

Verification Report for Sioux Falls Regional Sanitary Landfill—CAR462 Sioux Falls, South Dakota

Climate Action Reserve

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TABLE OF CONTENTS

1. Introduction	1
2. Objectives	1
3. Verification Scope	1
4. Standards Used to Verify Emissions (Criteria)	1
5. Overview of the Verification Process	2
5.1. Conflict of Interest Review	2
5.2. Verification Team	2
5.3. Verification Kick-off	2
5.4. Development of the Verification Plan	2
5.5. Emissions Reduction Data and Calculation Assessment	3
5.6. Site Visit	3
5.7. Corrective Actions and Supplemental Information	3
5.8. Verification Reporting	3
6. Site's Conformance with Verification Criteria	3
6.1. Project Description	3
6.2. Eligibility	3
6.2.1. Ownership and Title	3
6.2.2. Project Start Date	4
6.2.3. Additionality	4
6.2.3.1 Performance Standard Test	4
6.2.3.2 Legal Requirements Test	4
6.2.4. Regulatory Compliance	4
6.3. Project Performance Against CAR Protocol and Project Management System	5
6.3.1. Project Monitoring	5
6.3.2. Instrument Quality Assurance/Quality Control	6
6.3.3. Project Emissions	7
6.4. Emissions Reduction Calculation Assessment	7
6.5. Approved Variance or Deviations	8
6.6. Changes Due to Errata & Clarifications Issued by CAR	8
7. Verification Conclusion	9
9. Lead Verifier Signature	9
10. Senior Internal Reviewer Signature	9

1. Introduction

This report is provided to TerraPass Inc. as a deliverable of the Climate Action Reserve (CAR) project verification process. This report covers the verification of the Sioux Falls Regional Sanitary Landfill – CAR462 (the Project) for the period from July 1 through December 31, 2010. First Environment, Inc. (First Environment) conducted the verification from March to June 2011.

2. Objectives

The purpose of this verification was, through review of appropriate evidence, to establish that:

- the Project conforms to the requirements of the verification criteria, including all eligibility requirements, discussed in Section 4 of this report; and
- the data reported are accurate, complete, consistent, transparent, and free of material error or omission.

3. Verification Scope

Geographic Boundary	Sioux Falls Regional Sanitary Landfill, Sioux Falls, South Dakota
Emission Reduction Sources, Project Emissions, and Greenhouse Gases Verified	Emissions reductions (expressed in units of Carbon Dioxide equivalents, CO ₂ -e)) resulting from methane (CH ₄) destruction; Project emissions of carbon dioxide (CO ₂) from purchased electricity and fossil fuel combustion
Reporting Period	July 1, 2010 through December 31, 2010
Data Sources	Metered data and emission reduction calculations

4. Standards Used to Verify Emissions (Criteria)

Standard of Verification	• Climate Action Reserve Landfill Project Reporting Protocol, Version 3.0, December 2009 (CAR Protocol); • Climate Action Reserve Program Manual, March 2010; • Climate Action Reserve Landfill Project Protocol Version 3.0 Errata & Clarification, January 4, 2011 (Errata and Clarification);
Verification Process	• Section 8 of the Climate Action Reserve Landfill Project Protocol, Version 3.0, December 2009 (CAR Protocol); • Climate Action Reserve Verification Program Manual, December 2010; • ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions, 2006
Level of Assurance	Reasonable assurance
Materiality	Misstatements greater than one percent of the Project's emission reductions assertion are considered material; Qualitative non-conformities with the CAR Protocol are also considered material

5. Overview of the Verification Process

The verification process was utilized to gain an understanding of the Project's emission sources and reductions, to evaluate the collection and handling of data, to assess the means for reporting the associated data, and to verify the calculations that lead to the emission reductions.

The verification process was as follows:

- conflict of interest review;
- selection of Verification Team;
- initial interaction and kickoff meeting with primary TerraPass contact;
- development of the verification and sampling plan;
- review of management and data collection system;
- assessment of raw data and calculations for period under review;
- site visit;
- follow-up interaction with TerraPass contact for corrective action, clarification, or supplemental data as needed; and
- final statement and report submittal.

5.1. Conflict of Interest Review

Prior to beginning any verification project, First Environment conducts an evaluation to identify any potential conflicts of interest associated with the Project. No potential conflicts were found for this Project. First Environment also received authorization to continue verification services for TerraPass from CAR in a notification dated February 28, 2011.

5.2. Verification Team

First Environment's Verification Team consisted of the following individuals who were selected based on their verification experience, as well as familiarity with landfill operations.

Lead Verifier – Heather Moore
Verifiers – Natali Ganfer, Howard Kanter, Mary Pat Campbell
Senior Internal Reviewer – Jay Wintergreen

5.3. Verification Kick-off

The verification was initiated with a kick-off meeting on March 21, 2011 with the primary TerraPass contact. The meeting focused on confirming the scope, schedule, and data required for verification.

5.4. Development of the Verification Plan

The team formally documented its verification plan as well as determined the data-sampling plan. The verification plan was developed based on the discussion of key elements of the project verification process during the kick-off meeting. TerraPass was afforded the opportunity to comment on the key elements of the plan for verification. Based on items discussed and

agreed upon with TerraPass, the plan identified the First Environment project team members, project level of assurance, materiality threshold, and standards of evaluation and reporting for the verification. It also provided an outline of the verification process, established project deliverables, and presented a data-sampling plan designed to review all project elements in areas of potentially high risk of inaccuracy or non-conformance.

5.5. Emissions Reduction Data and Calculation Assessment

This assessment used information and insights gained during the previous steps to evaluate the collected data and the reported emissions reduction quantities, and identify if either contained material or immaterial misstatements.

5.6. Site Visit

Mary Pat Campbell conducted a site visit on April 19, 2011 to assess the Project's data management systems and interview personnel relevant to the Project for the verification period.

5.7. Corrective Actions and Supplemental Information

The team issued corrective actions and clarification requests during the verification process. TerraPass provided sufficient responses to all corrective action and clarification requests.

5.8. Verification Reporting

Verification reporting, represented by this report, documents the verification process and identifies its findings and results. Verification reporting consists of this report for TerraPass, a verification statement, and a list of findings to be submitted to the Climate Action Reserve.

6. Site's Conformance with Verification Criteria

6.1. Project Description

The Sioux Falls Regional Sanitary Landfill is located at 26727 464th Avenue, in Hartford, South Dakota and is owned and operated by the City of Sioux Falls. The City of Sioux Falls began operating a landfill methane destruction project in April 2006 where the landfill gas was directed to an open flare. A pipeline conveying landfill gas to a nearby ethanol plant became operational in February 2009. The project consists of approximately 90 gas extraction wells, lateral and header piping, condensate removal equipment, blowers, an open flare, and a pipeline which conveys the landfill gas to an off-site ethanol plant. Prior to this system, landfill gas was passively vented to the atmosphere.

6.2. Eligibility

The Sioux Falls Regional Sanitary Landfill meets the eligibility requirements set forth in the CAR Protocol and as described below.

6.2.1. Ownership and Title

Ownership of the verification emission reductions was demonstrated through a Verified Emission Reduction Purchase and Sale Agreement (VERPA) with the City of Sioux Falls and TerraPass, Inc.; establishing TerraPass' exclusive ownership rights to Environmental Attributes of any sort arising from the landfill gas combusted by the Project over the given reporting period,

including any CRTs generated. A second contract between the City of Sioux Falls and Great Plains Ethanol, LLC, d/b/a POET Biorefining-Chancellor (POET), gives the City of Sioux Falls the rights to the emission reduction associated with the landfill gas combusted at the ethanol plant. First Environment's review of both contracts indicated TerraPass' ownership.

Additionally, the CAR Project Developer's Attestation of Title has been completed by TerraPass and is on file with CAR. First Environment reviewed the Attestation of Title during the verification process and confirmed that it was completed correctly.

6.2.2. Project Start Date

First Environment confirmed that the project meets CAR's start date requirements. The Project start date is April 7, 2006. The project's start date was confirmed during the verification of the project's initial reporting period.

6.2.3. Additionality

The project passes both the Performance Standard Test and the Legal Requirements Test, as described below.

6.2.3.1 Performance Standard Test

The Project consists of an active landfill gas collection and destruction system at a landfill. Prior to this system, landfill gas was passively vented to the atmosphere; therefore, the Project meets activity No. 2 as described in Section 3.4.1 of the CAR protocol and passes the Performance Standard Test. First Environment previously verified the baseline scenario through on-site interviews. It was also previously confirmed that the landfill is not a bioreactor.

6.2.3.2 Legal Requirements Test

The landfill's design capacity of approximately 22 million megagrams exceeds 2.5 million megagrams and therefore falls under the NSPS regulations. The most current Tier II test, completed in July of 2008, revealed a site-specific NMOC emissions rate in calendar year 2010 of 23 Mg/yr, which is below the NSPS regulatory threshold of 50 Mg/yr. First Environment also reviewed the landfill's state permits, including its permit to operate and stormwater permits, and state and local laws which indicated that the project is voluntarily implemented.

Additionally, First Environment relied on the Attestation of Voluntary Implementation completed by TerraPass for the current reporting period. The Attestation is on file with CAR and was reviewed to confirm that it was completed correctly.

6.2.4. Regulatory Compliance

First Environment reviewed the facility's general stormwater discharge permit, Title V air quality operating permit, the most current Tier II report, and the Environmental Protection Agency's Enforcement and Compliance History Online (ECHO) database to inform the assessment of regulatory compliance. The cursory review of permits indicated that the site was in compliance and no violations of permits occurred during the reporting period.

First Environment also relied on the Attestation of Regulatory Compliance completed by TerraPass for the current reporting period. The Attestation is on file with CAR and was reviewed to confirm that it was completed correctly.

6.3. Project Performance Against CAR Protocol and Project Management System

The project was implemented in conformity with the CAR Landfill Project Reporting Protocol, Version 3.0. TerraPass developed and implemented a Monitoring Plan to track relevant project parameters and data sources. The Monitoring Plan was reviewed to determine compliance with the protocol requirements. Based on observations made during the site visit and review of relevant project documentation, First Environment found the Monitoring Plan to meet the requirements set forth by the CAR Protocol and the project to be implemented in accordance with the Monitoring Plan.

6.3.1. Project Monitoring

Landfill gas collected by the active landfill gas collection and control system is either destroyed by the open flare or conveyed off site through a pipeline to a nearby ethanol plant. The landfill gas destroyed in the open flare is continuously measured using a FCI ST98 Thermal Mass Flow Meter and recorded in 30-second intervals. The ST98 flow meter corrects the flow rates from ambient conditions to a standard temperature and pressure of 70°F and one atmosphere of pressure. The landfill gas sent off site is continuously measured by a Veris Verabar V100 Pitot Differential Pressure Sensor and totalized daily. The Veris Verabar flow meter corrects the totalizer readings from ambient conditions to a standard temperature and pressure of 59°F and one atmosphere of pressure. Data from both flow meters are connected to a supervisory control and data acquisition (SCADA) system.

The methane concentration of the landfill gas routed to the flare is measured at least weekly using a Landtec GEM-2000 portable gas analyzer. The methane concentration of the landfill gas conveyed through the pipeline is continuously measured and recorded every 30 seconds by a CAI L Series gas analyzer.

The flare thermocouple temperature is monitored to document the operation of the flare. The thermocouple temperature is monitored continuously and recorded every 30 seconds by the SCADA system. The operation of the pipeline is monitored by hour meter readings on the gas compressor and confirmed through sales receipts showing the total quantity of landfill gas delivered to the ethanol plant.

Table 1 summarizes the project monitoring system parameters and monitoring equipment employed by the project.

Table 1: Monitoring Equipment

Parameter	Monitoring Equipment	Frequency of Measurement	Frequency of Recording	Recording Device
Landfill gas flow (Pipeline)	Veris Verabar Flow Meter	Continuous	Daily	SCADA system
Landfill gas flow (flare)	ST98 Flow Meter	Continuous	Every 30 seconds	SCADA system
Methane Concentration (Pipeline)	CAI Gas Analyzer	Continuous	Every 30 seconds	SCADA system
Methane concentration (flare)	Landtec GEM-2000	Weekly	Weekly during reporting period; before each reading	Operational Spreadsheet

Parameter	Monitoring Equipment	Frequency of Measurement	Frequency of Recording	Recording Device
Operation of Pipeline	Hour meter	Continuous	Weekly; Checked by Monthly invoices	Manual
Hourly Operation of Flare	Thermocouple on the flare stack	Continuous	Every 30 seconds	SCADA System

6.3.2. Instrument Quality Assurance/Quality Control

TerraPass' instrument quality assurance/quality control (QA/QC) plan for the project's monitoring equipment complies with CAR's requirements.

Both flowmeters, the Veris Verabar and the ST98, are field checked for accuracy at least once each reporting period, inspected/cleaned once per quarter, and factory calibrated every five years in the case of Veris Verabar and every 18 months in the case of ST98. The flow sensor field checks are performed using a pitot tube. The CAI Gas Analyzer is field checked at least once every reporting period, inspected/cleaned every quarter, and auto-calibrates on a daily basis using a calibration gas. First Environment confirmed that the instrument's self-calibration was working properly during the site visit. The Landtec GEM-2000 is field checked and inspected/cleaned weekly before each use and was factory calibrated in January 2010. During the reporting period, all field checks showed the documented drift of monitoring instruments to be within the five percent accuracy range required by the CAR Protocol. Table 2 shows the dates during the current reporting period when instrument QA/QC was performed.

Table 2: Instrument QA/QC

Equipment Name	Quarterly Inspection/Cleaning	Field Check	Factory Calibration
Veris Verabar Flow Meter (Pipeline)	September 21, 2010 and October 13, 2010	September 21, 2010 and December 21, 2010	No manufacturer calibration requirement; previous calibration occurred when installed in February 2009
ST98 Flow Meter (Flare)	September 9, 2010 and October 14, 2010	September 30, 2010 and December 30, 2010	Accuracy check performed every 18 months, recalibrate if necessary. Last factory calibration occurred in August 2010
CAI Gas Analyzer	September 20, 2010 and October 13,	Auto-calibrates daily	No manufacturer calibration requirement; previous calibration occurred when installed in February 2009
Landtec GEM-2000	Weekly during reporting period; before each reading	Weekly during reporting period; before each reading	January 14, 2010

6.3.3. Project Emissions

Project emissions sources and the associated monitoring methodology are summarized in Table 3.

Table 3: Project Emissions

Project Emissions Source	Monitoring
Consumption of Purchased Electricity	Monthly electrical utility bills
Propane consumption used to re-start flare	Estimated quantity based on tank size

6.4. Emissions Reduction Calculation Assessment

The emission reduction calculations were reviewed to ensure accuracy in the formulas used and the raw data used as inputs. The formulas were tested to ensure consistency with the calculation methodology described in the CAR Protocol.

Landfill gas flow to the open flare was calculated by taking the 30-second standard cubic feet per minute (SCFM) readings from the ST98 flow meter, removing all readings when either the flow rate was less than zero or the thermocouple temperature was below 500°F indicating inoperativeness of the open flare, converting the SCFM to SCF, and aggregating the flow on a daily basis. The ST98 flow meter corrects gas flow recorded at ambient conditions to one atmosphere of pressure at 70°F, so an adjustment was made within the emission reduction calculations to adjust the flow to 60°F and one atmosphere of pressure. Landfill gas flow to the pipeline was determined from the Veris Verabar daily totalizer readings. The Veris Verabar flow meter corrects the flow recorded at ambient conditions to one atmosphere of pressure at 59°F, so an adjustment was made within the emission reduction calculations to adjust the flow to 60°F and one atmosphere of pressure.

Methane concentration measurements for the landfill gas directed to the flare were obtained weekly using a portable gas analyzer. Methane concentration measurements for the landfill gas conveyed through the pipeline were obtained from the CAI gas analyzer. The CAI gas analyzer outputs data every 30 seconds which were averaged daily and used in the emission reduction calculations.

Data substitution methodologies were employed at various times during the project when the continuous methane concentration data were missing. The project developer correctly employed data substitution methodologies according to Appendix E of the CAR Protocol for the length of the periods of missing data.

Project emissions were subtracted from total volume of methane destroyed. Project emissions were calculated by multiplying activity data by an appropriate emission factor.

Table 4 summarizes the input parameters used in the emission reduction calculations.

Table 4: Input parameters

Input Parameter	Name	Description/ Value
$LFG_{\text{pipeline},t}$	Quantity of LFG in the pipelines	Summed daily from metered data, corrected to 60°F and 1 atm
$LFG_{\text{flare},t}$	Quantity of LFG to flare	Summed daily from metered data, corrected to 60°F and 1 atm
$PR_{CH_4, \text{pipeline},t}$	Methane content in the pipelines	Averaged daily from SCADA data
$PR_{CH_4, \text{flare},t}$	Methane content to flare	Averaged weekly from GEM readings
DE_{pipeline}	Default destruction efficiency of pipeline	98%
DE_{flare}	Default destruction efficiency of open flare	96%
OX	Oxidation Factor	10%
DF_{pipeline}	Discount Factor for the pipeline	0
DF_{flare}	Discount Factor for the flare	10%
Flare Temperature Cut-off	Metered data below corresponding temperature cut-off are excluded from calculations.	500°F
EF_{FF}	Default propane emission factor (Table C.1 of the CAR Protocol)	5.74 kg CO ₂ /gal
EF_{EL}	Default purchased electricity emission factor (Table C.2 of the CAR Protocol, MROW subregion)	1,821.84 lb CO ₂ /MWh

Copies of the raw data used in the calculations, including flow data, methane content data, and utility and other fossil fuel invoices, were compared with the data used in the final calculations and tested for transcription or mathematical errors. All raw data sources and calculations over the entire verification period were reviewed. First Environment performed recalculations of emission reductions for the entire reporting period to assess whether they were free of material misstatement. First Environment found the emission reduction calculations to be free of material misstatement.

6.5. Approved Variance or Deviations

TerraPass did not request any variances from CAR for the current reporting period.

6.6. Changes Due to Errata & Clarifications Issued by CAR

The issuance of the Errata and Clarification, dated January 4, 2011, resulted in one change to the project, as follows:

- Attestation forms that the project developer submitted to CAR: First Environment reviewed the Attestation of Voluntary Implementation and the Attestation of Regulatory Compliance forms and confirmed that these forms were completed correctly and are on file with the CAR.

7. Verification Conclusion

Based on the assessments performed and the evidence collected, First Environment concludes that the Project GHG emissions reductions, due to the capture and combustion of methane gas, can be considered with a reasonable level of assurance:

- in conformance with the verification criteria, and
- without material discrepancy.

Verified results show:

Reporting Period: July 1, 2010 to December 31, 2010	Total
Baseline Emissions (tCO ₂ e)	96,417
Project Emissions (tCO ₂ e)	1,337
Emissions Reductions (tCO ₂ e)	95,080

9. Lead Verifier Signature



Heather I. Moore
Engineer II

10. Senior Internal Reviewer Signature



James T. Wintergreen
Senior Associate