

PROJECT REPORT FOR CSA STANDARDS GHG CLEANPROJECTS® REGISTRY

Regional District of Nanaimo > Regional Landfill



Regional District of Nanaimo (RDN) Landfill Gas (LFG) Capture and Combustion Greenhouse Gas (GHG) Emission Reductions Project

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The Regional District of Nanaimo (RDN) Landfill Gas (LFG) Capture and Combustion Greenhouse Gas (GHG) Emission Reductions Project (the Project) is located at 1105 Cedar Road, approximately five kilometers (km) south of downtown Nanaimo, British Columbia. The site is currently owned and operated by the Regional District of Nanaimo (RDN). The total area of the Site is approximately 40 hectares, with a landfill area of approximately 21 hectares. The Project involves biogas (used interchangeably with LFG in this report) recovery, biogas conditioning, and the destruction of the captured LFG. In 2003, the RDN installed 21 vertical wells, rehabilitated 4 vertical wells from an existing system, and installed a LFG control station. The system upgrade in 2003 was made of newly installed components and rehabilitated wells from the previous LFG collection system installed and commissioned in 1997.

The Project document for the RDN LFG Capture and Combustion GHG Emission Reductions Project has been developed for submission to GHG CleanProjects® Registry in accordance with the ISO 14064-2: Specification with guidance at the project level for quantification, monitoring, and reporting of GHG emission reductions or removal enhancements.

This Project document presents the emission reductions associated with the Project from January 1, 2013 to April 15, 2015 (Reporting period). It also provides context for the emission reduction claim summary and background to describe and explain the technical approach taken.

2.1. PROJECT BACKGROUND AND SCOPE

The Nanaimo LFG Capture and Combustion Project is located approximately five km south of downtown Nanaimo, British Columbia at 1105 Cedar Road, as showing in Figure 2-1. The Project involves biogas recovery, biogas conditioning, and the destruction of the captured LFG. In 2003, the RDN installed 21 vertical wells, rehabilitated 4 vertical wells from an existing system, and installed a LFG control station. Between 2005 and 2014, additional vertical wells and horizontal collection trenches were added and others were decommissioned from the system.

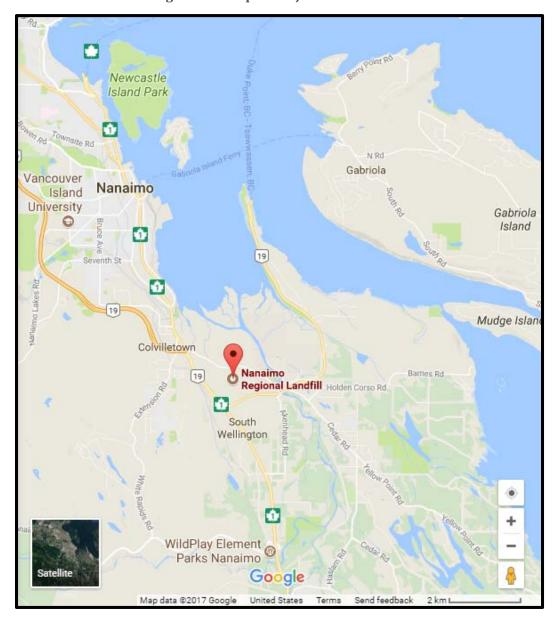


Figure 2-1. Map of Project site location.

Phase I of the Project was validated (positive finding) to a limited level of assurance for the 2004-2008 period. Phase I of the Project involved biogas recovery, conditioning, and flaring. At the end of 2008 and early 2009, significant renovation of the collection system and multiple upgrades and improvements to the facility's control plant, data recording, and collection systems were implemented, thus requiring a separate Project Plan for the 2009-2012 period.

As per the new 2009-2012 Project Plan, the LFG collection system is comprised of 31 connected vertical gas collection wells, and 4 horizontal gas collection trenches. The control system has been digitized and the destruction system includes the use of both a flare and a utilization facility.

The utilization facility includes two Jenbacher J312GS internal combustion engines (ICEs) that combust LFG as feedstock. Each engine is coupled to an Emerson Electric 800 kilowatt (kW) induction generator. The utilization facility is owned, constructed, maintained, and operated by Cedar Road LFG Inc. (Cedar Road). Cedar Road is a third party and does not have a claim on the emission reductions generated. The utilization facility only runs when the flare is operating. An outline of this process is shown in Figure 2-2.

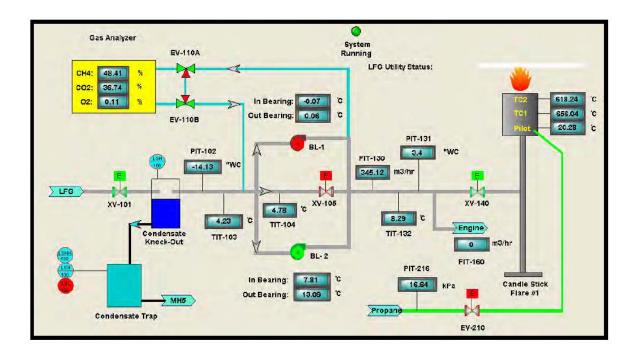


Figure 2-2. Diagram Schematic of the Project Process.

The source of GHG emissions for the baseline scenario is venting of methane (CH₄) directly to the atmosphere, otherwise captured and combusted in the flare or engines of the Project. The relevant GHG sources within the Project boundary (the RDN landfill) will be considered in the verification. The project period covered under this Project document is from January 1, 2013 through April 15, 2015. Emission reductions are calculated as the difference between the baseline emissions and the Project emissions.

2.2. PROJECT DETAILS

2.2.1. Project Title

Regional District of Nanaimo (RDN) Landfill Gas (LFG) Capture and Combustion Greenhouse Gas (GHG) Emission Reductions Project

2.2.2. Purpose(s) and Objective(s)

The primary objective of the Project is to recover, capture, condition, and destruct the LFG generated from the landfill to obtain GHG emission reductions compared to the baseline emissions, which is emissions of LFG containing CH₄ to the atmosphere with no controls.

2.2.3. Expected Lifetime of the Project

2.2.3.1. Site Life

Based upon data from topographic surveys and the historically assumed apparent density of 0.75 tonnes per cubic metre, the remaining airspace available for waste and daily cover at the Project site is 1,697,987 cubic metres, with a remaining site life of approximately 21 years, to 2038,with final cover applied in 2039. The LFG generation is expected to continue at least 20 years beyond the final cover.

2.2.3.2. Provincial Regulation

The Project site operates under Operation Certificate (OC) MR-01714, issued December 30, 2011 by the British Columbia Ministry of Environment (BC MOE). Section 1.3 of the OC states "Landfill gas must be managed in accordance with sections 4.2 and 6.4 of the Landfill Criteria for Municipal Solid Waste."

LFG emissions are regulated in the Province of British Columbia by two documents:

- > Landfill Criteria for Municipal Solid Waste (June 1993); and
- ➤ Landfill Gas Management Regulation (December 2008).

The "Landfill Criteria for Municipal Solid Waste" (hereinafter called the "Criteria") mandates the active collection and destruction of LFG if non-methanogenic organic compounds (NMOCs) associated with emissions of the waste mass exceed 150 tonnes per year. As indicated in the Design and Operations Plan for the Project site prepared by XCG Consultants (retained by RDN) in 2010, a maximum NMOC production rate of 47.8 tonnes per year will be reached in 2028, which is well short of the exceedance threshold (150 tonnes per year). Therefore, the collection and control of LFG at the Project site is not required in order to comply with provincial regulations associated with NMOC emissions.

The Landfill Gas Management Regulation (hereinafter called the "Regulation") stipulates that LFG shall be actively collected, at landfill sites assessed to generate more than 1,000 tonnes of CH_4 per year, by January 1, 2016.

As stipulated in the Regulation, the RDN submitted a LFG Assessment Report in December 2010, based upon the LFG generation modelling protocols outlined by the BC MOE document entitled, "Landfill Gas Generation Assessment Guidance Report," dated March 2009. Based upon this document, the Project site is generating in excess of 1,000 tonnes of CH₄ and will be mandated to collect LFG as of January 1, 2016.

As such, the Project will not be able to meet "surplus" lelement of the Project eligibility as of January 1, 2016. In other words, the lifetime of the Project ended as of January 1, 2016 for emission reduction credit purposes.

2.2.4. Type of GHG Emission Reduction or Removal Project

Project Type: LFG recovery project where GHG emission reduction is achieved by capturing and combusting LFG, including CH₄.

Similar to other typical LFG recovery projects, CH₄ is the only GHG that is of material significance. Other GHGs that are required to be quantified for emission reduction projects, such as nitrous oxides and refrigerants, are considered insignificant or immaterial when quantifying the GHG reduction of a LFG project.

2.2.5. Legal Land Description of Project or Unique Latitude and Longitude

The Project is located at Nanaimo Regional Landfill at 1105 Cedar Road, approximately five km south of downtown Nanaimo, British Columbia. The site is currently owned and operated by the RDN. The total area of the Site is approximately 40 hectares, with a landfill area of approximately 21 hectares. The Project involves LFG recovery, conditioning and the destruction of the captured LFG.

Project Latitude: 49.118950Project Longitude: -123.896695

2.2.6. Conditions Prior to Project Initiation

Before the initial LFG collection system that was installed and commissioned in 1997, the LFG emissions, including CH₄, were vented directly to the atmosphere.

2.2.7. Description of GHG Emission Reductions Achievement

The source of GHG emissions for the baseline scenario is venting of CH₄ directly to the atmosphere. The Project generates GHG emission reduction by capturing and combusting LFG, including CH₄, by RDN's combustion system, which is comprised of a flare and a utilization facility. The utilization facility includes two Jenbacher J312GS internal combustion engines (ICEs) that combust LFG as feedstock. The GHG reductions are calculated, therefore, from a baseline of emissions that would have been emitted from continued venting of LFG to the atmosphere at the RDN landfill.

2.2.8. Project Technologies, Products, Services and Expected Level of Activity

As per the new 2009-2012 Project Plan, the LFG collection system is comprised of 31 connected vertical gas collection wells, and 4 horizontal gas collection trenches. The control system has been digitized and the destruction system includes the use of both a flare and a utilization facility. The utilization facility includes two Jenbacher J312GS ICEs that combust LFG as feedstock. Each engine is coupled to an Emerson Electric 800 kW induction generator. The utilization facility is owned, constructed, maintained, and operated by Cedar Road LFG Inc. (Cedar Road). Cedar Road is a third party and does not have a claim on the emission reductions generated. The utilization facility, and therefore the ICEs, only runs when the flare is operating.

 $^{^1}$ "Surplus" means that reductions are not required through regulation or other obligations including voluntary commitments.

The LFG is combusted in an open type flare at the LFG Control Plant, located at the Project site. The reported minimum destruction efficiency of an open type flare is 98 percent. This destruction efficiency is based on the United States Environmental Protection Agency (EPA) document, AP-42 Section 13.5.² As reported by the United States EPA document, "Emission Factor Documentation for AP-42 Section 2.4," a CH₄ control efficiency of 99.9 percent can be assumed for any well operated and maintained LFG combustion equipment.³ A conservative CH₄ destruction efficiency of 98 percent was assumed for the Jenbacher type 312 (JGS 312 GS-L.L) ICEs operating as part of the LFG Utilization Plant.

2.2.9. Total GHG Emission Reductions and Removal Enhancements

The total GHG emissions reduction achieved during the reporting period is summarized and presented in Table 2-1.

Table 2-1. Total GHG Emission Reduction Summary (GHG Assertion)

	PFC	HFC	SF ₆	CO_2	CH ₄	N_2O	Total
Vintage Period	CO2e (tonnes)	CO2e (tonnes)	CO2e (tonnes)	CO2e (tonnes)	CO2e (tonnes)	CO2e (tonnes)	CO ₂ e (tonnes)
January 1, 2013 through December 31, 2013	-	-	-	-	25,928.0	-	25,928.0
January 1, 2014 through December 31, 2014	-	-	-	-	28,622.8	-	28,622.8
January 1, 2015 through April 15, 2015	-	-	-	-	8,302.3	-	8,302.3
Combined	-	-	-	-	62,853.1	-	62,853.1

For this Project, CH_4 is the only GHG that is of material significance. Other GHGs that are required to be quantified for emission reduction projects, such as carbon dioxide (CO_2), nitrous oxides (N_2O), hydrofluorocarbons (HFCs), perflurocarbons (PFCs) and Sulphur hexafluoride (SF_6) are considered insignificant or immaterial when quantifying the GHG reduction of the LFG Project.

2.2.10. Identification of Risks

There are no or negligible risks to annual emissions reductions claimed by the Project as the documents are based on empirical data of historic operation. In order to maintain Project performance in future years, RDN manages the risks described in Table 2-2.

² EPA. AP-42 Section 13.5. 2016. https://www3.epa.gov/ttn/chief/ap42/ch13/final/C13S05 12-13-16.pdf

³ EPA. Background Information Document for Updating AP42 Section 2.4 for Estimating Emissions from Municipal Solid Waste Landfills. 2008. https://www3.epa.gov/ttnchie1/ap42/ch02/draft/db02s04.pdf

Table 2-2. Risk to Annual Emission Reductions

Category	Identification and Descriptions
A. Risk	Make-up change in landfill waste mix, specifically substantial reduction in and/or diversion of organic waste.
A. Mitigation	Since the change of landfill waste mix would affect the LFG generation approximately 3-5 years later because of the relatively slow decomposition rate, there is no immediate impact to the Project. When it manifests as a Project impact, the Project would reflect the changes in LFG generation.
B. Risk	Force Majeure, which means circumstance or events that involve damage to installed infrastructure, which was not foreseeable by or within the reasonable control of RDN.
B. Mitigation	The Project would describe and reflect the changes in LFG utilization and flaring in the event of damage to installed infrastructure.
C. Risk	Construction or expansion projects that require the Project to be offline or changed in terms of fundamental design, infrastructure, and/or equipment.
C. Mitigation	When construction projects are conducted, appropriate plans are developed to minimize downtime and impact to the Project performance. In the case that the Project is partially taken offline for construction, the Project data will reflect changes and activities will be qualitatively described within the Project document.

2.2.11. Roles and Responsibility

Parties involved in the Project and descriptions of respective roles and responsibilities along with full contact information are summarized in Table 2-3.

Table 2-3. Summary of Project Contact, Roles, and Responsibilities

Primary Contact Information	Roles and Responsibilities
Jane Hamilton, Superintendent of Landfill Operations Regional District of Nanaimo 1105 Cedar Road Nanaimo, BC, V9X 1K9 Phone: 250-722-2044 Fax: 250-722-9437 Email: jhamilton@rdn.bc.ca	RDN, a local government corporation organised and existing under the laws of the Province of British Columbia. Role: Owner/operator of the landfill Responsibility: Installed and maintains LFG system (flare station and well-field), and supply LFG gas to the utilization facility. As Superintendent, Ms. Hamilton manages the landfill operations and oversees the Project operation.

Primary Contact Information	Roles and Responsibilities
Tom Johnson Project Verification Officer Green Municipal Corporation 24 Clarence Street Ottawa, Ontario K1N 5P3 Phone: 613-241-5221 x240 Email: Tjohnson@FCM.ca	GMC, a corporation formed under the laws of Canada, has reached an contractual agreement to take a potential claim or tile to any emission reductions (ERs) or emission reduction rights (ERRs) and benefits resulting from the Project. GMC was a group funded by the Federation of Canadian Municipalities (FCM) that funded GHG reduction initiatives. One of the conditions of a grant RDN received from FCM was that the RDN transferred the emission rights arising from the collection and flaring of gas to the GMC. GMC was deactivated in 2008. As Project Verification Officer, Mr. Johnson ensured conformance to all of the contractual requirements.
Paul Liddy Owner Cedar Road Bioenergy Inc. 1105 Cedar Road Nanaimo, BC, V9X 1K9 Email: pliddy@suncurrent.ca	CRB is a clean energy company that excels in processing biogas and reducing greenhouse gas emissions. The utilization facility at the Regional Landfill is owned, constructed, maintained, and operated by Cedar Road LFG Inc. (Cedar Road). Role: Landfill Gas Utilization Owner/Operator. Responsibility: Comply with RDN site and regulatory requirements, prime contractor for licensed to occupy area and supply of electricity solely to BC Hydro. CRB is a third party and does not have a claim on the emission reductions generated.
Michel Lefebvre, M.Sc., P. Eng. Senior Project Manager XCG Consultants Ltd. 10455-84th Avenue Edmonton, AB T6E 2H3 (Note: now with Tetra Tech Canada Ltd.) Email: Michel.LeFebvre@tetratech.com	XCG Consultants Ltd. (XCG) was retained by the Regional District of Nanaimo (RDN) to prepare the "Annual Emission Reduction Report" for the greenhouse gas (GHG) emission reductions associated with the Project at the site for 2013, 2014, and 2015. Role: Project Engineer. Responsibility: Landfill gas system design and support including the Project reporting. As Senior Project Manager, Mr. Lefebvre managed the overall tasks and activities involved in developing the annual report and reviewed the report documents for accuracy and validity.

Primary Contact Information	Roles and Responsibilities
Daniel Hegg, M.Sc., EMIT Lead Verifier and Project Manager Stantec Consulting Ltd. 400 - 655 Tyee Road Victoria, BC V9A 6X5 Phone: 250-217-9729 Email: daniel.hegg@stantec.com	Stantec Consulting Ltd (Stantec) was contracted by the Regional District of Nanaimo (RDN) to conduct an independent third-party verification of the greenhouse gas (GHG) assertion provided in the "RDN Annual Emission Reduction Report" (the Annual Project Report) for 2013, 2014, and 2015. As Lead Verifier and Project Manager, Mr. Hegg was responsible for planning and executing the verification in order to deliver an opinion as to whether the Project Report is presented fairly and in accordance with the verification criteria (GMC MVP and ISO 14064:3).
Charles C. Lee, Ph.D. Principal Consultant Trinity Consultants, Inc. 20 Corporate Park, Suite 200 Irvine, CA 92606 Phone: 949-981-8949 x102 Email: clee@trinityconsultants.com	Trinity Consultants, Inc. (Trinity) was contracted by Zerofootprint Software Inc. to consolidate the RDN Annual Emission Reduction Reports from 2013 through April 15, 2015 and develop a GHG Report for submission to GHG CleanProjects® Registry (the Registry). As Project Manager, Dr. Lee was responsible for the overall tasks and activities involved in developing the GHG report for the Registry.
Ron Dembo Zerofootprint Software Inc. 392 Markham Street Toronto, ON M6G 2K9 Canada Phone: 416-365-7557 Fax: 416-987-0623 Email: ron.dembo@zerofootprint.net	Zerofootprint Software Inc. (ZFP or "Buyer") under Emission Reduction Purchase Agreement with GMC ("Seller) is rightful owner of the Regional District of Nanaimo Landfill Gas Capture Carbon Reduction Offsets for the vintages: year 2013, year 2014, and January1st through April 15th, 2015. ZFP also is the entity that initially submitted the initial Canadian Standards Association (CSA) application for GHG CleanProjects® Registry. As Authorized Project Contact, Mr. Dembo was responsible to manage all communication with CSA with respect to the Project; make payments owing to CSA; and provide listing and delisting instructions to CSA with respect to the Project and emission reduction credits.

2.2.11.1. Offset Ownership and Responsible Entity

Zerofootprint Software Inc. (ZFP) is the rightful owner of the Regional District of Nanaimo Landfill Gas Capture Carbon Reduction Offsets for the vintages: year 2013, year 2014, and January1st through April 15th, 2015 as per

Emission Reductions Purchase Agreement⁴ between Green Municipal Corporation (GMC) and ZFP. dated September 15, 2015.

ZFP has duly authorized Trinity Consultants to re-prepare the GHG report so that ZFP can register the offsets for CSA Standards GHG CleanProjects® Registry since the offset has not been listed on any other registries or related registry entities.

2.2.12. Information Relevant for Eligibility of GHG Project

RDN implemented a project management approach to LFG capture and combustion process including GHG emission management at the project level that is consistent with the ISO 14064-2 principles.

In general, ISO 14064 helps to make improvements for the following areas:

- > Enhanced credibility, consistency, and transparency of GHG quantification, monitoring and reporting, including GHG project emission reductions and removal enhancements;
- > Enhanced environmental integrity of the GHG calculation and quantification;
- > Enhanced tracking of performance and progress in the reduction of GHG emissions and/or increase in GHG removals; and
- More transparent and accurate crediting and trade of GHG emission reductions.

In addition, this Project meets and is consistent with the annual reporting requirements as specified in Article 4.1(b) of the Project Transfer Agreement (Agreement) between the RDN and the Green Municipal Corporation (GMC) and prescribed in the Green Municipal Corporation Measurement, Monitoring, Reporting, and Verification Protocol (GMC MVP)⁵ for Greenhouse Gas Emission Reductions from designated projects funded through the Green Municipal Fund (GMF).

This protocol (GMC MVP) provides guidance for proponents of applicable projects on monitoring and reporting matters outlined in each of the following sections:

- Measuring and monitoring GHG emissions and quantifying the emission reductions that result from an applicable project;
- > Reporting on the GHG emissions reduction that result from an applicable project;
- > Selecting and retaining a verifier; and
- Conducting a verification and completing a verification report.

An "Emission Reduction" under the GMC MVP is defined as a real, measurable, verifiable, surplus, unique, incremental, and sustainable reduction in the GHG emission intensity resulting from a project relative to baseline emission intensity within the project boundaries, as such reductions, and are measured and reported as metric tonnes of carbon dioxide equivalent (CO_2e) in accordance with a defined set of measurement, monitoring and reporting criteria.

In general, RDN landfill and its GHG management program are committed to ISO principles as follows:

⁴ The Emission Reductions Purchase Agreement is provided in Appendix A.

⁵ The GMC MVP can be found in Appendix B.

- **Relevance:** Selecting the GHG sources, GHG sinks, GHG reservoirs, data, and methodologies appropriate to the needs of the intended user.
- **Completeness:** Including and/or addressing all relevant GHG emissions and removals. Include all relevant information to support criteria and procedures.
- **Consistency:** Enabling meaningful comparisons in GHG-related information.
- **Accuracy:** Reducing bias and uncertainties as far as is practical.
- **Transparency:** Disclosing sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence.
- **Conservativeness:** Using conservative assumptions, values, and procedures to ensure that GHG emission reductions or removal enhancements are not overestimated.

2.2.13. Summary Environmental Impact Assessment

An environmental impact assessment was not required for the RDN Project.

2.2.14. Relevant Outcomes from Stakeholder Consultations and Mechanisms for On-going Communication

RDN is not required by legislation or regulation to carry out public and/or other stakeholder consultations. Stakeholders are made aware, however, of the Project through obligatory and voluntary consultative activities carried out by related Project partners and interested parties.

2.2.15. Detailed Chronological Plan

Table 2-4 provides details of the Project implementation, including date of initiating the Project, end date of Project, frequency of monitoring and reporting and the Project period, including relevant Project activities in each step of the GHG Project cycle as well as transaction history.

Table 2-4. Summary of Project Timeline

Time Period	Activity or Events
1940s	The RDN landfill site opened in the 1940s and was approximately 37
	hectares in size.
1991	The 13.7-hectare operational area of the site was implemented with a high-density plastic liner and began receiving municipal solid waste (MSW) from the Regional District of Nanaimo.
1996	The 8.8-hectare unlined portion of the site was closed.
1997	Initial LFG collection system was installed in.
(Project-start)	
2003	LFG collection system expansion - Phase I: A consulting engineer was
(Project Expansion-Phase I)	retained by the RDN in April 2003 to design the LFG collection system expansion. In 2003, the RDN installed 21 vertical wells, rehabilitated 4 vertical wells from an existing system, and installed a LFG control station. Between 2005 and 2014, additional vertical wells and horizontal collection trenches were added and others were decommissioned from the system. Phase I of the Project involved LFG recovery, conditioning, and flaring.
2004 (Project Expansion-Phase II)	LFG collection system expansion - Phase II: The horizontal LFG collection trench design was completed by an engineering consultant in February 2004. The Phase II LFG collection system expansion also included the expansion of the vertical LFG collection well-field.

Time Period	Activity or Events
Late 2008 and early 2009	Significant renovation of the collection system and multiple upgrades and improvements to the facility's control plant, data recording, and collection systems were implemented, thus requiring a separate Project Plan for the 2009-2012 period.
	The control system has been digitized and the destruction system includes the use of both a flare and utilization facility.
April 2005	Project and Transfer Agreement (Agreement) is made as of April 15, 2005 between RDN and GMC to deliver and transfer emission reductions and emission reduction rights from RDN to GMC.
January 1, 2013-December 31, 2013 (2013 Reporting Period)	XCG Consultants Ltd. (XCG) was retained by the RDN and prepared the "2013 Annual Emission Reduction Report" for the greenhouse gas (GHG) emission reductions associated with the Project at the Site.
January 1, 2014-December 31, 2014 (2014 Reporting Period)	XCG was retained by the RDN and prepared the "2014 Annual Emission Reduction Report" for the GHG emission reductions associated with the Project at the site.
January 1, 2015-April 15, 2015 (2015 Reporting Period)	XCG was retained by the RDN and prepared the "2015 Emission Reduction Report" for the GHG emission reductions associated with the Project at the site.
September 15, 2015	Emission Reduction Purchase Agreement is made as of September 15, 2015 between Zerofootprint Software Inc. (ZFP or "Buyer") and GMC ("Seller). Seller is to sell, deliver and transfer to the Buyer, and the Buyer is to pay for and purchase the stipulated quantities of Verified Emission Reduction(s) or VERs set out in the Delivery Schedule of the agreement.
September 30, 2015	GMC sold and delivered 12,964 tonnes of CO ₂ e (2013 vintage) to ZFP as specified in the Delivery Schedule of the agreement.
October 15, 2015	GMC sold and delivered 12,964 tonnes of $CO_{2}e$ (2013 vintage) to ZFP as specified in the Delivery Schedule of the agreement.
November 1, 2015	GMC sold and delivered 14,311 tonnes of $CO_{2}e$ (2014 vintage) to ZFP as specified in the Delivery Schedule of the agreement.
December 1, 2015	GMC sold and delivered 14,311 tonnes of CO_2e (2014 vintage) to ZFP as specified in the Delivery Schedule of the agreement.
April 2016	GMC sold and delivered 8,302 tonnes of CO ₂ e (2015 vintage – January 1 st though April 15 th) to ZFP as specified in the Delivery Schedule of the agreement.
January 1, 2016 (Project-end)	The Landfill Gas Management Regulation (hereinafter called the "Regulation") stipulates that LFG shall be actively collected, at landfill sites assessed to generate more than 1,000 tonnes of CH ₄ per year, by January 1, 2016. As such, the Project will not be able to meet "surplus" element of the Project eligibility as of January 1, 2016. In other words, the lifetime of the Project is ended as of January 1, 2016.

3. SELECTION AND JUSTIFICATION OF BASELINE SCENARIO

As described by the Registry, the baseline scenario is the hypothetical reference case that best represents the conditions most likely to occur in the absence of a proposed GHG project. The baseline scenario typically represents the 'business as usual' situation and the Project represents the change from this practice. Prior to the implementation of the Project, there were no collection and destruction facilities at the Project site, and LFG was allowed to vent to the atmosphere. Reductions are calculated, therefore, from a baseline of continued venting of LFG emissions to the atmosphere at the Nanaimo Regional Landfill.

3.1. BASELINE SCENARIO SELECTION

The following six steps were used in identifying baseline scenario possibilities:

- Define the product or service provided by the project activity;
- Identify possible types of baseline scenarios;
- > Define and justify the geographic area and the temporal range used to identify baseline scenarios;
- Define and justify any other criteria used to identify baseline scenarios;
- Identify a final list of baseline candidates; and
- Identify baseline scenarios 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 scenario candidates.

In order to appropriately select baseline scenarios, the project activity must be clearly defined so as to select baseline scenario 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 British Columbia, Canada and the temporal range of project period will include the years 2013 through April 15, 2015. Table 3-1below lists potential baseline scenarios considering the project description and Source, Sinks, and Reservoirs (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 Scenario Possibilities

Venting to atmosphere (Business as usual – No LFG capture and combustion)

LFG capture and conversion to alternative fuel (methanol)

Incineration of waste

Composting

Table 3-1. Possible Baseline Scenarios

3.2. BASELINE SCENARIOS JUSTIFICATION

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

- Infrastructure
- Technology availability

- Financial
- > Legal requirement
- Resource & Data availability

Table 3-2below 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 scenarios and additional information are considered), completeness (all potential baseline scenarios are considered), consistency (same barriers are applied to all potential baseline scenarios 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.

Table 3-2. Barriers Assessment Table with Baseline Scenario Option Comparison

Barrier Type	Infrastructure	Technology availability	Financial	Legal requirement	Resource & Data availability
Project (LFG capture and combustion)	No barrier	No barrier	High costs associated with implementation of a new infrastructure	Not required by law	No barrier
Venting to atmosphere (business as usual)	No barrier	No barrier	No barrier	Not required / prohibited by law	No barrier
Capture and conversion to alternative fuel (methanol)	No barrier	Lack of proven technology to achieve this activity	Capital Cost of infrastructure is prohibitive	Not required by law	Lack of resources and data available for comparative purposes
Incineration of waste	No barrier	No barrier	Capital cost and cost of infrastructure is prohibitive	Not required by law	No barrier
Composting	No barrier	No barrier	Capital cost and cost of infrastructure is prohibitive	Not required by law	No barrier

4. INVENTORY OF SOURCES, SINKS, AND RESERVOIRS (SSR)

4.1. PROJECT AND GHG ASSESSMENT BOUNDARIES

The GHG assessment boundary for the Project includes all relevant emission sources from the operation of the LFG collection system to the ultimate destruction of the LFG. CO_2 emissions associated with the generation and destruction of LFG are considered biogenic emissions (as opposed to anthropogenic) and will not be included in the GHG reduction calculation. This is consistent with the Intergovernmental Panel on Climate Change's (IPCC's) guidelines for captured LFG.

Also included within the Project boundary is the utilization facility that uses two Jenbacher J312GS ICEs) that combust LFG as feedstock. Each engine is coupled to an Emerson Electric 800 kW induction generator. As previously noted, the utilization facility is owned, constructed, maintained, and operated by Cedar Roads.

It is worthy to note that a LFG storage balloon was added in 2012 to store LFG prior to combustion by the engines at the utilization facility. The implication of this storage has on emission reductions of the Project, for example, is that the portion of CH₄ stored in the balloon on the last day of each crediting period is assumed to be combusted. This assumption may lead to an over-estimation of claimed reductions (e.g., GHG reduction assertion). However, the magnitude of the discrepancy associated with such assumption is so small (less than 0.002% of claimed reduction) that it should be considered negligible or immaterial.

4.2. SOURCES, SINKS, AND RESERVOIRS (SSRS)

Project SSRs were identified based on definitions within ISO 14604-2: 2006 standards, which are summarized as follows:

- Source represents physical unit or process that releases a GHG into the atmosphere.
- Sink represents physical unit or process that removes a GHG from the atmosphere.
- > Reservoir represents physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store or accumulate a GHG removed from the atmosphere by a GHG sink or GHG captured from a GHG source.

As a starting point, potentially relevant SSRs were identified using the Project knowledge. The following are identified as relevant SSRs to be included in the quantification of a Project's net GHG emissions in CO_2e :

- **▶** Destruction of CH₄ via ICEs for electricity generation;
- Destruction of CH₄ via flare/flaring system; and
- > Emissions resulting from grid derived electrical energy used by compressors, blowers, and other fossil fuel powered equipment (flare pilot) at the LFG processing plant/stage (Plant parasitic load emissions).

Table 4-1 provides a comprehensive list of SSRs controlled by, affected by, or related to the Project, and how they relate to the baseline scenario. Emission SSRs are classified as either being included in the baseline scenario or additional to the baseline scenario as a result of Project implementation and ongoing operations. Note that all SSRs related to waste collection and landfill operations (i.e., upstream operations) are considered to be outside of the Project boundary as they would have occurred in the absence of the Project activity, and, therefore, are not considered in this Project-specific list of GHG SSRs.

Table 4-1. Baseline and Project Sources, Sinks, and Reservoirs

GHG Source Type	GHG Source, Sink, or Reservoir (SSRs)	Included in Baseline Emission (Yes or No)	Included in Project Emission (Yes or No)	Emission Type (C, R, or A) ¹	Comments
Landfill	Source: Fugitive emissions from landfill	Yes	No	R	The reduction of this Baseline emission source forms the basis of emission reductions achieved by this Project. Higher fugitive GHG emissions would have occurred if the Project did not exist, but the Project does not collect 100% of the methane and CO ₂ in landfill biogas. Fugitive emission from landfill is excluded from the Project emission quantification as the amount of fugitive emission is relatively and immaterial.
	Reservoir: Temporary CH ₄ storage	No	No	R	If any, it is temporary, thus net zero storage; therefore, consideration is not required.
LFG Collection System	Source: Fugitive GHGs from well heads and collection headers.	No	No	R	GHG would have occurred if the Project did not exist. However, fugitive emission from well heads and collection headers is excluded from the Project emission quantification as the amount of fugitive emission is relatively and immaterial.
	Source: GHGs resulting from grid derived electrical energy used by blowers, compressors, and other fossil fuel powered equipment.	No	No	R	Excluded based on simplification principle as well as any additional fuel used during the Baseline and Project scenario would be negligible or immaterial.

GHG Source Type	GHG Source, Sink, or Reservoir (SSRs)	Included in Baseline Emission (Yes or No)	Included in Project Emission (Yes or No)	Emission Type (C, R, or A) ¹	Comments
Flare System	Source: CH ₄ emissions	No	Yes	С	Some CH ₄ emissions remain from incomplete combustion by the flare system.
	Source: CO ₂ emissions from the combustion of LFG by flare	No	No	С	Biogenic CO_2 emissions are not included in the Project emission.
	Source: GHG emissions from the combustion of fossil fuel by pilot	No	No	С	Pilot fuel for flare stack is excluded as this has been shown to be immaterial relatively to LFG combustion.
	Sink: CH ₄ destruction from combustion of LFG by flare	No	Yes	С	Combustion of CH ₄ by the flare reduces GHG emissions.
ICEs for Electricity Generation System	Source: CH ₄ emissions	No	Yes	С	Some CH ₄ emissions remain from incomplete combustion by the ICE.
	Source: CO ₂ emissions from the combustion of LFG by ICEs	No	No	С	Biogenic CO_2 emissions are not included in the Project emission.
	Sink: CH ₄ destruction from combustion of LFG by ICEs	No	Yes	С	Combustion of CH ₄ by the ICE reduces GHG emissions.

Note 1: Controlled (C), Related (R), and Affected (A).

5. QUANTIFICATION AND CALCULATION OF GHG EMISSIONS/REMOVALS

Quantification of the reductions will be completed using the methodologies outlined below. In general, emission reductions are calculated using the following equation:

Emissions Reduction = Emissions Baseline - Emissions Project

The RDN Landfill Project creates a net reduction in GHG emissions that is surplus (additional), real, and not the result of a shutdown or cessation of an activity. The emission reductions related to the facility's operations are quantifiable based on metered and measured data, which meets the accuracy criteria via periodic calibration/maintenance or manufactured specification. The most precise factor or calculation approach was selected based on best available information when assumptions or estimates must be made in lieu of empirical data. When more than one selection option is available, the most conservative factors or calculation approaches were utilized to prevent any over-estimates. The following general quantification principles were relied on as they were intended to provide general guidance for Project proponents in quantifying resulting emission reductions in a manner that facilitates national and international consistency and accuracy in the calculation of GHG emissions reductions:

- The GMC MVP for GHG Reductions from Designated Projects Funded Through the GMF (Schedule B of Agreement between RDN and GMC);
- Revised 1996 IPCC Guidelines for National GHG Inventories:
- Good Practice Guidance and Uncertainty Management in National GHG Inventories; and
- ➤ ISO 14064-2 Greenhouse Gases Part 2: Specification with Guidance at the Project Level for Quantification, Monitoring and Reporting of GHG Emission Reductions or Removal enhancements, 2006.

5.1. BASELINE EMISSIONS

The volume of CH_4 recovered and captured that would otherwise have been released to the atmosphere represent the baseline scenario for this Project. The baseline scenario is somewhat variable and dynamic since the composition of CH_4 in LFG is variable and dynamic; thus the volume of CH_4 varies relative to factors such as the age of the landfill and the landfill waste mix. Since captured LFG volume and composition is measured, the quantity of CH_4 destroyed rather than released as fugitive emissions is known.

The baseline emissions for the Project can be determined according to the simplified calculation equation as follows:

Emissions Baseline = $V \times C \times D \times GWP_{CH4}$ [Equation 1]

Where,

Emissions Baseline = Emissions from baseline scenarios (tonnes CO₂e).

V = Volume of LFG recovered and captured (m³)

C = Concentration of CH₄ (% Vol.)

D = Density of CH₄ at 25°C and 1.0 Atmosphere (0.0006557 tonne/m³ CO₂e)

GWP_{CH4} = Global Warming Potential⁶ (GWP) for CH₄

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⁶ British Columbia has updated the global warming potentials (GWPs) that are used for various regulations including Greenhouse Gas Emission Reporting Regulation. The update took effect for 2014 calendar year emissions report and

5.2. PROJECT EMISSIONS

For this Project, the Project emissions would represent volume of CH₄ released into the atmosphere as result of incomplete combustion from the destruction system, which includes the use of both a flare and utilization facility with two ICEs that combust LFG as feedstock.

As discussed in Sections 2.2.7 and 2.2.8, the LFG is combusted in an open type flare at the LFG control system. The reported minimum destruction efficiency of an open type flare is 98 percent. This destruction efficiency is based on the EPA document, AP-42 Section 13.5. As reported by the EPA document, "Emission Factor Documentation for AP-42 Section 2.4", a CH₄ control efficiency of 99.9 percent can be assumed for any well operated and maintained LFG combustion equipment. A conservative CH₄ destruction efficiency of 98 percent was assumed for the ICE engines operating as part of the LFG utilization system.

The project scenario emissions for the Project can be determined according to the simplified calculation equation as follows:

Emissions $Project = V \times C \times D \times GWP_{CH4} \times (1 - Dst)$ [Equation 2]

Where,

Emissions $_{Project}$ = Emissions from project operations (tonne CO_2e). V = Volume of LFG recovered and captured (m³).

C = Concentration of CH_4 (%Vol.).

D = Density of CH₄ at 25° C and 1.0 Atmosphere (0.0006557 tonne/m³ CO₂e).

 GWP_{CH4} = GWP for CH_4

Dst = Flare and ICE destruction efficiency in fraction (0.98).

5.3. PROJECT EMISSIONS REDUCTION

Combining Equations 1 and 2, the total emission reduction equation for the Project can be simplified as follows:

Emissions Reduction = $V \times C \times D \times GWP_{CH4} \times Dst$ [Equation 3]

Where,

Emission Reduction = Emissions reduced or destructed from project operations (tonne CO₂e).

V = Volume of LFG recovered and captured (m³).

C = Concentration of CH_4 (V% Vol.).

D = Density of CH_4 at 25°C and 1.0 Atmosphere (0.0006557 tonne/m³ CO_2 e).

 $GWP_{CH4} = GWP \text{ for } CH_4$

Dst = Flare and ICE destruction efficiency in fraction (0.98).

Appendix C also provides additional details of sample calculations for RDN landfill emission reduction as reference.

subsequent reports under the Reporting Regulation. The updates to British Columbia's GWPs are in parallel with updates made 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 GWPs previously used were those from IPCC's 2nd Assessment Report. As such, methane GWP of 21 was used for 2013 data while methane GWP of 25 was sued 2014 and 2015 for this Project emission reduction report.

The Project emission, baseline emission, and the total emission reductions claimed are summarized in the Table 5-1.

Table 5-1. Summary of Baseline, Project, and Total Reduction Emission Estimates

Period	Baseline Emission CO ₂ e (tonnes)	Project Emission CO ₂ e (tonnes)	Total Reduction CO ₂ e (tonnes)
January 1, 2013 through December 31, 2013	26,457.1	529.1	25,928.0
January 1, 2014 through December 31, 2014	29,206.9	584.1	28,622.8
January 1, 2015 through April 15, 2015	8,471.7	169.4	8,302.3
Total GHG Emission Reduction	64,135.8	1,282.7	62,853.1

6. DATA INFORMATION MANAGEMENT SYSTEM AND DATA CONTROLS

6.1. DATA MONITORING AND CONTROL

The selected methodology requires that volume of methane be measured over the time period of the emission calculations. To enable this measurement, a methane measurement and data logging system was installed at the LFG Control Plant of the RDN landfill. This system measures the flow rate and concentration of methane as it flows from the landfill collection system into the combustion system (flare and ICEs).

6.1.1. Data Sources and Management

In general, measurement and monitoring of the Project and associated emission reductions take place as described hereafter.

6.1.1.1. Flow Instrumentation

Two flow measurement instruments are installed in the Control Plant (FIT-130), with the 4-20mA signal from an additional flow meter, located at the Utilization Facility (FIT-160) connected to the Control Plant PLC.

The flow measurement instruments are Thermal Instrument Company model 62-9 constant temperature differential thermal mass flow metres. These flow meters operate on the principal that the mass flow can be calculated based upon the amount of electrical power required to maintain a constant difference in temperature between two temperature sensors. As such, no temperature or pressure corrections are required, while the instrument retains its accuracy over a wide range of flow rates.

The specifications for the 62-9 thermal mass flow meter are as follows:

- Range: 0 to 800 standard cubic metres per hour (470 scfm);
- Output: 4-20 mA: and
- Accuracy: ±0.5 percent full scale.

It is important to note that flow data from FIT-130 were exclusively used for the purpose of the Project GHG emission reduction calculation since it measures the combined LFG flow before the gas flow is split between the Control Plant and Utilization Facility (Refer to Figure 2-2 for schematic diagram of the LFG flow).

6.1.1.2. Landfill Gas Analyzer

A LFG Analyzer is installed in the Control Plant (GA-120) for the purpose of monitoring gas composition both for operational and reporting reasons and for health and safety (i.e., ensuring that oxygen levels do not elevate to lower explosive concentrations, and that methane concentrations remain above the critical set point).

The LFG Analyzer, Nova Analytical Systems model 903C-CW, consists of a nondispersive infrared (NDIR) methane (CH_4) and carbon dioxide (CO_2) sensor and an electrochemical oxygen (O_2) sensor. Sensor specifications are as follows:

- Resolution: 0.1% for CH₄, CO₂, and O₂;
- Accuracy: ±1 percent full scale; and
- Sample flow rate: 1.0 litre per minute.

Output channels from the LFG analyzer include the following:

- CH₄ (percent volume) as 4-20 mA;
- CO₂ (percent volume) as 4-20 mA;
- O₂ (percent volume) as 4-20 mA;
- Calibration Fail; and
- General Analyzer Fault.

The LFG Analyzer is a continuous operation model with the pump running when the analyzer power is on. To accommodate continuous gas sample flow through the analyzer, when the Control Plant is not operating, two three-way solenoid valves (EV-110A/B) were installed in the gas analyzer sample loop. These solenoid valves are controlled by the PLC and place the analyzer in a closed-circuit gas recirculation loop when the Control Plant is off. When the Control Plant is on, the solenoid valves (EV-110A/B) state is altered to draw gas from the Intake Manifold and vent to the Discharge Manifold. (See Figure 2-2)

6.1.1.3. Programmable Logic Controller (PLC)

The Control Plant is controlled and operated by a ScadaPack PLC unit, equipped with a Maple Systems model HMI5121X 12" LCD touchscreen human machine interface (HMI). The PLC can be remote accessed through an internet connection to the Control Plant via ClearSCADA. The ClearSCADA terminal in the landfill office is also configured to download and store all historical data on the local drive. Battery backup for the PLC unit is provided by an Uninterrupted Power Supply (UPS) which provides temporary battery power supply in the event of power loss to the Control Plant. The Control Plant PLC is connected to the Utilization Facility PLC via Ethernet cable (i.e. data highway).

6.1.2. Records Management

6.1.2.1. PLC Data Download

Field Instrument data is stored on the ClearSCADA remote terminal, located in the landfill office. The data can be viewed using the ViewX program installed on this computer terminal.

Field Instrumentation data is recorded in two formats: discrete time interval, and event log formats. The discrete time interval data is recorded at fixed intervals as indicated by the "Sampling Time" set point (default: 10 minutes) which can be altered through the Control Plant HMI. The second format, discrete interval, records a data event for a given field instrument channel when there is a change in state (i.e. the value changes by a programmed percent of full scale).

6.1.2.2. Record Keeping

All inspection, maintenance and calibration records shall be maintained for a minimum period of ten years. All records shall be maintained in clearly marked binders.

In addition to the inspection, maintenance, and calibration records, all span gas bottle tags are kept with calibration records. At the end of each year, all inspection, maintenance, and calibration records are scanned to PDF format and archived for future reference and third party GHG reduction verification.

6.1.3. Quality Assurance and Quality Control

6.1.3.1. Periodic Inspection

Inspection of the Control Plant is undertaken at regular intervals to ensure the ongoing and continuous safe operation of the LFG Collection System. These inspections, presented herein should be undertaken, at a minimum, at weekly, monthly, and annual intervals.

The weekly Control Plant record/inspection is a general visual inspection of all mechanical and field instrumentation systems and record of field instrument values. The intent of the weekly record is to detect potential problems and maintenance issues with Control Plant components before they result in plant shutdown, while providing a weekly "snapshot" of field instrumentation readings.

The monthly Control Plant inspection, to be undertaken concurrently with a weekly inspection, is simply a more detailed visual inspection of the mechanical and electrical/field instrumentation components.

The annual inspection is both a visual inspection of all Control Plant mechanical and field instrumentation, as well as physical inspection of blowers, flanges, and safety equipment, and condensate management systems. It is noted that for all inspection events, special attention is given to the blower system. Further inspection, maintenance, or servicing may be required if unusual sounds or vibration are noted with respect to the blower unit.

6.1.3.2. Field Instrument Calibration

All Field Instrumentation shall be calibrated at regular intervals to ensure the safe operation of the Control Plant as well as facilitate greenhouse gas (GHG) emission reduction verification. Field Instrumentation which requires regular calibration is summarized as follows:

- **1.** PIT-102.
- 2. PIT-131.
- 3. TIT-103.
- **4.** TIT-104.
- **5.** TIT-132.
- **6.** FIT-131.
- 7. GA-1 (LFG Analyzer).

Critical to the verification of GHG credit offset emissions are the following field instruments:

- 1. 1. FIT-131.
- 2. 2. GA-1 (LFG Analyzer).

As indicated in Section 5.1.1.1, FIT-131 is a Thermal Instrument Company model 62-9 constant temperature differential thermal mass flow metre for which no temperature or pressure corrections are required. Hence, PIT-131 and TIT-132 are not deemed to be critical to the calculation of mass flow.

Field Instruments are calibrated, at a minimum, at the manufacturer's recommended calibration frequency as summarized in Table 5-1. It is noted that all field instruments, with the exception of the LFG Analyzer, are calibrated by third parties to ensure that these instruments are operating within design tolerances.

The LFG Analyzer may be field calibrated by a trained Control Plant Technician provided that field calibration records are maintained and that span gas tags are filed with the calibration records. In the event that the LFG Analyzer cannot be calibrated to within the manufacturer's specified accuracy range, then the instrument is shipped to the manufacturer for maintenance or the sensor replaced.

It is further recommended that the portable LFG Analyzer is calibrated on a weekly basis, as indicated in Table 5-1, prior to undertaking weekly inspection of the Control Plant.

Table 6-1. Field Instrument Calibration Schedule

Instrument	Tag ID	Location	Manufacturer	Model#	Calibration Interval
Temperature	TIT-103	Intake Manifold	Foxboro	PR-15UBS-002	Annual
Pressure	PIT-102	Intake Manifold	Foxboro	IGP20-A22B21C-M2	Annual
Pressure	PIT-131	Discharge Manifold	Foxboro	IGP20-A22B21C-M2	Annual
Temperature	TIT-104	Bypass	Foxboro	PR-15UBS-002	Annual
Temperature	TIT-132	Discharge Manifold	Foxboro	PR-15UBS-002	Annual
Flow	FIT-131	Discharge Manifold	Thermal Instrument	62-9/9500	Annual
LFG Analyzer	GA-120	Auxiliary Panel	Nova Analytical Systems	903C-CW	Monthly
Portable LFG Analyzer		Portable unit	CES-Landtech	GEM 2000	Weekly

6.1.3.3. Mechanical Maintenance

The Control Plant mechanical maintenance schedule (referencing key manufacturer's equipment maintenance documents) is summarized in Table 5-2. Key Control Plant mechanical components, which require regular maintenance, include the following:

- 1. Blower
 - a. motor coupler;
 - b. Inlet and outlet bearings;
 - c. Impeller;
 - d. Outlet check valve; and
 - e. Isolation pads.
- 2. Condensate Knock-out Pot
 - a. Flush drum; and
 - b. Clean ball valve assembly
- 3. Flame Arrestor
- 4. Thermal Valve
- 5. Flare

Table 6-2. Mechanical Equipment Maintenance Schedule

Equipment	Component	Maintenance Interval
	Bearing Lubrication:	3 month or 1500 hours
Blower	Bearing Cleaning	6 month
blower	Drive Alignment	12 month
	Impellar	12 months

Equipment	Component	Maintenance Interval
	Isolation Pad Replacement	3 year
	Check Valve Inspection	12 month
	Inspect and flush drum	Annually
Condensate Knock-Out Pot:	Inspect and Clean PVC ball valve assembly	Annually
Flame Arrestor:	Inspect and clean bank sheets	6 month
Thermal Valve:	Inspect plug assembly	6 month
	Inspect flare tip	Annually
Flare	Clean or replace spark plug	Annually
	Thermocouple inspection	Annually
	High Tension wire inspection	Annually

6.1.3.4. LFG Analyzer Maintenance

The LFG Analyzer is maintained as per manufacturer's specifications and summarized in Table 5-3. Key maintenance items, excluding regular inspection and calibration related activities include the following:

- > Filter replacement; and
- Oxygen Sensor replacement.

Key to the proper operation of the LFG Analyzer is ensuring that condensate does not saturate the analyzer filters and that they are replaced as per the manufacturer's recommendations. In the event that the LFG Analyzer is not operating within manufacturer's specifications and cannot be calibrated, all filters are replaced prior to replacing sensors or shipping to manufacturer for service.

Table 6-3. LFG Analyzer Maintenance Schedule

Part Type	Component	Maintenance Interval
	Cabinet Air Filter (155351-22)	12 Months
	Pre-Filter (25-64-30C)	12 Months
Filter Replacement	Final Filter (IDN6G)	12 Months
	Liquid Block (ACRO50)	24 Months
	H2S Scrubber (DIA-LN13X)	6 Months
Sensor Replacement:	O2 Sensor (KE25F3)	36 Months

7.1. EMISSION REDUCTION ASSERTION

This Project document for the RDN Landfill – LFG Capture and Combustion Project has been developed for submission to GHG CleanProjects® Registry in accordance with the Registry's requirements and ISO 14064-2: Specification with guidance at the project level for quantification, monitoring, and reporting of greenhouse gas (GHG) emission reductions or removal enhancements.

The total emissions reductions during the Project reporting period (January 1, 2013 through April 15, 2015), presented in Table 2-1, were 62,853 tonnes CO_2e .

7.2. CLOSURE

Trinity has undertaken all assignments in its role as an environmental engineering consulting firm using professional effort. On behalf of ZFP, Trinity has developed the GHG report including the GHG assertion for RDN's Landfill Gas Capture and Combustion Project using adequately ascertainable information, as defined by ISO 14064-2, obtained from a review of operational and regulatory records and available literature and documents. Trinity did not conduct direct GHG emissions monitoring or other environmental sampling and analysis in conjunction with this GHG report.

Based upon reasonable investigation, including any inquiry of those individuals responsible for obtaining the information, I hereby warrant that the submitted information is true, accurate and complete to the best of my knowledge and belief, and that all matters affecting the validity of the emission reduction claim or the protocol upon which it is based have been fully disclosed.

Signature: Charles C. Lee		Signature:		
Date:	December 13, 2017	Date: December 14, 201		
Name:	Charles C. Lee	Name: ROW S. DEMBO		
Title:	Principal Consultant	Title:		
Company:	Trinity Consultants, Inc.	Company: Zerofootprint Software Inc.		

The third party Verification Report was prepared by Stantec and is included as Appendix D. ISO 14064-3:2006 defines six principles which "are intended to ensure a fair representation and a credible and balanced account of GHG emission reductions and removal enhancements from projects" (ISO 14064-3:2006). The verification procedures developed and executed during the course of this verification present evidence such that each of these principles is satisfied.

- > Relevance Appropriate data sources are used to quantify, monitor or estimate GHG sources, and SSRs. Appropriate minimum thresholds are used to justify the exclusion or the aggregation of minor GHG sources or the number of data points monitored.
- > Completeness All SSRs identified in the protocol are established in the Project Documentation and all emissions in the Project are included within an identified SSR.
- > Consistency Uniform calculations are employed between the baseline and project condition and through the entire crediting period. Emission calculations for each SSR are calculated uniformly. If more accurate procedures and methodologies become available, documentation should be provided to justify the changes and show that all other principles are upheld.
- > Accuracy Measurements and estimates are presented, without bias as far as is practical. Where sufficient accuracy is not possible or practical, measurements and estimates should be used while maintaining the principle of conservativeness.
- > Transparency Information is presented in an open, clear, factual, neutral and coherent matter that facilitates independent review. All assumptions are stated clearly and explicitly and all calculation methodologies and background material are clearly referenced.
- > Conservativeness Appropriate parameters affecting the Project's SSRs are utilized in the calculation of the GHG Assertion. When parameters or data sources are highly uncertain, the choice of parameter or data source to be utilized results in an underestimation in the GHG Assertion (i.e. baseline emissions are underestimated, project emissions are overestimated).

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Signature: Charles C. Lee		Signature:		
Date:	December 13, 2017	Date: December 14, 201		
Name:	Charles C. Lee	Name: ROW S. DEMBO		
Title:	Principal Consultant	Title:		
Company:	Trinity Consultants, Inc.	Company: Zerofootprint Software Inc.		

APPENDIX A: EMISSION REDUCTIONS PURCHASE AGREEMENT

EMISSION REDUCTIONS PURCHASE AGREEMENT

SOFTWARE INC.

- and -

GREEN MUNICIPAL CORPORATION

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EMISSION REDUCTIONS PURCHASE AGREEMENT

THIS AGREEMENT is made on the $\sqrt{5}$ day of September, 2015 (the "Effective Date").

BETWEEN:

GREEN MUNICIPAL CORPORATION, a non-share capital corporation formed under the laws of Canada, with its head office at 24 Clarence Street, Ottawa, ON ("Sellen

- and -

ZEROFOOTPRINT SOFTWARE INC., a corporation formed under the laws of Ontario, with its head office at 197 Spadina Avenue, Suite 400, Toronto, ON ("Buyer")

(each a "Party" and, collectively, the "Parties")

WHEREAS:

- A. The Seller owns or will own certain voluntary greenhouse gas emission reductions created by the operation of the Regional District of Nanaimo's landfill gas capture project, as more fully described in Schedule A (the "Project"); and
- B. The Seller wishes to sell to the Buyer and the Buyer wishes to purchase from the Seller certain voluntary emission reductions resulting from the Project on the terms and conditions set forth in this Agreement.

NOW THEREFORE, in consideration of the mutual agreements, covenants and representations contained herein, the receipt and sufficiency of which are acknowledged by each Party, the Parties hereby agree as follows:

ARTICLE 1 DEFINITIONS AND INTERPRETATION

1.1 Definitions

For the purpose of this Agreement, unless the context otherwise requires, the following terms shall have the meanings ascribed to them below:

- "Affiliate" has the meaning ascribed thereto In the *Ontario Business Corporations Act*, R.S.O. 1990 cB.16, as amended;
- "Agreement" means this Emission Reductions Purchase Agreement between the Buyer and Seller, including all Schedules and attachments;
- "Applicable Laws" means in respect of any Person property, transaction or event all applicable laws, statutes ordinances, rules, by-laws, regulations, treaties and all applicable directives, writs, orders, judgments, decrees, injunctions, and awards of any Government Authority, having the force of law;
- "Applicable Program" means a mandatory GHG related legislative or regulatory requirement administered by a Government Authority or a voluntary GHG standard, program, scheme, registry, or protocol for the creation or use of GHG emission reductions, Including, without

limitation, the International Organization for Standardization ("**ISO**") in ISO 14064-2:2006 "Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements" and the Verified Carbon Standard:

"Authorization" means any permit, certificate, approval, registration, license, consent, filing, agreement, notarization, authority, directive, or exemption from, by or with any Authority, whether given by express action or deemed given by failure to act within any specified time period, and any and all corporate, creditor and shareholder approval or consent;

"Baseline", "Baseline Emissions" means the business as usual GHG emissions at the Site in the absence of the Project as measured in accordance with the measurement and calculation methodology set out in the GMC MVP;

"Business Day" means a day (other than a Saturday or Sunday) on which commercial banks in Toronto, Ontario are open for business;

"Buyer" has the meaning ascribed to it in the preamble to this Agreement;

"Buyer's Market Damages" means the sum of:

- (a) the product of the Shortfall Quantity and the positive difference (if any) between the Market Price and the Purchase Price, and
- (b) any and all reasonable transaction costs that the Buyer incurs in acquiring Replacement VERs (including, without limitation, registration fees, broker fees, commissions and legal fees);

"Buyer Representative" has the meaning ascribed to it in Section 3.3;

"Carbon Dioxide Equivalent" or "CO₂e" means the common unit of GHG measurement for all GHG emissions and associated reductions as calculated in accordance with the global warming potentials set out in Fourth Assessment Report of the Intergovernmental Panel on Climate Change, and measured in increments of one metric tonne of carbon dioxide equivalent;

"Change of Law" means a change in Applicable Law, Authorization, or an Applicable Program that has a material negative impact on the creation of the VERs or materially impedes the completion of the transaction between the Parties that is the subject of this Agreement;

"Confidential Information" has the meaning ascribed to it in Section 11.1;

"Delivery" means the process of delivering VERs from the Seller to the Buyer in accordance with Section 2.2 and "Deliver" and shall have a corresponding meaning;

"Delivery Date" means each date on which VERs are to be Delivered in accordance with the Delivery Schedule, or the written notice of the Buyer provided in accordance with Subsection 2.2(a);

"Delivery Failure" has the meaning ascribed to it in Subsection 5.1(b);

"Delivery Quantity" has the meaning ascribed to it in Subsection 2.1;

"Delivery Schedule" means the delivery schedule attached as Schedule B;

"Disclosing Party" has the meaning ascribed to it in Section 11.1;

"Dispute" has the meaning ascribed to it in section 10.1;

"Effective Date" has the meaning ascribed to it in the preamble to this Agreement;

"Emission Reduction(s)" or "ER(s)" means Real, Verifiable, Quantifiable, Surplus and Unique (as such terms are defined in the GMC MVP) decreases in emissions of GHGs relative to Baseline Emissions at the Project that result directly from the Project, as such reductions occur, and are measured, monitored, reported and Verified in accordance with the GMC MVP, and quantified in metric tonnes of CO₂e per year;

"Event of Default" has the meaning ascribed to it in Section 6.1;

"Force Majeure" means an event or circumstance that prevents a Party from performing its obligations under the Agreement, which event was not foreseeable by, within the reasonable control of, or the result of the negligence of the Party claiming the event, and which by the exercise of due diligence, that Party is not able to avoid or overcome, but does not include an inability to pay or normal weather variability;

"GHG" means any of carbon dioxide, methane, nitrous oxide, hydro-fluorocarbons, perfluorocarbons and sulphur hexafluoride;

"GMC MVP" means The Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocol for Greenhouse Gas Emission Reductions from Designated Projects Funded Through the Green Municipal Fund attached as Schedule C to this Agreement, as adapted if required for the purpose of registering the VERs with an eligible Registry;

"Goods and Services Tax" means the goods and services tax and harmonized sales tax payable pursuant to the *Excise Tax Act* (Canada). Where applicable any reference herein to GST shall be deemed to include a reference to the corresponding or similar provisions of provincial tax law and any related harmonized sales tax;

"Government Authority" means any international, federal, regional, state, provincial, local, municipal, governmental, administrative, fiscal, judicial, or government-owned body, commission, authority, tribunal, agency or entity;

"Intentional Delivery Failure" has the meaning ascribed to it in Subsection 5.1(d).

"Market Price" means the average price for VERs of a similar quantity and quality of the Shortfall Quantity or the Payment Shortfall Quantity, as applicable, and as quoted by three (3) brokers or vendors of VERs acceptable to the Parties;

"Material Adverse Change" means any material change in the business, operations, financial condition, assets, or properties of a Person that has materially impaired, or could reasonably be expected to materially impair, the ability of that Person to perform any or all of its obligations under this Agreement, which is not Change of Law;

"Party" and "Parties" have the meaning ascribed in the preamble to this Agreement;

"Payment Due Date" has the meaning ascribed to it in Section 2.3;

"Payment Failure" has the meaning ascribed to it in Section 5.2(a);

"Payment Shortfall Quantity" has the meaning ascribed to it in Section 5.2(a);

"Person" means an individual, firm, partnership, body corporate or other legal entity, a government or any department or agency thereof, a trustee, any unincorporated organization and the heirs, executors, administrators or other legal representatives of an individual, as the case may be;

"Project" has the meaning ascribed to it in the recitals of this Agreement;

"Project Owner" means the Regional District of Nanaimo;

"Purchase Price" per VER to be paid by the Buyer to the Seller upon receipt of each VER Delivered to the Buyer by the Seller;

"Receiving Party" has the meaning ascribed to it in Section 11.1;

"Register" means with respect to a VER, to register the VER with the Registry in accordance with its prescribed processes and "Registration" and "Registered" have comparable meanings;

"Registry" means a GHG registry approved by the Parties for the purpose of serializing and evidencing the origination, ownership, and Transfer of VERs, including the CSA Clean Projects Registry or such other registry to be selected and agreed to in writing by the Parties;

"Regulatory Status" means the status of the Project as either voluntary or mandatory under Applicable Laws;

"Replacement VERs" means ERs of an equivalent quality and type as the VERs to be delivered under this Agreement, as determined in the sole opinion of the Buyer acting reasonably:

"Representatives" has the meaning ascribed to it in Subsection 11.1(b);

"Schedules" means the following Schedules attached to and constituting and forming a part of this Agreement and references in this Agreement to such Schedules are to the Schedules attached hereto:

Schedule A - Project Description Schedule B - Delivery Schedule

Schedule C - GMC MVP

Schedule D - 2013 and 2014 Verification Reports

Schedule E - Transfer Form

Schedule F - Form of Officers' Certificate

"Seller" has the meaning ascribed to it in the preamble to this Agreement;

"Seller's Market Damages" means the sum of:

(a) the product of the Payment Shortfall Quantity and the positive difference (if any) between the Market Price and the Purchase Price; and

 (b) any and all reasonable transaction costs that the Seller incurs in reselling the Payment Shortfall Quantity (including, without limitation, registration fees, broker fees, commissions and legal fees);

"Shortfall Quantity" has the meaning ascribed to it in Subsection 5.1(e)(i);

"Term" has the meaning ascribed to it in Section 9.1;

"Transfer Form" means the instrument of transfer in the form attached as Schedule E;

"Verified Emission Reduction(s)" or "VER(s)" means a certificate, credit, offset, allowance or other instrument evidencing ownership, however titled, of one metric tonne of Emission Reductions arising from the operation of the Project in accordance with the Verification Report and Verified by a Verifier in accordance with the Verification Methodology, including all right, title, interest, entitlement, and benefit associated with or attributable to, the Emission Reductions, including, but not limited to:

- (a) the right to claim any right, credit, interest, offset, allowance, entitlement or benefit that may arise as a result of the VERs or the underlying Emission Reductions, under, as a result of or in relation to any Applicable Law or Applicable Program including, for greater certainty, in respect of VERs or the underlying Emission Reductions occurring prior to such VERs or Emission Reductions being mandated or required by any such legal, regulatory or administrative regime;
- (b) any form of acknowledgement by a Government Authority or Applicable Program that the VERs or the underlying Emission Reductions are entitled to be allocated, convertible to or fungible for, either at that time or at any time in the future, a credit, an allowance or any other right to discharge GHGs;
- (c) the right to claim, be allocated and obtain credit, allowance or such other right to discharge GHGs, or to convert the VERs or the underlying Emission Reductions to, or use them in place of, a credit, allowance or any other right to discharge GHGs or to comply with emissions reductions that are regulated by any Government Authority or under an Applicable Law, Applicable Program or Authorization;
- (d) the right to register and bank the VERs or the underlying Emission Reductions, and any right, credit, interest, offset, allowance, entitlement and benefit arising directly or indirectly therefrom or in relation thereto, both present and future, in, on or with any Applicable Program;
- (e) the right to claim all right, title and interest in, and benefits associated with the VERs or the underlying Emission Reductions, whether or not registered or banked in, on, or with any Applicable Program;
- (f) the right to transfer, or assign title to the VERs or the underlying Emission Reductions to any Person or entity and any right, credit, interest, offset, allowance, entitlement and benefit arising directly or indirectly therefrom or in relation thereto, both present and future, whether or not registered or banked in, on or with any Applicable Program;
- (g) the right to use the VERs or the underlying Emission Reductions, and any right, credit, interest, offset, allowance, entitlement and benefit arising directly or indirectly

therefrom or in relation thereto, both present and future, whether or not registered or banked in any Applicable Program, to:

- (i) emit GHG(s); and
- (ii) offset, or apply, surrender or retire, such removal, limitation, reduction, avoidance, sequestration or mitigation in emissions, credits or allowances to sources of GHG emissions as a means of, in whole or in part, complying with any obligation or goal to reduce emissions of, GHGs; and
- (h) the right to any revenue, entitlement, benefit, and other proceeds arising from or related to any of the foregoing:

"Verifier" has the meaning and qualifications ascribed thereto in Section 3.1 of the GMC MVP;

"Verification Methodology" means the methodology for the Verification of ERs as set forth in Verification Report;

"Verification Reports" means, in relation to a VER, the verification report of the Verifier applicable to such VER prepared in accordance with the Verification Methodology;

"Verify" and "Verification" means the act of a Verifier assessing the Emission Reductions in accordance, and attesting to their compliance, with the Verification Methodology and producing a detailed Verification Report that may be relied upon by the Parties; and

"Vintage" means the calendar year, or other reporting period specified by the Parties, in which the VERs are created.

1.2 Headings and Table of Contents

The inclusion of headings and a table of contents in this Agreement are for convenience of reference only and shall not affect the construction or interpretation hereof.

1.3 References

Unless otherwise specified, reference in this Agreement to Articles, Sections and Schedules are to Articles and Sections of and Schedules to this Agreement. The words "herein", "hereto", "hereunder" and other words of similar import refer to this Agreement as a whole and not to any particular article, section, paragraph or other subdivision of this Agreement.

1.4 Currency

Except where otherwise expressly provided, all amounts in this Agreement are stated and shall be paid in Canadian currency.

1.5 Time

Time is of the essence in this Agreement. When calculating the period of time within which or following which any act is done or step taken pursuant to this Agreement, the date that is the reference date in calculating such period shall be excluded. If the last day of such period is not a Business Day, the period in question shall end on the next Business Day.

1.6 Gender and Number

In this Agreement, words importing the singular include the plural and vice versa and words importing gender include all genders.

ARTICLE 2 PURCHASE, SALE, AND DELIVERY OF VERS

2.1 Purchase and Sale

Over the Term and in accordance the terms of this Agreement, the Seller shall sell, Deliver and transfer to the Buyer, and the Buyer shall pay for and purchase the stipulated quantities of VERs set out in the Delivery Schedule (the "**Delivery Quantity**") on or before the applicable Delivery Date.

2.2 Effecting and Evidencing Delivery

- (a) The Buyer may request Delivery of the 2013 Vintage or 2014 Vintage Delivery Quantities before the applicable Delivery Date(s) by providing to the Seller written notice of an earlier Delivery Date at least fifteen (15) Business Days prior to the intended earlier Delivery Date.
- (b) The Seller shall evidence Delivery on the applicable Delivery Date by delivering to the Buyer:
 - (i) a final invoice for total payment owing to the Seller (calculated as the product of the Purchase Price and the Delivery Quantity, plus any portion of the fees and taxes for which the Buyer is liable pursuant to Section 2.4) payable by the Buyer on the applicable Payment Due Date;
 - (ii) a particularized and executed Transfer Form; and
 - (iii) a certificate to be signed by a senior officer of the Seller in the form set forth in Schedule F certifying that the representations and warranties of the Seller in this Agreement are true and correct as if made at and as of the applicable Delivery Date and that the Seller has performed or complied with its covenants in this Agreement that are to be performed or complied with prior to the applicable Delivery Date.

2.3 Purchase Price and Payment

The Buyer shall, on or before the applicable payment due date set out in the Delivery Schedule (the "Payment Due Date"):

- (a) execute (in counterpart or otherwise) the Transfer Form provided by the Seller;
- (b) pay the Seller, for all Delivered VERs, the total payment amount owing to the Seller in accordance with Subsection 2.2(b)(i); and
- (c) ensure that all payments are made by standard cheque from the Buyer to the Seller, unless otherwise mutually agreed in writing by the Parties.

2.4 Fees and Taxes

- (a) Except as set forth herein, the Seller shall be responsible for any and all fees, taxes, charges and other costs relating to the development, implementation and continued operation of the Project, and the creation, and ownership of the VERs up to and including the time and place of their Delivery.
- (b) The Buyer shall be responsible for the payment of all fees, taxes and charges and taxes imposed on the transfer, receipt, or ownership of any VER from and after the time of its Delivery to the Buyer that are imposed by any Government Authority or are payable under any Applicable Laws, including the Goods and Services Tax.
- (c) Notwithstanding anything else to the contrary herein contained, the responsibility of the Buyer under paragraph (b) above does not include any taxes calculated with reference to the gross or net income or capital of the Seller that imposed on the Seller by any Government Authority or that may be payable by the Seller on income under any Applicable Laws.
- (d) Each of the Buyer and the Seller is a duly authorized Goods and Services Tax registrant in good standing, and is registered under Part IX of the *Excise Tax Act* (Canada). The Seller agrees to timely remit any Goods and Services Tax collected from the Buyer to the Receiver General for Canada in accordance with the *Excise Tax Act* (Canada).
- (e) In the event that a Party is required to pay an amount to, or for the benefit of, the other Party or an amount is forfeited to the other Party or a debt or other obligation owing by one Party to the other Party is reduced or extinguished without payment as a consequence of the breach, modification or termination of this Agreement, the Party making such payment or forfeiture or to whom such reduced or extinguished debt or other obligation is or was owed shall pay to the other Party the Goods and Services Tax, if any, required to be remitted to the Canadian government in respect of the amount of such payment, forfeiture or reduction or extinguishment pursuant to the Excise Tax Act (Canada).

2.5 Title Transfer

The Seller's legal title, including all right, title and interest in, and benefits associated with, the Delivered VERs shall transfer to the Buyer at the time and date of receipt of full payment for the Delivered VERs by the Seller in accordance with the terms of this Agreement. The fully executed Transfer Form together with proof of Seller's receipt of full payment for the Delivered VERs shall constitute good and valid evidence that all right, title and interest in, and benefits associated with, the VERs, including, without limitation, the exclusive right to use the subject VERs in any Applicable Program, has been transferred from the Seller to the Buyer.

ARTICLE 3 VERIFICATION AND REGISTRATION

3.1 Verification Reports(s)

The Parties acknowledge that the Verification Reports for the Vintage 2013 and 2014 VERs are attached at Schedule D and the Seller has caused the Project Owner to retain a Verifier to Verify and prepare Verification Report for the applicable portion of the 2015 Vintage VERs in

accordance with the GMC MVP and the terms of this Agreement. The Seller shall provide the Buyer with a copy of the 2015 Verification Report in respect of the 2015 Vintage VERs, on or before the date that is twenty (20) Business Days prior to the 2015 Delivery Date, or such other date agreed to by the Parties.

3.2 Registration

- (a) In the event that the VERs are Registered on a registry that is not the Registry or in an account that is not the Seller's Registry account, the Seller shall, prior to Delivery to the Buyer, ensure that the VERs are de-listed or transferred into the Seller's Registry account prior to effecting Delivery. The Seller shall bear all related expenses.
- (b) The Buyer shall effect the transfer and listing of the Delivered VERs transferred by the Seller into the Buyer's Registry account. The Seller shall cooperate with the Buyer and participate as required to ensure the Project is listed on the Registry and VERs can be transferred into the Buyer's Registry account after Delivery. The costs associated with the first Registration of the Project and any VERs transferred under this Agreement on the Registry shall be borne equally by the Parties in accordance with Section 11.2.

3.3 Audit and Access Rights

Upon the reasonable request of the Buyer (noting that a request during normal business hours, with sufficient notice and limited frequency shall be considered reasonable) and at Buyer's sole expense, the Seller shall: (a) make available to the Buyer and its directors, officers, employees, agents, accountants. lawyers, the Verifier or other representatives (the "Buyer Representatives") all of its documents and records whether in electronic or other form, that are reasonably attainable by the Seller that have been used to quantify the VERs, prepare the Verification Reports, confirm the status of the Project and/or quantity, quality, status or title of the VERs; and (b) make requests of the Project Owner to permit the Buyer Representatives, or any one of them, to visit, inspect and, if requested, investigate the Project properties during normal business hours, but without disrupting normal business operations and to have access to management of the Seller and/or the Project Owner to review and discuss the Project or the quantity, quality, status or title of the VERs.

ARTICLE 4 REPRESENTATIONS, WARRANTIES AND COVENANTS

4.1 Seller's Representations and Warranties

The Seller represents and warrants to the Buyer, either directly or indirectly through the Project Owner, that on the Effective Date and at the time of each Delivery:

- (a) it is a corporation that is duly organized, validly existing and in good standing under the laws of the jurisdiction where it is organized and has the power, authority and capacity to carry on its business and to enter into this Agreement and to carry out the transactions contemplated herein and therein;
- (b) it has not instituted, or had instituted against it, any proceeding and has not executed any agreement to authorize its participation in or commencement of any proceeding: (i) seeking to adjudicate it a bankrupt or insolvent; or (ii) seeking its

- dissolution or winding-up; or (iii) seeking appointment of a receiver, trustee, agent, custodian or other similar official for it or any substantial part of its assets;
- (c) the execution and delivery of this Agreement by the Seller and the completion of the transactions herein have been duly and validly authorized by all necessary actions on the part of the Seller;
- (d) this Agreement has been duly executed and delivered by the Seller and constitutes a legal, valid and binding obligation of the Seller enforceable against the Seller in accordance with its terms, subject to applicable bankruptcy laws;
- (e) the execution and delivery of this Agreement by the Seller and the performance of the obligations contemplated herein are fully authorized and do not and shall not:
 - (i) violate or conflict with any of the terms, conditions or provisions of (A) either of the Seller's constating documents and by-laws, (B) any Applicable Laws,
 (C) any Authorizations, or (D) any other agreement binding on or otherwise affecting the Seller, the Project, or the VERs; or
 - (ii) result in, require or permit the imposition of any encumbrance or lien of any kind on the Seller, the Project, or the VERs;
- (f) it has all required Authorizations and is in compliance with all Applicable Laws and Authorizations:
- (g) all Authorizations that are required to be obtained or submitted by it or the Project Owner with respect to development and operation of the Project and the execution and delivery of this Agreement and the performance of the obligations herein, have been obtained or submitted and are valid, in full force and effect and all conditions thereof have been complied with;
- (h) there is no current, pending or, to the best knowledge of the Seller, threatened, litigation, arbitration or administrative proceeding, or judgment or order of any Government Authority, that could reasonably be expected to have a material adverse effect on the Seller's ability to perform its obligations under this Agreement;
- (i) it has not committed an Event of Default, nor is an Event of Default continuing or reasonably foreseeable, with the passage of time;
- (j) it is, or will be at the time of Delivery, the sole and beneficial owner of the VERs Delivered to the Buyer and has good and marketable title to the Delivered VERs, free and clear of any and all security interest, or other lien, claim, charge, or encumbrance whatsoever;
- (k) it shall take all necessary steps to vest good and marketable title to the Delivered VERs in the Buyer, free from any and all security interest or other lien, claim, charge or encumbrance whatsoever
- (I) it has not sold, transferred, assigned or disposed of any right, title or interest in, or benefits associated with any of the VERs to be Delivered and sold to the Buyer under this Agreement, nor used, applied, retired, claimed any right or benefit associated with the VERs to be sold to the Buyer under this Agreement;

- (m) it does not represent or warrant the fitness of the VERs for any particular use by the Buyer under any Applicable Law, Authorization, or Applicable Program;
- (n) it has obtained any and all third party consents from the Project Owner required to Deliver VERs to the Buyer as contemplated in this Agreement;
- (o) to the best of the Seller's knowledge, after due inquiry with the Project Owner, the Project has been developed and operated as described in the applicable Verification Report and is in compliance with all Applicable Laws, Authorizations, and, if applicable, the requirements of an Applicable Program;
- (p) the applicable Verification Reports set out in Schedule D are valid and constitute the final Verification of the VERs by the Verifier;
- (q) the Regulatory Status of the Project is voluntary and the VERs are in excess of any Emission Reductions that may be required to be made by the Seller under Applicable Laws, Authorizations, or contractual commitments made by the Seller and are not the result of an action under any Applicable Law or Authorization;
- (r) the VERs to be transferred under this agreement are not listed on any registry; and
- (s) the data or information contained in any certificate, document or instrument delivered by it to the Buyer or to the Verifier in order to prepare the Verification Reports, is accurate, reliable, true and correct in all material respects and any such data has been calculated in accordance with industry standards and the Verification Methodology.

4.2 Buyer's Representations and Warranties

The Buyer represents and warrants to the Seller that on the Effective Date, and at the time of each Delivery:

- (a) it is a corporation that is duly organized, validly existing and in good standing under the laws of the jurisdiction where it is organized and has the power, authority and capacity to carry on its business and to enter into this Agreement and to carry out the transactions contemplated herein and therein;
- (b) it has not instituted, or had instituted against it, any proceeding and has not executed any agreement to authorize its participation in or commencement of any proceeding: (i) seeking to adjudicate it a bankrupt or insolvent; or (ii) seeking its dissolution or winding-up; or (iii) seeking appointment of a receiver, trustee, agent, custodian or other similar official for it or any substantial part of its assets;
- (c) the execution and delivery of this Agreement by the Buyer, and the completion of the transactions herein have been duly and validly authorized by all necessary action on the part of the Buyer;
- (d) this Agreement has been duly executed and delivered by the Seller and constitutes a legal, valid and binding obligation of the Buyer, enforceable against it in accordance with its terms, subject to applicable bankruptcy law;

- (e) the execution and delivery of this Agreement by the Buyer and the performance of the obligations contemplated herein are fully authorized and do not and shall not:
 - (i) violate or conflict with any of the terms, conditions or provisions of: (A) the Buyer's constating documents or by-laws, (B) any Applicable Laws, (C) any Authorization, or (D) any other agreement binding on or otherwise affecting the Buyer or the VERs; or
 - (ii) result in, require or permit the imposition of any encumbrance or lien of any kind on the Project, or the VERs;
- (f) it has all required Authorizations and is in compliance with all Applicable Laws and Authorizations:
- (g) all Authorizations that are required to be obtained or submitted by it with respect to the execution and delivery of this Agreement and the performance of the obligations herein, have been obtained or submitted and are valid, in full force and effect and all conditions thereof have been complied with;
- (h) there is no current, pending or, to the best of the Buyer's knowledge, threatened, litigation, arbitration or administrative proceeding or judgment or order of any Government Authority, that could reasonably be expected to have a material adverse effect on the Buyer's ability to perform its obligations under this Agreement;
- (i) it has not committed an Event of Default, nor is an Event of Default continuing or reasonably foreseeable, with the passage of time;
- (j) it expressly acknowledges that the Seller has not represented or warranted the fitness of the VERs for any particular or intended use by the Buyer; and
- (k) it has and will have the ability to pay for all VERs to be transferred from the Seller to the Buyer in accordance with the terms of this Agreement.

4.3 Covenants of Seller

The Seller hereby covenants and agrees with the Buyer that:

- (a) the Seller shall not and will take all reasonable steps to ensure the Project Owner will not sell, transfer, assign or otherwise deal with or use, dispose of any VERs that have been Delivered or are required to be Delivered to the Buyer pursuant to this Agreement to anyone other than the Buyer, unless previously agreed to in writing by the Buyer, or use, apply, retire, claim in respect of any compliance requirement (including any voluntary emission reductions targets) any VERs that have been Delivered or are required to be Delivered to the Buyer pursuant to this Agreement;
- (b) the Seller shall not, nor shall it cause or attempt to cause or assist any corporation, partnership, entity or person to commence any action, claim or demand of any nature or kind, in law or in equity, or take any action, that could in any way prejudice, hinder, impair or prevent the Buyer's ability to use, grant, sell, convey, assign, transfer or set over, or reduce or limit the value or usefulness of, the VERs transferred to and paid for by the Buyer in accordance with the terms of this Agreement; and

(c) it shall provide a 2015 Verification Report and shall not amend any Verification Report nor cause the Verifier to do so without the prior written approval of the Buyer.

4.4 Covenants of Buyer

The Buyer hereby covenants and agrees with the Seller that:

- it will take all necessary steps, in cooperation with the Seller, to effect the Registration, Delivery and transfer of the VERs in accordance with the terms of this Agreement;
- (b) it will pay the Seller for all Delivered VERs in accordance with the terms of this Agreement; and
- (c) it shall not amend any Verification Report nor cause the Verifier to do so without the prior written approval of the Seller.

ARTICLE 5 DELIVERY FAILURE, PAYMENT FAILURE AND CHANGE OF LAW

5.1 Delivery Failure

- (a) The Parties acknowledge and accept that:
 - (i) all Emissions Reductions giving rise to the VERs to be transferred under this Agreement have been successfully created by the Project Owner;
 - (ii) the 2013 and 2014 Vintage VERs to be transferred under this Agreement have been successfully Verified by the Verifier and evidenced in the Verification Reports set out in Schedule D; and
 - (iii) the portion of the 2015 Vintage VERs to be transferred under this Agreement shall be Verified by the Verifier following the end of the 2015 calendar year.
- (b) In the event that the Seller fails to Deliver any or all of the stipulated Delivery Quantities of VERs on or before the applicable Delivery Date for any reason, including matters beyond the control of the Parties, then a "**Delivery Failure**" shall have occurred and the Buyer shall have the rights and remedies set out in Sections 5.1(c) to 5.1(e), as applicable.
- (c) If the Delivery Failure is a result of a Force Majeure, including but not limited to the operation, suspension or failure of the Registry, the Parties shall take all reasonable steps and cooperate to remedy such Delivery Failure, and absent such remedy the Parties agree to complete Delivery in and through the transfer mechanism set out in this Agreement and form(s) set out in Schedule E and F.
- (d) If the Delivery Failure is a result of the willful breach or gross negligence of the Seller or a simple breach of Subsections 4.1(j), (k), or (l) of this Agreement by the Seller, an "Intentional Delivery Failure" will have occurred giving rise to the remedies set out in Section 5.1(e);

- (e) In the event of an Intentional Delivery Failure, an Event of Default will have occurred and the Buyer may, within fifteen (15) Business Days of the Intentional Delivery Failure, terminate this Agreement in accordance with Article 9 of this Agreement and/or elect to require the Seller to either:
 - (i) Deliver a quantity of Replacement VERs equal to the quantity of VERs that were not Delivered in accordance with the terms of this Agreement (the "Shortfall Quantity") within ten (10) Business Days; or
 - (ii) pay to the Buyer liquidated damages in an amount equal to the Buyer's Market Damages, which the Parties agree represents a fair estimate of the Buyer's damages incurred and is not a penalty, within three (3) Business Days.

5.2 Payment Failure

- (a) In the event that the Buyer fails to pay the Seller for any or all of the VERs Delivered to the Buyer in accordance with the terms of this Agreement (such quantity of VERs Delivered but not paid for, being the "Payment Shortfall Quantity"), then a "Payment Failure" shall have occurred, giving rise to the rights and remedies set out in this Section 5.2.
- (b) In the event of a Payment Failure, the Buyer shall have fifteen (15) Business Days to cure the Payment Failure, after which the Seller may terminate this Agreement in accordance with Article 9 of this Agreement and/or require the Buyer to:
 - (i) promptly return to the Seller within three (3) Business Days, at Buyer's expense, any VERs that have been Delivered to Buyer by Seller, but not paid for by Buyer in accordance with the terms of this Agreement; and
 - (ii) pay to the Seller liquidated damages in an amount equal to the Seller's Market Damages, which the Parties agree represents a fair estimate of the Seller's damages incurred and is not a penalty, within three (3) Business Days.

5.3 Change of Law

If a Change of Law occurs or is likely to occur, the Parties shall use their best efforts to obtain any exemptions in order to minimize or negate the impact of such Change of Law in order to complete the transaction that is the subject of this Agreement. If such an exemption is not obtainable, the Parties shall diligently and in good faith, attempt to renegotiate and amend this Agreement so as to achieve the same economic benefits from this Agreement as there would have been absent the Change of Law. If, after thirty (30) Business Days of negotiation following a Change of Law, the Parties are unable to reach agreement on an amendment to this Agreement, then either Party may terminate this Agreement, without cost or penalty to any of the Parties.

ARTICLE 6 EVENTS OF DEFAULT, DELIVERY FAILURE AND REMEDIES

6.1 Events of Default

Any one of the following shall constitute an event of default ("Event of Default") under this Agreement:

- (a) Seller has committed an Intentional Delivery Failure, which is not remedied in accordance with Section 5.1 of this Agreement;
- (b) a Payment Failure has occurred and is not remedied in accordance with Section 5.2 of this Agreement;
- (c) other than a breach set out in Subsection 6.1(a) or (b) of this Agreement, either Party is in breach of any covenant or material term of this Agreement and such breach is not remedied within thirty (30) Business Days of notice of the breach by the non-defaulting Party;
- (d) any representation or warrant made by a Party under this Agreement shall prove to have been false or misleading in any material respect when made or deemed repeated;
- (e) a Party becomes insolvent, indicates that it is unable to pay its debts as they become due, or has instituted, or had instituted against it, any proceeding or has taken any corporate action or executed any agreement to authorize its participation in or commencement of any proceeding: (i) seeking to adjudicate it a bankrupt or insolvent; or (ii) seeking its dissolution or winding-up; or (iii) seeking appointment of a receiver, trustee, agent, custodian or other similar official for it or for any substantial part of its assets; or
- (f) there has been a Material Adverse Change in respect of a Party.

6.2 Buyer Remedies on Default

If an Event of Default by the Seller as set out in Subsections 6.1(a), (c), (d), (e) and (f) has occurred and is continuing, the Buyer may:

- (a) suspend or terminate this Agreement in accordance with Article 9; and
- (b) subject to the limitation of liability in Article 7, exercise any and all rights and remedies available to the Buyer under this Agreement, in both law and equity.

6.3 Seller Remedies on Default

If an Event of Default by the Buyer has occurred as set out in Subsections 6.1(b) to (f) inclusive, has occurred and is continuing, the Seller may:

- (a) suspend or terminate this Agreement in accordance with Article 9; and
- (b) subject to the Limitation of Liability in Article 7, exercise any and all rights and remedies available to the Seller under this Agreement, in both law or equity.

ARTICLE 7 LIMITATION OF LIABILITY

7.1 Limitation of Liability

Each Party's maximum liability under this Agreement, whether in law or equity or on any other issue relating to any product or service provided by either Party pursuant to this Agreement,

shall be limited to the total amount equal to the product of the Purchase Price of the VERs not yet Delivered but required to be transferred pursuant to this Agreement. The Parties agree that no party shall be liable or be subject to any costs, fees or damages with respect to a Delivery Failure or Payment Failure that is caused by a Change of Law, or a Force Majeure related to the Registry or another registry and beyond the control of the Parties.

ARTICLE 8 FORCE MAJEURE

8.1 Conduct on Force Majeure

- (a) Each Party is excused from performance of its obligation under this Agreement if such obligations cannot be performed due to a Force Majeure, but only:
 - (i) for the duration of the Force Majeure;
 - (ii) if the Party claiming the Force Majeure gives the other Party immediate notice of all reasonable and pertinent details of the existence and continuance of Force Majeure; and
 - (iii) for so long as the Party claiming Force Majeure takes all reasonable steps to mitigate the Force Majeure.
- (b) If any material obligation under this Agreement is not performed due to the Force Majeure for more than sixty (60) Business Days, the Party not claiming the Force Majeure has the right to suspend its obligations without affecting any other obligation under this Agreement that is not affected by the Force Majeure or terminate this agreement in accordance with Article 9.

ARTICLE 9 TERMS AND TERMINATION

9.1 Term

This Agreement takes effect on the Effective Date and shall continue, subject to any early termination of this Agreement in accordance with its terms, until the date the Buyer has received Delivery of, and the Seller has received full payment for, all VERs required to be Delivered in accordance with this Agreement and such period shall constitute the term (the "**Term**") of this Agreement.

9.2 Buyer Termination Rights

The Buyer may terminate this Agreement if:

- (a) an Event of Default stipulated in Section 6.2 has occurred and is continuing; and
 - (i) at the time, it is not in material breach of this Agreement and an Event of Default stipulated in Section 6.3 has not occurred and is not continuing in which case Section 9.4 and 9.5 shall apply; or

(b) a Change of Law or Force Majeure has occurred and cannot be remedied in accordance with Sections 5.3 and Article 8, respectively in which case Sections 9.4 and 9.5 shall apply.

9.3 Seller Termination Rights

The Seller may terminate this Agreement if:

- (a) an Event of Default stipulated in Section 6.3 has occurred and is continuing; and
 - (i) at the time it is not in material breach of this Agreement and an Event of Default stipulated in Section 6.2 has not occurred and is not continuing, in which case sections 9.4 and 9.5 shall apply; or
- (b) a Change of Law or Force Majeure has occurred and cannot be remedied in accordance with Sections 5.3 and Article 8, respectively, in which case Sections 9.4 and 9.5 shall apply.

9.4 Notice

The terminating Party shall give the non-terminating Party at least three (3) Business Days written notice of termination specifying the reasons for termination and the termination date.

9.5 Covenants and Obligations and Termination

With respect to the Parties obligations and liabilities under this Agreement, each Party shall:

- (a) perform all covenants and obligations under this Agreement up to and including the termination date, and remain liable to the other Party in respect thereof;
- (b) be released from all obligations and liabilities arising after the termination date except for those obligations and liabilities set out in Article 7, 9, 10 and Section 2.4 and 11.1;
- (c) in the case of the Seller, pay any and all amounts owing under Section 5.1; and
- (d) in the case of the Buyer, pay any and all amounts owing under Section 5.2.

ARTICLE 10 DISPUTE RESOLUTION

10.1 Disputes

In the event any dispute, claim, question or difference (a "**Dispute**") arises with respect to this Agreement or its performance, enforcement, default, termination, or validity, such Dispute shall be resolved in accordance with this Article 10. The Party claiming a Dispute shall provide prompt written notice to the other Party of such claim.

10.2 Amicable Resolution

The Parties shall make reasonable efforts to amicably resolve any Dispute within fifteen (15) Business Days of receipt of the notice provided under Section 10.1.

10.3 Arbitration

If the Parties are unable to resolve a Dispute in accordance with Section 10.2, the Dispute shall be referred to and finally settled by a single arbitrator. All Disputes referred to arbitration shall be governed by the substantive laws of the Province of Ontario for the appointment of an arbitrator. The Parties agree that the chosen arbitrator shall have the requisite experience and appropriate technical expertise to decide the matter. The arbitration shall be in accordance with the *Arbitration Act, 1991* (Ontario).

10.4 Governing Law

This Agreement shall be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein.

10.5 Performance During Dispute Resolution

While efforts are being made to resolve a Dispute, the Parties shall continue to perform all obligations under this Agreement and shall continue to comply with all terms of this Agreement.

ARTICLE 11 GENERAL MATTERS

11.1 Disclosure of Confidential Information

"Confidential Information" means all information of a Party (including that of its Affiliates) that is not generally known to the public and that is disclosed by such Party (the "Disclosing Party") to the other Party (the "Receiving Party") or that is otherwise learned by, or comes into the possession or knowledge of, the Receiving Party in connection with, or as a result of, the evaluation, negotiation or execution of, or performance of the transactions contemplated by this Agreement. Confidential Information shall not include any information that:

- (i) the Receiving Party can establish, by documentary evidence, was already known by the Receiving Party at the time of the initial disclosure by the Disclosing Party;
- (ii) is or becomes publicly known through no wrongful act of the Receiving Party or its Representatives, or any other person subject to a confidentiality agreement in favour of the Disclosing Party;
- (iii) is rightfully received from a third party without similar restriction provided that the third party did not come into possession of the Confidential Information as a result, directly or indirectly, of a breach of an obligation of confidentiality owed by any person to the Disclosing Party;
- (iv) the Receiving Party can establish, by documentary evidence, was independently developed by or on behalf of the Receiving Party without reference to the Disclosing Party's Confidential Information; or
- (v) is approved for release by written authorization of the Disclosing Party;

- (a) Except as specifically permitted by this Agreement or required in accordance with Applicable Laws or Authorizations, the Receiving Party shall not publish, disclose, or otherwise divulge Confidential Information to any person, and shall not use Confidential Information of the Disclosing Party for any purpose other than the evaluating, negotiating, or the performance of the transactions contemplated by, this Agreement. The Receiving Party shall take appropriate steps to ensure Confidential Information is safeguarded in accordance with standards of practice that are consistent with the industry accepted best practices used or observed by comparable Persons in Ontario.
- (b) The Receiving Party may provide Confidential Information to those Verifiers, directors, other employees, Affiliates, agents, advisors, consultants and other representatives of Receiving Party ("Representatives") who have a need to know for the purposes of evaluating, negotiating, and performing the transactions contemplated by, this Agreement. The Receiving Party shall restrict access by such Representatives to only the Confidential Information they need for such purpose. Before such disclosure, the Receiving Party shall advise such Representatives of the sensitive and confidential nature of the Confidential Information. The Receiving Party shall be liable for any failure by its Representatives to comply with the terms of this Agreement.
- (c) If there is any unauthorized access to, disclosure or loss of, or inability to account for, any Confidential Information of the Disclosing Party, the Receiving Party shall promptly: (i) notify the Disclosing Party; (ii) take such actions as may be necessary or reasonably requested by the Disclosing Party to minimize the disclosure or loss; and (iii) cooperate in all reasonable respects with the Disclosing Party to minimize the impact of the disclosure or loss and any damage resulting therefrom.
- (d) The Receiving Party acknowledges that disclosure or use of Confidential Information in violation of this Agreement could cause irreparable harm to the Disclosing Party for which monetary damages may be difficult to ascertain or be an inadequate remedy. The Receiving Party therefore agrees that the Disclosing Party shall have the right, in addition to its other rights and remedies, to seek injunctive relief for any violation of this Section 11.1.
- (e) For greater certainty, a Party may disclose any Confidential Information required to be disclosed to an Applicable Program, any registry evidencing ownership of ERs or Government Authority, including descriptions and/or copies of, as applicable, the Project, Verification Reports and any such information that shall be made public by such Applicable Program or registry shall not be considered Confidential Information for the purposes of this Section 11.1 and either Party may publish, disclose, or otherwise divulge this information in any manner it sees fit.
- (f) No public announcement, by press release or otherwise, with respect to this Agreement or the transaction contemplated herein is to be made by a Party unless and until the text of the announcement and the time and manner of its release have been approved by the other Party. The Parties shall not disclose the financial details of this transaction, including but not limited to the Purchase Price of the VERs to be sold or sold in accordance with this Agreement.

11.2 Expenses

- (a) The Seller shall pay all legal fees related to the preparation of this Agreement, without adverse presumption or interpretation in favour of either Party.
- (b) The Seller and Buyer shall each pay fifty percent (50%) of the Registration fees incurred by the Buyer in relation to the first listing of the Project and the Delivered VERs on the Registry. Any subsequent fees related to additional or subsequent transfers on the Registry shall be borne solely by the Buyer.
- (c) Subject to Subsections 11.2(a) 11.2(b) above and except as otherwise specifically provided elsewhere in this Agreement, each of the Seller and the Buyer; respectively, shall be responsible for its own expenses (including fees and expenses of legal advisers, accountants and other professional advisers) in connection with the matters contemplated by this Agreement.

11.3 Entire Agreement

This Agreement constitutes the entire agreement between the Parties with respect to all the matters herein and its execution has not been induced by, nor do any of the Parties rely upon or regard as material, any representations or writings whatsoever not incorporated herein and made a part hereof and may not be amended or modified in any respect except by written instrument signed by the Parties hereto. Schedules referred to herein are incorporated by reference and form part of the Agreement.

11.4 Waiver, Amendment

Except as expressly provided in this Agreement, no amendment or waiver of this Agreement shall be binding unless executed in writing by the Party to be bound thereby. No waiver of any provision of this Agreement shall constitute a waiver of any other provision nor shall any waiver of any provision of this Agreement constitute a continuing waiver unless so expressly provided.

11.5 Enurement, Assignment

- (a) This Agreement shall enure to the benefit of and be binding upon the Parties hereto, and their respective heirs, executors, administrators, successors, assigns and legal representatives.
- (b) No Party may assign or transfer its rights pursuant to this Agreement without the prior written consent of the other. Any such purported assignment or transfer without such consent shall be deemed ineffective and void.
- (c) For greater certainty, after transfer of the VERs to, and payment in full to the Seller by, the Buyer, the Buyer may transfer all or a portion of its interest in the VERs from time to time and at any time without requiring any further consent from the Seller.

11.6 Notices

(a) Any notices, requests or other communications required to be given under this Agreement shall be given in writing to the individuals listed below, and shall be given by personal delivery, registered mail (postage prepaid) or by electronic means of communication (facsimile or email) addressed to the recipients as follows:

(i) For Seller:

Green Municipal Corporation 24 Clarence Street Ottawa, ON K1N 5P3

Attention: Coralia Bulhoes
Facsimile number: (613) 907-6226
Email: cbulhoes@fcm.ca

(ii) For the Buyer:

Zerofootprint Software Inc. 197 Spadina Avenue, Suite 400 Toronto, ON M5T 2C8

Attention: Ron Dembo Facsimile number: (416) 365-7557

Email: ron.dembo@zerofootprint.net

- (b) Any change of individual, facsimile number, email address or address for a Party shall be promptly communicated in writing to the other Party, in compliance with this section.
- (c) Any notice delivered in accordance with paragraph (a) above shall be deemed to have been received when delivered or, if mailed, at 12:01 a.m. on the third day after the day of mailing, or if given by electronic communication, on the day of transmittal thereof if given during the normal business hours of the recipient and on the Business Day during which such normal business hours next occur if not given during such hours on any day, provided that in the case of electronic communication, such notice, request, demand or other communication shall only be valid if: (i) followed by an original copy of such notice, request, demand or communication, delivered by courier or personal delivery; or (ii) the recipient specifically acknowledges receipt thereof. If the Party giving any demand, notice or other communication knows or ought reasonably to know of any difficulties with the postal system that might affect the delivery of mail, any such demand, notice or other communication may not be mailed but must be given by personal delivery or by electronic communication.

11.7 Invalidity of Provisions

Each of the provisions contained in this Agreement is distinct and severable and a declaration of invalidity or unenforceability of any such provision or part thereof by a court or arbitrator of competent jurisdiction shall not affect the validity or enforceability of any other provision hereof. To the extent permitted by Applicable Laws, the Parties waive any provision of law that renders any provision of this Agreement invalid or unenforceable in any respect. The Parties shall engage in good faith negotiations to replace any provision that is declared invalid or unenforceable with a valid and enforceable provision, the economic effect of that comes as close as possible to that of the invalid or unenforceable provision that it replaces.

11.8 Further Assurances

Each of the Parties shall promptly do, make, execute, deliver, or cause to be done, made, executed or delivered, all such further acts, documents and things as the other Party hereto may reasonably require from time to time to effect the Transfer of VERs from the Seller to the Buyer and shall use reasonable efforts and take all such steps as may be reasonably within its power to implement to their full extent the provisions of this Agreement.

11.9 Eligible Financial Contract

The Parties agree that this Agreement constitutes an "eligible financial contract" within the meaning of the *Bankruptcy* and *Insolvency Act* (Canada), the *Companies' Creditors Arrangement Act*, the *Winding-Up* and *Restructuring Act* and any other applicable Canadian insolvency legislation.

11.10 Independent Legal Advice

The Parties hereby acknowledge that they have been afforded the opportunity to obtain independent legal advice with respect to this Agreement prior to its execution and are executing this Agreement of their own volition. The Parties acknowledge that they read this Agreement, understand it and agree further to be bound by its terms and conditions.

11.11 Counterparts

This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same agreement. Delivery of a facsimile or other means of electronic communication of this Agreement executed by a Party, without any further act by such Party, shall be a valid form of execution and delivery of this Agreement by such Party.

IN WITNESS WHEREOF the Parties I	neret	have executed this Agreement.	
	Zero	ofootprint Software Inc.	
	Ву:	Name: Ron DEM 60	
		Title: CEO & FOUNDER	
	By:	Name: Title:	
	Gre	en Municipal Corporation	
	By:	-c: (1 Z	
	•	Name: Brock Carlton	
		Title: Chief Executive Officer	
	By		
		Name	

Title:

SCHEDULE A PROJECT DESCRIPTION

1.1 PROJECT DESCRIPTION

The Nanaimo Landfill Gas (LFG) Capture and Combustion GHG Emission Reductions Project is located approximately five kilometers (km) south of downtown Nanaimo, British Columbia. The project involves biogas recovery, conditioning and the destruction of the captured LFG. In 2003, the RON installed 21 vertical wells, rehabilitated 4 vertical wells from an existing system, and installed a LFG control station. Between 2005 and 2014, additional vertical wells and horizontal collection trenches were added and others were decommissioned from the system.

Phase I of the Project was validated (positive finding) to a limited level of assurance for the 2004-2008 period. Phase I of the Project involved biogas recovery, conditioning and flaring. At the end of 2008 and early 2009, significant remediation of the collection system and multiple upgrades and improvements to the facilities control plant, data recording and collection systems were implemented, thus requiring a separate Project Plan for the 2009-2012 period.

As per the new 2009-2012 Project Plan, the LFG collection system is comprised of 31 connected vertical gas collection wells, and 4 horizontal gas collection trenches. The control system has been digitized and the destruction system includes the use of both a flare and utilization facility. The utilization facility includes two Jenbacher J312GS internal combustion engines that combust LFG as feedstock. Each engine is coupled to an Emerson Electric 800 kW induction generator. The utilization facility is owned, constructed, maintained, and operated by Cedar Road LFG Inc. (Cedar Road). Cedar Road is a third party and does not have a claim on the emission reductions generated. The utilization facility only runs when the flare is operating.

Per the 2014 Project Report, Five vertical extraction wells (EX53 to EX57) were added in the Cell 1 to improve the LFG collection efficiency and reduce GHG emissions and four vertical extraction wells (EX06 to EX08, and EX27) were decommissioned.

FINAL REPORT

The source of GHG emissions for the Baseline condition is venting of methane directly to the atmosphere (otherwise captured and combusted in the flare or engines of the Project). The relevant GHG sources within the project boundary (the RON landfill) will be considered in the verification.

The following GHGs are included within the scope of the verification:

- carbon dioxide (CO2);
- methane (CH4);
- nitrous oxide (N20);
- hydrofluorocarbons (HFCs);
- perfluorocarbons (PFCs); and
- sulphur hexafluoride (SF6).

Emission reductions are calculated as the difference between the baseline emissions and the project emissions.

SCHEDULE B DELIVERY SCHEDULE

Delivery Schedule. On or before each Delivery Date set forth in the table below, the Seller shall deliver the Delivery Quantity. The Buyer shall pay the Purchase Price for VERs Delivered on a Delivery Date not later than the Payment Due Date. The parties may elect to move the Delivery Date forward as set out in Section 2.2 of this Emission Reduction Purchase Agreement.

Vintage	Delivery Date	Delivery Quantity (in tonnes CO₂e)	Payment Due Date
2013	September 30, 2015	12,964	The date that is the earlier of October 30, 2015 or 30 Business Days after Delivery*
2013	October 15, 2015	12,964	The date that is the earlier of November 15, 2015 or 30 Business Days after Delivery*
2014	November 1, 2015	14,311	The date that is the earlier of, November 30, 2015 or 30 Business Days after Delivery*
2014	December 1, 2015	14,311	The date that is the earlier of December 30, 2015 or 30 Business Days after Delivery*
2015	March 31, 2016	[8,196.01]**	The date that is the earlier of April 29, 2016 or 30 Business Days after Delivery*

^{*}In the event of an earlier Delivery Date as stipulated by Buyer in accordance with Subsection 2.2(a) of the Agreement.

^{**}As per the draft Emissions Reduction report for the Project for the period from January 1, 2015 to April 15, 2015. Parties acknowledge that the 2015 Vintage Delivery Quantity is to be confirmed in accordance with forthcoming 2015 Verification Report.

APPENDIX B: GREEN MUNICIPAL CORPORATION MEASUREMENT, MONITORING, REPORTING, AND VERIFICATION PROTOCOL

SCHEDULE "B"

The Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocol for Greenhouse Gas Emission Reductions from Designated Projects Funded Through the Green Municipal Fund

Schedule B

The Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocci for Greenhouse Gas Emission Reductions from Designated Projects Funded Through the Green Municipal Fund

Acknowledgements

The Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocol for Greenhouse Gas Emission Reductions from Designated Projects Funded Through the Green Municipal Fund (the "GMC MVP") has been developed through the valuable participation of a number of people and branches within the Government of Canada.

The Green Municipal Corporation ("GMC") would like to acknowledge the vital contributions made by the Greenhouse Gas Verification Centre, the Pilot Emissions, Reductions, Removals and Learnings Program ("PERLL"), Julie Desjardins of Desjardins & Associates, Christine Schuh of Price Waterhouse Coopers, Al Seskus of ICLEI and, the important participation and collaboration of the Technology Early Action Measures ("TEAM") Office.

The Government of Canada has several programs underway to respond to climate change including, but not limited to, the Domestic Emissions Trading system, a program for greenhouse gas ("GHG") mitigation technology development through Sustainable Development Technology Foundation, and the establishment of the Green Municipal Fund ("GMF"). The GMF is directed at achieving emission reductions from Canadian municipalities and administered by the Federation of Canadian Municipalities ("FCM"). Although these programs have different goals and requirements, they can work together to further develop a consistent approach for credible, cost-effective measurement, monitoring and reporting of GHG emissions and reductions that result from projects funded by the Government of Canada, and associated independent funding agencies. The objective of the following GMC MVP is to consolidate shared learning and experience in order to facilitate the accurate, verifiable and consistent measurement, monitoring, reporting and verification of GHG emissions and reductions that result from stipulated Projects that are funded through the GMF and provide a guide for municipalities and their service providers in undertaking these tasks. In keeping with these objectives, this GMC MVP will be regularly reviewed and updated to include further project-specific quantification methods and promote the consistency and acceptability of this protocol with international climate change initiatives.

1 Introduction

This Green Municipal Corporation Protocol has been compiled to facilitate the quantification and transfer of greenhouse gas ("GHG") emission reductions from new municipal projects that are funded through the Green Municipal Fund ("GMF") and stipulated by the Federation of Canadian Municipalities as Verifiable Emission Reduction projects. While facilitating municipal experience with emission markets is an important function, the Protocol is also attempting to generate a knowledge base that will strengthen the overall national understanding of, and experience with, all aspects of emission offset projects.

This Protocol is also intended to contribute to the research and data pertaining to the ability of landfill gas generation models to accurately predict the amount of landfill gas emitted from Canadian landfills. Specifically, this effort will assist Environment Canada and other government bodies in determining if the parameters currently used to estimate landfill emissions in Canada are sufficiently robust, and correctly reflect the landfill methane potential throughout Canada. As a result, proponents of municipal projects involving the capture and combustion of landfill gas will also be required to comply with the applicable quantification methodology in this Protocol in order to estimate the expected LFG emissions from their project, should they apply for funding through the Green Municipal Fund.

Applicability. The Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocol for Greenhouse Gas Emission Reductions from Stipulated Projects Funded Through the Green Municipal Fund (the "GMC MVP") is only applicable to projects that wish to be, or are, funded through the Green Municipal Fund and are designated by the Federation of Canadian Municipalities as Verifiable Emission Reduction projects ("Applicable Projects"). All Applicable Projects are intended to transfer any verified emission reductions resulting from the project to the Green Municipal Corporation ("GMC"). Currently, the GMC MVP provides for only the quantification of direct GHG emission reductions from Applicable Projects.

Overview. The GMC MVP provides guidance for proponents of Applicable Projects on monitoring and reporting matters outlined in each of the following sections:

- (i) Measuring and monitoring greenhouse gas ("GHG") emissions and quantifying the emission reductions that result from an Applicable Project;
- (ii) Reporting to the GMC on the GHG emissions reductions that result from an Applicable Project;
- (iii) Selecting and retaining a Verifier; and
- (iv) Conducting a Verification and completing a Verification Report.

Limited Use. This document is intended to be a guidance document for use by municipalities and their service providers, as well as GMC and its affiliates in accounting for, and potentially trading, GHG emission reductions resulting from Applicable Projects. No liability shall arise from reliance on this document for other than its intended use by the intended users, and for further clarification none of the Government of Canada, FCM, GMC or their affiliates shall incur any liability associated with any use of, or reliance on, this document.

"Emission Reduction". In order to consistently and accurately quantify GHG emission reductions, the proponent must first start with a clear and consistent definition of an Emission Reduction ("ER"). Throughout this Protocol an Emission reduction is defined as a real, measurable, verifiable, surplus, unique, incremental and sustainable reduction in the GHG emission intensity resulting from a Project relative to baseline emission intensity within the Project boundaries, as such reductions occur, and are measured and reported as metric tonnes of CO2 equivalent in accordance with a defined set of

measurement, monitoring and reporting criteria. These criteria for a valid emission reduction are expanded upon below.

Real. An emission removal or reduction is real if it is a reduction in actual emissions, resulting from a specific and identifiable action or undertaking, net of any "leakage", or increased GHG emissions resulting from the project's effects on a third party or jurisdiction.

Measurable. An emission removal or reduction is measurable if the actual GHG emissions intensity resulting from the operation of the project, and the GHG emissions intensity in the reference (or "baseline") case, can be quantified. Project-specific quantification guidelines for certain municipal projects are provided in section 1 of this Protocol.

Verifiable. An emission reduction verifiable if a qualified and independent verification professional is able to determine that the emission reduction calculations are accurate and free from material misstatement; the calculation methodology is acceptable, transparent and replicable; and the measurements, raw data, estimates and assumptions required to verify all calculations are accessible, available, secure and free from alteration.

Surplus. An emission reduction is surplus if it represents a net reduction that is not otherwise required through the legal or regulatory requirements of any level of government, affecting GHG emissions. In order to substantiate the surplus nature of an emission reduction, project proponents will need to address

- All relevant emission regulations/regulatory requirements in the project's jurisdiction
- Any operating standards which affect the status of the emission reductions generated by the project
- Current best practice in the project development area
- Any voluntary agreements within the sector or project area

Unique. An emission reduction is unique if it is reported and accounted for a singular purpose and not multiple programs, requirements, or benefits.

Incremental. An emissions reduction is incremental if it is the result of a new, incremental municipal project that commenced after it was approved for funding from the GMF. Project proponents will be required to provide information on the project timeline, current status and the results of any feasibility studies that affect the implementation date of the project.

Sustainable. Emission reductions are sustainable if they will create a continuous stream of emission reductions for more than 5 years and have the potential to create continued net emission reductions (based on the physical, rather than economic characteristics of the activity) beyond that period.

It is noteworthy that all qualifying emission reductions must result from: (i) projects that are located in Canada; and (ii) baseline emissions that would have been emitted in Canada.

Cost. It is estimated that it will cost a proponent between \$10,000 and \$30,000 to establish an internal reporting framework to complete all reports that must be filed with the GMC, and retain a qualified Verifier to complete the first Verification and Verification Report in accordance with sections 4 and 5 of this Protocol. Proponents of Applicable Projects are eligible for a GMF Project Performance Reporting Grant (the "GHG PPRA") for up to \$30,000 to mitigate the costs of implementing the measurement, monitoring, reporting and initial verification procedures outlined in this Protocol.

In accordance with the terms of the GHG PPRA (of which this Protocol forms an integral part), satisfactory completion of required reports in accordance with the specified timelines is a condition of disbursement. The first contribution towards eligible reporting costs will be made by FCM to the project proponent following the submission of the proponent's Project Description and the estimated GHG emission reductions calculated in accordance with this Protocol. The second contribution will be made to the project proponent following submission of the first Annual Emission Reduction Report and Verification Report in a form and substance acceptable to the GMC.

Figure 2 presents the contribution process incorporated into the project timeline.

Insert Figure 2				
		e e		

Figure 2 Project Timeline Indicating Contributions Under the PPRA

It is important to note that, in addition to the submission of the above-mentioned reports, the PPRA contains other conditions that must be fulfilled by the proponent prior to the contributions being made. Proponents are encouraged to consult the PPRA to ensure that they are fulfilling all of their contractual requirements, and to contact a GMC Project Verification Officer with any questions. Your questions may be directed to:

Mr. Tom Johnson
Project Verification Officer
Green Municipal Corporation
24 Clarence Street
Ottawa, Ontario
K1N 5P3
Tjohnson@FCM.ca
613-241-5221 x240

2 Measuring and monitoring greenhouse gas ("GHG") emissions and quantifying the emission reductions that result from an Applicable Project.

This section of the GMC MVP provides both general quantification principles and specific methods to measure, monitor and quantify direct GHG emission reductions resulting from different types of Applicable Projects including landfill gas capture/methane combustion projects. Generally, each project-specific quantification method provides a process for establishing and quantifying: the baseline GHG emissions in the absence of the project; the GHG emissions following the installation/operation of the project; and the associated GHG emission reductions resulting from the project. Proponents of Applicable Projects may be required to adapt the quantification method to address the specific circumstances of their project. In such cases, a detailed description and support for all such adjustments and estimates must be reported to the GMC as part of the GMC reporting process.

2.1 General Quantification Principles

The following general quantification principles are intended to provide general guidance for project proponents in quantifying resulting emission reductions in a manner that facilitates national and international consistency and accuracy in the calculation of GHG emissions reductions. Many of these principles are reflective of those included in thee Intergovernmental Panel on Climate Change Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the related Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, which are respectively available at:

- http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm
- http://www.ipcc-nggip.iges.or.jp/public/qp/qpgaum.htm

In General, the following key principles should be used as guidance for measuring, calculating, monitoring and reporting GHG emission reductions.

Accuracy. Accuracy is the relative measure of the exactness of relevant measures. This should enable estimates to be neither over nor under their true values, as far as can be judged, and that uncertainties are reduced as far as practical.

Best practices. Best practices means performance at least equivalent to the most cost-effective commercially applied monitoring methods.

Comparability. Estimates of emission reductions reported by participants should be comparable among all participants. Estimates of emissions should be comparable between the baseline condition and the project condition. Equivalent functions should be defined and applied. Comparable functional units (e.g. baseline and system elements), preferably equal, should be used.

Completeness. The baseline and project systems should cover all relevant GHGs and source categories. It should also include "leakage" effects, or the GHG effects of the project that go beyond the main elements of the project, as appropriate. Emission reduction calculations should also cover all relevant sources and sinks.

Conservatism. Emission reduction estimates must be calculated in a way that emission reductions are not overestimated.

Consistency. The baseline and the project systems should address the same key elements. Also, an emission reduction estimate should be internally consistent in all its elements over a period of years. An emission reduction estimate is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions from sources.

Cost-efficiency. The costs and effort necessary to document, measure, and report a GHG project should be reasonable, dependent on the desired level and amount of predicted emission reductions.

Practicality. Approaches employed for project documentation, measurement and reporting should be based on simple, well-tested principles.

Reliability. For the estimation of emissions from project-based activities the most realistic and most likely scenario shall be chosen as the baseline case. This Protocol provides specific quidance for certain municipal projects including landfill gas/ methane combustion projects.

Transparency. Assumptions, calculations, references and methodologies used for measurement and estimation of emissions shall be clearly explained and described to facilitate replication and assessment of the calculation by users of the reported information. The transparency of emission calculations is fundamental to the success of the process for the communication and consideration of this information.

Validity. For the estimation of emission reductions it is crucial that factors and assumptions used give a real measure of the real reductions achieved. The baseline must therefore be based on factors or assumptions that give an observable and/or realistic scenario.

2.1.1 Basic Conventions

The following basic conventions have also been established to facilitate the comparability of GHG emission calculations.

Metric units. All emission reduction calculations should be made or converted to metric units prior to completing the required reports.

Physical units of measure. To the extent possible, calculations should be made with physical units of measure such as mass, volume, length. Ratios of one parameter to another or quantities of fossil fuel measured in energy units should be avoided since they may contain systematic bias.

Emission reductions of individual GHGs should be calculated separately and then aggregated using Global Warming Potentials (GWPs). Emission factors for most calculations are GHG specific and are not presented in terms of CO₂ equivalents. Emission calculations should be completed for each GHG and then the appropriate IPCC GWP should be used express the total GHG emission reductions in the common unit of CO2 equivalents.

Comprehensiveness and Transparency. All information should be reported in a comprehensive and transparent manner by listing all assumptions, formulae, methodologies, technical specifications, and references (documents, contacts, websites, etc.).

Outsourcing and Off-loading. Outsourcing GHG intense activities does not necessarily affect GHG emissions. GHG emission reduction calculations should be governed by whether the activity in

question is still part of the overall system, rather than who is carrying out the activity. Outsourcing and offloading could potentially misrepresent GHG impacts by falsely identifying a transfer of burden as a reduction. If the project includes outsourcing of some tasks to an entity that can perform these tasks with fewer GHG emissions, this may, in limited circumstances be included in the HG emission reduction calculations.

Standard Operating Procedures and Instruments. Standard operating procedures (SOPs) describe, in detail, the laboratory methods to be used by the analyst and the training requirements for the analyst. Examples of SOPs include the Canadian General Standards Board's books of standards, the American Society for Testing and Materials, and the guidelines issued by the International Standards Organization such as Guide 25: General Requirements for the Competency of Calibration and Testing Laboratories. If a specific operating procedure or instrument has been used it should be expressly reported.

Sampling. Samples may be gathered in a number of different ways. The chosen sampling method should reflect: the nature of the data in question; typical process characteristics at the sampling locations; and applicable federal, provincial or local monitoring protocols or guidelines.

Uncertainty. Whenever possible, estimates of data uncertainty should be included and expressed as a quantitative measurement, such as plus or minus 10 tonnes, within a 15% level of confidence.

Direct vs. Indirect Emission Reductions. Currently, this Protocol provides for the quantification of only direct emission reductions resulting from municipal projects. The general principle for establishing whether an emission reduction is direct or indirect is the degree of control over the actual GHG emissions. Emissions from sources that are owned, leased or controlled by the project proponent (e.g. stacks, manufacturing processes and vents, company-owned/controlled vehicles) are considered "direct". A direct emission reduction would occur from reducing emissions at their source from activities including the capture and destruction of landfill gas. The most common indirect mission reduction results from reduced electricity consumption that reduces production and therefore GHG emissions from an unrelated thermal electricity generator.

Comparability of Project and Baseline. In calculating and reporting emissions reductions, the Project context and the Baseline context must be demonstrated to be comparable. Any differences between the systems should be identified and reported.

2.2 Landfill Gas Capture / Methane Combustion Projects

This GHG emission reduction quantification method is applicable only to Applicable Projects that involve the installation of equipment to capture and combust landfill gas. The following methodology allows for the quantification of only direct GHG emission reductions and does not take into consideration: (i) any indirect GHG or other contaminant emission reductions that may result from the subsequent use of heat or other products of such combustion; or (ii) any indirect GHG or other emission reductions that may result from offsetting emission intense electricity generation. The methodology includes: (i) general background on LFG; (ii) a reference methodology for estimating total LFG emissions; (iii) a methodology for estimating captured and combusted methane; and (iv) an emission reduction calculation method for direct reductions of GHG emissions.

2.2.1 General Background on LFG

Landfill gas ("LFG") is produced by the anaerobic decomposition of organic wastes and is composed mainly of two GHGs: methane and carbon dioxide. According to the Intergovernmental Panel on Climate Change, methane has a global warming potential that is 21 times that of carbon dioxide and is therefore has an atmospheric insulating effect that is 21 times more powerful than carbon dioxide. When the methane in LFG is captured and combusted into carbon dioxide and water there is a commensurate reduction in the total GHG emissions (measured as CO2 equivalents, or CO2e) emitted by the landfill.

When organic wastes are landfilled the decomposition process typically begins after 10 to 50 days, although the majority of methane and carbon dioxide is generated within 20 years of landfilling and emissions can continue for 100 years or more (Levelton, 1991). As a result, the age of the landfill as well as number of important site-specific factors will contribute to the generation of LFG at a landfill. These factors include waste composition, moisture content, temperature, pH, buffer capacity, availability of nutrients, waste density and particle size. Each is briefly outlined below.

Waste Composition: Waste composition is probably the most important factor affecting LFG generation rates and quantities. The amount of LFG produced is dependent on the amount of organic matter landfilled. The rate at which the gas is generated is dependent on the distribution and the types of organic matter in the landfill (Tchobanoglous, 1993).

Moisture Content: Since water is required for anaerobic degradation of organic matter, the amount of moisture within a landfill also significantly affects LFG generation rates.

Temperature: Anaerobic digestion is an exothermic (heat generating) process. The growth rates of bacteria tend to increase with temperature until an optimum is reached (Tchobanoglous, 1993). Therefore, landfill temperatures may be higher than ambient air temperatures. The extent to which ambient air temperatures influence the temperature of the landfill and gas generation rates depends mainly on the depth of the landfill. It has been observed that landfill temperatures fluctuate with long-term ambient temperature variations (Levelton, 1991).

pH and Buffer Capacity: The generation of methane in landfills is greatest when neutral pH conditions exist. Methanogenic bacteria activity is inhibited in acidic environments. For gas generation to continue, the pH of the landfill must not drop below 6.2 (Tchobanoglous, 1993).

Availability of Nutrients: Certain nutrients are required for anaerobic digestion. These include carbon, hydrogen, nitrogen and phosphorus. In general, Municipal Solid Waste (MSW) contains the necessary nutrients to support the required bacterial populations.

Waste Density and Particle Size: The particle size and density of the waste also influence gas generation. Decreasing the particle size increases the surface area available for degradation and therefore increases the gas production rate. The waste density, which is largely controlled by compaction of the waste as it is placed in the landfill, affects the transport of moisture and nutrients through the landfill, which also affects the gas generation rate.

2.2.2 A Reference Methodology for Estimating Total LFG Emissions

Methods for calculating the total landfill gas generated at a landfill are evolving but all are generally based on an exponential decay model dependent on many of the above-mentioned variables. This LFG quantification methodology is based on Landfill Gas Emissions Model (LandGEM) as set out by the US EPA Technology Transfer Network (TTN) and posted at:

http://www.epa.gov/ttn/catc/products.html#software

The GMC MVP requires proponents of Applicable Projects to use version 2.01 of the LandGEM model and the associated users manual to estimate total LFG emissions from the landfill in question. Given that different versions may produce different estimates, it is recommended that proponents of Applicable Projects do not use any version of the LandGEM other than 2.01. The estimate of total LFG emissions generated by the LandGEM model will be used by both project proponents applying for GMF funding to estimate their benchmark emission intensity and proponents of Applicable Projects in calculating and reporting their project emission intensity and GHG emission reductions.

The LandGEM model (version 2.01) requires proponents to input two parameters in order to estimate total LFG emissions. They are: (i) the methane generation rate, "k"; and (ii) the methane generation potential, " L_0 ". Further details and estimates of both of these parameters in the Canadian context are set out below.

(i) The methane generation rate, "k"

The table below provides the current values for the parameter 'k', the Methane Generation Rate, used in the calculation of landfill methane emissions in Canada. These figures have been in use since the early 1990's. Project proponents are asked to use these values as a starting point for their modeling calculations, however, if site-specific k-values exist, these should be used instead.

Recommended Environment Canada Methane Generation Rate (k) Values

Province	K	
British Columbia	0.028	
Alberta	0.006	
Saskatchewan	0.006	
Manitoba	0.006	
Ontario	0.024	
Quebec	0.024	
New Brunswick	0.011	
Prince Edward Island	0.011	
Nova Scotia	0.011	
Newfoundland	0.011	
Northwest Territories and Nunavut	0.003	
Yukon	0.003	

Source: B.H. Levelton & Associates, Inventory of Methane Emissions from Landfills in Canada. Prepared for Environment Canada, June 1991.

(ii) the methane generation potential, "L₀"

The theoretical and measured values of the methane generation potential of a landfill, L_o , range from 4.4 to 194 kg methane (CH₄)/tonne of waste (Pelt,1998). For the years 1941 through to 1989, a value for L_o of 165 kg of CH₄ /tonne of waste should be used as suggested by the U.S. EPA (Levelton, 1991). For the years 1990 and beyond, the following equation should be used to calculate a value of L_o (Ortech, 1994):

$$L_0 = (M_c *F_b *S)/2$$

where:

 M_c = tonnes of carbon per tonne of waste landfilled F_b = biodegradable fraction S = stoichiometric factor

The carbon content (M_c) in the waste on a dry basis is determined as a percentage of the waste disposed, and is divided into two categories - biodegradable carbon and refractory carbon. Biodegradable carbon is the carbon contained in degradable items such as food, paper and wood wastes. Refractory carbon is the carbon in items such as plastic that degrades very slowly and therefore results in virtually no GHG emissions. The biodegradable fraction (F_b) of the waste is determined by dividing the biodegradable carbon by the total carbon.

The stoichiometric factor in the equation above for methane is 16/12, which is equal to the ratio of the molecular mass of methane to that of carbon. The product of the three variables is then divided by two, given that approximately 50% of the LFG produced will be methane and the other 50% will be carbon dioxide (Pelt, 1998). Based on these considerations, a $L_{\rm o}$ of 117 kg CH₄ / tonne of waste has been calculated for certain Canadian landfills and is therefore recommended as a starting point for project proponents. However, if site-specific values exist for $L_{\rm o}$ these should be used instead.

2.2.3 Methodology For Estimating Captured And Combusted Methane

There are three components to estimating the captured and combusted methane resulting from a landfill gas capture and flaring project:

- i. Measuring the methane content of the landfill gas entering the capture system;
- ii. Measuring the flow rate of landfill gas entering the combustor; and
- iii. Measuring the destruction efficiency of the landfill gas combustor.

i. Measuring the methane content of the landfill gas entering the capture system

The concentration of methane in landfill gas can be sampled from outlets in the capture system (e.g. capture system headers) or directly prior to the combustor using a portable analyser (e.g. Landsurveyer 1). These instruments typically use a thermal conductivity sensor to measure %-gas. The instrument should be shop calibrated every six months against pure methane, and the calibration should be checked weekly on site against a standard landfill gas mixture. Manufacturers typically claim an accuracy of ±3.0% of the indicated value over the full 0 to 100 %-volume range in this application. This is the recommended method for proponents to measure the methane concentration in their landfill gas.

Should the uncertainty range of the gas analyser specified by the manufacturer exceed 5%, the onsite analysis described above must be supplemented every 6 months with laboratory analysis of the landfill gas using gas chromatography (GC) with a flame ionization detector (FID) as a quality control step.

ii. Measuring the flow rate of landfill gas entering the combustor

A gas flow meter must be installed as close to the landfill gas combustor as possible to measure the amount of landfill gas reaching the combustion mechanism. This flow meter typically consists of an annubar sensing element with a digital readout or multivariable transmitter. The annubar measures differential pressure Δp , static pressure p_s and gas temperature t simultaneously with a single tap in the process line. The transmitter electronics use these measurements to compensate the density parameter of the landfill gas (which is pre-programmed into the transmitter) for temperature and pressure fluctuations, and output the pressure and temperature compensated flowrate in standard cubic feet per minute (SCFM)¹. The transmitter also dynamically adjusts the flow coefficients making up the flowmeter 'constant' K for greater precision. The manufacturer typically claims an accuracy of $\pm 1.3\%$ of the indicated value over an 8:1 turndown range.

iii. Measuring the destruction efficiency of the landfill gas combustor

For most enclosed flares, manufacturers provide factory estimates of destruction efficiency. These can be used as default figures in the calculation of emission reductions but must be supplemented by

¹ As a basic convention, all imperial units should be converted to metric units prior to submitting documentation.

actual measured data using Environment Canada-approved measurement protocols every 6 months, if the manufacturer's stated accuracy range is greater than 5%.

For open flares, emission reduction for capture and flaring systems using open flares should be calculated using manufacturer-specified destruction efficiencies, provided data supporting the manufacturer's claims is available. Where such values are not available, default control efficiencies from the most recent available version of the United States Environmental Protection Agency (US EPA) "Compilation of Air Pollutant Emission Factors, AP-42" (available online at http://www.epa.gov/) shall be used. Since it is not possible to establish destruction efficiencies for open flares using existing measurement techniques, these calculations need not be supplemented by actual measured data.

Other combustors, such as internal combustion engines and turbines, also usually have a manufacturer-specified destruction efficiency or existing literature/research has already established the destruction efficiency of these equipment types. These can be used as default figures in the calculation of emission reductions but must be supplemented by actual measured data using Environment Canada-approved measurement protocols if the stated accuracy range is greater than 5%. Supplementary testing must be conducted once every six months.

2.2.4 Emission Reduction Calculation Method for Direct Reductions of GHGs

Landfill gas capture and combustion reduces GHG emissions by combusting and converting the methane component of LFG into carbon dioxide and water. The volume of methane combusted is determined by multiplying the measured methane concentration (in %CH₄/m³ LFG) by the measured volume (m³) of LFG. The volume of methane combusted and resulting volume of carbon dioxide produced can be calculated using the chemical equation for combustion of methane:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

The density, $\rho_{\rm S}$, of methane at the standard condition of 25 °C and 1 atmosphere pressure (atm) is found from the ideal gas law:

$$\rho_s = \frac{pM}{R_o T} = \frac{\text{(1 atm)(16.043 kg/mol)}}{\text{(0.08206)(298.15 K)}} = 0.6557 \text{ kg/m}^3 - \text{CH}_4$$

Where:

- p is the standard atmospheric pressure of 1 atmosphere (atm)
- R_o is the universal gas constant, 0.08206 m³-atm/kmole-K,
- T is the absolute temperature in Kelvin (K = °C + 273.15), and
- M is the molecular weight of methane in kg.

If the flowmeter indicates the landfill gas flow in standard cubic feet per minute (SCFM), the proponent must convert the volume in cubic feet to cubic meters multiplying by 0.02832 m³/ft³. Multiplying by the number of minutes of operation gives the total volume flared for a given time period.

The methane concentration in the landfill gas, (c) percent-by-volume, can be measured at headers or directly before the combustor a minimum of twice daily. These values should be averaged to give the daily mean methane concentration (\bar{c}). The product $\bar{c}V$ is then the daily volume of methane destroyed and $\rho_s \bar{c}V$ the corresponding mass. Finally, the methane emission reductions must be converted to, and reported in terms of CO2 equivalents. Given that methane has a 100 year global

warming potential of 21 relative to CO₂ on a mass basis², the daily average mass of GHGs destroyed,"*r*", expressed in kg CO₂ equivalent (CO₂e) can be determined in accordance with the following equation:

$$r=
ho_s \overline{c} V \ {\rm kg - CH_4/day} \ {\rm or} \ r=21
ho_s \overline{c} V \ {\rm kg - CO_{2E}/day}$$
 , , , , ,
$$ho_s = the \ density \ of \ Methane \ in \ kg \ / \ m^3$$

$$\overline{c} = the \ average \ concentration \ of \ methane \ in \%$$

$$V = total \ volume \ of \ methane \ in \ m^3$$

The resulting value, r, is then multiplied by the destruction efficiency (in percent) to obtain the actual net GHG reductions over the period of a day. Daily GHG reductions may then be totalled over the appropriate period of time to obtain monthly, quarterly and annual total emission reductions in compliance with internal record keeping requirements and the reporting obligations under this Protocol.

² Recent publications from the IPCC have changed the GWP for CH₄, however, the GWPs recommended for use under the UNFCCC and the Kyoto Protocol are used here

3 Reporting to the GMC on the GHG Emissions Reductions that Result from an Applicable Project

Proponents of Applicable Projects are required to report both their quarterly and annual emission reductions to the GMC in the form of a Quarterly Emission Reduction Report and an Annual Emission Reduction Reports in the form and substance set out below. In addition, Annual Emission Reduction Reports must be accompanied by the Verification Report of a qualified Verifier in accordance with Sections 4 and 5 of this Protocol.

All reports to the GMC shall include: (i) a copy of the Site and Project Description which is set out as Schedule A in the Project and Transfer Agreement between the Proponent and the GMC; (ii) the name and address of the project proponent, its roles and responsibilities, and any joint venture information; (iii) any and all project partnerships, expected cost-sharing arrangements and any cost-sharing/emission reduction claim ratios that have been negotiated between the project proponent and the project partners. All parties involved in the project shall attempt to clearly identify the nature of each party's involvement and their level of financial contribution so that double counting is eliminated. The GMC shall bear no liability whatsoever relating to multiple parties' roles and responsibilities under a project.

3.1 Quarterly Emission Reduction Reports

On or before each of April 15, July 15, October 15, and January 15 of each calendar year, the Proponent of an Applicable Project is required to report to the GMC on the GHG emission reductions resulting from the project during the periods from January 1 to March 31, April 1 to June 30, July 1 to September 30, and October 1 to December 31, respectively. The reports shall be in the form of a Quarterly Emission Reduction Report as set out below and shall include the following information: the total GHG emissions resulting from the project during the quarter, all supporting calculations, and all data to support such calculations. For landfill gas capture and combustion projects the supporting data attachments shall include:

- Daily records of average methane concentration for the reporting period;
- Daily average landfill gas flow meter logs;
- Copies of the manufacturer's attestation of destruction efficiencies for their combustion equipment and accuracy range for their monitoring equipment; and
- A detailed set of sample calculations using actual data for the calculation of the emission reduction from a day's activities.

All Quarterly Emission Reduction Reports shall be sent electronically, in .PDF format with searchable text functionality, to the GMC on or before the applicable deadline by emailing the same to:

tjohnson@FCM.ca

3.2 Annual Emission Reduction Reports

On or before January 31 of each calendar year, the Proponent of an Applicable Project is required to report to the GMC on the total GHG emission reductions resulting from the project during the preceding calendar year. The annual reports shall be in the form of an Annual Emission Reduction Report as set out below and shall include the following information: the total GHG emissions resulting

from the project during the year, all supporting calculations, all data to support such calculations, a description of how the emission reductions meet each of the criteria for a valid emission reduction set out in section of the Protocol. For landfill gas capture and combustion projects the supporting data attachments shall include:

- All Quarterly Emission Reduction Reports
- Daily records of average methane concentration for the reporting period;
- Daily average landfill gas flow meter logs;
- Copies of the manufacturer's attestation of destruction efficiencies for their combustion equipment and accuracy range for their monitoring equipment; and
- A detailed set of sample calculations using actual data for the calculation of the emission reduction from a day's activities. All Annual Emission Reduction Reports shall be sent electronically, in .PDF format with searchable text functionality, to the GMC on or before the applicable deadline by emailing the same to: dsalloum@fcm.ca.
- Evidence supporting the surplus nature of the emission reductions including: all relevant emission regulations applicable to the project and the proponent; any operating standards that may affect the use or validity of the emission reductions generated by the project; and any voluntary agreements applicable to the project, proponent or the project sector.

Each Annual Emission Reduction Report shall include updated information on each of the following:

- Surplus have any new regulations come into effect that affects the operation of the project? Have any changes been made to the Certificate of Approval under which the project operates?
- **Project Costs** Provide updated information on the project's capital costs and operation costs to date.
- Ownership and Partnerships Has the ownership of, or title to, the project and/or the
 emission reductions changed since the proposal or the last claim report was submitted?
 Have new partners joined the project, which may have a claim on a portion of the revenues
 generated through GMF Grant or Loan? If less than 100% of the emission reductions
 generated by the project have been transferred to the FCM through the project, indicate
 whether the remaining emission reductions have been transferred to a third party.
- **Project Funding** Have any new sources of funding, from either the public or private sector been secured? Specifically, is the project in receipt of any funding from a federal program or initiative other than GMF?

Each Annual Emission Reduction Report must be accompanied by the signed original Verification Report of an approved Verifier in accordance with section 4 of this Protocol. It is the proponent's responsibility to, at its own cost, retain a Verifier, provide to the Verifier with all relevant information to conduct the Verification including: all information pertaining to the project, including the proponent's GMF application, copies of any reports that were submitted to the GMC, and a copy of through the GMC MVP.

While an electronic copy of the Verification Report may be filed along with the Annual Emission Reduction Report, the signed original Verification Report must be sent by registered mail to:

Mr. Tom Johnson Project Verification Officer Green Municipal Funds (GMF) 24 Clarence Street Ottawa, Ontario K1N 5P3 Tjohnson@FCM.ca 613-241-5221 x240

and received by the Green Municipal Corporation by no later than February 21 of each reporting year.

4 Selecting and Retaining a Verifier

The proponent of an Applicable Project shall retain a qualified Verifier to conduct a project site and document review and provide an opinion regarding the accuracy of the proponent's emission reduction and Annual Emission Reduction Report(s) in accordance with this Protocol. All verifiers must meet the standard qualifications and agree to perform their duties in accordance with the terms set out in the Standard Retainer Letter, both of which are set out below.

4.1 Standard Qualifications for Verifiers

Qualified Verifiers must meet the following criteria:

- **Professional Certification**. The individual providing the opinion in the Verification Report must be either a Professional Engineer, Chartered Accountant, Certified Environmental Auditor, or other professional approved by the GMC.
- **Expertise**. The Verifier, or a member of their verification team must have both the technical knowledge of, and expertise in, the subject matter of the verification.
- Independence and Objectivity. The Verifier shall be independent from the proponent, free from conflict of interest, and objective in its assessment of the proponent's data and claims. The Verifier must be independent from the persons or entity that performed the emission reduction calculations for the proponent and will not have been an employee of the proponent in the last year. Further the verifier shall not: have a financial interest in the proponent; be economically dependent on the proponent for a substantial portion of the Verifier's (in the case of a sole proprietor or small partnership) or firm's annual revenue; or have an immediate relationship with the proponent.
- **Fiduciary Duty.** Although the proponent will pay the Verifier, the Verifier will agree to perform its verification and complete the Verification Report in a position of fiduciary responsibility to both the proponent and GMC.
- Conflict Resolution Procedure. The Verifier or the Verifier's firm will have a written procedure to address client grievances and resolve conflicts with clients.
- Security Policy. The Verifier or the Verifier's firm will have and implement a document security policy to ensure that all client documents and working papers are used and stored in a secure fashion while the verification is being undertaken.
- **Insurance.** The Verifier or the Verifier's firm will possess professional liability insurance in an amount consistent with standard industry practices for an entity of similar size.

The GMC will maintain a list of all Verifier's that have met these criteria and produced Verification Reports acceptable to GMC, for the reference of project proponents.

4.2 Standard Retainer Letter for Verifiers

[To be completed on Verifier's Letterhead and delivered as a signed original to the Proponents for Acceptance]

Date

Proponent's Name Proponent's Address

Re: Agreement to Provide Verification Services

I [Verifier's name] in my capacity as [position, firm] agree to conduct a verification of the emission reduction activities, data, calculations and reports resulting from the [Proponent's name, project description and location] in accordance with best practices and the procedures and requirements set out in the Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocol for Greenhouse Gas Emission Reductions from Designated Projects Funded Through the Green Municipal Fund (the "GMC MVP").

In undertaking this retainer, I hereby warrant that I have read the (the "GMC MVP"), and comply with all requirements and qualifications of a Verifier outlined therein. Specifically, I understand that my services in performing the above-mentioned verification activities will be undertaken in a position of fiduciary responsibility to both [the Proponent] and the Green Municipal Corporation.

The verification services to be provided to [the Proponent] include: reviewing all documents, data and information relevant to the determination of the GHG emission reductions resulting from the project in accordance with the GMC MVP; considering the reasonableness of all exercises of discretion, estimates and assumptions; making a site visit to examine and inspect the project in light of proposed specifications and operating parameters; conducting personal interviews with key personnel involved in the measurement, monitoring, quantification and reporting of the GHG emission reductions; assessing all systems, controls and documentation pertaining to GHG emission reductions; and preparing and submitting a Verification Report to [the Proponent] and the GMC in accordance with the GMC MVP.

Total fees owed by [the proponent] to [the Verifier/Firm] for the above-mentioned services will be [•] and due upon the approval of the Verification Report by the GMC. Any disputes regarding the Agreement to Provide Verification Services shall be resolved in accordance with [the Verifier's/ Firm's] Conflict Resolution Procedure, failing which, the laws of the Province of Ontario.

Yours truly,

[Verifier]

I hereby affirm that I have all necessary authority to bind [Firm] in the provision of the above services.

c. Project Verification Officer
 Green Municipal Funds (GMF)
 24 Clarence Street
 Ottawa, ON K1N 5P3

johnson@FCM.c	а

[The Proponent] accepts this retainer in accordance with the terms set out above	e.
[signature of representative of the Proponent]	[date]
I hereby affirm that I have all necessary authority to bind [the Proponent] in the services.	provision of the above

5 Conducting a Verification and Completing a Verification Report

The following section sets out the process for conducting a verification and completing the Verification Report, and provides a Verification Report Template to assist proponents of Applicable Projects and their Verifiers in completing the verification process.

5.1 Conducting a verification and completing the Verification Report

Annually, proponents of Applicable Projects are required to have a qualified Verifier conduct a verification of their GHG emission reduction activities including their Annual Emission Reduction Report. The verification shall include:

- (i) a site visit
- (ii) a personal interview with key personnel involved in the emission reduction measurement, monitoring, quantification and reporting of the GHG emission reductions
- (iii) a thorough document review of all data, documents, and working papers relevant to the measurement, monitoring, quantification and reporting of the GHG emission reductions, and
- (iv) the creation of a Verification Report in the form and substance below, which must be submitted to the Proponent in signed original form on the Verifier's letterhead, on or before February 21 of each calendar year following the calendar year being reported on.
- (i) Site Visit. A site visit shall include:
 - An examination of the Applicable Project and project site
 - · Observing all GHG emissions measurement, monitoring, and related data systems
 - Observing all relevant technology in light of applicable project and equipment specifications
 - Consideration of any anomalies or inconsistencies of the site and the project in light of original project specifications

This will allow the Verifier to complete the general site description/condition portion of the Verification Report which must include: a general site description; an opinion regarding the condition of the site and any relevant equipment and technology; a description and assessment of the GHG emissions measurement, monitoring, and related data systems; a description and explanation of any observed anomalies or inconsistencies; and an attestation that: "The Applicable Project site is as described in the project description, and all systems and technology were observed to be performing within applicable process and project specifications." If such an attestation is not accurate, the Verification Report must include all qualifications and the reasons that this attestation cannot be made.

- (ii) **Personal Interviews.** A personal interview with key personnel involved in the emission reduction measurement, monitoring, quantification and reporting of the GHG emission reductions shall include:
 - An identification of the key personnel involved in the emission reduction measurement, monitoring, quantification and reporting of the GHG emission reductions shall include

- Discussions to determine and obtain copies of all relevant documents
- Discussions to obtain a description of all data systems, controls and procedures pertaining to the quantification and reporting of GHG emission reductions
- Discussions to determine and obtain all operating permits, applicable regulatory requirements and standards
- Discussions to identify estimates, assumptions, and exercises of discretion, including the support or rationale for the same

This will allow the Verifier to complete the personal interview portion of the Verification Report which must include: a list of the key personnel involved in the emission reduction measurement, monitoring, quantification and reporting of the GHG emission reductions; a description of, and comment on, the appropriateness of all data systems, controls and procedures used to the quantify and report on GHG emission reductions; an identification of all exercises of discretion, estimates and assumptions, including any supporting material; and a description and explanation of any observed anomalies or inconsistencies.

- (iii) **Document Review.** A thorough document review of all data, documents, and working papers relevant to the measurement, monitoring, quantification and reporting of the GHG emission reductions, shall include, without limitation:
 - Reviewing the requirements of the GMC MVP so that the Verifier can attest that the reported emission reductions meet the requirements of the GMC MVP and the definition of an Emission Reduction as outlined in the Introduction
 - Reviewing all documents, data and information relevant to the measurement, monitoring and calculation of the GHG emission reductions resulting from the project in accordance with the GMC MVP
 - Examining the Quarterly and Annual Emission Reduction Reports for the calendar year being reported on and briefly reviewing any such reports for prior calendar years
 - Determining, and considering the reasonableness of, all exercises of discretion, estimates and assumptions
 - Assessing all data systems, controls and procedures pertaining to the quantification and reporting of GHG emission reductions, and
 - Examining all operating permits, and applicable regulatory requirements and standards to ensure that the reported emission reductions are surplus to such requirements (as defined in the Introduction of GMC MVP).

This will allow the Verifier to complete the document review portion of the Verification Report which must include: an itemization of all data, documents, and working papers reviewed; a description and comment on all data systems, controls and procedures used to the quantify and report on GHG emission reductions; an itemization of all operating permits, and applicable regulatory requirements and standards and assurance ensure that the reported emission reductions are surplus to such requirements; an identification of, and comment on, all exercises of discretion, estimates and assumptions; a description and explanation of any observed anomalies or inconsistencies; and an attestation that: "The reported GHG emission reductions are free from material misstatement and are in accordance with requirements of the GMC MVP". If such an attestation is not accurate, the Verification Report must include all qualifications and the reasons that this attestation cannot be made.

Timing. While the Verifier may conduct certain verification activities in the last quarter of the calendar year being reported on, the final document review and creation of the Verification Report must occur between January 1 and January 31 in the year following the calendar year being reported on. A

Verification Report must be submitted to the proponent of the Applicable Project and GMC on or before February 15 of the year following the calendar year being reported on. And a signed original Verification Report, on the letterhead of the Verifier's firm, must be received by GMC on or before February 21 of the year following the calendar year being reported on. After reviewing the Verification Report, the GMC may request and the Verifier shall provide, such further information, clarifications and documentation to support the proponent's contractual obligations to GMC.

Format. The Verification Report shall be in the following form.

5.2 Verification Report Template

[To be completed on Verifier's Letterhead and delivered as a signed original to the Proponents for Acceptance]

Date

Proponent's Name Proponent's Address

Re: Verification Report for Emissions Reductions created from [project name] during the [•] calendar year.

I [Verifier's name] in my capacity as [position, firm] have conducted a verification of the emission reduction activities, data, calculations and reports resulting from the [Proponent's name, project description and location] in accordance with best practices and the procedures and requirements set out in the *Green Municipal Corporation Measurement, Monitoring, Reporting and Verification Protocol for Greenhouse Gas Emission Reductions from Designated Projects Funded Through the Green Municipal Fund* (the "GMC MVP"). I have undertaken this work in a position of fiduciary responsibility to both [the Proponent] and the Green Municipal Corporation and in compliance with the requirements of the GMC MVP. Specifically, I have undertaken a site visit, conducted personally interviews and completed a thorough document review. Based on this analysis, I hereby attest that the documents, calculations and emission reduction claims of [the Proponent] are free from material misstatement and in accordance with the GMC MVP. Further detail of my findings follows.

(i) Site Description/Condition.

The site is [location, description, line diagrams, condition, etc.]. In my opinion, the general condition of the site and all equipment and processes required to create the emission reductions is [•].

The GHG emissions measurement, monitoring and related data systems consist of [•].

The following questions, anomalies and inconsistencies were noted during the site visit: [•].

I hereby attest that the Applicable Project site is as described in the project description, and all systems and technology were observed to be performing within applicable process and project specifications.

(ii) Personal Interview(s).

The following key personnel are involved in the emission reduction measurement, monitoring, quantification and reporting of the GHG emission reductions: [•].

We were informed that the data systems, controls and procedures used to quantify and report on the GHG emission reductions consist of [•].

I believe that these systems are [appropriate/effective or inappropriate/ineffective] for the following reasons: [•].

The following provides a list of all estimates, assumptions and exercises of discretion that the Proponent has had to rely upon in measuring, monitoring, quantifying and reporting the GHG emission reductions: [•]. The following materials and/or references were provided as support for such estimates, assumptions, discretionary decisions [•]. A description and possibly an explanation of all observed anomalies or inconsistencies follows [•].

(iii) Document Review.

The review consisted of an examination of the following data, documents and working papers [•].

The data systems, controls and procedures used to quantify and report on the GHG emission reductions consist of [•].

The Project/Site/Proponent are subject to the following relevant operating permits, regulatory requirements and standards: [•]. I affirm that the reported emission reductions are surplus to all such permits, requirements and standards. The following estimates, assumptions and exercises of discretion have been identified in the measurement, monitoring, quantification and reporting of the GHG emission reductions: [•]. I believe that such estimates, assumptions, discretionary acts are [reasonable/unreasonable] on the basis of [•]. The following anomalies or inconsistencies were observed: [•]. Such anomalies and/or inconsistencies may be consistent with/a result of [•].

Conclusion

In conclusion, after having conducted this verification in a position of fiduciary responsibility to both [the Proponent] and Green Municipal Corporation, I attest that the reported GHG emission reductions are free from material misstatement and are in accordance with the requirements of the GMC MVP.

Yours truly,

[Verifier]

I hereby affirm that I have all necessary authority to bind [Firm] in the provision of the above services.

c. Project Verification Officer
Green Municipal Funds (GMF)
24 Clarence Street
Ottawa, ON K1N 5P3
tjohnson@FCM.ca

References

Levelton, B.H., Levelton & Associates, *Inventory of Methane Emissions from Landfills in Canada*, Prepared for Environment Canada, June 1991.

Pelt, R. et al., *User's Manual Landfill Gas Emissions Mode*l, Version 2.0. Prepared for Control Technology Centre U.S. Environment Protection Agency and the U.S. Environmental Protection Agency Office of Research and Development, 1998.

Tchobanoglous, G., H. Theisen, and S. Vigil, *Integrated Solid Waste Management, Engineering Principles and Management Issues*, McGraw Hill, New York, 1993.

APPENDIX C: SAMPLE CALCULATIONS



ENGINEERING DESIGN CALCULATION

PROJECT IDENTIFICATION

CLIENT:	Regional District of Nanaimo	XCG FILE No.	4-2200-01-79				
PROJECT:	Nanaimo, BC	REPORT:	R422000179004				
CALCULATIO	ON IDENTIFICATION						
CALCULATIO	N REF. NO.: 001	NO. PAGES: (Including calculation co	3				
		(including calculation co	over sneet)				
CALCULATION DESCRIPTION:							
Sample Calcu	lations - RDN Landfill Emission	Reduction					
DESIGN:	Phillip Auclair	DAT	ΓΕ: December 10, 2014				
CHECKED:	Scott Ferguson	DAT					
SUPERVISED:		DAT	-				
PROJECT CON	NTROL: Michel Lefebvre	DAT	TE:				



XCG FILE No: 4-2200-01-79

PAGE:

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DATE:

December 10, 2014

DESIGNED BY:

Phillip Auclair

CHECKED BY:

Scott Ferguson, Michel Lefebvre

PROJECT:

Environmental Results Report

DESCRIPTION:

Sample Calculation - RDN Landfill Emission Reduction

Data is recorded for all channels at consistent time intervals.

The landfill gas control plant is considered "ON" if the following criteria are satisfied:

- Delta T (min) is less than or equal to 60 minutes:
- Methane concentration greater than 40% V/V:
- Flow (FIT-130) greater than 100 m³/hr; and
- Pressure (PIT-102) less than -5.0 inches of water column.

The flare is considered "ON" if one of the following two criteria is satisfied:

- Temperature (TC1) over 100°C; or
- Temperature (TC2) over 100°C.

The utilization facility is considered "ON" if the following criteria are satisfied:

• Flow (FIT-160) greater than 10 m³/hr.

The volume of LFG destroyed for a certain time period is calculated by multiplying the flow by the time period.

$$Q_r = \text{Flow Rate (m}^3/\text{hr)}$$

 $T_{\star} = \text{Time (hours)}$

 V_x = Volume of Landfill Gas Destroyed

$$V_{x} = \left(\frac{Q_{x} + Q_{x-1}}{2}\right) * (T_{x} - T_{x-1})$$

For the flow rate data recorded between 8:48:35 AM and 8:58:37 AM on 11/11/2014:

$$V_{8.58:37AM} = \left(\frac{367.12 + 366.72 \text{ m}^3/\text{hr}}{2}\right) * (8:58:37 \text{ AM} - 8:48:35 \text{ AM})$$

$$V_{8:58:37 AM} = 366.92 \text{ m}^3/\text{hr} * (10.032 \text{ min}) * \frac{\text{hr}}{60 \text{ min}}$$

$$V_{8:58:37AM} = 61.35 \,\mathrm{m}^3$$

The volume of landfill gas destroyed is the sum of the above volumes for all time periods. Only flow that meets one of the following two criteria is included in the sum:

- Flare is "ON"; and
- LFG Utilization Plant is "ON".

$$V_{Day} = \sum_{x}^{!} V_{x}$$



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PAGE:

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DATE:

December 10, 2014

DESIGNED BY:

Phillip Auclair

CHECKED BY:

Scott Ferguson, Michel Lefebvre

PROJECT:

Environmental Results Report

DESCRIPTION:

Sample Calculation - RDN Landfill Emission Reduction

The average daily methane concentration is calculated by taking the average of the methane concentrations for all data sets that satisfy the above criteria.

$$\overline{C}_{Day} = \frac{\sum_{1}^{X} c_{x}}{X}$$

Where:

 c_x = Methane concentration (% V/V) for time x

X = Total number of methane concentration measurements in a day that meet the above criteria

For 11/11/2014, the following average methane concentration and total flow was computed as per the GMC MVP:

$$\overline{C}_{11/11/2014} = 53.91\% \text{ V/V}$$

$$V_{11/11/2014} = 8,882.3 \,\mathrm{m}^3$$

To calculate the daily mass of methane destroyed, reported in equivalent tonnes of carbon dioxide, the following formula was used:

$$r = 25\rho_s \overline{CVD}_E$$

Where:

r = Mass of methane destroyed in equivalent tonnes of carbon dioxide (CO₂e)

 $\rho_{\rm s}$ = Density of methane at 25°C and 1.0 atmosphere (0.0006557 tonnes/m³)

 $D_{\it E}$ = Flare and LFG Utilization Plant destruction efficiency (0.98)

$$r_{11/11/2014} = 25 * 0.0006557 * 0.5391 * 8882.3 * 0.98$$

$$r_{11/11/2014} = 76.92 \text{ tonnes CO}_2 e$$

APPENDIX D: PROJECT VERIFICATION REPORT