and Sensitive Receptors

The proposed projects in the CWP would be constructed within the City of San Mateo; therefore, existing setting information is presented primarily for the City. In particular, most projects would be constructed within the eastern half of the City (see Figure 2-2 in Chapter 2), referred to as the Program Area, or at the wastewater treatment plant (WWTP) site (see Figure 2-5, also in Chapter 2). The Program Area is located generally in a mix of low-, medium-, and high-density residential neighborhoods and office and commercial centers combined with parks and open spaces. Sensitive resources, such as schools, hospitals, and residences, are located throughout the Program Area (see Chapter 14).

The WWTP Site consists of the existing WWTP, an undeveloped parcel to the north on Detroit Drive, three commercial parcels to the east (the Bayfront parcels), and an undeveloped parcel southwest of the WWTP on Dale Avenue. Sensitive resources near the WWTP Site include the Bayside/Joinville Park, which extends east of the WWTP and contains an off-leash dog walk. Bayside STEM Academy is directly south of the WWTP and Horrall/LEAD Elementary School is west of the WWTP, at the intersection of Dale Drive and Ocean View Avenue. Residential neighborhoods are located west of the existing WWTP, where the nearest residence is approximately 150 feet from the WWTP boundary, and southeast of the WWTP, where the nearest residence is approximately 500 feet from the WWTP boundary. Residences nearest to the Detroit Drive parcel, where new WWTP facilities may be constructed, are 400 feet west of that parcel.

Westerly through northwesterly winds are most common in the area, reflecting the orientation of the Bay and the San Francisco Peninsula.

Noise exposure in the City can be described as follows (City of San Mateo, 2009):

> *"...[noise] is dominated by traffic on highways and major arterial roads and trains on the Southern Pacific (SPRR)/Caltrain rail line. Aircraft activity associated with San Francisco International Airport does not significantly affect noise levels in San Mateo, although some neighborhoods in the northeastern portion of the City are impacted by the airport approach path. Localized noise sources include the San Mateo County Fairgrounds, when events are being held. Generally, noise created by manufacturing uses does not have a major impact on the community, although occasional complaints are received from neighbors immediately adjacent to the manufacturing sites."*

The City is located outside of the airport's community noise equivalent level 65 dBA noise contour.

Present day traffic volumes and noise levels at 50 feet (L_{dn}, or DNL) are provided in Table 4.6-1 of the General Plan EIR. Major streets located in the Program Area and their current L_{dn} include:

- El Camino Real between approximately 2nd Avenue and 42nd Avenue – L_{dn} at 50 feet ranges from 68.8 to 70.6 dB
- Delaware Street between approximately Poplar Street and Saratoga Avenue – L_{dn} at 50 feet ranges from 61.2 to 65.3 dB
- Third Avenue between approximately Mariners Island Boulevard and El Camino Real – L_{dn} at 50 feet ranges from 62.7 to 68.4 dB
- 42nd Avenue west of El Camino Real – L_{dn} at 50 feet of 63.4 dB
- Hillsdale Boulevard between approximately Norfolk Street and Campus Drive – L_{dn} at 50 feet ranges from 66.5 to 71 dB
- US-101 through all of San Mateo (with 10-foot tall sound walls) – L_{dn} at 50 feet of 84.9 dB
- State Route 92 (SR-92) between approximately the San Mateo Bridge to Ralston – L_{dn} at 50 feet ranges from 81.1 to 83.3 dB

Existing noise contours in the City are shown on Figure 4.6-2 in the General Plan EIR. The majority of the Program Area is located within the 60 to 64 dBA and the 65 to 69 dBA contours. The WWTP Site, including the existing WWTP, is located in the less than 60 dBA contour, though the nearby J. Hart Clinton Drive is located within the 60 to 64 dBA contour.

12.3 Regulatory Framework

The following sections describe the federal, state, and local noise regulations applicable to the CWP.

12.3.1 Federal Regulations

12.3.1.1 U.S. Environmental Protection Agency

EPA guidelines (1974) assist state and local governments in developing state and local laws, ordinances, regulations, and standards for noise. Because local regulations apply to the CWP, the EPA guidelines are not applicable.

12.3.1.2 Occupational Safety and Health Administration

On-site and occupational noise levels are regulated through the OSHA. The noise exposure level of workers is regulated at 90 dBA over an 8-hour work shift to protect hearing (29 Code of Federal Regulations 1910.95). On-site noise levels will generally range from 70 to 85 dBA. Areas where noise levels exceed 85 dBA will be posted as high-noise level areas, and hearing protection will be required when entering or working in those areas. The CWP will implement a hearing conservation program for applicable employees and maintain exposure levels below 90 dBA.

12.3.2 State Regulations

12.3.2.1 California Department of Industrial Relations, Division of Occupational Safety and Health

The California Department of Industrial Relations, Division of Occupational Safety and Health (also known as Cal/OSHA) enforces state noise regulations that are the same as the federal OSHA regulations described previously. Agency regulations are contained in the California Code of Regulations, Title 8, General Industrial Safety Orders, Article 105, Control of Noise Exposure, Sections 5095, et seq.

12.3.2.2 California Vehicle Code

Noise limits for highway vehicles are regulated under the California Vehicle Code, Sections 23130 and 23130.5. The limits are enforceable on the highways by the California Highway Patrol and county sheriff offices.

12.3.3 Local Regulations

12.3.3.1 General Plan

The Noise Element in the *City of San Mateo General Plan – Vision 2030* (General Plan) (City of San Mateo, 2010) establishes goals, objectives, and policies that address how potential noise effects are evaluated within the City's jurisdiction. The City established land use compatibility guidelines for various land uses in Tables N-1 and N-2 of the General Plan; these are summarized in Table 12-3.

TABLE 12-3
City of San Mateo Noise Sensitive Land Use Compatibility Guidelines for Community Noise Environments
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Land Use Category	Normally Acceptable Sound Level	Conditionally Acceptable Sound Level	Normally Unacceptable Sound Level
Single-family Residential	50 to 59	60 to 70	Greater than 70
Multi-family Residential	50 to 59	60 to 70	Greater than 70
Hotels, Motels and Other Lodging Houses	50 to 59	60 to 70	Greater than 70
Long-term Care Facilities	50 to 59	60 to 70	Greater than 70
Hospitals	50 to 59	60 to 70	Greater than 70
Schools	50 to 59	60 to 70	Greater than 70
Multi-family common open space intended for the use and enjoyment of residents	50 to 67	---	Greater than 67
Parks and Playgrounds	50 to 65	---	Greater than 65

Sound levels are shown in Ldn, decibels except for Parks and Playgrounds, which is shown in Leq, decibels.

The following noise policies are excerpted from the General Plan:

> *N 1.1: Interior Noise Level Standard. Require submittal of an acoustical analysis and interior noise insulation for all "noise sensitive" land uses listed in Table N-1 that have an exterior noise level of 60 dBA (L_{dn}) or above, as shown on Figure N-1. The maximum interior noise level shall not exceed 45 dBA (L_{dn}) in any habitable rooms.*
>
> *N 1.2: Exterior Noise Level Standard. Require an acoustical analysis for new parks, play areas, and multi-family common open space (intended for the use and the enjoyment of residents) that have an exterior noise level of 60 dBA (L_{dn}) or above, as shown on Figure N-1. Require an acoustical analysis that uses peak hour L_{eq} for new parks and play areas. Require a feasibility analysis of noise reduction measures for public parks and play areas. Incorporate necessary mitigation measures into residential project design to minimize common open space noise levels. Maximum exterior noise should not*

exceed 67 dBA (L_{dn}) for residential uses and should not exceed 65 dBA (L_{eq}) during the noisiest hour for public park uses.

N 2.1: Noise Ordinance. Continue implementation and enforcement of the City's existing noise control ordinance: a) which prohibits noise that is annoying or injurious to neighbors of normal sensitivity, making such activity a public nuisance, and b) restricts the hours of construction to minimize noise impact.

N 2.2: Minimize Noise Impact. Protect all "noise-sensitive" land uses listed in Tables N-1 and N-2 from adverse impacts caused by the noise generated on-site by new developments. Incorporate necessary mitigation measures into development design to minimize noise impacts. Prohibit long-term exposure increases of 3 dBA (L_{dn}) or greater at the common property line, or new uses which generate noise levels of 60 dBA (L_{dn}) or greater at the property line, excluding existing ambient noise levels.

N 2.3: Minimize Commercial Noise. Protect land uses other than those listed as "noise sensitive" in Table N-1 from adverse impacts caused by the on-site noise generated by new developments. Incorporate necessary mitigation measures into development design to minimize noise impacts. Prohibit new uses that generate noise levels of 65 dBA (L_{dn}).

12.3.3.2 San Mateo Municipal Code

Chapter 7.30 of the *San Mateo City Charter and Municipal Code* (Municipal Code) (City of San Mateo, 2015) establishes maximum permissible noise levels for various noise zones and land uses. The noise zones and the maximum permissible noise levels are shown in Table 12-4.

TABLE 12-4
San Mateo Municipal Code Maximum Permissible Noise Levels
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Noise Zone	Description	Time Period	Noise Level (dB)
1	All property in any single family residential zone (including adjacent parks and open space) as designated on the City's zoning map prepared pursuant to the provisions of Title 27, or any revisions thereto.	10:00 p.m. to 7:00 a.m. 7:00 a.m. to 10:00 p.m.	50 60
2	All property in any commercial/mixed residential, multi-family residential, specific plan district, or public utility district as designated.	10:00 p.m. to 7:00 a.m. 7:00 a.m. to 10:00 p.m.	55 60
3	All property in any commercial or central business district as designated on the City's zoning map prepared pursuant to the provisions of Title 27, or any revisions thereto.	10:00 p.m. to 7:00 a.m. 7:00 a.m. to 10:00 p.m.	60 65
4	All property in any manufacturing or industrial zone as designated on the City's zoning map prepared pursuant to the provisions of Title 27, or any revisions thereto.	Anytime	70

Source: City of San Mateo, 2015.

In addition, Chapter 7.30 of the Municipal Code states it is unlawful for any person to operate or cause to be operated any source of sound at any location within the City or allow the creation of any noise on property owned, leased, occupied or otherwise controlled by such person, which causes the noise level when measured on any other property to exceed:

- The noise level standard for that property as specified in above for a cumulative period of more than 30 minutes in any hour
- The noise level standard plus 5 dBA for a cumulative period of more than 15 minutes in any hour
- The noise level standard plus 10 dBA for a cumulative period of more than 5 minutes in any hour

- The noise level standard plus 15 dBA for a cumulative period of more than 1 minute in any hour
- The noise level standard or the maximum measured ambient noise level, plus 20 dBA for any period of time

If the measured ambient noise level for any area is higher than the standard established above, then the ambient noise level shall be the base noise level standard. In such cases, the noise levels shall be increased in 5-dBA increments above the ambient noise level.

The Municipal Code states that utility and street repairs, street sweepers, garbage services, emergency response warning noises, emergency generators and fire alarm systems are exempt from this chapter. The Municipal Code also notes that construction, alteration, repair or land development activities that are authorized by a valid City permit shall be allowed on weekdays between 7 a.m. and 7 p.m., on Saturdays between 9 a.m. and 5 p.m., and on Sundays and holidays between 12 p.m. and 4 p.m., or at such other hours as may be authorized or restricted by the permit, if they meet at least one of the following noise limitations:

- No individual piece of equipment shall produce a noise level exceeding 90 dBA at a distance of 25 feet. If the device is housed within a structure or trailer on the property, the measurement shall be made outside the structure at a distance as close to 25 feet from the equipment if possible.
- The noise level at any point outside of the property plane of the project shall not exceed 90 dBA.
- The operation of leaf blowers shall additionally comply with Chapter 10.80 in the Municipal Code (City of San Mateo, 2015).

In addition, Section 7.30.070 of the Municipal Code allows exceptions if the applicant can show to the city manager, or the manager's designee, that a diligent investigation of available noise abatement techniques indicates that immediate compliance with the requirements would be impractical or unreasonable. A permit to allow exception from the provisions may be issued, with appropriate conditions to minimize the public detriment caused by such exceptions. The duration of the permit will be as short as possible, but in no case for longer than 6 months. These permits are renewable upon showing good cause, and shall be conditioned by a schedule for compliance and details of compliance methods in appropriate cases.

Chapter 23.06 Administrative Code of the Municipal Code identifies the conditions under which construction work outside of regularly allowed hours may occur (City of San Mateo, 2015). Specifically, the Code states:

> As a condition of approval of a planning application issued pursuant to Title 26 and Title 27 of this code, a condition may be established which authorizes an exemption from the hours of work designated in Section 23.06.060 if the Building Official finds that:
>
> (a) The following criteria are met:
>
> (1) Permitting extended hours of construction will decrease the total time needed to complete the project thus mitigating the total amount of noise associated with the project as a whole; or
>
> (2) An emergency situation exists where the construction is necessary to correct an unsafe or dangerous condition resulting in obvious and eminent peril to public health and safety. If such a condition exists, the City may waive any of the remaining requirements outlined below.
>
> (b) The exemption will not conflict with any other conditions of approval required by the City to mitigate significant impacts.
>
> (c) The contractor or owner of the property will notify residential and commercial occupants of property adjacent to the construction site of the hours of construction activity which may

impact the area. This notification must be provided three days prior to the start of the construction activity.

(d) The approved hours of construction activity will be posted at the construction site in a place and manner that can be easily viewed by an interested member of the public.

(e) The Building Official may revoke the exemption at any time if the contractor or owner of the property fails to abide by the conditions of the exemption or if it is determined that the peace, comfort and tranquility of the occupants of adjacent residential or commercial properties are impaired because of the location and nature of the construction.

A Waiver of Work Hours application can be submitted for staff approval for nighttime work. A letter of notification must be sent to the residents in the surrounding neighborhood (Kenyon, 2015).

12.4 Assessment Methods and Thresholds of Significance

The analysis of impacts was based on noise levels of typical construction equipment and treatment plant facilities. One of the more recent and complete compilations of construction equipment noise is the Roadway Construction Noise Model prepared by the Federal Highway Administration (FHWA). The *Roadway Construction Noise Model User's Guide* (RCNM User Guide) (FHWA, 2006) is one of the most comprehensive construction noise databases ever developed in the United States, and the expected equipment noise levels listed in it are used for this evaluation. Given the linear nature of highway and pipeline construction, the method developed by FHWA can be reasonably applied to pipeline construction activities.

Equipment noise levels from Table 1 in the RCNM User Guide are shown in Table 12-5. All listed noise levels are maximum A-weighted sound pressure levels at a reference distance of 50 feet. The acoustical usage factor is the fraction of time that the equipment generates noise at the maximum level. The model calculates the total noise level at the receptor by determining the noise from each piece of equipment, taking into account the reduction of noise with distance due to geometric divergence, and logarithmically adding the contribution of each piece of equipment to get the total noise anticipated from all of the construction equipment. Geometric divergence is the primary mechanism of noise reduction close to a noise source. At farther distances, additional attenuation (e.g., ground effects and atmospheric attenuation) can be significant. This excess attenuation is not accounted for in the model; therefore, the model output should be considered conservatively high.

TABLE 12-5
Construction Equipment Noise Levels from the RCNM User Guide
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Equipment Description	Acoustical Usage Factor (%)	Specified L_{max} at 50 feet (dBA)	Actual Measured L_{max} at 50 feet (dBA)	Number of Actual Data Samples
All Other Equipment Greater than 5 Horsepower	50	85	N/A	0
Auger Drill Rig	20	85	84	36
Backhoe	40	80	78	372
Bar Bender	20	80	N/A	0
Blasting	N/A	94	N/A	0
Boring Jack Power Unit	50	80	83	1
Chain Saw	20	85	84	46
Clam Shovel (dropping)	20	93	87	4
Compactor (ground)	20	80	83	57
Compressor (air)	40	80	78	18

TABLE 12-5

Construction Equipment Noise Levels from the RCNM User Guide

Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Equipment Description	Acoustical Usage Factor (%)	Specified L_{max} at 50 feet (dBA)	Actual Measured L_{max} at 50 feet (dBA)	Number of Actual Data Samples
Concrete Batch Plant	15	83	N/A	0
Concrete Mixer Truck	40	85	79	40
Concrete Pump Truck	20	82	81	30
Concrete Saw	20	90	90	55
Crane	16	85	81	405
Dozer	40	85	82	55
Drill Rig Truck	20	84	79	22
Drum Mixer	50	80	80	1
Dump Truck	40	84	76	31
Excavator	40	85	81	170
Flat Bed Truck	40	84	74	4
Front End Loader	40	80	79	96
Generator	50	82	81	19
Generator (less than 25 kilovolt-amperes, VMS signs)	50	70	73	74
Gradall	40	85	83	70
Grader	40	85	N/A	0
Grapple (on backhoe)	40	85	87	1
Horizontal Boring Hydraulic Jack	25	80	82	6
Hydra Break Ram	10	90	N/A	0
Impact Pile Driver	20	95	101	11
Jackhammer	20	85	89	133
Man Lift	20	85	75	23
Mounted Impact Hammer (hoe ram)	20	90	90	212
Pavement Scarafier	20	85	90	2
Paver	50	85	77	9
Pickup Truck	40	55	75	1
Pneumatic Tools	50	85	85	90
Pumps	50	77	81	17
Refrigerator Unit	100	82	73	3
Rivet Buster/chipping gun	20	85	79	19
Rock Drill	20	85	81	3
Roller	20	85	80	16
Sand Blasting (single nozzle)	20	85	96	9

TABLE 12-5

Construction Equipment Noise Levels from the RCNM User Guide

Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Equipment Description	Acoustical Usage Factor (%)	Specified L_{max} at 50 feet (dBA)	Actual Measured L_{max} at 50 feet (dBA)	Number of Actual Data Samples
Scraper	40	85	84	12
Shears (on backhoe)	40	85	96	5
Slurry Plant	100	78	78	1
Slurry Trenching Machine	50	82	80	75
Soil Mix Drill Rig	50	80	N/A	0
Tractor	40	84	N/A	0
Vacuum Excavator (vac-truck)	40	85	85	149
Vacuum Street Sweeper	10	80	82	19
Ventilation Fan	100	85	79	13
Vibrating Hopper	50	85	87	1
Vibratory Concrete Mixer	20	80	80	1
Vibratory Pile Driver	20	95	101	44
Warning Horn	5	85	83	12
Welder/Torch	40	73	74	5

Source: FHWA, 2006.

N/A = not applicable

As described in the RCNM User Guide, the average noise level from each piece of equipment is determined by the following formula for geometric spreading:

Reference Noise Level – 20*log(distance to receptor/50) + 10*log(usage factor %/100)

The total noise level is determined in the model adding of the decibel contribution for each piece of equipment. Additional details are provided in the RCNM User Guide.

Review of the table of construction equipment noise levels indicates that the loudest equipment generally emits noise in the range of 80 to 90 dBA at 50 feet. Noise at any specific receptor is dominated by the closest and loudest equipment. The types and numbers of construction equipment near any specific receptor location will vary over time. At this time, the specific types and relative locations of construction equipment are not precisely known. The construction noise estimate was based on conservative assumptions of multiple pieces of loud equipment operating close to each other. This is believed to be a conservative, yet realistic, scenario. Assumptions include the following:

- One piece of equipment generating a reference noise level of 85 dBA at 50 feet with a 40 percent usage factor located at the edge of the construction area
- Two pieces of equipment generating reference 85-dBA noise levels located 50 feet farther away from the edge of construction
- Two more pieces of equipment generating reference 85-dBA noise levels located 100 feet farther away the edge of construction

Average construction equipment noise levels at various distances, based on this scenario, are presented in Table 12-6. This extrapolation likely overstates noise impacts because it only considers geometric spreading and does not account for atmospheric absorption, ground effects, or other noise attenuation mechanisms.

TABLE 12-6
Construction Equipment Noise Levels versus Distance
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Distance from Construction Boundary (feet)	L_{eq} Noise Level (dBA)
50	83
100	79
200	74
400	69
800	63
1,600	58

Sound barriers are a common noise minimization measure that may be implemented to address construction or operational noise concerns. Noise walls interrupt noise propagation and create an "acoustic shadow zone." The sound pressure level is lower in the shadow zone than in the respective unobstructed free field. Permanent noise barriers typically consist of earthen berms, freestanding walls (usually concrete), a combination of berms and walls, or pre-engineered panels. The effectiveness of these barriers depends on two primary design features:

1. The barrier must be high enough to break the line of sight between the observer and the noise source and long enough to prevent noise leaks around the ends.
2. Noise must not be transmitted through the barrier.

The effectiveness of a noise barrier is quantified by its field insertion loss, which is the difference in the noise levels at the same location before and after the barrier is constructed.

Plywood walls, mass-loaded vinyl (vinyl impregnated with metal), and hay bales have been used to create temporary walls around noisy equipment or site perimeters. The barrier should be tall enough to block the line of sight to the noise-generating portion of project area. For most diesel-powered equipment, the wall would have to be tall enough to block the line of sight to the engine exhaust. A barrier wall constructed of ¾-inch plywood that minimizes open spaces (gaps) may achieve a 5- to 10-dBA reduction; a practical limit of barrier effectiveness is typically 20 dBA.

12.4.1 Thresholds of Significance

The CWP would cause a significant impact related to noise if it would result in the following:

- Exposure of persons to or generation of noise levels in excess of standards established in the General Plan or noise ordinance, or applicable standards of other agencies.
- Exposure of persons to or generation of excessive ground borne vibration or ground borne noise levels.
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

- For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, the project would expose people residing or working in the project area to excessive noise levels.
- For a project within the vicinity of a private airstrip, the project would expose people residing or working in the project area to excessive noise levels.

12.5 Environmental Impacts

The Program Area is not located within an airport land use plan area, within 2 miles of a public airport or private airstrip. Therefore, noise impacts related to airports are not discussed further. Table 12-7 summarizes noise impacts from the CWP.

TABLE 12-7
Summary of Noise Impacts
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Impact	In-System Storage Program	Full Conveyance Program	New Headworks Project	Primary Clarifier Project
Impact 12-1. Construction of the CWP could result in generation of noise levels in excess of standards.	Significant and unavoidable impact	Significant and unavoidable impact	Significant and unavoidable impact	Significant and unavoidable impact
Impact 12-2. Operation of the CWP could result in a substantial temporary or permanent increase in ambient noise levels in the project vicinity above levels existing without the CWP.	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation
Impact 12-3. Implementation of the CWP could generate perceptible offsite vibration.	Significant and unavoidable impact	Significant and unavoidable impact	Significant and unavoidable impact	Significant and unavoidable impact

Impact 12-1. Construction of the CWP could result in generation of noise levels in excess of standards.

In-System Storage Program

For temporary construction activities, the Municipal Code provides higher sound levels when authorized by a City permit and in compliance with Chapter 7.30 of the San Mateo Municipal Code.

Collection System Projects

Construction activities related to pipeline repair, upgrades, replacements, and new pipes would occur throughout the duration of the CWP and throughout the Program Area. As previously discussed, Section 7.30 of the Municipal Code states that utility repairs are exempt from the noise standards.

For individual pipeline projects involving replacement or new pipeline construction, the construction duration would be approximately 3 to 5 days for a 500-foot segment. Therefore, the period of greatest potential noise generation from pipeline replacement or new pipeline construction in any one area would be limited in duration. Major construction activities that may generate substantial noise would be expected to be 1 to 4 months in duration for major pump station improvements and up to 6 months for in-system equalization basin construction. The construction schedule for collection system projects would comply with the days and hours set forth in the Municipal Code.

The Municipal Code states that the noise level at any point outside of the property plane of the project shall not exceed 90 dBA. As shown in Table 12-6, the average construction equipment noise level would be approximately 83 dBA at 50 feet. Many of the typical pieces of construction equipment listed in Table 12-5 have individual measured noise levels at 50 feet up to 83 dBA. The Noise Element of the General Plan (City

of San Mateo, 2010) notes that doubling of the distance from a fixed noise source results in a 6 dBA decrease in noise level. Therefore, the average construction equipment noise level and the noise level for many individual pieces of construction equipment at 25 feet would be approximately 89 dBA, below the 90 dBA threshold. Most construction would be taking place more than 25 feet from the property plane. However, if individual construction equipment such as jackhammers, clam shovels, or auger drill rigs that could generate noise at 84 dBA or higher at 50 feet (see Table 12-5) are used, the equipment could exceed the 90 dBA limit if used close to the property plane. This is a potentially significant impact. Implementation of **Mitigation Measure 12-1a Develop and implement construction noise minimization measures**, **Mitigation Measure 12-1b Operate a construction noise hot line**, and **Mitigation Measure 12-1c Resolve construction noise complaints** would help minimize construction noise impacts from collection system construction projects. However, on occasion individual equipment noise may still exceed 90 dBA at the property plane, even with mitigation implemented. Impacts from construction would be significant and unavoidable, depending on the equipment type and location used.

Wastewater Treatment Plant Projects

Construction of treatment plant facilities is expected to generally be similar to other industrial projects in terms of the equipment used and types of activities; typical construction equipment is listed in Table 12-5. Noise levels will vary during the construction period, depending on the construction phase. Construction of industrial facilities can generally be divided into five phases that use different types of construction equipment: (1) site preparation and excavation; (2) concrete pouring; (3) steel erection; (4) mechanical installation; and (5) cleanup (Miller et al., 1978).

Average or equivalent construction noise levels projected at various distances from the site are presented in Table 12-8. These results are representative of long-term averages; instantaneous levels could be higher or lower, depending on the specific activity. Most new wastewater treatment facilities would need to be constructed on piles, because of the soil conditions at the WWTP Site. As listed in Table 12-5, pile drivers could have a measured noise level of 101 dBA at 50 feet or 107 dBA at 25 feet. The pile drivers and other equipment could exceed 90 dBA at the property plane, depending on location used. This is a potentially significant impact for the In-System Storage Program. Implementation of **Mitigation Measure 12-1a Develop and implement construction noise minimization measures**, **Mitigation Measure 12-1b Operate construction noise hot line**, and **Mitigation Measure 12-1c** Resolve **construction noise complaints** would help minimize noise impacts from wastewater treatment construction projects. However, individual equipment noise may still exceed 90 dBA at the property plane, even with mitigation incorporated. In addition, nighttime construction would be performed occasionally, when WWTP operations must be taken offline for several hours, as allowed through an hours of work exemption. Impacts from construction would be significant and unavoidable.

TABLE 12-8
Average Construction Noise Levels at Various Distances
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Construction Phase	Noise Level (dBA)		
	At 375 feet	At 1,500 feet	At 3,000 feet
Demolition, Site Clearing, and Excavation	71	59	53
Concrete Pouring	60	48	42
Steel Erection	69	57	51
Mechanical	69	57	51
Cleanup	71	59	53

Source: Barnes et al. (1976)

Full Conveyance Program

The construction noise impacts of the Full Conveyance Program would be the same as described for the In-System Storage Program. Potentially significant construction impacts could occur from use of construction equipment that exceeds 90 dBA at the property plane. Implementation of **Mitigation Measure 12-1a Develop and implement construction noise minimization measures**, **Mitigation Measure 12-1b Operate a construction noise hot line**, and **Mitigation Measure 12-1c Resolve construction noise complaints** would help minimize noise impacts from collection system and wastewater treatment construction projects. However, individual equipment noise may still exceed 90 dBA at the property plane, even with mitigation incorporated. In addition, nighttime construction would be required occasionally, when WWTP operations must be taken offline for several hours. Construction noise impacts of the Full Conveyance Program would be significant and unavoidable.

New Headworks Project and Primary Clarifier Project

The impacts of the New Headworks Project and Primary Clarifier Project would be the same as described for the In-System Storage Program. Potentially significant construction impacts could occur from use of construction equipment that exceeds 90 dBA at the property plane. Implementation of **Mitigation Measure 12-1a Develop and implement construction noise minimization measures**, **Mitigation Measure 12-1b Operate a construction noise hot line**, and **Mitigation Measure 12-1c Resolve construction noise complaints** would help minimize noise impacts from project construction. However, individual equipment noise may still exceed 90 dBA at the property plane, even with mitigation incorporated. In addition, nighttime construction would be required occasionally, when WWTP operations must be taken offline for several hours. Construction noise impacts from the New Headworks Project and Primary Clarifier Project would be significant and unavoidable.

Impact 12-2. Operation of the CWP could result in a substantial temporary or permanent increase in ambient noise levels in the project vicinity above levels existing without the CWP.

In-System Storage Program

The General Plan defines a substantial or significant increase as an increase in the existing L_{dn} of at least 3 dBA at noise sensitive receivers such as residences, hotels/motels/lodging, long-term care facilities, hospitals, schools, and multifamily common open-space areas (see Figure 14-2). A project would also be considered to a have a significant impact if it generates noise levels above an L_{dn} of 60 dBA at noise-sensitive receivers and above L_{dn} 65 dBA in commercial areas.

Short-term operational and maintenance activities may result in a temporary increase in noise levels, but such levels are not anticipated to exceed current noise levels from operations and maintenance. In addition, the new infrastructure would be in better condition and require less maintenance than existing infrastructure, reducing the amount of maintenance required.

Pump station projects include replacing existing pumps with larger pumps or installing new pumps, which could increase the level of noise generated by the pumps. However, the pumps would be located underground, and changes in noise levels would not be expected to be discernible at the ground surface. The in-system storage basin would include new pumps to empty the basin after use; these pumps would be underground and their noise would not be expected to be discernible at the ground surface. In addition, the in-system storage basin pumps would typically be used only a few times each year.

Off-site operational sound levels are anticipated to be less than existing operational noise levels. The new WWTP facilities would be located farther from sensitive receptors than the existing facilities they would replace and could reduce noise levels compared to existing conditions. No substantial permanent increase in ambient noise levels from implementation of the In-System Storage Program would be expected. Implementation of **Mitigation Measure 12-2 Incorporate noise minimization in WWTP facility design** would further reduce any noise generated.

Full Conveyance Program

The operational noise impacts of the Full Conveyance Program would be the same as described for the In-System Storage Program. Short-term operational and maintenance activities may result in a temporary increase in noise levels, but the levels are not anticipated to exceed current noise levels from operations and maintenance. In addition, the new infrastructure would be in better condition and require less maintenance than existing infrastructure, reducing the amount of maintenance required.

Pump station projects include (1) replacing existing pumps with larger pumps or installing new pumps, which could increase the level of noise generated by the pumps, and (2) the new Dale Avenue Pump Station, which would include new pumps. However, the pumps would be located underground, and changes in noise levels would not be expected to be discernible at the ground surface.

Offsite operational sound levels are anticipated to be less than existing operational noise levels. The new WWTP facilities would be located farther from sensitive receptors than the existing facilities they would replace. The newer equipment would require less maintenance, operate more efficiently, and be enclosed in upgraded buildings, all contributing to reducing noise levels compared to existing conditions. No substantial permanent increase in ambient noise levels from implementation of the Full Conveyance Program would be expected. Implementation of **Mitigation Measure 12-2 Incorporate noise minimization in WWTP facility design** would reduce any noise generated.

New Headworks Project and Primary Clarifier Project

The operational noise impacts of the New Headworks Project and Primary Clarifier Project would be the same as described for operations of the WWTP for the In-System Storage Program. Offsite operational sound levels are anticipated to be less than existing operational noise levels. The new facilities would be located on Detroit Drive, farther from sensitive receptors than the existing facilities they would replace. The newer equipment would require less maintenance and operate more efficiently, contributing to reduced noise levels compared to existing conditions. No substantial permanent increase in ambient noise levels from implementation of the New Headworks or the Primary Clarifier Project would be expected. Implementation of **Mitigation Measure 12-2 Incorporate noise minimization in WWTP facility design** would further reduce any noise generated.

Impact 12-3. Implementation of the CWP could generate perceptible offsite vibration.

In-System Storage Program

Construction of pipeline projects in roadways or construction of in-system storage basins could be 50 to 100 feet from residences, potentially creating perceptible vibration. Construction of the In-System Storage Program would entail pile driving, primarily at the WWTP Site, which could create perceptible offsite vibration. Depending on the nature of activity and the type and proximity to structures, various vibration criteria, such as Federal Transit Administration criteria, could be exceeded. Implementation of **Mitigation Measure 12-3 Incorporate vibration issues into project construction** would reduce the effects of offsite vibration. However, depending on type, location, and duration of the construction activity, vibration impacts may still exceed applicable criteria; impacts from construction may be significant and unavoidable.

The equipment that would be used in the In-System Storage Program would be well balanced and designed to produce very low vibration levels throughout the life of the facilities. In addition, the new WWTP facilities would be located farther from sensitive receptors than the existing facilities they would replace. No operational vibration impacts would be expected.

Full Conveyance Program

Construction of pipeline projects in roadways or construction of the new Dale Avenue Pump Station could be 50 to 100 feet from residences, potentially creating perceptible vibration. Construction of the Full Conveyance Program would entail pile driving, primarily at the WWTP Site, which could create perceptible offsite vibration. Depending on the nature of activity and the type and proximity to structures, various

vibration criteria, such as Federal Transit Administration criteria, could be exceeded. Implementation of **Mitigation Measure 12-3 Incorporate vibration issues into project construction** would reduce the effects of offsite vibration. However, depending on type, location, and duration of the construction activity, vibration impacts may still exceed applicable criteria; impacts from construction may be significant and unavoidable.

The equipment that would be used in the Full Conveyance Program would be well balanced and designed to produce very low vibration levels throughout the life of the facilities. In addition, the new WWTP facilities would be located farther from sensitive receptors than the existing facilities they would replace. No operational vibration impacts would be expected.

New Headworks Project and Primary Clarifier Project

Construction of the New Headworks Project and Primary Clarifier Project would entail pile driving, which could create perceptible offsite vibration. Depending on the nature of activity and the type and proximity to structures, various vibration criteria, such as Federal Transit Administration criteria, could be exceeded. Implementation of **Mitigation Measure 12-3 Incorporate vibration issues into project construction** would reduce the effects of offsite vibration. However, depending on type, location, and duration of the construction activity, vibration impacts may still exceed applicable criteria; impacts from construction may be significant and unavoidable.

The equipment that would be used in the New Headworks Project and Primary Clarifier Project would be well balanced and designed to produce very low vibration levels throughout the life of the facilities. In addition, the new WWTP facilities would be located farther from sensitive receptors than the existing facilities they would replace. No operational vibration impacts would be expected.

12.6 Mitigation Measures

Mitigation Measure 12-1a. Develop and implement construction noise minimization measures. General noise minimization measures available to reduce sound levels from construction activities include but are not limited to the following:

- Specify general construction noise mitigation measures that require the contractor to use equipment that is in good working order, adequately muffled, and maintained in accordance with the manufacturers' recommendations.
- Use semi-permanent stationary equipment (e.g., generators and lights) with "quiet" packages (as available) and stationing it as far from sensitive areas as possible.
- During construction, erect temporary barriers using materials such as intermodal containers or frack tanks, plywood walls, mass-loaded vinyl (vinyl impregnated with metal), or hay bales. Barriers shall be erected as close as safely feasible to the noise source. Barriers shall be used when equipment is expected to exceed 90 dBA at the property plane, based on actual measured noise levels for the specific equipment, as cited in *Roadway Construction Noise Model User's Guide* (FHWA, 2006). The barrier shall be designed to provide sufficient attenuation to reduce noise to less than 90 dBA at the property plane, as feasible.

If a diligent investigation of available noise abatement techniques indicates that immediate compliance with the requirements would be impractical or unreasonable, the contractor shall obtain an exceptions permit per Section 7.30.070 of the Municipal Code. The permit shall be issued by the city manager, or the manager's designee, with appropriate conditions to minimize the public detriment caused by such exceptions. The duration of the permit shall be as short as possible, but in no case for longer than 6 months.

Mitigation Measure 12-1b. Operate a construction Noise Hot Line. The City shall establish a telephone number for use by the public to report any significant undesirable noise conditions associated with construction and demolition of CWP projects. If the telephone is not staffed 24 hours per day, the City shall include an automatic answering feature, with date and time stamp recording, to answer calls when the

phone is unattended. This telephone number shall be posted at the project site during construction and demolition so that it is visible to passersby. This telephone number shall be maintained during CWP construction.

Mitigation Measure 12-1c. Resolve construction Noise Complaints. Throughout construction of the CWP, all legitimate project-related noise complaints shall be documented, investigated, evaluated, and resolved as feasible. The City or its authorized agent shall be responsible for the following:

- Use the Noise Complaint Resolution Form typically suggested by the California Energy Commission, or a functionally equivalent procedure, to document and respond to each noise complaint.
- Attempt to contact the person(s) making the noise complaint within 24 hours.
- Conduct an investigation to attempt to determine the source of noise related to the complaint.
- If the noise complaint is legitimate, implement feasible measures to reduce the noise.

Mitigation Measure 12-2. Incorporate noise minimization in WWTP facility design. The final WWTP design would implement necessary measures so that noise-generating equipment with appropriate noise-minimization features to comply with applicable requirements. Potential noise design measures include but are not limited barriers, enclosures, vibration isolation, and quieter equipment specifications. Final design shall include noise minimization measures to limit sound levels attributable to each project to an increase in existing L_{dn} of less than 3 dBA or L_{dn} of 60 dBA at noise-sensitive receivers and less than L_{dn} 65 dBA in commercial areas.

Mitigation Measure 12-3. Incorporate vibration issues into project construction. As part of the final design effort, the potential for construction activities to result in excess vibration shall be assessed and site specific minimization measures for each CWP project implemented as necessary.

12.7 References

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