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GREENHOUSE GAS PROJECT VERIFICATION STATEMENT AND TECHNICAL REPORT

BNQ CLIENT N^o: 41116-1

VERIFIED PROJECT:

HIGHWAY 101 LANDFILL GAS CAPTURE PROJECT – YEAR 2008

PRESENTED TO:

HALIFAX RENEWABLE ENERGY CORPORATION

PREPARED BY:

Charles Landry and Hélène Lahaie

GREENHOUSE GAS PROJECT VERIFICATION STATEMENT AND TECHNICAL REPORT
Client N°: 41116-1 – Verified Organization: HALIFAX RENEWABLE ENERGY CORPORATION
HIGHWAY 101 LANDFILL GAS CAPTURE PROJECT – YEAR 2008

The GHG Emission Reduction Project submitted for verification was represented by:

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Verification Statement and Technical Report written by:



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in collaboration with
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2010-04-16

Date

Verification Statement and Technical Report reviewed by:



Isabelle Landry, GHG Program Manager

2010-04-16

Date

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1. PROJECT SCOPE, OBJECTIVES, CRITERIA, ASSURANCE LEVEL AND MATERIALITY

1.1 Project Quantification Report Title

Greenhouse Gas Quantification 2008, Highway 101 Landfill Gas Capture Project, prepared March 12th, 2010, by 3P Analysis and Consulting.

The Project Report was presented, together with a Project Plan, entitled Greenhouse Gas Project Plan, Highway 101 Landfill Gas Capture Project, prepared by 3P Analysis and Consulting, and a Calculator (LFG Calculator 2008V10.xls).

The BNQ considers the Project Plan and the Calculator as an integral part of the Project Report. The project documents are presented together in **Annex 1** of this Verification Statement.

1.2 Project Scope and Period Covered

The greenhouse gas emission reduction project consists of landfill gas collection, treatment, combustion and electricity conversion, at the Highway 101, Sackville sanitary landfill (also called Mount Uniacke sanitary landfill), Nova Scotia, Canada.

LATITUDE: +44° 48' 40.18"

LONGITUDE: -63° 46' 32.90"

The project scope includes all sources involved in the following activities:

- Capture of the landfill gas (LFG) from waste decomposition (containing carbon dioxide (CO₂) and methane (CH₄));
- LFG treatment;
- Electricity produced from the LFG combustion;
- Project equipment and building maintenance;
- Electricity consumption from the grid (lighting only);
- Construction activities.

However, the following activities are not included in the project scope:

- Site activities related to the leachate treatment (Halifax Regional Municipality's responsibility);
- CO₂ from the waste decomposition (considered biogenic as per the Alberta methodology¹ and other industry-related project protocols).

No sinks or reservoirs were identified in the project scope.

The reporting period for which the Verification Statement was produced covers from January 1st, 2008 to December 31st, 2008.

1 Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion, September 2007, Alberta Environment, p.1.

1.3 Verification Objectives

The objective of the verification was to assess the GHG assertion against ISO 14064-3 requirements in order to produce a Verification Statement based on general principles including completeness, transparency, conservativeness, accuracy, consistency and relevance, with a level of assurance that is reasonable. Those principles are stated in ISO 14064-2.

1.4 Program and Verification Criteria

The Highway 101 Landfill Gas Capture Project does not participate in any GHG program. The verification criteria used for verification purposes were as follows:

- ISO 14064-3: 2006 – Specification with guidance for the validation and verification of greenhouse gas assertions;
- ISO 14064-2: 2006 - Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements;
- Emission Reduction Benefits (ERB) Supply Agreement, Agreement between Highland Energy Inc. and Nova Scotia Power Incorporated (NSPI), reached on September 23rd, 2005, Nova Scotia.

1.5 Level of Assurance

The agreed level of assurance was reasonable.

1.6 Concept of Materiality

Quantitative material discrepancy was set at 5% of the total emission reductions and 5% per source. This level of materiality was established in order to support a reasonable level of assurance.

Qualitative material discrepancy includes significant omissions, misrepresentations or lack of collaboration.

With regard to the intention behind the use of this concept, the following note from ISO 14064-3:2006 standard, section 2.29 is explicit: "...The concept of materiality is used to identify information that, if omitted or misstated, would significantly misrepresent a GHG assertion to intended users, thereby influencing their conclusions. Acceptable materiality is determined by the validator, verifier or GHG program based on the agreed level of assurance..."

2. VERIFICATION TEAM

The verification process was performed by the following BNQ team members:

Hélène Lahaie, On-Site GHG Verifier;

Charles Landry, GHG Lead Verifier;

Isabelle Landry, GHG Program Manager;

Nicolas Turgeon, GHG Expert.

3. PROJECT AND ORGANIZATION OF INFORMATION

The Highway 101 landfill project scenario under verification consists of the capture of landfill gas (LFG), its treatment, combustion and conversion into electricity delivered to the Nova Scotia Power Inc. (NSPI) grid. The GHG related to the emission reductions was mainly methane (CH₄) originating from the decomposition of sanitary wastes. Wastes were deposited by the Halifax Regional Municipality in the landfill during the years from 1976 through 1997.

Before closure of the landfill to solid waste disposal, in 1995, a flare and gas wells were installed for odour control. Issues concerning leachate distribution and the material used as daily cover reduced the efficiency of the large diameter gas wells. The use of the gas system deteriorated until it was no longer operational in 2001.

In light of the above, a new LFG capture system was implemented in 2006 and the current electricity production started on November 1st of the same year. For project purposes, some new equipment was installed, including blowers, compressors, chiller heat exchanger, knock out tank, filters and combustion engines coupled with generators. Existing buildings were used for operational and management activities.

3.1 Baseline Scenario

Below is the description of the baseline scenario as presented in the Project Report:

“...The baseline condition represents the emissions of GHGs from waste decomposition in a landfill that would have been released to the atmosphere without LFG capture and combustion under controlled conditions. The baseline condition is thus dependent on the volume of LFG captured and combusted, and not on the size, waste composition, operational method or other characteristics of the project landfill...”

3.2 GHG Types, Emission Sources, Sinks and Reservoirs

Methane (CH₄) from waste decomposition was the main greenhouse gas (GHG) involved in the project. Other sources, such as construction activities, electrical power from the grid used (for lighting only), fuel for one pick-up truck (approximately 100 litres of fuel per month) are considered negligible by the project proponent. All operational equipment uses the electricity generated from the combustion of the CH₄ captured on-site.

Carbon dioxide (CO₂) from the waste decomposition and from the CH₄ combustion was considered a biogenic source as per the Alberta methodology² and other industry-related project protocols.

No sinks or reservoirs were identified.

2 Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion, September 2007, Alberta Environment, p.1.

3.3 Verified Data and Information

Here are the main data and information verified by the BNQ:

1) Greenhouse gas information management system:

- Monitoring data (gas flow, gas concentration and engine data);
- Maintenance schedule and calibration evidence.

2) GHG data:

- Integrated daily CH₄ volume data from the flowmeter (LFG flow) and the gas analyser (% of CH₄ in the LFG);
- Delivered electricity measured by the NSPI (kW/h).

3) Visual observations of wells and flare (flare is existent but was not in service during the on-site visit).

4) Landfill gas collection system design plan.

5) Requirements and constraints from the following agreements:

- Emission Reduction Benefits (ERB) Supply Agreement, Agreement between Highland Energy Inc. and Nova Scotia Power Incorporated, reached on September 23rd, 2005, Nova Scotia.
- Emission Reduction Benefits (ERB) Measurement, Verification and Claim Reporting Protocol for the Capture and Utilisation of Landfill Gas at the Mount Uniacke Landfill, Halifax, Nova-Scotia – ERB Supplier: Highland Energy Inc., June 2005.
- Sackville Project Agreement, Agreement between Halifax Regional Municipality and Highland Energy Inc., October 16th, 2002, Nova Scotia.
- Power Purchase Agreement for Renewable Energy, Agreement between Highland Energy and Nova Scotia Power Inc., December 8th, 2004, Nova Scotia.

6) Relevant legal requirements:

- **Solid Waste-Resource Management Regulations** made under Section 102 of the *Environment Act* S.N.S. 1994-95, c. 1, O.I.C. 96-79 (February 6, 1996), Nova Scotia (N.S.) Reg. 25/96, as amended up to O.I.C. 2007-102 (February 22, 2007), N.S. Reg. 61/2007.
- **Municipal Solid Waste Landfill Guidelines**, Nova Scotia Environment and Labour, October 24th, 1997, latest rev. Nov. 10, 2004.

3.4 Greenhouse Gas Assertion Description

The Greenhouse Gas assertion, found below, was taken from the Project Report:

"The project has adhered to the previously established measurement plan and has achieved **44,802** tonnes of CO₂ equivalent reductions for the period from January 1st, 2008 to December 31st, 2008."

4. CONTEXT AND VERIFICATION ACTIVITIES

4.1 Preliminary Assessment and Required Action Requests (RARs)

A preliminary assessment report was issued and transmitted on November 5th, 2009, with the following results.

Preliminary Assessment Summary

Required actions requests (RARs):	6
Clarification requests:	4
Elements to be revised – Format or terminology:	1

4.2 On-Site Visit Preparation

The following activities took place to prepare for the on-site visit:

- Project documentation review;
- Legal requirements review;
- Consultation of the industry status in the National Inventory Report, Greenhouse Gas Sources and Sinks in Canada, 1990-2007, Environment Canada, April 2009;
- Landfill Gas Emission Reduction Methodologies consultation:
 - United Nations Framework Convention on Climate Change (UNFCCC), Approved consolidated baseline methodology, Clean Development Mechanism (CDM), ACM0001, v.11;
 - Chicago Climate Exchange (CCX), Landfill Methane Collection and Combustion, Offset Project Protocol, 2009/8/20;
 - Alberta Environment, Quantification Protocol for Landfill Gas Capture and Combustion, sept.2007;
- Landfill Gas Technical Expert consultation.

4.3 Sampling Plan and Verification Plan

The Sampling Plan preparation was based by consulting the monitoring plans in the following methodologies:

- UNFCCC, Approved consolidated baseline methodology, CDM, ACM0001, v.11;
- CCX, Landfill Methane Collection and Combustion, Offset Project Protocol, 2009/8/20;
- Alberta Environment, Quantification Protocol for Landfill Gas Capture and Combustion, sep.2007;

The Verification Plan, version 2, was issued and transmitted to the project proponent on November 10th, 2009.

4.4 On-Site Verification and Required Action Requests

The on-site visit, made on November 12th, 2009, allowed data gathering to verify the GHG assertion in terms of:

- Monitoring and calibration:
 - Commissioning reports for the flowmeter and analyser (April 4th, 2008);
 - Log book for operations;
 - Nova Scotia Power Inc. (NSPI) invoices and meter information;
 - Maintenance schedule for engines;
 - Collected data based on the Sampling Plan.

- GHG information for quantification corroboration:
 - NSPI invoices and meter information;
 - Integrated daily CH₄ volume data from both flowmeter and gas analyser;
 - Electricity produced by the project.

The on-site visit generated two RARs.

4.5 BNQ Data Integration

After the data-gathering visit, monitoring data were assessed and corroborations were developed by the BNQ. These verification activities generated three other RARs.

4.6 Required Action Request (RAR) Status and Project Verification Progress Report

On March 8th, 2010, the BNQ produced a progress report to summarize the background of this verification mandate and report on the proponent's progress in resolving the required action requests (RARs) and any clarification requests raised by the BNQ with regard to the Quantification Report, Project Plan and Project Calculator. That report, which details all the RARs and clarification requests raised by the BNQ, is presented in **Annex 2** of this Verification Statement.

In the report in question, the BNQ summarized all discrepancies to be resolved with regard to the main principles of ISO 14064-2:2006 and in relation to the spirit and intention of the ERB Agreement binding the project proponent to Nova Scotia Power Inc. (NSPI). On March 12th, 2010, the project proponent provided responses to all the RARs and clarification requests that had not yet been resolved. The treatment of the corrections proposed by the project proponent to resolve the four RARs that were still open as of March 8th, 2010, is presented in **Annex 3** of this Verification Statement.

In brief, the BNQ raised 15 RARs and 13 clarification requests in the framework of this verification mandate. The project proponent resolved 14 of the 15 RARs and responded to all the clarification requests. The only RAR not resolved by the project proponent concerns missing raw data (raw LFG flows and raw CH₄ concentrations). That unresolved RAR is treated in greater detail in section 5.1 of this Verification Statement.

4.7 BNQ Corroborations

Five different types of corroborations were performed by the BNQ to verify whether the project proponent's GHG project was plausible:

- The total GHG reduction stemming from the CH₄ combustion into CO₂ from the electricity generated by the 2008 project using the US-EPA calculator considering a degree of tolerance in the order of +/- 10% (by Charles Landry from the BNQ).
- Agreement between the project proponent's statement with regard to the electricity generated by the project (see LFG Calculator 2008V10.xls) and the sum of the monthly invoices and meters for the electricity purchased by the NSPI (by H  l  ne Lahaie from the BNQ).
- The potential and nominal capacity of the project generators (using the technical specification sheet) in relation to the electricity produced by the project. That corroboration aimed at verifying that the electricity produced by the project was not overestimated (by H  l  ne Lahaie from the BNQ).
- The total LFG volumes captured by the project compared with the potential volume estimated in the framework of an economic feasibility study conducted by Environment Canada in 1996. That corroboration aimed at verifying that the LFG volumes reported were not overestimated (by H  l  ne Lahaie from the BNQ).
- The electricity generated by the project (taken from "DI.ANE's electronic logging system records data") compared to the monthly invoices and meters for the electricity purchased by the NSPI (by H  l  ne Lahaie from BNQ).

4.8 Verification Statement Preparation

To summarize, the preparation of this Verification Statement was based on the following information sources:

- Preliminary assessment results;
- Observations obtained from the on-site visit;
- Last version of the Project Report (Greenhouse Gas Quantification 2008, Highway 101 Landfill Gas Capture Project, Prepared March 12th, 2009, including the Project Plan and the LFG Calculator);
- BNQ corroborations;
- Final status of any RARs or clarification requests raised by the BNQ (see Annex 2 and Annex 3 of this Verification Statement).

5. VERIFICATION RESULTS

5.1 Relevance and Sufficiency of Pieces of Evidence Supporting the GHG Verification Statement

The raw data relating to the production of electricity generated by the project were measured by the NSPI, which had no interest in overestimating those values since it is that company that purchases the electricity and is in charge of maintaining and calibrating the meter equipment for the electricity generated. The data are relevant and sufficient.

It was not possible to obtain the raw data measurements of the LFG flows and CH₄ concentrations in the LFG for this project as verified. In most quantification protocols specific to this type of project, those raw data are considered essential.

One RAR was raised by the BNQ in an attempt to obtain the raw data in question from the project proponent. To date, the proponent has only provided integrated data to the BNQ, i.e. the daily CH₄ volumes that were in fact the result of the LFG flows multiplied by its CH₄ concentration on a 24-hour basis. The project proponent was never able to extract and provide separate raw data pertaining to the LFG flows and CH₄ concentrations from its databank.

In order to clarify this situation, a phone interview was conducted with Marc Arsenault, Senior Automation Specialist, CBCL Limited Consulting Engineers. Mr. Arsenault had programmed and installed the totaliser that integrates the LFG flows measured by the flowmeter and the CH₄ concentrations measured by the gas analyser. Here is the basic information received from Mr. Arsenault:

" ...

- The totaliser totals the CH₄ volumes every second by integrating the LFG flows and the CH₄ concentrations that are measured every second.
- Every day, at midnight, the totaliser transfers the following information into the project proponent's databank:
 - Total CH₄ volume for the past 24 hours;
 - CH₄ concentration measured in the LFG at midnight;
 - Oxygen (O₂) concentration measured in the LFG at midnight;
 - Date of the records.
- The project proponent's databank currently makes it possible to extract only the integrated data but not the raw data.
- By connecting a portable computer to the project proponent's databank, it is possible to transfer the integrated data from the databank to an Excel worksheet."

The Excel file of the GHG project calculations provided by the project proponent (the "LFG Calculator 2008 V10.xls") presents the integrated data per 24 hours for the 2008 year. These are the only activity data that the BNQ had on hand to verify the gases concerned by this project (LFG and CH₄).

For the above-mentioned reasons, the RAR raised about this matter was not completely resolved by the project proponent. However, the BNQ was able to reassure itself as to the credibility of the project proponent's GHG assertion. Six corroborations performed by the BNQ made it possible to estimate that the GHG emission reductions reported by the project proponent were plausible.

5.2 Quantification Methodology and Relevant GHG and Source Selection

The quantification of the emission reductions was completed with two different methodologies for two different periods as follows:

The Chicago Climate Exchange Inc (CCX) Methodology

Period: January 1st, 2008 to March 31st, 2008

- Methodology used: Chicago Climate Exchange, Landfill Methane Collection and Combustion Offset Project Protocol, 2009/8/20, Chicago Climate Exchange Inc (CCX).

The CCX methodology estimates the CH₄ emission reductions based on the electricity produced. The electricity produced by the project is measured historical data. That information is adequate for the purposes of this verification.

The project proponent slightly modified the calculation method, however, in relation to that of the CCX. The "Lower Heat Value" (LHV) of the CH₄ of 918.35 Btu/ft³ was used rather than the "Higher Heat Value" (HHV) of the CH₄ of 1012 Btu/ft³ recommended in the CCX protocol. Selecting that value tended to create an overestimate in the order of 9% in the emission reductions for the 3 months during which that method was used (January, February and March 2008). The discrepancy represents an overestimate in the reductions in the order of 2% for all reductions reported (3 months at 9% discrepancy divided by 12 months). The quantitative material discrepancy was set at 5% of the total emission reductions and 5% per source. The material discrepancy threshold was therefore not exceeded although the project proponent's estimate was less conservative than would have been expected.

The Alberta Quantification Protocol

Period: April 1st to December 31st, 2008

- Methodology used: Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion, September 2007, Alberta Environment.
- Calculation tool: Quantification Protocol for Landfill Gas Capture and Combustion, Calculation Module, April 2007, Alberta.

The Alberta protocol was used with a daily CH₄ volume from the combination of the gas flowmeter and analyser data. The daily CH₄ volume captured by the project infrastructures is also measured historical data. The value is however acceptable in terms of the corroborations performed by the BNO.

The project proponent slightly modified the calculation method of the Alberta Protocol, however, by using the daily CH₄ volumes captured (integrated data) rather than the directly measured raw data (LFG flows and CH₄ concentrations).

The selection of the project's GHG source is now acceptable, following the resolution of the RARs raised by the BNO, which involved the absence of a selection process for the GHG sources in the project proponent's initial documents.

Finally, selecting not to quantify the relevant GHG sources for the baseline scenario was also justified by the project proponent in order to close another RAR on the subject.

5.3 Baseline Scenario Selection

The baseline scenario was adequate. It was clarified by the project proponent following RARs raised by the BNO.

5.4 Emission Factors and Data Monitoring

Emission factors were not necessary since CH₄ was the only GHG significantly involved. A global warming potential of 21 was used (Intergovernmental Panel on Climate Change (IPCC). Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Reporting Instructions, 1997).

Data were integrated from the flowmeter and gas analyser for the Alberta calculation tool and electricity production data were provided by the NSPI through invoices and meter information.

Based on the monitoring requirements of the NSPI ERB Agreement, the following observations were made.

- Monitoring of the flare system: Monitoring, as well as associated procedures, are lacking. This situation does not conform to requirements as per the Emission Reduction Benefits Supply Agreement³
- Monitoring of the flowmeter: Inspection by a third party was done yearly instead of every 18 months, which conforms to supplier requirements as per the written communication from David McLennan, Dec. 23rd, 2009.
- Monitoring of the gas analyser: Third-party calibration and inspection was done yearly, but is recommended by the supplier every 6 months. However, inspection did not show any observable impact as per the written communication from David McLennan, Dec. 23rd, 2009.

5.5 Uncertainty in Assessment and Considerations

Sources of uncertainty were as follows:

- Methane global warming potential: Not relevant to the Verification Statement
- Methodology limits: Both selected methodologies were generally recognized
- Measuring devices: According to the manufacturers' technical specification sheets for the flowmeter and gas analyser used for this project, the degree of uncertainty of these devices is under 5% in both cases.

5.6 GHG Information Management System Evaluation and Data Quality

Although the integrated landfill gas data and the meter data pertaining to the electricity produced provide a good level of quality, the GHG Information Management System in place did not succeed in detecting a material discrepancy resulting in an overestimate of approximately 50% in the total emission reductions reported in a former Project Report. The discrepancy was no longer applicable, however, since the RAR raised on that matter had been resolved.

The quality assurance and quality control (QA/QC) program did not reveal any methodological errors or inconsistencies among the different project documents (Project Report, Project Plan and LFG Calculator). RARs previously raised by the BNQ in that regard had been resolved by the project proponent.

3 Emission Reduction Benefits Supply Agreement, Agreement between Highland Energy Inc. and Nova Scotia Power Incorporated, made as of September 23rd 2005, Nova Scotia.

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The DI.ANE XT control system saves the operational data from the generators for a 3-month period. The data are also compiled manually on paper every day. A single copy of the paper log exists and the electronic data are not kept beyond 3 months. Data security is therefore weak. Although the data are not directly involved in assessing the GHG reduction, they are however essential for studying the operating conditions of the generators and for recording their downtime.

There are no records showing that the flare is regularly tested for proper functioning. In the event of a major breakdown in generators, it is not certain that the project proponent would be able to effectively and safely use the torch to avoid emitting the CH₄ already captured by the system into the atmosphere.

In addition, the totaliser for the LFG flows and CH₄ concentrations does not make it possible to extract the raw data.

The proponent's project began before such a system was required in accordance with the requirements of the standard ISO 14064-2: 2006. The project proponent adapted this project to the ISO 14064-2:2006 requirements after receiving RARs from the BNQ.

The project proponent's GHG information management system is not mature and robust.

The data quality is however acceptable following the resolution of the RARs raised by the BNQ.

5.7 Project Conformity to the Selected Criteria – 14064-2: 2006 and NSPI ERB Agreement

ISO 14064-2:2006

The spirit and intention of the principles of relevance, consistency, accuracy and conservativeness in the ISO 14064-2:2006 standard were, for all intents and purposes, respected.

The principles of completeness and transparency were not, however, as well respected due to the project proponent's inability to extract and supply the raw data pertaining to the LFG flows and CH₄ concentrations.

The BNQ nevertheless wishes to recognize the effort that the project proponent invested to have this project comply with the spirit and intention of ISO 14064-2:2006, particularly in light of the fact that no criteria or programs were initially targeted by the project.

NSPI ERB Agreement

The BNQ was only able to conduct a partial verification for this agreement since some pages are missing in the version provided by the project proponent (annexes and appendices in particular). Consequently, the BNQ cannot officially comment on the conformity of the project proponent's quantification for this agreement. However, the verification of the proponent's project in relation to the agreement's available sections did not make it possible to detect any material discrepancy with regard to the spirit and intention of the document. The following minor discrepancies were however detected by the BNQ:

- Raw data are not available (LFG flows and CH₄ concentrations);
- There are no records that demonstrate that operational tests for the flare were conducted;
- The project proponent's calculation method was slightly different from that required by the NSPI (the method was nevertheless modified at the request of the BNQ since it used carbon reductions stemming from the transfer of fossil fuels outside the boundaries of the project verified here);
- The unique character of the emission reduction benefits (ERB) generated by the project could be reinforced by a solemn declaration by the project proponent mentioning that the benefits were not used for purposes other than those provided for in the agreement reached with the NSPI.

5.8 Materiality

The project proponent did not succeed in providing the raw data concerning the project's gases (LFG and CH₄) to resolve the RAR that the BNQ raised on that matter. However, the BNQ nevertheless concluded that the reductions reported by the project proponent were plausible by using six corroborations. On the basis of the BNQ's corroborations, and following the resolution of other RARs raised in the framework of this verification mandate, there are no longer any qualitative or quantitative material discrepancies in the documents and the calculator of the project verified here.

5.9 Additionality

The project's additionality was demonstrated by the project proponent. The RARs raised by the BNQ on that subject were resolved by the project proponent.

6. VERIFICATION STATEMENT

According to the verifications made by the BNQ, and in light of what was mentioned above, our opinion on the project proponent's 2008 GHG assertion is described below.

Accuracy of the GHG Assertion

The corroborations performed by the BNQ to verify the GHG assertion made it possible to establish that the emissions reported were, for all intents and purposes, accurate.

On the basis of the verification procedures, the information provided was true, accurate and supported the assertion that the project's total reductions for the 2008 year reached approximately **44 802 t CO₂e**, considering the associated uncertainty (see the previous text with regard to the uncertainty in question).

With the exception of the missing raw data pertaining to the monitoring of gases (LFG flows and CH₄ concentrations), the pieces of evidence were deemed relevant and sufficient.

There was no material discrepancy and no restrictions apply to the opinion of the verifiers.

ISO 14064-2:2006

The spirit and intention of the principles of relevance, consistency, accuracy and conservativeness in the ISO 14064-2:2006 standard were, for all intents and purposes, respected.

The principles of completeness and transparency were not, however, as well respected due to the project proponent's inability to extract and supply the raw data pertaining to the LFG flows and CH₄ concentrations.

The BNQ nevertheless wishes to recognize the effort that the project proponent invested to have this project comply with the spirit and intention of ISO 14064-2:2006, particularly in light of the fact that no criteria or programs were initially targeted by the project.

NSPI ERB Agreement

The BNQ wishes to underscore that the conformity to the NSPI ERB Agreement was requested by the project proponent after this verification had already begun, i.e. during a conference call held on January 12th, 2010.

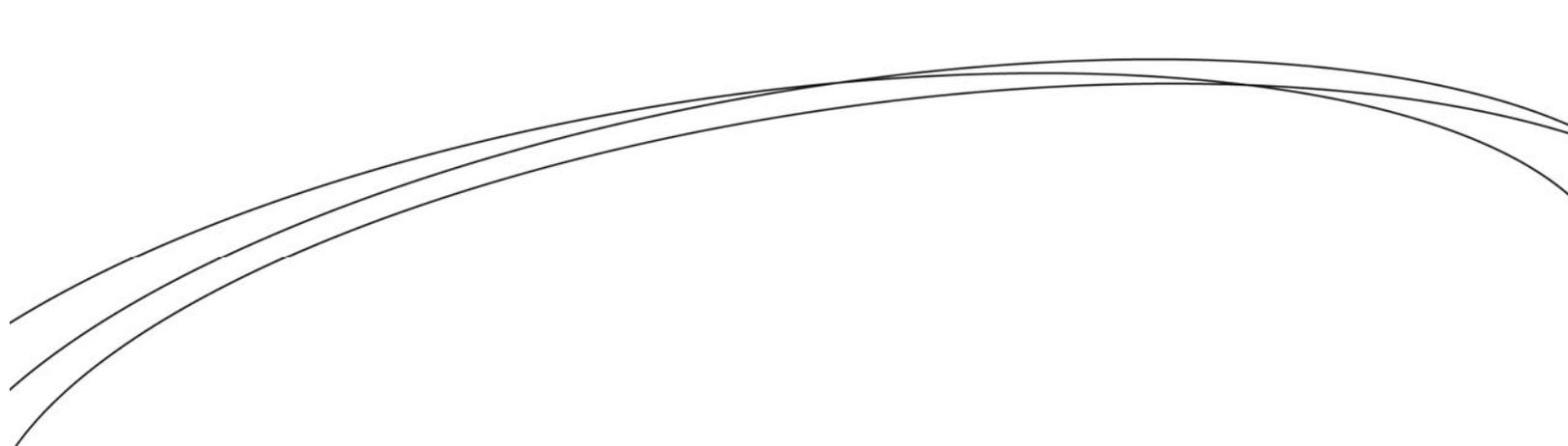
The BNQ was only able to conduct a partial verification for this agreement since some pages are missing in the version provided by the project proponent (annexes and appendices in particular). Consequently, the BNQ cannot officially comment on the conformity of the project proponent's quantification for this agreement. However, the verification of the proponent's project in relation to the agreement's available sections did not make it possible to detect any material discrepancy with regard to the spirit and intention of the document. The following minor discrepancies were however detected by the BNQ:

- Raw data are not available (LFG flows and CH₄ concentrations);
- There are no records that demonstrate that operational tests for the flare were conducted;
- The project proponent's calculation method was slightly different from that required by the NSPI (the method was nevertheless modified at the request of the BNQ since it used carbon reductions stemming from the transfer of fossil fuels outside the boundaries of the project verified here);
- The unique character of the emission reduction benefits (ERB) generated by the project could be reinforced by a solemn declaration by the project proponent mentioning that the benefits were not used for purposes other than those provided for in the agreement reached with the NSPI.

In no case may this partial opinion with regard to the NSPI ERB Agreement be considered a legal notice.

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ANNEX 1

PROPONENT PROJECT DOCUMENTS:

PROJECT REPORT, PROJECT PLAN AND CALCULATOR

Greenhouse Gas Quantification 2008

Highway 101 Landfill Gas Capture Project

**Prepared March 12, 2010 by
3P Analysis and Consulting**

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Introduction

This report describes the GHG reductions from the capture and combustion of landfill gas and generation of electricity in the province of Nova Scotia, Canada.

This report focuses on the quantification of GHG reductions for the period from January 1, 2008 to December 31, 2008

Name of the Project Proponent

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GHG Programs

According to the Halifax Renewable Energy Corporation and the Regional Municipality of Halifax, the landfill is not subject to Canadian regulations requiring it to collect its landfill gas. The site is owned by the Regional Municipality of Halifax, which has entered into a 20-year gas rights agreement with the Halifax Renewable Energy Corp.

Intended User(s) of this Report

The intended users of this report are the Halifax Renewable Energy Corporation and the purchaser of the emission credits. This report will form the basis of the quantification of the GHG emission reductions which are required under the contract the two organizations have entered into. This report will be verified by an independent third party and the subsequent verification statement will be submitted to both parties.

GHG Assertions

The project has adhered to the previously established measurement plan and has achieved **44,802** tonnes of CO₂ equivalent reductions for the period from Jan 1, 2008 to December 31, 2008.

Project Description

The approximately 84-acre landfill opened in 1976 and accepted waste until 1997. Approximately 4 million tons of material was deposited at the site. Gas is extracted from seventy-five vertical collection wells installed in the landfill. A network of pipes is used to transport the collected gas from the wells to the power plant located at the eastern edge of the landfill. High pressure, centrifugal blowers and compressors located at the power plant apply vacuum to the collection piping to extract LFG (landfill gas) from the wells.

Electrical power is generated via combustion in two (2) GE/Jenbacher reciprocating engines that are specifically designed to operate on LFG. The in-service date of both

engines was October 12, 2006 and the Effective Date was November 1, 2006. Each of the two engine sets is rated to produce roughly 1,063 kilowatts of electricity. According to manufacturer specifications, the GE/Jenbacher engines input energy at full load is 9,995 MBTU/hr. The heat rate is therefore 9402.6 BTU/kW-hr based on the lower heating value.

A LFG flare, which was in use prior to start-up of the power plant, remains available as a back-up to the generating station, although the power plant accepts all of the LFG that is recovered.

The LFG is first treated to remove moisture and particulates. The treated LFG is then pressurized, cooled and injected into engines that are coupled to generators. Combustion of the gas in the engines powers the generators to produce electricity that is then delivered to the electrical grid.

A DI.ANE XT control system is used to record information about each engine's performance including engine operating hours, engine pressure and temperature, and exported electricity. The DI.ANE's electronic logging system records data from the engines and stores it in an on-site database where the last three months are held before being overwritten. None of this data is used in the calculation of GHG emissions. On-site system operators also complete performance logs for each engine on a daily basis.

In addition to the above mentioned engine data logging system, a measurement and data logging system was installed in early 2008. This system measures the flow rate and concentration of methane as it flows from the landfill site into the engines. The system totalizes methane gas flow on a second by second basis and at midnight each day, the following is stored:

- Date/Time for this record
- Total methane gas volume flow for the previous 24 hours
- Percentage of methane (at midnight)
- Percentage of O₂ (at midnight)

The systems does not log or store any other data. This daily data can be exported out to an Excel compatible spreadsheet file. The data logging system became fully operational in April 2008.

GHG Emissions Reductions from the Project

As outlined in the Project Plan, there are two methodologies for measuring and quantifying the emission reductions from the project:

Methodology 1 – Electricity output of engine – Chicago Climate Exchange protocol - Jan 1, 2008 to Mar 31, 2008

This methodology was taken from the “CHICAGO CLIMATE OFFSET PROJECT PROTOCOL - Landfill Methane Collection and Combustion Offset Projects” protocol document. The amount of methane destroyed is based on a calculation using the generated electricity as the activity data, as follows:

$$\text{Tonnes}_{CH_4} = (ELEC_{(generated)} \times HO_{(engine)} \times MolWt_{CH_4} \times GasCons \times VolConv \times GWP_{CH_4}) / 1,000,000 / LHV_{CH_4} \times DE$$

Where

Tonnes_{CH_4} - Tonnes of methane destroyed, in tonnes CO2e

$ELEC_{(generated)}$ - Electricity generated in kWh, measured monthly

$HO_{(engine)}$ - Heat output of generator based on Btu input, 9402.6 Btu/kWh

LHV_{CH_4} - Lower heating value of methane, 918.35 Btu/ft³

$MolWt_{CH_4}$ - Molecular weight of methane, 16.04 g/mole

$GasCons$ - Gas constant, 0.041632 mole/litre

$VolConv$ - Volume conversion, 28.32 litres/ft³

GWP_{CH_4} - Global Warming Potential of methane, 21

DE - Destruction Efficiency, 0.992, taken from Emission Reductions Supply Agreement, Schedule 'B' (page 6)

A table of measured and calculated values for the Jan 1, 2008 to March 31, 2008 time period is located in the Appendix – Table 1.

Methodology 2 – Measured Methane and Specified Calculation from Emission Reduction Benefits Supply Agreement – Apr 1, 2008 to Dec 31, 2008

The amount of emission reductions is calculated using the calculation outlined in the Emission Reduction Benefits Supply Agreement between Halifax Renewable Energy Corporation and the purchaser of the emission credits (Schedule B, page 7). The calculation is based on the Ideal Gas Law and is the following:

$$\text{Tonnes}_{CH_4} = (PV / RT \times MWt_{CH_4}) / 1,000,000 \times GWP_{CH_4} \times DE$$

Where

$Tonnes_{CH_4}$ - Tonnes of methane destroyed, in tonnes CO₂e
 P - Pressure, in atmospheres, at the measurement point.
 V - Volume of methane, in cubic meters
 R - Gas constant, .08205 m³.atm / mole.°K
 T - Absolute temperature, in °K, at the measurement point
 $MW_{t_{CH_4}}$ - Molecular weight of methane, 16.04 g/mole
 GWP_{CH_4} - Global Warming Potential of methane, 21
 DE - Destruction Efficiency, 0.992

The monitoring system became fully operational on April 5, 2008. The first 4 days of April 2008 were estimated using the average of the remaining days of April. In addition, there were two days, June 23, 2008 and November 25, 2008, when the data logger did not measure any methane. This was due to maintenance on the data logger. Both of these days have been set to 0 measurement.

The summary table of the data is included in the Appendix –Table 1, which covers the period from Apr 1, 2008 to Dec 31, 2008

Relevant Good Practice Guidance Used in the Project

Relevant good practice guidance procedures and criteria used to quantify the emission reductions from this project include:

- Emission Reduction Benefits Supply Agreement between Halifax Renewable Energy Corporation and purchaser of emission credits
- CHICAGO CLIMATE OFFSET PROJECT - Landfill Methane Collection and Combustion Offset Projects protocol
- Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion
- WRI/WBCSD GHG Protocol for Projects, December 2005
- ISO 14064-2 2006

Date and Time Period of the Report

This report covers the period from January 1, 2008 to December 31, 2008.

Appendix A – Table 1– Monthly Summary of Landfill Gas Emission Reductions , Jan 1, 2008 to Dec 31, 2008

Calculation of Emission Reductions - 2008					
	Volume of Landfill Gas Delivered at 1 atmospheric pressure (note 2)	Electrical Generation	Average % Methane Content	Quantity of Methane Delivered	Quantity of CO2e Emission Reductions from Combustion of Methane
	[m3]	[MWh]	%	[kg]	[t CO₂e]
January (note 1)	560,157.15	834.15	-	160,202.95	3,364.26
February (note 1)	524,017.98	740.80	-	142,274.91	2,987.77
March (note 1)	560,157.15	808.36	-	155,249.45	3,260.24
April	631,416.38	769.35	47.0%	195,604.49	4,107.69
May	632,617.03	800.83	47.5%	197,389.06	4,145.17
June	503,180.91	680.80	47.4%	161,570.37	3,392.98
July	499,561.28	637.49	51.8%	169,446.56	3,558.38
August	498,603.98	726.08	54.3%	178,237.45	3,742.99
September	503,305.04	721.10	54.7%	179,696.64	3,773.63
October	617,408.62	813.05	51.6%	209,766.39	4,405.09
November	490,410.22	758.32	48.6%	182,193.40	3,826.06
December	592,632.57	759.37	51.9%	201,796.29	4,237.72
Total	6,613,468.32	9,049.71		2,133,427.96	44,801.99

note 1 - these three months use the CCX calculation methodology

note 2 - the CCX methodology does not calculate LFG volume, the volumes for the first three months are estimated from the averages of the measured data.

Greenhouse Gas Project Plan

Highway 101 Landfill Gas Capture Project

**Prepared by
3P Analysis and Consulting**

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Introduction

This Project Plan describes the GHG reductions from the capture and combustion of landfill gas and generation of electricity the province of Nova Scotia, Canada.

Disclaimer

Although the project was started well before the ISO 14064 standard was released, this document attempts to create an ISO compliant project document and was prepared well after implementation of the project. As such, not all data monitoring and collection was implemented originally to support an ISO document. Such discrepancies, assumptions and estimates are noted in the report.

Name of the Project Proponent

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GHG Programs

According to Halifax Renewable Energy Corporation (HREC) and the Regional Municipality of Halifax, the landfill is not subject to Canadian regulations requiring it to collect its landfill gas. The site is owned by the Regional Municipality of Halifax, which has entered into a 20-year gas rights agreement with HREC.

Intended User(s) of this Report

The intended users of this report are the Halifax Renewable Energy Corporation and the purchaser. This report will form the basis of the quantification of the GHG emission reductions which are required under the contract the two organizations have entered into. This report will be verified by an independent third party and the subsequent verification statement will be submitted to both parties.

Project Description

The approximately 84-acre landfill opened in 1976 and accepted waste until 1997. Approximately 4 million tons of material was deposited at the site. Gas is extracted from seventy-five vertical collection wells installed in the landfill. A network of pipes is used to transport the collected gas from the wells to the power plant located at the eastern edge of the landfill. High pressure, centrifugal blowers and compressors located at the power plant apply vacuum to the collection piping to extract LFG (landfill gas) from the wells.

Electrical power is generated via combustion in two (2) GE/Jenbacher reciprocating engines that are specifically designed to operate on LFG. The in-service date of both engines was October 12, 2006 and the Effective Date was November 1, 2006. Each of the two engine sets is rated to produce roughly 1,063 kilowatts of electricity. According to manufacturer specifications, the GE/Jenbacher engines input energy at full load is 9,995 MBTU/hr. The heat rate is therefore 9402.6 BTU/kW-hr based on the lower heating value. Landfill gas destruction for the time period covered in this report was calculated using electricity production data.

A LFG flare is available as a back-up to the generating station, although the power plant accepts all of the LFG that is recovered.

The LFG is first treated to remove moisture and particulates. The treated LFG is then pressurized, cooled and injected into engines that are coupled to generators. Combustion of the gas in the engines powers the generators to produce electricity that is then delivered to the electrical grid.

A DI.ANE XT control system is used to record information about each engine's performance including engine operating hours, engine pressure and temperature, and exported electricity. The DI.ANE's electronic logging system records data from the engines and stores it in an on-site database where the last three months are held before being overwritten. None of this data is used in the calculation of GHG emissions. On-site system operators also complete performance logs for each engine on a daily basis.

In addition to the above mentioned engine data logging system, a methane measurement and data logging system was installed in early 2008. This system measures the volume of methane as it flows from the landfill site into the engines. The system totalizes methane gas flow on a second by second basis and at midnight each day and the following data is stored:

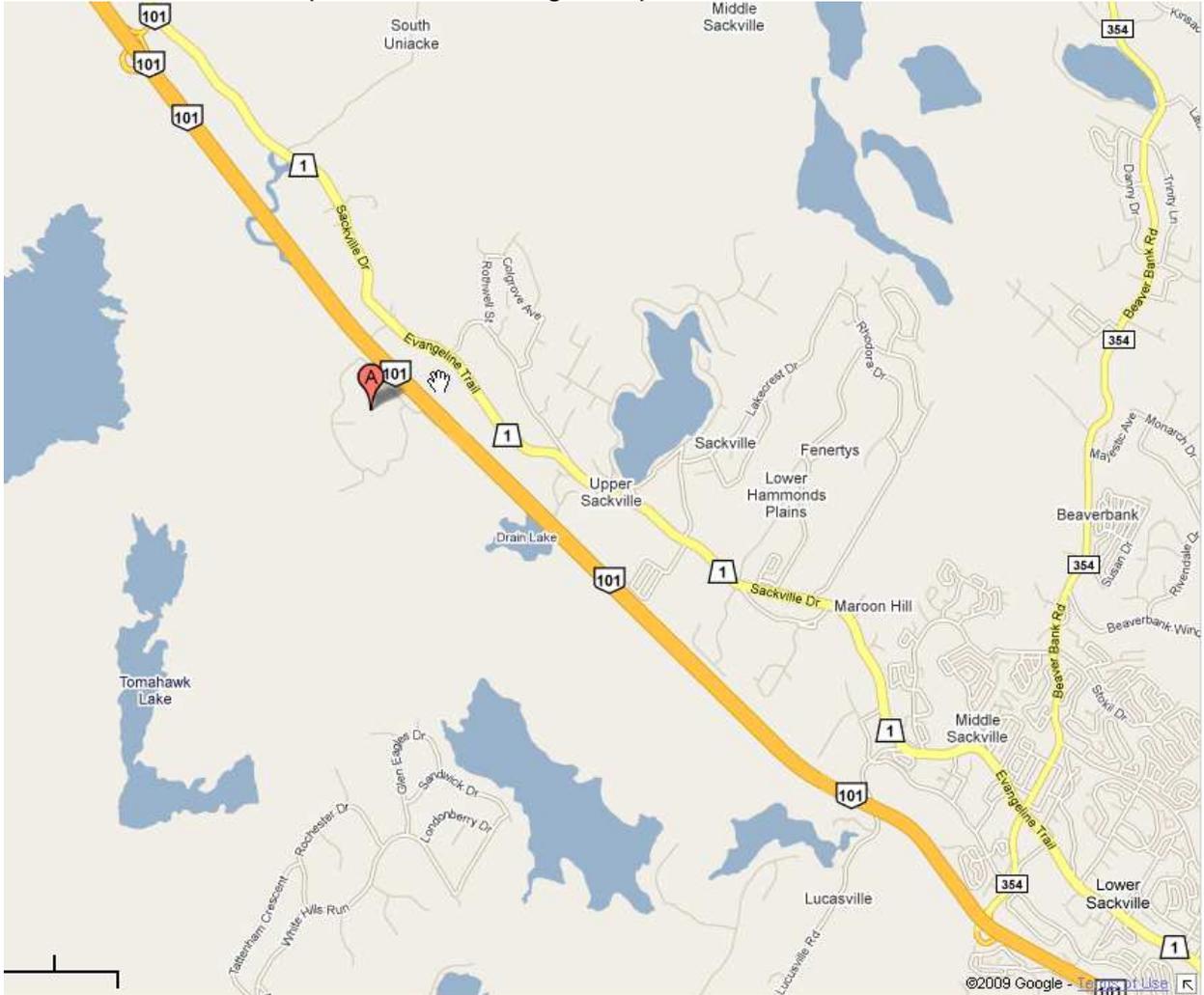
- Date/Time for this record
- Total methane gas volume flow for the previous 24 hours
- Percentage of methane (at midnight)
- Percentage of O₂ (at midnight)

The systems does not log or store any other data. This daily data can be exported out to an Excel compatible spreadsheet file. The data logging system became fully operational in April 2008.

Project Location

The landfill is located on Highway 101 in Sackville, Nova Scotia. It is referred to as the 'Highway 101 Landfill', the 'Sackville Landfill' and the 'Mt. Uniacke Landfill'.

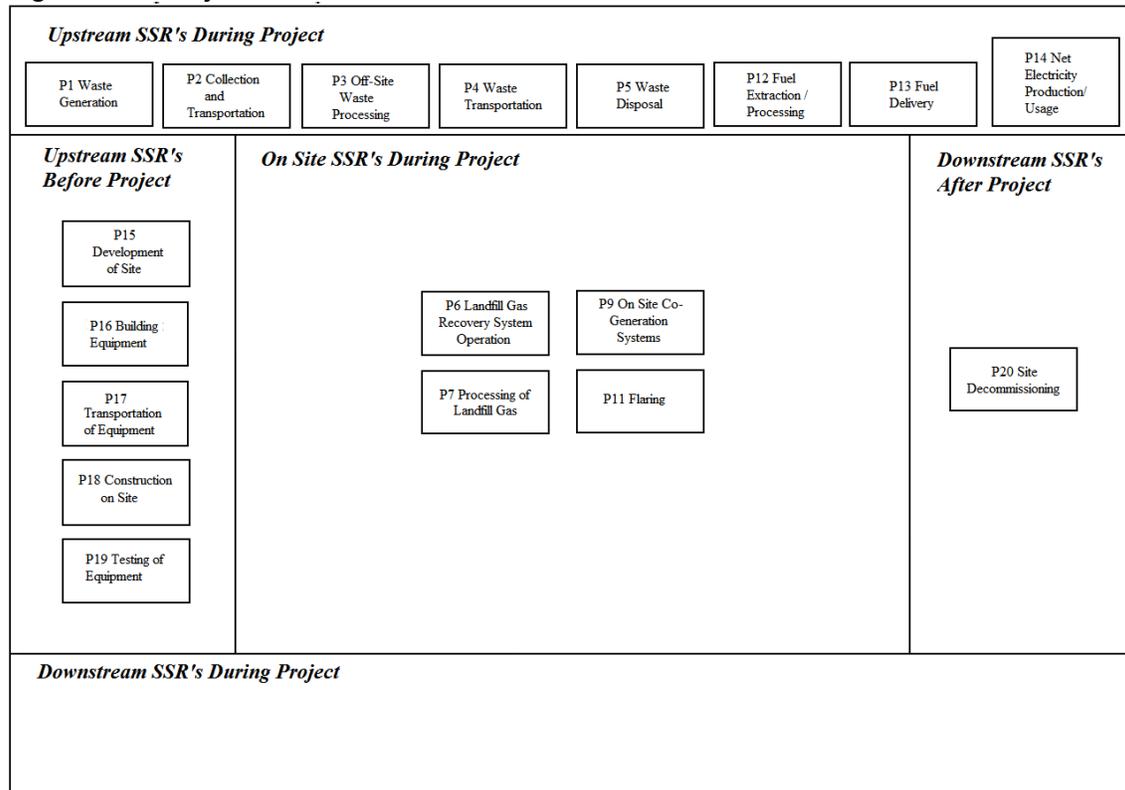
The center of the landfill is at latitude is +44° 48' 40.18", longitude is -63° 46' 32.90". Below is a map taken from Google Maps.



Identification of Project SSRs (Sources, Sinks and Reservoirs)

Based on the “Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion”¹, the project SSRs were organized in a Life Cycle Diagram in Figure 1. Descriptions of each of the SSRs and their classification as controlled, related or affected are provided in Table 1.

Figure 1 – Project Elements



¹ For brevity, all SSR's related to thermal generation and flaring were not included as these elements are not part of this project.

Table 1 – Project SSRs

1. SSR	2. Description	3. Controlled, Related or Affected
Upstream SSRs during Project Operation		
P1Waste Generation	Streams of solid waste are produced in a number ways, depending on the source of these residues. Quantities for each of the energy inputs related to the generation of the waste streams would be contemplated to evaluate functional equivalence with the baseline condition.	Related
P2 Collection and Transportation	Solid waste may be transported to the project site by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SSR, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the baseline condition.	Related
P3 Off-Site Waste Processing	Solid waste may be processed using a series of mechanical processes, heavy equipment and conveyors. This equipment would be fuelled by diesel, gasoline, or natural gas resulting in GHG emissions, or electricity. Quantities and types for each of the energy inputs would be tracked.	Related
P4 Waste Transportation	Organic residues may be transported to the project site by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SSR, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the baseline condition.	Related
P5 Waste Processing and Disposal	Waste may be handled at a disposal site by transferring the waste from the transportation container, spreading, burying, processing, otherwise dealing with the waste using a combination of loaders, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs may need to be tracked.	Controlled
P12 Fuel Extraction and Processing	Each of the fuels used throughout the on-site component of the project will need to be sourced and processed. This will allow for the calculation of the greenhouse gas emissions from the various processes involved in the production, refinement and storage of the fuels. The total volumes of fuel for each of the on-site SSRs are considered under this SSR. Volumes and types of fuels are the important characteristics to be tracked.	Related
P13 Fuel Delivery	Each of the fuels used throughout the on-site component of the project will need to be transported to the site. This may include shipments by tanker or by pipeline, resulting in the emissions of greenhouse gases. It is reasonable to exclude fuel sourced by taking equipment to an existing commercial fuelling station as the fuel used to take the equipment to the site is captured under other SSRs and there is no other delivery.	Related
P14 Net Electricity Production/ Usage	Electricity may be required for operating the facility. This power may be sourced either from internal generation, connected facilities or the local electricity grid. Metering of electricity may be netted in terms of the power going to and from the grid. Quantity and source of power are the important characteristics to be tracked as they directly relate to the quantity of greenhouse gas emissions.	Related
Onsite SSRs during Project Operation		
P6 Landfill Gas Recovery System Operation	Landfill gas recovery systems require compressors and other equipment for the gathering and distribution of the gas at the project facility. This equipment may be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels, such as landfill gas, may also be used in some rare cases. Quantities and types for each of the	Controlled

	energy inputs may need to be tracked.	
P7 Processing of Landfill Gas	Landfill gas will likely have a higher concentration of carbon dioxide and other impurities than may be acceptable for the any number of uses. Mechanical equipment may be required to treat the landfill gas in order meet the required specifications. This may require several energy inputs such as natural gas and diesel. Quantities and types for each of the energy inputs would be tracked.	Controlled
P9 On Site Co-Generation Systems	On site co-generation systems may be included at the project site. This generation could require the combustion of landfill gas, and may be supplemented by fossil fuels precipitating greenhouse gas emissions. Volumes and types of fuels are the important characteristics to be tracked.	Controlled
P11 Flaring	Flaring of the landfill gas may be required during upset conditions or during maintenance. Emissions of greenhouse gases would be contributed from the combustion of the LFG as well as from any natural gas used in flaring to ensure more complete combustion. Quantities of LFG being flared and quantities of any pilot fuels or supplemental fuels would need to be tracked.	Controlled
Downstream SSRs during Project Operation		
None		
Other		
P15 Development of Site	The site may need to be developed. This could include civil infrastructure such as access to electricity, gas and water supply, as well as sewer etc. This may also include clearing, grading, building access roads, etc. There will also need to be some building of structures for the facility such as storage areas, storm water drainage, offices, vent stacks, firefighting water storage lagoons, etc., as well as structures to enclose, support and house the equipment. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to develop the site such as graders, backhoes, trenching machines, etc.	Related
P16 Building Equipment	Equipment may need to be built either on-site or off-site. This includes all of the components of the storage, handling, processing, combustion, air quality control, system control and safety systems. These may be sourced as pre-made standard equipment or custom built to specification. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment for the extraction of the raw materials, processing, fabricating and assembly.	Related

Baseline Scenarios

The baseline is the most appropriate and best estimate of a reference case for which the project can be compared to. The baseline scenario covers the same time period as the project.

The following six steps were used in identifying baseline candidates:

1. Define the product or service provided by the project activity
2. Identify possible types of baseline candidates
3. Define and justify the geographic area and the temporal range used to identify baseline candidates
4. Define and justify any other criteria used to identify baseline candidates
5. Identify a final list of baseline candidates
6. Identify baseline candidates that are representative of common practice. In identifying the baseline candidates that are of common practice, then those baseline scenarios whose GHG emissions are higher than those of common practice can be eliminated from the list of potential baseline candidates.

In order to appropriately select baseline candidates, the project activity must be clearly defined so as to select baseline scenarios/candidates that provide the same service. In this case, the service provided is the management of municipal solid waste (MSW). Therefore, alternative methods for the management of MSW will be considered as baseline candidates. The geographic area considered will be all of Nova Scotia and the temporal range will include the years 2005 to 2012. The table below lists potential baseline scenarios considering the project description and SSRs, alternative project types, activities and technologies, data availability, reliability and limitations and any other relevant information concerning present or future conditions.

Project Activity	Baseline Candidates
Landfill gas capture, combustion and electricity generation	<ol style="list-style-type: none"> 1. Business as usual (no LFG capture and destruction) 2. Capture & flare 3. Capture & conversion to methanol (fuel) 4. Waste Incineration 5. Composting

Justification of Baseline Scenario

In order to arrive at a final baseline candidate, a barriers test was performed. The following barriers were utilized in assessing each baseline candidate:

- Financial
- Legal requirements

- Technology availability
- Resource & Data availability
- Infrastructure

The table below lists the barriers associated with each of the identified baseline candidates.

The procedure selected addresses the principals of transparency (clear process to list all potential baseline scenarios) , relevance (all relevant baseline scenario and additional information are considered), completeness (all potential baseline scenarios are considered), consistency (same barriers are applied to all potential baseline scenario in order to be as objective as possible) and conservativeness (the option that is the most likely, and that will not over-estimate the emission reduction is selected).

Based on the comparative assessment of barriers, the business as usual scenario in which there is no capture and flare system in place, was identified as the most appropriate baseline scenario.

Barrier	Project (capture, combust to generate electricity)	Current state (No capture and flare system in place)	Capture and flare	Capture and conversion to methanol	Waste Incineration	Composting
Financial	High costs associated with implementation of a new infrastructure	No barrier	Medium to High costs associated with implementation of a new infrastructure	Cost of infrastructure is prohibitive	Capital cost and cost of infrastructure is prohibitive	Capital cost and cost of infrastructure is prohibitive
Legal Requirements	Not required by law	Not required by law	Not required by law	Not required by law	Not required by law	Not required by law
Technology availability	No barrier	No barrier	Lack of proven technology to achieve these objectives	Lack of proven technology to achieve this activity	No barrier	No barrier
Infrastructure	No barrier	No barrier	No barrier	No barrier	No barrier	No barrier
Resource & Data availability	No barrier	No barrier	Lack of resources and data available for comparative purposes	Lack of resources and data available for comparative purposes	No barrier	No barrier

Additionality

There are three basic issues that need to be resolved to determine if the project is additional:

- Is the project a legal requirement?

Since there is no federal, provincial or municipal legislation that requires that landfills in Nova Scotia install landfill gas collection and destruction systems. Therefore, the project is additional. More background information on the legal/legislative aspects of Additionality are in Appendix 3.

- Is the project common practice?

Approximately only 17% of the methane emissions from landfills in Canada have landfill gas collection and destruction systems². There are only 9 operating landfills in Nova Scotia as of December 2009.

(<http://www.gov.ns.ca/nse/waste/solidwastedisposal.asp>) and only the Highway 101 landfill has a methane capture and destruction system. Therefore, the project is additional.

- Is there a financial burden that emission credits can alleviate?

There are considerable financial burdens that were undertaken by the project proponent. These include the purchasing of materials, construction costs and negotiations with local electrical authorities. These costs are hoped to be offset by the selling of the emission credits generated by the project. Currently this project is not financially viable without the sale of the emission credits.

Therefore, the project is additional.

Identification of Baseline SSRs (Sources, Sinks and Reservoirs)

Based on “Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion”, the baseline SSRs were organized in a Life Cycle Diagram in Figure 2. Descriptions of each of the SSRs and their classification as controlled, related or affected are provided in Table 2.

² Total emissions from Solid Waste Disposal on Land in 2007 was 20,000 kt CO₂e (from National Inventory Report Greenhouse Gas Sources and Sinks in Canada 1990–2007, table S-2) Total amount of methane captured and flared in Canada was 165 kt CH₄ (3,465 kt CO₂e) (National Inventory, table A3-44). This ratio was 17%.

Figure 2 – Baseline Elements

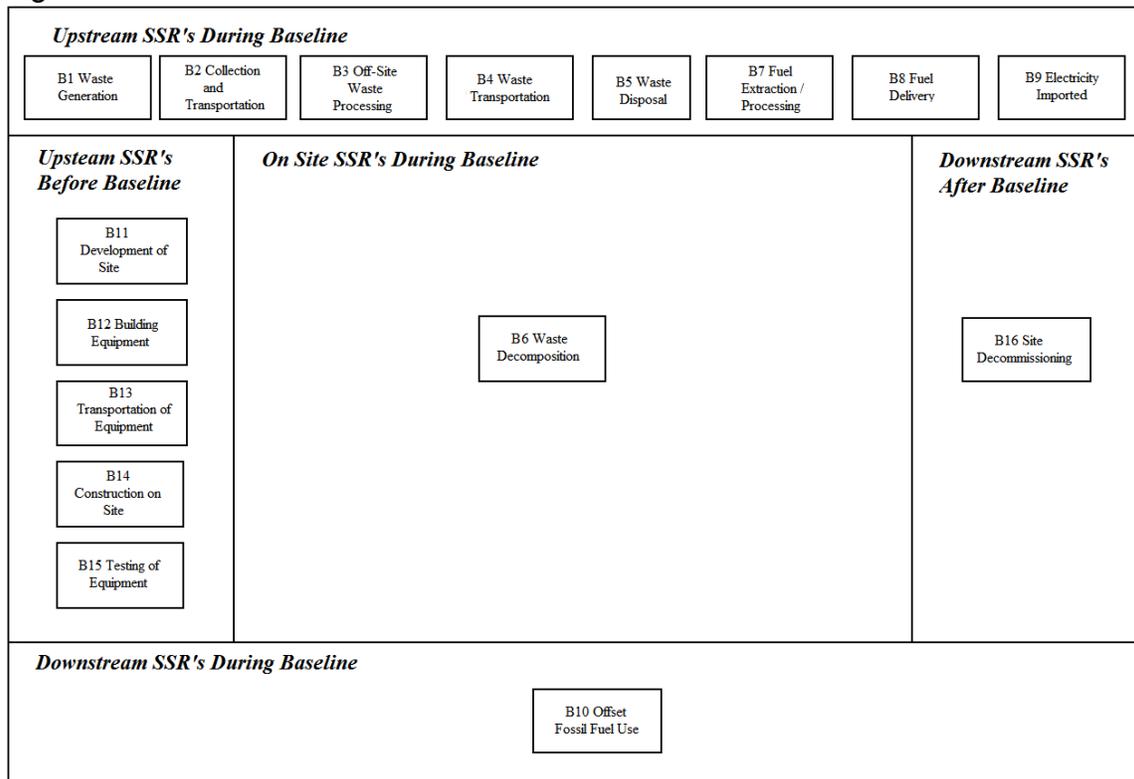


Table 2 – Baseline SSRs

1. SSR	2. Description	3. Controlled, Related or Affected
Upstream SSRs during Baseline Operation		
B1 Waste Generation	Streams of solid waste are produced in a number ways, depending on the source of these residues. Quantities for each of the energy inputs related to the generation of the waste streams would be contemplated to evaluate functional equivalence with the baseline condition.	Related
B2 Collection and Transportation	Solid waste may be transported to the project site by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SS, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the baseline condition.	Related
B3 Off-Site Waste Processing	Solid waste may be processed using a series of mechanical processes, heavy equipment and conveyors. This equipment would be fuelled by diesel, gasoline, or natural gas resulting in GHG emissions, or electricity. Quantities and types for each of the energy inputs would be tracked.	Related
B4 Waste Transportation	Organic residues may be transported to the project site by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SSR, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the baseline condition.	Related
B5 Waste Disposal	Waste may be handled at a disposal site by transferring the waste from the transportation container, spreading, burying, processing, otherwise dealing with the waste using a combination of loaders, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs may need to be tracked.	Controlled
B7 Fuel Extraction and Processing	Each of the fuels that may be offset by the consumption of the landfill gas used off-site would need to be sourced and processed. This will allow for the calculation of the greenhouse gas emissions from the various processes involved in the production, refinement and storage of the fuels. The total volumes of fuel for each of the on-site SS's are considered under this SSR. Volumes and types of fuels are the important characteristics to be tracked.	Related
B8 Fuel Delivery	Each of the fuels used throughout the on-site component of the project will need to be transported to the site. This may include shipments by tanker or by pipeline, resulting in the emissions of greenhouse gases. It is reasonable to exclude fuel sourced by taking equipment to an existing commercial fuelling station as the fuel used to take the equipment to the site is captured under other SSRs and there is no other delivery.	Related
B9 Electricity Imported	Electricity may be produced off-site to cover the electricity demand not being produced by the landfill gas recovery facility. This electricity will be produced at an emissions intensity as deemed appropriate. Measurement of the gross quantity of electricity produced by the facility will need to be tracked to quantify this SSR.	Related
Onsite SS's during Baseline Operation		
B6 Waste Decomposition	Waste may decompose in the disposal facility resulting in the production of methane. Disposal site characteristics and mass disposed of at each site may need to be tracked.	Controlled
Downstream SS's during Baseline Operation		
B10 Offset Fossil Fuel Use	Fossil fuel use may occur off-site to cover the energy that may be supplied by the landfill gas exported from the landfill gas recovery facility. Volumes and types of fuels are the important characteristics to be tracked.	Related
Other		
B11 Development of	The site of the material processing and disposal facilities may need to be developed. This could include civil infrastructure such as access to	Related

Site	electricity, gas and water supply, as well as sewer etc. This may also include clearing, grading, building access roads, etc. There will also need to be some building of structures for the facility such as storage areas, storm water drainage, offices, vent stacks, firefighting water storage lagoons, etc., as well as structures to enclose, support and house the equipment. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to develop the site such as graders, backhoes, trenching machines, etc.	
B12 Building Equipment	Equipment may need to be built either on-site or off-site. This includes all of the components of the storage, handling, processing, combustion, air quality control, system control and safety systems. These may be sourced as pre-made standard equipment or custom built to specification. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment for the extraction of the raw materials, processing, fabricating and assembly.	Related
B13 Transportation of Equipment	Equipment built off-site and the materials to build equipment on-site, will all need to be delivered to the site. Transportation may be completed by train, truck, by some combination, or even by courier. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels to power the equipment delivering the equipment to the site.	Related
B14 Construction on Site	The process of construction at the site will require a variety of heavy equipment, smaller power tools, cranes and generators. The operation of this equipment will have associated greenhouse gas emission from the use of fossil fuels and electricity.	Related
B15 Testing of Equipment	Equipment may need to be tested to ensure that it is operational. This may result in running the equipment using test anaerobic digestion fuels or fossil fuels in order to ensure that the equipment runs properly. These activities will result in greenhouse gas emissions associated with the combustion of fossil fuels and the use of electricity.	Related
B16 Site Decommissioning	Once the facility is no longer operational, the site may need to be decommissioned. This may involve the disassembly of the equipment, demolition of on-site structures, disposal of some materials, environmental restoration, re-grading, planting or seeding, and transportation of materials off-site. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to decommission the site.	Related

Selection of Relevant SSRs for the Project and the Baseline

Each of the SSRs from the project and baseline condition were compared and evaluated as to their relevancy using the guidance provided in Annex VI of the “Guide to Quantification Methodologies and Protocols: Draft”, dated March 2006 (Environment Canada). The justification for the exclusion or conditions upon which SS’s may be excluded is provided in Table 3 below. All other SSRs listed previously are included.

Table 3 – Relevant SSRs

1. Identified SSR	2. Baseline (C, R, A)	3. Project (C, R, A)	4. Include or Exclude from Quantification	5. Justification for Exclusion
Upstream SSRs				
P1Waste Generation	N/A	Related	Exclude	Excluded as the generation of solid waste are not impacted by the implementation of the project and as such the baseline and project conditions will be functionally equivalent.
B1Waste Generation	Related	N/A	Exclude	
P2 Collection and Transportation	N/A	Related	Exclude	Excluded as the emissions from transportation are negligible and likely functionally equivalent to the baseline scenario.
B2 Collection and Transportation	Related	N/A	Exclude	
P3 Off-Site Waste Processing	N/A	Related	Exclude	Excluded as the off-site processing of solid waste is not impacted by the implementation of the project and as such the baseline and project conditions will be functionally equivalent.
B3 Off-Site Waste Processing	Related	N/A	Exclude	
P4 Waste Transportation	N/A	Related	Exclude	Excluded as the emissions from transportation are negligible and likely functionally equivalent to the baseline scenario.
B4 Waste Transportation	Related	N/A	Exclude	
P5 Waste Disposal	N/A	Controlled	Exclude	Excluded as the disposal of waste at the site is not impacted by the implementation of the project and as such the baseline and project conditions will be functionally equivalent.
B5 Waste Disposal	Controlled	N/A	Exclude	
P12 Fuel Extraction and Processing	N/A	Related	Exclude	No additional fuel is required for the project operation
B7 Fuel Extraction and Processing	Related	N/A	Exclude	Excluded based on conservative principle as well as any additional fuel used during the baseline would be negligible.
P13 Fuel Delivery	N/A	Related	Exclude	Excluded as the emissions from transportation are negligible and likely greater under the baseline condition.
B8 Fuel Delivery	Related	N/A	Exclude	
P14 Net Electricity Production/ Usage	N/A	Related	Include	N/A
B9 Electricity	Related	N/A	Exclude	Excluded based on conservative principle

Imported				as well as any additional fuel used during the baseline would be negligible.
Onsite SSRs				
P6 Landfill Gas Recovery System Operation	N/A	Controlled	Include	N/A
P7 Processing of Landfill Gas	N/A	Controlled	Include	N/A
P9 On Site Co-Generation Systems	N/A	Controlled	Include	N/A
P11 Flaring	N/A	Controlled	Include	N/A. Pilot fuel for flare stack is excluded as this has been shown to be immaterial.
B6 Waste Decomposition	Controlled	N/A	Include	N/A
Downstream SSRs				
B10 Offset Fossil Fuel Use	Related	N/A	Exclude	No additional off site Fossil Fuel Use is present in Baseline.
Other				
P15 Development of Site	N/A	Related	Exclude	Emissions from site development are not material given the long project life, and the minimal site development typically required.
B11 Development of Site	Related	N/A	Exclude	Emissions from site development are not material for the baseline condition given the minimal site development typically required.
P16 Building Equipment	N/A	Related	Exclude	Emissions from building equipment are not material given the long project life, and the minimal building equipment typically required.
B12 Building Equipment	Related	N/A	Exclude	Emissions from building equipment are not material for the baseline condition given the minimal building equipment typically required.
P17 Transportation of Equipment	N/A	Related	Exclude	Emissions from transportation of equipment are not material given the long project life, and the minimal transportation of equipment typically required.
B13 Transportation of Equipment	Related	N/A	Exclude	Emissions from transportation of equipment are not material for the baseline condition given the minimal transportation of equipment typically required.
P18 Construction on Site	N/A	Related	Exclude	Emissions from construction on site are not material given the long project life, and the minimal construction on site typically required. See Appendix 2 for calculations.
B14 Construction on Site	N/A	Related	Exclude	Emissions from construction on site are not material for the baseline condition given the minimal construction on site typically required.
P19 Testing of Equipment	N/A	Related	Exclude	Emissions from testing of equipment are not material given the long project life, and the minimal testing of equipment typically required.
B15 Testing of	Related	N/A	Exclude	Emissions from testing of equipment are

Equipment				not material for the baseline condition given the minimal testing of equipment typically required.
P20 Site Decommissioning	N/A	Related	Exclude	Emissions from decommissioning are not material given the long project life, and the minimal decommissioning typically required.
B16 Site Decommissioning	Related	N/A	Exclude	Emissions from decommissioning are not material for the baseline condition given the minimal decommissioning typically required.

Figure 3 and Figure 4 show the SSRs for monitoring in the Project and Baseline, respectively

Figure 3 Project SSRs for monitoring (grey background)

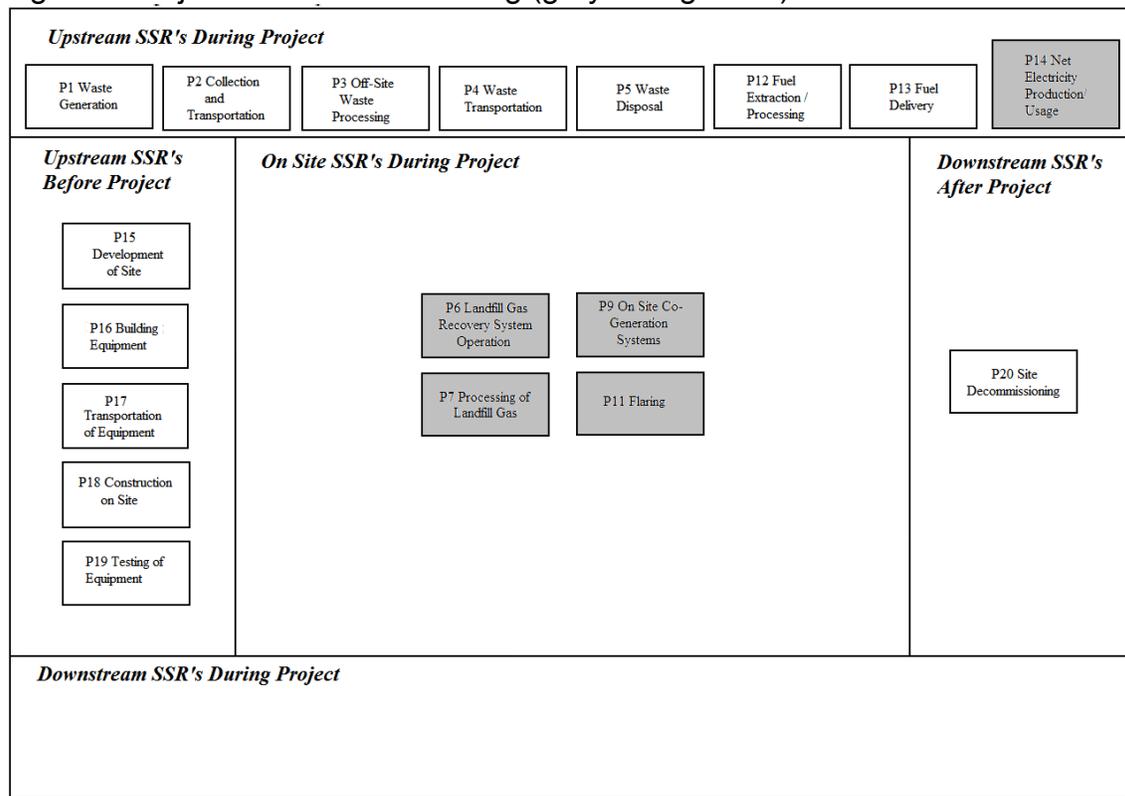
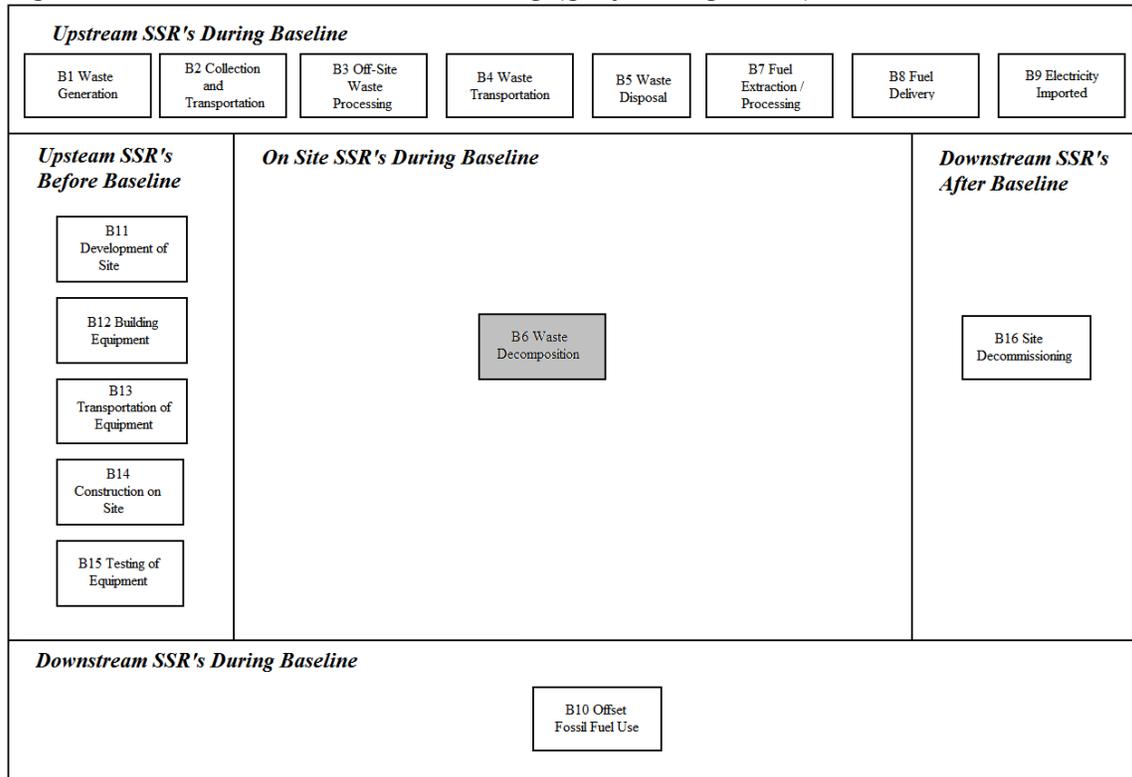


Figure 4 Baseline SSRs for monitoring (grey background)



Calculation of element B6 – Waste decomposition

The amount of methane being released to the atmosphere due to anaerobic decomposition can be estimated using various theoretical models. This was done for this project during the feasibility stage to determine the potential maximum amount of methane available.

The collection of every molecule of methane being released is not physically or economically possible. It becomes a question of the number and location of boreholes to be drilled versus the extra expense in drilling the holes and the energy involved in pumping and processing the landfill gas. In addition, the more boreholes that are drilled, the lower the methane concentration in the LFG and the more difficult it becomes to combust these in an engine used to generate electricity.

Most LFG protocols recognize this trade-off and only attempt to quantify the emission reductions from methane that is collected and destroyed. The following was adapted from the Alberta Protocol, section 1.1, which was used as a basis for this Project Plan.

“The baseline condition represents the emissions of GHGs from waste decomposition in a landfill that would have been released to the atmosphere without LFG capture and combustion under controlled conditions. The baseline condition is thus dependent on the volume of LFG captured and combusted, and not on the size, waste composition, operational method or other characteristics of the project landfill. This allows the protocol to be applied across a variety of landfills with an equivalent result.

This protocol does not attempt to estimate or quantify the total GHG emissions from a landfill. The GHG reduction calculation is based on the measurement of the *volume of LFG collected and the assumption that all of the LFG collected would have been released in the absence of an LFG collection system*. Thus the calculation of the total volume of methane generated in the landfill, using modeling or other calculation methods, is not required under this protocol.”

GHG Emission Reduction Calculations

As outlined above, there are two systems for measuring and quantifying the emission reductions from the project:

Methodology 1 – Electricity output of engine – Chicago Climate Exchange protocol - Jan 1, 2008 to Mar 31, 2008

This methodology was taken from the “CHICAGO CLIMATE OFFSET PROJECT PROTOCOL - Landfill Methane Collection and Combustion Offset Projects” protocol document, section 8, page 14. Appendix 1 shows how the CCX formulas were rearranged to produce the formula below. The amount of methane destroyed is based on a calculation using the generated electricity as the activity data, as follows:

$$\text{Tonnes}_{CH_4} = (ELEC_{(generated)} \times HO_{(engine)} \times MolWt_{CH_4} \times GasCons \times VolConv \times GWP_{CH_4}) / 1,000,000 / LHV_{CH_4} \times DE$$

Where

$Tonnes_{CH_4}$ - Tonnes of methane destroyed, in tonnes CO2e

$ELEC_{(generated)}$ - Electricity generated in kWh, measured monthly

$HO_{(engine)}$ - Heat output of generator based on Btu input, 9402.6 Btu/kWh

LHV_{CH_4} - Lower heating value of methane, 918.35 Btu/ft³

$MolWt_{CH_4}$ - Molecular weight of methane, 16.04 g/mole

$GasCons$ - Gas constant, 0.041632 mole/litre

$VolConv$ - Volume conversion, 28.32 litres/ft³

GWP_{CH_4} - Global Warming Potential of methane, 21

DE - Destruction Efficiency, 0.992, taken from Emission Reductions Supply Agreement, Schedule 'B' (page 6)

Methodology 2 – Measured Methane and Specified Calculation from Emission Reduction Benefits Supply Agreement – Apr 1, 2008 to Dec 31, 2008

This methodology used the calculation in Schedule B of the Emission Reduction Benefits Supply Agreement, page 7. The amount of emission reductions is based on the Ideal Gas Law and is the following:

$$\text{Tonnes}_{CH_4} = (PV / RT \times MWt_{CH_4}) / 1,000,000 \times GWP_{CH_4} \times DE$$

Where

$Tonnes_{CH_4}$ - Tonnes of methane destroyed, in tonnes CO₂e

P - Pressure, in atmospheres, at the measurement point.

V - Volume of methane, in cubic meters

R - Gas constant, .08205 m³.atm / mole.°K

T - Absolute temperature, in °K, at the measurement point

MWt_{CH_4} - Molecular weight of methane, 16.04 g/mole

GWP_{CH_4} - Global Warming Potential of methane, 21

DE - Destruction Efficiency, 0.992

The monitoring system became fully operational on April 5, 2008.

Quality Assurance and Quality Control

Since the primary data used in the quantification of the emission reductions is from the methane data logging system, the following processes have been implemented to ensure the integrity of the data.

- The data logger is accessible by only a few individuals;
- The exported data is only handled by two individuals involved in the preparation of the Quantification Reports.
- The exported data is graphed to identify any anomalies.
- The emission reductions are compared with previous similar time periods to determine if they are still reasonable.
- The methane measurement system is calibrated at a minimum of once per year. This calibration uses a sample of gas of known methane concentration to check whether the methane measures it correctly.

Relevant Good Practice Guidance Used in the Project

Relevant good practice guidance procedures and criteria used to quantify the emission reductions from this project include:

- CHICAGO CLIMATE OFFSET PROJECT - Landfill Methane Collection and Combustion Offset Projects protocol
- Alberta Specified Gas Emitters Regulation – Quantification Protocol for Landfill Gas Capture and Combustion
- WRI/WBCSD GHG Protocol for Projects, December 2005
- ISO 14064-2 2006
- CCX® Project Guidelines: Landfill Gas Version 1

Appendix 1 – CCX formulas

Formulas from the CHICAGO CLIMATE OFFSET PROJECT
PROTOCOL - Landfill Methane Collection and Combustion Offset Projects,
section 8, page 14

Equation 1b

$$CH_{4recovered} = (kWh \times [BTU / kWh]) / 918.5$$

Where the Lower Heating Value of methane has been used as this was how the heat rate of the engine generator was stated in this case.

This can be rewritten as Equation 1bx

$$CH_{4recovered} = (ELEC_{(generated)} \times HO_{(engine)}) / LHV_{CH_4}$$

Equation 2

$$CH_{4combusted} = (CH_{4recovered} \times 16.04 \times [1/10^6]) \times [1/24.04] \times 28.32 \times DE$$

This can be rewritten as Equation 2x:

$$CH_{4combusted} = (CH_{4recovered} \times MolWt_{CH_4} \times GasCons \times VolConv) / 1,000,000 \times DE$$

Equation 4

$$ER = (CH_{4combusted} \times 21 \times (1 - OF)) - PE$$

This can be rewritten as Equation 4x

$$Tonnes_{CH_4} = (CH_{4combusted} \times GWP_{CH_4} \times (1 - OF)) - PE$$

Where both *OF* and *PE* are both 0 for this project.

Combining Equations 1bx, 2x and 4x

$$Tonnes_{CH_4} = (ELEC_{(generated)} \times HO_{(engine)} \times MolWt_{CH_4} \times GasCons \times VolConv \times GWP_{CH_4}) / 1,000,000 / LHV_{CH_4} \times DE$$

Appendix 2 – Calculations of construction emissions

Construction of a Landfill gas collection system at the Hy.101 landfill in Sackville, Nova Scotia for the purpose of collecting the LFG and utilizing it as a fuel to generate renewable energy and to reduce emissions of a greenhouse gas(methane).

The following are details on the "carbon footprint" of the construction of the collection system.

In November 2005 Highland commenced construction of the LFG collection system. The system consisted of 74 drilled wells and HDPE electrofused piping to connect the wells to a gas processing facility where the LFG was used as fuel to generate renewable energy.

The total time of construction was 5 months (Nov 2005 to Mar 2006). The wells were drilled in 10 weeks and the piping was installed in 16 weeks.

During the construction phase a drilling rig using a Caterpillar diesel engine as a power source for the drill was used as well as a Caterpillar backhoe (4200) for backup support trenching, and to install the piping.

The drilling rig was utilized for 400 hours. The fuel consumption for the machine was 20 litres per hour. Therefore the diesel fuel consumption for this machine at the construction site was 8000 litres of diesel fuel.

The backhoe was utilized for 1000 hours and consumed 10 litres per hour. Therefore the diesel fuel consumption for the backhoe at the construction site was 10,000 litres.

Total diesel fuel consumption for both vehicles during construction was 18,000 litres.

Using an emission factor of 2.3 kg CO₂e /litre diesel, gives about 41 tonnes CO₂e emitted during the construction of the collection system. This amount is negligible compared to the expected emission reductions of approximately 40,000 to 50,000 tCO₂e per year.

See calculations:

Reference: Government of Canada GHG Inventory as submitted to the UNFCCC Page 620 (table 11-12) Emission factors for energy mobile combustion sources

Diesel Vehicles:

Emit 2.3 kilograms of CO₂e per litre of fuel consumed

Appendix 3 – Demonstration of Legal Additionality Requirements

Highway 101 Landfill, Sackville, Nova Scotia

The following is an investigation into the legislative/legal requirements of the landfill as relating to the capture and destruction of landfill gas.

2001/2003

Highland Energy first investigated the regulatory requirements regarding the Highway 101 Landfill while it was conducting its "due diligence" when negotiating the gas rights agreement with Halifax Regional Municipality (HRM). In our process of inquiry, and in discussions with HRM and the Nova Scotia Dept. of Environment, it was confirmed to Highland that there was no regulatory requirement to capture and combust the landfill gas being generated at the site. Based on this information, Highland executed an agreement with HRM to obtain ownership of the landfill gas in exchange for sharing in the revenue derived from Highland's efforts to achieve commercial benefits from the collection and utilization of the landfill gas. Emission reductions are specifically cited in the gas rights agreement negotiated with HRM.

2005

Highland entered into an agreement to sell all of the emission reductions created between 2008 and 2012 to a third party. Both parties conducted their "due diligence" with regards to the additionality of the emission reductions and both parties concluded that there was no regulatory obligation to capture and combust the landfill gas. Therefore, both agreed that the project was "additional". This mutual conclusion regarding additionality was written into the contract.

2008

Highland applied to the Chicago Climate Exchange (CCX) to offer the emission reductions created in 2007 for sale on the CCX. A validation/verification report was prepared including the question of additionality. Again it was determined, after contacting the Nova Scotia Dept. of Environment, that there was no regulatory requirement to capture and combust the landfill gas thus making the project additional to any regulatory requirement to do so.

2009

Further investigation, relating to a verification report for the third party purchaser of the emission reductions, with the Nova Scotia Dept. of Environment reveals that, in the standard application form to be filed with the department for approval of the construction of a "Municipal Solid Waste Landfill", there is no requirement to control, collect or combust the landfill gas created at the proposed site.

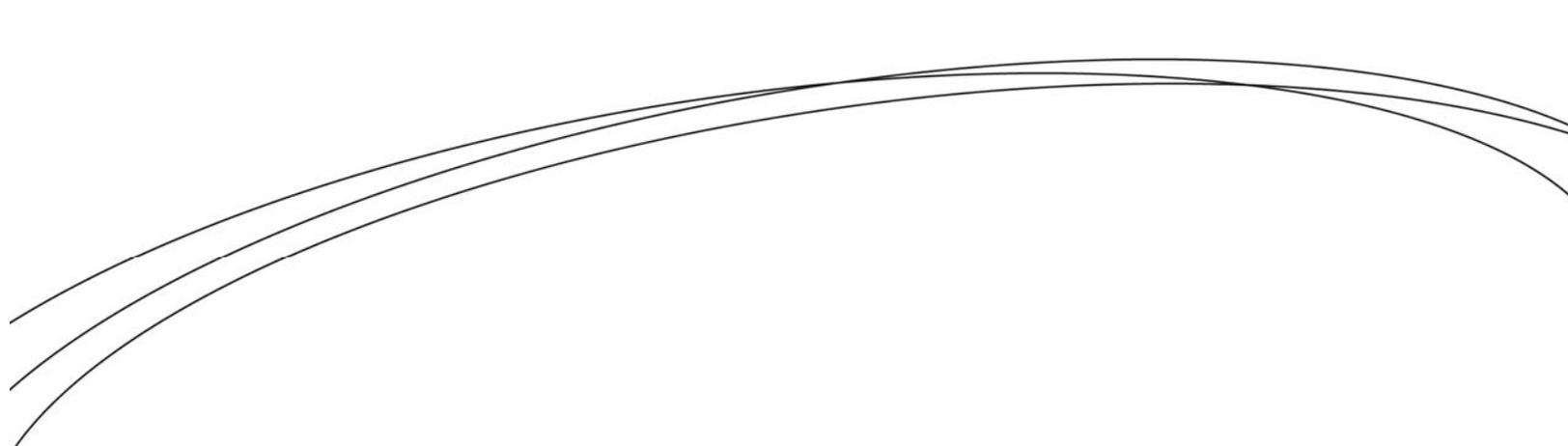
In subsequent conversations with personnel from the Nova Scotia Dept. of Environment the individuals spoken to affirmed that:

- 1) Older closed landfills, such as Highway 101 Landfill in Sackville, Nova Scotia, were never subject to any regulation with regards to control and disbursement of landfill gas and would not be subject to regulation in the future.
- 2) There are no regulations requiring new landfills to control and disburse landfill gas.

Given this information it is possible to conclude that the Highway 101 Landfill in Sackville, Nova Scotia:

- 1) Was never, in the past, subject to regulation requiring the capture and combustion of the landfill gas
- 2) Is not, at this time, subject to regulation requiring the capture and combustion of the landfill gas
- 3) Will not be, in the future, subject to regulation requiring the capture and combustion of the landfill gas.

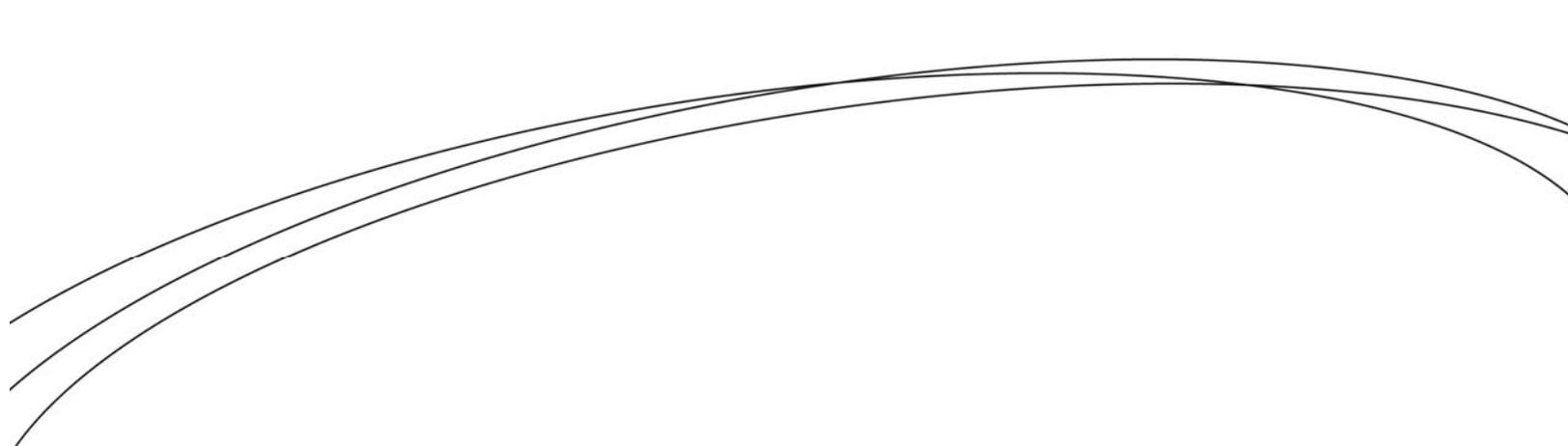
Therefore the Highway 101 Landfill at Sackville, Nova Scotia meets all legal and legislative requirements regarding additionality.



ANNEX 2

BNQ GHG PROJECT VERIFICATION PROGRESS REPORT

Details removed for confidentiality reasons



ANNEX 3

BNQ REQUIRED ACTION REQUESTS (RARs) FINAL STATUS REPORT

Details removed for confidentiality reasons