Northeast
Maryland
Waste
Disposal
Authority

March 29, 2018

Laramie Daniel, Compliance Program
Maryland Department of the Environment
Air and Radiation Management Administration
1800 Washington Boulevard, Suite 715
Baltimore, Maryland 21230-1720

Subject: 2017 Annual Emission Certification Report & Analysis of Toxic Air Pollutants
Gude Landfill, Rockville, MD

Dear Laramie:

The Northeast Maryland Waste Disposal Authority is pleased to submit two copies of the 2017 Annual Emissions Certification Report and Analysis of Toxic Air Pollutants for the Gude Landfill Gas-to-Energy Project in Montgomery County, Maryland (Operating Permit 031-02253) as required by COMAR 26.11.01.05-1 and 26.11.02.19D.

The report documents were completed using operating data recorded by facility representatives, results of emissions testing performed at the facility and default emission factor data provided by the USEPA.

The facility is in compliance with Maryland's Air Toxic Regulations (COMAR 26.11.15) for the calendar year 2017.

If you have any questions regarding this report, please do not hesitate to contact me.

Sincerely,

Chris Skaggs
Executive Director

Cc: Don Birnesser

MCLFG118258MLA

410.333.2730 / 410.333.2721 fax / authority@nmwda.org
nmwda.org / Business-to-Business Recycling: mdrecycles.org
Tower II - Suite 402, 100 S. Charles Street, Baltimore, MD 21201-2705

Comprehensive Waste Management Through Recycling, Reuse, Resource Recovery and Landfill

APTIM
200 Horizon Center
Trenton, New Jersey 08691
Tel: 609-584-8900
Fax: 609-588-6300
www.aptim.com

March 27, 2018

Ms. Amanda Moore
Project Manager
Northeast Maryland Waste Disposal Authority
100 South Charles Street
Tower II – Suite 402
Baltimore, MD 21201

Gude Landfill
Rockville, Maryland
2017 Annual Emissions Certification Report

Dear Ms. Moore:

Aptim Environmental and Infrastructure, Inc. (APTIM) is submitting one copy of the 2017 Annual Emissions Certification Report for the Gude Landfill-Gas-to-Energy Facility in Rockville, Maryland, in accordance with Permit to Operate (PTO) 031-02253. Two copies of the report must be submitted to the MDE offices by April 1, addressed to:

Maryland Department of the Environment
Air and Radiation Management Administration
1800 Washington Boulevard Suite 715
Baltimore, MD 21230-1720
Attn: Laramie Daniel, Compliance Program

The Responsible Official for the site must complete and submit the Certification of Truth, Accuracy, and Completeness with the report. In addition, a statement should be included certifying that the site is in compliance with the air toxic regulations.

Also please recognize that with the permanent shutdown of the Facility on June 1, 2017, the emissions for the flare was approx. 150% of that reported for 2016, while the engine emissions had an approx. 50% reduction.

Should you have any questions and/or comments, please do not hesitate to contact the undersigned at 609-588-6398.

Respectfully Submitted,

Aptim Environmental & Infrastructure, Inc.

John V. Esmet
Project Manager

Attachment

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard, Suite 715 • Baltimore Maryland 21230-1720
410-537-3000 • 1-800-633-6101 • http://www.mde.state.md.us
Air and Radiation Management Administration
Air Quality Compliance Program
410-537-3220

FORM 1:

GENERAL FACILITY INFORMATION
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2017

A. FACILITY IDENTIFICATION	Do Not Write in This Space
Facility Name *Gude Landfill Gas-to-Energy Facility*	Date Received Regional
Address *600 E. Gude Drive*	Date Received State
City *Rockville* County *Montgomery* Zip Code *20850*	AIRS Code
B. Briefly describe the major function of the facility	FINDS Code
Landfill Gas To Energy	SIC Code
	Facility Number:
	TEMPO ID:

C. SEASONAL PRODUCTION (%, if applicable)

Winter *(Dec.-Feb.)*	Spring *(Mar – May)*	Summer *(Jun – Aug)*	Fall *(Sept – Nov)*
25%	*25%*	*25%*	*25%*

Reviewed by:

Name Date

D. Explain any increases or decreases in emissions from the previous calendar year for each registration at this facility.

Small variation due to changes in operation and gas collection

E. CONTROL DEVICE INFORMATION (for NOx and VOC sources only)

Control Device	Capture Efficiency	Removal Efficiency
Landfill Gas Collection Flare System	*N/A*	*98.0% (Permit)*
848 kW GE Jenbacher Engine	*N/A*	*97.2%(AP-42)*

I am familiar with the facility and the installations and sources for which this report is submitted. I have personally examined the information in this report, which consists of 18 pages (including attachments), and certify that the information is correct to the best of my knowledge.

CHRISTOPHER SKAGGS	*EXECUTIVE DIRECTOR*	*03/29/2018*
Name (Print/Type)	Title	Date
Signature		*410-333-2730* Telephone

1/09/08

FORM 2:

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2017

Facility Name: Gude Landfill Gas-to-Energy Facility Facility ID: 031-02253 Pollutant: VOC

Equipment Description/ Registration No.	SCC Number	Fuel		Actual Emissions Tons/yr	Actual Emissions Lbs/day	Operating Schedule (Actual) Hrs/dy	Dys/wk	Wk/yr	Days/yr	TOSD Lbs/dy	Operating Schedule Hrs/dy	Start	End	Emissions Methods
Landfill Gas Flare System 9-0738		Landfill Gas	S	0.10	0.60	24	7	52	337	0.24	24			C3
			F	--	--					--				
GE Jenbacher Engine 9-0889		Landfill Gas	S	0.08	1.15	24	7	52	145	1.15	24			C1
			F	--	--					--				
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
Total				0.18	1.76					1.39				

S - Stack Emissions F - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

TOSD: Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This section needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emissions separately for each fuel.

Emission Estimation Method

A1-U.S. EPA Reference Method
A2-Other Particulate Sampling Train
A3-Liquid Absorption Technique
A4-Solid Absorption Technique
A5-Freezing Out Technique
A9-Other, Specify

C1-User calculated based on source test or other measurement
C2-User calculated based on material balance using engineering knowledge of the process
C3-User calculated based on AP-42
C4-User calculated by best guess/engineering Judgment

C5-User calculated based on a State or local agency emission factor
C6-New construction, not operational
C7-Source closed, operation ceased
C8-Computer calculated based on standard

FORM 2:

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2017

Facility Name: Gude Landfill Gas-to-Energy Facility Facility ID: 031-02253 Pollutant: NOx

Equipment Description/ Registration No.	SCC Number	Fuel		Actual Emissions Tons/yr	Actual Emissions Lbs/day	Operating Schedule (Actual) Hrs/dy	Dys/wk	Wk/yr	Days/yr	TOSD Lbs/dy	Operating Schedule Hrs/dy	Start	End	Emissions Methods
Landfill Gas Flare System 9-0738		Landfill Gas	S	2.68	15.94	24	7	52	337	18.42	24			C1
			F	--	--					--				
GE Jenbacher Engine 9-0889		Landfill Gas	S	2.72	37.69	24	7	52	145	37.69	24			C1
			F	--	--					--				
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
Total				5.41	53.63					56.11				

S - Stack Emissions F - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

TOSD: Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This section needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emissions separately for each fuel.

Emission Estimation Method

A1-U.S. EPA Reference Method
A2-Other Particulate Sampling Train
A3-Liquid Absorption Technique
A4-Solid Absorption Technique
A5-Freezing Out Technique
A9-Other, Specify

C1-User calculated based on source test or other measurement
C2-User calculated based on material balance using engineering knowledge of the process
C3-User calculated based on AP-42
C4-User calculated by best guess/engineering Judgment

C5-User calculated based on a State or local agency emission factor
C6-New construction, not operational
C7-Source closed, operation ceased
C8-Computer calculated based on standard

FORM 2:

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2017

Facility Name: Gude Landfill Gas-to-Energy Facility Facility ID: 031-02253 Pollutant: SO2

Equipment Description/ Registration No.	SCC Number	Fuel		Actual Emissions Tons/yr	Actual Emissions Lbs/day	Operating Schedule (Actual) Hrs/dy	Dys/wk	Wk/yr	Days/yr	TOSD Lbs/day	Operating Schedule Hrs/dy	Start	End	Emissions Methods
Landfill Gas Flare System 9-0738		Landfill Gas	S	0.06	0.34	24	7	52	337					C1, C3
			F	--	--									
GE Jenbacher Engine 9-0889		Landfill Gas	S	0.02	0.29	24	7	52	145					C1, C3
			F	--	--									
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
Total				0.08	0.62									

S - Stack Emissions F - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

TOSD: Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This section needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emissions separately for each fuel.

Emission Estimation Method

A1-U.S. EPA Reference Method
A2-Other Particulate Sampling Train
A3-Liquid Absorption Technique
A4-Solid Absorption Technique
A5-Freezing Out Technique
A9-Other, Specify

C1-User calculated based on source test or other measurement
C2-User calculated based on material balance using engineering knowledge of the process
C3-User calculated based on AP-42
C4-User calculated by best guess/engineering Judgment

C5-User calculated based on a State or local agency emission factor
C6-New construction, not operational
C7-Source closed, operation ceased
C8-Computer calculated based on standard

FORM 2:

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2017

Facility Name: Gude Landfill Gas-to-Energy Facility Facility ID: 031-02253 Pollutant: CO

Equipment Description/ Registration No.	SCC Number	Fuel		Actual Emissions Tons/yr	Actual Emissions Lbs/day	Operating Schedule (Actual) Hrs/dy	Dys/wk	Wk/yr	Days/yr	TOSD Lbs/dy	Operating Schedule Hrs/dy	Start	End	Emissions Methods
Landfill Gas Flare System 9-0738		Landfill Gas	S	6.71	39.86	24	7	52	337					C1
			F	--	--									
GE Jenbacher Engine 9-0889		Landfill Gas	S	14.28	197.54	24	7	52	145					C1
			F	--	--									
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
			S											
			F											
Total				20.99	237.40									

S - Stack Emissions F - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

TOSD: Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This section needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emissions separately for each fuel.

Emission Estimation Method

A1-U.S. EPA Reference Method
A2-Other Particulate Sampling Train
A3-Liquid Absorption Technique
A4-Solid Absorption Technique
A5-Freezing Out Technique
A9-Other, Specify

C1-User calculated based on source test or other measurement
C2-User calculated based on material balance using engineering knowledge of the process
C3-User calculated based on AP-42
C4-User calculated by best guess/engineering Judgment

C5-User calculated based on a State or local agency emission factor
C6-New construction, not operational
C7-Source closed, operation ceased
C8-Computer calculated based on standard

FORM 3: PM

EMISSIONS CERTIFICATION REPORT

Particulate Matter

Calendar Year: 2017

Facility Name: Gude Landfill Gas-to-Energy Facility **Facility ID:** 031-02253 **Pollutant:** PM

Equipment Description/ Registration No.	SCC Number	Fuel		PM – Filterable		PM 10 –Filterable		PM 2.5 – Filterable		PM Condensable		Operation	Emissions Methods
				Tons/yr	Lbs/day	Tons/yr	Lbs/day	Tons/yr	Lbs/day	Tons/yr	Lbs/day	Days/yr	
Landfill Gas Flare System 9-0738		Landfill Gas	S	0.13	0.747	0.13	0.747	0.13	0.747	0.38	2.24	337	C3
			F	--	--	--	--	--	--	--	--		
GE Jenbacher Engine 9-0889		Landfill Gas	S	0.05	0.748	0.05	0.748	0.05	0.748	0.16	2.24	145	C3
			F	--	--	--	--	--	--	--	--		
			S										
			F										
			S										
			F										
			S										
			F										
			S										
			F										
			S										
			F										
			S										
			F										
			S										
			F										
			S										
			F										
Total				0.18	1.49	0.18	1.49	0.18	1.49	0.54	4.48		

S - Stack Emissions F - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emissions separately for each fuel.

Emission Estimation Method

A1-U.S. EPA Reference Method
A2-Other Particulate Sampling Train
A3-Liquid Absorption Technique
A4-Solid Absorption Technique
A5-Freezing Out Technique
A9-Other, Specify

C1-User calculated based on source test or other measurement
C2-User calculated based on material balance using engineering knowledge of the process
C3-User calculated based on AP-42
C4-User calculated by best guess/engineering Judgment

C5-User calculated based on a State or local agency emission factor
C6-New construction, not operational
C7-Source closed, operation ceased
C8-Computer calculated based on standard

FORM 4:

TOXIC AIR POLLUTANTS

Calendar Year: 2017

EMISSIONS CERTIFICATION REPORT

Facility Name: Gude Landfill Gas-to-Energy Facility **Facility ID:** 031-02253 **Pollutant:** Hydrochloric Acid *

Equipment Description/ Registration Number[1]	Actual Emissions			Control Device**	% Efficiency
	Tons/yr	Lbs/day	Lbs/hr		
Landfill Gas Flare System 9-0738	0.4	2.28	0.1	O	0
GE Jenbacher Engine 9-0889	0.1	1.95	0.1	O	0
TOTALS	0.5	4.23	0.2		

* Please attach all calculations.

* See Attachment 1 for the minimum reporting values.

**Control Device
S = Scrubber
B = Baghouse
ESP = Electrostatic Precipitator
A = Afterburner
C = Condenser
AD = Adsorbtion
O = Other

[1]Emissions must be broken down by equipment registration number (ex. 9-0076, 9-0077)

FORM 5:

BILLABLE TOXIC AIR POLLUTANTS

Calendar Year: 2017

Emissions Certification Report

Facility Name: Gude Landfill Gas-to-Energy Facility Facility ID#: 031-02253

Chemical Name	CAS Number		Actual Emissions				Estimation Method
			Tons/year	Lbs/day	Lbs/hr		
carbon disulfide	75-15-0	S	0.00	0.00	0.00		C1
		F					
carbonyl sulfide	463-58-1	S	0.00	0.00	0.00		C3
		F					
chlorine	7782-50-5	S	N/A	N/A	N/A		
		F					
cyanide compounds	57-12-5	S	N/A	N/A	N/A		
		F					
hydrochloric acid	7647-01-0	S	0.50	4.23	0.20		C3
		F					
hydrogen fluoride	7664-39-3	S	N/A	N/A	N/A		
		F					
methyl chloroform	71-55-6	S	0.00	0.00	0.00		C1
		F					
methylene chloride	75-09-2	S	0.00	0.00	0.00		C1
		F					
perchloroethylene	127-18-4	S	0.00	0.00	0.00		C1
		F					
phosphine	7803-51-2	S	N/A	N/A	N/A		
		F					
titanium tetrachloride	7550-45-0	S	N/A	N/A	N/A		
		F					
TOTALS			0.50	4.23	0.20		

S-Stack Emissions F-Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

PLEASE NOTE: Be sure to attach all data and calculations necessary to support the emissions figures shown above.

Emission Estimation Method

A1-U.S. EPA Reference Method
A2-Other Particulate Sampling Train
A3-Liquid Absorption Technique
A4-Solid Absorption Technique
A5-Freezing Out Technique
A9-Other, Specify

C1-User calculated based on source test or other measurement
C2-User calculated based on material balance using engineering knowledge of the process
C3-User calculated based on AP-42
C4-User calculated by engineering judgment
C5-User calculated based on a State or local agency factor
C6-New construction, not operational
C7-Source closed, operation ceased
C8-Computer calculated based on standards

This form is to include only the chemicals identified.

FORM 6: Greenhouse Gases

GREENHOUSE GAS AIR POLLUTANTS

Calendar Year: 2017

EMISSIONS CERTIFICATION REPORT

Facility Name: Gude Landfill Gas-to-Energy Facility **Facility ID:** 031-02253 **Pollutant:** Carbon Dioxide *

Equipment Description/ Registration Number[1]	Actual Emissions		
	Tons/yr	Lbs/day	Lbs/hr
Landfill Gas Flare System 9-0738	6,968.5	41,396.9	1,724.9
GE Jenbacher Engine 9-0889	2,801.6	38,754.2	1,614.8
TOTALS	9,770.1	80,151.1	3,339.6

This form must be used to report Greenhouse gas emissions:

- carbon dioxide (CO2)
- methane (CH4)
- nitrous oxide (N2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulfur hexafluoride (SF6)

* Use a separate form for each pollutant.

* Please attach all calculations.

[1]Emissions must be broken down by equipment registration number (ex. 9-0076, 9-0077)

FORM 6: Greenhouse Gases

GREENHOUSE GAS AIR POLLUTANTS

Calendar Year: 2017

EMISSIONS CERTIFICATION REPORT

Facility Name: Gude Landfill Gas-to-Energy Facility **Facility ID:** 031-02253 **Pollutant:** Methane *

Equipment Description/ Registration Number[1]	Actual Emissions		
	Tons/yr	Lbs/day	Lbs/hr
Landfill Gas Flare System 9-0738	27.5	163.3	6.8
GE Jenbacher Engine 9-0889	16.5	228.7	9.5
TOTALS	44.0	392.0	16.3

[1]Emissions must be broken down by equipment registration number (ex 9-0076, 9-0077)

This form must be used to report Greenhouse gas emissions:

- carbon dioxide (CO2)
- methane (CH4)
- nitrous oxide (N2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulfur hexafluoride (SF6)

* Use a separate form for each pollutant.

* Please attach all calculations.

FORM 6: Greenhouse Gases

GREENHOUSE GAS AIR POLLUTANTS

Calendar Year: 2017

EMISSIONS CERTIFICATION REPORT

Facility Name: Gude Landfill Gas-to-Energy Facility **Facility ID:** 031-02253 **Pollutant:** N20 *

Equipment Description/ Registration Number[1]	Actual Emissions		
	Tons/yr	Lbs/day	Lbs/hr
Landfill Gas Flare System 9-0738	0.05	0.28	0.01
GE Jenbacher Engine 9-0889	0.02	0.28	0.01
TOTALS	0.07	0.55	0.02

[1]Emissions must be broken down by equipment registration number (ex. 9-0076, 9-0077)

This form must be used to report Greenhouse gas emissions:

- carbon dioxide (CO2)
- methane (CH4)
- nitrous oxide (N2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulfur hexafluoride (SF6)

* Use a separate form for each pollutant.

* Please attach all calculations.

Northeast Maryland Waste Disposal Authority - Gude Landfill
Reporting Year: 2017

yellow highlight - denotes Input Data

OPERATING DATA

Month	Flare Operation		JEN Engine Operation*	
	Hours	Days	Hours	Days
Jan	744.0	31.0	735.0	30.6
Feb	672.0	28.0	661.0	27.5
Mar	744.0	31.0	669.0	27.9
Apr	720.0	30.0	678.0	28.3
May	622.0	25.9	727.0	30.3
Jun	720.0	30.0	0.0	0.0
Jul	628.0	26.2	0.0	0.0
Aug	588.0	24.5	0.0	0.0
Sep	720.0	30.0	0.0	0.0
Oct	596.0	24.8	0.0	0.0
Nov	637.0	26.5	0.0	0.0
Dec	689.0	28.7	0.0	0.0
TOTAL	**8,080.0**	**336.7**	**3,470.0**	**144.6**

**Engine Plant shut down as of 6/1/2017.*

LANDFILL GAS USAGE DATA

Month	LFG to Flare (MMscf)	Avg LFG Flare Flow Rate (cfm)	Avg Flare Methane Content[1] (%)	Avg Flare Carbon Dioxide Content[2] (%)	LFG to JEN Engine[4] (MMscf)	Avg LFG JEN Engine Flow Rate[4] (cfm)	Avg Engine Methane Content[1,4] (%)	Avg Engine Carbon Dioxide Content[2,4] (%)
Jan[3]	6.32	141.6	34.40%	30.3%	14.51	329.0	37.85%	27.9%
Feb[3]	5.86	145.4	32.20%	28.7%	14.74	371.6	34.85%	27.3%
Mar	6.84	153.3	27.90%	27.3%	14.95	372.5	39.96%	29.4%
Apr	5.68	131.5	34.55%	31.0%	12.58	309.1	40.77%	29.6%
May	14.86	398.1	40.10%	33.1%	15.54	356.4	45.85%	31.3%
Jun	22.38	518.0	43.00%	31.7%	0.00	0.0	N/A	N/A
Jul	22.38	593.9	30.50%	27.2%	0.00	0.0	N/A	N/A
Aug	22.38	634.3	29.23%	26.4%	0.00	0.0	N/A	N/A
Sep	22.38	518.0	33.28%	28.7%	0.00	0.0	N/A	N/A
Oct	22.38	625.8	34.10%	28.3%	0.00	0.0	N/A	N/A
Nov	22.38	585.5	35.13%	28.1%	0.00	0.0	N/A	N/A
Dec	22.38	541.3	35.98%	27.5%	0.00	0.0	N/A	N/A
TOTAL	**196.2**	-	-	-	**72.3**	-	-	-
AVERAGE	-	**415.6**	**34.20%**	**29.0%**	-	**347.7**	**39.86%**	**29.1%**

[1] CH4 readings derived from daily operator plant readings.

[2] CO2 readings derived from monthly GEM readings. For missing readings, the months prior and following a missing reading are averaged.

[3] Flare CO2 readings for January and February 2016 are derived from plant readings

[4] Engine Plant shut down as of 6/1/2017.

DEVICE DESTRUCTION EFFICIENCIES FOR LFG CONSTITUENTS

Flare System	98.0%	Manufacturer design for NMOC; Permit 031-2253
Jenbacher Engine	97.2%	AP-42 Table 2.4-3 (10/08)

LFG ANALYSIS DATA

Component	Concentration (ppmv)	
Total Reduced Sulfur (TRS)	3.52	
VOC (as Hexane)	235	AP-42 Table 2.4-2 footnote

Northeast Maryland Waste Disposal Authority - Gude Landfill
Reporting Year: 2017

Summary of LFG Flow Data and Operating Parameters			
Parameter	Units	Flare System	JEN Engine
Site-specific CH4 Content	%	34.2%	39.9%
Site-specific CO2 Content	%	29.0%	29.1%
Site-specific LFG Heat Content	Btu/scf of LFG	341.97	398.55
Site-specific LFG Flow to Device	MMscf/yr	196.21	72.32
CH4 Flow to Device	MMscf/yr	67.10	28.82
Days per Year of Operation	Days/Yr	336.67	144.58
Hours per Year of Operation	Hrs/Yr	8,080.00	3,470.00
LFG Flow to Device, Apr-Sep	MMscf	110.05	28.12
CH4 Flow to Device, Apr-Sep	MMscf	38.36	12.25
Hours of Operation, Apr-Sep	Hours	3,998.00	1,405.00
Days of Operation, Apr-Sep	Days	166.58	58.54

Sample Calculations:

1. Site-specific LFG Heat Content

Standard CH4 heat content = 1000 Btu/scf

LFG Heat Content (Btu/scf) = CH4 Content of LFG (%) * CH4 Heat Content (Btu/scf)

2. CH4 Flow to Device

CH4 Flow to Device (MMScf) = CH4 Content (%) * LFG Flow to Device (MMscf)

3. Normalized LFG Flow to Device (adjusted to 50% CH4)

Normalized LFG Flow to Device (MMscf) = Site-specific LFG flow (MMscf) * Site-specific CH4 Content (%) / Standard CH4 Content (50%)

EMISSION FACTORS

Equipment	Pollutant	Factor	Units	Reference
Flare	NOx	80	lb/MMdscf CH4	Manufacturer data
Flare	CO	200	lb/MMdscf CH4	Manufacturer data
Flare	VOC	51.71	lb/MMdscf LFG	Concentration in LFG; AP-42 Section 2.4, equations 3 and 4
Flare	TPM	15	lb/MMdscf CH4	AP-42 Table 2.4-4 (10/08)
Flare	TPM10	15	lb/MMdscf CH4	AP-42 Table 2.4-4 (10/08)
Flare	TPM2.5	15	lb/MMdscf CH4	AP-42 Table 2.4-4 (10/08)
Flare	FPM	3.75	lb/MMdscf CH4	Historical calculations; FPM/TPM = 0.25, AP-42 Table 1.4-2
Flare	FPM10	3.75	lb/MMdscf CH4	Historical calculations; FPM/TPM = 0.25, AP-42 Table 1.4-2
Flare	FPM2.5	3.75	lb/MMdscf CH4	Historical calculations; FPM/TPM = 0.25, AP-42 Table 1.4-2
Flare	CPM	11.25	lb/MMdscf CH4	Historical calculations; CPM/TPM = 0.75, AP-42 Table 1.4-2
Flare	SO2	0.58	lb/MMdscf LFG	TRS concentration in LFG; AP-42 Section 2.4, equations 3 and 4
Flare	CH4	Mass Balance		
Flare	CO2	Mass Balance		
Flare	N2O	6.30E-04	kg/MMBtu	40 CFR 98 Table C-2
GE Jenbacher Engine	NOx	1.57	lb/hr	Emissions test data (4/20/2017). Derived lb/hr from g/BHP result. **NOx lb/hr= 0.620** g/BHP NOx***1148.8** BHP/**453.6** g/lb
GE Jenbacher Engine	CO	8.23	lb/hr	Emissions test data (4/20/2017). Derived lb/hr from g/BHP result. **CO lb/hr= 3.25** g/BHP CO***1148.8** BHP/**453.6** g/lb
GE Jenbacher Engine	VOC	0.05	lb/hr	Emissions test data (4/20/2017). Derived lb/hr from g/BHP result. **VOC lb/hr= 0.019** g/BHP VOC***1148.8** BHP/**453.6** g/lb
GE Jenbacher Engine	TPM	15	lb/MMdscf CH4	AP-42 Table 2.4-4 (10/08)
GE Jenbacher Engine	TPM10	15	lb/MMdscf CH4	AP-42 Table 2.4-4 (10/08)
GE Jenbacher Engine	TPM2.5	15	lb/MMdscf CH4	AP-42 Table 2.4-4 (10/08)
GE Jenbacher Engine	FPM	3.75	lb/MMdscf CH4	Historical calculations; FPM/TPM = 0.25, AP-42 Table 1.4-2
GE Jenbacher Engine	FPM10	3.75	lb/MMdscf CH4	Historical calculations; FPM/TPM = 0.25, AP-42 Table 1.4-2
GE Jenbacher Engine	FPM2.5	3.75	lb/MMdscf CH4	Historical calculations; FPM/TPM = 0.25, AP-42 Table 1.4-2
GE Jenbacher Engine	CPM	11.25	lb/MMdscf CH4	Historical calculations; CPM/TPM = 0.75, AP-42 Table 1.4-2
GE Jenbacher Engine	SO2	0.58	lb/MMdscf LFG	TRS concentration in LFG; AP-42 Section 2.4, equations 3 and 4
GE Jenbacher Engine	CH4	Mass Balance		
GE Jenbacher Engine	CO2	Mass Balance		
GE Jenbacher Engine	N2O	6.30E-04	kg/MMBtu	40 CFR 98 Table C-2

Calculation Constants		
298	deg K	Default temperature of LFG, 25 deg C, AP-42 Section 2.4
32	g/gmol	MW of total reduced sulfur (TRS)
64	g/gmol	MW of SO2
8.21E-05	m^3 - atm/gmol - K	Ideal gas constant
35.31	ft^3/m^3	conversion factor
453.6	g/lb	conversion factor
86.18	g/gmol	MW of VOC as Hexane (AP-42 Table 2.4-2)

CRITERIA POLLUTANT EMISSIONS CALCULATIONS

Northeast Maryland Waste Disposal Authority - Gude Landfill
Reporting Year: 2017

Device: **Landfill Gas Flare System**

Pollutant	Actual Emissions		Emissions	TOSD*
	TPY	lb/day	Basis	lb/day
NOx	2.68	15.94	Manufacturer Data	18.42
CO	6.71	39.86	Manufacturer Data	-
VOC	0.10	0.60	AP-42, manuf control eff.	0.24
TPM	0.50	2.99	AP-42	-
TPM10	0.50	2.99	AP-42	-
TPM2.5	0.50	2.99	AP-42	-
FPM	0.13	0.75	Historical calcs, AP-42	-
FPM10	0.13	0.75	Historical calcs, AP-42	-
FPM2.5	0.13	0.75	Historical calcs, AP-42	-
CPM	0.38	2.24	Historical calcs, AP-42	-
SO2	0.06	0.34	LFG test data, AP-42	-

* TOSD = Typical Ozone Season Day (Apr-Sep), applies to NOx and VOC only.

Northeast Maryland Waste Disposal Authority - Gude Landfill
Reporting Year: 2017

Device: **GE Jenbacher Engine**

Pollutant	Actual Emissions		Emissions	TOSD*
	TPY	lb/day	Basis	lb/day
NOx	2.72	37.69	Test data	37.69
CO	14.28	197.54	Test data	-
VOC	0.08	1.15	Test data	1.15
TPM	0.22	2.99	AP-42	-
TPM10	0.22	2.99	AP-42	-
TPM2.5	0.22	2.99	AP-42	-
FPM	0.05	0.75	Historical calcs, AP-42	-
FPM10	0.05	0.75	Historical calcs, AP-42	-
FPM2.5	0.05	0.75	Historical calcs, AP-42	-
CPM	0.16	2.24	Historical calcs, AP-42	-
SO2	0.02	0.29	LFG test data, AP-42	-

* TOSD = Typical Ozone Season Day (Apr-Sep), applies to NOx and VOC only.

TOXIC AIR POLLUTANT EMISSIONS CALCULATIONS

Northeast Maryland Waste Disposal Authority - Guda Landfill
Reporting Year: 2017

LFG Flow to Flares =	196.21	MMscf/yr	LFG Flow to JEN Engine =	72.32	MMscf/yr
Flare Operating Days =	336.67	days/yr	JEN Engine Operating Days =	144.58	days/yr
Flare Operating Hours =	8080	hrs/yr	JEN Engine Operating Hours =	3470.00	hrs/yr

Pollutant	Molecular Weight (g/gmol)	Concentration (ppmv)	Flare Pollutant Inflow (lb/yr)	Flare Destruction Efficiency	Flare Emissions			JEN Engine Pollutant Inflow (lb/yr)	JEN Engine Destruction Efficiency	JEN Engine Emissions			Facility Total Emissions		
					(lb/day)	(lb/hr)	(ton/yr)			(lb/day)	(lb/hr)	(ton/yr)	(lb/day)	(lb/hr)	(ton/yr)
1,1,1-Trichloroethane (methyl chloroform)	133.4	0.04	2.7	98.0%	0.00	0	0	1.0	97.2%	0.00	0	0	0.00	0	0
1,1,2,2-Tetrachloroethane	167.85	0.06	5.0	98.0%	0.00	0.0	0.0	1.9	97.2%	0.00	0.0	0.0	0.00	0.0	0.0
1,1,2,3,4,4-Hexachloro-1,3-butadiene (Hexachlorobutadiene)	260.76	0.06	7.8	98.0%	0.00	0.000	0.00	2.9	97.2%	0.00	0.000	0.00	0.00	0.000	0.00
1,1,2-Trichloroethane	133.4	0.06	4.0	98.0%	0.00	0.0	0	1.5	97.2%	0.00	0.0	0	0.00	0.0	0
1,1-Dichloroethane (ethylidene dichloride)	98.96	1.18	58.5	98.0%	0.00	0	0	21.6	97.2%	0.00	0	0	0.01	0	0
1,1-Dichloroethene (vinylidene chloride)	96.94	0.06	2.9	98.0%	0.00	0.0	0	1.1	97.2%	0.00	0.0	0	0.00	0.0	0
1,2,4-Trichlorobenzene	181.45	0.05	5.5	98.0%	0.00	0.0	0	2.0	97.2%	0.00	0.0	0	0.00	0.0	0
1,2-Dichloroethane (ethylene dichloride)	98.96	0.06	3.0	98.0%	0.00	0.0	0.00	1.1	97.2%	0.00	0.0	0.00	0.00	0.0	0.00
1,2-Dichloropropane (propylene dichloride)	112.99	0.06	3.4	98.0%	0.00	0	0	1.3	97.2%	0.00	0	0	0.00	0	0
1,3-Butadiene (vinyl ethylene)	54.09	0.06	1.6	98.0%	0.00	0.00	0.000	0.6	97.2%	0.00	0.00	0.000	0.00	0.00	0.000
1,3-Dichloropropene	110.97	0.06	3.3	98.0%	0.00	0.00	0.00	1.2	97.2%	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	147.02	0.04	2.9	98.0%	0.00	0	0.0	1.1	97.2%	0.00	0	0.0	0.00	0	0.0
1,4-Dioxane (1,4-diethylene dioxide)	88.11	0.06	2.6	98.0%	0.00	0	0.0	1.0	97.2%	0.00	0	0.0	0.00	0	0.0
2,2,4-Trimethylpentane	114.23	0.05	3.4	98.0%	0.00	0.0	0	1.3	97.2%	0.00	0.0	0	0.00	0.0	0
2-Butanone (methyl ethyl ketone)	72.11	1.27	45.9	98.0%	0.00	0	0	16.9	97.2%	0.00	0	0	0.01	0	0
4-Methyl-2-pentanone (Methyl isobutyl ketone)	100.16	0.06	3.0	98.0%	0.00	0	0	1.1	97.2%	0.00	0	0	0.00	0	0
Acrylonitrile *	53.06	6.33	168.2	98.0%	0.01	0.00	0.00	62.0	97.2%	0.01	0.00	0.00	0.02	0.00	0.00
Allyl chloride (3-Chloro-1-propene)	76.52	0.06	2.3	98.0%	0.00	0.00	0.0	0.8	97.2%	0.00	0.00	0.0	0.00	0.00	0.0
Benzene	78.11	0.272	10.5	98.0%	0.00	0.00	0.0	3.9	97.2%	0.00	0.00	0.0	0.00	0.00	0.0
Benzyl chloride	126.58	0.06	3.8	98.0%	0.00	0.00	0.0	1.4	97.2%	0.00	0.00	0.0	0.00	0.00	0.0
Bromomethane (Methyl bromide)	94.94	0.06	2.9	98.0%	0.00	0.00	0.00	1.1	97.2%	0.00	0.00	0.00	0.00	0.00	0.00
Bromoethene (Vinyl bromide)	106.95	0.06	3.2	98.0%	0.00	0.0	0	1.2	97.2%	0.00	0.0	0	0.00	0.0	0
Carbon disulfide	76.14	0.06	2.3	98.0%	0.00	0.0	0	0.8	97.2%	0.00	0.0	0	0.00	0.0	0
Carbon tetrachloride	153.82	0.04	3.1	98.0%	0.00	0.0	0.00	1.1	97.2%	0.00	0.0	0.00	0.00	0.0	0.00
Carbonyl sulfide (Carbon oxysulfide) *	60.08	0.49	14.7	98.0%	0.00	0.0	0	5.4	97.2%	0.00	0.0	0	0.00	0.0	0
Chlorine *	35.45	42	745.5	n/a	n/a	n/a	n/a	274.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chlorobenzene	112.56	0.06	3.4	98.0%	0.00	0.0	0	1.2	97.2%	0.00	0.0	0	0.00	0.0	0
Chloroethane (Ethyl chloride)	64.51	0.208	6.7	98.0%	0.00	0.000	0.00	2.5	97.2%	0.00	0.000	0.00	0.00	0.000	0.00
Chloromethane (Methyl chloride)	50.49	0.06	1.5	98.0%	0.00	0.0	0.0	0.6	97.2%	0.00	0.0	0.0	0.00	0.0	0.0
Dichloromethane (Methylene chloride)	84.93	0.115	4.9	98.0%	0.00	0	0	1.8	97.2%	0.00	0	0	0.00	0	0
Ethylbenzene	106.17	0.868	46.1	98.0%	0.00	0	0	17.0	97.2%	0.00	0	0	0.01	0	0
Hexachlorobutadiene	260.76	0.06	7.8	98.0%	0.00	0.000	0.00	2.9	97.2%	0.00	0.000	0.00	0.00	0.000	0.00
n-Hexane	86.18	0.78	33.7	98.0%	0.00	0	0	12.4	97.2%	0.00	0	0	0.00	0	0
Hydrochloric Acid *	36.46	42	766.7	0.0%	2.28	0.1	0.4	282.6	0.0%	1.95	0.1	0.1	4.23	0.2	0.5
Mercury (Total) *	200.59	0.000292	0.0	0.0%	0.00	0.0000	0.000	0.0	0.0%	0.00	0.0000	0.000	0.00	0.0000	0.000
Methyl tert-butyl ether (MTBE)	88.15	0.084	3.7	98.0%	0.00	0	0	1.4	97.2%	0.00	0	0	0.00	0	0
Styrene (Vinylbenzene)	104.15	0.06	3.1	98.0%	0.00	0	0	1.2	97.2%	0.00	0	0	0.00	0	0
Tetrachloroethylene (Perchloroethylene)	165.83	0.265	22.0	98.0%	0.00	0	0	8.1	97.2%	0.00	0	0	0.00	0	0
Toluene (Methyl benzene)	92.14	4.16	191.9	98.0%	0.01	0	0	70.7	97.2%	0.01	0	0	0.03	0	0
Tribromomethane (Bromoform)	252.73	0.04	5.1	98.0%	0.00	0.00	0.0	1.9	97.2%	0.00	0.00	0.0	0.00	0.00	0.0
Trichloroethylene (Trichloroethene)	131.39	0.158	10.4	98.0%	0.00	0	0	3.8	97.2%	0.00	0	0	0.00	0	0
Trichloromethane (Chloroform)	119.38	0.04	2.4	98.0%	0.00	0.0	0.00	0.9	97.2%	0.00	0.0	0.00	0.00	0.0	0.00
Vinyl acetate	86.09	0.06	2.6	98.0%	0.00	0.0	0	1.0	97.2%	0.00	0.0	0	0.00	0.0	0
Vinyl chloride (Chloroethene)	62.5	1.78	55.7	98.0%	0.00	0.0	0.00	20.5	97.2%	0.00	0.0	0.00	0.01	0.0	0.00
Xylenes (o-, m-, p-, mixtures)	106.17	0.39	20.7	98.0%	0.00	0	0	7.6	97.2%	0.00	0	0	0.00	0	0
Total Air Toxics					2.32	0.10	0.40			2.01	0.10	0.10	4.34	0.20	0.50

* Laboratory data not available; default values from AP-42 Section 2.4 were used.

Pollutant Inflow (lb/yr) = Conc (ppmv)/10^6 * MW (g/gmol) / 8.21E-05
(atm-m3/gmol-K)/ 298 K / 35.31 (ft3/m3) / 453.6 (g/lb) * 10^6

GREENHOUSE GAS EMISSIONS CALCULATIONS

Northeast Maryland Waste Disposal Authority - Gude Landfill
Reporting Year: 2017

Calculation Constants and Input Parameters

Description	Value	Units
Default temperature of LFG, 25 deg C, AP-42 Section 2.4	298	deg K
Ideal gas constant	8.21E-05	(m^3 - atm) / (gmol - K)
MW of CO2	44.01	g/gmol
MW of CH4	16.044	g/gmol
Default N2O factor, 40 CFR 98 Table C-2	6.30E-04	kg/MMBtu

Emissions Parameter	Units	Flares	JEN Engine
Site-specific CO2 Content of LFG	%	29.0%	29.1%
Site-specific CH4 Content of LFG	%	34.2%	39.9%
Site-specific LFG heat content	Btu/scf	342.0	398.6
LFG Flow to Device	MMscf/yr	196.21	72.32
Days of Operation	Days/Yr	336.67	144.58
Hours of Operation	Hrs/Yr	8080.00	3470.00
Destruction Efficiency	%	98.0%	97.2%
Volume of CO2 Emissions	MMscf/yr	124.02	49.86
Mass of CO2 Emissions	TPY	6968.5	2801.6
	lb/day	41396.9	38754.2
	lb/hr	1724.9	1614.8
Volume of CH4 Emissions	MMscf/yr	1.342	0.807
Mass of CH4 Emissions	TPY	27.5	16.5
	lb/day	163.3	228.7
	lb/hr	6.8	9.5
Mass of N2O Emissions	TPY	0.05	0.02
	lb/day	0.28	0.28
	lb/hr	0.01	0.01

Calculation Notes:

1. CO2 Emissions

-Burning LFG produces CO2, and LFG also contains CO2.

- The CO2 emissions from burning LFG are calculated using the site-specific CH4 and CO2 contents of the LFG and assuming that all CH4 in the LFG is burned. 1 mole of CH4 produces 1 mole of CO2.

Sample Calculations for CO2 :

a. Volume of Emissions (MMscf/yr) = LFG flow to device (MMscf/yr) * (LFG CO2 content % + LFG CH4 content %)

b. Mass of Emissions (lb/yr) = Volume Emissions (MMscf/yr) * 10^6 (scf/MMscf) / 35.31 (cf/m3)* MW (g/gmol) / Gas Constant (atm-m3/gmol-K) / LFG Temperature (K) / 453.6 (g/lb)

2. CH4 Emissions

- LFG contains CH4. Uncombusted CH4 is released from the flares and engines.

Sample Calculations for CH4:

a. Volume of Emissions (MMscf/yr) = LFG flow to device (MMscf/yr) * LFG CH4 content (%) * (1-Destruction Efficiency %)

b. Mass of Emissions (lb/yr) = Volume Emissions (MMscf/yr) * 10^6 (scf/MMscf) / 35.31 (cf/m3)* MW (g/gmol) / Gas Constant (atm-m3/gmol-K) / LFG Temperature (K) / 453.6 (g/lb)

3. N2O Emissions

N2O Emissions (ton/yr) = LFG flow to device (MMscf/yr) * LFG Heat content (Btu/scf) * N2O factor (kg/MMBtu) * 2.2 (lb/kg)/ / 2000 (lb/ton)