Monitoring report form

(Version 05.1)

MONITORING REPORT		
Title of the project activity	Aurá Landfill Gas Project	
UNFCCC reference number of the project activity	0888	
Version number of the monitoring report	1	
Completion date of the monitoring report	02/07/2015	
Monitoring period number and duration of this monitoring period	Monitoring Period Number 10 From 01/01/2015 to 30/06/2015 (both days included)	
Project participant(s)	Brazil: Conestoga-Rovers & Associados Engenharia S/A Norway: Nordic Environment Finance Corporation	
Host Party	Brazil	
Sectoral scope(s)	Scope 13: Waste handling and disposal	
Selected methodology(ies)	ACM0001- Consolidated methodology for landfill gas project activities- ver 4	
Selected standardized baseline(s)	Not Applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	147,286 tCO_2 Calculated on a pro-rata basis of 181 days of monitoring in the year 2015 (between the 01 January 2015 to 30 June 2015)	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	Not Applicable	176,725

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Aurá Landfill Gas Project has been developed at the Aurá Landfill (Site), originally called the Aterro Sanitário do Aurá. The Site has received non-hazardous solid municipal, industrial, commercial, institutional, and some agricultural wastes for approximately 16 years. Carbon dioxide (CO_2) and methane (CH_4) are generated by the anaerobic decomposition of the above-noted wastes placed at the Site. These compounds are then passively emitted to the atmosphere.

Purpose of the Project Activity

The purpose of the project activity is to collect landfill gas (LFG) at the Aurá Landfill and combust the extracted LFG over a ten year-period, utilizing a high efficiency enclosed flare, thereby reducing greenhouse gas emissions (GHG) and generating Certified Emission Reductions (CERs).

Installed Technology and Equipment

The project involved the construction of a LFG collection system consisting of horizontal trenches and vertical LFG extraction wells, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to collect the LFG.

The LFG collected from the Site is combusted in an enclosed LFG flare with full process controls and instrumentation installed and operating. The state-of-the-art flare is capable of providing sufficient temperature and retention time of the extracted LFG for complete destruction of hydrocarbons.

Relevant dates for the project activity

Conestoga-Rovers & Associates (CRA) started design activities in late 2005 and construction a year later in 2006. Constructed by February 2007 and ready for commissioning, the first monitoring period was from April 30, 2007 to September 30, 2008.

Total GHG emission reductions achieved in this monitoring report

The Certified Emission Reductions (CERs) volume claimed for the monitoring period extending from January 01, 2015 to June 30, 2015 is 176,725 t CO_2e.

A.2. Location of project activity

The project activity is located at:
Host country: Brazil
State: Pará
Municipality: Belém
Physical location:
The Aurá Landfill is located 19 kilometers (km) from the center of the City of Belém, State of Pará, Brazil, and is 8 km from the center of the City of Ananindeua. The entire Site covers an area of 120 hectares (ha) and the waste fill area of the Site is approximately 30 ha in size. The Site is located west of Curuperé Creek and east of the Parque Ambiental de Belém.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Brazil (host)	Conestoga-Rovers & Associados Engenharia S/A	No
Norway	Nordic Environment Finance Corporation	No

A.4. Reference of applied methodology and standardized baseline

The approved baseline and monitoring methodology applied to this project is the approved ACM0001 – Consolidated Baseline Methodology for Landfill Gas Project Activities- Version 4.0[1].

This methodology also refers to the following tool:

- "Tool to calculate the emission factor for an electricity system", version 4.0, EB75 annex 15; https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf

A.5. Crediting period of project activity

The crediting period for this project is from April 30, 2007 to April 29, 2017 (fixed). This is the 10th consecutive monitoring period corresponding to January 01, 2015 to June 30, 2015.

A.6. Contact information of responsible persons/entities

Conestoga-Rovers & Associados Engenharia S/A
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SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The technology used to gather the LFG is a grid of horizontal gas extraction wells within the landfill, connected to a centralized blower system used to induce vacuum. Upon collection of the LFG, the methane component of the LFG is combusted in a state-of-the-art high-efficiency enclosed flare. The Global Warming Potential (GWP) of the LFG is reduced by the destruction of the methane portion of the LFG.

[1] Available at: https://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_TX29WGSXE4781NKGQGCDPTHM2F3V3D/ACM0001%20_ver4.pdf?t=S0R8bmdiZ2MwfDB7cVPH2pPsqYrA5MN_FjlO.

The LFG management system is comprised of the following three major components:

1. LFG management facility - houses mechanical and electrical components required for the extraction and delivery of LFG for disposal by flaring
2. LFG collection field - removes LFG from the wastes within the limit of waste and includes trenches and collection piping to convey LFG from the field to the LFG management facility
3. Condensate management system - removes liquid condensate from the LFG collection system and directs the condensate to the leachate collection system

The design for the overall landfill gas (LFG) management system for the Site was completed by Conestoga-Rovers & Associates (CRA) from late 2005 to mid 2006. Construction of the LFG management system commenced in early 2006, and the facility was commissioned in the spring of 2007. The start date of the project activity is September 1, 2007.

To date there have been nine issuances of CERs, as follows:

Verification N	Monitoring Period	CERs	Date of Issuance
First	Apr 30, 2007 to Sep 30, 2008	32,265 tCO_2e	Aug 12, 2009
Second	Oct 1, 2008 to Jan 31, 2009	51,524 tCO_2e	Aug 13, 2009
Third	Feb 1, 2009 to Aug 31, 2009	83,077 tCO_2e	Mar 4, 2010
Fourth	Sep 1, 2009 to Feb 28, 2010	87,595 tCO_2e	Oct 27, 2010
Fifth	Mar 1, 2010 to Dec 31, 2010	234,835 tCO_2e	Nov 16, 2011
Sixth	Jan 1, 2011 to Oct 31, 2011	286,399 tCO_2e	January 14, 2013
Seventh	Nov 1, 2011 to Dec 31,2012	482,110 tCO2e	May 17, 2013
Eighteenth	Jan 1,2013 to Dec 31,2013	429,046 tCO2e	May 28, 2014
Nineteenth	Jan 1,2014 to Dec 31,2014	470,186 tCO2e	July 8, 2015
TOTAL CERs ISSUED TO DATE		**2,157,037 tCO_2e**	

During the current monitoring period January 01, 2015 to June 30, 2015, there have been the following major maintenance activities:

Description	Date of maintenance activity	Period
Valve SV5 cleaning	March 31,2015	14:40h to 15:30h
Valve SV5 cleaning	May 20, 2015	10:45h to 11:30h
Valve SV5 was changed	June 04, 2015	14:18h to 15:20h
Landtec Panel card D2- 08TR maintenance	June 15, 2015	10:15h to 11:15h

Sometimes, during the current monitored period the system went down a few times. It is also worth mentioning that no CERs are being claimed for emissions reductions occurring under these circumstances.

There is no major deviation of project monitoring activities from applied methodology and all monitoring activities are being done in accordance with the said methodology as well as with the approved monitoring plan.

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

There are no temporary deviations from the registered monitoring plan or the applied methodology.

B.2.2. Corrections

There are no corrections to project information or parameters fixed at validation that have been approved during this monitoring period or submitted with this monitoring report.

B.2.3. Changes to start date of crediting period

There are no changes to the start date of the crediting period that have been approved during this period or submitted with this monitoring report.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

There is no monitoring plan to the registered PDD that was not included at registration.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

The monitoring plan was revised and approved before the period of this monitoring report on October 4, 2009.

B.2.6. Changes to project design of registered project activity

There are no changes to the project design of the project activity that have been approved during this monitoring period or submitted with this monitoring report.

B.2.7. Types of changes specific to afforestation or reforestation project activity

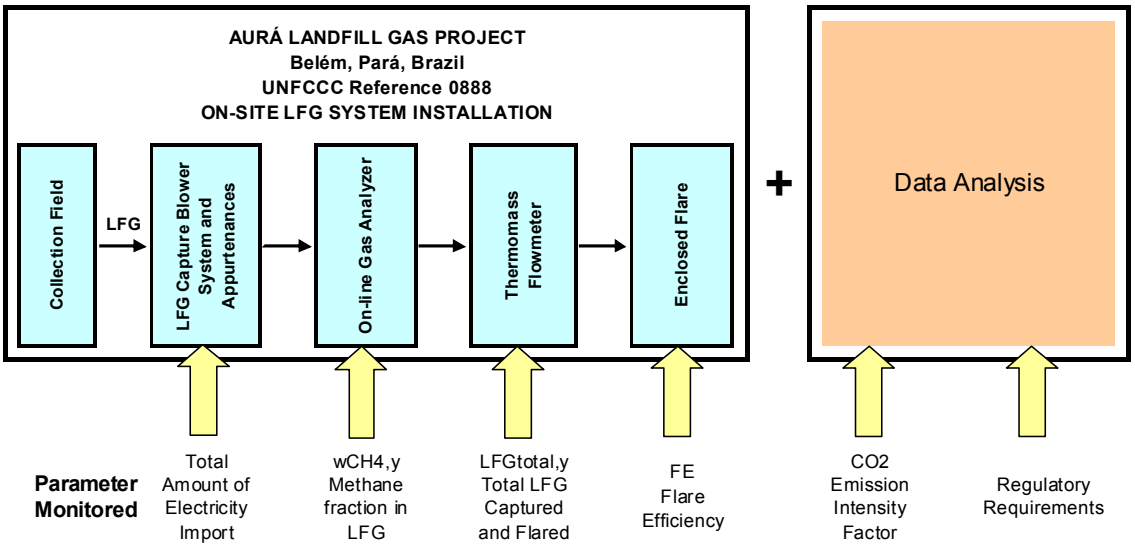
Not applicable.

SECTION C. Description of monitoring system

The LFG monitoring program is designed to collect system operating data required to safely and effectively operate the system as required for the verification of CERs. This data is collected in real time, and provides a continuous record that is easy to monitor, review, and verify.

The monitoring methodology is based on the direct measurement of the quantity of LFG captured and destroyed by the LFG management system. The actual tonnage of methane emissions reduced by the project is calculated based on the flow rate of the LFG, methane concentration, and destruction/conversion efficiency of the combustion equipment. The monitoring plan provides for the continuous measurement of both LFG quantity and quality using a continuous flow meter and online LFG analyzer. The methane emissions reduced by the flare are determined on the flow, methane content, flare temperature and time.

Monitoring Points



Flow measurement

LFG collected by the System and subsequently flared is measured via a flow measuring device suitable for measuring the velocity and volumetric flow of a gas. The flow measurements are taken within the piping itself, and the flow sensors are connected to a transmitter that is capable of collecting and sending continuous data to the Landtec recording system. The equipment selected allows for measurement of flow parameters, normalized to a standard temperature, pressure, and gas composition.

The thermal mass flow meter must be calibrated every 18 months as per manufacturer specifications. Equipment calibration procedures are specified by the equipment manufacturer, and calibration of the sensors is required on this schedule to ensure the quality and validity of the data. The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used. The equipment selected provides a minimum accuracy of +/- 1 percent by volume. The measured flow is recorded approximately once per two minutes.

All data that is collected is recorded for the permanent record. Both electronic and hard copies of the data are maintained for auditing purposes and for use in the calculation of CERs.

Gas quality

The two parameters that are most pertinent to the verification of CERs, as well as the safe and efficient operation of the system, are the concentrations of methane and oxygen in the gas stream. These two parameters are measured via a common sample line that is run to the main collection

system piping, and measured in real time by two separate sensors, one each for methane and oxygen.

Compensation for temperature and pressure is not required for the methane and oxygen sensors and the sensors are designed to operate within specified temperature and pressure conditions. Equipment calibration is automatic as specified by the equipment manufacturer. Calibration of the sensors is conducted on a regular basis to ensure the quality and validity of the data. Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected calibration range of the gas stream to be measured. The equipment selected provides an accuracy of at least +/- 1 percent by volume. Gas compositions are measured approximately once per two minutes.

Emission reduction calculations

Guidelines and directives in order to standardize the data acquisition and handling processes are in place for calculating the generation of Certified Emission Reductions (CERs) for the project. The Site uses a Landtec™ data acquisition device [Field Analytical Unit – (FAU)], which measures parameters such as methane (CH_4) concentration, flare temperature, and landfill gas flow on a continuous-basis. The data is collected and stored on-site using a Field Server Unit (FSU), which also sends the data to a Landtec server in California (USA) for off-site storage and back-up. Through the EnviroComp Report Service (ECRS), the data is viewed and downloaded to a spreadsheet file for further analysis.

A series of procedures are in place to retrieve and store the data, and set up tables and reports for the verification events. Based on operational data and the applicable monitoring methodology, the emission reductions are calculated on a monthly basis and compiled in a monitoring report during a verification exercise.

Data collection and record keeping

The monitoring methodology requires the continuous measurement of the quantity and quality of the LFG being flared. A summary of all data collection and reporting requirements, as listed in the UNFCCC ACM0001 (version 4) monitoring methodology, and a summary of on-site monitoring responsibilities and frequencies are provided below.

SUMMARY OF SITE MONITORING RESPONSIBILITIES
Landfill Gas Development Project
Aurá Landfill
Belém, Pará, Brazil

Project Activity	*Equipment*	*Personnel*	*Responsibilities*	*Frequency*
Quantity of LFG Captured	Flow Meter	Site Operator	* Verify the flow meter and FSU are operating correctly and collecting gas flow rate data continuously	Daily
Methane Fraction in LFG	Gas Analyser	Site Operator	* Verify the FAU and FSU are operating correctly and collecting gas composition data continuously	Daily
Flare Efficiency	Flare Stack	Site Operator	* Arrange for qualified technician to perform stack testing	Annually
Flare Operation Time	Flare Stack	Site Operator	* Verify the FSU is recording the flare temperature on a continual basis	Daily

			* Follow operation and maintenance requirements as outlined in the Operation and Maintenance Report	
Amount of Electricity Used	n/a	Site Operator	* Collect all Electricity bills and file on-Site and to office.	Monthly

In addition to the previous monitoring practices, the Project Participant keeps records of sustainable development parameters to monitor benefits the project activity is having in the area. Amongst these monitored parameters are:

- record keeping of job creation: includes number of employees hired and definition of responsibilities of employees working at the LFG collection system plant;
- income generation: includes incomes of all employees working at LFG collection system plant;
- tracking of odour complaints (dealt with by landfill operator): for this monitoring period there were no odour complaints during February, April and May 2015. For the rest of the period, the complaints were addressed by the City of Belém by taking the appropriate action;
- landfill safety: subsurface migration of LFG is monitored on a monthly basis through monitoring rounds of the applied vacuum on the collection field. Negative pressure readings indicate the gas is being collected by the combustion system avoiding LFG migrating to the surroundings. Furthermore, Aura Landfill Gas Project has an Environment and Safety Plan for Capture and Flare;
- technology transfer and communication of results have been presented in papers submitted to conferences held in North America;
- training records of personnel: meetings are performed on site for training and communication purposes, attendees include field, administrative and technical personnel from CRA.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/parameter:	GWP_{CH4}
Unit	tCO_2e/tCH_4
Description	Global warming Potential (GWP) value for methane
Source of data	Decisions under UNFCCC and the Kyoto Protocol As described in the CDM standard "Application of the global warming potentials to clean development mechanism project activities and programme of activities for the second commitment period of the Kyoto Protocol", emission reductions of CDM projects occurring from 1 January 2013 onwards shall be determined using the GWP adopted at the CMP in Durban (IPCC Table 2.14 Errata, i.e. 25 for methane, 298 for N2O, 14 800 for HFC 23 and 22 800 for SF6).
Value(s) applied)	25
Choice of data or measurement methods and procedures	As per guidance in ACM0001 ver. 04 (1996-IPCC Guidelines for National Greenhouse Gas Inventories).
Purpose of data	Baseline emission calculations
Additional comments	-

Data/parameter:	D_{CH4}
Unit	tCH_4/m^3CH_4
Description	Methane density
Source of data	ACM0001- Consolidated Baseline Methodology for Landfill Gas Project Activities - version 04
Value(s) applied)	0.0007168
Choice of data or measurement methods and procedures	As per guidance in ACM0001 ver. 04
Purpose of data	Baseline emission calculations
Additional comments	-

D.2. Data and parameters monitored

Data/parameter:	$LFG_{total,y}$
Unit	Nm^3
Description	Total amount of landfill gas captured and flared
Measured/calculated/default	Measured
Source of data	On-Line LFG flow meter (thermo mass)
Value(s) of monitored parameter	Multiple, continuously measured. Values submitted in excel tables with this report.
Monitoring equipment	Type: Thermal Instrument Co Model 62-9/9500 thermal flowmeter Serial # 2012001 Flowrate Readout Accuracy: ± 1 % Full Scale Calibration frequency: 18 months Date of last calibration: February 28, 2014 Validity: August 27, 2015
Measuring/reading/recording frequency:	Continuously
Calculation method (if applicable):	Not applicable
QA/QC procedures:	The flowmeter is recalibrated as per manufacturer's recommendation.
Purpose of data:	Baseline emission calculations
Additional comments:	-

Data/parameter:	FE
Unit	%
Description	Flare/combustion efficiency determined by the operation hours (1) and the methane content in the exhaust gas (2)
Measured/calculated/default	Measured/calculated
Source of data	(1) The temperature of the flare is continuously recorded within the Field Service Unit (FSU) (2) Flare stack samplings by certified laboratories: The flare efficiency of data is used for the period after the sample until a new one is done.

Value(s) of monitored parameter	(1) Multiple, continuously measured (2) FE= 99.9964%
Monitoring equipment	Type K. calibrated by PAKARI Identification Number: 250 Accuracy: +/- 2.2°C Date of last calibration: March 31, 2014 Validity: March 30, 2015 Identification Number: 251 Accuracy: +/- 2.2°C Date of last calibration: March 31, 2014 Validity: March 30, 2015 Identification Number: 252 Accuracy: +/- 2.2°C Date of last calibration: March 31, 2014 Validity: March 30, 2015 Identification Number: 253 Accuracy: +/- 2.2°C Date of last calibration: March 31, 2014 Validity: March 30, 2015 Identification Number: 148 Accuracy: +/- 2.2°C Date of last calibration: January 19, 2015 Validity: January 18, 2016 Identification Number: 149 Accuracy: +/- 2.2°C Date of last calibration: January 19, 2015 Validity: January 18, 2016 Identification Number: 150 Accuracy: +/- 2.2°C Date of last calibration: January 19, 2015 Validity: January 18, 2016 Identification Number: 151 Accuracy: +/- 2.2°C Date of last calibration: January 19, 2015 Validity: January 18, 2016 Thermocouples # 250, 251, 252, 253 were replaced by Thermocouples # 148,149,150, 151 on February 13, 2015 (2) EcoSampling Flare sampled on July 31, 2014: FID chromatograph equipment CAI - California Analytical Instruments Model 600 HFID
Measuring/reading/recording frequency:	Measuring frequency: (1) continuously every two minutes and (2) monitored annually
Calculation method (if applicable):	(1) Operation hours according to temperature of the flare (2) EcoSampling tests already include the calculation on FE = (1-(mass flow out of flare/mass flow into flare))*100
QA/QC procedures:	Regular maintenance to ensure optimal operation of controlled combustion environment.
Purpose of data:	Baseline emissions calculations
Additional comments:	Determined by (1) measurement of operation time of flare (with temperature); (2) measurement of methane content in the exhaust gas.

Data/parameter:	$wCH_{4,y}$
Unit	m^3 CH_4/m^3 LFG
Description	Methane fraction in the landfill gas
Measured/calculated/default	Measured
Source of data	Measured by continuous gas quality analyser
Value(s) of monitored parameter	Multiple, continuously measured. Values submitted in excel tables with this report.
Monitoring equipment	Landtec Field Analytical Unit (FAU), calibration automatically checked. Type: FAU Serial Number: GA 08798 Calibration frequency: 12 months Accuracy:+/- 1% Date of last calibration: July 12, 2014 Validity: July 11, 2015 Type: FAU Serial Number GA 08676 Calibration frequency: 12 months Accuracy: +/- 1% Date of last calibration: December 16, 2014 Validity: December 16, 2015 FAU #8798 was replaced by FAU #8676 on January 01, 2015 Type: Gas Cylinder Serial Number 161954 Composition: CH_4 50%; CO_2 35% Date of last calibration: March 30, 2012 Validity: 36 months Type: Gas Cylinder Serial Number EFH5153 Composition: O_2 -4% Date of last calibration: March 26, 2012 Validity: 36 months Type: Gas Cylinder Serial Number AF5106 Composition: CH_4 50%; CO_2 35% Date of last calibration: October 25, 2013 Validity: 36 months Gas Cylinder CH4 #161954 was replaced by Gas Cylinder CH4 #AF5106 on April 17, 2015
Measuring/reading/recording frequency:	Continuously
Calculation method (if applicable):	Not applicable
QA/QC procedures:	Calibration of equipment as per manufacturer specifications to ensure validity of data measured
Purpose of data:	Baseline emission calculations
Additional comments:	-

Data/parameter:	EL_{IMP}
Unit	MWh
Description	Total amount of electricity import to meet project requirements
Measured/calculated/default	Measured
Source of data	Electric meter – Centrais Elétricas do Pará- CELPA
Value(s) of monitored parameter	January 2015: 8.227 MWh February 2015: 9.437 MWh March 2015: 9.661 MWh April 2015: 8.510 MWh May 2015: 8.333 MWh June 2015: 8.313 MWh January 01, 2015 to June 30, 2015: 52.481 MWh
Monitoring equipment	Energy measurement meters. These meters are installed by the local electric provider Centrais Elétricas do Pará S.A. (CELPA), are sealed and tamper proof LANDIS+GYR Model: SAGA 1000-1681-B Accuracy: 0.5% Serial number: 362496 Conformity Inspection: April 22, 2014 LANDIS+GYR Model: SAGA 1000-1681-B Accuracy: 0.5% Serial number: 362496 Conformity Inspection: February 23, 2015
Measuring/reading/recording frequency:	Measuring frequency: monthly meter reading by the electricity distribution company (CELPA) representative and billing to the company
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	The manufacturer specification doesn't ensure the equipment validation frequency. Centrais Elétricas do Pará S.A. (CELPA) make annual conformity inspection.
Purpose of data:	Project emission calculations
Additional comments:	-

Data/parameter:	EF_{grid}
Unit	tCO_2e/MWh
Description	CO_2 emission intensity of electricity and/or other energy carriers in ID4
Measured/calculated/default	Calculated
Source of data	Most recent data for the build margin and operating margin (2013) found on the Brazilian Governments Ministry of Science and Technology website: (http://www.mct.gov.br/index.php/content/view/346665.html#ancora)

Value(s) of monitored parameter	For 2013 (http://www.mct.gov.br/index.php/content/view/346665.html#ancora) 0.432 tCO_2e/MWh

Average Operating Margin	0.593	tCO_2e/MWh
Build Margin*	0.271	tCO_2e/MWh
Calculation of Grid Emission Factor		
Emission Factor = (OM*0.5) + (BM*0.5) = (0.593*0,5) + (0.271*0,5) = 0.432 tCO_2e/MWh		

Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annually ex-post
Calculation method (if applicable):	The build margin and operation margin are weighted as 50 percent and 50 percent respectively, in accordance with "Tool to Calculate the Emission Factor for an Electricity System "– version 4.0.0 (EB 75)
QA/QC procedures:	Not applicable
Purpose of data:	Project emissions calculations
Additional comments:	-

Data/parameter:	AF
Unit	None
Description	Regulatory requirements relating to landfill gas projects
Measured/calculated/default	Test
Source of data	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{reg,y}$ at renewal of the credit period
Value(s) of monitored parameter	Zero
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annually
Calculation method (if applicable):	Not applicable
QA/QC procedures:	Not applicable
Purpose of data:	Baseline emission calculations
Additional comments:	-

D.3. Implementation of sampling plan

Not Applicable.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

The approved baseline methodology applied to this project is the approved ACM0001 ver. 4 (dated 28 July 2006) – Consolidated Baseline Methodology for Landfill Gas Project Activities.

All greenhouse gas (GHG) emission reductions generated by the implementation of the project activity are considered fully additional based on the lack of previous LFG management activities

and the current environmental regulations in Brazil. There are no existing or pending regulatory requirements requiring the Site to implement any form of LFG emission reductions program. There was no LFG recovery and combustion system in place at the Site prior to the project implementation. Therefore, the project baseline is the uncontrolled release of LFG to the atmosphere.

Version 04 of ACM0001 methodology does not separate baseline emissions from project emissions. It computes directly the emission reductions. In order to keep consistency with the methodology, in this monitoring report document, the same is done.

The following formulae were used to estimate emission reductions for the project activity:

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} - ET * CEF_{thermal,y}$

Where:

- ER_y are the emission reductions, measured in tCO_2e
- $MD_{project,y}$ is the amount of methane actually destroyed/combusted during the time period t, measured in tCH_4
- $MD_{reg,y}$ is the amount of methane that would have been destroyed/combusted during the time period t in the absence of the project activity, measured in tCH_4
- GWP_{CH4} is the approved Global Warming Potential value for methane, 25 tCO_2e/tCH_4
- EL_y is net quantity of electricity displaced during a given period t, measured in MWh
- $CEF_{electricity,y}$ is the CO_2 emissions intensity of the electricity displaced, measured in tCO_2e/MWh
- ET is the quantity of thermal energy displaced, measured in TeraJoules (TJ)
- $CEF_{thermal,y}$ is the CO_2 emissions intensity of the thermal energy displaced, measured in tCO_2e/TJ

It is noted that while the terms for electricity and thermal energy have been included to be consistent with the overall formulation stated in ACM0001 ver.4, energy displacement is not a component of the proposed project activity. As a result, the above equation reduces to the following form for the project activity:

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4}$

And $ER_y = MD_{project,y} * GWP_{CH4}$

The methane destroyed by the project activity during a given time period t can be determined by the following: monitoring the quantity of methane actually flared and LFG used to generate electricity and to produce thermal energy, and is given by:

$MD_{project} = MD_{flared} + MD_{electricity} + MD_{thermal}$

For the proposed project activity, $MD_{electricity} = MD_{thermal} = 0$, as there is no energy displacement component of the project. As a result, the total actual quantity of methane captured and destroyed will be metered ex post once the project activity is operational, and:

$MD_{project} = MD_{flared}$

and,

$MD_{flared,y} = LFG_{flare,y} * wCH_4,y * DCH_4 * FE$

Where:

- $MD_{flared,y}$ is the quantity of methane destroyed by flaring in a given time period t, measured in tCH_4
- LFG_{flare} is the quantity of landfill gas flared during the time period t, measured in cubic meters (m^3)
- wCH_4 is the average methane fraction of the landfill gas as measured during the given time period t and expressed as a fraction of CH_4 volume per LFG volume (m^3 CH_4/m^3 of LFG)
- FE is the flare efficiency (the fraction of the methane destroyed, in percent)
- DCH_4 is the methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at STP (0 degree Celsius and 1.013 bar), which is 0.0007168 tCH_4/m^3CH_4 (as per consolidated methodology ACM0001 Ver. 4)

As a result, the formula to estimate emission reductions for the project activity is the following:

$ER_y = (LFG_{flare,y} * wCH_4,y * DCH_4 * FE) * GWP_{CH4}$

2015	LFGflare,y	wCH4,y	DCH4	FE	GWPCH4
January	3,474,205.426	0.51425	0.0007168	0.999964	25
February	2,884,004.658	0.52087	0.0007168	0.999964	25
March	3,294,533.272	0.53137	0.0007168	0.999964	25
April	3,234,050.190	0.52642	0.0007168	0.999964	25
May	3,297,907.070	0.51156	0.0007168	0.999964	25
June	2,846,306.360	0.50316	0.0007168	0.999964	25

E.2. Calculation of project emissions or actual net GHG removals by sinks

Methodology ACM0001 ver. 4 clearly states that the CO2 emission intensity of the electricity consumed by the project activity must be taken into account. In the project activity, electrical consumption is associated with the blower system used to draw landfill gas to the enclosed drum flare.

According ACM001 ver.4 “Possible CO2 emissions resulting from combustion of other fuels than the methane recovered should be accounted as project emissions. Such emissions may include fuel combustion due to pumping and collection of landfill gas or fuel combustion for transport of

generated heat to the consumer locations. In addition, electricity required for the operation of the project activity, including transport of heat, should be accounted and monitored. Where the project activity does not involve electricity generation, project participants should account for CO2emissions by multiplying the quantity of electricity required with the CO2emissions intensity of the electricity displaced (CEFelectricity,y)".

PEy= ELimport,y* EFgrid,y

PEy= 52.481 MWh * 0.432 t CO2e/MWh

PEy= 22.67 t CO2e

An estimate of the grid emission factor for Brazil is calculated based on the calculation for the combined margin emission factor for the Brazilian interconnected grid, weighting the build margin and operating margin 50 percent and 50 percent respectively in accordance with the Tool to Calculate the Emission Factor for an Electricity System-Version 4.0.0The most recent data for the build margin and operating margin is for 2013 and is found on the Brazilian Governments Ministry of Science and Technology website: (http://www.mct.gov.br/index.php/content/view/346665.html#ancora).

TOTAL EMISSIONS RESULTING FROM ELECTRICAL CONSUMPTION
AURÁ LANDFILL GAS PROJECT
AURÁ LANDFILL
BELÉM, PARÁ, BRAZIL

Period	***Quantity of Electricity Imported (MWh)*** ***ELimp***	***CO_2 Emission Intensity (tCO2e/MWh)*** ***EFgrid***	***CO_2 Emissions Produced (tCO_2e)*** ***PE***
January 2015	8.227	0.432	3.55
February 2015	9.437	0.432	4.08
March 2015	9.661	0.432	4.17
April 2015	8.510	0.432	3.68
May 2015	8.333	0.432	3.60
June 2015	8.313	0.432	3.59
Total	52.481	0.432	22.67

E.3. Calculation of leakage

No leakage effects need to be accounted under methodology ACM0001 ver. 4 (E.2=0).

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

The following formulae were used to estimate emission reductions for the project activity:

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} - ET * CEF_{thermal,y}$

Where:

- ER_y are the emission reductions, measured in tCO_2e
- $MD_{project,y}$ is the amount of methane actually destroyed/combusted during the time period t, measured in tCH_4
- $MD_{reg,y}$ is the amount of methane that would have been destroyed/combusted during the time period t in the absence of the project activity, measured in tCH_4
- GWP_{CH4} is the approved Global Warming Potential value for methane, 25 tCO_2e/tCH_4
- EL_y is net quantity of electricity displaced during a given period t, measured in MWh
- $CEF_{electricity,y}$ is the CO_2 emissions intensity of the electricity displaced, measured in tCO_2e/MWh
- ET is the quantity of thermal energy displaced, measured in TeraJoules (TJ)
- $CEF_{thermal,y}$ is the CO_2 emissions intensity of the thermal energy displaced, measured in tCO_2e/TJ

It is noted that while the terms for electricity and thermal energy have been included to be consistent with the overall formulation stated in ACM0001 ver.4, energy displacement is not a component of the proposed project activity. As a result, the above equation reduces to the following form for the project activity:

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4}$

Considering that there is no regulatory or contractual requirement determining MDreg, an adjustment factor (AF) is used:

$MD_{reg} = MD_{project} * AF$

Based on the project context, an "Adjustment Factor" of 0 percent is used for the project.

$MD_{reg,y} = MD_{project,y} \times AF$
$MD_{reg,y} = MD_{project,y} \times 0$

And $ER_y = MD_{project,y} * GWP_{CH4}$

The methane destroyed by the project activity during a given time period t can be determined by the following: monitoring the quantity of methane actually flared and LFG used to generate electricity and to produce thermal energy, and is given by:

$MD_{project} = MD_{flared} + MD_{electricity} + MD_{thermal}$

For the proposed project activity, $MD_{electricity} = MD_{thermal} = 0$, as there is no energy displacement component of the project. As a result, the total actual quantity of methane captured and destroyed will be metered ex post once the project activity is operational, and:

$MD_{project} = MD_{flared}$

and,

$MD_{flared,y} = LFG_{flare,y} * wCH_4,y * DCH_4 * FE$

Where:

- $MD_{flared,y}$ is the quantity of methane destroyed by flaring in a given time period t, measured in tCH_4
- LFG_{flare} is the quantity of landfill gas flared during the time period t, measured in cubic meters (m^3)
- wCH_4 is the average methane fraction of the landfill gas as measured during the given time period t and expressed as a fraction of CH_4 volume per LFG volume (m^3 CH_4/m^3 of LFG)
- FE is the flare efficiency (the fraction of the methane destroyed, in percent)
- DCH_4 is the methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at STP (0 degree Celsius and 1.013 bar), which is 0.0007168 tCH_4/m^3CH_4 (as per consolidated methodology ACM0001 Ver. 4)

As a result, the formula to estimate emission reductions for the project activity is the following:

$ER_y = (LFG_{flare,y} * wCH_4,y * DCH_4 * FE) * GWP_{CH4}$

The following table summarizes the baseline emissions of the project activity. Electronic spread sheets are attached to present full calculations of the monitoring report.

CERTIFIED EMISSION REDUCTIONS SUMMARY

Monitoring Period	***CO_2 Equivalent Reduced (tCO_2e) BEy***	***CO2 Emissions Produced (tCO_2e) PEy***	***Emissions reductions (tCO_2e/month) ERy***
January/2015	32,039	3.55	32,035
February/2015	26,927	4.08	26,923

March/2015	31,369	4.17	31,365
April/2015	30,508	3.68	30,505
May/2015	30,240	3.60	30,236
June/2015	25,665	3.59	25,662
Total	176,748	22.67	176,725

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	176,748	22.67	-	-	176,725	176,725

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

As recorded in the PDD, it was estimated that for Aurá Landfill Project 297,012.9 t CO_2e would be claimed throughout the full 2015 reporting year. Calculated on a pro-rata basis of 181 days of monitoring in the year 2015 (between the 01 January 2015 to 30 June 2015) the amount is 147,286 t CO2

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	147,286 t CO_2e	176,725 t CO_2e

E.6. Remarks on difference from estimated value in registered PDD

The actual quantity of CERs achieved in this Project is higher (approximately 20%) than the quantity of CERs estimated in the PDD.

There are external factors outside of the Project Participant's control that have resulted in higher total of CERs claimed during the current monitoring period in relation to what was estimated in the registered PDD. The registered PDD included estimation of CERs based on Site assumptions as per the Site Owner (Belem City Hall) observations. One of these assumptions was the Site receiving waste up to 2010 inclusive. However, the landfill managed by Belem City Hall received waste on 2011, 2012, 2013, 2014 and 2015 continues to do so.

Furthermore, the Site owner (Belem City Hall) has increased the amount of waste received overtime; and (2) there have been some improvements like the optimization of waste disposal (more localized), better drainage systems, daily cover implementation (including covering all areas of previous disposal), availability of equipment and labour, and better housekeeping of the Site.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
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Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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