
Appendix E

Noise and Vibration Technical Report

NCE has made every effort to provide this report and all associated information in an accessible format. If you need the appendices in an alternative format please contact Jeffrey Esquivel, (916) 341-6337, jeffery.esquivel@calrecycle.ca.gov.

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**Noise and Vibration Impact Study for
Small/Medium Composting Project
Permitting**

Noise and Vibration Impact Study Small/Medium Composting Project Permitting

Prepared for:

**California Department of Resources
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Attachments

ATTACHMENT 1 – CONSTRUCTION NOISE CALCULATIONS

ATTACHMENT 2 – OPERATIONAL NOISE CALCUATIONS

List of Acronyms and Abbreviations

ASP	Aerated Static Pile
CalEEMod	California Emissions Estimator Model®
CASP	Covered Aerated Static Pile
CNEL	Community Noise Equivalent Level
cy	Cubic Yards
dB	Decibel
dBA	A-Weighted Decibel
ft.	feet
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
Hz	Hertz
in/sec	Inches per Second
L _{dn}	Day-Night Noise Level (a.k.a. DNL)
L _{eq}	Equivalent Energy Level
L _{max}	Maximum Level of Noise
m	Meters
MM NOI-1	Mitigation Measure Noise-1
OPR	[California] Office of Planning and Research
PEIR	Program Environmental Impact Report
PPV	Peak Particle Velocity
RCNM	Roadway Construction Noise Model
RMS	Root Mean Square
SB	Senate Bill
TNM	Traffic Noise Model
TPY	Tons per Year

Noise and Vibration Impact Study for Small/Medium Composting Project Permitting

1.0 INTRODUCTION

1.1 Project Overview

The California Department of Resources Recycling and Recovery (CalRecycle) is preparing a Program Environmental Impact Report (PEIR) pursuant to Senate Bill (SB) 1046 to facilitate the permitting and development of small and medium compostable material handling facilities and operations throughout California. The PEIR is designed to support implementation of SB 1383 by increasing California's capacity to process organic waste diverted from landfills through the development of additional composting facilities throughout the State. Implementation of SB 1046 would result in the construction and operation of new small and medium composting facilities that process agricultural, food, and green materials.

1.2 Purpose and Objectives

This technical report provides the noise and vibration analyses prepared in support of the PEIR for the CalRecycle Small and Medium Composting Facilities Program.

Yorke evaluated the potential for noise and vibration impacts associated with construction and operation of representative composting facility scenarios developed for the program. This report contains:

- A description of the representative facility scenarios and analysis assumptions;
- A screening-level analysis of construction noise and vibration impacts; and
- An analysis of operational noise and vibration impacts.

1.3 Project Location

The program area encompasses the entire State of California. The program is intended to facilitate the development and operation of new small and medium compostable material handling facilities and operations; however, specific facility locations have not been identified.

1.4 Facility Operations and Project Description

The Statewide program would facilitate the development and operation of small and medium compostable material handling facilities that process agricultural, vegetative food, green, and other organic materials. As defined by SB 1046, small facilities, which are anticipated to occupy approximately 5 acres, would process up to 10,000 tons per year (TPY) of material, and would have an on-site capacity of up to 5,000 cubic yards (cy). Medium facilities, which are anticipated to occupy approximately 11 acres, would process up to 25,000 TPY of material, and would have an on-site capacity of up to 12,500 cy.

Composting operations typically involve feedstock receiving and preparation, active composting, curing, screening, and product export. Incoming feedstocks may be ground, shredded, and sorted to remove contaminants before being placed into windrows, positively covered aerated static piles (CASPs), or negatively aerated static pile (ASP) systems for active composting. ASPs use blowers to aerate the piles. Following the active composting phase, material would be cured, screened to remove oversized materials and contaminants, and transported off-site for use as a soil amendment

in agricultural, landscaping, and horticultural applications. Equipment commonly used during operations includes loaders, grinders, screeners, water trucks, and haul trucks. Windrow composting operations use windrow turners to agitate and aerate the piles; windrow turners can be self-propelled or towed by a tractor, loader, or other heavy equipment.

Heavy equipment operations, such as chipping, grinding, front-loader use, and truck activities associated with composting facility operations, are anticipated to occur during daytime hours, generally between 6:00 a.m. and 6:00 p.m., Monday through Saturday. However, some local jurisdictions define daytime hours as beginning at 7:00 a.m. and apply more stringent noise standards during nighttime or early morning hours. Accordingly, facilities located in proximity to sensitive receptors may require modified operating hours (e.g., 7:00 a.m. to 7:00 p.m.) or other noise reduction measures to comply with applicable local noise standards. The anticipated noise-generating equipment and estimated noise levels for each equipment type are presented in Table 1-1.

Table 1-1: List of Noise Generating Equipment

Equipment Type	Estimated Sound Level at 50 ft. (dBA)	Usage Factor %
Grinders ¹	90	50%
Screens ¹	85	50%
Stackers ¹	80	40%
Colorizer ¹	85	50%
Emergency Generator ^{1,3}	82	50%
Emergency Fire Pump ^{1,3}	85	50%
Tractors ²	84	40%
Excavator ²	85	40%
Loader ²	84	40%
Water Truck ²	84	40%
Windrow Turner ⁴	84	40%
Sweeper Truck ²	80	10%
Fuel Truck ²	84	5%

Notes/Sources:

¹ Manufacturer specifications and published product literature.

² Federal Highway Administration (FHWA) 2006: pg. 3. Water truck and fuel truck noise levels were assumed to be equivalent to dump truck operations. A 5 percent usage factor was assumed for fuel truck activities due to the intermittent nature of on-site equipment refueling.

³ Usage factors shown are representative of periodic testing and maintenance activities. For purposes of evaluating noise during emergency conditions, emergency generators and fire pumps were separately evaluated assuming 100% utilization.

⁴ Windrow turner noise levels and usage factors were assumed to be equivalent to a loader based on comparable engine horsepower and operating characteristics.

2.0 NOISE AND VIBRATION FUNDAMENTALS

2.1 Definition and Measurement of Noise

Sound is a pressure wave created by a moving or vibrating source that travels through a fluid medium, such as air or water. Noise is defined as a sound or aggregated sounds that are perceived

as dissonant, irritating, objectionable, intrusive, and/or disruptive to the quality of daily life. Sound is measured on a logarithmic scale of sound pressure level known as the decibel (dB) scale. A-weighted decibels (dBA) approximate the subjective response of the human ear to broad frequency sound sources by discriminating against very low and very high frequencies of the audible spectrum. The dBA scale is weighted to reflect only those frequencies that are audible to the human ear, generally defined as a range of 20 to 20,000 hertz (Hz). Figure 2-1 presents a range of noise levels associated with common indoor and outdoor activities.

Figure 2-1: Typical Noise Levels and Effects on People

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110	Rock band
Jet flyover at 1,000 feet		
	100	
Gas lawnmower at 3 feet		
	90	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower, 100 feet	70	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60	
		Large business office
Quiet urban daytime	50	Dishwasher in next room
Quiet urban nighttime	40	Theater, large conference room (background)
Quiet suburban nighttime		
	30	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20	
		Broadcast/recording studio
	10	
	0	

Source: Caltrans 2013, pg. 2-20.

2.2 Noise Descriptors

Environmental noise descriptors are generally based on time weighted averages, rather than instantaneous noise levels. Noise levels emitted by various sources are often expressed as equivalent energy level (L_{eq}). Maximum Level of Noise (L_{max}) is the root mean squared (RMS) maximum level of a noise source or environment measured on a sound level meter during a designated time interval (e.g., 15, 30, or 60 minutes) using fast meter response.

Because sound levels at a particular location typically vary over the course of the day and because people tend to be more sensitive to noise in the evening and at night than during the morning and afternoon, sound levels are commonly averaged over a 24-hour period as it is important to account for the difference in human response to daytime and nighttime noise. Noise is more disturbing at night than during the day and noise indices have been developed to account for the varying duration of noise events over time, as well as community response to them. The Community Noise

Equivalent Level (CNEL) adds a 5-dB penalty to the “evening” noise levels (i.e., 7:00 p.m. to 10:00 p.m.) and a 10-dB penalty to the “nighttime” noise levels (i.e., 10:00 p.m. to 7:00 a.m.). The Day-Night Noise Level (L_{dn}) adds a 10-dB penalty to the “nighttime” noise levels. The latter two expressions of average “nighttime” sound levels are nearly equivalent, and while a general plan noise element usually refers to CNEL, standards cited from certain state and federal regulations may use L_{dn} ¹. (Caltrans 2013: pg. 2-48)

2.3 Noise Range

Decibel scales are logarithmic, such that an increase from 30 to 40 dB represents a tenfold increase in sound level, while an increase from 30 to 50 dB represents a hundredfold increase. Human perception of sound loudness, however, is subjective. Everyday sounds normally range from 30 dBA (very quiet, such as a soft whisper) to approximately 100 dBA [very loud, such as the noise produced by a jet flyover at a distance of 1,000 feet (ft.)].

2.4 Human Response to Changes in Noise Levels

In general, the healthy human ear is most sensitive to sounds between 1,000 Hz and 5,000 Hz and it perceives a sound within that range as being more intense than a sound with a higher or lower frequency with the same magnitude. For purposes of this report, as well as with most environmental documents, overall sound levels are determined by applying frequency weighted adjustments to spectral sound levels. The dBA weighting scale is used to mimic human hearing response; therefore, sound is reported in terms of dBA. Typically, the human ear can barely perceive a change in noise level of 3 dBA. A change in noise level of 5 dBA is readily perceptible and a change of 10 dBA is perceived as being twice or half as loud.

2.5 Sound Propagation

Sound is transmitted in the air by pressure variations from its source to the surroundings. While absorption by air is one of the factors attributing to the weakening of a sound during transmission, the sound level also decreases as the sound propagates away from the source. Depending on the source of the sound, for every doubling of distance, the level will be reduced between 3 and 6 dB. The reduction of a sound is called attenuation. Other factors for noise attenuation are terrain absorption (terrain loss) and shielding/obstructions (insertion loss).

To reduce line-of-sight noise transmission, sound walls are commonly installed between a noise source and a receptor, such as along freeways or near sensitive land uses. Other natural or manmade features, such as buildings, hills, rough terrain, and dense vegetation, can also contribute to noise attenuation. Standard sound walls typically reduce noise levels by 5 to 10 dBA, with taller walls providing greater attenuation. However, high-performance acoustic barriers, depending on their design, materials, and installation, can achieve reductions of 20 dBA or more. These barriers are most effective when placed close to either the noise source or the receptor.

2.6 Vibration Transmission

Construction activity can result in varying degrees of ground-borne vibration, depending on the equipment and methods employed. Operation of construction equipment can cause vibrations that spread through the ground that diminish in strength with distance, similar to sound attenuation.

¹ CNEL and L_{dn} are discussed herein because they are used in the California General Plan Guidelines for evaluating land use compatibility. However, operational noise impacts in this report are evaluated using L_{eq} , consistent with the noise standards commonly used by local jurisdictions.

While such ground-borne vibration is not a threat to humans or animals, buildings founded on the soil near a construction site may respond to these vibrations with varying effects, ranging from no perceptible effects at the lowest levels, low rumbling sounds and perceptible vibrations at moderate levels, and slight damage at the highest levels. Vibration amplitudes are usually expressed in peak particle velocity (PPV) or RMS vibration velocity. The PPV and RMS velocity are normally described in inches per second (in/sec). PPV is the maximum, instantaneous positive or negative peak of the vibration signal. PPV is often used in monitoring construction vibration since it is related to the stresses that are experienced by buildings and is generally not used to evaluate human response.

3.0 NOISE STANDARDS

3.1 Federal

The Federal Transit Administration (FTA) has developed procedures and significance criteria for evaluating noise and vibration impacts associated with construction activities. The FTA Transit Noise and Vibration Impact Assessment Manual identifies a construction noise impact threshold of 80 dBA L_{eq} at residential (i.e., sensitive) receptors (FTA 2018: pg. 179). Because specific facility locations and applicable local jurisdictional noise standards are not known at the program level, the FTA construction noise criterion was used to evaluate potential construction noise impacts. Future facilities developed under the program may be subject to more restrictive local noise standards, where applicable.

3.2 State of California 2017 General Plan Guidelines

The State of California General Plan Guidelines provide land use compatibility criteria based on CNEL. These guidelines are commonly used by local jurisdictions in developing noise standards and evaluating land use compatibility.

The California Governor's Office of Planning and Research's (OPR's) noise element guidelines include recommended exterior and interior noise level standards for local jurisdictions to identify and prevent the creation of incompatible land uses due to noise, e.g., residential next to industrial. The guidelines contain a table that describes the compatibility of various land uses with a range of environmental noise levels in terms of CNEL. Table 3-1, State of California Land Use Compatibility for Community Noise Environments, reproduces the guidelines for determining acceptable and unacceptable community noise exposure limits for various land use categories. The guidelines also present adjustment factors that may be used to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Table 3-1: State of California Land Use Compatibility for Community Noise Environments

Land Use Category	Community Noise Exposure (L_{dn} or CNEL, dBA)			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Residential – Low Density, Single-Family, Duplex, Mobile Homes	50-60	55-70	70-75	75-85
Residential – Multiple Family	50-65	60-70	70-75	70-85
Transient Lodging – Motel, Hotels	50-65	60-70	70-80	80-85
Schools, Libraries, Churches, Hospitals, Nursing Homes	50-70	60-70	70-80	80-85
Auditoriums, Concert Halls, Amphitheaters	N/A	50-70	N/A	65-85
Sports Arenas, Outdoor Spectator Sports	N/A	50-75	N/A	70-85
Playgrounds, Neighborhood Parks	50-70	N/A	65-75	75-85
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50-70	N/A	70-80	80-85
Office Buildings, Business Commercial and Professional	50-70	65-75	75-85	N/A
Industrial, Manufacturing, Utilities, Agriculture	50-75	70-80	75-85	N/A

Source: California Governor's OPR 2017: pg. 374.

3.3 Local Noise Standards

Because specific facility locations have not been identified, the applicable General Plan Noise Element policies, municipal code requirements, and noise ordinance provisions cannot be determined at this time. Future facilities developed under the program would be required to comply with the noise standards, policies, and ordinances adopted by the local jurisdiction with authority over the Project site.

Local jurisdictions throughout California commonly regulate noise through General Plan Noise Elements and municipal noise ordinances that establish land use compatibility criteria, exterior and interior noise standards for sensitive land uses, restrictions on construction hours, and limits on operational noise levels. Because these requirements vary among jurisdictions, site-specific noise analyses may be required during subsequent Project-level environmental review to evaluate consistency with applicable local noise standards and ordinance requirements.

4.0 SENSITIVE RECEPTORS

Sensitive receptors (a.k.a. noise-sensitive receptors) are land uses that may be adversely affected by excessive noise levels. These receptors typically include residences, schools, hospitals, places of worship, libraries, and similar uses where occupants may be more susceptible to noise disturbance.

Because specific facility locations have not been identified, the location of future sensitive receptors relative to individual composting facilities cannot be determined at this time. Therefore, the noise analysis was conducted using representative sensitive receptor distances to evaluate

potential construction and operational noise impacts. Future facilities developed under the program may require site-specific noise analyses to evaluate impacts on nearby sensitive receptors and compliance with applicable local noise standards.

5.0 FUTURE COMMUNITY NOISE IMPACTS

5.1 Construction

5.1.1 Methodology

5.1.1.1 Noise

The screening-level noise analysis for construction activities was completed based on methodology developed by the FHWA at the John A. Volpe National Transportation Systems Center and other technical references consistent with California Emissions Estimator Model® (CalEEMod) outputs (equipment utilization). The FHWA methodology uses actual noise measurement data collected during the Boston “Big Dig” project (1991–2006) as reference levels for a wide variety of construction equipment in common use, including equipment anticipated to be used for development of facilities under the program.

The FHWA noise model provides relatively conservative predictions because it does not account for site-specific geometry, dimensions of nearby structures, and local environmental conditions that can affect sound transmission, reflection, and attenuation. As a result, actual measured sound levels at receptors may vary somewhat from predictions and are typically lower. Additionally, the impacts of noise upon receptors are subjective because of differences in individual sensitivities and perceptions.

Because specific facility locations have not been identified, Project-specific construction noise analyses cannot be conducted at the program level. Therefore, construction noise levels were evaluated using representative construction equipment fleets for the small and medium composting facility scenarios and a representative sensitive receptor distance of 50 meters (m) [164 ft.]. The FHWA methodology predicts hourly equivalent sound levels (L_{eq}) generated by simultaneous construction equipment operation. Predicted noise levels were compared to the FTA daytime construction noise impact criterion of 80 dBA L_{eq} for residential receptors. Because specific facility locations and applicable local construction noise standards are unknown, the FTA criterion was used as a screening-level significance threshold for this program-level analysis. Future facilities developed under the program may require site-specific noise analyses to evaluate compliance with applicable local noise standards and ordinances, particularly where sensitive receptors are located closer than 50 m (164 ft.) or where local jurisdictions have adopted more restrictive noise standards.

5.1.1.2 Vibration

During construction activities, each composting facility would generate noise and vibration due to operation of off-road equipment, portable equipment, and vehicles at or near the Project site. No strong sources of vibrations (e.g., hard rock-breaking, large pile-driving) are anticipated to be required during the construction of the proposed facilities. FTA has published standard vibration velocities for construction equipment operations. The PPV vibration threshold for human annoyance is 0.2 in/sec (Caltrans 2020: pg. 22). Building damage can be cosmetic or structural. Generally, a PPV vibration threshold of approximately 0.3 in/sec is sufficient to avoid physical damage to engineered structures and 0.2 in/sec for non-engineered structures (FTA 2018: pg. 186; Caltrans 2020: pg. 24).

Table 5-1 presents average source levels in terms of velocity for different types of construction equipment. Table 5-2 presents the human response to different levels of ground-borne vibration and noise (Caltrans 2020: pg. 22). A vibration threshold of 0.2 PPV was selected as the significance threshold.

The vibration source level (PPV_{ref}) for each piece of equipment at a reference distance of 25 ft. was determined per Table 5-1. The following equation was then used to apply the propagation adjustment to the source reference level to account for the distance from the equipment to the receiver:

$$PPV_{equip} = PPV_{ref} \times \left(\frac{25}{D}\right)^{1.5}$$

where:

- PPV_{equip} = the peak particle velocity of the equipment
adjusted for distance, in/sec
 PPV_{ref} = the source reference vibration level at 25 ft,
in/sec
 D = distance from the equipment to the receiver, ft

Source: FTA 2018: pg. 185.

Table 5-1: FTA Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 ft. (in/sec)	
Pile Driver (Impact)	Upper Range	1.518
	Typical	0.644
Pile Driver (Sonic)	Upper Range	0.734
	Typical	0.170
Clam Shovel Drop (Slurry Wall)		0.202
Hydromill (Slurry Wall)	In Soil	0.008
	In Rock	0.017
Vibratory Roller		0.210
Hoe Ram		0.089
Large Bulldozer		0.089
Caisson Drilling		0.089
Loaded Trucks		0.076
Jackhammer		0.035
Small Bulldozer		0.003

Source: FTA 2018: pg. 184.

Note: This table is reproduced from FTA 2018 for reference purposes. Not all equipment listed in the table is anticipated to be used during construction of facilities evaluated under this PEIR.

Table 5-2: Human Response to Continuous Vibration from Traffic

PPV (in/sec)	Human Response
0.4-0.6	Unpleasant
0.2	Annoying
0.1	Begins to Annoy
0.08	Readily Perceptible
0.006-0.019	Threshold of Perception

Source: Caltrans 2020, pg. 22.

5.1.2 Impacts Analysis

5.1.2.1 Noise

The Project is expected to require up to approximately 1 year of planned work activities (i.e., from mobilization to substantial completion) comprising five construction phases:

1. Site preparation;
2. Grading;
3. Building construction;
4. Paving; and
5. Architectural coating.

During each of the construction phases, there would be a different mix of equipment operating, and cumulative noise levels would vary based on the amount of equipment in operation and the location of each activity at the Project site. In general, use of off-road equipment and portable equipment would generate noise due to engine mechanicals, engine exhaust, driveline mechanicals, shaft-driven devices and accessories, hydraulics operation, ground friction and displacement, and gravity drops (i.e., dumping and unloading).

Temporary construction noise would occur during site preparation, grading, building construction, and paving activities when heavy equipment is operating. Construction activities are anticipated to occur during daytime hours. Because specific facility locations have not been identified, applicable local construction hour restrictions cannot be determined at this time. Future facilities developed under the program would be required to comply with local construction hour restrictions and noise ordinance requirements established by the jurisdiction with authority over the Project site. Construction noise would be temporary in nature and would cease upon completion of construction.

Tables 5-3 and 5-4 summarize the estimated daytime construction noise levels for the representative small and medium composting facility scenarios at a receptor distance of 50 m (164 ft.) and compare the results to the FTA construction noise impact criterion of 80 dBA L_{eq} . Construction noise levels that do not exceed the FTA criterion are considered Less Than Significant.

Table 5-3: Estimated Construction Noise Levels at a Representative Sensitive Receptor (50 Meters) – Small Facility Scenario

Construction Phase	Modeled Noise Level ¹ (L _{eq} dBA)	Significance Threshold ² (L _{eq} dBA)	Exceeds Threshold? (Yes/No)
Site Preparation	76	80	No
Grading	76	80	No
Building Construction	74	80	No
Paving	78	80	No
Architectural Coating	66	80	No

Notes:

¹ Estimated using FHWA Roadway Construction Noise Model (RCNM) methodology and CalEEMod construction activity data (FHWA 2006: 3).

² FTA construction noise criterion of 80 dBA L_{eq} at residential receptors (FTA 2018: pg. 179).

Table 5-4: Estimated Construction Noise Levels at a Representative Sensitive Receptor (50 Meters) – Medium Facility Scenario

Construction Phase	Modeled Noise Level ¹ (L _{eq} dBA)	Significance Threshold ² (L _{eq} dBA)	Exceeds Threshold? (Yes/No)
Site Preparation	76	80	No
Grading	79	80	No
Building Construction	74	80	No
Paving	78	80	No
Architectural Coating	66	80	No

Notes:

¹ Estimated using FHWA RCNM methodology and CalEEMod construction activity data (FHWA 2006: 3).

² FTA construction noise criterion of 80 dBA L_{eq} at residential receptors (FTA 2018: pg. 179).

As shown in Tables 5-3 and 5-4, the estimated average construction noise levels at the representative sensitive receptor would be below the FTA construction noise criterion of 80 dBA L_{eq}. Therefore, temporary construction noise impacts would not exceed applicable significance thresholds and would be Less Than Significant.

IMPACT: Less Than Significant

5.1.2.2 Vibration

Based on the information presented in Table 5-1, vibration levels at the nearest off-site structure² would not exceed the screening-level significance threshold of 0.2 in/sec PPV. In addition, high-vibration construction equipment, such as pile drivers, are not anticipated to be used during construction of the representative facility scenarios. Therefore,

² For purposes of the vibration analysis, the nearest off-site structure was assumed to be located 50 ft. from construction activities. This assumption is more conservative than the representative sensitive receptor distance of 164 ft. (50 m) used in the noise analysis because the nearest off-site structure may not be a noise-sensitive receptor.

construction-related vibration impacts would be Less Than Significant, as shown in Table 5-5.

Table 5-5: Estimated Peak Activity Daytime Vibration Impacts

Equipment	Vibration Levels at Nearest Off-Site Building (PPV at 50 ft.)	Exceeds Threshold? ¹ (Yes/No)
Clam Shovel	0.07	No
Hydromill (In Soil)	<0.01	No
Vibratory Roller/Compactor	0.07	No
Hoe Ram/Hydraulic Breaker	0.03	No
Large Bulldozer/Crawler Tractor	0.03	No
Caisson Drilling/Boring	0.03	No
Loaded Dump Trucks	0.03	No
Jackhammer (Pneumatic)	0.01	No
Small Bulldozer/Excavator/Backhoe	<0.01	No

Note:

¹ A screening-level vibration significance threshold of 0.2 in/sec PPV was used to evaluate potential building damage and human annoyance impacts.

IMPACT: Less Than Significant

5.2 Operations

5.2.1 Methodology

5.2.1.1 Off-Site Traffic Noise

The evaluation of Project-related traffic noise is based on established FHWA principles for assessing roadway noise. FHWA Traffic Noise Model (TNM) identifies traffic volume, vehicle mix, vehicle speeds, and the distance between roadways and receptors as the primary factors influencing traffic noise levels (FHWA 2021: pgs. 29-32). As part of this methodology, FHWA guidance indicates that traffic noise levels increase logarithmically, such that a doubling of traffic volumes is generally required to result in an approximately 3-dBA increase in noise levels, which represents the minimum change that may be perceptible to the human ear (FHWA 2011, pgs. 9-10). This relationship is commonly used in qualitative traffic noise assessments to evaluate the potential for project-related changes in traffic conditions to result in noticeable increases in ambient noise levels.

5.2.1.2 On-Site Noise

The inverse square law was used to estimate sound pressure level of on-site noise sources at the nearest sensitive receptor. To determine the sound attenuation over a distance using the inverse square law, an idealization needs to be made in which there are no reflective surfaces or barriers between the source and the location at which the sound level is being determined. According to the inverse square law, it can be shown that for each doubling of distance from a point source, the sound pressure level decreases by approximately 6 dB.

5.2.1.3 *Vibration*

Typical operational equipment includes blowers (ASP facilities only), loaders, grinders, screeners, tractors, water trucks, sweeper trucks, haul trucks, and windrow turners (windrow facilities only). These activities are not anticipated to involve high-vibration equipment commonly associated with substantial ground-borne vibration impacts, such as pile drivers, blasting, or similar vibration-intensive activities. Accordingly, a qualitative assessment of potential operational vibration impacts was conducted.

5.2.2 *Impacts Analysis*

5.2.2.1 *Off-Site Traffic Noise*

Vehicle activity associated with facility operations includes employee and light-duty commercial vehicle trips, tractor trailer trips, and fuel truck deliveries. Estimated average daily vehicle trips for each representative composting facility scenario are summarized in Table 5-6. Small facilities would generate approximately 52 daily trips, and medium facilities would generate approximately 110 daily trips.

In general, a doubling of traffic volume is required to increase noise levels by approximately 3 dBA, which is considered the minimum change that may be perceptible to people. Given the relatively low number of daily vehicle trips associated with the representative facility scenarios, operational traffic is not expected to substantially increase roadway noise levels. Because future facility locations and haul routes are unknown, the distribution of operational truck traffic on specific roadway segments cannot be determined at the program level. Future facilities may also be subject to site-specific traffic studies during local permitting and environmental review to evaluate truck access, haul routes, and other transportation-related considerations, and identify any necessary mitigation measures. While operational traffic noise impacts would generally be expected to be less than significant, the potential for significant traffic noise impacts cannot be ruled out for all future facilities under the proposed program. Therefore, operational traffic noise impacts are conservatively considered Potentially Significant.

Table 5-6: Estimated Average Daily Vehicle Trips for Representative Composting Facility Scenarios

Scenarios	Facility Size	Active Technology	Trips/day		
			Employee and Light Duty Commercial Vehicles	Tractor Trailers	Total
1	Small	Windrows	18	34	52
2		Positive CASP	18	34	52
3		Negative ASP with Filter	18	34	52
4	Medium	Windrows	26	84	110
5		Positive CASP	26	84	110
6		Negative ASP with Filter	26	84	110

IMPACT: Potentially Significant

Mitigation Measure Noise-1 (MM NOI-1): Conduct a Project-Specific Traffic Impact Analysis and Implement Required Mitigation Measures

For future facilities that have the potential to substantially increase traffic volumes on roadways serving noise-sensitive land uses, a project-specific traffic impact analysis shall be conducted during subsequent project-level environmental review. The analysis shall evaluate project-generated traffic on affected roadway segments and identify any significant transportation impacts and associated mitigation measures. Any transportation-related mitigation measures identified through the analysis and required by the lead agency, such as haul route modifications, restrictions on truck operating hours, or other measures intended to reduce transportation-related impacts, shall be incorporated into the project and implemented.

5.2.2.2 *On-Site Noise*

The number of equipment assumed for each representative facility scenario is listed in Table 5-7. To provide a conservative assessment of operational noise impacts, all equipment was assumed to be operating simultaneously, although this condition is not expected to occur during most routine facility operations.

Emergency generators and emergency fire pumps are operated during emergency conditions, or for routine, limited duration maintenance and testing activities, and are not expected to operate concurrently with normal facility operations. Accordingly, these sources were not included in the operational noise analysis. However, a separate screening-level evaluation indicates that, assuming continuous operation during an emergency event (100% usage factor), a diesel emergency generator and diesel emergency fire pump would generate noise levels ranging from approximately 26 to 47 dBA and 29 to 50 dBA, respectively, at representative sensitive receptor distances evaluated in this analysis. Therefore, operation of emergency equipment is not expected to substantially contribute to operational noise impacts at nearby receptors.

Blowers are often enclosed, located in containers, buildings, or behind biofilters and are not typically considered a dominant noise source at composting facilities. Therefore, operation of blowers is not expected to substantially contribute to operational noise impacts at nearby receptors.

Table 5-8 summarizes the estimated operational noise levels for representative small and medium composting facilities at various receptor distances. To provide a conservative assessment of operational noise impacts, all noise-generating equipment was assumed to operate at the same distance from the representative sensitive receptor, without the benefit of intervening barriers, topography, buildings, vegetation, compost piles, or other sound-attenuating features. Consequently, the predicted noise levels likely overestimate actual noise exposure at nearby receptors.

As shown in Table 5-8, estimated operational noise levels for the representative small and medium composting facility scenarios would not exceed the representative daytime noise threshold of 60 dBA (L_{eq}) at distances of approximately 2,000 ft. from routine facility operations. Therefore, future facilities located beyond 2,000 ft. from sensitive receptors would generally be expected to comply with typical daytime noise standards. Facilities located within 2,000 ft. of sensitive receptors may require site-specific noise impact analyses during subsequent Project-level environmental review to demonstrate compliance

with applicable local noise standards. Because the analysis conservatively assumes all equipment operates simultaneously at the same distance from the receptor and does not account for attenuation from buildings, sound walls, berms, topography, vegetation, compost piles, or other shielding features, actual noise levels may be lower than those predicted herein. Such site-specific conditions should be considered during subsequent Project-level environmental review, as appropriate.

Table 5-7: Equipment List for Representative Composting Facility Scenarios

Scenario	1	2	3	4	5	6
Facility Size	Small			Medium		
Active Technology	Windrows	Positive CASP	Negative ASP with Filter	Windrows	Positive CASP	Negative ASP with Filter
Grinders	1	1	1	1	1	1
Screens	1	1	1	1	1	1
Stackers	1	1	1	1	1	1
Colorizer	0	0	0	1	1	1
Emergency Generator	1	1	1	1	1	1
Emergency Fire Pump	1	1	1	1	1	1
Tractors	1	1	1	1	1	1
Excavator	1	1	1	1	1	1
Loader	2	2	2	3	3	3
Windrow Turner	1	0	0	1	0	0
Water Truck	1	1	1	1	1	1
Sweeper Truck	1	1	1	1	1	1
Fuel Truck	1	1	1	1	1	1

Table 5-8: Estimated Operational Noise Levels at Representative Sensitive Receptor Distances for Small and Medium Composting Facilities

Scenarios	Facility Size	Noise Level dBA (L_{eq}) at Nearest Sensitive Receptor				
		50 m (164 ft.)	100 m (328 ft.)	200 m (656 ft.)	500 m (1,640 ft.)	610 m (2,000 ft.)
1–3	Small	81	75	69	61	59
4–6	Medium	82	76	70	62	60
Representative Daytime Sensitive Receptor Noise Threshold (L_{eq} , dBA) ¹		60	60	60	60	60
Exceeds Threshold? (Yes/No)	Small	Yes	Yes	Yes	Yes	No
	Medium	Yes	Yes	Yes	Yes	No

Note:

¹ A daytime noise level of 60 dBA is presented as a screening threshold because it is commonly used by cities and counties for evaluating operational noise at residential receptors. Actual applicable noise standards may vary by jurisdiction and should be verified during Project-level environmental review.

IMPACT: Potentially Significant

Mitigation Measure Noise-2 (MM NOI-2): Implement Operational Noise Reduction Measures

For facilities located within approximately 2,000 ft.³ of a sensitive receptor, local jurisdictions shall require preparation of a site-specific noise impact analysis during Project-level environmental review. The analysis shall evaluate operational noise levels at nearby sensitive receptors and identify feasible measures necessary to achieve compliance with applicable local noise standards. Such measures may include, but are not limited to:

- Maintaining all powered equipment in accordance with manufacturer specifications;
- Public notice of activities shall be provided to nearby sensitive receptors of potential noise-generating activities;
- All motorized equipment shall be shut down when not in use;
- Locating stationary noise-generating equipment as far as practicable from nearby sensitive receptors;
- Using existing buildings, stockpiles, berms, or topographic features to provide noise shielding;
- Installing sound walls, acoustic barriers, earthen berms, shipping-container walls, or similar acoustical shielding measures;
- Providing additional setbacks from nearby sensitive receptors;
- Implementing alternative measures demonstrated by a qualified acoustical consultant to achieve compliance with applicable local noise standards; and/or
- To achieve an interior noise level consistent with applicable noise standards, the installation of double pane windows and building insulation shall be offered to residences directly affected by significant operational noise levels generated by the noise-generating facility. If accepted by the homeowner, the Project applicant shall provide the funding necessary to install the appropriate noise-reducing building improvements.

Any measures identified in the site-specific noise analysis and determined to be necessary to achieve compliance with applicable local noise standards shall be implemented as part of the project.

³ The 2,000-ft. distance is a screening distance for operational noise evaluation and should not be interpreted as a required setback distance from sensitive receptors. Facilities located within 2,000 ft. of a sensitive receptor may still demonstrate compliance with applicable local noise standards through a site-specific noise impact analysis and implementation of noise attenuation measures, as necessary.

It is reasonable to expect that project-specific acoustical analyses and associated conditions of approval would reduce operational noise impacts to a less-than-significant level. However, because future facility locations, receptor distances, and the specific noise attenuation measures that may be required are unknown at the program level, the degree to which such measures would be required and their effectiveness cannot be determined at this time. Therefore, for CEQA compliance purposes, operational noise impacts are conservatively considered Potentially Significant.

IMPACT: Potentially Significant

5.2.2.3 *Vibration*

The operations phase of the proposed composting facilities is not anticipated to involve substantial sources of vibration due to the nature of the operation. In addition, intense sources of vibration decrease substantially within 30 to 50 ft. of the source and would occur well within the facility boundary. As such, operational vibration impacts would be Less Than Significant.

IMPACT: Less Than Significant

6.0 CONCLUSIONS

Construction noise generated by development of representative small and medium composting facilities would occur during daytime hours, be temporary in nature, and cease upon completion of construction activities. As shown in Tables 5-3 and 5-4, estimated construction noise levels at a sensitive receptor located at a representative distance of 50 m (164 ft.) and beyond would remain below the FTA screening-level significance threshold of 80 dBA. Therefore, construction noise impacts would be Less Than Significant.

Neither construction nor operation of representative composting facilities is expected to generate substantial ground-borne vibration. Construction-related vibration levels would remain below the applicable screening threshold and routine facility operations would not involve vibration-intensive equipment or activities. Therefore, construction and operational vibration impacts would be Less Than Significant.

Operational traffic associated with facility employees, feedstock deliveries, compost export, and support vehicles would represent a relatively minor increase in roadway traffic. Because future facility locations and haul routes are unknown, the distribution of operational truck traffic on specific roadway segments cannot be determined at the program level. Future facilities may also be subject to site-specific traffic studies during local permitting and environmental review to evaluate roadway, intersection, and haul route conditions, and identify any necessary mitigation measures. While operational traffic noise impacts would generally be expected to be less than significant, the potential for significant traffic noise impacts cannot be ruled out for all future facilities under the proposed program. Therefore, operational traffic noise impacts are conservatively considered Potentially Significant.

Operational noise generated by compost processing, material handling, screening, grinding, and associated facility activities has the potential to result in significant impacts at nearby sensitive receptors. As shown in Table 5-8, operational noise levels would generally be below a representative daytime residential threshold of 60 dBA (L_{eq}) at distances of approximately 2,000 ft. and beyond from routine facility operations. Facilities located within 2,000 ft. of a sensitive

receptor may require Project-specific noise impact analyses and noise attenuation measures during subsequent Project-level environmental review. Because future facility locations, receptor distances, and the specific noise attenuation measures that may be needed are unknown, compliance with applicable local noise standards cannot be verified at the program level. Therefore, operational noise impacts are conservatively considered Potentially Significant.

7.0 REFERENCES

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- FTA 2018. Transit Noise and Vibration Impact Assessment, 2018. Pgs. 179, 184-186. Website (https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf).

ATTACHMENT 1 – CONSTRUCTION NOISE CALCULATIONS

Table 1-1: Estimated Construction Attenuated Sound Levels of Small Facilities at Nearest Sensitive Receptor (dBA)

Phase Name	CalEEMod Equipment Type	Equipment Count	RCNM Construction Equipment Type	Usage Factor	Reference SPL L _{REF} (dBA)	Distance to Receptor (ft)	Terrain Coefficient (dBA/ft)	Insertion Loss (dBA)	Window Loss (dBA)	Attenuated SPL L _{MAX} (dBA)	Attenuated SPL L _{EQ} (dBA)	Count RMS L _{MAX} (antilog)	Count RMS L _{EQ} (antilog)	Count SPL L _{MAX} (dBA)	Count SPL L _{EQ} (dBA)
Site Preparation	Rubber Tired Dozers	3	Tractor (rubber tire)	40%	84	164	0.0000	0	0	73.7	69.7	7.00E+07	2.80E+07	78.5	74.5
Site Preparation	Tractors/Loaders/Backhoes	4	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	3.72E+07	1.49E+07	75.7	71.7
Grading	Excavators	1	Excavator (hydraulic)	40%	85	164	0.0000	0	0	74.7	70.7	2.94E+07	1.18E+07	74.7	70.7
Grading	Graders	1	Grader	40%	85	164	0.0000	0	0	74.7	70.7	2.94E+07	1.18E+07	74.7	70.7
Grading	Rubber Tired Dozers	1	Tractor (rubber tire)	40%	84	164	0.0000	0	0	73.7	69.7	2.33E+07	9.34E+06	73.7	69.7
Grading	Tractors/Loaders/Backhoes	3	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	2.79E+07	1.12E+07	74.5	70.5
Building Construction	Cranes	1	Crane	16%	85	164	0.0000	0	0	74.7	66.7	2.94E+07	4.70E+06	74.7	66.7
Building Construction	Forklifts	3	Forklift (front end loader)	40%	80	164	0.0000	0	0	69.7	65.7	2.79E+07	1.12E+07	74.5	70.5
Building Construction	Generator Sets	1	Generator (<25 KVA quiet design)	50%	70	164	0.0000	0	0	59.7	56.7	9.30E+05	4.65E+05	59.7	56.7
Building Construction	Tractors/Loaders/Backhoes	3	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	2.79E+07	1.12E+07	74.5	70.5
Building Construction	Welders	1	Welding Machine (arc welding)	50%	70	164	0.0000	0	0	59.7	56.7	9.30E+05	4.65E+05	59.7	56.7
Paving	Cement and Mortar Mixers	2	Drum Mixer	50%	80	164	0.0000	0	0	69.7	66.7	1.86E+07	9.30E+06	72.7	69.7
Paving	Pavers	1	Paver (asphalt)	50%	85	164	0.0000	0	0	74.7	71.7	2.94E+07	1.47E+07	74.7	71.7
Paving	Paving Equipment	2	Paver (asphalt)	50%	85	164	0.0000	0	0	74.7	71.7	5.88E+07	2.94E+07	77.7	74.7
Paving	Rollers	2	Roller	20%	85	164	0.0000	0	0	74.7	67.7	5.88E+07	1.18E+07	77.7	70.7
Paving	Tractors/Loaders/Backhoes	1	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	9.30E+06	3.72E+06	69.7	65.7
Architectural Coating	Air Compressors	1	Compressor (air)	40%	80	164	0.0000	0	0	69.7	65.7	9.30E+06	3.72E+06	69.7	65.7
Ref. Dist. (ft)				50											

Table 1-2: Combined Sound Levels Per Construction Phase for Small Facilities

Phase Name	ΣRMS L _{MAX}	ΣRMS L _{EQ}	ΣSPL L _{MAX} (dBA)	ΣSPL L _{EQ} (dBA)
Site Preparation	1.07E+08	4.29E+07	80.3	76
Grading	1.10E+08	4.40E+07	80.4	76
Building Construction	8.70E+07	2.79E+07	79.4	74
Paving	1.75E+08	6.89E+07	82.4	78
Architectural Coating	9.30E+06	3.72E+06	69.7	66

Table 1-3: Estimated Construction Attenuated Sound Levels of Medium Facilities at Nearest Sensitive Receptor (dBA)

Phase Name	CalEEMod Equipment Type	Equipment Count	RCNM Construction Equipment Type	Usage Factor	Reference SPL L _{REF} (dBA)	Distance to Receptor (ft)	Terrain Coefficient (dBA/ft)	Insertion Loss (dBA)	Window Loss (dBA)	Attenuated SPL L _{MAX} (dBA)	Attenuated SPL L _{EQ} (dBA)	RMS L _{MAX} (antilog)	RMS L _{EQ} (antilog)	Count L _{MAX} (dBA)	Count SPL L _{EQ} (dBA)
Site Preparation	Rubber Tired Dozers	3	Tractor (rubber tire)	40%	84	164	0.0000	0	0	73.7	69.7	7.00E+07	2.80E+07	78.5	74.5
Site Preparation	Tractors/Loaders/Backhoes	4	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	3.72E+07	1.49E+07	75.7	71.7
Grading	Excavators	2	Excavator (hydraulic)	40%	85	164	0.0000	0	0	74.7	70.7	5.88E+07	2.35E+07	77.7	73.7
Grading	Graders	1	Grader	40%	85	164	0.0000	0	0	74.7	70.7	2.94E+07	1.18E+07	74.7	70.7
Grading	Rubber Tired Dozers	1	Tractor (rubber tire)	40%	84	164	0.0000	0	0	73.7	69.7	2.33E+07	9.34E+06	73.7	69.7
Grading	Tractors/Loaders/Backhoes	2	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	1.86E+07	7.44E+06	72.7	68.7
Grading	Scrapers	2	Scraper	40%	85	164	0.0000	0	0	74.7	70.7	5.88E+07	2.35E+07	77.7	73.7
Building Construction	Cranes	1	Crane	16%	85	164	0.0000	0	0	74.7	66.7	2.94E+07	4.70E+06	74.7	66.7
Building Construction	Forklifts	3	Forklift (front end loader)	40%	80	164	0.0000	0	0	69.7	65.7	2.79E+07	1.12E+07	74.5	70.5
Building Construction	Generator Sets	1	Generator (<25 kVA quiet design)	50%	70	164	0.0000	0	0	59.7	56.7	9.30E+05	4.65E+05	59.7	56.7
Building Construction	Tractors/Loaders/Backhoes	3	Backhoe (with loader)	40%	80	164	0.0000	0	0	69.7	65.7	2.79E+07	1.12E+07	74.5	70.5
Building Construction	Welders	1	Welding Machine (arc welding)	50%	70	164	0.0000	0	0	59.7	56.7	9.30E+05	4.65E+05	59.7	56.7
Paving	Pavers	2	Paver (asphalt)	50%	85	164	0.0000	0	0	74.7	71.7	5.88E+07	2.94E+07	77.7	74.7
Paving	Paving Equipment	2	Paver (asphalt)	50%	85	164	0.0000	0	0	74.7	71.7	5.88E+07	2.94E+07	77.7	74.7
Paving	Rollers	2	Roller	20%	85	164	0.0000	0	0	74.7	67.7	5.88E+07	1.18E+07	77.7	70.7
Architectural Coating	Air Compressors	1	Compressor (air)	40%	80	164	0.0000	0	0	69.7	65.7	9.30E+06	3.72E+06	69.7	65.7
Ref. Dist. (ft)				50											

Table 1-4: Combined Sound Levels Per Construction Phase for Medium Facilities

Phase Name	ΣRMS L _{MAX}	ΣRMS L _{EQ}	ΣSPL L _{MAX} (dBA)	ΣSPL L _{EQ} (dBA)
Site Preparation	1.07E+08	4.29E+07	80.3	76
Grading	1.89E+08	7.56E+07	82.8	79
Building Construction	8.70E+07	2.79E+07	79.4	74
Paving	1.76E+08	7.05E+07	82.5	78
Architectural Coating	9.30E+06	3.72E+06	69.7	66

ATTACHMENT 2 – OPERATIONAL NOISE CALCUATIONS

Table 2-1: Estimated Operational Attenuated Sound Levels of Small Facilities at Nearest Sensitive Receptor at 50 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	164	0	0	0	9.3E+07	4.6E+07	79.7	77
Diesel Screens	50%	85	1	164	0	0	0	2.9E+07	1.5E+07	74.7	72
Diesel Stackers	40%	80	1	164	0	0	0	9.3E+06	3.7E+06	69.7	66
Tractors	40%	84	1	164	0	0	0	2.3E+07	9.3E+06	73.7	70
Excavator	40%	85	1	164	0	0	0	2.9E+07	1.2E+07	74.7	71
Loader	40%	84	2	164	0	0	0	2.3E+07	1.9E+07	73.7	73
Windrow Turner	40%	84	1	164	0	0	0	2.3E+07	9.3E+06	73.7	70
Water Truck	40%	84	1	164	0	0	0	2.3E+07	9.3E+06	73.7	70
Sweeper Truck	10%	80	1	164	0	0	0	9.3E+06	9.3E+05	69.7	60
Fuel Truck	5%	84	1	164	0	0	0	2.3E+07	1.2E+06	73.7	61
Combined Operational Noise Levels										81	

Table 2-2: Estimated Operational Attenuated Sound Levels of Small Facilities at Nearest Sensitive Receptor at 100 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	328	0	0	0	2.3E+07	1.2E+07	73.7	71
Diesel Screens	50%	85	1	328	0	0	0	7.3E+06	3.7E+06	68.7	66
Diesel Stackers	40%	80	1	328	0	0	0	2.3E+06	9.3E+05	63.7	60
Tractors	40%	84	1	328	0	0	0	5.8E+06	2.3E+06	67.7	64
Excavator	40%	85	1	328	0	0	0	7.3E+06	2.9E+06	68.7	65
Loader	40%	84	2	328	0	0	0	5.8E+06	4.7E+06	67.7	67
Windrow Turner	40%	84	1	328	0	0	0	5.8E+06	2.3E+06	67.7	64
Water Truck	40%	84	1	328	0	0	0	5.8E+06	2.3E+06	67.7	64
Sweeper Truck	10%	80	1	328	0	0	0	2.3E+06	2.3E+05	63.7	54
Fuel Truck	5%	84	1	328	0	0	0	5.8E+06	2.9E+05	67.7	55
Combined Operational Noise Levels										75	

Table 2-3: Estimated Operational Attenuated Sound Levels of Small Facilities at Nearest Sensitive Receptor at 200 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	656	0	0	0	5.8E+06	2.9E+06	67.6	65
Diesel Screens	50%	85	1	656	0	0	0	1.8E+06	9.2E+05	62.6	60
Diesel Stackers	40%	80	1	656	0	0	0	5.8E+05	2.3E+05	57.6	54
Tractors	40%	84	1	656	0	0	0	1.5E+06	5.8E+05	61.6	58
Excavator	40%	85	1	656	0	0	0	1.8E+06	7.3E+05	62.6	59
Loader	40%	84	2	656	0	0	0	1.5E+06	1.2E+06	61.6	61
Windrow Turner	40%	84	1	656	0	0	0	1.5E+06	5.8E+05	61.6	58
Water Truck	40%	84	1	656	0	0	0	1.5E+06	5.8E+05	61.6	58
Sweeper Truck	10%	80	1	656	0	0	0	5.8E+05	5.8E+04	57.6	48
Fuel Truck	5%	84	1	656	0	0	0	1.5E+06	7.3E+04	61.6	49
Combined Operational Noise Levels											69

Table 2-4: Estimated Operational Attenuated Sound Levels of Small Facilities at Nearest Sensitive Receptor at 500 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	1640	0	0	0	9.3E+05	4.6E+05	59.7	57
Diesel Screens	50%	85	1	1640	0	0	0	2.9E+05	1.5E+05	54.7	52
Diesel Stackers	40%	80	1	1640	0	0	0	9.3E+04	3.7E+04	49.7	46
Tractors	40%	84	1	1640	0	0	0	2.3E+05	9.3E+04	53.7	50
Excavator	40%	85	1	1640	0	0	0	2.9E+05	1.2E+05	54.7	51
Loader	40%	84	2	1640	0	0	0	2.3E+05	1.9E+05	53.7	53
Windrow Turner	40%	84	1	1640	0	0	0	2.3E+05	9.3E+04	53.7	50
Water Truck	40%	84	1	1640	0	0	0	2.3E+05	9.3E+04	53.7	50
Sweeper Truck	10%	80	1	1640	0	0	0	9.3E+04	9.3E+03	49.7	40
Fuel Truck	5%	84	1	1640	0	0	0	2.3E+05	1.2E+04	53.7	41
Combined Operational Noise Levels										61	

Table 2-5: Estimated Operational Attenuated Sound Levels of Small Facilities at Nearest Sensitive Receptor at 610 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	2000	0	0	0	6.3E+05	3.1E+05	58.0	55
Diesel Screens	50%	85	1	2000	0	0	0	2.0E+05	9.9E+04	53.0	50
Diesel Stackers	40%	80	1	2000	0	0	0	6.3E+04	2.5E+04	48.0	44
Tractors	40%	84	1	2000	0	0	0	1.6E+05	6.3E+04	52.0	48
Excavator	40%	85	1	2000	0	0	0	2.0E+05	7.9E+04	53.0	49
Loader	40%	84	2	2000	0	0	0	1.6E+05	1.3E+05	52.0	51
Windrow Turner	40%	84	1	2000	0	0	0	1.6E+05	6.3E+04	52.0	48
Water Truck	40%	84	1	2000	0	0	0	1.6E+05	6.3E+04	52.0	48
Sweeper Truck	10%	80	1	2000	0	0	0	6.3E+04	6.3E+03	48.0	38
Fuel Truck	5%	84	1	2000	0	0	0	1.6E+05	7.8E+03	52.0	39
Combined Operational Noise Levels										59	

Table 2-6: Estimated Operational Attenuated Sound Levels of Medium Facilities at Nearest Sensitive Receptor at 50 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	164	0	0	0	9.3E+07	4.6E+07	79.7	77
Diesel Screens	50%	85	1	164	0	0	0	2.9E+07	1.5E+07	74.7	72
Diesel Stackers	40%	80	1	164	0	0	0	9.3E+06	3.7E+06	69.7	66
Diesel Colorizer	50%	85	1	164	0	0	0	2.9E+07	1.5E+07	74.7	72
Tractors	40%	84	1	164	0	0	0	2.3E+07	9.3E+06	73.7	70
Excavator	40%	85	1	164	0	0	0	2.9E+07	1.2E+07	74.7	71
Loader	40%	84	3	164	0	0	0	2.3E+07	2.8E+07	73.7	74
Windrow Turner	40%	84	1	164	0	0	0	2.3E+07	9.3E+06	73.7	70
Water Truck	40%	84	1	164	0	0	0	2.3E+07	9.3E+06	73.7	70
Sweeper Truck	10%	80	1	164	0	0	0	9.3E+06	9.3E+05	69.7	60
Fuel Truck	5%	84	1	164	0	0	0	2.3E+07	1.2E+06	73.7	61
Combined Operational Noise Levels										82	

Table 2-7: Estimated Operational Attenuated Sound Levels of Medium Facilities at Nearest Sensitive Receptor at 100 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	328	0	0	0	2.3E+07	1.2E+07	73.7	71
Diesel Screens	50%	85	1	328	0	0	0	7.3E+06	3.7E+06	68.7	66
Diesel Stackers	40%	80	1	328	0	0	0	2.3E+06	9.3E+05	63.7	60
Diesel Colorizer	50%	85	1	328	0	0	0	7.3E+06	3.7E+06	68.7	66
Tractors	40%	84	1	328	0	0	0	5.8E+06	2.3E+06	67.7	64
Excavator	40%	85	1	328	0	0	0	7.3E+06	2.9E+06	68.7	65
Loader	40%	84	3	328	0	0	0	5.8E+06	7.0E+06	67.7	68
Windrow Turner	40%	84	1	328	0	0	0	5.8E+06	2.3E+06	67.7	64
Water Truck	40%	84	1	328	0	0	0	5.8E+06	2.3E+06	67.7	64
Sweeper Truck	10%	80	1	328	0	0	0	2.3E+06	2.3E+05	63.7	54
Fuel Truck	5%	84	1	328	0	0	0	5.8E+06	2.9E+05	67.7	55
Combined Operational Noise Levels										76	

Table 2-8: Estimated Operational Attenuated Sound Levels of Medium Facilities at Nearest Sensitive Receptor at 200 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	656	0	0	0	5.8E+06	2.9E+06	67.6	65
Diesel Screens	50%	85	1	656	0	0	0	1.8E+06	9.2E+05	62.6	60
Diesel Stackers	40%	80	1	656	0	0	0	5.8E+05	2.3E+05	57.6	54
Diesel Colorizer	50%	85	1	656	0	0	0	1.8E+06	9.2E+05	62.6	60
Tractors	40%	84	1	656	0	0	0	1.5E+06	5.8E+05	61.6	58
Excavator	40%	85	1	656	0	0	0	1.8E+06	7.3E+05	62.6	59
Loader	40%	84	3	656	0	0	0	1.5E+06	1.8E+06	61.6	62
Windrow Turner	40%	84	1	656	0	0	0	1.5E+06	5.8E+05	61.6	58
Water Truck	40%	84	1	656	0	0	0	1.5E+06	5.8E+05	61.6	58
Sweeper Truck	10%	80	1	656	0	0	0	5.8E+05	5.8E+04	57.6	48
Fuel Truck	5%	84	1	656	0	0	0	1.5E+06	7.3E+04	61.6	49
Combined Operational Noise Levels										70	

Table 2-9: Estimated Operational Attenuated Sound Levels of Medium Facilities at Nearest Sensitive Receptor at 500 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	1640	0	0	0	9.3E+05	4.6E+05	59.7	57
Diesel Screens	50%	85	1	1640	0	0	0	2.9E+05	1.5E+05	54.7	52
Diesel Stackers	40%	80	1	1640	0	0	0	9.3E+04	3.7E+04	49.7	46
Diesel Colorizer	50%	85	1	1640	0	0	0	2.9E+05	1.5E+05	54.7	52
Tractors	40%	84	1	1640	0	0	0	2.3E+05	9.3E+04	53.7	50
Excavator	40%	85	1	1640	0	0	0	2.9E+05	1.2E+05	54.7	51
Loader	40%	84	3	1640	0	0	0	2.3E+05	2.8E+05	53.7	54
Windrow Turner	40%	84	1	1640	0	0	0	2.3E+05	9.3E+04	53.7	50
Water Truck	40%	84	1	1640	0	0	0	2.3E+05	9.3E+04	53.7	50
Sweeper Truck	10%	80	1	1640	0	0	0	9.3E+04	9.3E+03	49.7	40
Fuel Truck	5%	84	1	1640	0	0	0	2.3E+05	1.2E+04	53.7	41
Combined Operational Noise Levels										62	

Table 2-10: Estimated Operational Attenuated Sound Levels of Medium Facilities at Nearest Sensitive Receptor at 610 Meters (dBA)

Noise Sources	Usage Factor	L _{REF}	Number of Equipment	D	TC	IL	WL	RMS		Operational Noise Level (dBA)	
		dBA		ft	dBA/ft	dBA	dBA	L _{MAX}	L _{EQ}	L _{MAX}	L _{EQ}
Diesel Grinders	50%	90	1	2000	0	0	0	6.3E+05	3.1E+05	58.0	55
Diesel Screens	50%	85	1	2000	0	0	0	2.0E+05	9.9E+04	53.0	50
Diesel Stackers	40%	80	1	2000	0	0	0	6.3E+04	2.5E+04	48.0	44
Diesel Colorizer	50%	85	1	2000	0	0	0	2.0E+05	9.9E+04	53.0	50
Tractors	40%	84	1	2000	0	0	0	1.6E+05	6.3E+04	52.0	48
Excavator	40%	85	1	2000	0	0	0	2.0E+05	7.9E+04	53.0	49
Loader	40%	84	3	2000	0	0	0	1.6E+05	1.9E+05	52.0	53
Windrow Turner	40%	84	1	2000	0	0	0	1.6E+05	6.3E+04	52.0	48
Water Truck	40%	84	1	2000	0	0	0	1.6E+05	6.3E+04	52.0	48
Sweeper Truck	10%	80	1	2000	0	0	0	6.3E+04	6.3E+03	48.0	38
Fuel Truck	5%	84	1	2000	0	0	0	1.6E+05	7.8E+03	52.0	39
Combined Operational Noise Levels										60	