RUBY CANYON ENGINEERING

Verification Report

CAR406 Moccasin Mike Landfill Gas Project

Reporting Period: January 1, 2017 – December 31, 2017

Prepared for:

Element Markets, LLC

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Table of Contents

1.0 Introduction 2
1.1 Project Background & Site Description 2
1.2 Responsible Party 2
1.3 Verification Team 2
1.4 Objectives 2
1.5 Scope 2
1.6 Verification Criteria 3
2.0 Verification Activities Summary 3
3.0 Verification Findings 4
3.1 Assessment of the GHG Emission Reductions Project Operations 4
3.2 GHG Project Boundary (sources, sinks and/or reservoirs) 4
3.3 Project Eligibility Criteria 4
3.4 Ownership of Generated Emission Reductions 6
3.5 GHG Monitoring and Management Systems 6
3.6 Instrument QA/QC 6
3.7 Assessment of GHG Emission Reductions Calculations 7
4.0 Verification Results 7
5.0 Conclusion 8

1.0 Introduction

Ruby Canyon Engineering, Inc. (RCE) was contracted to perform the verification of the Moccasin Mike Landfill Gas Project (Project) for the reporting period January 1, 2017 through December 31, 2017 to the Climate Action Reserve (Reserve) Landfill Project Protocol 3.0 (Protocol). The Project is located in Superior, WI at the Moccasin Mike Landfill (Landfill).

1.1 Project Background & Site Description

The Landfill opened in 1976 and is estimated to close in 2024. It is owned by the City of Superior, WI. The landfill has a permitted waste area of 200 acres. The landfill design capacity is 2.88 million Mg. The Project consists of the collection of landfill gas (LFG) from the landfill and its subsequent destruction by combustion in an open flare at the site.

1.2 Responsible Party

Project Developer: City of Superior (City)
Landfill Owner: City of Superior (City)
Carbon Credit Manager: Element Markets, LLC (EM)

1.3 Verification Team

The RCE verification team consisted of the following individuals who were selected based upon verification experience and knowledge of the landfill methane sector.

Lead Verifier: David LaGreca
Senior Internal Reviewer: Phillip Cunningham
Team Member: Samantha Phillips

1.4 Objectives

The goal of the verification activities was to ensure that the claimed GHG emission reductions were complete, consistent, accurate, transparent, and permanent and that the Project was in compliance with the Reserve's project additionality, monitoring, and reporting requirements. Furthermore, the verification activities ensure that the data provided to RCE is well documented and free of any material errors or omissions.

1.5 Scope

The scope of the verification consisted of the following independent and objective activities:

- Review the reporting period's Project Monitoring Plan;
- Conduct a site visit to the Project location;
- Review the Project data acquisition and quality control procedures;
- Review the Project's baseline emissions and confirm the baseline and Project boundaries;
- Review the Project's evidence of environmental and regulatory requirements to ensure that the Project is additional;
- Review the Project's emission reduction calculations;
- Review the Project documents and data against the criteria listed in Table 1;
- Issue requests for additional documentation, clarifications, and corrective actions as necessary; and
- Issue a verification report, verification statement, and list of findings to EM, the City and the Reserve.

1.6 Verification Criteria

Table 1 – Summary of Verification Criteria

Criteria	Details
Standard of Verification	• The Reserve Landfill Project Protocol Version 3.0 (December 2, 2009) • Errata and Clarifications to Landfill Project Protocol Version 3.0 (June 18, 2015) • The Reserve Program Manual (September 1, 2015) • The Reserve Verification Program Manual (February 8, 2017)
Verification Process	The Reserve Verification Program Manual and ISO 14064-3 Specification with guidance for the validation and verification of greenhouse gas assertions
Level of Assurance	Reasonable assurance
Materiality	97% accuracy level (less than 3% error) because total annual emission reductions are 25,000 < tCO_2e <100,000.

2.0 Verification Activities Summary

The Verification process consisted of the following activities as outlined in the verification plan:

- RCE completed a NOVA/COI form to identify any potential conflict of interest with the Project or with EM. The NOVA/COI form was submitted to the Reserve and the COI assessment revealed no conflicts of interest and was approved by the Reserve on February 14, 2018.
- RCE held a verification kick-off meeting with the City and EM on March 12, 2018. During the kick-off meeting RCE reviewed the verification objectives and process, reviewed the verification schedule, and requested the verification background documents.
- RCE performed a strategic review and risk assessment of the received data and support documents in order to understand the scope and areas of potential risk in the GHG emissions reductions.
- RCE developed a risk-based sampling plan based upon the strategic review and risk assessment. The verification plan and sampling plan were used throughout the verification and were revised as needed based upon additional risk assessments.
- RCE conducted a site visit on April 3, 2018. During the site visit RCE performed key personnel interviews; inspected the Project equipment; and observed the onsite GHG management systems and data gathering, monitoring, and handling practices.
- RCE performed a risk-based desktop review of the submitted verification documents. The desktop review included an assessment of the GHG calculation methods and inputs, source data completeness, GHG management and monitoring systems, evidence of regulatory compliance, and record retention practices.
- RCE submitted requests for corrective actions and additional documentation to the City and EM throughout the verification.
- RCE's senior internal reviewer conducted a review of the verification sampling, report, and statement.
- RCE issued a final verification report, verification statement, and list of findings.
- RCE held an exit meeting with the City and EM on May 11, 2018.

3.0 Verification Findings

3.1 Assessment of the GHG Emission Reductions Project Operations

The Project currently collects landfill gas from the Landfill and destroys it via combustion in an open flare mounted on a flare skid adjacent to the landfill. The LFG is pulled from 27 vertical wells at the landfill and passes through a clean-out that removes condensate which is transferred to the landfill's condensate collection system.

RCE confirmed that the landfill is not a bioreactor and does not re-circulate leachate nor add any liquid other than leachate in a controlled fashion to accelerate or enhance the anaerobic biodegradation of the waste.

3.2 GHG Project Boundary (sources, sinks and/or reservoirs)

According to the Protocol, carbon dioxide and methane are the only GHGs included in the Project boundary from both the baseline and Project activities. The emissions resulting from the Project activity must be deducted from the Project baseline emissions in order to calculate total emission reductions. These Project emissions include the carbon dioxide resulting from the consumption of electricity from the grid and consumption of propane related to Project activities. Baseline emissions are the total amount of methane that would have been vented to the atmosphere less the oxidation of methane by soil bacteria. Table 2 lists the sources of GHG emissions reviewed during the verification of the Project.

Table 2 – Summary of the Project GHG Sources, Sinks and Reservoirs

Activity	GHG Sources, Sinks & Reservoirs
Baseline	• CH_4 vented to the atmosphere. • Percent methane oxidized by soil bacteria. As the landfill is not covered with a synthetic liner, a 10% oxidation factor resulting from natural oxidation by soil bacteria was applied to the baseline emissions.
Project	• CH_4 from the incomplete combustion of LFG sent to the flare. • CO_2 from the combustion of fossil fuels used during operation and maintenance of the Project activity. • CO_2 resulting from the consumption of imported electricity.

3.3 Project Eligibility Criteria

The Protocol specifies four eligibility rules that a project must meet in order to register emission reductions with the Reserve: Location, Project Start Date, Additionality, and Regulatory Compliance. Below is a summary of the Reserve eligibility requirements and the Project's compliance to each requirement.

- **Eligibility Rule 1**: Location

  The Project is a US-based landfill located in the town of Superior, WI. The Project therefore meets this eligibility requirement. RCE confirmed this during the site visit.

- **Eligibility Rule 2**: Project Start Date

  The Landfill Project Protocol states a project start date is the date when methane was first continuously destroyed in a qualifying destruction device at the site. RCE confirmed the Project start date of April 28, 2009. RCE reviewed Project start date documents including the original construction permit for the flare, a 2009 compliance inspection report, and a 2009 memo from the City of Superior indicating the project start date to confirm that the Project first began continuous methane destruction on April 28, 2009. The Project submittal form was completed and submitted to the Reserve on December 11, 2008.

- **Eligibility Rule 3**: Additionality

  Performance Standard Test

  RCE confirmed that the Project meets the Performance Standard Test, Scenario 1. Prior to the Project activity, the Landfill collected and passively vented LFG, with no combustion occurring. RCE confirmed this through review of the State of Wisconsin Air Pollution Control Construction Permit dated November 18, 2008, and through historical satellite data. While on site, RCE observed no evidence of a previous landfill gas collection system.

  Thus, the Project passes the Performance Standard Test number 1 since it involves:

  "Installation of a landfill gas collection system and a new qualifying destruction device at an eligible landfill where landfill gas has never been collected and destroyed prior to the project start date."

  Legal Requirement Test

  During the site visit, RCE interviewed the City about the procedures to ensure that the Project meets environmental compliance requirements and the Legal Requirement Test. The City monitors federal, local, and state regulations to ensure that the Project is in environmental compliance and that there is no mandate to collect and combust LFG. RCE confirmed that there are currently no laws or ordinances requiring the Landfill to collect and destroy LFG.

  The Landfill is a municipal solid waste (MSW) landfill that exceeds the design capacity of 2.5 million megagrams (Mg) or 2.5 million cubic meters as specified in the New Source Performance Standards (NSPS) codified in Title 40 of the Code of Federal Regulations (CFR) Part 60, Subpart WWW, Section 60.752. The landfill is therefore required to conduct Tier II testing, but due to permitting of the landfill prior to the 1977 CAA Amendments, Title V permits are not required. RCE reviewed the Air and Operating Permit for this facility and confirmed compliance with all pertinent WI state DNR air quality requirements.

  RCE examined the NMOC modeling results for the landfill. The NMOC emission rate for 2017 was 12.56 Mg/year and well below the 50 Mg/year threshold for a required gas collection and combustion system. The NMOC Tier II test was renewed in July 2014 and is valid through 2019. RCE therefore concluded that the Landfill is not required to destroy LFG.

  RCE also reviewed the Project's Monitoring Plan which defines how the Project continues to exceed the Legal Requirement Test. Landfill personnel review local, state, and federal regulations prior to each verification period in order to confirm that there are no new requirements or laws that mandate a GCCS be in place. The Attestation of Voluntary Implementation form was signed after the end of the reporting period and uploaded to the Reserve on March 20, 2018, stating that the project was implemented and established voluntarily.

  During the review of the supporting evidence, RCE did not observe any indication that the Landfill was mandated to destroy LFG. Additionally, there are no local, state or federal requirements for the installation of a GCCS at the Landfill. Therefore, the results of the review indicated that the City is following its Monitoring Plan procedures to assure that it passes the Legal Requirement Test.

- **Eligibility Rule 4**: Regulatory Compliance

  The City works with a variety of 3rd party consultants at the landfill that provide regulatory compliance assistance. RCE reviewed the procedures described in EM's monitoring plan to ensure that the Project remains in compliance with all applicable local, state, and federal requirements. RCE searched the Environmental Protection Agency's Enforcement & Compliance History Online (ECHO) database and confirmed through examining the Wisconsin Department of Natural Resources (DNR) 2017 inspection reports that there were no compliance issues during the reporting period. Previous direct inquiries with

WI DNR redirected RCE to the State compliance database. RCE confirmed that the Intermediate Cover non-compliance issue from 2016 was resolved in Quarter 3 of 2016 and did not impact the 2017 RP. RCE reviewed several environmental and operating permits including the Solid Waste License and confirmed that all leachate and wastewater is sent to the City of Superior's wastewater treatment plant, thus negating the requirement for a wastewater permit.

During RCE's review there was no evidence of noncompliance found. The Landfill is following procedures from the Monitoring Plan for ensuring regulatory compliance of Project activities. Finally, RCE confirmed signature of the Attestation of Regulatory Compliance, after the end of the reporting period, which was uploaded to the Reserve on March 20, 2018.

3.4 Ownership of Generated Emission Reductions

RCE reviewed the completed Attestation of Title which states that the City owns the emission reduction credits generated by the Project, which was uploaded to the Reserve on March 20, 2018. RCE also reviewed the Carbon Credit Purchase and Sale Agreement between the Landfill and EM, confirming ownership of emission reductions by the Project Developer, The City of Superior, WI.

3.5 GHG Monitoring and Management Systems

RCE reviewed the data management systems during the site visit and desktop review. RCE completed the majority of the GHG management systems review during the site visit by observing the onsite procedures and interviewing the personnel responsible for the Project. The onsite review included an assessment of the Project data collection, processing and handling procedures, recordkeeping and data storage, quality control and assurance procedures, record retention systems, and a field tour of the Project equipment. The desktop review included a detailed review of the Project monitoring plan and its conformance to Protocol requirements. RCE also confirmed that the Project was implemented according to the Monitoring Plan.

The primary project data include the LFG flow to the flare, thermocouple temperature of the flare, and methane content of the LFG. The LFG flow is continuously measured by a Rosemount 3051 flow meter installed in the horizontal section of pipe leading from the blowers. During the site visit, RCE observed the position of the flow meters is correct to allow for laminar flow of landfill gas. The flow meter underwent repairs in 2016 during which the standard flow temperature was adjusted to 85 degrees F by calibration technicians to prevent subsequent system failures. The flow meter is calibrated at 1 atm, though calculations are adjusted to account for temperature readings taken at 85 degrees F. The flare temperature is continuously measured by a thermocouple installed in the flare housing. All continuously monitored data is totalized and queried every 8 minutes by a Yokogawa data recorder, averaging the minimum and maximum flow for that period. The methane content of the landfill gas is measured continuously by a Siemens Ultramat 23 methane analyzer and recorded every 8 minutes along with the flow rate and flare temperature.

During the site visit RCE reviewed the data storage and retention policies of the City and verified they were in conformance with the Protocol requirements and followed the Monitoring Plan. All data is kept for a period of ten years after the information is generated or seven years after the last verification.

3.6 Instrument QA/QC

RCE reviewed evidence that the flow meters and methane analyzers met instrument QA/QC requirements as outlined in the Protocol for cleaning, inspection, and calibration. The Project Monitoring Plan describes the procedures for instrument field checks and calibrations which conform to Protocol requirements. The landfill gas flow meter at the flare (Rosemount 3051 Serial # 434191) was inspected and calibrated by third-party contractor, Aspect Electrical Engineering & Services, LLC, on 3/14/2017, 6/14/2017, 9/12/2017, and 12/8/2017, during which all drifts were found to be within the Protocol stipulated +/- 5% threshold. All project methane readings were taken by an UltraMat23 IR Gas analyzer, model # 7MB2337-3D10-5CR1, Serial # X4-

442. The same third party carried out calibration of the methane analyzer during quarterly inspections, on 3/14/2017, 6/14/2017, 9/12/2017, and 12/8/2017, during which all drifts were found to be within the Protocol stipulated +/- 5% threshold.

Aspect Electrical Engineering & Services, LLC performed quarterly cleaning and inspections of the flow meter and methane analyzer on 3/14/2017, 6/14/2017, 9/12/2017, and 12/8/2017 and documented the results; specifically the "as found" and "as left" condition of Project equipment. In addition, the flow meter was checked for calibration accuracy by Aspect Electrical Engineering & Services, LLC during each of the quarterly inspections. The last accuracy check on 12/8/2017 falls within the last two months of the reporting period.

The flow meter manufacturer, Emerson Process Management, requires a factory calibration check every 3 years, with the last factory calibration occurring on 8/24/2016. The UltraMat23 Gas analyzer was last factory calibrated 7/29/2015, within the 5-year calibration frequency required by the Protocol. In addition, the K-type thermocouple mounted on the flare was inspected and calibrated on a quarterly basis, ensuring accuracy of the temperature readings throughout the reporting period.

3.7 Assessment of GHG Emission Reductions Calculations

The emission reduction calculation assessment included a review of Project assumptions, raw data inputs, and accuracy of calculations. RCE assessed the completeness of the raw data and how the data are transferred to the calculation spreadsheet. RCE reviewed the formulas and raw data inputs for accuracy and compliance with Protocol requirements

The Project data consisted of raw data in the form of monthly and quarterly spreadsheets of flare flow and eight-minute sums of the flare and methane data, which were summarized in the calculation workbooks. RCE compared data in the raw flow data spreadsheets to the respective eight-minute sums, and then compared those data and the weekly GEM readings to the calculation workbooks. RCE confirmed that no erroneous methane readings (CH4 readings greater than 100 percent) were used in final calculation. No discount was required because methane is recorded continuously. RCE confirmed that a 96 percent destruction efficiency was assigned to the Project's open flare. RCE ensured that operational checks for flare temperature (>500 °F) were correctly applied. EM used equation 5.2 to adjust flow readings from 85 degrees Fahrenheit to the Protocol standard conditions of 60 degrees Fahrenheit and 1 atm.

RCE reviewed source documentation for Project emissions from purchased electricity, confirmed that appropriate emission and conversion factors were used, and reviewed the use of Protocol equations for Project emissions in EM's calculation workbook.

RCE confirmed that there were no instances of data substitution for this reporting period.

RCE recalculated the GHG emission reductions and compared the results to EM's calculations to determine if the GHG emission reductions were materially correct. RCE re-calculated the eight-minute increments of LFG flow to the flare, monthly average methane concentrations, and project emissions. RCE found no material misstatements in the final Project GHG reductions calculations. Emissions reductions increased approximately 49.5 percent in RP 2017 from the previous 2016. This large increase is due to the following: First, during the 2016 RP, there was a rolling summer brown out in the electricity supply to the landfill as well as a botched culvert replacement in November which knocked out electricity to the landfill; Second, the Reserve's Policy Memo dated May 1, 2018 accounted for a 19 percent adjustment to the methane global warming potential (GWP) used to calculated total ERs.

4.0 Verification Results

EM provided sufficient evidence and documentation of its emission reductions, data collection procedures, and monitoring and quality control procedures. The verification process focused on verifying the emission

reduction calculations and the source data used to quantify the emission reductions in accordance with the Reserve Landfill Project Protocol 3.0. The following is a summary of the verification results.

The Project reported emission reductions of 54,708 metric tons of CO_2e from January 1, 2017 to December 31, 2017 as per the information provided in EM's calculation spreadsheets. During final review, RCE identified no material misstatements in the data or emission reductions calculations. Table 3 defines the emission reductions verified for this reporting period. During the verification process, RCE made requests for clarifications and additional documentation to complete the verification. EM and the City sufficiently addressed all requests. The details of these requests are documented in RCE's List of Findings provided to the Reserve, EM, and the City.

5.0 Conclusion

RCE conducted a risk-based analysis of the Project's GHG emission reductions including a strategic review of the Project data and evidence. Based upon the processes and procedures and the evidence collected, RCE concludes that the Project emission reductions resulting from the capture and destruction of LFG during the reporting period January 1, 2017 through December 31, 2017 can be considered:

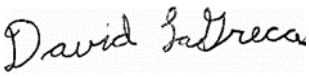
- In conformance with the Reserve Landfill Project Protocol 3.0,
- Without material discrepancy, and
- Verified to a reasonable level of assurance

Table 3 - Emission Reductions Verified for January 1, 2017 through December 31, 2017

Year	Baseline Emissions CO_2e (tonnes)	Project Emissions CO_2e (tonnes)	Emission Reductions CO_2e (tonnes)
2017	54,785	77	54,708
Total	**54,785**	**77**	**54,708**

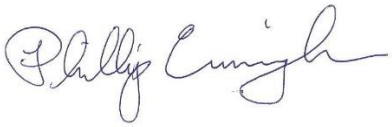
Note: Due to rounding, individual values might not equal totals and values are not representative of raw data used in the emission reductions calculation.

Lead Verifier Signature



David LaGreca

Senior Internal Reviewer Signature



Phillip Cunningham