SCS ENGINEERS

Franklin R. Bowerman Landfill

Quantitative Odor Analysis

Prepared For:

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August 2017

File No. 01201114.07

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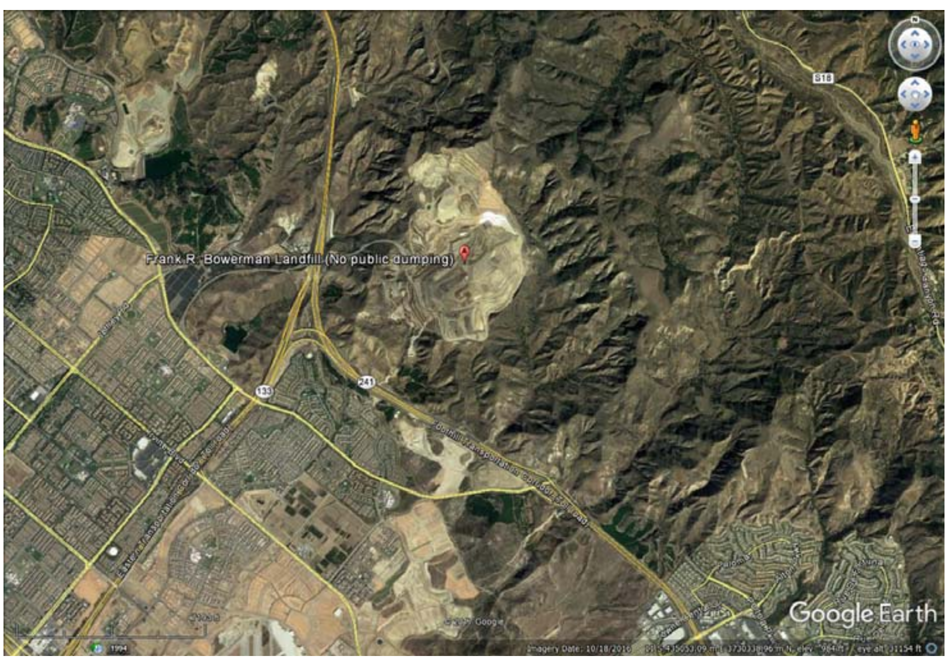
1 INTRODUCTION

SCS Tracer Environmental (SCS), a division of SCS Engineers, has been contracted to provide technical services to Orange County Waste & Recycling (OCWR) with the goal to better understand reported odor episodes that have recently occurred in the neighborhood near the Frank R. Bowerman Landfill (FRB). As part of these services, SCS previously conducted an onsite assessment to identify potential sources of odor at FRB and collected samples to estimate the strength of the odor sources. The results of the onsite odor assessment, historical published data, and in house data that SCS obtained from past evaluations at other OCWR landfills were used to model the potential worst case odor footprint associated with ongoing routine landfill operations at FRB (see Figure 1-1).

The AERMOD atmospheric dispersion model was used to predict odor concentrations at locations surrounding FRB. Odor concentrations are expressed in units of dilutions-to-threshold (D/T) which represent the number of dilutions required so that a volume of odorous air would no longer be detected by 50% of the population. Typically, odors become a nuisance at or above 7 D/T [1]. In order to assess the potential for significant odor impacts from FRB, the Bay Area Air Quality Management District's (BAAQMD's) Regulation 7 [2] odor nuisance standard of 4 D/T was used for comparison since it is one of the most restrictive odor regulations in the country that is based upon a concentration limit. The South Coast Air Quality Management District (SCAQMD) does not have a nuisance regulation based upon objective odor concentration. In the SCAQMD a nuisance is subjectively determined by the Air Pollution Control Officer.

Following this Introduction, Section 2 summarizes the methodology used in the analysis while Section 3 presents the results. Finally, the appendices provide supporting documentation that was used in the analysis.

FIGURE 1-1 Project Location [3]



2 METHODOLOGY

SCS identified the following odor sources at FRB that were further evaluated as part of the quantitative odor analysis.

Identified Potential Odor Sources	
Power Plant: Regen Flare	Covered Areas Under Repair
Power Plant: Excess Gas Flare	Tank Farm
Power Plant: Engine Exhaust	Condensate Spraying on Unpaved Roads
Working Face	PGM Covered Areas
Covered Areas	Waste Trucks

Further discussion on the model setup for the identified sources is provided in the following sections.

2.1 ODOR EMISSION RATES

The first step of the quantitative odor analysis was to develop representative odor emission rates for the odor sources identified at the FRB Landfill. Odor emission rates were calculated by multiplying each source's odor concentration (D/T) times its volumetric flow rate (m^3/s). Representative odor concentrations were assigned to each source based upon odor samples collected from the FRB Landfill and prior odor studies conducted by SCS on similar sources. A summary of the odor concentrations and sources are provided below.

Odor Source	Odor Concentration (D/T)	Basis For Concentration Used
Regen Flare	421	Samples collected from FRB (typically 70 ppmv H2S)
Excess Gas Flare	30	Regen Flare sample prorated to 5 ppmv H2S
Engine Exhaust	30	Regen Flare sample prorated to 5 ppmv H2S
Working Face	135	Samples collected from FRB
Covered Areas	19	Samples collected from FRB
Covered Areas Under Repair	38	Samples collected from FRB
Tank Farm	45	Samples collected from FRB
Condensate Spraying	362	Samples collected from FRB
PGM Covered Areas	118	Samples collected from Prima Landfill
Waste Trucks	135	Assumed the same as the working face

Volumetric flow rates for the flares and engine were based on typical gas flow rates noted by power plant personnel. The volumetric flow rates for the fugitive sources were determined by first estimating the source's total surface area and then estimating the vertical velocity of the gas generated by the odor source [4,5,6]. Details on the estimated volumetric flow rates are provided in Appendix A. A summary of the calculated odor emission rates is provided in the following table.

Odor Source	Odor Emission Rate (D/T x m³/sec)
Regen Flare	75
Excess Gas Flare	8
Engine Exhaust	99
Working Face	4,286
Covered Areas	17
Covered Areas Under Repair	20
Tank Farm	540
Condensate Spraying	289
PGM Covered Areas	3,211
Waste Trucks (per truck)	0.01

The odor emission rate for waste truck traffic was further expanded to incorporate the maximum trucks anticipated to be onsite hourly based on the following assumptions:

- 7,000 tons of waste received per day
- 50% of the waste is received from 7:00 am to 11:00 am
- 40% of the waste is received from 11:00 am to 3:00 pm
- 10% of the waste is received from 3:00 pm to 5:00 pm
- Each waste truck holds 20 tons of waste

2.2 ODOR DISPERSION MODELING

The American Meteorological Society / Environmental Protection Agency Regulatory Model (AERMOD Version 16216R) [4] was used to simulate the atmospheric dispersion of potential odor emissions from the proposed composting site. AERMOD was selected because it can model impacts from multiple sources at multiple receptors using local meteorological data. The AERMOD model was initially developed in 1991 and adopted in 2005 by the United States Environmental Protection Agency (EPA). This model is considered EPA's preferred regulatory model for both simple and complex terrain. Input data for AERMOD included:

- source locations;
- source physical dimensions;
- odor emission rates;
- meteorological data;
- terrain data;
- receptor locations; and
- model options.

The flare and engines were modeled as point sources based on available stack parameters and flow rates. With the exception of the waste trucks, the fugitive emission sources, were also modeled as point sources with effective diameters calculated from the estimated surface area the source covers. The waste trucks were modeled as an area line source with variable emission rates incorporated in the model to account for the reduced truck traffic anticipated throughout the day. See Appendix B for details on the source parameters.

Five years of meteorological data from the SCAQMD's Mission Viejo monitoring station (2008-2012) [5] was used in the analysis. The meteorological data was pre-processed by the SCAQMD to be compatible with AERMOD. See Appendix C for the quarterly and annual wind roses.

Typically, local terrain data is included in the dispersion modeling. In this case, however, the SCAQMD guidelines warn that AERMOD can under predict impacts at receptor elevations lower than source elevations. Since FRB is located at a higher elevation than the neighboring areas, flat terrain was selected for analysis as a conservative approach.

Next, AERMOD was used to generate a 5,000 meter by 5,000 meter receptor grid evenly spaced at 100 meter intervals over the surrounding area (see Figure 2-2). AERMOD was then used to estimate the maximum projected odor concentrations at each receptor location for various time periods based upon five years of meteorological data. Impacts at the receptor grid points were processed into contours of constant odor concentration in units of dilution-to-threshold ratios (D/T) and overlaid onto maps of the area surrounding the landfill.

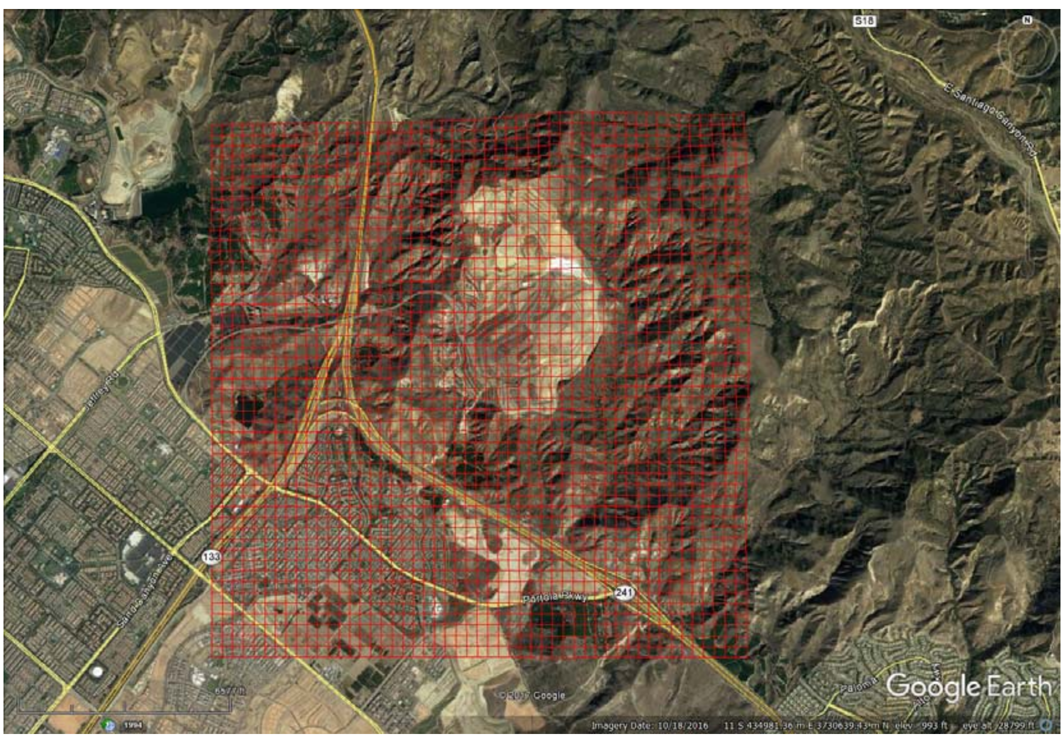
Modeling was conducted in accordance with SCAQMD guidelines [6] using the following model options and assumptions:

- All coordinates used the UTM Zone 11, NAD83 coordinate system.
- Regulatory defaults were used (except that flat terrain was used instead of elevated terrain).
- The rural dispersion mode was used instead of urban due to the remote location of the facility.
- The effects of building downwash were included since the flare and engine stacks are located next to a building.
- With the exception of the waste trucks and working face, the sources were modeled as operating 24 hours per day, 7 days per week.
- The waste trucks and working face emissions were modeled as operating from 7:00 AM to 5:00 PM with variable emission rates to account for the decrease in waste received throughout the day.
- Receptor heights were set to ground level (zero meters) per the SCAQMD guidelines.

FIGURE 2-1 Dispersion Modeling Source Locations [3,4]

Legend
Red Path =Waste Truck Line Area Source Location

FIGURE 2-2 Dispersion Modeling Receptor Grid [3,4]



2.3 SIGNIFICANT RISK THRESHOLD

The South Coast Air Quality Management District (SCAQMD) has local jurisdiction over air quality issues in the region where the FRB Landfill is located. The SCAQMD has adopted Rule 402 Nuisance [7] which states:

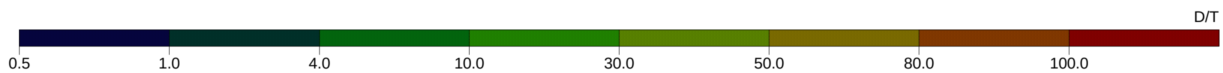
> *"A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property."*

Since SCAQMD Rule 402 does not provide a numeric D/T threshold, the BAAQMD's Regulation 7 [2] odor nuisance standard of 4 D/T was used as the threshold for significant odors since it is one of the most restrictive odor regulations in the country. While research has should that most populations do not complain about odors until they reach a significant level of about 7 D/T, for the purposes of this study we are using 4 D/T for that benchmark.

3 RESULTS

3.1 FRB LANDFILL

Results from the AERMOD odor dispersion modeling run was processed into contours of D/T odor impact. These contours were then overlaid onto satellite imagery. Figures 3-1 through 3-8 present the D/T odor impact contours for the FRB Landfill. The odor impacts are shown at contours from 0.5 D/T to over 100 D/T, as shown in the legend below.



The various figures present the D/T odor impacts for the following time periods:

- 1-hour (peak);
- 2-Hour (peak)
- 4-Hour (peak)
- 8-Hour (peak)
- 12-Hour (peak)
- 24-Hour (peak)
- Monthly (peak)
- Annual (average)

As a conservative measure, D/T odor impacts beyond the landfill's property boundary were compared to the BAAQMD's odor nuisance threshold of 4 D/T. As seen from all of the figures, odor impacts beyond the landfill property boundary were below the 4 D/T odor nuisance threshold. The modeling also predicts that with the exception of a small portion near Highway 241, the maximum modeled impacts beyond the landfill footprint are generally less than 1 D/T which implies that odors will not be detected by the public.

Modeled results may be scaled higher in magnitude to reflect a 3-minute average versus a 1-hour averaged concentration output. The scaling was accomplished using the following formula (Workbook of Atmospheric Estimates, US Environmental Protection Agency, 1970):[8]

$$X_s = X_k \left(\frac{t_k}{t_s}\right)^{0.2}$$

Where

$X_s = concentration\ for\ shorter\ (3\ minute)\ averaging\ time$

$X_k = Concentration\ for\ 1\ hr\ averaging\ period$

$t_k = 60\ minutes\ in\ 1\ hour$

$t_s = 3\ minutes$

The net correction factor as a result of this conversion is 1.8205. This correction was done to accommodate odor impacts that generally occur on a very short time scale of less than one hour.

Using this approach the odor footprint of the FRB Landfill for concentrations greater that 1 D/T but less than 2 D/T could slightly encroach the northern edge of the Portola Springs community under worst case conditions. Such condition occur very infrequently (less than 1% of the time) throughout the year.

It should be noted that these modeled impacts are odor impacts solely related to the landfill and do not encompass any background odor or impacts from other local sources. Our research has showed that other significant sources of odor exist in the region and have a significant effect on the Portola Springs community. Our measurements of ambient odors in the region indicate that the background odor of 11 D/T to 19 D/T is fairly consistent with all wind directions. So a possible, but improbable impact of 1-2 D/T from the landfill, as part of the overall background odor, is insignificant.

FIGURE 3-1 FRB Landfill Odor Impacts (1-Hour Peak D/T Concentrations) [3,4]

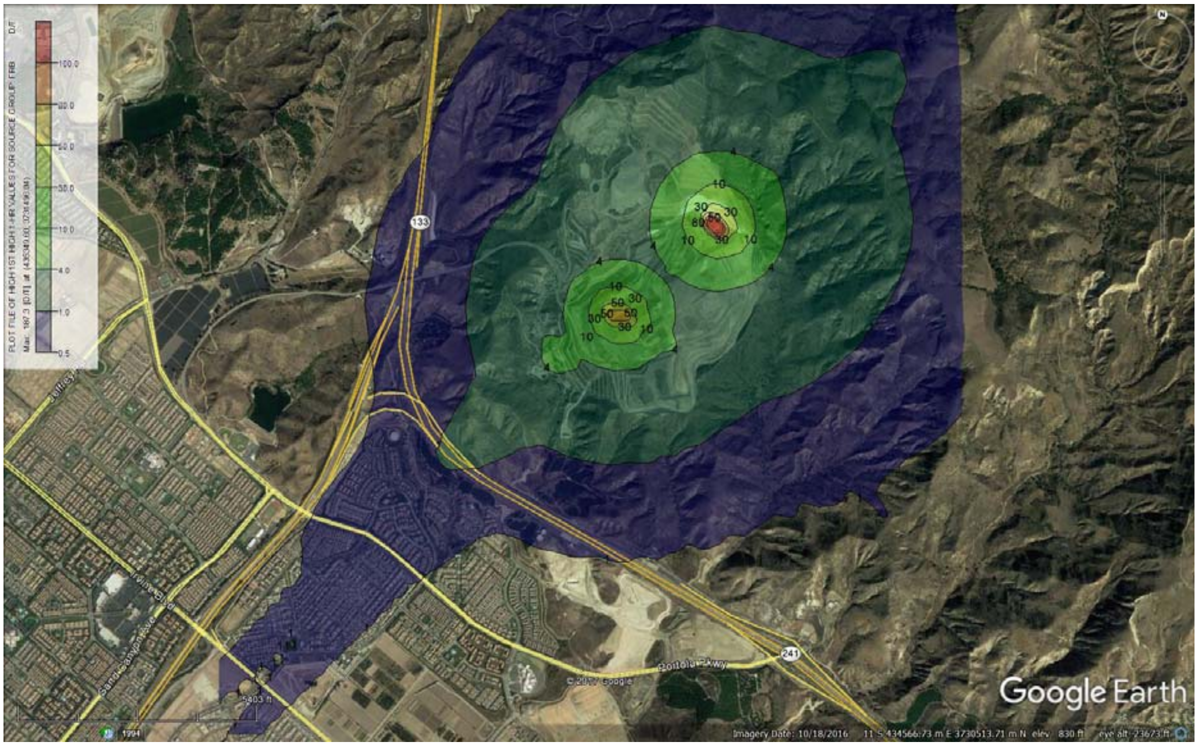


FIGURE 3-2 FRB Landfill Odor Impacts (2-Hour Peak D/T Concentrations) [3,4]

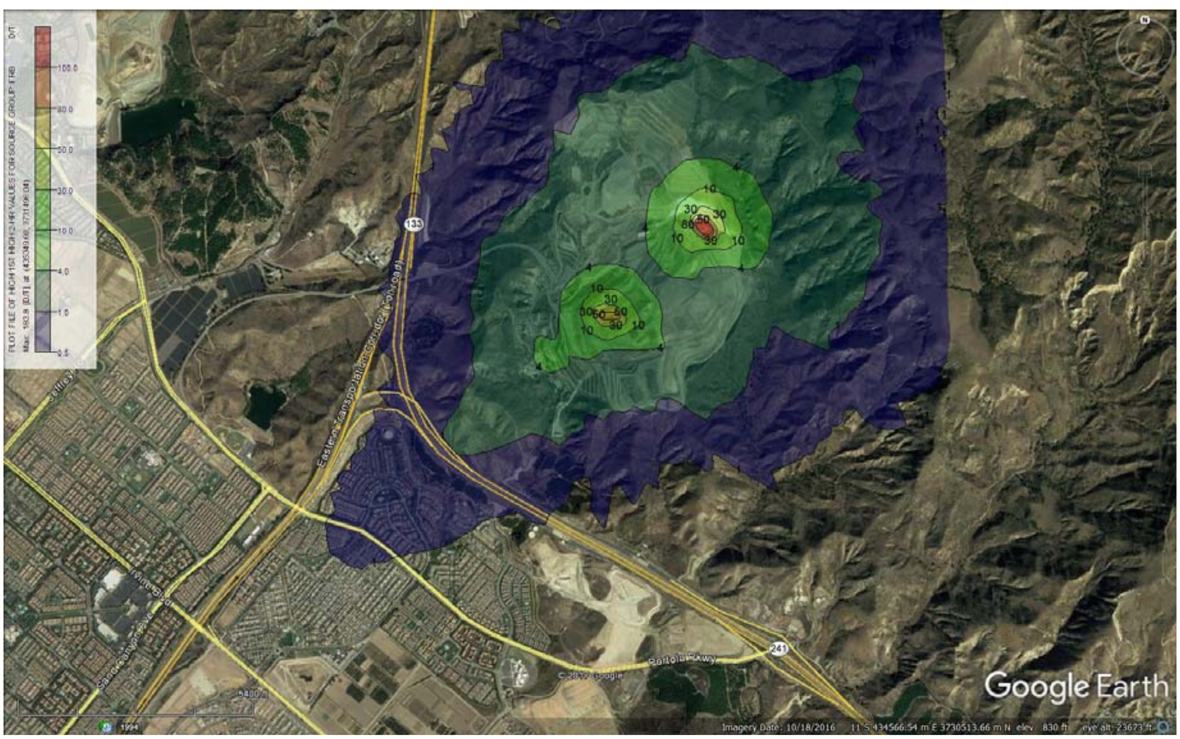


FIGURE 3-3 FRB Landfill Odor Impacts (4-Hour Peak D/T Concentrations) [3,4]

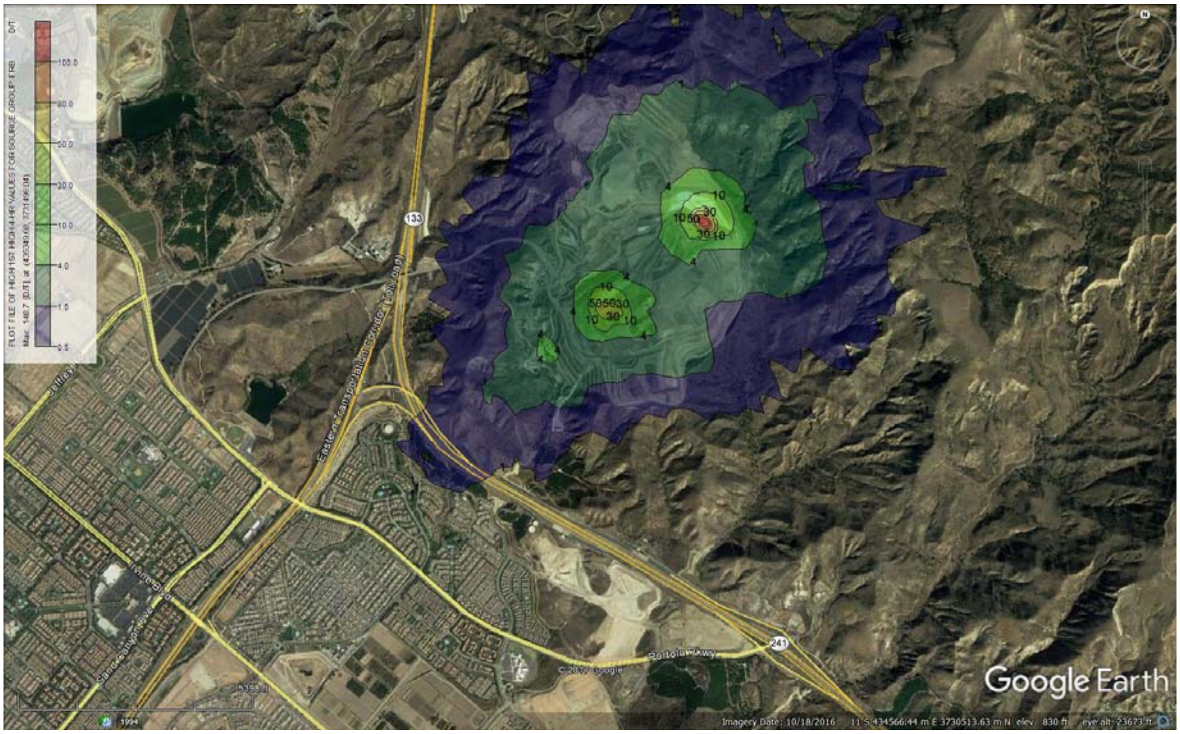


FIGURE 3-4 FRB Landfill Odor Impacts (8-Hour Peak D/T Concentrations) [3,4]

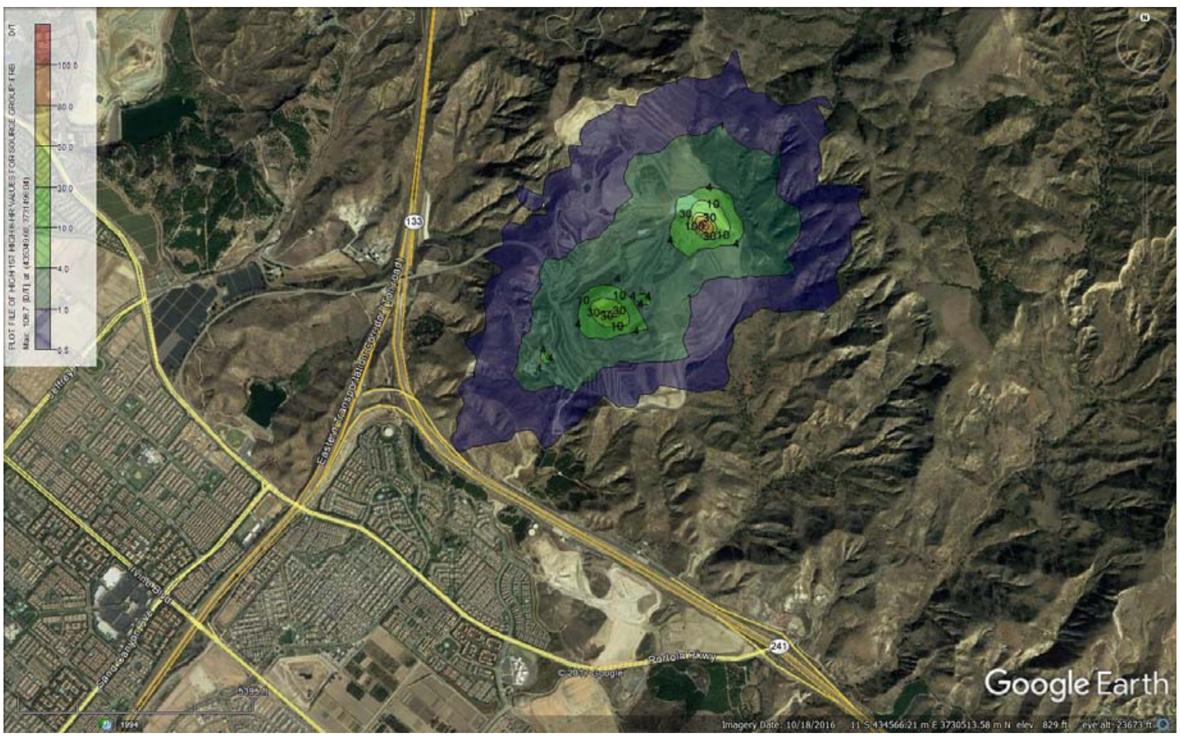


FIGURE 3-5 FRB Landfill Odor Impacts (12-Hour Peak D/T Concentrations) [3,4]

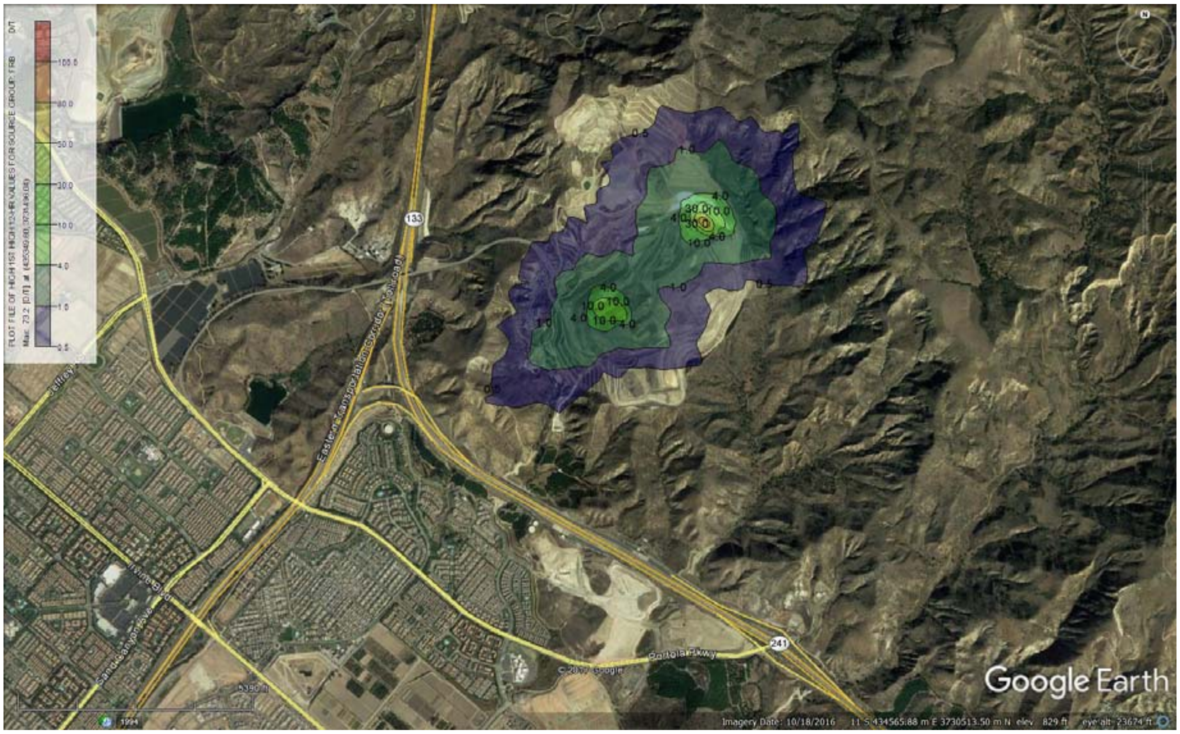


FIGURE 3-6 FRB Landfill Odor Impacts (24-Hour Peak D/T Concentrations) [3,4]

FIGURE 3-7 FRB Landfill Odor Impacts (Monthly Peak D/T Concentrations) [3,4]

FIGURE 3-8 FRB Landfill Odor Impacts (Annual Average D/T Concentrations) [3,4]

3.2 OPTIONAL COMPOSTING

SCS understands that OCWR is considering the installation of a composting facility at the FRB Landfill. Consequently, SCS utilized the modeled source parameters and odor emission rates from the quantitative odor analysis conducted for the Santiago Canyon Landfill to evaluate the potential impacts from composting operations at FRB. The odor sources identified from Scenario #1 of the proposed Santiago Canyon project[9] were located at the center of the FRB Landfill and modeled to evaluate the potential impacts. Scenario #1 consisted of representative odor emission rates for covered aerated static pile composting of green, wood, and food wastes at a rate of about 500 tons per day. Typical sources of odor from such composting operations were identified based upon prior odor studies [1]. The emission sources modeled from Scenario #1 are summarized in Table 3-1.

TABLE 3-1 Typical Sources of Odor at Composting Facilities [1]

Odor Source	Scenario #1 Odor Sources (X = Yes)
Raw feedstock piles	X
Composting piles	X
Curing piles	X
Finished piles	X
Grinding and mulching	X
Detention pond	X
Biofilters	X
Compost trucks	X

Odor emission rates were calculated by multiplying each source's odor concentration (D/T) times its volumetric flow rate (m^3/s). Representative odor concentrations were assigned to each source based upon prior odor studies conducted by SCS of similar wastes and composting operations. Volumetric flow rates were determined by first estimating each source's total surface area and then estimating the vertical velocity of the gas generated by the composting process [10,11,12]. See Tables D-1 and D-2 in Appendix D for the estimated odor emission rates and related vertical velocities from Scenario #1. Note, the odor emission rates were developed using the following assumptions:

- Each scenario assumed a total of 17 trucks were on-site and on the access road per hour based on 170 trucks per day maximum and a 7:00 am to 5:00 pm operating schedule.
- Each truck was assumed to be carrying covered compost material.
- Compost density was assumed to be 1,000 lb/yd^3.
- Covered composting and curing piles in Scenario #1 were assumed have zero D/T odor concentration since they would be under negative pressure from the forced aeration system.

Figures 3-9 and 3-10 present the D/T odor impact contours for just the composting operations and the combined odor impacts from the landfill and optional composting operations, respectively. Figure 3-9 suggests that composting operations by themselves will generate less than 0.5 D/T beyond the landfill footprint. A comparison of Figure 3-10, which shows the impacts from landfill and composting operations, and Figure 3-1, which shows just landfill operations, indicates no discernible difference, further suggesting that installation of a composting facility similar to Scenario #1 evaluated for the Santiago Canyon Landfill at FRB would not create an odor issue compared to the existing odor footprint.

FIGURE 3-9 Covered Aerated Static Pile Composting Odor Impacts (1-Hour Peak D/T Concentrations) [3,4]

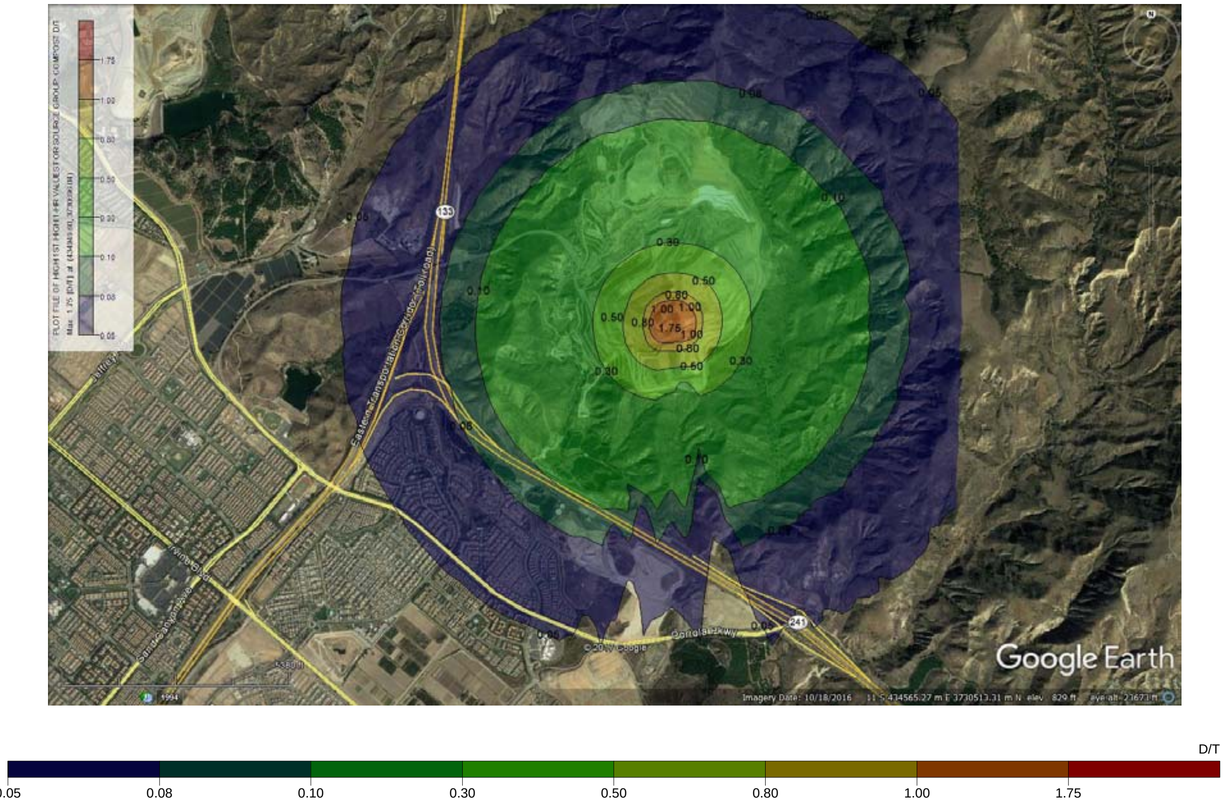
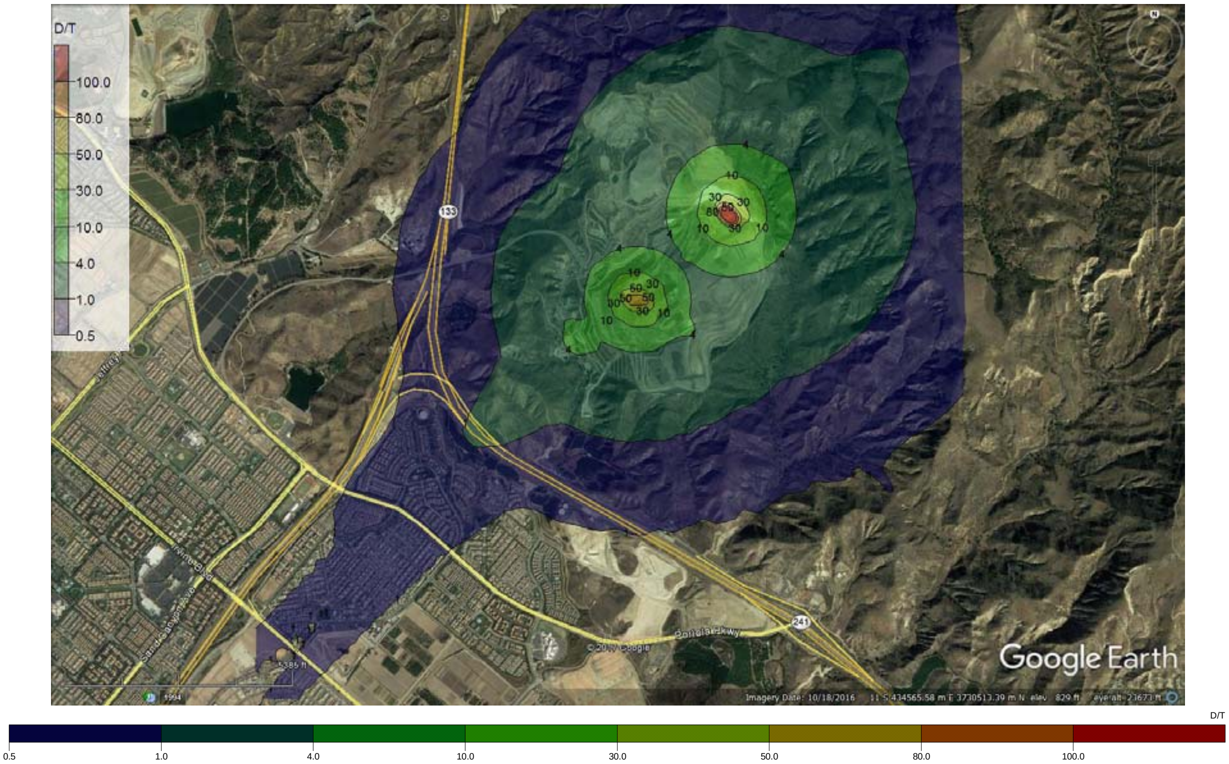


FIGURE 3-10 FRB Landfill Operations and Optional Composting Odor Impacts (1-Hour Peak D/T Concentrations) [3,4]



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APPENDIX A – LANDFILL VERTICAL VELOCITIES

Franklin R. Bowerman Landfill
Quantitative Odor Analysis
Vertical Velocity Data

Identified Potential Sources	Velocity (m/sec)	Basis for Velocity
Power Plant: Regen Flare	2.54E-02	LFG Flow Rate of 380 SCFM
Power Plant: Excess Gas Flare	3.77E-02	LFG Flow Rate of 565 SCFM
Power Plant: Engine Exhaust	4.67E-01	LFG Flow Rate of 7,000 SCFM
Working Face	6.35E-03	From previous tracer study on cap soil
Normal Covered Areas	1.08E-06	See Covered Area Velocity calculation below
Covered Areas under repair	1.08E-05	Assumed 10 x the normal cover area velocity
Tank Farm	5.00E-02	Conservative estimate
Condensate Spraying of Roads	1.33E-04	See Condensate Spray Velocity calculation below
PGM Covered Areas	5.44E-03	From previous tracer study on dry PGM
Waste Trucks	2.74E-06	From Santiago Canyon Model

Covered Area Velocity		
Average Landfill Gas Collected	7400	SCFM
Capture Efficiency	0.75	Percent
Gas Not Captured	1850	SCFM
Gas Not captured	0.873	m3/second
Surface area of system	200	Acres
Surface area of system	809,372	Square Meters
Vertical Velocity	**1.08E-06**	**m/sec**

Condensate Spray Velocity	
Evaporation Rate from Pool	
Temperature (celsius)	25
Surface Area (m2)	500
Mass rate (kg/sec)	0.049
Assumptions	
R (m3-atm/k-mol)	8.21E-05
Pressure (atm)	1
Temperature (celsius)	25
Temperature (k)	298.15
Molecular Weight (H2O)	18
Calculations	
Vapor Density (g/m3)	735.80
Vapor rate (m3/sec)	0.0666
Vertical Velocity (m/sec)	**0.00013**

APPENDIX B – LANDFILL ODOR EMISSION RATES

Franklin R. Bowerman Landfill
Quantitative Odor Analysis
Point Source Parameters

Identified Potential Sources	Stack Height (m)	Stack Diameter (m)	Flow Rate (SCFM)	Velocity (m/sec)	Release Temperature (F)	Odor Conc. (D/T)	Source Strength (D/T*m^3/sec)
Power Plant: Regen Flare	10	3	380	0.025	1,500	421	75
Power Plant: Excess Gas Flare	10	3	565	0.038	1,500	30	8
Power Plant: Engine Exhaust	10	3	7000	0.467	1,500	30	99

Identified Potential Sources	Length (m)	Width (m)	Area (m^2)	Effective Diameter (m)	Velocity (m/sec)	Odor Conc. (D/T)	Source Strength (D/T*m^3/sec)
Working Face	100	50	5,000	80	6.35E-03	135	4,286
Covered Areas Normal	807	1,000	807,000	1,014	1.08E-06	19	17
Covered Areas under repair	100	500	50,000	252	1.08E-05	38	20
Tank Farm	40	6	240	17	5.00E-02	45	540
Condensate Spraying of Roads	1,200	5	6,000	87	1.33E-04	362	289
PGM Covered Areas	100	50	5,000	80	5.44E-03	118	3,211

Franklin R. Bowerman Landfill
Quantitative Odor Analysis
Waste Truck Parameters

Identified Potential Sources	Length (m)	Width (m)	Area (m^2)	Vert Flow (m/sec)	Odor Conc. (D/T)	Source Strength (D/T*m^3/sec)
Waste Truck (per truck)	10	3	30.00	2.74E-06	135	0.01

Tons per truck		20						
Truck Traffic	7am-11am	50%						
	11am-3pm	40%						
	3pm-5pm	10%						
Daily Waste Acceptance		Trucks per Day	Trucks per hour			Source Strength (D/T*m3/sec)		
			7am-11am	11am-3pm	3pm-5pm	7am-11am	11am-3pm	3pm-5pm
Average Daily Tons	7,000	350	44	35	18	0.5	0.4	0.2

Franklin R. Bowerman Landfill
Quantitative Odor Analysis
Model Parameters

Source Type	Description	UTM X	UTM Y	Release Height	Diameter	Exit_Temp	Exit Velocity	Odor Concentration	Odor Emission Rate
		(m)	(m)	(m)	(m)	(F)	[m/s]	(D/T)	(D/T*m3/sec)
POINT	Working Face	435371.79	3731516.70	1	80	Ambient	6.35E-03	135	4286
POINT	Covered Areas	434955.76	3731165.12	1	1013.65	Ambient	1.08E-06	19	17
POINT	Tank Farm	434283.92	3730642.79	2	17.5	Ambient	5.00E-02	45	540
POINT	Condensate Spray	434908.52	3730786.17	1	87.4	Ambient	1.33E-04	362	289
POINT	Cover areas under repair	434956.31	3730992.17	1	252.3	Ambient	1.08E-05	38	20
POINT	Excess Flare	434165.47	3730872.70	10	3	1,500	3.77E-02	30	8
POINT	Regen Flare	434165.26	3730866.14	10	3	1,500	2.54E-02	421	75
POINT	Engine Exhaust	434189.60	3730912.91	10	3	1,500	4.67E-01	30	99
POINT	PGM Covered Area	434699.14	3730906.97	1.0000488	160	Ambient	5.44E-03	118	3211

Source Type	Description	Plume Width (m)	Odor Emission Rate	Odor Emission Rate per Area
			(D/T*m3/sec)	(D/T*m/sec)
Line-Area	Waste Trucks	9	0.5	2.33E-05
Sources Generated	**UTM X**	**UTM Y**	**Release Height**	**Length**
	(m)	**(m)**	**(m)**	**(m)**
A0000001	434294.77	3731178.41	2.59	32.02
A0000002	434297.92	3731147.74	2.59	32.33
A0000003	434292.76	3731116.85	2.59	30.31
A0000004	434280.87	3731088.15	2.59	31.11
A0000005	434273.76	3731056.69	2.59	24.88
A0000006	434274.95	3731030.06	2.59	35.12
A0000007	434290.05	3730997.61	2.59	38.15
A0000008	434312.02	3730964.68	2.59	31.56
A0000009	434335.84	3730946.41	2.59	55.28
A0000010	434364.96	3730899.79	2.59	52.75
A0000011	434389.37	3730853.89	2.59	64.99
A0000012	434409.54	3730792.25	2.59	55.61
A0000013	434425.36	3730738.61	2.59	53.3
A0000014	434444.6	3730687.39	2.59	61.91
A0000015	434484.06	3730638.39	2.59	45.16
A0000016	434519.87	3730610	2.59	39.58
A0000017	434555.05	3730588.64	2.59	46.36
A0000018	434602.12	3730579.63	2.59	39.24
A0000019	434639.54	3730585.79	2.59	61.78
A0000020	434701.61	3730577.33	2.59	20.25
A0000021	434724.49	3730579.52	2.59	14.74
A0000022	434737.01	3730594.11	2.59	23.46
A0000023	434726.78	3730618.21	2.59	51.73
A0000024	434682.42	3730646.02	2.59	63.34
A0000025	434626.81	3730669.68	2.59	42.95
A0000026	434608.57	3730707.63	2.59	74.91
A0000027	434589.59	3730779.52	2.59	50.71
A0000028	434582.85	3730829.78	2.59	50.71
A0000029	434575.7	3730877.47	2.59	52.56
A0000030	434596.92	3730922.83	2.59	73.42
A0000031	434660.2	3730960.06	2.59	73.42
A0000032	434724.2	3730997.81	2.59	79.07
A0000033	434783.01	3731050.67	2.59	79.07
A0000034	434840.64	3731102.76	2.59	84.66
A0000035	434918.88	3731137.47	2.59	84.97
A0000036	434987.76	3731187.22	2.59	84.97
A0000037	435058.47	3731239.98	2.59	79.09
A0000038	435069.64	3731318.28	2.59	79.09
A0000039	435080.41	3731395.27	2.59	75.92
A0000040	435111.75	3731462.06	2.59	60.76
A0000041	435156.25	3731497.4	2.59	63.93
A0000042	435213.58	3731469.11	2.59	63.93
A0000043	435272.63	3731440.37	2.59	63.39
A0000044	435335.91	3731436.64	2.59	63.39

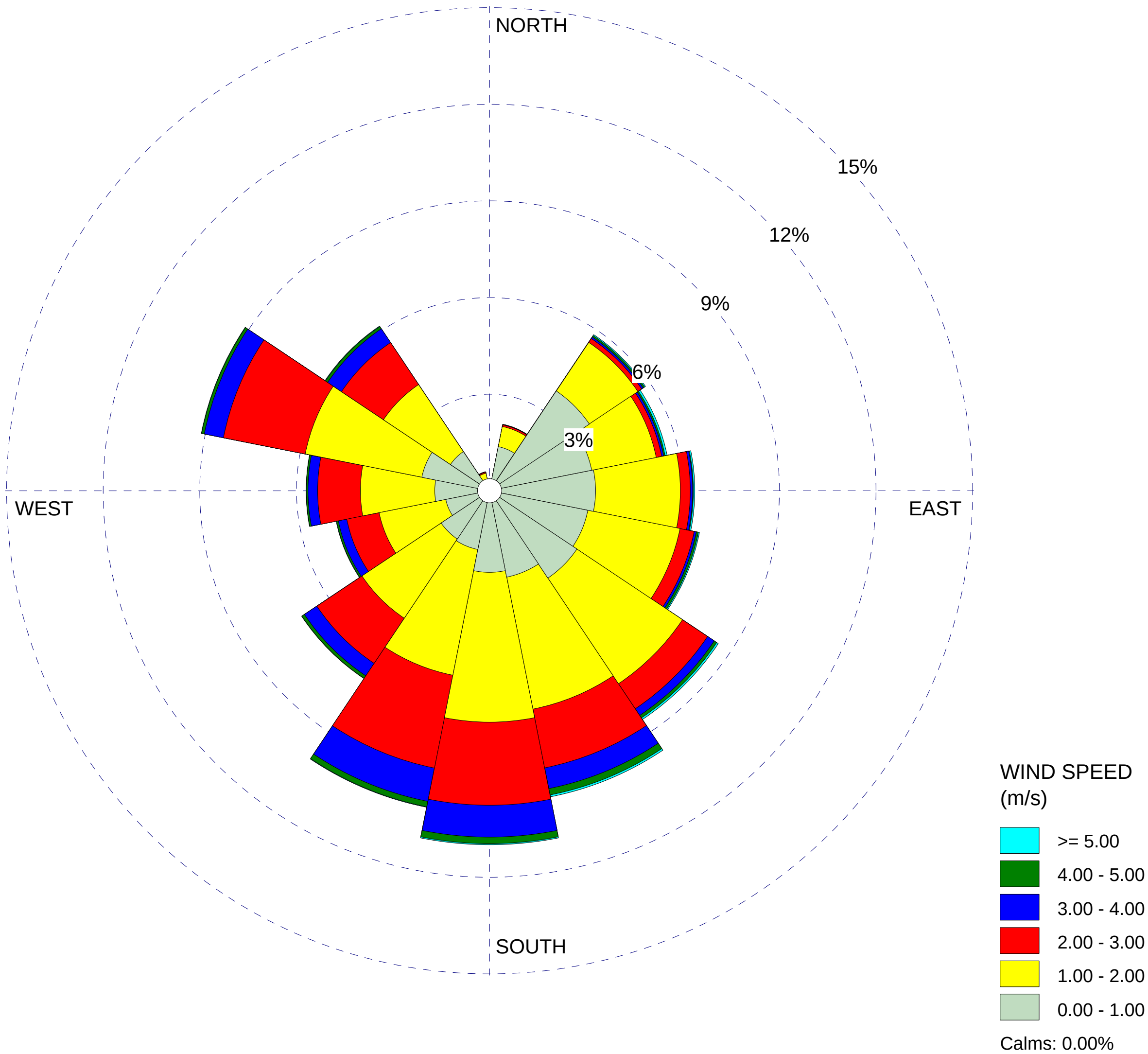
APPENDIX C – METEOROLOGICAL DATA WINDROSES

WIND ROSE PLOT:

MISSION VIEJO - WINDROSE
(2008 - 2012)

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 1/1/2008 - 01:00
End Date: 12/31/2012 - 23:59

COMPANY NAME:

MODELER:

CALM WINDS:

0.00%

TOTAL COUNT:

43569 hrs.

AVG. WIND SPEED:

1.58 m/s

DATE:

7/18/2016

PROJECT NO.:

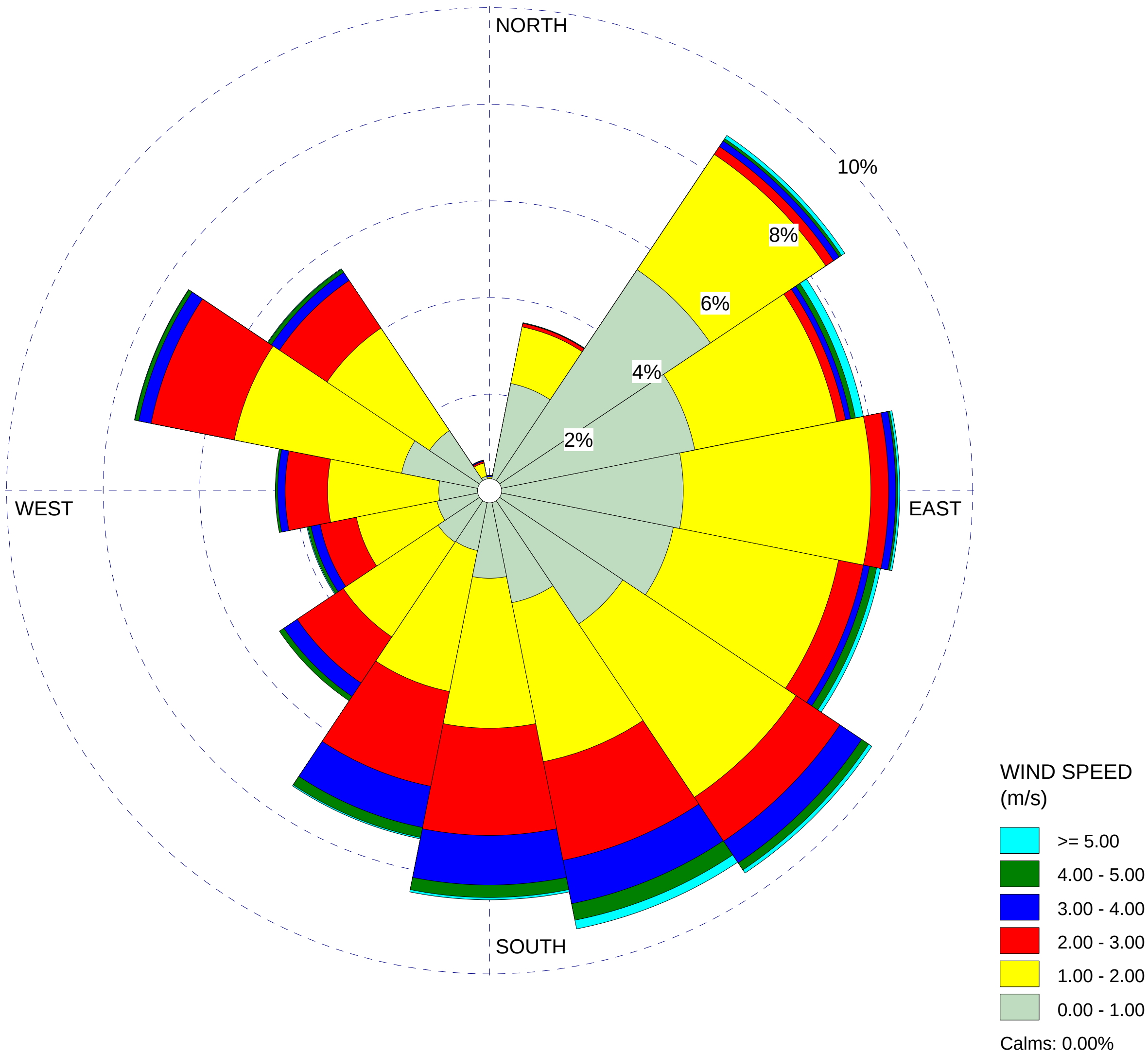
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

MISSION VIEJO - WINDROSE - 1ST QUARTER (2008 - 2012)

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 1/1/2008 - 01:00** **End Date: 3/31/2012 - 23:59**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **10726 hrs.**	
	AVG. WIND SPEED: **1.57 m/s**	DATE: **7/18/2016**	PROJECT NO.:

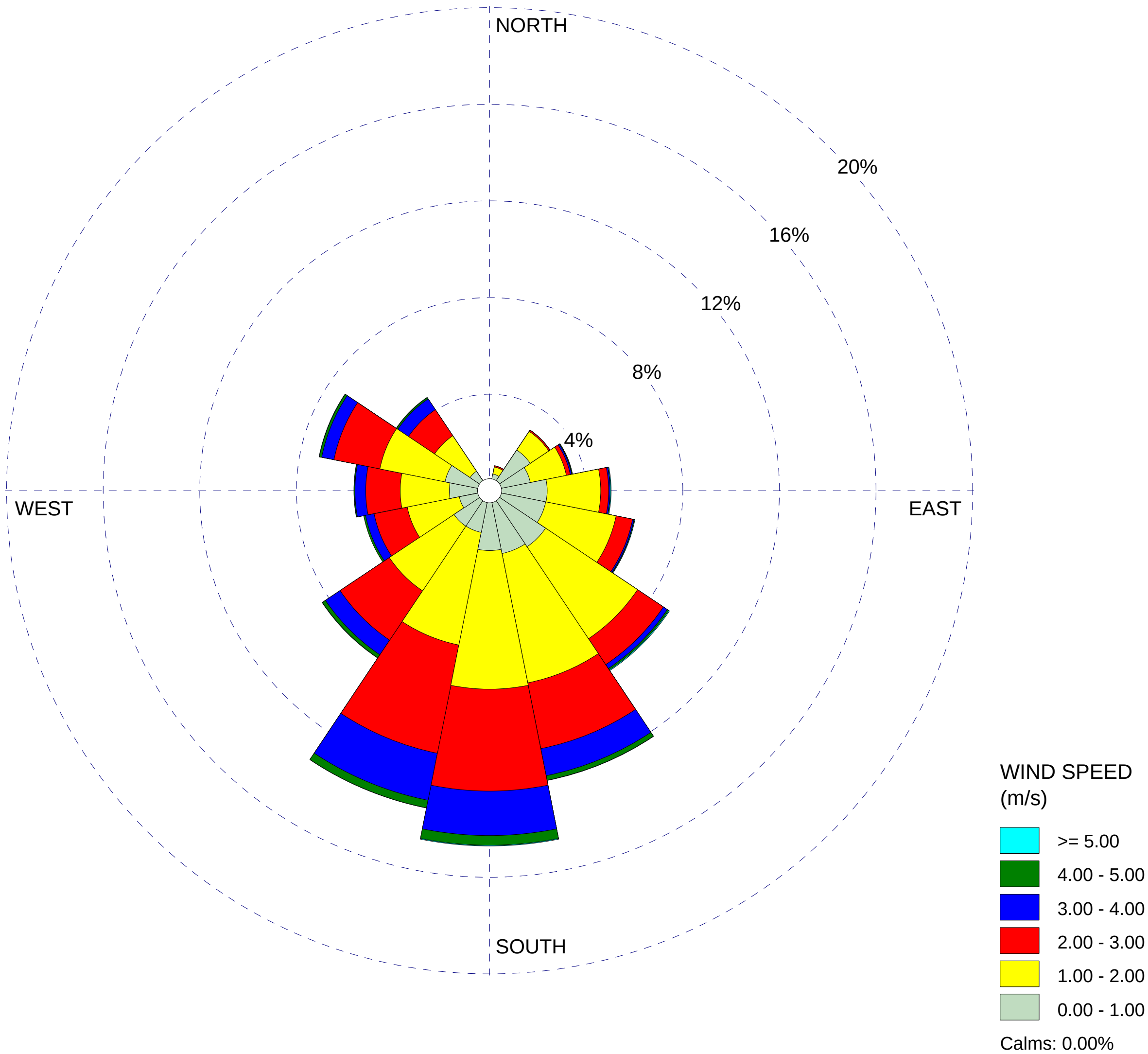
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

MISSION VIEJO - WINDROSE - 2ND QUARTER (2008 - 2012)

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 4/1/2008 - 00:00 **End Date: 6/30/2012 - 23:59**	MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **10870 hrs.**	
	AVG. WIND SPEED: **1.73 m/s**	DATE: **7/18/2016**	PROJECT NO.:

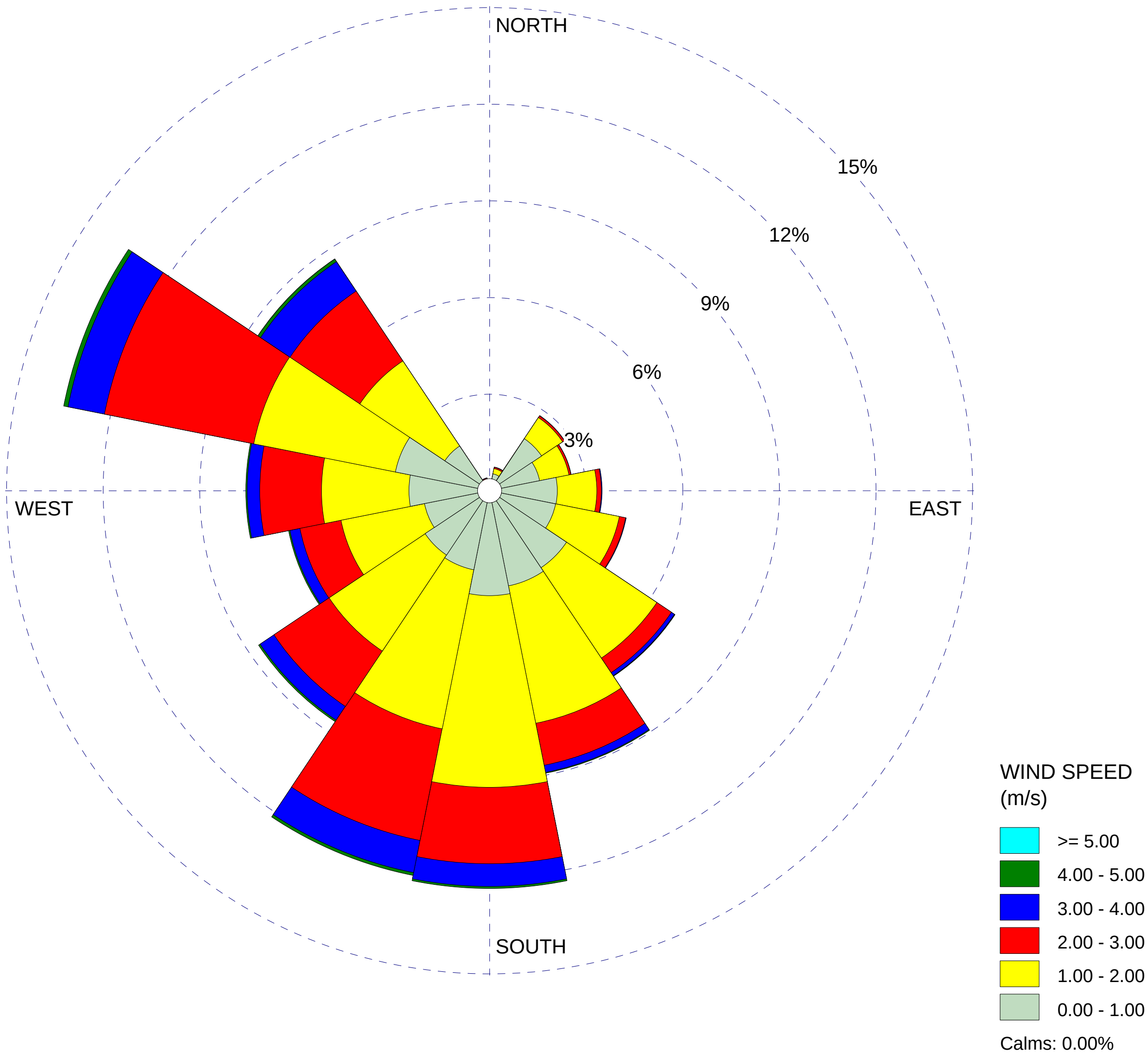
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

MISSION VIEJO - WINDROSE - 3RD QUARTER (2008 - 2012)

DISPLAY:

Wind Speed
Direction (blowing from)



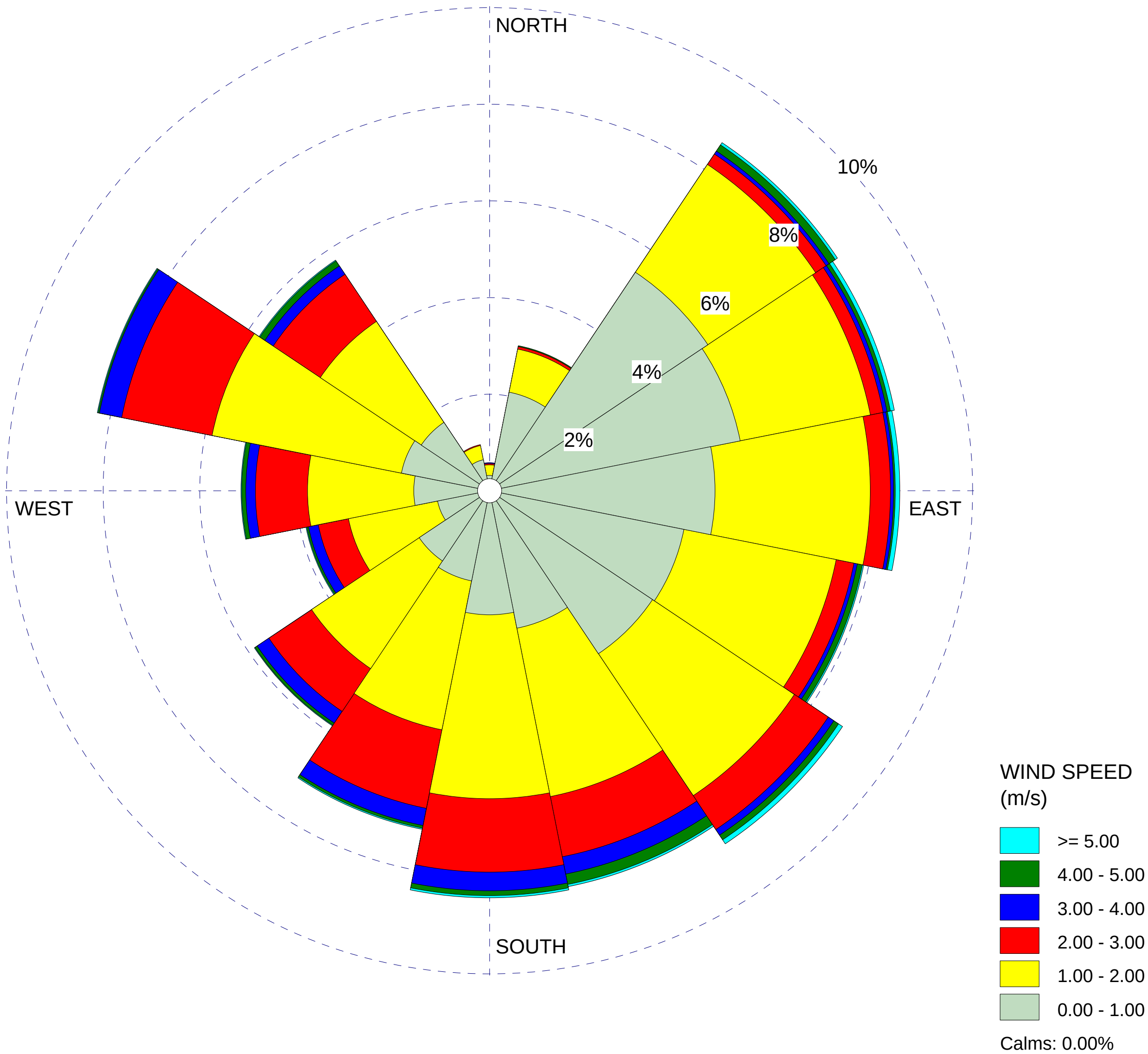
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 7/1/2008 - 00:00 **End Date: 9/30/2012 - 23:59**	MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **10979 hrs.**	
	AVG. WIND SPEED: **1.59 m/s**	DATE: **7/18/2016**	PROJECT NO.:

WIND ROSE PLOT:

MISSION VIEJO - WINDROSE - 4TH QUARTER (2008 - 2012)

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 10/1/2008 - 00:00** **End Date: 12/31/2012 - 23:59**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **10994 hrs.**	
	AVG. WIND SPEED: **1.43 m/s**	DATE: **7/18/2016**	PROJECT NO.:

APPENDIX D – COMPOSTING ODOR EMISSION PARAMETERS

Table D-1 Odor Emission Rates - Scenario #1 (Covered Aerated Static Pile Composting of Green, Wood, and Food Wastes @ 500 tpd)

Source No.	Source Description	Source Area Percent of Site (%)	Source Area (m2)	Gas Vertical Velocity (m/s)	Odor Concentration (D/T)	Gas Flow Rate (m3/s)	Source Odor Emission Rate (D/T)*(m3/s)	Source Odor Emission Rate per Area (D/T)*(m/s)	UTM X SW Corner (m)	UTM Y SW Corner (m)	Length (m)	Width (m)	Release Height (m)
1	Raw Feedstock Piles	7%	6708	2.19E-06	1272	1.47E-02	1.87E+01	2.79E-03	431994	3738029	81.9	81.9	1
2	Composting and curing piles (covered)	35%	33541	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	431943	3737978	183.1	183.1	1
3	Composting and curing piles (uncovered)	15%	14375	4.09E-06	1272	5.88E-02	7.48E+01	5.20E-03	431975	3738010	119.9	119.9	1
4	Finished compost piles	7%	6708	4.09E-06	1272	2.74E-02	3.49E+01	5.20E-03	431994	3738029	81.9	81.9	1
5	Grinding /mulching areas	2%	1917	2.19E-06	1272	4.20E-03	5.34E+00	2.79E-03	432013	3738048	43.8	43.8	1
6	Detention pond	20%	19166	2.19E-06	12.7	4.20E-02	5.33E-01	2.78E-05	431966	3738001	138.4	138.4	0
7	Biofilters	7%	6708	4.09E-06	0.26	2.74E-02	7.14E-03	1.06E-06	431994	3738029	81.9	81.9	1
8	Other (e.g. internal roads)	7%	6708	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	431994	3738029	81.9	81.9	0
	Totals:	100%	95831										

Source No.	Source Description	Source Area Percent of Site (%)	Source Area (m2)	Gas Vertical Velocity (m/s)	Odor Concentration (D/T)	Gas Flow Rate (m3/s)	Source Odor Emission Rate (D/T)*(m3/s)	Source Odor Emission Rate per Area (D/T)*(m/s)	UTM X SW Corner (m)	UTM Y SW Corner (m)	Length (m)	Width (m)	Release Height (m)
9	Truck #01	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431594	3737005	3	10	1.5
10	Truck #02	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431653	3736997	3	10	1.5
11	Truck #03	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431715	3737007	3	10	1.5
12	Truck #04	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431775	3737049	3	10	1.5
13	Truck #05	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431828	3737100	3	10	1.5
14	Truck #06	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431855	3737169	3	10	1.5
15	Truck #07	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431866	3737244	3	10	1.5
16	Truck #08	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431876	3737320	3	10	1.5
17	Truck #09	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431874	3737395	3	10	1.5
18	Truck #10	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431869	3737470	3	10	1.5
19	Truck #11	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431884	3737544	3	10	1.5
20	Truck #12	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431924	3737607	3	10	1.5
21	Truck #13	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431916	3737681	3	10	1.5
22	Truck #14	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431879	3737744	3	10	1.5
23	Truck #15	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431840	3737805	3	10	1.5
24	Truck #16	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431894	3737847	3	10	1.5
25	Truck #17	(n/a)	30	2.74E-06	318	8.22E-05	2.61E-02	8.71E-04	431949	3737899	3	10	1.5

Notes:

Composting site = 23.7 acres = 1031518 ft2 = 95831 m2

Compost density = 1,000 lb/yd3 = 593.3 kg/m3

Compost daily limit = 500 tpd = 453600 kg/day

170 truck trips per day @ 10 hours per day (7 am to 5 pm) = 17 trucks per hour

TABLE D-2 Odor Vertical Velocities

Ventilation Rate (m3/hr-bin)	CO2 Generated (g/kg)	CH4 Generated (g/kg)	N2O Generated (g/kg)	NH3 Generated (g/kg)	CO2 Density (g/m3)	CH4 Density (g/m3)	N2O Density (g/m3)	NH3 Density (g/m3)	CO2 Generated (m3/kg)	CH4 Generated (m3/kg)	N2O Generated (m3/kg)	NH3 Generated (m3/kg)	Total Gas Generated (m3/kg)	Composting Time * (s)	Generation Rate (m3/kg-s)
0.9	78	0.12	0.0064	2.4	1842	668	1834	717	4.23E-02	1.80E-04	3.49E-06	3.35E-03	4.59E-02	6652800	6.90E-09
0.7	66	0.09	0.0061	2	1842	668	1834	717	3.58E-02	1.35E-04	3.33E-06	2.79E-03	3.88E-02	6652800	5.83E-09
0.5	42	0.052	0.0051	1.2	1842	668	1834	717	2.28E-02	7.78E-05	2.78E-06	1.67E-03	2.46E-02	6652800	3.69E-09

* (11 weeks)(7 days/week)(24 hr/day)(60 min/hr)(60 s/min) = 6652800 seconds

Santiago Compost Limit (tpd)	Santiago Compost Cycle (days)	Santiago Compost Onsite (tons)	Santiago Compost Onsite (kg)	Santiago Compost Density (kg/m3)	Santiago Compost Volume (m3)	Santiago Compost Height (m)	Santiago Compost Area (m2)	Gas Generation Rate (m3/kg-s)	Odor Vertical Velocity (m/s)	Comments
850	60	51000	46267200	593.3	77983	1.75	44562	6.90E-09	7.16E-06	
850	60	51000	46267200	593.3	77983	1.75	44562	5.83E-09	6.05E-06	
850	60	51000	46267200	593.3	77983	1.75	44562	3.69E-09	3.83E-06	Open windrow sources (all)
500	60	30000	27216000	593.3	45872	1	45872	6.90E-09	4.09E-06	Covered aerated static pile (aerated sources)
500	60	30000	27216000	593.3	45872	1	45872	5.83E-09	3.46E-06	
500	60	30000	27216000	593.3	45872	1	45872	3.69E-09	2.19E-06	Covered aerated static pile (non-aerated sources)

Santiago Compost Trucks (trucks/day)	Santiago Compost Trucks (trucks/hr)	Santiago Compost Truck (tons/truck)	Santiago Compost Onsite (kg)	Santiago Compost Density (kg/m3)	Santiago Compost Volume (m3)	Santiago Compost Height (m)	Santiago Compost Area (m2)	Gas Generation Rate (m3/kg-s)	Odor Vertical Velocity (m/s)	Comments
170	17	22	19958.4	593.3	34	1.25	27	3.69E-09	2.74E-06	Trucks (all)