

Attachment 2



Prepared for: Riverbend Landfill
Prepared by: Michael A. Minor
Date: October 30, 2014
Subject: Noise Analysis Update
Project: Riverbend Landfill Noise Analysis

Introduction

This memorandum provides an updated noise analysis for the Riverbend Landfill. The previous full report, *Riverbend Landfill Noise Analysis*, MM&A, November 2, 2009 (Noise Memorandum, 2009), is provided as supporting information in Attachment A. This update was performed because some of the operational characteristics at the site have changed since the initial report was published. Changes include relocation of the maintenance shop, reduced operational hours, modified expansion plans, and updated list of landfill related equipment.

Additional data and information, including an introduction to acoustics, summary of noise regulations, measured noise levels and previous projections of noise levels at nearby noise sensitive properties from the Noise Memorandum (2009) report are provided in Attachment A. This update focuses on the revisions to operations, modified expansions plans, and changes in equipment being used at the facility.

Summary of Findings

Due to changes in the operations at the landfill, an updated noise impacts analysis was performed. The analysis relies on the previously measured noise levels to verify compliance with Oregon Department of Environmental Quality (ODEQ) noise criteria. The sound level measurements used in this analysis were taken early on a Sunday morning, when the site was closed, and therefore remain an accurate measure of the lower ambient noise levels at noise sensitive properties near the site.

To verify compliance with Oregon Department of Environmental Quality (ODEQ) noise criteria, a noise levels analysis was performed for the same nine representative residential properties used in the previous analysis. One site was to the north on SW Masonville Rd, four were along Highway 18, west of the landfill, one was at the recreational vehicle park, and the last three were east of the landfill.

There was no exceedance of the ODEQ ambient criteria noted. Noise from landfill operations is predicted to be below the existing ambient noise levels for all noise sensitive properties, except R6, west, south and north of the site due to noise from Highway 18. Noise levels at R6 are predicted to increase by up to 4 dB, which is still well below the 10 dBA criteria. There are also three residences east of the landfill where operational noise levels sometimes equal or exceed existing ambient noise levels by approximately 1 to 2 dB or less, however the noise levels from landfill operations are still well below the 10 dBA ODEQ criteria.

Noise Regulations

The ODEQ noise control program was eliminated on July 1, 1991; however the state noise regulations were not rescinded. The ODEQ sets standards for new and existing industrial and commercial noise sources. The ODEQ noise ordinance is given in Table 1.

Statistical Descriptor	Existing Noise Source		New Noise Source	
	7am – 10pm	10pm – 7am	7am – 10pm	10pm – 7am
L ₅₀	55	50	55	50
L ₁₀	60	55	60	55
L ₀₁	75	60	75	60

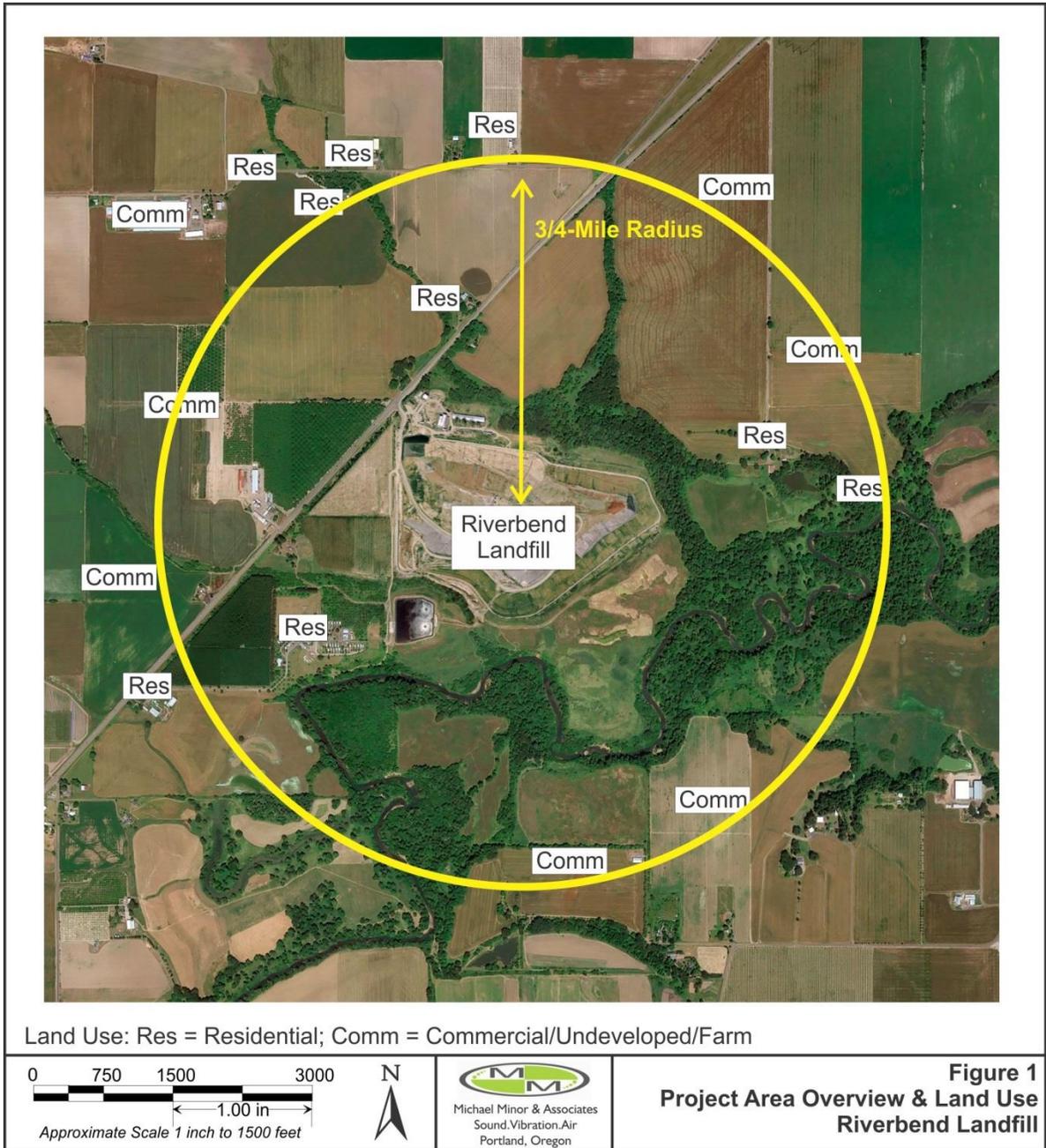
Based on the start year of 1981 for Riverbend Landfill, the project site would be considered a new industrial noise source because it was commenced after January 1, 1975. The ODEQ also has an ambient degradation criterion that limits the change in ambient noise levels to no more than 10 dBA for the L₁₀ and L₅₀ statistical descriptors in any one hour.

Analysis Methodology

Noise monitoring was performed at Riverbend Landfill between Thursday, August 27, and Tuesday September 1, 2009. The measurements included a Sunday measurement when the site is closed, to establish accurate existing ambient noise levels. Because the monitoring data used to establish the ambient noise levels was taken early on a Sunday morning when the land fill was not in operation, and there are no other notable noise sources in this area, this data remains valid for this analysis update.

Noise monitoring also captured a variety of landfill related noise sources including the unloading of large dump trucks, garbage trucks and tractor trailers, noise from trucks climbing the hill to the current landfill area, and dozers in use moving and compacting garbage.

Figure 1 is an overview of the landfill site with sensitive land uses within a 3/4-mile radius of the site identified. Figure 2 is a detailed site view with the noise monitoring locations, tipper and nearest residence identified. Complete data and additional information from the noise monitoring is provided in Noise Memorandum (2009) in Attachment A.



Monitoring Site Descriptions

Site M1 was located near the main activity, and includes measurements of the tipper, a large mechanical device that empties tractor trailers full of garbage. This device has the potential to produce a loud bang when the rear door of the trailer slams shut. A photo of the tipper is shown in Figure 2. Site M2 is located just north of the current operations, slightly down hill, with a clear line-of-sight to the operations. Site M3 was used primarily to obtain truck noise while climbing the hill to the landfill. Site M4 is located approximately 1300 feet to the east of the current landfill operations area, also with a clear line-of-sight to landfill operation.

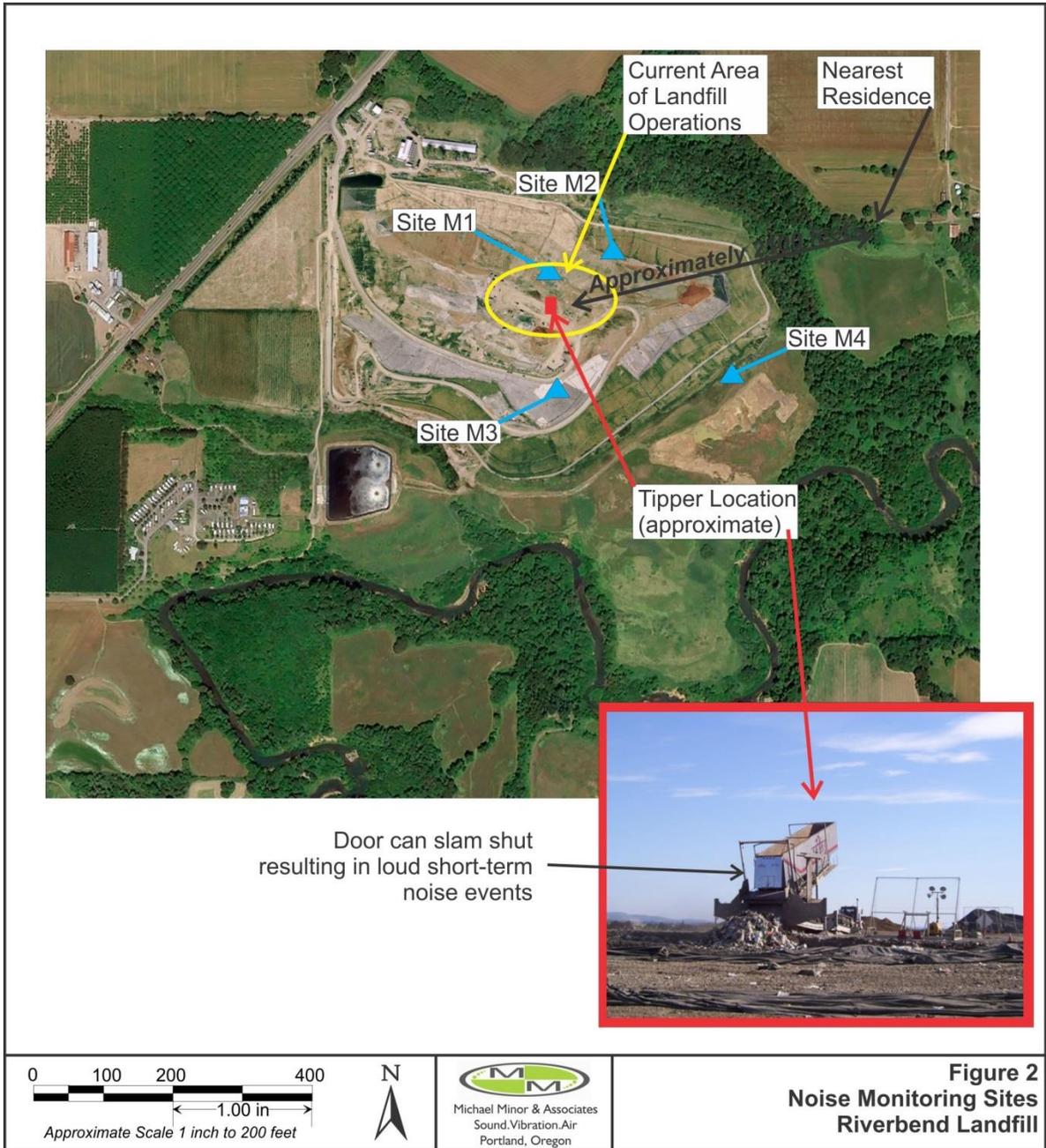


Figure 2
Noise Monitoring Sites
Riverbend Landfill

Noise Impact Analysis

There are several steps that need to be completed in order to accurately assess noise from the landfill operations, including:

1. Establishing accurate existing ambient noise levels;
2. Obtaining accurate reference measurements of the noise producing activities; and
3. Determining the statistical contribution of operational noise and early morning increase in noise levels at the nearby residences.

Each of these steps are outlined in the following sections. The results of the noise analysis under the Oregon DEQ regulations are also provided.

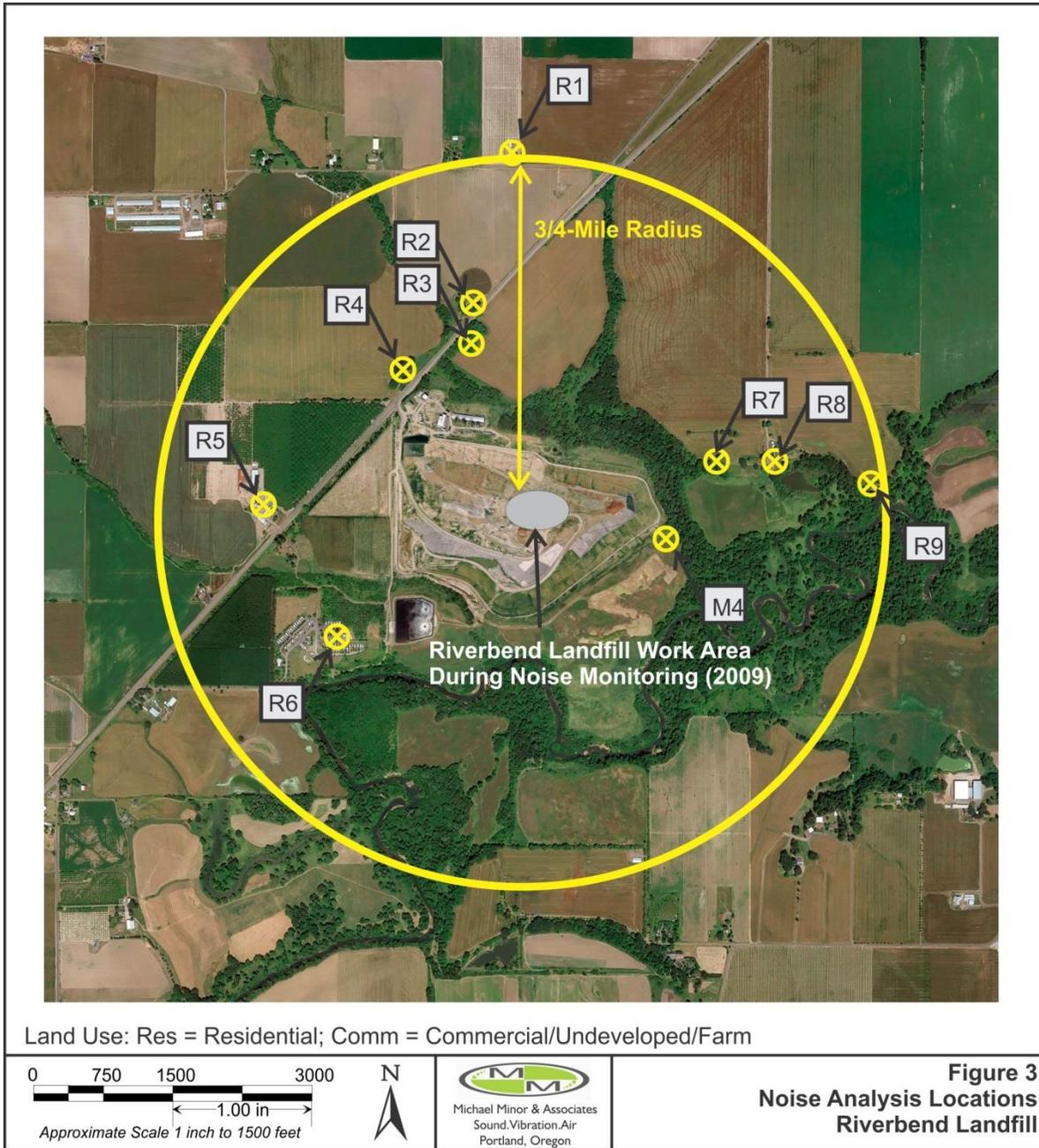
Ambient Noise Levels

The existing ambient noise at and near the site was determined from measured data between Saturday, August 29 at 10:00 pm and Monday, August 30, 2009 at 4:00 am. At the time of these measurements, the landfill operated Monday through Saturday, from around 4:30 am until 5:00 pm, and therefore, the only reasonable time to measure ambient noise levels was on a Sunday or holiday. The data measured between 7:00 pm on Saturday evening and 4:00 am Monday morning was used to establish the existing ambient noise levels. This data is still considered valid, as the landfill is the only major noise source in the area, and noise levels during early morning hours would not be expected to have changed since this data was taken.

The land use surrounding the site was inspected and noise sensitive land uses within $\frac{3}{4}$ mile were identified. Nine (9) representative noise sensitive properties surrounding the landfill were selected for a detailed noise analysis. The analysis was performed for start-up noise that occurs early in the morning hours when noise from the landfill would have the most severe effects on residents.

Ambient noise levels for each of the sites was derived from the Sunday morning ambient noise measurements. Details on the measurements are included in the Noise Memorandum (2009) attached in Attachment A. Receivers R1 through R9 that are used in this analysis are shown in Figure 3. Table 2 provides a summary of the predicted ambient L_{10} and L_{50} noise levels between 3:45 and 6:45 am. As is described, landfill operational hours were modified, and therefore the measurements between 3:45 and 5:45 AM (grayed shading) are not used for the analysis, as the facility is closed during these hours.

Rec# ¹	Site Description	Distance (ft)	Ambient Noise Levels on Sunday Morning					
			3:45 – 4:45 am		4:45 – 5:45 am		5:45 – 6:45 am	
			L_{10}	L_{50}	L_{10}	L_{50}	L_{10}	L_{50}
M4	East of landfill	1300	32.9	30.9	38.6	35.2	40.0	36.5
R1	SW Masonville Rd	3950	51.3	47.0	52.3	48.6	54.0	49.5
R2	NW of site on H-18	2380	58.8	54.5	59.8	56.1	61.5	57.0
R3	NW of site on H-18	1960	58.0	53.7	59.0	55.3	60.7	56.2
R4	NW of site on H-18	2090	58.4	54.1	59.4	55.7	61.1	56.6
R5	West of site on H-18	2900	57.9	53.6	58.9	55.2	60.6	56.1
R6	SE of site (RV park)	2560	50.8	46.5	51.8	48.1	53.5	49.0
R7	Two Residences east	2110	32.9	30.9	38.6	35.2	40.0	36.5
R8	of site (same property)	2550	32.9	30.9	38.6	35.2	40.0	36.5
R9	East most residence	3650	32.9	30.9	38.6	35.2	40.0	36.5



Landfill Operations

Noise measurements from monitoring sites M1, M2 and M3 were used to quantify noise from operations at the landfill. Close proximity measurements of the tipper and general landfill operations, including dozer operations, garbage trucks, back-up beepers, and other miscellaneous noise sources were taken at Sites M1 and M2. Pass-by measurements of off-road dump trucks were taken at Site M3, which was on an uphill grade to the top of the landfill. Measurement data from site M4 was used to establish noise propagation characteristics of the equipment and to establish ambient levels based on a Sunday morning measurement.

Riverbend landfill uses equipment typically found at landfill sites. This includes heavy use of a landfill dozer, compactor, off-road trucks, garbage trucks, a tipper and other miscellaneous supporting equipment. The major noise producing equipment would be the dozer, compactor, off-road trucks, and the gates on garbage trucks slamming when on the tipper.

One of the revisions to operations at the landfill was a modification of the equipment list. Major changes include replacing the larger Caterpillar D8H dozer with a slightly smaller Caterpillar D7R dozer, and using a Caterpillar D6R dozer for a spare instead of the Caterpillar D7R dozer. The landfill also replaced the Caterpillar 836G compactor with a smaller Caterpillar 826G compactor. Although the new dozer and compactor are smaller than the previous version, no change was made to the reference noise levels, as the actual difference in noise levels between the units is typically only 1 to 2 dB, a level that is typically not perceptible. Using the measured data with the louder equipment will assure a conservative noise impact analysis.

An updated summary of the equipment used at the landfill, typical usage and noise levels at 50 feet are provided in Table 3. For comparison, see Noise Memorandum (2009), in Attachment A for the equipment used in the previous analysis.

Table 3. Landfill Equipment List with Site Usage and Typical Noise Levels			
Equipment Type	Model	Usage	Typical Maximum Noise Level at 50 ft.
Dozer	D7R	Fairly consistently during operational hours	88 - 94 dBA @ 50 ft
Dozer	D6R	Spare – normally only used if the D7R is in service	88 - 92 dBA @ 50 ft
Off Road Haul Truck	Volvo A-25	Some daytime hauling	86 dBA @ 35 mph
Off Road Haul Truck	Cat 730	Some daytime hauling	86 dBA @ 35 mph
Hydraulic Excavator	Cat 325	Rarely	82 - 88 dBA @ 50 ft
Waste Compactor	Cat 826G	Fairly consistently during operational hours	88 - 92 dBA @ 50 ft
Waste Compactor	Cat 826C	Spare	88 - 92 dBA @ 50 ft
Tipper	Columbia	Fairly consistently during operational hours	Worst case banging levels of 86 to 95 dBA

In addition to the equipment changes, the landfill also modified the operational hours, which are now Monday through Friday 6:00 AM to 4:30 PM, and 7:00 am to 3:30 PM on Saturday, with full closure on Sundays. Previously, landfill began operations at approximately 4:30 AM and continued till 5:00 PM, Monday through Saturday.

In addition to the changes provided above, the maintenance shop, which used to be located in the south-west quadrant of the property was relocated the north-west quadrant of the property, near the main office buildings. Although this facility does produce some noise, it is not a significant source when compared to the noise from the landfill operations.

Finally, the expansion plans for the facility have also changed. The current proposed expansion includes a small extension to the north, called Module 10, with a second expansion to the west, called Module 11, which is toward SR 18 remaining north of the stream. Figure 4

provides a view of the proposed expansion areas, location of the shop facility, and the location of landfill noise sources for the ODEQ analysis.

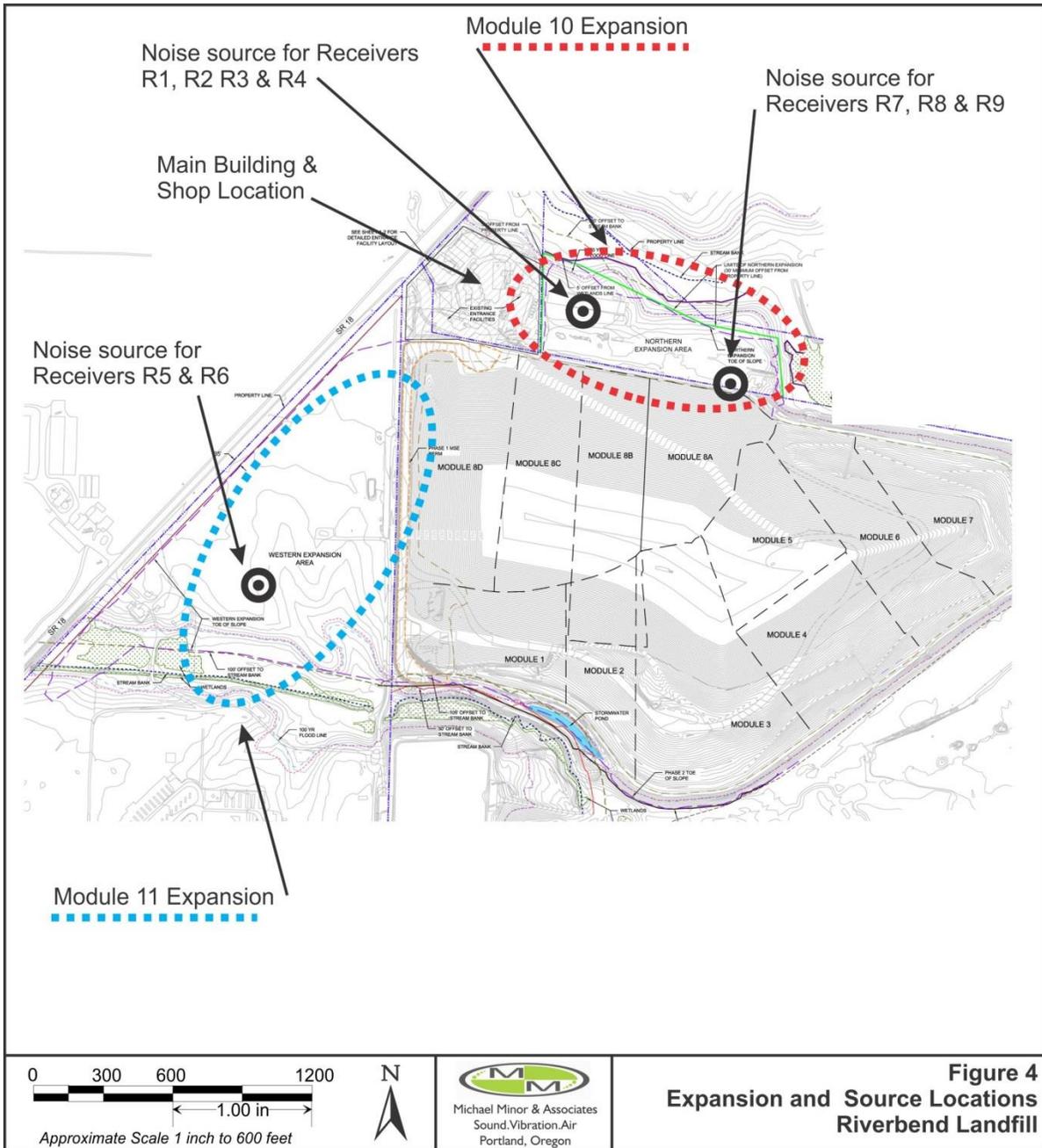


Figure 4
Expansion and Source Locations
Riverbend Landfill

ODEQ Noise Level Analysis

To show compliance with the ODEQ regulations, ambient noise level analysis was performed for the 9 representative residential properties within ¾ mile of the landfill. Site R1 is directly north of the site along SW Masonville Rd, approximately 750 feet from Highway 18, and 2,900 feet from the northern expansion. Noise levels at this residence are dominated by traffic along Highway 18 and no noise impacts were identified, with a maximum increase in noise levels of only 1.7 dB using the worst case Sunday morning ambient data. The results of the analysis for R1 are provided in Table 4.

Table 4: ODEQ Noise Analysis for R1						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	54.0	49.5	50.9	44.6	1.7	1.2
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	54.0	49.5	35.4	33.9	0.1	0.1
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	54.0	49.5	45.6	42.1	0.6	0.7
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	54.0	49.5	44.2	36.8	0.4	0.2

Receivers R2 through R5 are all single family residences located along highway 18, within 135 and 165 feet of the highway. As with receiver R1, the dominant noise source at all four of these locations is traffic noise from Highway 18. There were no exceedances of the ODEQ ambient criteria, and all noise from the landfill is predicted to be below the existing ambient at all four residences, with a worst case increase of 1.6 dB L10, and 1.2 dB L50. Tables 5 through 8 provide the results for Receivers R2 through R5.

Table 5: ODEQ Noise Analysis for R2						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.5	57.0	53.9	47.6	0.7	0.5
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.5	57.0	38.4	36.9	0.0	0.0
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.5	57.0	48.6	45.1	0.2	0.3
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.5	57.0	47.2	39.8	0.2	0.1

Table 6: ODEQ Noise Analysis for R3						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.7	56.2	55.7	49.4	1.2	0.8
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.7	56.2	40.2	38.7	0.0	0.1
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.7	56.2	50.4	46.9	0.4	0.5
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	54.0	49.5	49.0	41.6	0.3	0.1

Table7: ODEQ Noise Analysis for R4						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.1	56.6	54.2	47.9	0.8	0.5
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.1	56.6	38.7	37.2	0.0	0.0
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.1	56.6	48.9	45.4	0.3	0.3
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	61.1	56.6	47.5	40.1	0.2	0.1

Table 8: ODEQ Noise Analysis for R5						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.6	56.1	57.3	51.0	1.6	1.2
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.6	56.1	41.8	40.3	0.1	0.1
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.6	56.1	52.0	48.5	0.6	0.7
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	60.6	56.1	50.6	43.2	0.4	0.2

Receiver R6 is a recreational vehicle park located on landfill property. The site is approximately 2,500 feet from current operations. Noise from landfill operations at the RV park are predicted to have a worst case increase of 4.4 dB for the L10, and 3.4 for the L50, both are well below the ODEQ 10 dB increase criteria. These increases would only occur when landfill operations were located in the south west section of the landfill. The results of the ODEQ analysis for Receiver R6 are provided in Table 9.

Table 9: ODEQ Noise Analysis for R6						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	53.5	49.0	55.9	49.6	4.4	3.4
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	53.5	49.0	40.4	38.9	0.2	0.4
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	53.5	49.0	50.6	47.1	1.8	2.2
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	53.5	49.0	49.2	41.8	1.4	0.8

Sites R7 through R9 are located to the east of the landfill, with substantial distance and physical shielding from traffic noise on Highway 18. At receiver R7, the closest site to the landfill, the existing L10 was increased by 2.2 to 3.4 dBA, and the L50 increased by 1.7 to 3.6 dB. None of the noise readings meet, or exceed the ODEQ 10 dBA increase criteria. Data for Receivers R7 through R9 are provided in Tables 10 through 12.

Table 10: ODEQ Noise Analysis for R7						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	38.3	34.6	2.2	2.2
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	38.3	33.3	2.2	1.7
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	40.1	37.7	3.1	3.6
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	40.8	30.3	3.4	0.9

Table 11: ODEQ Noise Analysis for R8						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	36.9	33.2	1.7	1.7
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	36.9	31.9	1.7	1.3
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	38.7	36.3	2.4	2.9
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	39.4	28.9	2.7	0.7

Table 12: ODEQ Noise Analysis for R9						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	35.5	31.8	1.3	1.3
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	35.5	30.5	1.3	1.0
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	37.3	34.9	1.9	2.3
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
5:45 AM	40.0	36.5	38.0	27.5	2.1	0.5

Conclusion

Noise from landfill operations does not, and is not, projected to meet or exceed the ODEQ noise level criteria at properties near the landfill:

- For all noise sensitive properties west, south and north of the site, noise from landfill operations was determined to be below the existing ambient noise levels.
- For three residences east of the landfill where operational noise levels sometimes exceed existing ambient noise levels, the maximum noise level increase is well below the 10 dBA ODEQ criteria.

Attachment A

Riverbend Landfill Noise Report November 2009



Prepared for: Tommy Brooks
Prepared by: Michael A. Minor
Date: Monday, November 02, 2009
Subject: Noise Monitoring Results
Project: Riverbend Landfill Noise Analysis

This memorandum summarizes the findings of noise monitoring and projections from the Riverbend Landfill. Included is an introduction to acoustics, summary of noise regulations, measured noise levels and projections of noise levels at nearby noise sensitive properties.

Summary of Findings:

Noise monitoring was performed over a four day period, including two weekend days. Noise data was measured near the current landfill operations area and included several measurements of the tipper and the D8N dozer during normal operations. General landfill operations were also measured at approximately 500 feet from the main dumping area. Pass-by measurements of off-road trucks and other garbage related delivery vehicles were also performed. Finally, normal landfill operations were measured at approximately 1300 feet from the site, with a clear line-of-sight to operations.

Sound level measurements taken on Sunday morning, when the site is closed, were used to establish the ambient noise levels at, and around the site. The ambient data from Sunday measurements, along with normal operational noise levels measured around the landfill, were used to predict noise levels at noise sensitive properties near the site.

To verify compliance with Oregon Department of Environmental Quality (ODEQ) noise criteria, an ambient noise levels analysis was performed for nine representative residential properties within $\frac{3}{4}$ mile of the landfill. One site was to the north on SW Masonville Rd, four were along Highway 18, west of the landfill, one was at the recreational vehicle park, and the last three were east of the landfill. Ambient noise levels were also measured at the measurement site that is 1300 feet from the current landfill work site.

There was no exceedance of the ODEQ ambient criteria noted. Noise from landfill operations is predicted to be below the existing ambient noise levels for all noise sensitive properties west, south and north of the site due to noise from Highway 18. There are three residences east of the landfill where operational noise levels sometimes exceed existing ambient noise levels, however the maximum noise level only exceeded the existing ambient by 3.7 dBA, and is well below the 10 dBA ODEQ criteria. There are no noise sensitive properties that currently meet or exceed the ODEQ criteria.

Introduction to Acoustics

Human response to sound levels is subjective and can vary greatly from person to person. Factors that can influence individual response include the loudness, frequency, the amount of background noise present before an intruding noise and the nature of the work or activity (e.g., sleeping) that the noise affects.

Sound is defined as any pressure variation that the human ear can detect, from barely perceptible sounds to sound levels that can cause hearing damage. The magnitude of the variations of the air pressure from the static or normal air pressure is a measure of the sound level. The number of cyclic pressure variations per second is the frequency of sound.

The unit used to measure the loudness of noise is the decibel (dB). To better approximate the sensitivity of the human ear to sounds of different frequencies, the A-weighted decibel scale was developed. Because the human ear is less sensitive to higher and lower frequencies, the A-weighted scale reduces the sound level contributions of these frequencies. When the A-weighted scale is used, the decibel levels are denoted as dBA.

A 10-dBA change in noise levels is judged by most people as a doubling of sound level. The smallest change in noise level that a human ear can perceive is about 3 dBA, and increases of 5 dBA or more are clearly noticeable. Normal conversation ranges between 44 and 65 dBA when speakers are 3 to 6 feet apart.

Noise levels in a quiet rural area at night are typically between 32 and 35 dBA. Quiet urban nighttime noise levels range from 40 to 50 dBA. Noise levels during the day in a noisy urban area are frequently as high as 70 to 80 dBA. Noise levels above 110 dBA become intolerable and then painful, while levels higher than 80 dBA over continuous periods can result in hearing loss. Table 1 shows sound levels for some common noise sources and compares their relative loudness to that of an 80 dBA source such as a garbage disposal or food blender. Constant noises tend to be less noticeable than irregular or periodic noises.

Noise levels used in this analysis are stated as sound pressure levels in terms of decibels on the A-scale (dBA). The A-scale is used in most ordinances and standards. To account for the time-varying nature of noise several noise metrics are useful. The equivalent sound pressure level (L_{eq}) is defined as the average noise level, on an energy basis, for a stated time period (for example, hourly).

Other commonly used noise descriptors include the L_n , L_{max} , and L_{min} . The L_{max} and L_{min} are the greatest and smallest RMS (root-mean square) sound levels, in dBA, measured during a specified measurement period. The sound level descriptor L_n is defined as the sound level exceeded “n” percent of the time. For example, the L_{25} is the sound level exceeded 25 percent of the time; therefore during a 1-hour measurement, an L_{25} of 60 dBA means the sound level equaled or exceeded 60 dBA for 15 minutes during that hour.

Table 1: Sound Levels and Relative Loudness of Typical Noise Sources

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 ft)	140	Threshold of pain	64 times as loud
50-hp siren (100 ft)	130		32 times as loud
Loud rock concert near stage Jet takeoff (200 ft)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 ft)	110		8 times as loud
Jet takeoff (2,000 ft)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 ft)	90		2 times as loud
Kitchen garbage disposal, food blender (2 ft), Pneumatic drill (50 ft)	80	Moderately loud	Reference loudness
Vacuum cleaner (10 ft) Passenger car at 65 mph (25 ft)	70		1/2 as loud
Large store air-conditioning unit (20 ft)	60		1/4 as loud
Light auto traffic (100 ft)	50	Quiet	1/8 as loud
Bedroom or quiet living room Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 ft)	30	Very quiet	
High quality recording studio	20		
Acoustic Test Chamber	10	Just audible	
	0	Threshold of hearing	

Sources: Beranek (1988) and EPA (1971)

Noise Propagation

There are several factors that determine how sound levels decrease over a distance. Under ideal conditions, a point noise source in free space will attenuate at a rate of 6 dB each time the distance from the source doubles (using the inverse square law). An ideal line source (such as constant flowing traffic on a busy highway) reduces at a rate of approximately 3 dB each time the distance doubles. Under real-life conditions, however, interactions of sound waves with the ground often result in attenuation that is slightly higher than the *ideal* reduction factors given above. Other factors that affect the attenuation of sound with distance include existing structures; topography; foliage; ground cover; and atmospheric conditions such as wind, temperature, and relative humidity. The potential effects of these factors on sound propagation are described below.

Attenuation refers to the reduction in loudness, or amplitude, of noise as it moves away from the noise source.

- Existing structures can substantially affect noise levels. Structures can reduce noise by physically blocking the sound transmission and, under special circumstances, may cause an increase in noise levels if the sound is reflected off the structure and transmitted to a nearby receiver location. Measurements have shown that a single-

story house has the potential, through shielding, to reduce noise levels by as much as 10 dB or greater. The actual noise reduction will depend greatly on the geometry of the noise source, receiver, and location of the structure. Increases in noise caused by reflection are normally 3 dB or less, which is the minimum change in noise levels that can be noticed by the human ear.

- Topography includes existing hills, berms, and other surface features between the noise source and receiver location. As with structures, topography can potentially reduce or increase sound, depending on the geometry of the area. When placed between the noise source and receiver, hills and berms can have an effect on noise levels. In many situations, berms are used as noise mitigation because they physically block the noise source from the receiver location. In some locations, however, the topography can cause an overall increase in sound levels by either reflecting or channeling the noise towards a sensitive receiver location.
- Dense foliage can slightly reduce noise levels. The Federal Highway Administration (FHWA) assumes up to a 5 dBA reduction in traffic noise for locations that have at least 100 feet of dense evergreen foliage.
- Ground cover between the receiver and the noise source can also affect noise transmission. For example, sound will travel very well across reflective surfaces such as water and pavement, but can be attenuated when the ground cover is field grass, lawn, or even loose soil.
- Atmospheric conditions that can affect the transmission of noise include wind, temperature, humidity, and precipitation. Wind can increase sound levels if it is blowing from the noise source to the receiver; conversely, it can reduce noise levels if blowing in the opposite direction. Noise propagation can also be affected when the temperature gradient is such that an inversion is formed. Other atmospheric conditions such as humidity and precipitation are rarely severe enough to result in noticeable changes in noise level propagation. Because weather conditions frequently change, it is not realistic to consider atmospheric conditions in many (since this is not a traffic noise study?) noise studies.

Noise Regulations

The ODEQ noise control program was eliminated on July 1, 1991; however the state noise regulations were not rescinded. The ODEQ sets standards for new and existing industrial and commercial noise sources. The ODEQ noise ordinance is given in Table 2.

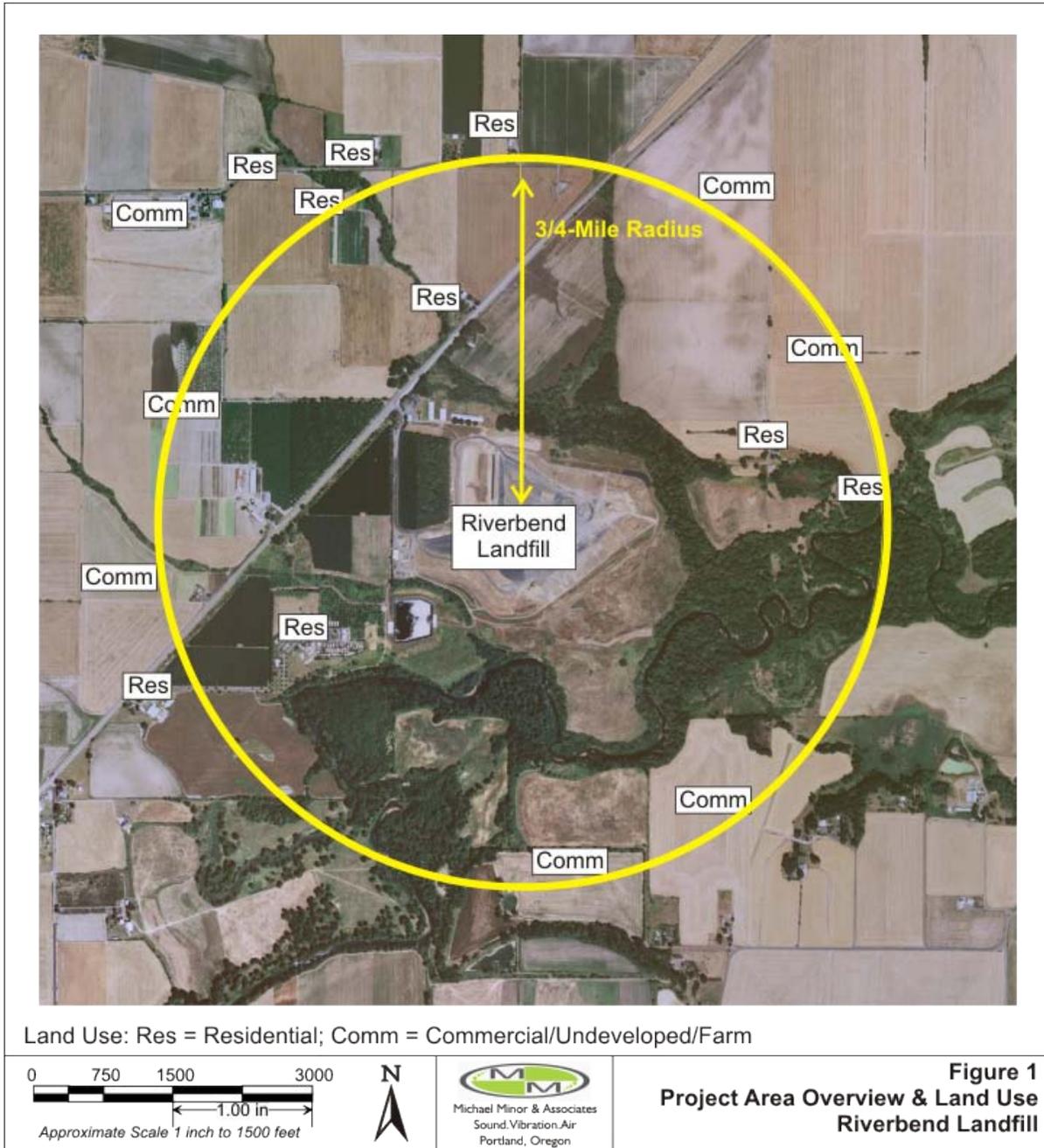
Statistical Descriptor	Existing Noise Source		New Noise Source	
	7am – 10pm	10pm – 7am	7am – 10pm	10pm – 7am
L ₅₀	55	50	55	50
L ₁₀	60	55	60	55
L ₀₁	75	60	75	60

Based on the start year of 1981 for the Riverbend Landfill, the project site would be considered a new industrial noise source because it was commenced after January 1, 1975. The ODEQ also has an ambient degradation criterion that limits the change in ambient noise levels to no more than 10 dBA for the L₁₀ and L₅₀ statistical descriptors in any one hour.

Analysis Methodology

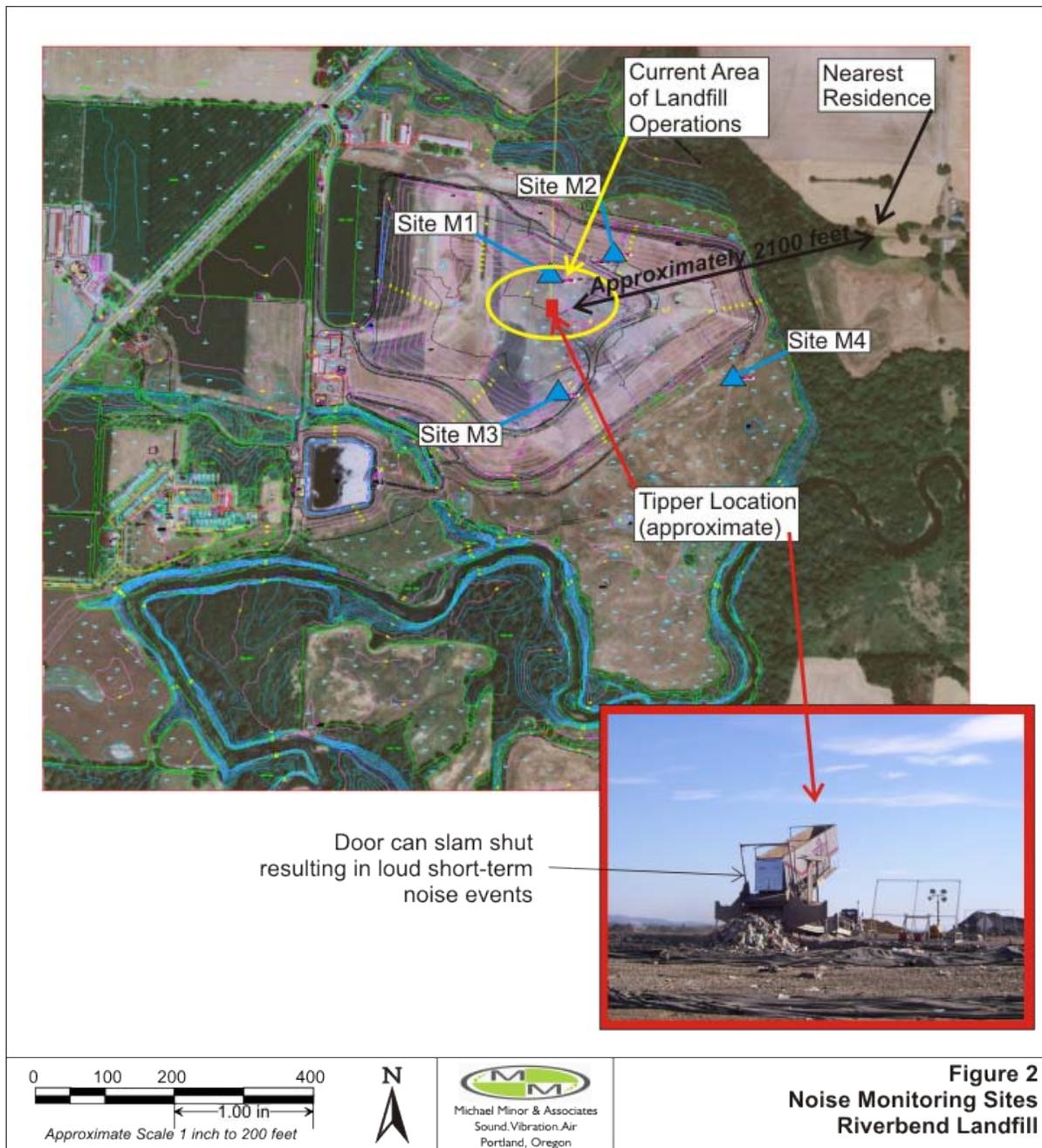
Noise monitoring was performed at four locations around the Riverbend Landfill. Monitoring was performed between Thursday, August 27, and Tuesday September 1, 2009. The measurements included a Sunday measurement when the site is closed, to establish accurate existing ambient noise levels. The sites were selected to capture a variety of noise coming from the site, including the unloading of large dump trucks, garbage trucks and tractor trailers, noise from trucks climbing the hill to the current landfill area and dozers moving and compacting garbage. Figure 1 is an overview of the landfill site with sensitive land uses within a 3/4-mile radius of the site identified. Figure 2 is a detailed site view with the noise monitoring locations, tipper and nearest residence identified.

All noise measurements were taken in accordance with the American National Standards Institute (ANSI) procedures for community noise measurements. The measurement locations were at least 5 feet from any solid structure to prevent acoustical reflections and at a height of 5 feet of the ground. The equipment used for noise monitoring included a Bruel & Kjaer Type 2260 Sound Level Meter equipped with statistical analysis and sound recording and three Bruel & Kjaer Type 2236 Sound Level Meters. The meters were calibrated prior to, and after the measurement period using a Bruel & Kjaer Type 4231 Sound Level Calibrator. All systems meet or exceed the requirements for an ANSI Type 1 noise measurement system.



Monitoring Site Descriptions

Site M1 was located near the main activity, and includes measurements of the tipper, a large mechanical device that empties tractor trailers full of garbage. This device has the potential to produce a loud bang when the rear door of the trailer slams shut. A photo of the tipper is shown in Figure 2. Site M2 is located just north of the current operations, slightly down hill, with a clear line-of-sight to the operations. Site M3 was used primarily to obtain truck noise while climbing the hill to the landfill. Site M4 is located approximately 1300 feet to the east of the current landfill operations area, also with a clear line-of-sight to landfill operation.



Noise Monitoring Results

There are several steps that need to be completed in order to accurately assess noise from the landfill operations, including:

1. Establishing accurate existing ambient noise levels;
2. Obtaining accurate reference measurements of the noise producing activities; and
3. Determining the statistical contribution of operational noise and early morning increase in noise levels at the nearby residences.

The existing ambient noise at and near the site was determined from measured data between Saturday, August 29 at 10:00 pm and Monday, August 30, 2009 at 4:00 am. Because the

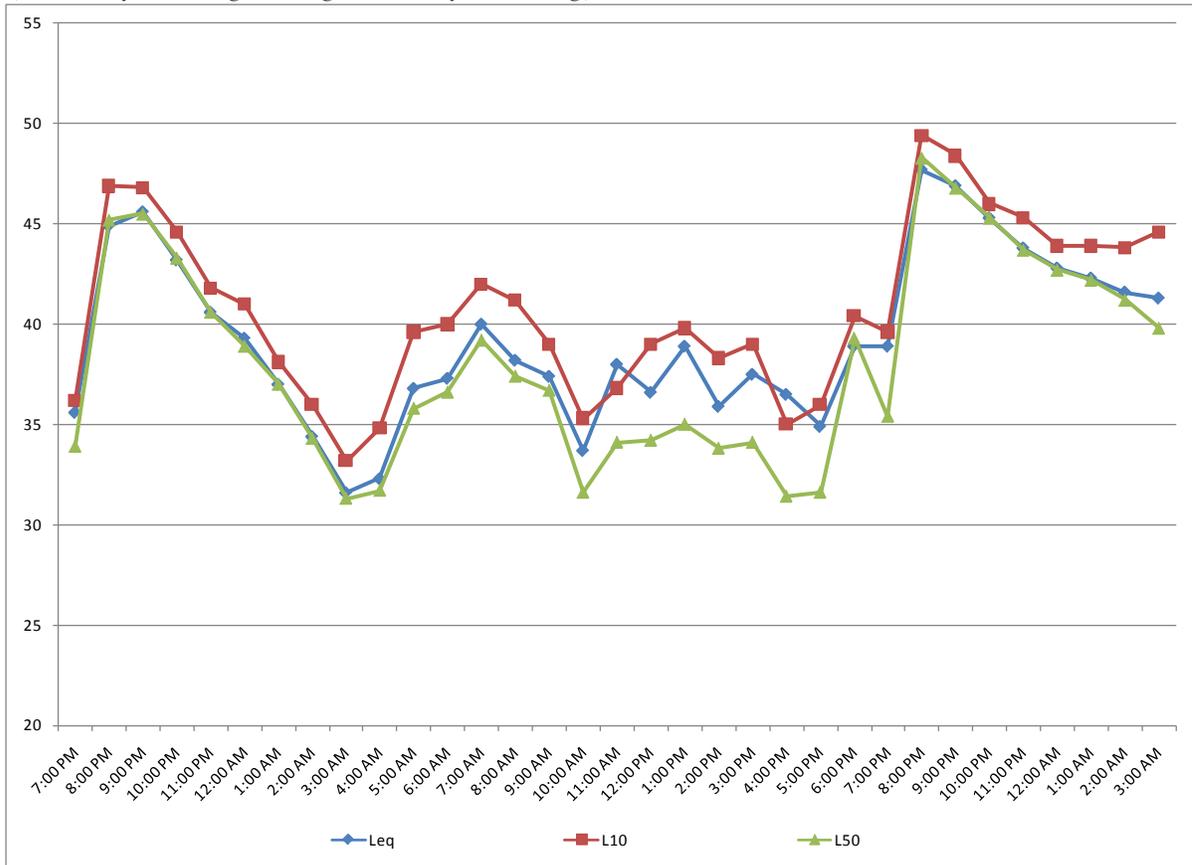
landfill operates Monday through Saturday, from around 4:30 am until 5:00 pm, the only reasonable time to measure ambient noise levels was on a Sunday or holiday. Therefore, the data measured between 7:00 pm on Saturday evening and 4:00 am Monday morning was used to establish the existing ambient noise levels.

Data from sites M2 and M4 were selected to establish the existing ambient noise levels. Site M2 would provide ambient noise levels for locations that may have some noise from traffic on Highway 18. Site M4, which is well shielded from Highway 18 by the landfill, provides ambient noise levels for locations with shielding from Highway 18, or that are located farther away from the highway. For a baseline reference, hourly L_{eq} , L_{01} , L_{10} and L_{50} were calculated using Bruel & Kjaer Type 7820 Sound Analysis software (BK-7820). Figures 3 and 4 are plots of the measured noise levels at the two sites between 7:00 pm on Saturday evening and 4:00 am Monday morning.

Figure 3: Site M2 Ambient Noise Levels
(Saturday evening through Monday Morning)



Figure 4: Site M4 Ambient Noise Levels
(Saturday evening through Monday Morning)



The ambient noise levels at site M2 ranged from 40 to 49 dBA L_{eq} , with the statistical L_{10} and L_{50} varying from 41 to 50 dBA (L_{10}) and 40 to 49 dBA (L_{50}). There were some notable peaks around 8:00 pm that are attributed to aircraft flyovers based on audio recordings taken at site M1. Site M4, which is shielded from Highway 18 by the landfill berm, has hourly L_{eq} noise levels ranging from 32 to 48 dBA, with L_{10} levels of 33 to 49 dBA and L_{50} levels of 31 to 48 dBA. Noise levels in this range are typical for a rural undeveloped area that is not near any major highways.

Nighttime Ambient Noise Levels

The main concern for site operation is early morning noise from the initial start-up, which occurs around 4:30 am. Therefore, it was important to extract and examine the early morning noise levels for comparison with the ODEQ regulations. Nighttime hourly energy average noise levels (L_{eq}) ranged from 40 to 47 dBA at Site M2, and 32 to 43 dBA at Site M4. The higher noise levels at Site M2 are due to the closer proximity to Highway 18. Tables 3 and 4 provide a summary of the nighttime ambient noise levels near and at the landfill, including the hourly L_{eq} , L_{01} , L_{10} and L_{50} noise levels all in dBA for Sites M2 and M4 respectively.

Start Time	L_{eq}	L₀₁	L₁₀	L₅₀
10:00 PM	47	50	49	47
11:00 PM	44	47	46	44
12:00 AM	43	46	45	43
1:00 AM	41	44	43	41
2:00 AM	40	45	42	39
3:00 AM	43	50	47	42
4:00 AM	44	49	48	44
5:00 AM	46	52	49	45
6:00 AM	46	51	48	45
Minimum	40	44	42	39
Maximum	47	52	49	47

Start Time	L_{eq}	L₀₁	L₁₀	L₅₀
10:00 PM	43	45	45	43
11:00 PM	41	43	42	41
12:00 AM	39	42	41	39
1:00 AM	37	39	38	37
2:00 AM	34	37	36	34
3:00 AM	32	35	33	31
4:00 AM	32	37	35	32
5:00 AM	37	41	40	36
6:00 AM	37	42	40	37
Minimum	32	35	33	31
Maximum	43	45	45	43

At site M2, the L₁₀ ranged from 42 to 49 dBA and the L₅₀ from 39 to 47 dBA. At site M4, the L₁₀ ranged from 33 to 45 dBA and the L₅₀ from 31 to 43 dBA. The lower readings at M4 are due to the shielding from Highway 18.

The ODEQ regulations allow any 1-hour period to be used for compliance verification. That is, if an ODEQ standard is exceeded in any 1-hour period, that standard has not been met. Therefore, for the purpose of proper analysis, three operational hours in the morning were compared in order to determine the worst case hour to be used for compliance with the ODEQ regulations. Because landfill activities begin between 4:30 and 4:45 am, the existing ambient noise was predicted for the hours of 3:45 – 4:44 am; 4:45 – 5:44 am; and 5:45 – 6:44 am. This allows for a comparison of the initial morning landfill operations when existing ambient noise levels are lowest. Table 5 provides the L_{eq}, L₀₁, L₁₀, and L₅₀ for Site M4 for the hours indicated.

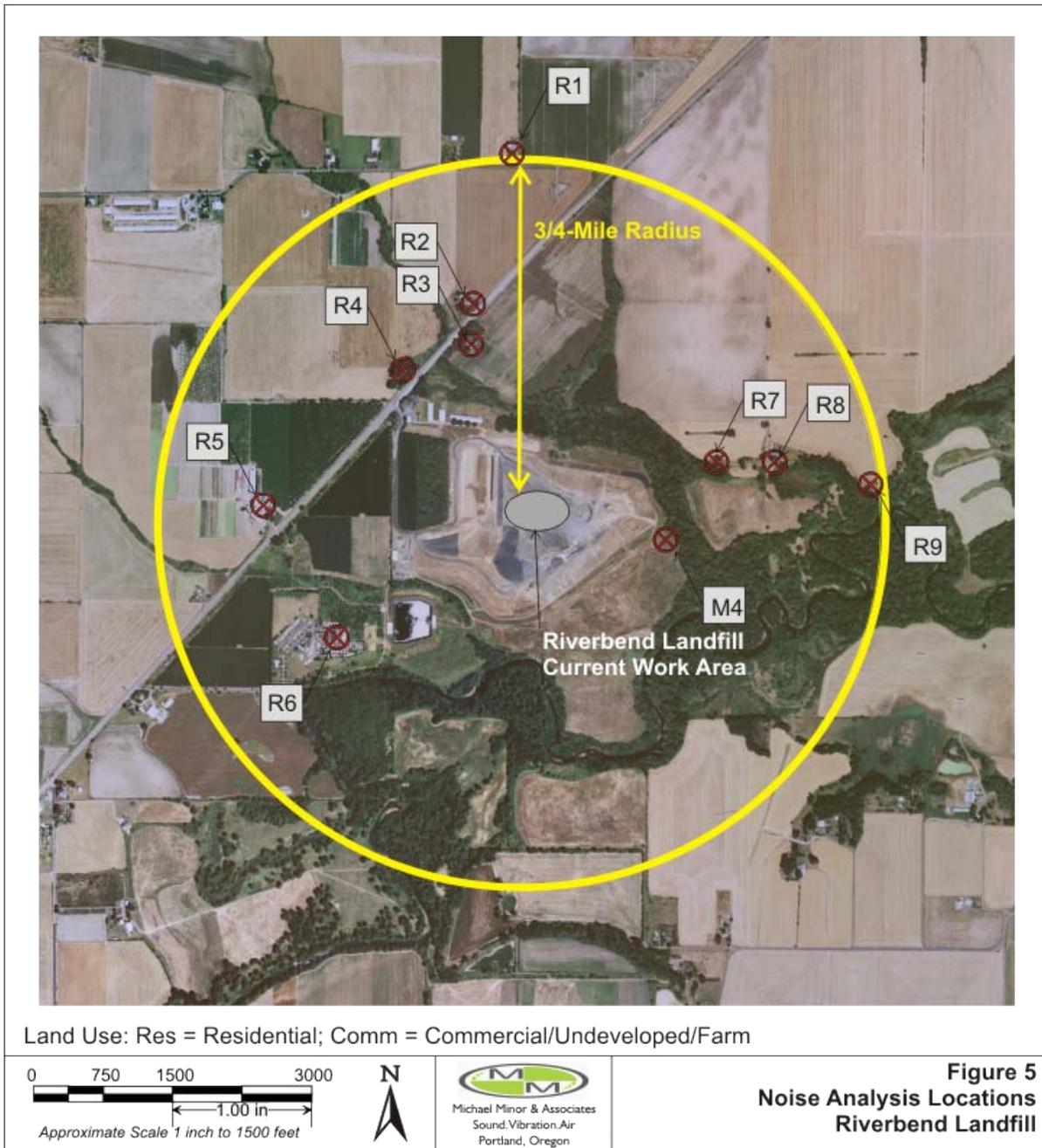
Start Time	L _{eq}	L ₀₁	L ₁₀	L ₅₀
3:45 AM	31	34	33	31
4:45 AM	36	40	39	35
5:45 AM	37	42	40	37
Minimum	31	34	33	31
Maximum	37	42	40	37

Morning Ambient Noise Levels

The land use surrounding the site was inspected and noise sensitive land uses within ¼ mile were identified. Nine (9) representative noise sensitive properties surrounding the landfill along with monitoring site M4 were selected for a detailed noise analysis. The analysis was performed for start-up noise that occurs early in the morning hours when noise from the landfill would have the most severe effects on residents.

Ambient noise levels for sites along Highway 18 are derived from the Sunday morning ambient noise measurements at Site M2. Three receivers located to the east of the site had the ambient level determined by measured data at site M4, also taken on Sunday morning. The receivers, R1 through R9, are shown in Figure 5 and Table 6 provides a summary of each location and the measured (at M4) and predicted (at R1 through R9) ambient L₁₀ and L₅₀ noise levels between 3:45 and 6:45 am.

Rec# ¹	Site Description	Distance (ft)	Ambient Noise Levels on Sunday Morning					
			3:45 – 4:45 am		4:45 – 5:45 am		5:45 – 6:45 am	
			L ₁₀	L ₅₀	L ₁₀	L ₅₀	L ₁₀	L ₅₀
M4	East of landfill	1300	32.9	30.9	38.6	35.2	40.0	36.5
R1	SW Masonville Rd	3950	51.3	47.0	52.3	48.6	54.0	49.5
R2	NW of site on H-18	2380	58.8	54.5	59.8	56.1	61.5	57.0
R3	NW of site on H-18	1960	58.0	53.7	59.0	55.3	60.7	56.2
R4	NW of site on H-18	2090	58.4	54.1	59.4	55.7	61.1	56.6
R5	West of site on H-18	2900	57.9	53.6	58.9	55.2	60.6	56.1
R6	SE of site (RV park)	2560	50.8	46.5	51.8	48.1	53.5	49.0
R7	Two Residences east	2110	32.9	30.9	38.6	35.2	40.0	36.5
R8	of site (same property)	2550	32.9	30.9	38.6	35.2	40.0	36.5
R9	East most residence	3650	32.9	30.9	38.6	35.2	40.0	36.5



Operational Noise Levels

Noise measurements from monitoring sites M1, M2 and M3 were used to quantify noise from operations at the landfill. Close proximity measurements of the tipper and general landfill operations, including dozer operations, garbage trucks, back-up beepers, and other miscellaneous noise sources were taken at Sites M1 and M2. Pass-by measurements of off-road dump trucks were taken at Site M3, which was on an uphill grade to the top of the landfill. Measurement data from site M4 was used to establish noise propagation characteristics of the equipment and to establish ambient levels based on a Sunday morning measurement.

Riverbend landfill uses equipment typically found at landfill sites. This includes heavy use of a landfill dozer, off-road trucks, garbage trucks, a tipper and other miscellaneous supporting equipment. The major noise producing equipment would be the dozer, off-road trucks, and the gates on garbage trucks slamming when on the tipper. A summary of the equipment used at the landfill, typical usage and noise levels at 50 feet are provided in Table 7.

Equipment Type	Model	Usage	Typical Maximum Noise Level at 50 ft.
Dozer	D8N	Fairly consistently during operational hours	88 - 94 dBA @ 50 ft
Dozer	D6H	Spare – normally only used if the D8N is in service	88 - 92 dBA @ 50 ft
Dozer	D7	Rarely	88 - 92 dBA @ 50 ft
Off Road Haul Truck	Volvo A-25	Some daytime hauling	86 dBA @ 35 mph
Off Road Haul Truck	Volvo A-35	Some daytime hauling	86 dBA @ 35 mph
Hydraulic Excavator	Cat 325	Rarely	
Waste Compactor	Cat 836G	Fairly consistently during operational hours	88 - 92 dBA @ 50 ft
Waste Compactor	Cat 826C	Spare	88 - 92 dBA @ 50 ft
Tipper	Columbia	Fairly consistently during operational hours	Worst case banging levels of 86 to 95 dBA

ODEQ Noise Level Analysis

An early morning analysis of site M4 was performed using the ODEQ ambient increase criteria. Site M4 is approximately 1300 feet east of current landfill operations. The measured ambient L_{10} and L_{50} from Sunday morning was compared to normal operational noise levels for a typical Friday, Saturday, Monday and Tuesday morning startup. In addition, this site was also used as a reference site for ambient noise levels for locations that are well shielded from Highway 18.

Hourly L_{10} and L_{50} noise levels for normal operations on Friday, Saturday, Monday and Tuesday, August 28, 29 and September 1 and 2 were calculated using BK-7820 software. The results were compared to the ambient noise levels in Table 6. The results of the analysis are provided in Table 8.

The analysis shows that at 1300 feet from the active landfill site, there are no increases of the ambient L_{10} or L_{50} over the ODEQ 10.0 dBA criteria, and therefore the site is within the ODEQ ambient increase criteria. During operational hours, the maximum increase over the Sunday ambient was 6 dBA for the L_{10} on Tuesday morning. For those hours where the operational noise levels from the landfill are equal to or lower than the ambient noise levels measured on Sunday morning, the site change in noise levels is noted as “No Change.”

Table 8: ODEQ Noise Analysis at Site M4						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	38.3	34.8	5.4	3.9
4:45 AM	38.6	35.2	42.0	36.9	3.4	1.7
5:45 AM	40.0	36.5	40.0	36.3	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	32.9	31.0	No Change	0.1
4:45 AM	38.6	35.2	34.3	30.8	No Change	No Change
5:45 AM	40.0	36.5	40.0	35.0	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	41.7	37.9	8.8	7.0
4:45 AM	38.6	35.2	41.9	39.4	3.3	4.2
5:45 AM	40.0	36.5	41.8	39.4	1.8	2.9
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	37.6	34.7	4.7	3.8
4:45 AM	38.6	35.2	44.6	36.4	6.0	1.2
5:45 AM	40.0	36.5	42.5	32.0	2.5	No Change

Nearby Residential Sites

In addition to performing the ODEQ analysis at site M4, ODEQ ambient noise level analysis was also performed for the 9 representative residential properties within $\frac{3}{4}$ mile of the landfill. Site R1 is directly north of the site along SW Masonville Rd, approximately 750 feet from Highway 18. At no time was the noise from the landfill predicted to meet, or exceed the existing ambient noise levels in this area. Noise levels at this residence would be dominated by traffic along Highway 18. It is important to note that the ambient data was collected at a time when there is typically less traffic on the highway, and therefore the ambient noise levels would be lower than what would be expected on weekdays or Saturday. The results of the analysis for R1 are provided in Table 9.

Receivers R2 through R5 are all single family residences located along highway 18, within 135 and 165 feet of the near lanes. As with receiver R1, the dominant noise source at all four of these locations is traffic noise from Highway 18. There were no exceedances of the ODEQ ambient criteria, and all noise from the landfill is predicted to be below the existing ambient at all four residences. Tables 10 through 13 provide the results for Receivers R2 through R5.

Receiver R6 is a recreational vehicle park located on landfill property. The site is approximately 2500 feet from current operations. Noise from landfill operations at the RV park are predicted to be below the existing ambient noise levels. The results of the ODEQ analysis for Receiver R6 are provided in Table 14.

Sites R7 through R9 are located to the east of the landfill, with substantial distance and physical shielding from traffic noise on Highway 18. These are the only locations where the operations of the landfill were predicted to exceed the existing ambient noise levels. At receiver R7, the existing ambient L_{10} was exceeded by 0.2 to 3.7 dBA during landfill operations, and the L_{50} was exceeded twice, once by 1.9 dBA, and once by 0.6 dBA. Landfill noise levels were also predicted to exceed the existing L_{10} ambient at R8 and R9 by levels of less than 3 dBA. None of the noise readings meet, or exceed the 10 dBA ODEQ criteria. Data for Receivers R7 through R9 are provided in Tables 15 through 17.

Table 9: ODEQ Noise Analysis for R1						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	51.3	47.0	44.3	29.8	No Change	No Change
4:45 AM	52.3	48.6	47.9	37.3	No Change	No Change
5:45 AM	54.0	49.5	49.6	43.3	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	51.3	47.0	29.7	26.9	No Change	No Change
4:45 AM	52.3	48.6	31.8	28.7	No Change	No Change
5:45 AM	54.0	49.5	34.1	32.6	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	51.3	47.0	36.6	29.1	No Change	No Change
4:45 AM	52.3	48.6	43.6	40.1	No Change	No Change
5:45 AM	54.0	49.5	44.3	40.8	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	51.3	47.0	34.8	28.6	No Change	No Change
4:45 AM	52.3	48.6	36.9	33.3	No Change	No Change
5:45 AM	54.0	49.5	42.9	35.5	No Change	No Change

Table 10: ODEQ Noise Analysis for R2						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.8	54.5	46.5	32.0	No Change	No Change
4:45 AM	59.8	56.1	50.1	39.5	No Change	No Change
5:45 AM	61.5	57.0	51.8	45.5	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.8	54.5	31.9	29.1	No Change	No Change
4:45 AM	59.8	56.1	34.0	30.9	No Change	No Change
5:45 AM	61.5	57.0	36.3	34.8	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.8	54.5	38.8	31.3	No Change	No Change
4:45 AM	59.8	56.1	45.8	42.3	No Change	No Change
5:45 AM	61.5	57.0	46.5	43.0	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.8	54.5	37.0	30.8	No Change	No Change
4:45 AM	59.8	56.1	39.1	35.5	No Change	No Change
5:45 AM	61.5	57.0	45.1	37.7	No Change	No Change

Table 11: ODEQ Noise Analysis for R3						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.0	53.7	47.3	32.8	No Change	No Change
4:45 AM	59.0	55.3	50.9	40.3	No Change	No Change
5:45 AM	60.7	56.2	52.6	46.3	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.0	53.7	32.7	29.9	No Change	No Change
4:45 AM	59.0	55.3	34.8	31.7	No Change	No Change
5:45 AM	60.7	56.2	37.1	35.6	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.0	53.7	39.6	32.1	No Change	No Change
4:45 AM	59.0	55.3	46.6	43.1	No Change	No Change
5:45 AM	60.7	56.2	47.3	43.8	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	51.3	47.0	34.8	28.6	No Change	No Change
4:45 AM	52.3	48.6	36.9	33.3	No Change	No Change
5:45 AM	54.0	49.5	42.9	35.5	No Change	No Change

Table12: ODEQ Noise Analysis for R4						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.4	54.1	47.1	32.6	No Change	No Change
4:45 AM	59.4	55.7	50.7	40.1	No Change	No Change
5:45 AM	61.1	56.6	52.4	46.1	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.4	54.1	32.5	29.7	No Change	No Change
4:45 AM	59.4	55.7	34.6	31.5	No Change	No Change
5:45 AM	61.1	56.6	36.9	35.4	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.4	54.1	39.4	31.9	No Change	No Change
4:45 AM	59.4	55.7	46.4	42.9	No Change	No Change
5:45 AM	61.1	56.6	47.1	43.6	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	58.4	54.1	37.6	31.4	No Change	No Change
4:45 AM	59.4	55.7	39.7	36.1	No Change	No Change
5:45 AM	61.1	56.6	45.7	38.3	No Change	No Change

Table 13: ODEQ Noise Analysis for R5						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	57.9	53.6	45.6	31.1	No Change	No Change
4:45 AM	58.9	55.2	49.2	38.6	No Change	No Change
5:45 AM	60.6	56.1	50.9	44.6	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	57.9	53.6	31.0	28.2	No Change	No Change
4:45 AM	58.9	55.2	33.1	30.0	No Change	No Change
5:45 AM	60.6	56.1	35.4	33.9	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	57.9	53.6	37.9	30.4	No Change	No Change
4:45 AM	58.9	55.2	44.9	41.4	No Change	No Change
5:45 AM	60.6	56.1	45.6	42.1	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	57.9	53.6	36.1	29.9	No Change	No Change
4:45 AM	58.9	55.2	38.2	34.6	No Change	No Change
5:45 AM	60.6	56.1	44.2	36.8	No Change	No Change

Table 14: ODEQ Noise Analysis for R6						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	50.8	46.5	49.8	39.2	No Change	No Change
4:45 AM	51.8	48.1	51.5	45.2	No Change	No Change
5:45 AM	53.5	49.0	51.5	45.2	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	50.8	46.5	33.7	30.6	No Change	No Change
4:45 AM	51.8	48.1	36.0	34.5	No Change	No Change
5:45 AM	53.5	49.0	36.0	34.5	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	50.8	46.5	45.5	42.0	No Change	No Change
4:45 AM	51.8	48.1	46.2	42.7	No Change	No Change
5:45 AM	53.5	49.0	46.2	42.7	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	50.8	46.5	38.8	35.2	No Change	No Change
4:45 AM	51.8	48.1	44.8	37.4	No Change	No Change
5:45 AM	53.5	49.0	44.8	37.4	No Change	No Change

Table 15: ODEQ Noise Analysis for R7						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	36.0	32.5	3.1	1.6
4:45 AM	38.6	35.2	39.7	34.6	1.1	No Change
5:45 AM	40.0	36.5	37.7	34.0	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	30.6	28.7	No Change	No Change
4:45 AM	38.6	35.2	32.0	28.5	No Change	No Change
5:45 AM	40.0	36.5	37.7	32.7	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	39.4	35.6	6.5	4.7
4:45 AM	38.6	35.2	39.6	37.1	1.0	1.9
5:45 AM	40.0	36.5	39.5	37.1	No Change	0.6
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	35.3	32.4	2.4	1.5
4:45 AM	38.6	35.2	42.3	34.1	3.7	No Change
5:45 AM	40.0	36.5	40.2	29.7	0.2	No Change

Table 16: ODEQ Noise Analysis for R8						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	35.2	31.7	2.3	0.8
4:45 AM	38.6	35.2	38.9	33.8	0.3	No Change
5:45 AM	40.0	36.5	36.9	33.2	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	29.8	27.9	No Change	No Change
4:45 AM	38.6	35.2	31.2	27.7	No Change	No Change
5:45 AM	40.0	36.5	36.9	31.9	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	38.6	34.8	5.7	3.9
4:45 AM	38.6	35.2	38.8	36.3	0.2	1.1
5:45 AM	40.0	36.5	38.7	36.3	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	34.5	31.6	1.6	0.7
4:45 AM	38.6	35.2	41.5	33.3	2.9	No Change
5:45 AM	40.0	36.5	39.4	28.9	No Change	No Change

Table 17: ODEQ Noise Analysis for R9						
Friday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	33.7	30.2	0.8	No Change
4:45 AM	38.6	35.2	37.4	32.3	No Change	No Change
5:45 AM	40.0	36.5	35.4	31.7	No Change	No Change
Saturday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	28.3	26.4	No Change	No Change
4:45 AM	38.6	35.2	29.7	26.2	No Change	No Change
5:45 AM	40.0	36.5	35.4	30.4	No Change	No Change
Monday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	37.1	33.3	4.2	2.4
4:45 AM	38.6	35.2	37.3	34.8	No Change	No Change
5:45 AM	40.0	36.5	37.2	34.8	No Change	No Change
Tuesday						
One-Hour Start Time	Sunday Ambient (dBA)		Operational Levels (dBA)		Change	
	L₁₀	L₅₀	L₁₀	L₅₀	L₁₀	L₅₀
3:45 AM	32.9	30.9	33.0	30.1	0.1	No Change
4:45 AM	38.6	35.2	40.0	31.8	1.4	No Change
5:45 AM	40.0	36.5	37.9	27.4	No Change	No Change

Conclusion

Noise monitoring was performed over a four day period, including two weekend days, and was used to establish noise levels related to general landfill operations. Pass-by measurements of off-road trucks and other garbage related delivery vehicles were also performed. Sound level measurements taken on Sunday morning, when the site was closed, were used to establish the ambient noise levels at, and around the site. Ambient sound levels measured on Sunday morning are likely lower than early morning ambient sound levels would be during a typical weekday or Saturday due to reduced traffic on Sunday mornings. The measured noise levels were used to predict noise levels at noise sensitive properties near the site and verify compliance with Oregon Department of Environmental Quality (ODEQ) noise criteria. The analysis was performed for nine representative residential properties within $\frac{3}{4}$ mile of the landfill.

Noise from landfill operations was predicted to be below the existing ambient noise levels for all noise sensitive properties west, south and north of the site due to noise from Highway 18. There are three residences east of the landfill where operational noise levels sometimes exceed existing ambient noise levels, however, the maximum noise level only exceeded the existing ambient by approximately 4 dBA, which is well below the 10 dBA ODEQ criteria. There are no noise sensitive properties that currently meet or exceed the ODEQ criteria.