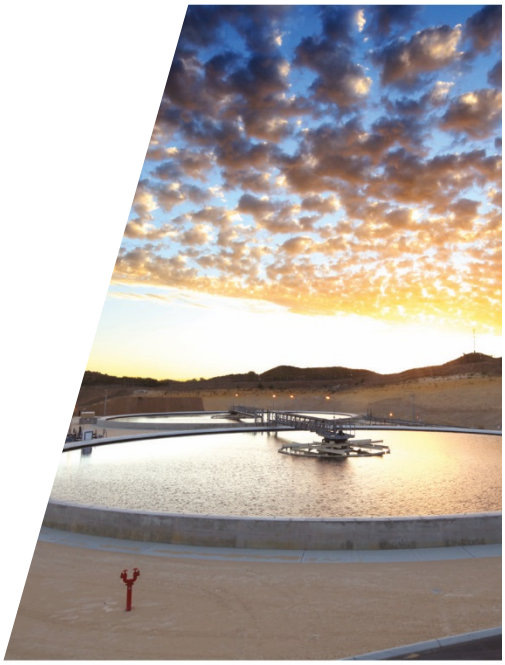
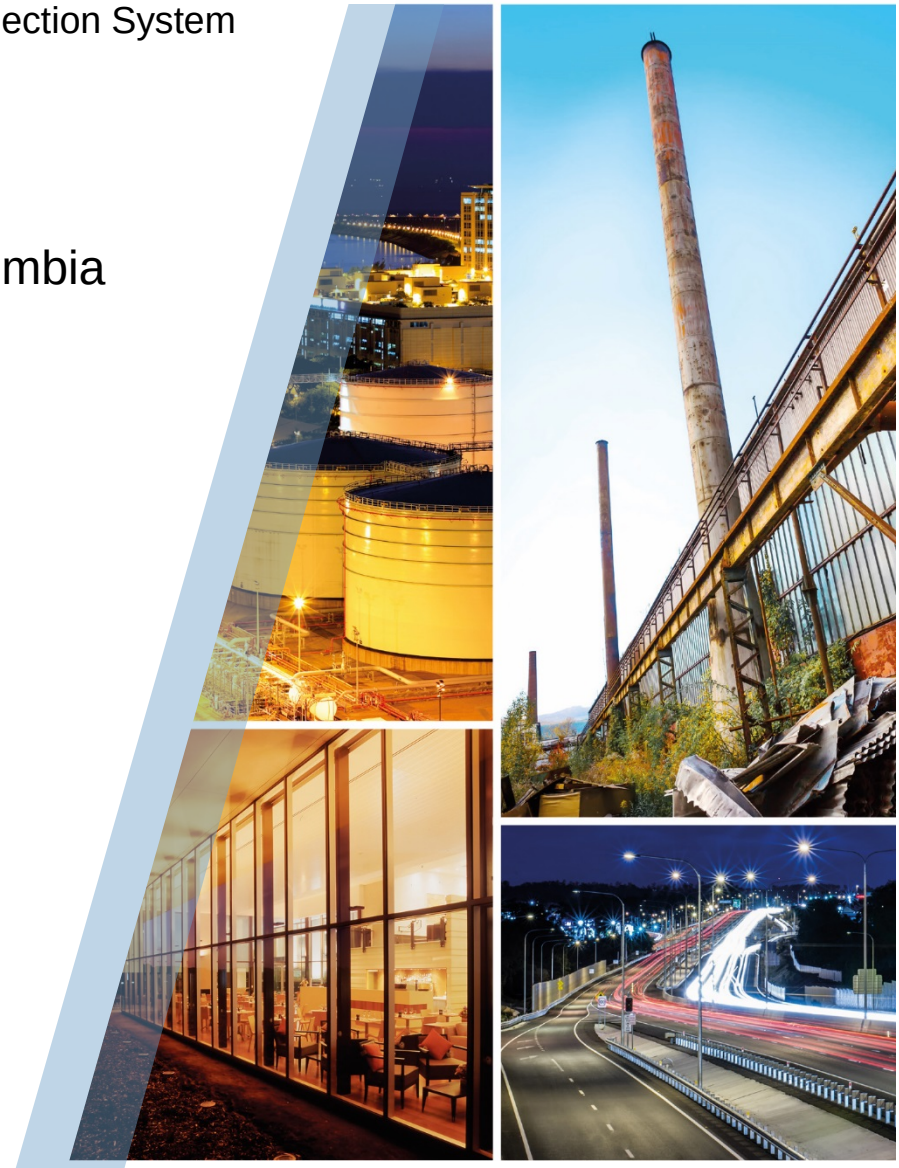


Verification Report

2017 Greenhouse Gas Emissions Reductions
Coquitlam Landfill Gas Collection System



Metro Vancouver
Burnaby, British Columbia

Table of Contents

Table Index

Appendix Index

1. Third Party Verification Summary

Project Proponent Information	
Name of Local Government Project Proponent(s)	*Metro Vancouver*
Name of Third Party Verification Organization	*GHD Limited*
Project Proponent Contact	Name: Francis J. Ries, B.Sc., P.Eng. Title: Senior Project Engineer Phone: 604-436-6803 Email: francis.ries@metrovancouver.org
Project Report Information	
Project Report Title	Coquitlam Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Report - 2017 Reporting Year dated May 28, 2018 ☒ Copy of Project Report attached in Appendix A
Timing and Amount of reductions being claimed	The emission reductions of 534.9 tonnes of carbon dioxide equivalent (tCO_2e) are claimed from this project during January 1, 2017 to December 31, 2017.
Third Party Information: Authorization and Sign off	
Third Party Contact	Name: Deacon Liddy Title: Vice-President Phone: 604-214-0510 Email: deacon.liddy@ghd.com
Verification Statement	☒ I declare that the GHG reductions claimed in the Project Report for 2017 reporting year are fair and reasonable in accordance with the verification criteria and Coquitlam Landfill Gas Collection System Upgrade Project Plan January 2013, in all material respects.
Third Party Verifier Signature: Designate Signature Date:	 May 30, 2018

2. Introduction

Metro Vancouver retained GHD Limited (GHD) to complete a verification of the Coquitlam Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project (Project) for the period of January 1 to December 31, 2017 (inclusive).

Metro Vancouver is required to report to the Provincial Government annually under the Climate Action Revenue Incentive Program (CARIP) framework as a part of Metro Vancouver's commitment to the Climate Action Charter.

GHD has prepared this Verification Report in accordance with ISO Standard ISO 14064 Greenhouse Gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions (ISO 14064-3) and with the requirements of the British Columbia (B.C.) Green Communities Committee Becoming Carbon Neutral Guidebook.

3. Verification Objective

The objective of the verification is to provide Metro Vancouver, the B.C. Ministry of Environment Climate Action Secretariat, and the B.C. Ministry of Municipal Affairs & Housing with assurance that the Project Reductions emissions report contains no material discrepancy and was prepared in accordance with the verification criteria.

4. Verification Scope

The following sections describe the scope of the Verification.

4.1 Project Emission Sources

The Project emission sources after implementation of the project activities include the following:

- Flaring Combustion Sources
  - Destruction of LFG in an enclosed flare with the upgraded LFG collection system
- Electricity Consumption
- Fossil Fuels Consumption
  - Pilot flaring (Propane for a pilot)

The Facility emission sources prior to implementation of the project included the following:

- Flaring Combustion Sources
  - Destruction of LFG in an enclosed flare with the system before upgrades
- Electricity Consumption
- Fossil Fuels Consumption
  - Pilot flaring (Propane for a pilot)

Following the Guidance Document to the BC Emission Offsets Regulation (November 2010), all electricity generated for use on BC Hydro's centralized electrical grid is considered carbon neutral. The updated guidance (Guide to the B.C. Emission Offsets Regulation, September 2014), does not indicate an emission factor for electricity generation being equivalent to zero. The Project Plan was validated based on the November 2010 Guidance and continues the assumption that electricity generation and consumption is carbon neutral for the 2017 Project Report.

The emissions from fossil fuels consumption are considered to have not changed as a result of the project implementation.

4.2 Geographical and Operational Boundaries

The verification included the reductions from Phase 1 of the Landfill Gas (LFG) Collection System Upgrade which is primarily located on the northern half of Metro Vancouver's Coquitlam Landfill. This facility is a closed landfill on a 33-hectare site, located south of the Trans-Canada Highway, east of the Brunette River, and about 400 meters north of the Fraser River. The site entrance is located at:

1001 United Boulevard,
Coquitlam, BC V3K 7A7

The landfill site currently has a single tenant: Eaglequest Golf Inc. (Eaglequest). Eaglequest operates a golf course on the northern section of the landfill, including a driving range. The southwest section of the Landfill was previously tenanted by Wastech Services Ltd. (Wastech).

4.3 Reduction Emission Sources

The greenhouse gas emission reductions result from methane combustion by flaring.

4.4 Reporting Period

The reporting period is between January 1, 2017 and December 31, 2017.

4.5 Use of this Report

This report has been prepared for the use of Metro Vancouver, the B.C. Ministry of Environment Climate Action Secretariat and the B.C. Ministry of Municipal Affairs & Housing.

5. Verification Standards and Criteria

5.1 Verification Standards

GHD has applied ISO 14064-3 as the standard for this verification.

5.2 Verification Criteria

GHD has applied the following criteria for this verification:

- ISO 14064 Greenhouse Gases - Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals, ISO, March 2006 (ISO 14064-1).
- ISO 14064 Greenhouse Gases - Part 3: Specification with Guidance for the Validation and Verification of Greenhouse Gas Assertions, ISO, March 2006 (ISO 14064-3).
- Becoming Carbon Neutral: a Guidebook for Local Governments in British Columbia, the Green Communities Committee, Version 2, July 2011.
- Approved Consolidated Baseline and Monitoring Methodology ACM0001 "Flaring or Use of Landfill Gas," UNFCCC Clean Development Mechanism, Version 13.0.0.

- Methodological Tool "Emissions from Solid Waste Disposal Sites," UNFCCC Clean Development Mechanism, Version 06.0.1.
- Coquitlam Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Plan, January 4, 2013.

5.3 Level of Assurance

GHD has conducted the verification to a reasonable level of assurance. The verification statement is worded in a manner to meet the requirements set forth in ISO 14064-3.

5.4 Materiality

Quantitative materiality for this verification is set at plus or minus 5 percent of the reported emissions. An individual error, omission, misstatement or the aggregate effect of discrete errors, omissions, or misstatements may be considered material.

6. Verification Plan

GHD developed a Verification Plan including a Sampling Plan based on a preliminary review of the data initially provided. GHD's Verification Plan was revised, as required, throughout the course of the verification to address questions or initial concerns with data originally provided. The Verification Plan is provided in Appendix B.

6.1 Facility Emission Terminology

The Project includes the following main groups used in the emission reduction calculations:

Terminology	Approximate Emissions (tonnes CO_2e)	Calculation Methodology
GHG emission reduction credits	534.9	Follow the methodology from CDM ACM0001, Version 17.0.0 "Flaring or use of landfill gas" Equation: $Offset\ emission = (1 - OX) \times [CH_{4,dest,project} - CH_{4,dest,exisiting}] \times GWP_{CH4}$ Where OX = Fraction of CH_4 in LFG that would be oxidized in the top layer of SWDS, default = 0.1 GWP_{CH4} = 25.

Terminology	Approximate Emissions (tonnes CO_2e)	Calculation Methodology
CO_2 equivalent amount of destroyed CH_4 in the project activities	5,387.7	Follow the methodology from CDM ACM0001, Version 17.0.0 "Flaring or use of land fill gas" Amount of destroyed CH_4 was determined using LFG flow rate to flare and $\%CH_4$ in LFG per the requirements of CDM Methodological tool "Project emissions from flaring" Option A, assumes a default destruction efficiency 98%.
CO_2 equivalent amount of destroyed CH_4 in the existing/baseline system	4,793.3	Following the CDM Methodological Tool "Emissions from solid waste disposal site" Version 07.0 and the methodology in the validated project plan. Assumes the stated manufacturer's CH_4 destruction efficiency of 98%.

6.2 Final Sampling Plan

GHD developed a Sampling Plan based on GHD's review of the verification criteria.

Table 6.1 summarizes the final sampling plan of material sources.

Table 6.1 Sample Plan

Data/Information Description	Data/Information Source	Collection Frequency	Sample Size/Action
Detailed Process Overview	Process flow diagram for the Facility	N/A	N/A
Baseline Emission			
Landfill Gas Measurement	LFG flow rate to destruction equipment (m^3/h)	Continuous (recorded every minute)	All data from verification period.
	CH_4 Fraction in LFG (% by volume)	Continuous (recorded every minute)	All data from verification period.
Data Accuracy	Flow Meter Calibration	Manufacturer recommended	All data from verification period.
	CH_4 Analyzer Calibration	monthly	All data from verification period.
	Calibrated Portable Gas Analyzer	N/A	All data from verification period.
Back up of data acquisition systems	Site Personnel	N/A	Review frequency of data backup and interview site personnel.
Note: 1. Project Emission are considered to be zero.			

7. Verification Schedule

The following details the schedule of GHD's verification, identifying the dates of key tasks and completion of major milestones:

- Contract Award – May 5, 2018
- Site visit – not required for this reporting year as no changes in facility operations, last visited on April 24, 2015
- Request, receive and review documents and raw data from Metro Vancouver – May 6/7, 2018
- Kick off meeting – May 11, 2018
- Submit draft verification plan to Metro Vancouver – May 11, 2018
- Metro Vancouver to provide draft 2017 Reductions Report – May 14, 2018
- Independent Peer Review – May 28, 2018
- Submit draft verification report to Metro Vancouver – May 30, 2018
- Issue final Verification Report and Verification Statement – May 30, 2018

8. Verification Procedures

GHD used the verification procedures detailed in the Verification Plan to assess the following:

1. Accuracy and completeness of annual GHG emissions
2. Uncertainty of external data sources used
3. Emission assumptions
4. Accuracy of emission calculations
5. Potential magnitude of errors and omissions

To sustain a risk-based assessment, the GHD Project Team identified and determined risks related to GHG sink and source emissions during both the desk reviews and the follow-up interviews. The GHD Project Team particularly focused on the accuracy and completeness of provided information. The components of the document review and follow-up interviews are detailed below.

8.1 Methodologies Used to Assess/Verify Emissions Data

- Document Review:
  - Review of data and information to confirm the correctness and completeness of presented information.
  - Cross-checks between information provided in the methodology and information from independent background investigations.
  - Determine sensitivity and magnitude analysis for parameters that may be the largest sources of error.

- Follow-up Interviews:
  - Via email
- Interviews with Facility personnel to:
  - Cross-check information provided
  - Test the correctness of critical formulae and calculations
  - Review data management and recording procedures

The document review shall establish to what degree the presented documentation meets the verification standards and criteria.

The GHD Project Team's document review during the verification process shall comprise, but not be limited to, an evaluation of whether or not:

- The documentation's completeness and comprehensiveness and whether the structure and verification criteria and its associated guidance were followed.
- The monitoring methodologies are justified and appropriate for the specific facility.
- The assumptions for the emission calculation are conservative and appropriate.
- The reporting methodology clearly identifies the frequency of and responsibility and authority for monitoring, measurement, and data recording activities and sufficiently describes quality control/quality assurance/management control procedures.

8.2 Details of Site Visit

There were no changes to the Project operations at the Site from 2015 to 2017, and thus a site visit was not required. The last site visit was completed on April 24, 2015 and there have been no changes to facility operations since this date.

8.3 Assessment of Risk and Magnitude of Potential Errors, Omissions or Misrepresentations

Based on GHD's initial review of the Facility operations, GHD prepared Table 8.1, which summarizes the potential risk and magnitude of potential errors, omissions, or misrepresentations.

Table 8.1 Risk Assessment

Potential Risk Area	Percentage of Emissions (%) and Percent Change Year Over Year	Risk Type (Inherent, Control, Detection)	Risk Level (High, Moderate, Low)	Justification
Conformance of the Project with the Project Plan	N/A	Inherent	Low	If the project quantification methodology deviates from the quantification protocol and the validation, it would result in a non-conformance with the verification criteria.
		Control	Moderate	
		Detection	Low	

Table 8.1 Risk Assessment

Potential Risk Area	Percentage of Emissions (%) and Percent Change Year Over Year	Risk Type (Inherent, Control, Detection)	Risk Level (High, Moderate, Low)	Justification
Conformance with the Quantification Protocol	N/A	Inherent	Moderate	To maintain the low detection risk, GHD reviewed the Project Report against the Project Plan and the Quantification Protocol.
		Control	Moderate	
		Detection	Low	
LFG Flow Rate	100% of total baseline emission (45% reduction in net GHG emission reductions in 2017)	Inherent	Low	The reduction calculation is based on the additional LFG collection efficiency resulting from the implementation of the Project. Collection efficiency is estimated by dividing the measured LFG collected by the modeled generation rate. A dynamic baseline is created by setting the baseline at the collection efficiency prior to project implementation. The LFG flow rate is continuously metered; however the change in flow rate fluctuates more than 5%. Therefore, the Control risk was set at high. The detection risk was medium; therefore, GHD reviewed sample sets of data.
		Control	High	
		Detection	Medium	
CH_4 fraction in LFG		Inherent	Low	Methane fraction in LFG was used for quantifying the total flared methane. The methane fraction by volume was directly measured using the on-Site analyzer. The fluctuations in the methane fraction may exceed 5%; thus, the control risk was set at high. GHD reviewed all methane data and performed a sample recalculation over two days, allowing a medium detection risk.
		Control	High	
		Detection	High	

Note:

1. During the verification, any new risks or material concerns that could potentially lead to errors, omissions and misrepresentations will be identified, reviewed and assessed.

9. Verification Findings

The following subsections provide details of GHD's findings as well as GHD's conclusions.

9.1 Verification Findings

GHD has reviewed the provided documents and did not find any material or immaterial discrepancies. GHD has concluded that the 2017 assertion emission reduction has been compiled consistent with the requirements of verification criteria. GHD has cross-checked the following:

- GHD reviewed the project with the project plan.
- GHD reviewed the quantification methodologies. While, GHD notes that new versions of the quantification methodologies are available. For 2017, Metro Vancouver applied the quantification methodology versions as identified in the validated Project Plan, which is acceptable. The following represent the new quantification methodology versions, which would be applied if the project operations changed significantly and the Project Plan required re-validation:
  - Approved Consolidated Baseline and Monitoring Methodology ACM0001 "Flaring or Use of Landfill Gas," UNFCCC Clean Development Mechanism, Version 17.0.
  - Methodological Tool "Emissions from Solid Waste Disposal Sites," UNFCCC Clean Development Mechanism, Version 07.0.
- GHD recalculated the amount of destroyed CH_4 in the project activities for two dates: February 18, 2017 and October 20, 2017.
- GHD recalculated the sum of daily GHG reductions and compared this with the totals obtained by Metro Vancouver.

9.2 Data Management System and Controls

Metro Vancouver has contracted a third party (SCS Engineers) to operate and monitor the flare station. The monitoring data is transferred into two pathways: primary data pathway and secondary data pathway. The primary data pathway is managed by SCS Engineers. The data from instrumentation is automatically transferred daily to the database via secure network connection and then standard checks of the data are automatically performed. If any issues are flagged, the issues are reviewed by a technical expert. SCS Engineers process and check the data on a monthly basis and provide monthly summary reports to Metro Vancouver. Those monthly summary reports are used for calculating and reporting GHG reductions by Metro Vancouver.

The secondary data pathway is managed by Metro Vancouver. The data from instrumentation is continuously recorded on a memory card (Yokogawa system) on site, and then manually transferred to Metro Vancouver on a monthly basis. The secondary data is used to cross check the primary data from SCS Engineers. All data is archived on a back-up database system at the Metro Vancouver offices.

10. Verification Team

10.1 Roles and Responsibilities

Lead Verifier – Deacon Liddy, P.Eng., MBA - Mr. Liddy led the verification and was responsible for development of the verification plan. Mr. Liddy reviewed the project risk assessment, recalculation of raw data, data management and draft findings. Mr. Liddy prepared and signed the verification statement and verification report.

Verifier – Rowan Crouch, E.I.T. – Mr. Crouch acted as a verifier under the direction of Mr. Liddy and is responsible for assisting with developing and revising the verification plan, and completing the verification calculations. Mr. Crouch assisted with the preparation of the verification statement and verification report.

Peer Reviewer – Anothai Setameteekul, P.Eng. - Ms. Setameteekul conducted a peer review of the verification plan risk assessment and verification report and findings.

10.2 Qualifications

Deacon Liddy, P.Eng., MBA. – Mr. Liddy is a Principal with GHD and an experienced GHG validator and verifier, having completed over 60 GHG validation/verifications. Mr. Liddy has participated in the development of emission reduction projects and additionally assessments under the PERRL and CDM mechanisms in Canada and Brazil respectively. Mr. Liddy has been the lead verifier for completion of greenhouse gas verifications conducted on behalf of Alberta Environment for emission offset projects for landfill gas, biomass, tillage, composting and fuel switching for lumber kilns. Mr. Liddy has completed verifications of greenhouse gas emission intensity baseline applications and annual compliance reports under the Alberta Specified Gas Emitters Regulation. In addition, Mr. Liddy was accredited by the California Air Resource Board as a lead verifier of greenhouse gas inventories and was part of GHD's verification team that completed over 60 verifications in 2010.

Rowan Crouch, E.I.T. – Mr. Crouch is a civil engineer based out of GHD's Vancouver office and has experience in civil construction projects including construction oversight, contract development, and contract administration. Mr. Crouch currently provides operational support for two landfill gas generation facilities, and assists in the management of the maintenance work done at both facilities.

Anothai Setameteekul, M.A.Sc., P.Eng. – Ms. Setameteekul has worked as a Greenhouse Gas Engineer based in GHD's Calgary office. She has been involved in quantifying annual GHG emissions and conducting GHG verifications at industrial facilities, including Oil Sands facilities, Cement Plants, Refinery, Upstream Oil and Gas facilities, Power Plants, and Steel manufacturing. Ms. Setameteekul is familiar with the British Columbia Reporting Regulation, Alberta Specified Gas Emitters Reporting Regulation and Ontario Emissions Reporting Regulation. Ms. Setameteekul is also accredited by the California Air Resource Board as a lead verifier of greenhouse gas emissions for Oil and Gas system and process emissions sectors. Ms. Setameteekul has completed over 50 verifications since 2012.

Ms. Setameteekul graduated with a Master's degree in Industrial System Engineering from the University of Regina. Ms. Setameteekul worked as a research assistant in International Testing

Center for CO_2 Capture (ITC). Her work at ITC was related to CO_2 capture using chemical absorption process. Ms. Setameteekul worked as a process engineer to evaluating process performance such as process efficiency, air emission, liquid effluent, waste, utility consumption, etc. at a carbon capture test facility.

11. Statement of Verification

GHD Limited has undertaken a reasonable assurance engagement of the accompanying Project Report of Metro Vancouver's Coquitlam Landfill Gas Collection System Upgrade Project for the period January 1, 2017 to December 31, 2017, with the asserted emission reduction (or removal enhancement) of 534.9 tonnes CO_2e.

Metro Vancouver's Responsibility for the Project Report

Metro Vancouver is responsible for the preparation of the Project Report in accordance with the:

- Becoming Carbon Neutral: a Guidebook for Local Governments in British Columbia, the Green Communities Committee, Version 2, July 2011.
- *Approved Consolidated Baseline and Monitoring Methodology ACM0001 "Flaring or Use of Landfill Gas," UNFCCC Clean Development Mechanism, Version 13.0.0.*
- *Methodological Tool "Emissions from Solid Waste Disposal Sites," UNFCCC Clean Development Mechanism, Version 06.0.1.*
- Coquitlam Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Plan, January 4, 2013.

This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation of a Project Report that is free from material misstatement, whether due to fraud or error. This responsibility includes the development of the Project Report, which encompasses the collection of data, performance of calculations and presentation of information.

Our Responsibility

Our responsibility is to express an opinion on the Project Report based on the evidence we have obtained. GHD is an eligible verification body meeting the qualification requirements of the verification criteria. We conducted our reasonable assurance engagement in accordance with the International Organization for Standardization (ISO) 14064-3 "Specification with guidance for the validation and verification of greenhouse gas assertions." These standards require that we plan and perform this engagement to obtain reasonable assurance about whether the assertions in the Project Report are materially correct and are a fair and reasonable representation of the project's GHG reduction and there have been no material changes to how the project was carried out compared to the description of the project in the Project Plan.

This engagement has been conducted according to the methodology detailed in the verification report by a team of verifiers described in the cover letter. The verification report includes the techniques and processes used to test the GHG information and associated assertions, along with any additional information used in verification.

Opinion

In our opinion, the greenhouse gas emission reductions and removal enhancements stated in the Project Report for the period to January 1, 2017 to December 31, 2017 (inclusive) are a fair and reasonable representation of the project's GHG reduction in accordance with the verification criteria and Coquitlam Landfill Gas Collection System Upgrade Project Plan January 2013, in all material respects.

This independent reasonable verification statement is intended for Metro Vancouver, the B.C. Ministry of Environment - Climate Action Secretariat, and the B.C. Ministry of Municipal Affairs & Housing.

12. Limitation of Liability

Because of the inherent limitations in any internal control structure, it is possible that fraud, error, or non-compliance with laws and regulations may occur and not be detected. Further, the verification was not designed to detect all weakness or errors in internal controls so far as they relate to the requirements set out above, as the verification has not been performed continuously throughout the period, and the procedures performed on the relevant internal controls were on a test basis. Any projection of the evaluation of control procedures to future periods is subject to the risk that the procedures may become inadequate because of changes in conditions, or that the degree of compliance with them may deteriorate.

The verification opinion expressed in this report has been formed on the above basis.

GHD's review of the Emissions Report claimed included only the information discussed above. While the review included observation of the systems used for determination of the claimed Emissions Report, GHD did not conduct any direct field measurements and has relied on the primary measurement data and records provided by Metro Vancouver as being reliable and accurate. No other information was provided to GHD or incorporated into this review. GHD assumes no responsibility or liability for the information with which it has been provided by others.

The information and opinions rendered in this report are exclusively for use by Metro Vancouver. GHD will not distribute or publish this report without Metro Vancouver's consent except as required by law or court order. The information and opinions expressed in this report are given in response to a limited assignment and should only be evaluated and implemented in connection with that assignment. GHD accepts responsibility for the competent performance of its duties in executing the assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

All of Which is Respectfully Submitted,

GHD

Deacon Liddy, P. Eng. (Lead Verifier)

Rowan Crouch, E.I.T. (Verifier)

Appendices

Appendix A
Coquitlam Landfill Gas Collection System Upgrade Greenhouse Gas Emission Reduction Project Report

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Coquitlam Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Report

2017 Reporting Year

May 28, 2018

This report was prepared by the staff of the Air Quality Policy and Management Division of Metro Vancouver. The project team included Conor Reynolds P.Eng., Francis Ries P.Eng., Ali Ergudenler, P.Eng., Paul Litt P.Eng., and Amy Thai, M.Sc.

Questions on the report should be directed to AQInfo@metrovancouver.org or the Metro Vancouver Information Centre at 604-432-6200.

Contact us:
Metro Vancouver
Air Quality Policy and Management Division
4330 Kingsway, Burnaby, BC V5H 4G8
604-432-6200
www.metrovancouver.org

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

BC	Province of British Columbia
BFS	Blower/Flare Station
˚C	degrees Celsius
CAS	Climate Action Secretariat
CDM	Clean Development Mechanism
Charter	Climate Action Charter
CO2e	carbon dioxide equivalent
CRA	Conestoga-Rovers & Associates
EIA	environmental impact assessment
EOR	Emission Offsets Regulation
GCC	Green Communities Committee
GGRTA	Greenhouse Gas Reduction Targets Act
GHG	greenhouse gas
GVS&DD	Greater Vancouver Sewerage & Drainage District
GWP	global warming potential
h	hour
ha	hectare
HMI	human-machine interface
IPCC SAR	Intergovernmental Panel on Climate Change Second Assessment Report
ISO	International Organization for Standardization
LFG	landfill gas
m	metre
m^3	cubic metre
mm	millimeter
MOE	Ministry of the Environment [British Columbia]
O&M	operations and maintenance
PCT	Pacific Carbon Trust (now the Climate Investment Branch of the CAS)
PLC	programmable logic controller
QA	quality assurance
QC	quality control
scfm	standard cubic feet per minute
SSR	sources, sinks, and reservoirs
UBCM	Union of BC Municipalities

1.0 COMPLIANCE WITH EMISSION OFFSETS REGULATION

1.1 Project Start Date

The first activities of the Project occurred in 2012, with project operations commencing on April 23, 2012.

1.2 Project Plan Statement of Assurance

Metro Vancouver retained Ruby Canyon Engineering (RCE) to conduct a validation of the "Coquitlam Landfill – Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Plan (Jan 4, 2013)" (the "Project Plan"). The Project Plan has been validated in accordance with the BC Green Communities Committee's (GCC) "Becoming Carbon Neutral Guidebook", the Clean Development Mechanism ACM0001 Flaring or use of landfill gas protocol, and the Pacific Carbon Trust (PCT) Draft British Columbia (BC) Landfill Gas Management Protocol. RCE issued its report entitled "Validation Report for Coquitlam Landfill Gas Collection System Upgrade Greenhouse Gas Emissions Reductions Project Plan" on January 4, 2013.

The Validation Statement of Assurance from RCE's report is reproduced in below:

"Ruby Canyon Engineering Inc. (RCE) has been engaged by Metro Vancouver to examine the following assertions relating to Coquitlam Landfill Gas Collection System Upgrade, Greenhouse Gas Emissions Reductions Project Plan, January 4, 2013, prepared by Metro Vancouver.

- *The project start date is after November 29, 2007;*
- *The project is located in British Columbia;*
- *The baseline scenario will result in a conservative estimate of the greenhouse gas (GHG) reduction to be achieved by the Metro Vancouver Coquitlam Landfill Gas Collection System Upgrade (Project);*
- *There are financial, technological or other obstacles to carrying out the Project that are overcome or partially overcome by the incentive of having a GHG reduction recognized as an emission offset under the BC Climate Action Charter Green Communities Committee Carbon Neutral Framework;*
- *The selected sources, sinks and reservoirs will ensure that the total of the emission reduction is an accurate and a conservative estimation of the GHG reduction;*
- *Metro Vancouver has a superior claim of ownership of the resulting reduction to that of any other person.*

RCE confirms through its independent third-party assessment that the Project Plan, including the assertions, data and information, are presented fairly, in all material respects, in accordance with the following validation criteria:

- *ACM0001 v13.0.0: "Flaring or use of landfill gas"*
- *ACM0001 v11: "Consolidated baseline and monitoring methodology for landfill gas project activities"*
- *CDM Tool: "Emissions from solid waste disposal sites v6.0.1"*
- *CDM Tool: "Project emissions from flaring v2.0"*
- *CDM Tool: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream v2.0.0"*
- *PCT Draft BC Landfill Gas Management Protocol*
- *BC's Greenhouse Gas Reduction Targets Act Emission Offsets Regulation*
- *BC Climate Action Charter*
- *Green Communities Committee's "Becoming Carbon Neutral Guidebook"*
- *ISO 14064-3 "Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions"*

The validation activities were conducted in accordance with the principles and requirements of ISO 14064-3 and the Emission Offsets Regulation. RCE is an American National Standards Institute (ANSI)-accredited validation body meeting the requirements in the BC Emission Offsets Regulation. RCE conducted a risk-based analysis of the Project Plan GHG assertions and a strategic review of the Project Plan data and evidence. Based upon the processes and procedures and the evidence collected, RCE concludes with a reasonable level of assurance that the Project Plan, including the assertions in the Project Plan, prepared by Metro Vancouver is presented fairly, in all material respects, in accordance with the validation criteria."

1.3 Validation Period and Baseline Applicability Period

As indicated in RCE's validation report (attached as part of the Project Plan document), the validation period for the project is April 23, 2012 through April 23, 2022. The Baseline Applicability Period covers the same time period.

1.4 Consistency between Project Plan and Project Implementation

Metro Vancouver asserts that the Project implementation is consistent with the project details articulated in the validated Project Plan. Phase 1 of the Project began operations in April 23, 2012, with subsequent project phases not yet implemented as of December 31, 2017.

Project operations between January 1 and December 31, 2017 were consistent with the validated Project Plan in all aspects, with the exception of the adjustment of the Global Warming Potential (GWP) for methane per guidance from the BC Ministry of Environment. This deviation from the plan is detailed below, along with mitigation measures employed in calculating GHG reduction credits for the 2017 crediting period:

1) CH_4 Global Warming Potential - In their "2014 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions", the BC Ministry of Environment indicates that *"Recent updates to British Columbia's GWPs have been made in line with updates by the United Nations Framework Convention on Climate Change and the Canadian Federal Government, to GWPs approved by the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report."* The "2016/17 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions" from the BC Ministry of Environment provides confirm that the new GWPs applied in 2014 continue to be the most recent values. Per guidance from these documents, the methane GWP used in the Project emissions reduction calculations has been modified to 25 starting from 2014. Because the Project baseline is dependent on the tonnage of methane captured and destroyed during the baseline period, no modifications to the Project baseline are required in response to the changed GWP.

2.0 PROJECT DESCRIPTION

2.1 GHG Assertion

This Project Report summarizes activities under the validated Project Plan commencing on January 1, 2017 at Metro Vancouver's Coquitlam Landfill. During the crediting period from January 1 – December 31, 2017, the project activity resulted in a reduction of GHG emissions by the amount of 534.9 tonnes CO_2e.

2.2 Supporting Calculations

2.2.1 Project & Baseline Sources, Sinks and Reservoirs

CDM approved consolidated baseline and monitoring methodology ACM0001, "Flaring or use of landfill gas", version 13.0.0 provides a summary of all SSRs relevant to quantifying baseline and project emissions. Table 1 following is derived from Table 1 in the ACM0001 document, and lists only the relevant sources, as outlined in the validated Project Plan.

Table 1 Identification of "Relevant" Sources, Sinks and Reservoirs

SSR	Controlled ®, Related ® or Affected (A)		Monitored or Estimated	Justification
	Baseline	Project		
Upstream SSRs Before Operation				
None				
Upstream SSRs During operation				
P5 Electricity Usage *(Emissions from on-site electricity use)*	Related	N/A	Monitored (BC Hydro electricity meter for landfill site)	Per ACM0001, may be an important emission source. Only CO_2 emissions are considered; CH_4 and N_2O emissions associated with electricity generation are excluded for simplification, as they are assumed to be very small.
On-site SSRs During Operation				
B1 Waste Decomposition *(Emissions from decomposition of waste at the landfill site)*	Related	N/A	Monitored (gas flows to flare) and Estimated (total LFG generation)	The major source of emissions in the baseline. Only CH_4 emissions are included; N_2O emissions are considered to be negligible (this is conservative), and CO_2 emissions the decomposition of organic waste are not accounted.
P3 Flaring *(On-site fossil fuel consumption due to the project activity other than for electricity generation)*	N/A	Controlled	Monitored (Annual flare pilot propane consumption)	Per ACM0001, may be an important emission source. Only CO_2 emissions are considered; CH_4 and N_2O emissions associated with on-site fossil fuel use are excluded for simplification, as they are assumed to be very small.
Downstream SSRs During Operation				
None				
Downstream After Operation				
None				

Note that the Baseline and Project Sink "Methane Oxidation" is not included in Table 1, "relevant" SSRs. The ACM0001 protocol includes an allowance for Methane Oxidation in the calculation of Waste Decomposition emissions (B1) under the Baseline.

2.2.2 Quantification Methodologies

Quantification methods used to calculate GHG emissions for the Project and Baseline are detailed for each relevant SSR, below. These methods are based on those methods provided in the CDM approved consolidated baseline and monitoring methodology ACM0001, "Flaring or use of landfill gas", version 13.0.0. Subsidiary CDM methodological documents have also been employed, including:

- "Methodological tool: Emissions from solid waste disposal sites" (Version 06.0.1)
- "Project emissions from flaring" (Version 02.0.0),
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0).

Where options are presented in the Protocol or Methodological tool, the project-specific choice is described and justified below. Otherwise, methodologies are simply summarized without restating the justifications provided in the Protocol. All equations provided below are numbered according to the equation numbering utilized in the ACM0001 protocol for easy reference.

Baseline emissions

As indicated in Table 1 above, the only relevant emissions associated with the Baseline condition are those associated with waste decomposition at the landfill site. Because fuel switching / beneficial use of the LFG is considered to be out of project scope, the baseline emissions for the project can be determined according a simplified version of ACM0001 equation (1):

$$BE_y = BE_{CH4,y} \qquad \text{(ACM0001 Eq 1)}$$

Where:

BE_y = Baseline emissions in year y (t CO_2e/yr)
$BE_{CH4,y}$ = Baseline emissions of methane from the Solid Waste Disposal Site (SWDS) in year y (t CO_2e/yr)

Baseline emissions of methane from the SWDS $BE_{CH4,y}$ are determined from ACM0001 equation (2):

$$BE_{CH4,y} = (1- OX_{top\_layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} \qquad \text{(ACM0001 Eq 2)}$$

Where:

$BE_{CH4,y}$ = Baseline emissions of LFG from the SWDS in year y (t CO_2e/yr)
OX_{top_layer} = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless). ACM0001 default value for OX_{top_layer} = 0.1.
$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH_4/yr)
$F_{CH4,BL,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y (t CH_4/yr)
GWP_{CH4} = Global warming potential of CH_4 (t CO_2e/t CH_4). ACM0001 default value for GWP_{CH4}= 25.

Baseline emissions: Project Methane Destruction –Ex Post Determination

During the 2017 crediting period, the amount of methane in the LFG which was flared or otherwise destroyed in the project activity $F_{CH4,PJ,y}$ is determined as the sum of the quantities of methane:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - PE_{flare,y} / GWP_{CH4} \qquad \text{(derived from ACM0001 Eq 3\&4)}$$

Where:

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,sent\_flare,y}$ = Amount of methane in the LFG which is sent to the flare in year y (t CH_4/yr)
$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (t CO_2e/yr)
GWP_{CH4} = Global warming potential of CH_4 (t CO_2e/t CH_4)

Project emissions from flaring $PE_{flare,y}$ are calculated according the following equation from CDM Methodological Tool "Project emissions from flaring" (Version 02.0.0):

$$PE_{flare,y} = GWP_{CH4} \times \Sigma F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$ ("Project emissions from flaring" Eq 15)

Where:

$PE_{flare,y}$ = Project emissions from flaring of the residual gas in year y (tCO_2e)
GWP_{CH4} = Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$ = Mass flow of methane in the residual gas in the minute m (kg)
$\eta_{flare,m}$ = Flare efficiency in minute m

The flare employed in both the Baseline and Project scenarios is an enclosed flare. A flare emissions test was conducted by a 3rd party consultant on December 20, 2017, with results indicating methane destruction efficiency in excess of 99.9%. However, in order to ensure coherence with the validated Project Plan baseline which assumed a flare efficiency of 98% (per manufacturers specification), the "Project emissions from flaring" Option B: "Measured flare efficiency" of $\eta_{flare,m} = 0.98$ is employed in the 2017 project emissions calculation.

Per ACM0001 guidance, the amount of methane in the LFG which is sent to the flare $F_{CH4,sent\_flare,y}$ is calculated using the following equation:

$$F_{CH4,sent\_flare,y} = \Sigma F_{CH4,sent\_flare,h} \times Op_{flare,h}$$ (derived from ACM0001 Step A.1 description)

Where:

h = hour in the year (from 1 to 8760 for which the flow and flare/combustion device operating status are measured.
$F_{CH4,sent\_flare,h}$ = amount of methane in the LFG which is sent to the flare in hour h (t CH_4/h)
$Op_{flare,h}$ = the operating status of the flare in hour h. If the flare operated for any portion of the hour, h=1, else if the flare did not operate for any portion of the hour, h=0.

The amount of methane in the LFG which is sent to the flare in hour h ($F_{CH4,sent\_flare,h}$) is determined using CDM Methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0). The existing flare flow measurement device is a PEI TruTube Flow Meter comprised of a Veris Verabar flow element, 2 Rosemount pressure transducers (1 differential and 1 static) and a temperature sensor, which reports gas flow in standard / normal volumetric units. The temperature of the gas stream is less than 60˚C, so Methodological Tool Option 2A (Volume flow – dry basis) is used to determine $F_{CH4,sent\_flare,h}$.

Baseline emissions: Baseline Methane Destruction

As indicated in the validated Project Plan, because of concerns with the ACM0001 v13 baseline calculation approach, Metro Vancouver have selected the baseline system calculation approach employed in ACM0001

v11, which provides a more conservative and flexible approach that is better suited to this Project case. ACM0001 v11 equations 2, 3, 5 and 7 (Option 2) have been translated to employ ACM0001 v13 variable naming, to produce the following equation:

$$F_{CH4,BL,y} = \varepsilon_{BL} / \varepsilon_{PR,y} \times F_{CH4,PJ,y} = (F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,y} / F_{CH4,y}) \times F_{CH4,PJ,y}$$ (derived from ACM0001 v11 Eq 2, 3, 5,7)

Where:

$F_{CH4,BL,y}$ = Amount of methane in the LFG which would have been captured and destroyed in year y under the baseline system (t CH4/yr)
ε_{BL} = Methane capture and destruction efficiency of the baseline system (fraction)
$\varepsilon_{PR,y}$ = Methane capture and destruction efficiency of the system used in the project activity for year y (fraction)
$F_{CH4,BL,y}$ = Amount of methane in the LFG which would have been captured and destroyed in year y under the baseline system (t CH4/yr)
$F_{CH4,BL,x-1}$ = Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (t CH4/yr)
$F_{CH4,x-1}$ = Estimated amount of methane in the LFG generated in the SWDS in the year prior to the implementation of the project activity (t CH4/yr)
$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is captured in the project activity in year y (t CH4/yr)
$F_{CH4,y}$ = Estimated amount of methane in the LFG generated in the SWDS in project year y (t CH4/yr)

Per ACM0001, CDM Methodological Tool "Emissions from solid waste disposal sites" (v6.0.1) is used to determine both the estimated amount of methane in the LFG generated in the SWDS in the year prior to the implementation of the project activity ($F_{CH4,x-1}$) and the estimated amount of methane in the LFG generated in the SWDS in project year y ($F_{CH4,y}$).

In order to best accommodate the development of this project, which includes development of new LFG capture system in two phases, with 2-3 different steps in capture efficiency expected before full project development, a hybrid of ACM0001 v11 "Step 2: Estimation of the destruction efficiency of the system used in the project activity" Options 1 and 2 is used. Under this approach, the ratio of the baseline capture efficiency to project capture efficiency will be recalculated each year until all project systems have been fully installed, when it will be fixed for the remainder of the project lifetime. Table 2 details the calculation approach, with the equation employed for the 2017 crediting period highlighted in green:

Table 2 Baseline system methane capture equations over the project lifetime

Year	Project Year	$F_{CH4,BL,y}$ Equation
2012	1	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,1} / F_{CH4,1}) \times F_{CH4,PJ,1}$
2013	2	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,2} / F_{CH4,2}) \times F_{CH4,PJ,2}$
2014	3	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,3} / F_{CH4,3}) \times F_{CH4,PJ,3}$
2015	4	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,4} / F_{CH4,4}) \times F_{CH4,PJ,4}$
2016	5	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,5} / F_{CH4,5}) \times F_{CH4,PJ,5}$
2017	6	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,6} / F_{CH4,6}) \times F_{CH4,PJ,6}$
2018 – 2021	7-10	$(F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,7..10} / F_{CH4,7..10}) \times F_{CH4,PJ,7..10}$

Per the validated Project Plan, the two years prior to project startup, 2010 and 2011, represent good operation of the existing (pre-project) LFG capture system. The baseline condition for this project is considered to be the existing landfill gas collection network, existing blower station, and enclosed flare installed in 2011. For the

baseline condition, the system is assumed to have an availability of 95%, and flare is assumed to have a manufacturer's rated destruction efficiency of 98%. Per the validated Project Plan, the baseline system destruction efficiency *($F_{CH4,BL,x-1}$ / $F_{CH4,x-1}$)*, determined as an average of the system destruction efficiencies in 2010 and 2011, is 44.9%.

Project Emissions

As indicated in Table 1 above, the only relevant emissions associated with the Project condition are those associated electricity and fossil fuel consumption due to the project activity. Under ACM0001 v13, Project emissions for a given year (PE_y) are determined as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} \quad \text{(ACM0001 v13 Eq 22)}$$

Where:

PE_y = Project emissions in year y (t CO2/yr)
$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year y (t CO2/yr)
$PE_{FC,y}$ = Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (t CO2/yr)

Per the validated Project Plan, consumption of electricity due to the project activity is expected to represent a very small increment over the electricity that was required to operate the existing system prior project implementation. Further, under guidance associated with the BC Emission Offsets Regulation (Pacific Carbon Trust, 2010, Guidance Document to the BC Emission Offsets Regulation v2.0), "all electricity generated for use on BC Hydro's centralized electrical grid is considered carbon neutral." As such, $PE_{EC,y}$ = 0 for all project years.

Per the validated Project Plan, consumption of fossil fuels due to the project activity is not expected to differ from the consumption of fossil fuels by existing system prior project implementation. Propane gas is used to provide a pilot flame for the flare, and propane required is not expected to increase with project implementation. Further, vehicles powered by fossil fuels are used as part of onsite operations and maintenance, but the amount of fuel consumed onsite is very small, and is not expected to increase significantly under the project scenario. As such, it is assumed that $PE_{FC,y}$ = 0 for all project years.

Emission reductions

Under ACM0001 v13, Project emissions reductions for a given year (ER_y) are determined as follows:

$$ER_y = BE_y - PE_y \quad \text{(ACM0001 v13 Eq 23)}$$

Where:

ER_y = Emission reductions in year y (t CO2e/yr)
BE_y = Baseline emissions in year y (t CO2e/yr)
PE_y = Project emissions in year y (t CO2/yr)

2.2.3 Sample Calculations for 2017 GHG Reduction Crediting Year

Table 3 following provides a monthly summary of the measured flow rate and methane concentration of landfill gas sent to the flare during the 2017 crediting period. Also included are details of the flare operating time. Note that 2017 operations were quite similar to 2016 operations, with slightly higher flare uptime (91.9% vs 91.4%), and slightly lower total flow to flare (220.6 tonnes vs 253.8 tonnes).

Table 3 2017 GHG Reduction Crediting Period Flare Operating Data Summary

	Flare Operating Hours	Flare Uptime Percentage	Average LFG CH_4 Conc.	CH_4 Flow to Flare	CH_4 Emissions from Flare
	$\Sigma Op_{flare,h}$		$v_{i,t,db}$	$\Sigma F_{CH4,sent\_flare,h}$	$PE_{flare,y} / GWP_{CH4}$
	(hours)	%	% CH_4 by vol.	tonnes CH_4	tonnes CH_4
January	682	91.7%	43.1	19.2	0.6
February	543	78.0%	44.3	12.3	0.3
March	592	79.6%	44.0	13.2	0.4
April	609	84.6%	41.1	17.3	0.4
May	671	90.2%	44.0	15.8	0.5
June	694	96.3%	36.9	19.7	0.4
July	724	97.3%	33.9	19.8	0.4
August	744	100.0%	38.0	21.7	0.4
September	720	100.0%	39.6	22.3	0.4
October	653	87.8%	42.6	19.2	0.4
November	701	97.3%	46.9	21.7	0.4
December	740	99.4%	47.5	18.5	0.5
Annual	8072	91.9%	41.7	220.6	5.1

The total methane destroyed under the project condition in the 2017 crediting period can be determined from the total methane flow to the flare and calculated methane emissions from the flare:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - PE_{flare,y} / GWP_{CH4} = \mathbf{220.6 - 5.1 = 215.5}\ \textbf{tonnes } CH_4$$

As indicated the validated Project Plan, the baseline methane destruction efficiency for the LFG capture system was 44.9%, and the expected total LFG methane generation for the 2017 calendar year was estimated to be 426.9 tonnes. The baseline methane destruction for the 2017 crediting period is calculated as follows:

$$F_{CH4,BL,y} = \varepsilon_{BL} / \varepsilon_{PR,y} \times F_{CH4,PJ,y} = (F_{CH4,BL,x-1} / F_{CH4,x-1}) / (F_{CH4,PJ,6} / F_{CH4,6}) \times F_{CH4,PJ,6} =$$
$$\mathbf{0.449 / (215.5 / 426.9) \times 215.5 = 191.7}\ \textbf{tonnes } CH_4$$

Taken together, the project methane destruction and baseline methane destruction during the 2017 crediting period can then be used to determine the 2017 baseline emissions:

$$BE_{CH4,y} = (1- OX_{top\_layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} = \mathbf{(1-0.1) \times (215.5 - 191.7) \times 25 = 534.9\ tonnes\ CO_2e}$$

Finally, the emissions reductions for the 2017 crediting period are calculated as the difference between the baseline emissions for the crediting period, and the project emissions for the crediting period. Project emissions associated with unflared methane have already been adjusted for above, and per the validated Project Plan it is assumed that there are no incremental project emissions associated with project electricity or fossil fuel use. The emissions reductions for the 2017 crediting period are simply:

$$ER_y = BE_y - PE_y = \mathbf{535.5 - 0 = \underline{534.9\ tonnes\ CO_2e}}$$

3.0 EVIDENCE OF OWNERSHIP

Metro Vancouver is the sole owner of the Coquitlam Landfill, and all of landfill gas collection equipment that forms both the baseline and project collection systems. Metro Vancouver asserts that it has exclusive rights to legal and commercial benefits of reductions associated with this GHG reduction project.

4.0 COMPLIANCE ASSERTION

Metro Vancouver asserts that the Project Report for the 2017 GHG reduction crediting period meetings all requirements of the BC Green Communities Committee's (GCC) "Becoming Carbon Neutral Guidebook".

- Project Start Date: April 23, 2012,which is after Metro Vancouver's signing of the Climate Action Charter on November 29, 2007;
- Project Report Period: January 1 – December 31, 2017, which is within the Project's validation and baseline applicability period of April 23, 2012 – April 23, 2022.
- Project Validation: The project plan "Coquitlam Landfill – Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Plan (Jan 4, 2013)" was validated by Ruby Canyon Engineering, as indicated in their report "Validation Report for Coquitlam Landfill Gas Collection System Upgrade Greenhouse Gas Emissions Reductions Project Plan (Jan 4, 2013)".
- Project Completion: Phase 1 of the project has been carried out in accordance with the approved and validated Project Plan. Further project phases have not yet been completed.

4.1 Validated Project Plan

The validated project plan "Coquitlam Landfill – Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Plan (Jan 4, 2013)" is available online[1].

[1] Available at: http://www.metrovancouver.org/services/air-quality/climate-action/our-operations/capturing-landfill-gas/Pages/default.aspx

5.0 REFERENCES AND SUPPORTING DOCUMENTS

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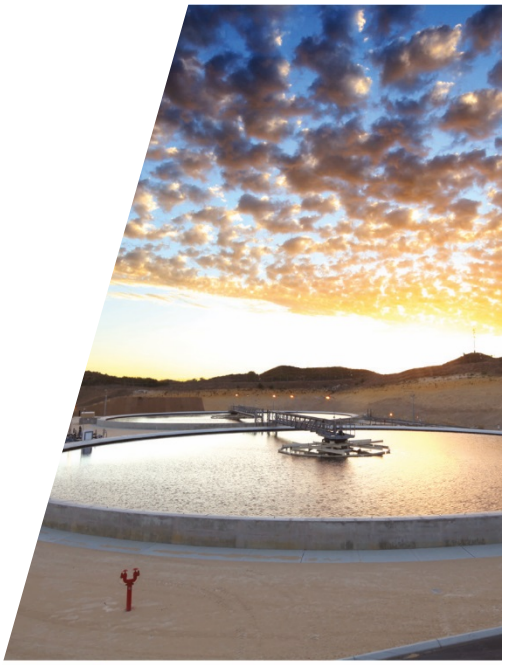
Appendix B
2017 GHG Reduction Credits Verification Plan, Coquitlam Landfill Gas Collection System Upgrade Project



Verification Plan

2017 GHG Reduction Credits Verification
Coquitlam Landfill Gas Collection System
Upgrade Project

Metro Vancouver,
Burnaby, British Columbia

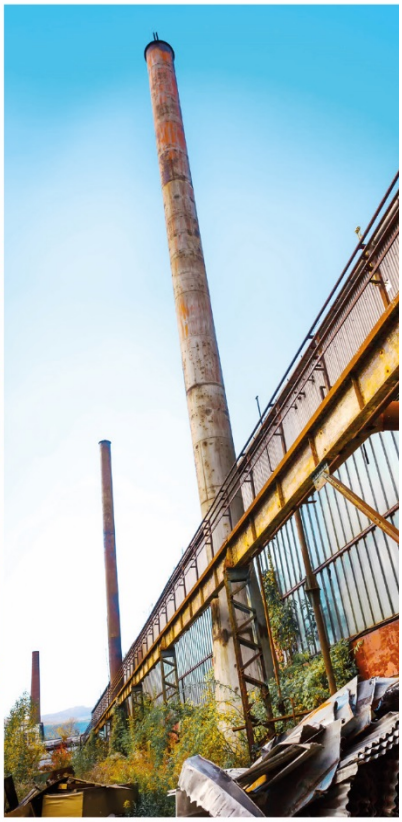


Table of Contents

1. Introduction

Metro Vancouver Regional District (Metro Vancouver) retained GHD Limited to verify the greenhouse gas (GHG) emission reductions (Reductions) generated as a result of the 2017 operations of the project entitled Coquitlam Landfill Gas Collection System Upgrade: GHG Emission Reduction Project (Project) at the Coquitlam Landfill (Site). The 2017 Project Report documents the Reductions resulting from the period from January 1 to December 31, 2017.

Metro Vancouver is required to report to the Provincial Government annually under the Climate Action Revenue Incentive Program (CARIP) framework as a part of Metro Vancouver's commitment to the Climate Action Charter.

The verification procedures required are identified in the Green communities Committee's Becoming Carbon Neutral Guidebook. GHD has prepared this Verification Plan in accordance with ISO Standard ISO 14064 Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions (ISO 14064 3).

2. Verification Objective

The objective of this verification is to provide Metro Vancouver, the BC Ministry of Environment Climate Action Secretariat, and the B.C. Ministry of Municipal Affairs & Housing with assurance that the reported Reductions are free of material misstatements and that the Reductions were developed in conformance with applicable program criteria.

3. Level of Assurance

The verification will be conducted to a reasonable level of assurance. If a verification statement can be provided to a reasonable level of assurance, in accordance with the requirements of ISO 14064-3 "Specification with guidance for the validation and verification of greenhouse gas assertions," GHD will issue the verification statement in a manner similar to "Based on our verification the emissions Reductions presented in the GHG Assertion are presented fairly and are free of material misstatements."

4. Scope

4.1 Facility Emissions Sources

The Facility emission sources after implementation of the project include the following:

- Flaring Combustion Source
  - Destruction of Landfill gas (LFG) in an enclosed flare with the upgraded LFG collection system
- Electricity Consumption

- Fossil Fuels Consumption
  - Pilot flaring (Propane for a pilot flame)

The Facility emission sources prior to implementation of the project included the following:

- Landfill Gas Venting Sources
  - Destruction of LFG by flaring with the system before upgrades
- Electricity Consumption
- Fossil Fuel Consumption
  - Pilot flaring (Propane for a pilot flame)

Following the Guidance Document to the BC Emission Offsets Regulation (November 2010), all electricity generated for use on BC Hydro's centralized electrical grid is considered carbon neutral. The updated guidance (Guide to the B.C. Emission Offsets Regulation, September 2014), does not have any indication in regards to the emission factor for electricity generation being equivalent to zero. The Project Plan was validated based on the November 2010 Guidance and continues the assumption that electricity generation and consumption is carbon neutral for the 2017 Project Report.

The emissions from fossil fuel consumption are considered to have not changed as a result of the project implementation.

4.2 Geographical and Operational Boundaries

The verification will include the Reductions from Phase 1 of the Landfill Gas (LFG) Collection System Upgrade which is located primarily on the northern half of the Coquitlam Landfill. This facility is a closed landfill on a 33-hectare site, located south of the Trans-Canada Highway, east of the Brunette River, and about 400 metres north of the Fraser River.

The site entrance is located at:

1001 United Boulevard
Coquitlam, British Columbia V3K 7A7

The landfill site currently has a single tenant: Eaglequest Golf Inc. (Eaglequest). Eaglequest operates a golf course on the northern section of the landfill, including a driving range. The southwest section of the Landfill was previously tenanted by Wastech Services Ltd. (Wastech).

4.3 Emission Reduction Sources

The greenhouse gas emission reductions result from methane combustion by flaring.

4.4 Reporting Period

The reporting period is between January 1, 2017 and December 31, 2017.

4.5 Use of this Report

This report has been prepared for the use of Metro Vancouver, the BC Ministry of Environment Climate Action Secretariat, and the B.C. Ministry of Municipal Affairs & Housing.

5. Verification Standards

For this verification, GHD will apply ISO 14064-3 as the verification standard.

6. Verification Criteria

For this verification, GHD will apply the following verification criteria:

- ISO 14064 Greenhouse gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals, ISO, March 2006 (ISO 14064-1).
- ISO 14064 Greenhouse gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions, ISO, March 2006 (ISO 14064-3).
- Approved Consolidated Baseline and Monitoring Methodology ACM0001 "Flaring or Use of Landfill Gas," UNFCCC Clean Development Mechanism, Version 13.0.0.
- Methodological Tool "Emissions from Solid Waste Disposal Sites," UNFCCC Clean Development Mechanism, Version 06.0.1.
- Coquitlam Landfill Gas Collection System Upgrade: Greenhouse Gas Emission Reduction Project Plan, January 4, 2013.

7. Verification Schedule

The following presents a verification schedule:

- Contract Award – May 5, 2018
- Kick off meeting – May 11, 2018
- Request, receive and review documents and raw data from Metro Vancouver – May 6/7, 2018
- Metro Vancouver to provide draft 2017 Reductions Report – May 6/7, 2018
- Submit draft verification plan to Metro Vancouver – May 11, 2018
- Independent Peer Review – May 15, 2018
- Submit draft verification report to Metro Vancouver – May 15, 2018
- Issue final Verification Report and Verification Statement – May 18, 2018

8. Verification Team

8.1 Roles and Responsibilities

Lead Verifier – Deacon Liddy, MBA, P.Eng. – Mr. Liddy will lead the verification and is responsible for development of the verification plan. Mr. Liddy will develop the risk assessment, complete the recalculation of raw data, data management and draft findings. Mr. Liddy will prepare and sign the verification statement and verification report.

Verifier – Rowan Crouch, E.I.T. – Mr. Crouch will act as a verifier under the direction of Mr. Liddy and is responsible for assisting with developing and revising the verification plan, and completing the verification calculations. Mr. Crouch will assist with the preparation of the verification statement and verification report.

Project Peer Reviewer – Anothai Setameteekul, M.A.Sc., P.Eng. – Ms. Setameteekul will conduct a peer review of the draft verification report.

8.2 Qualifications

Deacon Liddy, MBA, P.Eng. – Mr. Liddy is an Associate with GHD and an experienced GHG validator and verifier, having completed over 60 GHG validation/verifications. Mr. Liddy has participated in the development of emission reduction projects and additionally assessments under the PERRL and CDM mechanisms in Canada and Brazil respectively. Mr. Liddy has been the lead verifier for completion of greenhouse gas verifications conducted on behalf of Alberta Environment for emission offset projects for landfill gas, biomass, tillage, composting and fuel switching for lumber kilns. Mr. Liddy has completed verifications of greenhouse gas emission intensity baseline applications and annual compliance reports under the Alberta Specified Gas Emitters Regulation. In addition, Mr. Liddy was accredited by the California Air Resource Board as a lead verifier of greenhouse gas inventories and was part of GHD's verification team that completed over 60 verifications since 2010.

Rowan Crouch, E.I.T. – Mr. Crouch is a civil engineer based out of GHD's Vancouver office and has experience in civil construction projects including construction oversight, contract development, and contract administration. Mr. Crouch currently provides operational support for two landfill gas generation facilities, and assists in the management of the maintenance work completed at both facilities.

Anothai Setameteekul, M.A.Sc., P.Eng. – Ms. Setameteekul has worked as a Greenhouse Gas Engineer based in GHD's Calgary office. She has been involved in quantifying annual GHG emissions and conducting GHG verifications at industrial facilities, including Oil Sands facilities, Cement Plants, Refinery, Upstream Oil and Gas facilities, Power Plants, and Steel manufacturing. Ms. Setameteekul is familiar with the British Columbia Reporting Regulation, Alberta Specified Gas Emitters Reporting Regulation and Ontario Emissions Reporting Regulation. Ms. Setameteekul is also accredited by the California Air Resource Board as a lead verifier of greenhouse gas emissions for Oil and Gas system and process emissions sectors. Ms. Setameteekul has completed over 50 verifications since 2012.

Ms. Setameteekul graduated with a Masters degree in Industrial System Engineering from the University of Regina. Ms. Setameteekul worked as a research assistant in International Testing Center for CO_2 Capture (ITC). Her work at ITC was related to CO_2 capture using chemical absorption process. Ms. Setameteekul worked as a process engineer to evaluating process performance such as process efficiency, air emission, liquid effluent, waste, utility consumption, etc. at a carbon capture test facility.

9. Assessment of Risk and Magnitude of Potential Errors, Omissions or Misrepresentations

Based on GHD's initial review of the Project operations, Table 9.1 summarizes the potential risk and magnitude of potential errors, omissions or misrepresentations, as currently known.

Table 9.1 Risk Assessment

Potential Risk Area	Percentage of Emissions (%) and Percent Change Year Over Year	Risk Type (Inherent, Control, Detection)	Risk Level (High, Moderate, Low)	Justification
Conformance of the Project with the Project Plan	N/A	Inherent	Low	If the project quantification methodology deviates from the quantification protocol and the validation, it would result in a non-conformance with the verification criteria. To maintain the low detection risk, GHD reviewed the Project Report against the Project Plan and the Quantification Protocol.
		Control	Moderate	
		Detection	Low	
Conformance with the Quantification Protocol	N/A	Inherent	Moderate	
		Control	Moderate	
		Detection	Low	
LFG Flow Rate	100% of total baseline emission	Inherent	Low	The reduction calculation is based on the additional LFG collection efficiency resulting from the implementation of the Project. Collection efficiency is estimated by dividing the measured LFG collected by the modeled generation rate. A dynamic baseline is created by setting the baseline at the collection efficiency prior to project implementation. The LFG flow rate is continuously
		Control	High	

Table 9.1 Risk Assessment

Potential Risk Area	Percentage of Emissions (%) and Percent Change Year Over Year	Risk Type (Inherent, Control, Detection)	Risk Level (High, Moderate, Low)	Justification
		Detection	Medium	metered; however the change in flow rate fluctuates more than 5%. Therefore, the Control risk was set at high. The detection risk was medium; therefore, GHD reviewed sample sets of data.
CH_4 fraction in LFG		Inherent	Low	Methane fraction in LFG was used for quantifying the total flared methane. The methane fraction by volume was directly measured using the on-Site analyzer. The fluctuations in the methane fraction may exceed 5%; thus, the control risk was set at high. GHD reviewed all methane data and performed a sample recalculation over two days, allowing a medium detection risk.
		Control	High	
		Detection	High	

Note:

1. During the verification, any new risks or material concerns that could potentially lead to errors, omissions and misrepresentations will be identified, reviewed and assessed.

During the review, any new risks or material concerns that could potentially lead to errors, omissions and misrepresentations will be identified, reviewed and assessed.

10. Sampling Plan

GHD developed a Sampling Plan based on GHD's review of the verification criteria. GHD's Sampling Plans are dynamic and the Sampling Plan was revised, as required, throughout the course of the verification.

Table 10.1 summarizes the final sampling plan of material sources.

Table 10.1 Sample Plan

Data/Information Description	Data/Information Source	Collection Frequency	Sample Size/Action
Detailed Process Overview	Process flow diagram for the Facility	N/A	N/A
Baseline Emission			
Landfill Gas Measurement	LFG flow rate to destruction equipment (m^3/h)	Continuous (recorded every minute)	All data from verification period.
	CH_4 Fraction in LFG (% by volume)	Continuous (recorded every minute)	All data from verification period.
Data Accuracy	Flow Meter Calibration	Manufacturer recommended	All data from verification period.
	CH_4 Analyzer Calibration	monthly	All data from verification period.
	Calibrated Portable Gas Analyzer	N/A	All data from verification period.
Back up of data acquisition systems	Site Personnel	N/A	Review frequency of data backup and interview site personnel.

Note:
1. Project Emission is considered as zero.

11. Quantitative Testing

GHD will recalculate the values identified above using raw data whenever possible and assess against any relevant verification criteria. Where engineering estimates have been implemented, GHD will recalculate the engineering estimates and evaluate whether the estimate methodology is reasonable. The verification quantitative testing will be conducted in accordance with the requirements of ISO 14064-3, Sections 4.6, and 4.7.

In addition to quantitative testing, GHD will also conduct qualitative testing including of Metro Vancouver's GHG information systems and its controls, in accordance with the requirements of ISO 14064-3, Section 4.5.

12. Materiality Level

Quantitative materiality for this verification is set at plus or minus 5 percent of the total reductions reported in the Project Report. In addition, a series of discrete errors, omissions or misrepresentations, or individual or a series of qualitative factors, when aggregated, may be considered material.

13. Verification Procedures

The procedures used in this verification will be used to assess the following:

1. Accuracy and completeness of Project Report
2. Uncertainty of external data sources used
3. Emission assumptions
4. Accuracy of emission calculations
5. Potential magnitude of errors and omissions

To sustain a risk-based assessment, the GHD Project Team will identify and determine risks related to GHG emission reductions during both the reviews and interviews. The GHD Project Team will particularly focus on the accuracy of provided information and the credibility of the data provided. The components of the document review and follow-up interviews are:

- Document Review:
  - Review of data and information to confirm the correctness and completeness of presented information.
  - Cross-checks between information provided in the Reductions Report and information from independent background investigations.
  - Determine sensitivity and magnitude analysis for parameters that may be the largest sources of error.
  - Comparison of Reductions from 2017 with Reductions from previous reporting year(s).
- Follow-up Interviews:
  - Via telephone
  - Via email

The document review shall establish to what degree the presented project documentation meets the verification standards and criteria.

The GHD Project Team's document review during the verification process shall comprise, but not be limited to, an evaluation of whether or not:

- The documentation is complete and comprehensive and follows the structure and criteria given in the relevant protocol.
- Monitoring methodologies are justified and appropriate for the specific project.

- The assumptions for the baseline remain valid for the project condition.
- The assumptions behind the inventory are conservative and appropriate.
- The calculation of reductions is appropriate and uses conservative assumptions for estimating reductions.
- The GHG information system and its controls are sufficiently robust to minimize the potential for errors, omissions, or misrepresentations.

The GHD Project Team will interview Facility personnel to:

- Cross-check information provided
- Test the correctness of critical formulae and calculations
- Review data management and recording procedures

GHD will request the following documents:

- Coquitlam Landfill Gas Collection System Upgrade – GHG Emission Reduction Project Plan (with Validation Report) if there any changes or update beside the version dated January 4, 2013.
- Coquitlam Landfill Gas Collection System Upgrade – GHG Emission Reduction Project Report period from January 1 to December 31, 2017.
- Calculation spreadsheet
- Raw data that is used in the calculations
- 2017 Annual Coquitlam Landfill Gas Collection System O&M Report
- Equipment Manual/Calibrations during the verification period:
  - Gas analysis manual
  - Pressure Transmitter
  - LFG flow calculation
  - Pressure Transmitter Calibration

14. Closure

The Verification Plan is considered to be a dynamic document that will require modification and adaptation to project conditions as encountered during the completion of the Verification process. GHD will communicate the changes to the verification plan with Metro Vancouver throughout the verification process.

All of Which is Respectfully Submitted,
GHD

Deacon Liddy, P.Eng., MBA

Rowan Crouch, E.I.T.

about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

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