

CLINTON LANDFILL #2 GAS COLLECTION AND COMBUSTION VCS MONITORING REPORT



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1 PROJECT DETAILS

1.1 Summary Description of Project

The project activity is the capture and destruction of methane from the Clinton Landfill #2, via combustion engines and two open flares. The generated electricity is sold to the local grid.

Clinton Landfill #2 opened in 1989, and closed in 2010. Clinton Landfill accepts municipal solid waste and non-hazardous special waste, which includes commercial solid waste, sludge, conditionally exempt small quantity generator waste, and industrial solid waste, among other waste types. The landfill was permitted for ten cells and a total capacity is 4.7 million cubic yards of waste. It accepted approximately 270,000 short tons of waste per year during operation.

In 1998, an active methane recovery and destruction system was constructed at Clinton landfill #2 to maintain compliance with federal and state standards regarding the control of non-methane organic compounds (NMOCs) and landfill gas (35 IAC, Part 220).

The project seeks credit for the voluntary emissions reductions over and above those achieved by the previously installed, mandated gas collection system. The original system consisted of 40 landfill gas wells, piping, and a 550 scfm open flare. Implementing the project's gas-to-energy activity entailed the addition of 10 wells, more powerful blowers, gas measurement meters, two 1.6-MW Caterpillar 3520C engine generator sets, gas conditioning equipment, a building to house the generators, and associated interconnection and metering devices.

Note that the displacement of fossil fuels resulting from this activity is not included in this project and emissions reductions from the offsite use of electricity are not addressed. More details about the project can be found in Project Design document.

1.2 Sectoral Scope and Project Type

The project activity falls into Sectoral Scope 13 – Waste Handling and Disposal. The project meets the criteria of a landfill gas project activity as defined in the CDM Approved Consolidated Baseline Methodology ACM0001 Version 10, "Consolidated baseline and monitoring methodology for landfill gas project activities." The project is not a grouped project.

1.3 Project Proponent

TerraPass, Inc.

Nick Facciola, Carbon Offset Portfolio Manager (nick@terrapass.com): Nick is responsible for creating monitoring reports, performing quality assurance on project data, performing necessary VER calculations, and managing verification of project credits.

Peter Freed, Director (pfreed@terrapass.com): Mr. Freed oversees Nick's work.

Mark Mondik, CFO (mark@terrapass.com): Mr. Mondik represents the project credits for sale.

1.4 Other Entities Involved in the Project

Dewitt Energy Associates, LLC (Project Owner)

Edwin Ingalls, General Manager (eingalls@edgewater.net): Ed Ingalls oversees DeWitt Energy Associates, which owns and operates the plant that generates electricity from the captured landfill gas. DeWitt Energy is also the original owner of the carbon credits that will be offered for sale.

Ryan Ingalls, Plant Manager (ryaningalls@edgewater.net): Ryan Ingalls runs day-to-day operations of the electricity plant, and is responsible for implementing the monitoring plan onsite and maintaining project equipment.

Peoria Disposal Company (Landfill Owner)

George Armstrong, Vice President Engineering and Consulting Services (garmstrong@pdcare.com): Mr. Armstrong oversees the operation, maintenance, and monitoring of the gas collection system and project flares.

1.5 Project Start Date

The project start date is January 24, 2007, the day on which the Project began delivering electricity to the grid.

1.6 Project Crediting Period

The crediting period began on July 1, 2009. It will cease on June 30, 2018, for a total length of nine years.

1.7 Project Location

The project is located at Clinton Landfill #2, a small landfill located at 9560 Heritage Road in Clinton, IL, in DeWitt County. The landfill occupies approximately 64 acres of a 153-acre permitted site. The project is conducted within the property owned by Clinton Landfill, Inc. This property's GPS coordinates are 40° 6' 51.411" N and -88° 57' 28.7994" W. The project engines are housed in a free-standing building along the northern edge of the waste area.

1.8 Title and Reference of Methodology

The approved methodology applied for this project is the CDM Approved Consolidated Baseline Methodology ACM0001 Version 10, "Consolidated baseline and monitoring methodology for landfill gas project activities."

The following tools are referenced in the methodology, and are also applied in the calculation of VERs generated during the reporting period:

- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption (version 01) (EB39, annex 7);"
- "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site (version 05) (EB55, annex 18);"

- “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 02) (EB41, annex 11).”

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The project was implemented and has been operational since 1/24/2007. During the reporting period, LFG has been sent to both the power plant and the project flares.

2.2 Deviations from the Monitoring Plan

The project deviated from the monitoring plan in five ways:

-The PDD described a web-based reporting tool that would aggregate monitored parameters for the engines. In fact, during 2011 the project manually recorded methane measurements at the engine skid taken with a handheld methane analyzer. These measurements were then entered into spreadsheet documents, which are stored in computers at the Clinton power plant as well as on servers at DeWitt Energy Associates headquarters in New York State.

-Total electricity generated by the project is tracked through monthly electricity bills from the power company's metering efforts, rather than from the meters themselves.

-Engine operating hours were also tracked by each engine's operating clock, which continuously updates a totalized read out of operating hours. Operating clock hours are manually recorded every weekday at 8 am.

-We use a flare efficiency of 96%, which is widely used in well established carbon protocols for flares operated under US EPA 40CFR60.18, which is the case here.

-The reference temperature and pressure of the flow meters monitoring the engine and the flare differ from the standards assumed in the PDD (60°F instead of 68°F most notably). We calculate the methane density for gas monitored at the engine and flare #1 as based on 60°F and 14.696psi and we use 60°F and 14.73psi at the flare #2.

2.3 Grouped Project

Not Applicable

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	Regulatory requirements relating to landfill gas projects
Data unit:	n/a
Description:	Regulatory requirements relating to landfill gas projects

Source of data:	U.S. Code of Federal Regulations and Illinois Administrative Code
Value applied:	n/a
Purpose of the data:	This data is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period. Relevant regulations are converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{BL,y}$) and used to determine the baseline destruction efficiency and the adjustment factor (AF).
Any comment:	

Data Unit / Parameter:	GWP_{CH_4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC
Value applied:	21
Purpose of the data:	This parameter is used in the calculation of baseline emissions, as well as project emissions related to operation of the back-up flare
Any comment:	

Data Unit / Parameter:	D_{CH_4}
Data unit:	$lbs\ CH_4/ft^3$
Description:	Methane density
Source of data:	US EPA conversion factor, "Basic Concepts in Environmental Science," Conversion Factors, Volume (Gas) @STP http://www.epa.gov/apti/bces/reference/reference.htm
Value applied:	0.0416 @ "1 atm and 68°F" (baseline scenario in PDD), 0.04226 @ 14.696 psi and 60°F, 0.04235 @ 14.73 psi and 60°F
Purpose of the data:	This parameter is used in the calculation of baseline emissions
Any comment:	$D_{CH_4} = \text{Molecular Weight of Methane (16.043 lb/lbmol)} \times P_{\text{Reference}} / \text{Universal Gas Constant (10.73 psia-ft}^3/\text{lbmol-}^\circ\text{R)} / T_{\text{Reference}}$ This value differs between Flare #1 and the engine (with flow meters using 14.696 psi as the reference temperature) and Flare #2 (with flow meter using 14.73 psi). The baseline calculations used a slightly different value of 0.0416 lb CH_4/ft^3 or 0.0000189 metric tons CH_4/ft^3 . We use the adjusted values now to account for variations of standard pressure and temperature references.

Data Unit / Parameter:	$BE_{CH_4, SWDS, y}$
Data unit:	tCO ₂ e
Description:	Methane generation from the landfill in the absence of any gas collection activity at year y
Source of data:	Calculated using a first-order decay equation as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Value applied:	See calculation in PDD
Purpose of the data:	Used for ex ante estimation of the amount of methane that would have been generated in a given year, as well as to establish baseline scenario emissions reductions
Any comment:	

Data Unit / Parameter:	$MD_{BL, 2006}$
Data unit:	tCH ₄
Description:	Amount of methane which would have been destroyed historically for calendar year 2006 if the baseline scenario had been chosen instead of the project scenario
Source of data:	Calculated in the PD based on historic project data. $MD_{BL, 2006} = \epsilon_{BL} * MG_{2006}$
Value applied:	1,950
Purpose of the data:	Used to calculate the adjustment factor (AF)
Any comment:	

Data Unit / Parameter:	$MG_{BL, 2006}$
Data unit:	tCH ₄
Description:	Amount of methane generated historically for calendar year 2006, the year before the start of project activity
Source of data:	Calculated using a first-order decay equation as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Value applied:	12,130
Purpose of the data:	Used to calculate the methane destruction efficiency of the collection system in the baseline scenario
Any comment:	

Data Unit / Parameter:	ϵ_{BL}
Data unit:	Percent
Description:	Methane destruction efficiency of the collection system in the baseline scenario
Source of data:	Derived from the amount of methane generated and destroyed in the baseline scenario in 2006 (the year prior to project implementation)
Value applied:	16.1%
Purpose of the data:	Used to calculate the project's Adjustment Factor (AF)
Any comment:	We use a value of 16.1% as determined in the validated PDD

The following parameters were not monitored and used in the "Tool to determine project emissions from flaring gases containing methane":

Data Unit / Parameter:	η_{flare}
Data unit:	Percent
Description:	Destruction efficiency of an open flare
Source of data:	Seebold, J.G. et al. "Reaction Efficiency of Industrial Flares: The Perspective of the Past," (2003).
Value applied:	96%
Purpose of the data:	Used to determine amount of methane destroyed in the two open flares
Any comment:	Seebold calculates the overall destruction efficiency of industrial gas flares to be 96.4%. We use the conservative figure of 96%, which is widely used in well established carbon protocols for flares operated under US EPA 40CFR60.18, which is the case here.

The following parameters were not monitored and used in the "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion":

Data Unit / Parameter:	$W_{C, Propane}$
Data unit:	lbs C/lbs Propane
Description:	Weighted average mass fraction of carbon in propane
Source of data:	The fraction of carbon in propane comes from the US EPA clean energy resources calculator (http://www.epa.gov/cleanenergy/energy-resources/refs.html), reflecting data from the US EPA 2009 Greenhouse Gas inventory.
Value applied:	0.817
Purpose of the data:	Used to calculate project emissions from consumption of propane

	in the open flares
Any comment:	

The following parameters were not monitored and used in the “Tool to calculate baseline, project, and/or leakage emissions from electricity consumption”:

Data Unit / Parameter:	EF _{EL, grid}
Data unit:	tCO ₂ /MWh
Description:	Carbon emission factor of electricity
Source of data:	Selected as the conservative default value in accordance with Option A2 of “Tool to calculate baseline, project, and/or leakage emissions from electricity consumption”
Value applied:	1.3
Purpose of the data:	Used to calculate project emissions from consumption of electricity
Any comment:	The Project meets the criterion described in the tool: “Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources.”

The following parameters were not monitored and used in the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site:”

Data Unit / Parameter:	Φ
Data unit:	N/A
Description:	Model correction factor to account for model uncertainties
Source of data:	Default value prescribed in the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Value applied:	0.9
Purpose of the data:	To adjust for model uncertainties
Any comment:	

Data Unit / Parameter:	OX
Data unit:	N/A
Description:	Oxidation factor, reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste
Source of data:	Default factor in “Tool to determine methane emissions avoided

	from disposal of waste at a solid waste disposal site” for managed solid waste disposal sites covered with oxidizing material
Value applied:	0.1
Purpose of the data:	To adjust for methane oxidized in soil/cover material
Any comment:	

Data Unit / Parameter:	F
Data unit:	Percent methane
Description:	Fraction of methane in the solid waste disposal site gas (volume fraction)
Source of data:	Default factor in “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” for methane fraction in SWDS gas
Value applied:	0.5
Purpose of the data:	To adjust for fraction of methane present in landfill gas
Any comment:	

Data Unit / Parameter:	DOC _f
Data unit:	N/A
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, prescribed in “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Value applied:	0.5
Purpose of the data:	To adjust for the fraction of degradable organic carbon that can decompose in a solid waste disposal site
Any comment:	

Data Unit / Parameter:	MCF
Data unit:	N/A
Description:	Methane correction factor
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, prescribed in “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Value applied:	1.0
Purpose of the data:	Used to account for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS
Any comment:	Clinton Landfill is an anaerobic managed disposal site, therefore

	we use a factor of 1.0 as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
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Data Unit / Parameter:	$P_{n,j,x}$														
Data unit:	Weight fraction of the waste type j														
Description:	Used in ex-ante calculations of the emissions of the landfill in the baseline scenario														
Source of data:	Sampling conducted by Iowa Department of Natural Resources and reported in a 2006 report entitled “Iowa Statewide Waste Characterization Study”														
Value applied:	<table> <tr> <th>Waste Type</th><th>% by weight</th></tr> <tr> <td>Wood and wood products</td><td>10.4</td></tr> <tr> <td>Pulp, paper, cardboard (not sludge)</td><td>33.0</td></tr> <tr> <td>Food, food waste, bev & tobacco</td><td>10.6</td></tr> <tr> <td>Textiles</td><td>4.9</td></tr> <tr> <td>Garden, yard and park waste</td><td>3.1</td></tr> <tr> <td>Glass, plastic, metal, other inert</td><td>38.0</td></tr> </table>	Waste Type	% by weight	Wood and wood products	10.4	Pulp, paper, cardboard (not sludge)	33.0	Food, food waste, bev & tobacco	10.6	Textiles	4.9	Garden, yard and park waste	3.1	Glass, plastic, metal, other inert	38.0
Waste Type	% by weight														
Wood and wood products	10.4														
Pulp, paper, cardboard (not sludge)	33.0														
Food, food waste, bev & tobacco	10.6														
Textiles	4.9														
Garden, yard and park waste	3.1														
Glass, plastic, metal, other inert	38.0														
Purpose of the data:	Used to adjust fraction of degradable organic carbon by waste type														
Any comment:	Iowa borders on Illinois has a similar climatic and demographic profile														

Data Unit / Parameter:	DOC_j														
Data unit:	N/A														
Description:	Fraction of degradable organic carbon (by weight) in waste type j														
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5) prescribed in “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”														
Value applied:	<table> <tr> <th>Waste Type</th><th>DOC - % dry waste</th></tr> <tr> <td>Wood and wood products</td><td>50</td></tr> <tr> <td>Pulp, paper, cardboard (not sludge)</td><td>44</td></tr> <tr> <td>Food, food waste, bev & tobacco (not sludge)</td><td>38</td></tr> <tr> <td>Textiles</td><td>30</td></tr> <tr> <td>Garden, yard and park waste</td><td>49</td></tr> <tr> <td>Glass, plastic, metal, other inert</td><td>0</td></tr> </table>	Waste Type	DOC - % dry waste	Wood and wood products	50	Pulp, paper, cardboard (not sludge)	44	Food, food waste, bev & tobacco (not sludge)	38	Textiles	30	Garden, yard and park waste	49	Glass, plastic, metal, other inert	0
Waste Type	DOC - % dry waste														
Wood and wood products	50														
Pulp, paper, cardboard (not sludge)	44														
Food, food waste, bev & tobacco (not sludge)	38														
Textiles	30														
Garden, yard and park waste	49														
Glass, plastic, metal, other inert	0														
Purpose of the data:	Used to adjust fraction of degradable organic carbon by waste type														
Any comment:	Further discussion of this parameter can be found in Annex 1 of the previously validated PDD														

Data Unit / Parameter:	k_j										
Data unit:	N/A										
Description:	Decay rate for the waste type j										
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3) prescribed in "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"										
Value applied:	<table> <tr> <th>Waste Type (j)</th><th>k</th></tr> <tr> <td>Wood, wood products, straw</td><td>0.06</td></tr> <tr> <td>Pulp, paper, cardboard (not sludge), textiles</td><td>0.03</td></tr> <tr> <td>Other (non-food) organic putrescible garden/park waste</td><td>0.1</td></tr> <tr> <td>Food, food waste, sludge, bev & tobacco</td><td>0.185</td></tr> </table>	Waste Type (j)	k	Wood, wood products, straw	0.06	Pulp, paper, cardboard (not sludge), textiles	0.03	Other (non-food) organic putrescible garden/park waste	0.1	Food, food waste, sludge, bev & tobacco	0.185
Waste Type (j)	k										
Wood, wood products, straw	0.06										
Pulp, paper, cardboard (not sludge), textiles	0.03										
Other (non-food) organic putrescible garden/park waste	0.1										
Food, food waste, sludge, bev & tobacco	0.185										
Purpose of the data:	Used to assess the decay rate of various waste types under project climatic conditions										
Any comment:	The project site meets the climatic conditions of the "Boreal and Temperate/Wet" designation. More discussion can be found in the PDD.										

3.2 Data and Parameters Monitored

Data Unit / Parameter:	LFG _{electricity, 2011}
Data unit:	Standard cubic feet (scf)
Description:	Amount of landfill gas combusted in power plant at normal temperature and pressure in 2011
Source of data:	DeWitt Energy Associates
Description of measurement methods and procedures to be applied:	Rosemount 3095 MultiVariable Mass Flow Transmitter measures differential pressure, static pressure, and process temperature continuously and automatically converts these parameters into a compensated mass flow value at reference conditions 60 degrees F and 14.696 psia.
Frequency of monitoring/recording:	Flow is measured continuously and recorded continuously to Yokogawa data recorders.
Value monitored:	LFG flow (by means of differential pressure, static pressure, and process temperature) totaling 378,212,000 scf
Monitoring equipment:	Rosemount 3095 MultiVariable Mass Flow Transmitter, s/n 20768
QA/QC procedures to be applied:	This meter is maintained according to manufacturer specification which is every 5 years; and was last calibrated on 4/21/2010
Calculation method:	n/a

Any comment:	See Rosemount Transmitters T&P Config.pdf
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Data Unit / Parameter:	LFG _{Flare 1, 2011}
Data unit:	Standard cubic feet (scf)
Description:	Amount of landfill gas flared at normal temperature and pressure in Flare 1 in 2011
Source of data:	Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Rosemount 3095 MultiVariable Mass Flow Transmitter measures differential pressure, static pressure, and process temperature continuously and automatically converts these parameters into a compensated mass flow value at reference conditions 60 degrees F and 14.696 psia.
Frequency of monitoring/recording:	Flow is measured continuously and recorded continuously to Yokogawa data recorders.
Value monitored:	Landfill gas flow totaling 6,390,776 scf
Monitoring equipment:	Rosemount 3095 MultiVariable Mass Flow Transmitters, s/n 41863
QA/QC procedures to be applied:	This meter is maintained according to manufacturer specification, which is every 5 years; and was last calibrated on 12/17/2010.
Calculation method:	n/a
Any comment:	See Rosemount Transmitters T&P Config.pdf.

Data Unit / Parameter:	LFG _{Flare 2, 2011}
Data unit:	Standard cubic feet (scf)
Description:	Amount of landfill gas flared at normal temperature and pressure in Flare 2 in 2011
Source of data:	Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Rosemount 3095 MultiVariable Mass Flow Transmitter measures differential pressure, static pressure, and process temperature continuously and converts these parameters into a compensated mass flow value at reference conditions 60°F and 14.73 psia.
Frequency of monitoring/recording:	Flow is measured continuously and recorded continuously to Yokogawa data recorders.
Value monitored:	Landfill gas flow totaling 301,047,288 scf
Monitoring equipment:	Rosemount 3095 MultiVariable Mass Flow Transmitter, s/n 39105
QA/QC procedures to be applied:	This meter is maintained according to manufacturer specification which is every 5 years; and was last calibrated on 4/21/2010
Calculation method:	n/a
Any comment:	See Rosemount Transmitters T&P Config.pdf.

Data Unit / Parameter:	LFG _{Total, 2011}
Data unit:	Standard cubic feet (scf)
Description:	Total amount of landfill gas flared at normal temperature and pressure in 2011
Source of data:	Calculated in Clinton Emissions Reductions VCS-CDM Calculator 2011.xlsx
Description of measurement methods and procedures to be applied:	Aggregate yearly the continuously monitored data.
Frequency of monitoring/recording:	Flow of each stream is measured continuously and recorded continuously to Yokogawa data recorders.
Value monitored:	Calculated at 685,650,064 scf
Monitoring equipment:	See individual flow streams
QA/QC procedures to be applied:	See individual flow streams
Calculation method:	Calculated as $[LFG_{\text{electricity}, 2011} + LFG_{\text{Flare1}, 2011} + LFG_{\text{Flare2}, 2011}]$
Any comment:	

Data Unit / Parameter:	PE _{flare, 2011}
Data unit:	tCO ₂
Description:	Project emissions from flaring of the residual gas stream in 2011
Source of data:	Calculated as per the "Tool to determine project emissions from flaring gases containing Methane" and modified equation in PDD
Description of measurement methods and procedures to be applied:	Calculated
Frequency of monitoring/recording:	N/A
Value monitored:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	PE _{flare, 2011} is accounted for in the calculation of the methane destroyed in the landfill gas flares, as use of the flares' destruction efficiency accounts for undestroyed methane gas: $LFG_{\text{flare}, 2011} * W_{\text{CH}_4, \text{flare}, 2011} * D_{\text{CH}_4} * \eta_{\text{flare}}$
Any comment:	

Data Unit / Parameter:	W _{CH4} , power plant
Data unit:	percent
Description:	Methane fraction in landfill gas at the power plant
Source of data:	DeWitt Energy Associates
Description of measurement methods and procedures to be applied:	Methane fraction is measured approximately weekly with an Elkins Earthworks Envision.
Frequency of monitoring/recording:	Approximately weekly
Value monitored:	Methane fraction
Monitoring equipment:	Elkins Earthworks Envision methane analyzer, s/n 1003016.
QA/QC procedures to be applied:	Meters are calibrated to reference gases before daily use. These meters are factory calibrated annually
Calculation method:	In accordance with ACM0001 v10, we take the 95% lower confidence interval of all methane measurements taken during the reporting period, which results in a representative value of 60.5% methane
Any comment:	

Data Unit / Parameter:	W _{CH4} , Flare 1
Data unit:	percent
Description:	Methane fraction in landfill gas at Flare 1
Source of data:	Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Methane fraction is measured continuously with a Siemens Ultramat 23 Gas Analyzer. Backup measurements are taken with a portable handheld gas analyzer and used as necessary.
Frequency of monitoring/recording:	Continuously (backup measurements taken at least once per week)
Value monitored:	Methane fraction
Monitoring equipment:	Siemens Ultramat 23 Gas Analyzer, s/n N1A2-146; Landtec GEM2000 s/n GM7332; or Elkins Earthworks ENV-100 s/n 1003005 and 1011012
QA/QC procedures to be applied:	The Siemens analyzer is calibrated annually to span gas in the field
Calculation method:	Annual average results in 54.0%
Any comment:	The backup measurements using the GEM and ENV-100 were not used for project data during 2011.

Data Unit / Parameter:	W _{CH4} , Flare 2
Data unit:	percent
Description:	Methane fraction in landfill gas at Flare 2
Source of data:	Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Methane fraction is measured continuously with a Siemens Ultramat 23 Gas Analyzer. Backup measurements are taken with a portable handheld gas analyzer and used as necessary.
Frequency of monitoring/recording:	Continuously (backup measurements taken at least once per week)
Value monitored:	Methane fraction
Monitoring equipment:	Siemens Ultramat 23 Gas Analyzer, s/n N1A1-699; Landtec GEM2000 s/n GM7332; or Elkins Earthworks ENV-100 s/n 1003005 and 1011012
QA/QC procedures to be applied:	This meter is calibrated annually to span gas in the field
Calculation method:	Annual average results in 61.7%
Any comment:	The backup measurements using the GEM and ENV-100 were not used for project data during 2011.

Data Unit / Parameter:	T
Data unit:	°F
Description:	Temperature of landfill gas
Source of data:	DeWitt Energy Associates, Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Landfill gas temperature is monitored continuously, and automatically converted by the respective flow meter/transmitter into compensated total flow value at reference conditions 60 degrees F and 14.696 [or 14.73] psia.
Frequency of monitoring/recording:	Temperature is monitored continuously
Value monitored:	Gas temperature
Monitoring equipment:	Temperature sensor part of flow meter equipment listed in LFG _{electricity} , 2011, LFG _{Flare 1} , 2011, LFG _{Flare 2} , 2011
QA/QC procedures to be applied:	See LFG _{electricity} , 2011, LFG _{Flare 1} , 2011, LFG _{Flare 2} , 2011
Calculation method:	N/A
Any comment:	

Data Unit / Parameter:	P
Data unit:	atm
Description:	DeWitt Energy Associates, Peoria Disposal Company
Source of data:	Project participants
Description of measurement methods and procedures to be applied:	Landfill gas pressure is monitored continuously, and automatically converted by the respective flow meter/transmitter into compensated total flow value at reference conditions 60 degrees F and 14.696 [or 14.73] psia.
Frequency of monitoring/recording:	Pressure is monitored continuously
Value monitored:	Gas pressure
Monitoring equipment:	Static pressure sensor part of flow meter equipment listed in LFG _{electricity, 2011} , LFG _{Flare 1, 2011} , LFG _{Flare 2, 2011}
QA/QC procedures to be applied:	See LFG _{electricity, 2011} , LFG _{Flare 1, 2011} , LFG _{Flare 2, 2011}
Calculation method:	N/A
Any comment:	

Data Unit / Parameter:	EL _{LFG}
Data unit:	MWh
Description:	Net amount of electricity generated using project landfill gas (and delivered to the grid)
Source of data:	DeWitt Energy Associates
Description of measurement methods and procedures to be applied:	This data is reported in monthly electricity bills DeWitt Energy Associates receives from Ameren, the local utility
Frequency of monitoring/recording:	Monthly
Value monitored:	Total kWh produced
Monitoring equipment:	kWh meters provided by Ameren
QA/QC procedures to be applied:	Ameren is responsible for QA/QC for these meters
Calculation method:	Annual aggregation of 169.85 MWh
Any comment:	Tracked to verify operating hours of project

Data Unit / Parameter:	Operation of the energy plant
Data unit:	Hours
Description:	Operation of the energy plant

Source of data:	Dewitt Energy Associates
Description of measurement methods and procedures to be applied:	Each engine has a totalizer that counts the cumulative amount of hours the engine is in operation. This figure is recorded every weekday.
Frequency of monitoring/recording:	Engine hours are continuously monitored/recorded by the totalizer. This figure is manually recorded by project personnel every weekday.
Value monitored:	Operation of the energy plant
Monitoring equipment:	Flow totalizer
QA/QC procedures to be applied:	N/A
Calculation method:	Annual aggregation of 6,824 hours for Engine #1 and 7,929 hours for Engine #2
Any comment:	This is monitored to ensure methane destruction is only claimed for periods when the electricity plant is operational

Data Unit / Parameter:	Operation of the flares
Data unit:	Hours
Description:	Operation of the flare
Source of data:	Peoria Disposal Company
Description of measurement methods and procedures to be applied:	As a proxy for operation of the flares, flare operating temperature is measured continuously
Frequency of monitoring/recording:	Continuously
Value monitored:	Flare temperature
Monitoring equipment:	Flare thermocouple
QA/QC procedures to be applied:	N/A
Calculation method:	Any flow measured during periods when the flares' operating temperatures are less than 500 degrees F is considered uncombusted, and ignored in the calculation of $LFG_{\text{Flare 1, 2011}}$ and $LFG_{\text{Flare 2, 2011}}$
Any comment:	This is monitored to ensure methane destruction is only claimed for periods when the flares are operational.

Data Unit / Parameter:	$PE_{\text{EC, 2011}}$
Data unit:	tCO ₂
Description:	Project emissions from electricity consumption by the project activity during 2011

Source of data:	Calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Description of measurement methods and procedures to be applied:	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Frequency of monitoring/recording:	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Value monitored:	Calculation resulting in 236 tCO ₂
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$EC_{PJ, 2011} * EF_{EL, grid} * (1 + TDL_{2011})$
Any comment:	

Data Unit / Parameter:	PE _{FC, Propane, 2011}
Data unit:	tCO ₂ e
Description:	Project emissions from fossil fuel combustion in 2011, stemming from propane used to power the flares' pilot lights
Source of data:	Calculated as per "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
Description of measurement methods and procedures to be applied:	As per "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
Frequency of monitoring/recording:	As per "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
Value monitored:	Calculated as 0.34 tCO ₂
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$FC_{Propane, 2011} * COEF_{Propane, 2011} / 2204.6$
Any comment:	2204.6 is the conversion factor for pounds to metric tons

Data Unit / Parameter:	MG _{Project, 2011}
Data unit:	tCH ₄
Description:	Amount of methane generated during 2011
Source of data:	Estimated using the actual amount of waste disposed in the landfill as per version 05 of "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"

Description of measurement methods and procedures to be applied:	As per version 05 of "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Frequency of monitoring/recording:	As per version 05 of "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value monitored:	Calculated result of 12,364
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	As per version 05 of "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Any comment:	

Data Unit / Parameter:	MD _{electricity, 2011}
Data unit:	tCH ₄
Description:	Quantity of methane destroyed at the power plant
Source of data:	Derived from amount of LFG sent to power plant, methane measurements at power plant, and density of methane
Description of measurement methods and procedures to be applied:	Calculated in "Output Tables" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of monitoring/recording:	Annual aggregation
Value monitored:	Calculated as 4,385 tCH ₄
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$(LFG_{electricity, 2011} * W_{CH_4, power\ plant} * D_{CH_4})/2204.6$
Any comment:	2204.6 is the conversion factor for pounds to metric tons

Data Unit / Parameter:	MD _{Flare 1, 2011}
Data unit:	tCH ₄
Description:	Quantity of methane destroyed in Flare 1
Source of data:	Derived from amount of LFG sent to Flare 1, methane measurements at Flare 1, Flare 1's destruction efficiency and density of methane
Description of measurement methods and procedures to be applied:	Calculated in "Output Tables" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of	Annual aggregation

monitoring/recording:	
Value monitored:	Calculated as 64 tCH ₄
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$(LFG_{\text{Flare 1, 2011}} * w_{\text{CH}_4, \text{Flare 1}} * \eta_{\text{flare}} * D_{\text{CH}_4})/2204.6$
Any comment:	2204.6 is the conversion factor for pounds to metric tons

Data Unit / Parameter:	MD _{Flare 2, 2011}
Data unit:	tCH ₄
Description:	Quantity of methane destroyed in Flare 2
Source of data:	Derived from amount of LFG sent to Flare 2, methane measurements at Flare 2, Flare 2's destruction efficiency and density of methane
Description of measurement methods and procedures to be applied:	Calculated in "Output Tables" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of monitoring/recording:	Annual aggregation
Value monitored:	Calculated as 3,425 tCH ₄
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$(LFG_{\text{Flare 2, 2011}} * w_{\text{CH}_4, \text{Flare 2}} * \eta_{\text{flare}} * D_{\text{CH}_4})/2204.6$
Any comment:	2204.6 is the conversion factor for pounds to metric tons

Data Unit / Parameter:	PE ₂₀₁₁
Data unit:	tCO ₂ e
Description:	Emissions in 2011 in the project scenario
Source of data:	Equal to the project emissions from electricity consumption and combustion of fossil fuel in the flares' pilot lights
Description of measurement methods and procedures to be applied:	Calculated in "PEElectricity consumption" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of monitoring/recording:	Annual aggregation
Value monitored:	Calculated as 236.60 tCH ₄
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A

applied:	
Calculation method:	$PE_{EC, 2011} + PE_{FC, Propane, 2011}$
Any comment:	

Data Unit / Parameter:	$\epsilon_{PR, 2011}$
Data unit:	percent
Description:	Methane destruction efficiency of the collection system used in the project activity in 2011
Source of data:	Derived from the amount of methane generated and destroyed in the project scenario in 2011
Description of measurement methods and procedures to be applied:	Calculated in "Output Tables" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of monitoring/recording:	N/A
Value monitored:	Calculated as 63.7%
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$(MD_{Project, 2011} / MG_{Project, 2011})$
Any comment:	

Data Unit / Parameter:	AF
Data unit:	percent
Description:	Adjustment Factor
Source of data:	Derived from the relative methane destruction efficiencies of the collection systems in the project and baseline scenarios
Description of measurement methods and procedures to be applied:	Calculated in "Output Tables" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of monitoring/recording:	N/A
Value monitored:	Calculated as 25.3%
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$\epsilon_{BL} / \epsilon_{PR, 2011}$
Any comment:	

Data Unit / Parameter:	BE ₂₀₁₁
Data unit:	tCO ₂ e
Description:	Adjustment Factor
Source of data:	Baseline emissions of the landfill in year 2011, in the baseline scenario
Description of measurement methods and procedures to be applied:	Calculated, see PDD for derivation of simplified formula
Frequency of monitoring/recording:	N/A
Value monitored:	Calculated as 123,555 tCO ₂ e
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$MD_{\text{Project, 2011}} * (1 - AF) * GWP_{\text{CH}_4}$
Any comment:	

Data Unit / Parameter:	ER ₂₀₁₁
Data unit:	tCO ₂ e
Description:	Creditable emissions reductions in 2011
Source of data:	Calculated as the difference between baseline emissions and project emissions
Description of measurement methods and procedures to be applied:	Calculated in "Output Tables" of <i>Clinton Emissions Reductions VCS-CEM Calculator 2011.xlsx</i>
Frequency of monitoring/recording:	N/A
Value monitored:	Calculated as 123,318 tCO ₂ e
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	$BE_{2011} - PE_{2011} = MD_{\text{Project, 2011}} * (1 - AF) * GWP_{\text{CH}_4} - PE_{2011}$
Any comment:	

The following parameters were monitored or calculated and used in the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion:”

Data Unit / Parameter:	FC _{Propane, 2011}
Data unit:	Lbs of propane/year
Description:	Quantity of propane combusted in project flares in 2011
Source of data:	Propane receipts provided by Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Collect all propane receipts from 2011.
Frequency of monitoring/recording:	Periodic
Value monitored:	Quantity of propane consumed by the project. Totals 250 pounds for 2011.
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	We assume all propane purchased in 2011 was used, as a conservative measure.

Data Unit / Parameter:	COEF _{Propane, 2011}
Data unit:	lb CO ₂ /lb propane
Description:	CO ₂ emission coefficient for propane
Source of data:	Calculated as per “Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Description of measurement methods and procedures to be applied:	As per “Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Frequency of monitoring/recording:	As per “Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Value monitored:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	W _{C, Propane, 2011} * 44/12 = 2.996
Any comment:	

The following parameters were monitored and used in the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site:”

Data Unit / Parameter:	W_x
Data unit:	Tons
Description:	Total amount of organic waste disposed in year x (tons)
Source of data:	Illinois Environmental Protection Agency Annual Landfill Capacity Reports. Clinton Landfill disposal information can be found in “Region Four: East Central Illinois.” http://www.epa.state.il.us/land/landfill-capacity/index.html
Description of measurement methods and procedures to be applied:	Clinton Landfill reports annual disposal totals to the state on an annual basis. TerraPass monitors the IEPA’s Annual Landfill Capacity Reports and incorporates new data as it becomes available.
Frequency of monitoring/recording:	Continuously, aggregated annually
Value monitored:	Tons of waste landfilled during the year
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	This monitoring report incorporates new waste disposal data from 2009 and 2010 in the calculation of $MG_{\text{Project, 2011}}$. The landfill closed in 2010.

The following parameters were monitored and used in the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption:”

Data Unit / Parameter:	TDL_{2011}
Data unit:	percent
Description:	Transmission and distribution losses attributable to the use of local grid electricity
Source of data:	U.S. Energy Information Administration “2010 Annual Energy Review,” p. 66 http://www.eia.doe.gov/aer/pdf/pages/secnote2.pdf
Description of measurement methods and procedures to be applied:	The EIA releases a study of the U.S. Energy sector every few years, including a figure for percent of electricity lost in transmission and distribution. TerraPass monitors these updates and uses the most recent figures available.
Frequency of monitoring/recording:	Annually

Value monitored:	Percent of electricity lost in transmission and distribution
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	We apply the 7% figure noted in the “2010 Annual Energy Review.”

Data Unit / Parameter:	EC _{PJ} , 2011
Data unit:	MWh
Description:	Quantity of electricity consumed by the project in 2011
Source of data:	Monthly energy bills provided by DeWitt Energy Associates and Peoria Disposal Company
Description of measurement methods and procedures to be applied:	Collect utility bills each month
Frequency of monitoring/recording:	Monitored continuously, aggregated monthly on utility bills
Value monitored:	Quantity of electricity consumed by the project
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	Annual aggregation of 13,576 MWh
Any comment:	

3.3 Description of the Monitoring Plan

A strong monitoring plan is important to ensure that project data is of high quality. TerraPass strives to ensure that the monitoring plan reflects actual monitoring procedures onsite, conforms to equipment manufacturer specifications, and meets the standards of ACM0001.

The following table provides a summary of monitored parameters.

Parameter	Data source	Frequency	Party	Notes
Normalized flow to generators	Continuous flow meter (Rosemount Transmitter)	Captured continuously	DeWitt Energy operations technician	Continuous flow data is submitted periodically to TerraPass

Normalized flow to flares	Continuous flow meter (Rosemount Transmitter)	Captured continuously	Peoria Disposal Company technician	Continuous flow data is submitted periodically to TerraPass
Landfill gas temperature and pressure	Continuous flow meter	Captured continuously	DeWitt Energy operations technician/PDC technician	Flow readings are normalized to standard temperature and pressure by flow meter, thus temperature and pressure are not tracked separately
Total electricity generated	kWh meters	Hourly	Ameren	Total generated electricity is reported in DeWitt Energy's monthly electricity bills, used to verify methane destruction
Engine Operating Hours	Operating hours meters	Hourly	DeWitt Energy operations technician	Cumulative engine operating hours are recorded daily
Flare Operating Hours	Flare Thermocouples	Continuously	Peoria Disposal Company	At temperatures above 500 degrees F, flare is assumed to be operational
Methane fraction at flares	Siemens Ultramat 23 continuous gas analyzers	Continuously	Peoria Disposal Company	Continuous methane data is submitted periodically to TerraPass
Methane fraction at power plant	Handheld meter (Elkins Earthworks Envision)	At least weekly	DeWitt Energy operations technician	Methane data is aggregated in a spreadsheet manually and sent to TerraPass periodically. Field calibration records also kept on meter
Waste Disposed	Scale readings as submitted to Illinois Environmental Protection Agency	Annually	Peoria Disposal Company personnel	TerraPass will collect this data annually from IEPA reports as they become available
Grid electricity used by Project	Electricity bills for DeWitt Energy/PDC	Monthly	DeWitt Energy/PDC staff	
Propane used by the project	Propane receipts for PDC	Periodically	PDC	
Operating permits	DeWitt Energy personnel, PDC, Illinois EPA	Annually	TerraPass	TerraPass will ensure operating permits are valid and complete

The following chart provides a summary of the equipment calibration plan.

Equipment	Calibration Procedure	Frequency	Party
Project flow meters: Rosemount 3095 Multivariable Mass Flow Transmitters (3)	Factory calibration	5-years	Factory-authorized representative
Generator kilowatt-hour meter	As recommended by manufacturer	Once every 3-6 months	Ameren
DeWitt Energy Elkins Earthworks Envision	Field calibrate against reference gas cylinder, record results	Daily prior to use	DeWitt Energy operations technician
DeWitt Energy Elkins Earthworks Envision	Factory calibration	At least annually	Factory-authorized representative
Siemens Ultramat 23 continuous methane analyzers (2)	Field calibrate against reference gases, record results	At least annually	PDC technician
Peoria Disposal Company Landtec GEM	Field calibrate against reference gas cylinder, record results	Daily prior to use	PDC technician
Peoria Disposal Company Landtec GEM	Factory calibration	At least annually	Factory-authorized representative

Project Personnel and Responsibilities

DeWitt Energy has overall responsibility for data collection and quality assurance for engine related data. Training procedures for monitoring processes are the following:

1. Creation of reference materials that detail monitoring procedures, recordkeeping requirements, and equipment use.
2. Use of manual as the basis for training sessions prior to the start of official project monitoring, as well as regular updates to the manual and refresher training sessions as required by equipment or process changes.

DeWitt Energy Associates is also responsible for day-to-day operation of the energy plant, including collection of methane readings, field calibration of the handheld methane analyzer, recording of engine operating hours (recorded every weekday), and manual recording of totalized gas flow (recorded approximately weekly). DeWitt Energy also oversees the factory calibration of project equipment related to the generators.

Peoria Disposal Company is responsible for data collection and quality assurance for flare related data. George Armstrong oversees day-to-day operation of the project well field and two open flares. Dedicated Yokogawa data recorders continuously record gas flow, methane, and flare operating temperature for each flare. PDC is responsible for factory calibration of the meters related to the flares.

TerraPass is responsible for collating data, performing additional quality assurance checks, preparing project emissions reductions calculations in accordance with the PDD and ACM0001, and preparing monitoring reports and VCS documentation.

Data Generation and Storage

Project data is generated on site by project meters, or through utility bills/propane receipts. For the engines, data from project meters is backed up through manual records, i.e. totaled flow, weekly methane readings, and engine operating hours are entered into Excel spreadsheets for long-term storage. Field calibration data for the DeWitt Energy owned Elkin Earthworks Envision meter are stored on the instrument itself. Utility bills are stored on site, and also scanned for storage on DeWitt servers and transfer to TerraPass.

Continuous flow, methane, and flare temperature data for the two project flares is recorded to flash memory cards on two Yokogawa data recorders, and also backed up wirelessly to an online SCADA system. Field calibration records for the flare flow meters, continuous methane analyzers, and the PDC owned Landtec GEM are stored at PDC offices in Peoria, IL. Field calibration events for the Landtec GEM are recorded manually in a weekly monitoring log. Utility bills and propane receipts are stored on site in the Landfill offices, and scanned for transfer to TerraPass.

Project data is submitted to TerraPass in electronic format on an approximately quarterly basis. TerraPass typically receives flow, methane, and engine operating hours in Excel format. Utility bills, factory calibration certificates are transmitted to TerraPass in PDF form. These data submittals form the basis of the TerraPass's calculation of credits generated during each monitoring period. TerraPass also collects current copies of permits and ensures that all necessary permits are valid.

All project data, documents, permits, and calculations are stored on TerraPass's server, which is backed up weekly to a remote server as well as to physical hard drive on site.

Internal Auditing Procedures

Quality Assurance is provided by TerraPass's independent review of all Project data and calibration records on a quarterly basis. TerraPass's handling of Project data includes the following steps:

- Integration of new data submittals into past performance data;
- Review of data for anomalies, inconsistencies, and outlying data points;
- Completeness checks of data for gas quality, gas quantity, and evidence of destruction;
- Review of electricity generation and engine operating hours in relationship to Project performance.

TerraPass works with DeWitt Energy Associates and Peoria Disposal Company to resolve any issues identified during the quality assurance review.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

All project calculations and aggregated raw data can be found in the Excel workbook "Clinton Emissions Reductions VCS-CDM Calculator 2011."

According to ACM0001 version 10, baseline emissions for the project are equal to:

$$BE_{2011} = (MD_{\text{Project}, 2011} - MD_{\text{BL}, 2011}) * GWP_{\text{CH}_4}$$

and,

$$MD_{\text{BL}, 2011} = MD_{\text{Project}, 2011} * AF$$

Substituting the second equation into the first equation leaves us with the following simplified expression for baseline emissions:

$$BE_{2011} = MD_{\text{Project}, 2011} * (1 - AF) * GWP_{\text{CH}_4}$$

First, we calculate $MD_{\text{Project}, 2011}$. $MD_{\text{Project}, 2011}$ is equal to the sum of the methane destroyed in each project device, or:

$$MD_{\text{Project}, 2011} = MD_{\text{electricity}, 2011} + MD_{\text{Flare 1}, 2011} + MD_{\text{Flare 2}, 2011}$$

In accordance with ACM0001 v10, we calculate $MD_{\text{electricity}, 2011}$ according to the equation:

$$MD_{\text{electricity}, 2011} = LFG_{\text{electricity}, 2011} * W_{\text{CH}_4, \text{ power plant}} * D_{\text{CH}_4} / 2,204.6$$

Substituting in the total amount of LFG sent to the engines in 2011 (378,212,000 scf), the 95% lower confidence interval of all methane measurements taken at the power plant (60.5%), and the density of methane (0.04166 lbs/ft³) and dividing by the number of lbs in a ton (2,204.6) to convert our final number to metric tons, we calculate that the generators destroyed 4,385 tons of methane in 2011.

In accordance with the PDD, we derive the following equation for methane destroyed by each flare (which takes into account the emissions of uncombusted methane due to the flare's destruction efficiency):

$$MD_{\text{Flare } x, 2011} = (LFG_{\text{Flare } x, 2011} * W_{\text{CH}_4, \text{ Flare } x} * D_{\text{CH}_4} * \eta_{\text{flare}}) / 2,204.6$$

Substituting in the total amount of LFG sent to Flare 1 in 2011 (6,390,776 scf), the weighted average methane concentration at Flare 1 in 2011 (54.0%), the density of methane (0.04166 lbs/ft³), the destruction efficiency of the open flare (0.96) and dividing by the number of pounds in a ton (2,204.6) to convert our final number to metric tons, we calculate that Flare 1 destroyed 64 tons of methane in 2011.

Substituting in the total amount of LFG sent to Flare 2 in 2011 (301,047,288 scf), the weighted average methane concentration at Flare 2 in 2011 (61.7%), the density of methane (0.04235 lbs/ft³ at this flow meter's reference condition), the destruction efficiency of the open flare (0.96), and dividing by the number of lbs in a ton (2,204.6) to convert our final number to metric tons, we calculate that Flare 2 destroyed 3,425 tons of methane in 2011.

Thus $MD_{\text{Project, 2011}}$ is equal to 7,874 tons of methane. The total methane destroyed by project activity is less than the total quantity of gas generated over the same year (12,364 tons CH_4) and thus is used as $MD_{\text{project, 2011}}$.

Next, we must calculate the adjustment factor (AF). The adjustment factor is equal to:

$$AF = \epsilon_{BL} / \epsilon_{PR, 2011}$$

With

$$\epsilon_{PR, 2011} = MD_{\text{Project, 2011}} / MG_{\text{Project, 2011}}$$

In the PDD, ϵ_{BL} was found to be 16.1%.

In order to calculate $\epsilon_{PR, 2011}$, we substitute in the total amount of methane destroyed by the project in 2011 (7,874 tons) and divide by the total amount of methane generated by the project in 2011. $MG_{\text{Project, 2011}}$ was calculated in the "Clinton Methane Generation Calculator 2011" according to the first order decay equation prescribed by the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site." In the Methane Generation Calculator, we incorporated new waste disposal figures from 2009 and 2010 data published by the Illinois EPA (see "Waste Disposal Totals 2011" workbook). Since the landfill stopped accepting waste in 2010, we leave zeroes for 2011 and beyond in the inputs. After running the model, $MG_{\text{Project, 2011}}$ was calculated to be 12,364 tons, which yields a project destruction efficiency of 63.7% ($\epsilon_{PR, 2011}$).

Dividing the baseline destruction efficiency by the project destruction efficiency, we calculate the adjustment factor to be $16.1/63.7 = 0.253$.

Returning to our simplified equation for the project's baseline emissions,

$$BE_{2011} = MD_{\text{Project, 2011}} * (1 - AF) * GWP_{CH_4}$$

we now enter in all previously calculated values as well as a value of 21 for GWP_{CH_4} (in accordance with ACM0001 v10), to produce a baseline emissions estimate of 123,555 tons of carbon dioxide equivalent.

Operational Hours of Project

It is important that credits are only claimed for methane sent to the destruction devices while the project was operating, in order to ensure that the landfill gas was actually destroyed.

The project engines' operational hours are tracked in two ways, first by kWh produced and sold to the grid per month, and engine clock hours. The raw data for both of these parameters can be found on the "Engine Operating Hours" spreadsheet of the "Clinton Emissions Reductions VCS-CDM Calculator 2011" workbook.

When total amount of landfill gas sent to the generators is graphed against the total amount of kWh produced in each month and against the engine operating clock hours in each month, total LFG tracks closely with both parameters (see "Engine Operating Hours" spreadsheet). We can also be confident that all gas sent to the engines was destroyed, because each engine is equipped with a solenoid valve that will not open to deliver gas to the engines unless the engines are operating and ready to destroy gas.

The project flares' operating hours are tracked by the proxy of flare operating temperature. Any flow measured by the flare flow meters when the flare operating temperature was less than 500 degrees F is considered uncombusted and ignored in the calculation of $LFG_{Flare\ 1,\ 2011}$ and $LFG_{Flare\ 2,\ 2011}$.

4.2 Project Emissions

There are two relevant sources of project emissions in this case: indirect emissions related to the project's electricity consumption, and emissions related to combustion of propane in the flares' pilot lights. Thus

$$PE_{2011} = PE_{EC,\ 2011} + PE_{FC,\ Propane,\ 2011}$$

The vast majority of the time, the project engines are self-powered by the electricity generated from the landfill gas, and emissions associated with electricity consumption are biogenic. However, the project engines and the project flares did consume grid electricity in 2011 (tracked by monthly utility bills from Ameren). We calculate the emissions associated with this grid electricity consumption according to the following equation, as dictated by the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption:"

$$PE_{EC,\ 2011} = EC_{PJ,\ 2011} * EF_{EL,\ grid} * (1 + TDL_{2011})$$

The amount of electricity consumed by the project ($EC_{PJ,\ 2011}$) is totaled on the "PEElectricity consumption" worksheet of the "Clinton Emissions Reductions VCS-CDM Calculator 2011" workbook. According to monthly utility bills, the project consumed 167.850 MWh of electricity in 2011. Next, we apply the default factor of 1.3 for the grid emissions factor ($EF_{EL,\ grid}$) as provided for in the PDD and the tool described above. Lastly, we apply a value of 7% to account for transmission and distribution losses (TDL_{2011}), in accordance with p.66 of the U.S. Energy Information Administration "2010 Annual Energy Review."

Substituting these values for the variables in the equation above, we calculate the project emissions from electricity consumption to be 236.26 tons of carbon dioxide equivalent in 2011.

We calculate the emissions associated with the combustion of propane according to the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion:"

$$PE_{FC,\ Propane,\ 2011} = FC_{Propane,\ 2011} * COEF_{Propane,\ 2011}$$

As specified in the tool,

$$COEF_{Propane,\ 2011} = w_{C,\ Propane,\ 2011} * 44/12$$

The amount of propane consumed by the project ($FC_{Propane,\ 2011}$) is totaled on the "PEFC Propane" worksheet of the "Clinton Emissions Reductions VCS-CDM Calculator 2011" workbook. According to propane receipts, the project consumed 250 pounds of propane in 2011. Using the weighted average mass fraction of carbon in propane (0.817 according to the US EPA) for $w_{C,\ Propane,\ 2011}$, and dividing by 2,204.60 to convert our final total from pounds to tons, we calculate the emissions from propane combustion to be 0.34 tons of carbon dioxide equivalent.

Adding both sources of project emissions produces a total of 237 tons of carbon dioxide equivalent in 2011.

4.3 Leakage

No leakage effects need to be accounted for under the ACM0001 methodology (p.12).

4.4 Summary of GHG Emission Reductions and Removals

Emissions reductions produced in 2011 are equal to the difference between the baseline emissions and the project emissions, or

$$ER_{2011} = BE_{2011} - PE_{2011}$$

Subtracting project emissions (237) from baseline emissions (123,555) results in **123,318** net emissions reductions for 2011.

5 ADDITIONAL INFORMATION

5.1 Ownership of Emissions Reductions

DeWitt Energy's exclusive right to extract landfill gas and share the revenue from any sale of carbon credits with Clinton Landfill is made explicit in "2004 DeWitt LFG Contract Redacted.pdf" and "2008 DeWitt Revised LFG Contract Redacted.pdf" documents. TerraPass has exclusive right to market any VERs arising from the project (see "TerraPass – DeWitt contract.pdf").

5.2 Regulatory Compliance

DeWitt Energy Facility

The DeWitt Energy power plant has been operated in accordance with the law at all times during the reporting period. The project's permit to operate is included with the other report attachments as "DeWitt Construction Permit IEPA.pdf."

A search for Enforcement Orders on the Illinois Environmental Protection Agency's website¹ revealed no Enforcement Orders were ever issued to DeWitt Energy Associates.

Clinton Landfill

A search of the Illinois EPA Facility Compliance Tracking System² does not show any inspection violation notices issued to Clinton Landfill #2.

A search for Enforcement Orders on the Illinois Environmental Protection Agency's website (see footnote 1) revealed that two Orders were issued to Clinton Landfill #2 in the history of its operation. The first was issued on 7/22/2004, related to improper waste disposal procedures (see "Clinton Landfill 2004 Settlement.pdf"); this settlement was unrelated to the collection of landfill gas at the site. The second Enforcement Order was issued on 1/6/2011 for continued odor

¹ <http://www.epa.state.il.us/cgi-bin/en/orders/orders.pl>

² <http://epadata.epa.state.il.us/land/WebFACTS/index.asp>

violations at the site starting in April 2009 (see “Clinton Landfill 2011 Settlement.pdf”). Related to these violations and the settlement, the Landfill installed a second flare, which became operational on June 24, 2010.

Since the validated project baseline deduction increases over time to account for gas that would have been required to be destroyed under NSPS rules at an operating (and therefore growing) landfill, the installation of the second flare does not affect the additionality of the project. Additionally, the annual compliance report submitted to the Illinois EPA for the year 2010 shows the Landfill was operated in compliance during the year, except for the instances noted in the report which were all successfully resolved (see “2010 Clinton Landfill Air Compliance Report.pdf”). Note that the 2011 annual compliance report is not yet available at the issuance of this monitoring report.

During 2011 the landfill operated the gas system on its application for a Title V Clean Air Act permit (see “Flare 1 Modification CAAPP Construction Permit 10-28-2010.pdf” and “Flare 2 CAAPP Construction Permit 10-28-2010.pdf”).

5.3 Raw Data Files

Raw data files are cited throughout the Clinton Emissions Reductions VCS-CDM Calculator 2011” workbook.

5.4 Manufacturer Maintenance Recommendations

The project has several meters that require regular maintenance as follows:

- Three Rosemount 3095 Multivariable Mass Flow Transmitters, which requires a factory calibration every five years (see “Rosemount Cal Frequency Recommendation.pdf”, and “Rosemount Specifications.pdf”).
- A portable gas analyzer Elkins Earthworks Envision owned by DeWitt Energy. According to the manufacturer, this device should be field calibrated before every use in the field and factory calibrated annually (see “Envision Maintenance Recommendation.pdf”, and “Envision Specifications.pdf”).
- A portable gas analyzer Landtec GEM owned by Peoria Disposal Company. According to the manufacturer, this device should be field calibrated before every use in the field and factory calibrated annually (see “Landtec Service Recommendation.pdf”, and “Landtec GEM2000 Specifications.pdf”).
- Two Siemens Ultramat 23 continuous gas analyzers. These devices should be calibrated to span gas once a year (see page 2-12 on “Ultramat 23 Specifications.pdf”).

5.5 Factory Calibrations During the Reporting Period

The pressure transmitter of the engine flow meter (Rosemount 3095 Multivariable Mass Flow Transmitter) was factory calibrated once during the previous reporting period, on 4/21/2010. The transmitter’s previous calibration was its factory certification at purchase, when it was installed brand new as part of the power plant skid in January 2007.

As a part of the 4/21/2010 factory calibration procedure, the as found calibration showed the transmitter to underreport temperature by a maximum of 4.42% (see “Rosemount Factory Cal

4.21.10.pdf"). According to the manufacturer, temperature measured by the transmitter is not linearly correlated with the final mass flow reading produced by the transmitter, and further any error in the final mass flow reading would be LESS than the measured temperature error (see "Rosemount As-Found Reading Interpretation.pdf"). Since the temperature error measured in the as found calibration is less than 5%, we can consider the flow readings produced by the transmitter prior to 4/21/2010 to be within 5% of the true value.

The Elkins Earthworks Envision meter owned by DeWitt Energy with serial number 1003016 was factory calibrated on 3/30/2010 and again on 3/17/2011 (see corresponding files in the Verification Package).

The Landtec GEM owned by Peoria Disposal Company was previously factory calibrated on 10/15/2010 and again during the reporting period on 5/12/2011 and 11/29/2011 (see corresponding files in the Verification Package). Note that this portable analyzer was not used for project data.

The Siemens Analyzers were purchased in 2010 and factory certified on 3/16/2010 and 2/12/2010 respectively (see "Flare 1 Siemens Cert 3.16.2010.pdf" and "Flare 2 Siemens Cert 2.12.2010.pdf"). The analyzer at Flare 1 was field calibrated on 8/17/11 and again on 10/28/11 and the analyzer at Flare 2 was field calibrated on 10/13/11 (see corresponding files in the Verification Package).

The Flare 1 pressure transmitter was factory calibrated on 12/17/2010 (see "Flare 1 Rosemount Factory Cal 12.17.2010.pdf") and the Flare 2 pressure transmitter was factory calibrated on 4/21/2010 (see "Flare 2 Rosemount Factory Cal 4.21.2010.pdf").