MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	EnviroServ Chloorkop Landfill Gas Recovery Project
Reference number of the project activity	0925
Version number of the monitoring report	09
Completion date of the monitoring report	26/09/2012
Registration date of the project activity	27/04/2007
Monitoring period number and duration of this monitoring period	3 01/01/2010 – 31/03/2012
Project participant(s)	EnviroServ (Pty) Ltd Japan Carbon Finance Ltd
Host Party(ies)	South Africa
Sectoral scope(s) and applied methodology(ies)	Sectoral scope: 13 Waste handling and disposal Applied methodology: AM0011 version 02
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	522,497
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	326,017

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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1. Purpose of the project activity:

The purpose of the project is to extract landfill gas at the EnviroServ Chloorkop Landfill Site and to combust the landfill gas by flaring. Landfill gas consists of approximately 50% methane, which has a global warming potential 21 times greater than CO_2. Through the destruction of methane, the emissions of greenhouse gas are reduced.

2. General description of the project activity:

Landfill site

The EnviroServ Chloorkop Landfill Site has been used for the disposal of municipal solid waste since 1997, receiving approximately 396 000 tons of waste per annum. The waste accepted includes general (or domestic) waste, garden waste, soil and builder's rubble. To date, five cells have been constructed and the construction of the sixth cell is in progress.

Landfill Gas Collection System

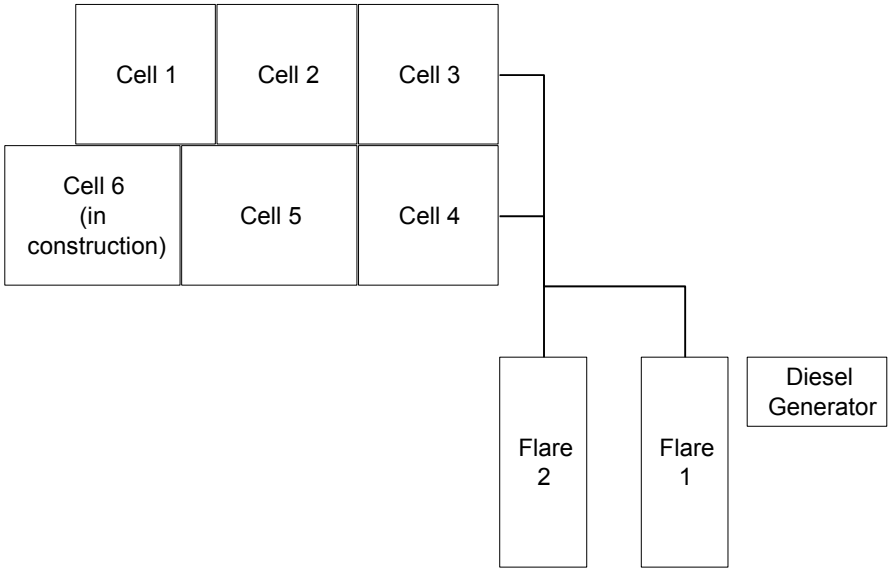
Vertical wells were installed in cells 1 to 3 by augering into the existing waste body once the cell reached final grade. Horizontal collectors were installed in cells 4, 5 and 6 and involved the excavation of trenches into the waste at intermediate intervals before a cell reached final grade. In both cases, perforated piping was installed in gravel backfill for collection of the landfill gas under a vacuum. The vertical wells and horizontal piping were connected to a number headers leading to the flare installations.

Flare System

There are two flare installations. The flares used are high temperature enclosed flares.

The two flare installations are situated alongside each other. An emergency diesel fueled electricity generator supplies emergency power to the flare installations in the event of a failure of the power from the electricity grid.

A diagram of the landfill cells, flare installations and diesel generator are given below:



A.2. Location of project activity

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The project activity is located at the EnviroServ Chloorkop landfill site, Ekurhuleni Metropolitan Municipality, Gauteng Province, South Africa.

GPS coordinates: 26° 02' 30.35" S, 28° 10' 04.58" E

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 if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	EnviroServ (Pty) Ltd – Private	Yes
Japan	Japan Carbon Finance Ltd – Private	Yes

A.4. Reference of applied methodology

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The methodology utilised for the project is AM0011 version 02 – landfill gas recovery with electricity generation and no capture or destruction of methane in the baseline scenario.

A.5. Crediting period of project activity

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The first renewable crediting period for the project, as given in the PDD and project view page, was from 1/7/2007 to 30/6/2014 (i.e. for 7 years). A request was submitted to the Executive Board that the start of the crediting period be changed to 19/1/2008, which was the date on which operation of the project started. A reply to this request was received and the crediting period was changed to 19/1/2008 to 18/1/2015.

SECTION B. Implementation of project activity
B.1. Description of implemented registered project activity
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1. Starting date of operation and phased implementation.

The EnviroServ Chloorkop Landfill Site consists of five waste disposal cells with a sixth in construction. Construction of the wellfield was done in a phased manner. The first six vertical wells were installed in cells 1, 2 and 3 in 2005 as a pilot trial. These were followed by 23 additional vertical wells in cells 1, 2 and 3, and 5 horizontal collectors in two layers in cell 4, and the first flare in 2007. Commissioning of this initial phase took place in late 2007 with the first gas being flared on 19/1/2008 (the start date of the project activity). Eight additional vertical wells were installed in 2008 with additional horizontal collectors being installed in cells 5 and 6 from 2008. Installation of the second flare was completed in December 2008 and started operation in January 2009.

2. Actual operation of the project activity during this monitoring period.

During this monitoring period, both flares were in operation, with flare 1 operating at about 75% of its design capacity and flare 2 at about 53% of its design capacity. The design capacity of each flare is 2,000 Nm^3/h. The throughput of the flares was dictated by the amount of landfill gas available from the wellfield.

Significant events that caused downtime of the flares and the total hours of downtime during the months in which there was downtime, were the following:

Month	Significant Events	Downtime (hours)
January 2010	Power failure, schedule maintenance.	13.5
February 2010	Power failure, control system communication errors, thermocouple failure.	30
March 2010	Power cable repairs	1.5
April 2010	Power failure, 3 monthly maintenance service flare 1, and high level in knock-out pot.	15
May 2010	Faulty methane analyser card flare 1. 3 monthly maintenance service flare 2.	163.5
June 2010	Thermocouple failure, high level in knockout pot flare 1. Communication error, high level in knockout pot flare 2.	45
July 2010	Thermocouple failures flare 1. Flame arrestor repairs, high level in knockout pot flare 2.	72
August 2010	Power failure. Air compressor failure. High level in knockout pot flare 1.	151.5
September 2010	Power failure.	110.5
October 2010	Power failure. Knockout pot maintenance.	50.5
November 2010	Thermocouple failure flare 1. Repair leak in gas main flare 2.	261
December 2010	Power failure.	21.5
January 2011	Power failure. Gas analyser sampling problem flare 2.	20.5
February 2011	Repairs to knockout pot flare 1. Communication failure flare 2.	113.0
March 2011	Power failure.	3.0
April 2011	Gas main maintenance, flowmeter errors flare 1. Gas analyser sampling problem flare 2.	55.5
May 2011	Flowmeter communication error, power failure.	128

June 2011	3 monthly maintenance services, power failure.	13.0
July 2011	Power failure. Analyser error flare 2.	26.5
August 2011	Thermocouple failre, analyser error flare 1. Flowmeter communication error flare 2.	21
September 2011	Analyser low readings flare 1.	23.5
October 2011	Repairs to gas main flare 1. 3 monthly maintenance service.	31.0
November 2011	Analyser low readings flare 2.	0.5
December 2011	Repairs to gas main flare 1. Repairs to gas collection system flare 2.	155
January 2012	Flame failure. Power failure	20
February 2012	Control system problems. Power failure. New gas main connection for flare 2.	41.5
March 2012	Power failure	8

The following measuring equipment was replaced during this monitoring period:

Equipment tag number	**Equipment Description**	**Date replaced**	**Reason for replacement**
3092-E-172	Carbon dioxide analyser card, flare 1	4/1/10	Faulty card
3092-E-188	Thermocouple, flare 1	10/2/10	Thermocouple failure
3092-E-188	Thermocouple, flare 1	10/3/10	Thermocouple failure
3092-E-172	Carbon dioxide analyser card, flare 1	7/4/10	Faulty card
3092-E-151	Thermocouple, flare 1	6/5/10	Thermocouple failure
3449-E-188	Thermocouple, flare 2	7/5/10	Thermocouple failure
3092-E-172	Methane analyser card	12/5/10	Faulty card
3092-E-172	Carbon dioxide analyser card, flare 1	9/6/10	Faulty card
3449-E-172	Methane analyser card	15/6/10	Faulty card
3449-E-172	Carbon dioxide analyser card, flare 2	17/6/10	Faulty card
3092-E-188	Thermocouple, flare 1	22/6/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	14/7/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	2/8/10	Thermocouple faulty
3092-E-151	Thermocouple, flare 1	19/8/10	Thermocouple faulty
3092-E-188	Thermocouple, flare 1	19/8/10	Thermocouple faulty
3092-E-151	Thermocouple, flare 1	30/8/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	1/9/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	22/9/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	29/9/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	19/10/10	Thermocouple failure
3092-E-188	Thermocouple, flare 1	19/10/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	22/11/10	Thermocouple failure
3092-E-151	Thermocouple, flare 1	30/5/11	Thermocouple failure
3092-E-151	Thermocouple, flare 1	29/8/11	Thermocouple failure
3092-E-151	Thermocouple, flare 1	14/9/11	Thermocouple failure
3092-E-151	Thermocouple, flare 1	3/10/11	Thermocouple failure

3449-FM-118	Gas flowmeter flare 2	6/10/11	Routine calibration

B.2. Post registration changes

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

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There were no temporary deviations from the registered monitoring plan or applied methodology during this monitoring period.

B.2.2. Corrections

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There were no corrections during this monitoring period.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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A request was made to revise the monitoring plan in August 2010. During the first verification, SGS United Kingdom Ltd, raised one FAR that required a revision to the monitoring plan. The revisions included the exclusion of three parameters (namely $LFG_{app\ i,y}$, T_{LFG}, P_{LFG}) required to close out the FAR from the first verification, a change in data units (from cubic meters to Normal cubic meters), a change in units from %,g/m3 to % for the methane fraction in landfill gas, details on the calibration procedures and accuracies of the monitoring equipment, and updating the Monitoring Information in Annex 4 to be consistent with corrections made in the revised monitoring plan and to include the monitoring parameters for '*Amount of Landfill gas used for electricity generation*' and '*Amount of electricity generated*'. The revised monitoring plan was approved by the CDM Executive Board on 20/12/2010.

There were no permanent changes from the applied methodology.

B.2.4. Changes to project design of registered project activity

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There were not changes to the project design of the registered project activity.

B.2.5. Changes to start date of crediting period

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The first renewable crediting period for the project, as given in the PDD and project view page, was from 1/7/2007 to 30/6/2014 (i.e. for 7 years). A request was submitted to the Executive Board that the start of the crediting period be changed to 19/1/2008, which was the date on which operation of the project started. A reply to this request was received and the crediting period was changed to 19/1/2008 to 18/1/2015.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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Not applicable.

SECTION C. Description of monitoring system

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Data collection, recording, aggregation and reporting

To ensure the integrity of all the monitoring information generated by the project, two independent streams of data are received for the flares; telemetry data (primary) and check sheet data (secondary).

Primary data is defined as the data representing the main variables for the calculation of the emission reductions. This data is captured from the various sensors by a data acquisition system and is then sent from the site through a telemetry system to a website managed by Netrix, which then provides access to the data to Biogas Technology Ltd (Biogas). Netrix through Biogas were subcontracted by ENER-G Systems

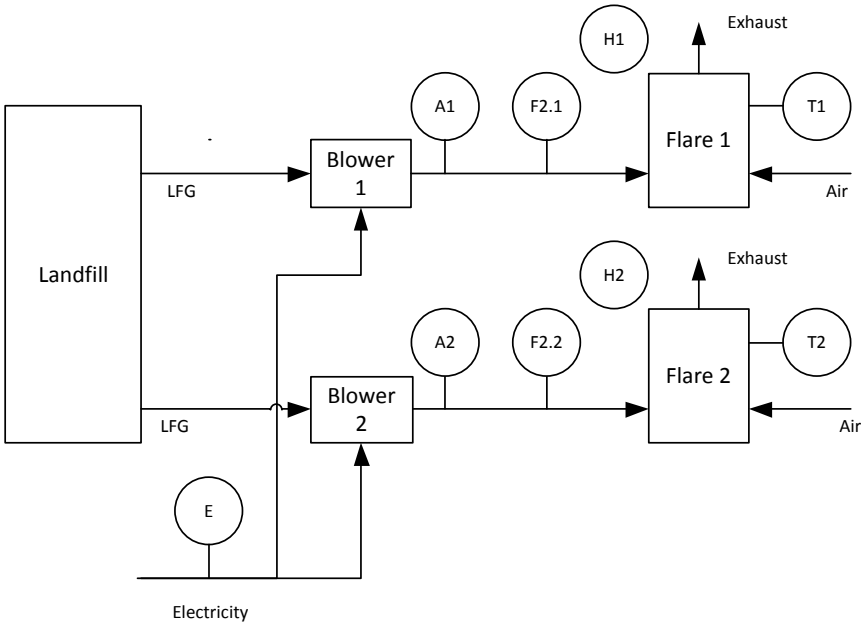
(Pty) Ltd (Ener-G), the company that manages the wellfield and the flare for EnviroServ. The information is received by Biogas via a website, and is downloaded weekly.

Secondary data is defined as variables measured visually on site and includes the primary data variables. These variables are recorded twice a day during day-shift. This data is recorded on the daily check sheet and filed at the ENER-G Systems offices.

The primary data from the Netrix website for the month is saved in comma separated value (CSV) format and pasted into an Excel spreadsheet workbook. This workbook calculates the number of emission reductions, transfers the results to an operations report and produces a graph and a data table. The primary data is the only data used in the calculation of emission reductions. This information is then used to create monthly report on the emission reductions. There is a separate monthly workbook for each flare.

The monthly information is copied into the summary workbook which gives the total values for the monitoring period.

A line diagram showing the relevant measuring points is given below.



	Parameter	Description	Instrument tag number
F2.1	$LFG_{flared,y}$	Total amount of landfill gas flared in flare 1	3092-FM-118
F2.2		Total amount of landfill gas flared in flare 2	3449-FM-118
A1	W_{CH4}	Methane fraction of landfill gas to flare 1	3092-E-172
A2		Methane fraction of landfill gas to flare 2	3449-E-172
H1	Flare hours	Working hours for flare 1	N/A
H2		Working hours for flare 2	N/A
T1	Flare temperature	Flare temperature flare 1	3092-E-151
T2		Flare temperature flare 2	3449-E-151
E	EL_{IMP}	Electricity consumed by project	-

Data security and archiving

All data and information obtained over the crediting period of the project is stored and archived in an ISO 9001 approved filing system and kept for the life of the project, plus a further 2 years.

The data system uses 128 bit SSL Encryption for security. The system is further protected by user names and passwords to restrict access.

Data is generated from the monitoring equipment and passed to the Netrix system in an electronic format, which can't be tampered with. Once the information is sent via a GPRS SIM card to the Netrix website, it is held securely. Access to the gathered data is only possible via a username and password, which is provided by Netrix.

With regards to workbook, Biogas does not password protect workbooks for any of its sites as the workbooks are in Microsoft excel format, and passwords in excel can easily be deactivated or by-passed.

All the data is transferred via email and CD from Ener-G to Enviroserv on a monthly basis. The data is received and archived in a folder on the EnviroServ access controlled server. The CD's are archived in a secure locked cupboard. Access to the server is controlled by the EnviroServ IT department using the following process:

- The user needs to fill in a user application form requesting access to this folder.
- The Process Operations Manager would need to approve access to this group by signing the application form off.
- The signed form will need to be either scanned and e-mailed or faxed to IT.
- A call needs to be logged with service desk to request access to this group.
- One of the System Administrators will then grant access to this group.
- For the access to take affect the user will need to log off and log back onto the system.

The folder is backed up as described in the process below:

- Currently this folder resides on a server's RAID5 Array drive which is located on a fibre attached SAN which provides additional redundancy.
- This drive is backed up using Backup Exec 12.5 using the following schedules
- Daily starts at 5:00pm in the afternoons
    - Backup Media is LTO4
    - Retension is 5 weeks off-site at MetroFile
    - Backup Schedule Monday to Friday unless the daily falls within a monthly or yearly schedule
- Monthly 5:00pm in the afternoons
    - Backup Media is LTO4
    - Retension is 1 Year off-site at MetroFile
    - Backup Schedule is Last day of the month unless this day falls on a weekend or public holiday in which case it will be the day before the start of that weekend or public holiday. Monthly schedule do not apply if it falls within a yearly backup schedule
- Yearly 5:00pm in the afternoons
    - Backup Media is LTO 4
    - Retension is Infinate off-site at MetroFile and are only recalled on request.
    - Backup Schedule is Last day of the Year unless this day falls on a weekend or public holiday in which case it will be the day before the start of that weekend or public holiday.

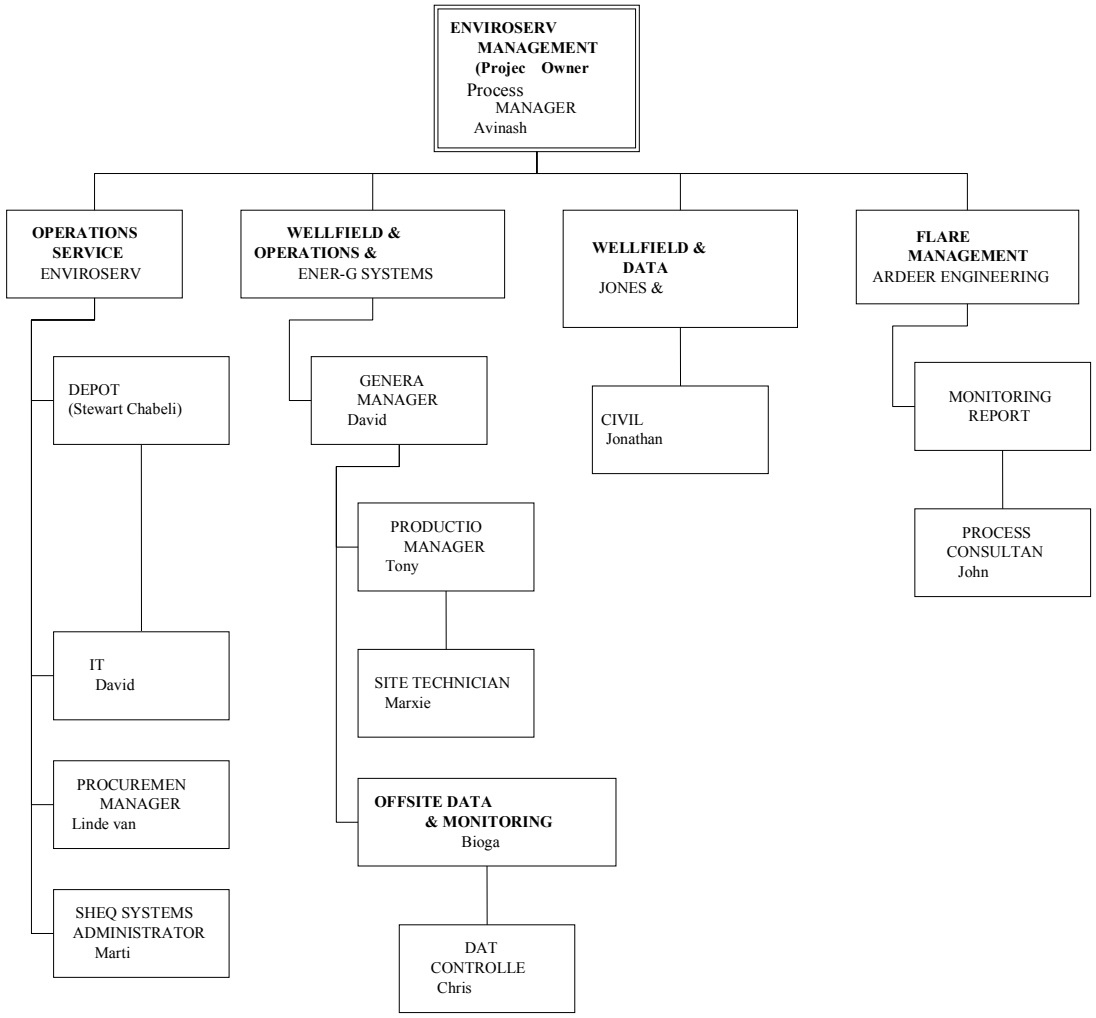
Emergency procedures for the monitoring system

The calculation carried out in the Biogas workbook includes a validation check on the methane concentration, combustion temperature and flow of gas to the flare (see step 2 in the data calculation description in Section E1 below). If any of these parameters are outside the defined limits, the emission

reduction value is set to zero i.e. no emission reductions are claimed for the period in which any of these parameters are outside the defined limits.

Roles and responsibilities

An organogram of the Chloorkop Gas Project Team is given below:



The responsibilities and authorities of those in the various positions are as follows:

Position	Responsibilities	Authorities
EnviroServ Process Operations Manager	Overall responsibility for the landfill gas system. Overall responsibility for the Quality Management System for the landfill gas system. Reviews performance data on landfill gas system and submits comments to Ener-G Chairs monthly review meetings between EnviroServ and Ener-G on the operation of the landfill gas system	Provides and manages resources for operation of the landfill gas system

Position	Responsibilities	Authorities
	Stores and archives data received from Ener-G on the Enviroserv Chloorkop CDM folder on the server. Compiles monthly report and submits to the JCF.	
EnviroServ Depot Manager	Liaison between Ener-G and rest of landfill site. Advises Ener-G of aspects of landfill operation that may impact on operation of the landfill gas system.	
EnviroServ IT Manager	Manages the IT system in EnviroServ. Provides data storage and archiving (backup) of data for the landfill gas system.	Provides resources for data storage and backup.
EnviroServ Procurement Manager	Manages procurement in EnviroServ. Manages the procurement of spares and services for the landfill gas system.	Manages resources and systems for procurement.
Ener-G General Manager	Overall responsibility for managing the landfill gas system.	Manages resources for the landfill gas system.
Ener-G Production Manager	Operation of the landfill gas system. Reviews workbook data from Biogas, comments if necessary. Advises Biogas of any comments on the workbook data. Approves monthly report Compiles monthly reports and together with workbooks from Biogas submits to Enviroserv via email and cd. Attends monthly meetings with Enviroserv to discuss operations and maintenance of the plant. Draws up purchase requisitions to purchase items for the plant and submits to Enviroserv for approval.	Controls the landfill gas system
Ener-G Site Technician	Day-to-day operation of the landfill gas system	Controls the landfill gas sytem
Biogas Data Controller	Reviews and compares primary and secondary data from flare	Selects primary or secondary data that goes into the monthly

Position	Responsibilities	Authorities
	system. Prepares monthly workbook and submits to Ener-G General Manager. Reviews comments from Ener-G and EnviroServ and makes changes as necessary.	workbook.
Jones & Wagener Civil Consultant	Reviews data on well field and flare performance on a ad-hoc basis when required by Enviroserv to do so. Submits comments to Ener-G General Manager& Enviroserv Process Operations Manager Provides technical support to Ener-G and Enviroserv	Recommends changes to operation of landfill gas system to Ener-G and EnviroServ. .
Ardeer Engineering Process Consultant	Assists in compiling draft monitoring report (report required for verification of emission reductions by DOE). Submits draft monitoring report to EnviroServ Process Operations Manager for approval and issue. Provides Process and technical support to Ener-G and Enviroserv.	-

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 of methane
Source of data	Methodology AM0011 version 2
Value(s) applied	21
Purpose of data	Baseline emission calculations
Additional comment	

Data/Parameter	D_{CH4}
Unit	tCH_4/Nm^3CH_4
Description	Density of methane at 0 degree Celsius and 1,013 bar
Source of data	Methodology ACM0001 version 1
Value(s) applied	0.0007168
Purpose of data	Baseline emission calculations
Additional comment	

D.2. Data and parameters monitored

Data/Parameter	Q
Unit	Nm^3
Description	Total amount of landfill gas collected at Normal Temperature and Pressure
Measured/Calculated /Default	Measured value
Source of data	Flowmeter
Value(s) of monitored parameter	Flare 1: 28,100,196; Flare 2: 20,287,287; Total: 48,387,483
Monitoring equipment	Thermal mass flowmeter. The typical accuracy of the thermal mass flowmeters is ±1.5% of reading, +0.5 % of full scale. Calibration frequency is 3 years. Validity of calibration is 3 years from time the flowmeter is taken into service after calibration.
Measuring/Reading/ Recording frequency	Data is monitored continuously. Data is aggregated monthly and yearly
Calculation method (if applicable)	NA
QA/QC procedures	The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards.
Purpose of data	Baseline emission calculation
Additional comment	The flowmeters used are thermal mass flowmeters. These flowmeters express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of the LFG is necessary. The flow measurement for Q is the same as that for $LFG_{flared,y}$,as there was no electricity generation in this monitoring period and hence $Q = LFG_{flared,y}$.

	Flare 1	Flare 2	
Equipment number	3092-FM-118	3449-FM-118	
		Up to 6/10/2011	After 6/10/2011
Serial number	99047602000	A309F902000	99047702000
Last calibration	24/10/2008	1/4/2008	10/03/11
Taken into service	23/11/2009	19/01/2009	6/10/2011

<table>
<tr><td>Data/Parameter</td><td>$LFG_{flared,y}$</td></tr>
<tr><td>Unit</td><td>Nm^3</td></tr>
<tr><td>Description</td><td>Total amount of landfill gas flared</td></tr>
<tr><td>Measured/Calculated /Default</td><td>Measured value</td></tr>
<tr><td>Source of data</td><td>Flowmeter</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td>Flare 1</td><td>Flare 2</td><td>Total</td></tr>
<tr><td>28,100,196</td><td>20,287,287</td><td>48,387,483</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Thermal mass flowmeter.
The typical accuracy of the thermal mass flowmeters is ±1.5% of reading, +0.5 % of full scale.
Calibration frequency is 3 years. Validity of calibration is 3 years from the time the flowmeter is taken into service after calibration.
The flowmeter on flare 2 was replaced on 6/10/2011 for routine calibration.
<table>
<tr><td></td><td>Flare 1</td><td colspan="2">Flare 2</td></tr>
<tr><td>Equipment number</td><td>3092-FM-118</td><td colspan="2">3449-FM-118</td></tr>
<tr><td></td><td></td><td>Up to 6/10/2011</td><td>After 6/10/2011</td></tr>
<tr><td>Serial number</td><td>99047602000</td><td>A309F902000</td><td>99047702000</td></tr>
<tr><td>Last calibration</td><td>24/10/2008</td><td>1/4/2008</td><td>10/03/11</td></tr>
<tr><td>Taken into service</td><td>23/11/2009</td><td>19/01/2009</td><td>6/10/2011</td></tr>
</table>
</td></tr>
<tr><td>Measuring/Reading/ Recording frequency</td><td>Data is monitored continuously.
Data is aggregated monthly and yearly</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Correction factor applied for methane concentration</td></tr>
<tr><td>QA/QC procedures</td><td>The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards.</td></tr>
<tr><td>Purpose of data</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comment</td><td>The flowmeters used are thermal mass flowmeters. These flowmeters express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of the LFG is necessary. The values used in the emission calculations are the 30-minute quantities given in the monthly emission reduction workbooks.</td></tr>
</table>

Data/Parameter	$LFG_{leachate,y}$
Unit	Nm^3
Description	Total amount of landfill gas used for leachate evaporation
Measured/Calculated /Default	Measured value
Source of data	NA
Value(s) of monitored parameter	NA
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	NA
Calculation method (if applicable)	NA
QA/QC procedures	NA
Purpose of data	NA
Additional comment	No facilities installed for the evaporation of leachate using LFG. No LFG used for leachate evaporation.

Data/Parameter	$LFG_{electricity,\ y}$
Unit	Nm^3
Description	Total amount of landfill gas used for electricity generation
Measured/Calculated /Default	Measured value
Source of data	NA
Value(s) of monitored parameter	NA
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	NA
Calculation method (if applicable)	NA
QA/QC procedures	NA
Purpose of data	NA
Additional comment	No facilities installed for the generation of electricity from LFG. No LFG used for electricity generation.

<table>
<tr><td>Data/Parameter</td><td>W_{CH4}</td></tr>
<tr><td>Unit</td><td>%</td></tr>
<tr><td>Description</td><td>Methane fraction in landfill gas</td></tr>
<tr><td>Measured/Calculated /Default</td><td>Measured value</td></tr>
<tr><td>Source of data</td><td>Fixed Gas Analyser</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td>Flare 1</td><td>Flare 2</td><td>Weighted average</td></tr>
<tr><td>49,9%</td><td>50.3%</td><td>50.1%</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
Infrared continuous analyser
The typical accuracy of the analyzer is 2% full scale per month.
Calibration frequency is at least once per month using a supply of span gas.
The span gas has a methane concentration of 40%v/v.

<table>
<tr><td></td><td>Flare 1</td><td>Flare 2</td></tr>
<tr><td>Equipment number</td><td>3092-E-172</td><td>3449-E-172</td></tr>
<tr><td>Serial number</td><td>I-02177</td><td>I-04311</td></tr>
</table>

There were 5 instances for flare 1 and 3 instances for flare 2 where the calibration of the analysers using the span gas gave values greater than the stated accuracy of the instrument. The values used to calculate the emission reductions were reduced by the amount the calibration check exceeded the methane concentration of the span gas. This was applied to the period from the previous calibration to the current calibration. This was to ensure a conservative approach to the calculation of the emission reductions.

The dates of calibration, the calibration check results and the periods affected are given in the table below.

<table>
<tr><td>Flare</td><td>Date of calibration</td><td>Calibration check results %v/v</td><td>Period affected</td></tr>
<tr><td>1</td><td>2/8/10</td><td>42.1</td><td>2/7/10 to 2/8/10</td></tr>
<tr><td>1</td><td>4/2/11</td><td>42.0</td><td>3/1/11 to 4/2/11</td></tr>
<tr><td>1</td><td>1/4/11</td><td>42.3</td><td>2/3/11 to 1/4/11</td></tr>
<tr><td>1</td><td>1/8/11</td><td>42.2</td><td>1/7/11 to 1/8/11</td></tr>
<tr><td>1</td><td>3/11/11</td><td>42.1</td><td>14/10/11 to 3/11/11</td></tr>
<tr><td>1</td><td>30/11/11</td><td>42.1</td><td>16/11/11 to 30/11/11</td></tr>
<tr><td>2</td><td>8/2/10</td><td>43.5</td><td>4/1/10 to 8/2/10</td></tr>
<tr><td>2</td><td>1/4/10</td><td>42.7</td><td>1/3/10 to 1/4/10</td></tr>
<tr><td>2</td><td>2/6/11</td><td>42.1</td><td>3/5/11 to 2/6/11</td></tr>
</table>
</td></tr>
<tr><td>Measuring/Reading/ Recording frequency</td><td>Measured by continuous gas quality analyser.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>NA</td></tr>
<tr><td>QA/QC procedures</td><td>The gas analyzer is calibrated using a span gas that has been calibrated according to ISO/IEC 17025 standards.</td></tr>
<tr><td>Purpose of data</td><td>Baseline emission calculations</td></tr>
</table>

Additional comment	The values used for the emission reduction calculations are the 30-minute values given in the monthly emission reduction workbooks.

Data/Parameter	**FE**
Unit	%
Description	Flare efficiency (combustion efficiency)
Measured/Calculated /Default	Default
Source of data	Revised and approved monitoring plan
Value(s) of monitored parameter	90%
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Not measured.
Calculation method (if applicable)	NA
QA/QC procedures	NA
Purpose of data	Baseline emission calculations
Additional comment	No flare testing was done in this monitoring period. The value of 90% is used for the calculation of the emission reductions as this it the default value given in the monitoring report in the case where no flare efficiency testing is done.

Data/Parameter	**Flare hours**
Unit	Hours
Description	Flare working hours
Measured/Calculated /Default	Measured
Source of data	Control system clock
Value(s) of monitored parameter	Flare 1: 18,857 / Flare 2: 18,955 / Total: 37,812
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Data is monitored continuously
Calculation method (if applicable)	NA
QA/QC procedures	The time/date stamps for the measured parameters are generated by Netrix system on the flares. The time of the Netrix system on the flare is compared to that of the Netrix web server in the UK every time data is uploaded, and reset automatically.
Purpose of data	Baseline emission calculations
Additional comment	The flare working hours are calculated by the Biogas monthly workbook from date/time stamps for the measured parameters for the periods when the flare is operating within the manufacturer's limits.

<table>
<tr><td>Data/Parameter</td><td>Flare temperature</td></tr>
<tr><td>Unit</td><td>°C</td></tr>
<tr><td>Description</td><td>Temperature of flare</td></tr>
<tr><td>Measured/Calculated /Default</td><td>Measured value</td></tr>
<tr><td>Source of data</td><td>Thermocouple</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td>Flare 1</td><td>Flare 2</td><td>Weighted Average</td></tr>
<tr><td>981</td><td>932</td><td>957</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td></td><td>Flare 1</td><td>Flare 2</td></tr>
<tr><td>Equipment number</td><td>3092-E-151 ($T_{Combust}$)</td><td>3449-E-151 ($T_{Combust}$)</td></tr>
<tr><td>Equipment number</td><td>3092-E-188 (top thermocouple)</td><td>3449-E-151 (top thermocouple)</td></tr>
</table>
Type: N type thermocouple
The typical accuracy of this type of thermocouple is ±0.75% of the measured temperature
The thermocouples do not have serial numbers.
The thermocouples are calibrated by means of a check done every 3 months using a portable temperature probe and monitor.
</td></tr>
<tr><td>Measuring/Reading/ Recording frequency</td><td>Data is monitored continuously.
Data is aggregated monthly and yearly.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>NA</td></tr>
<tr><td>QA/QC procedures</td><td>See monitoring equipment above</td></tr>
<tr><td>Purpose of data</td><td>Baseline emission calculations</td></tr>
<tr><td>Additional comment</td><td>The combustion temperature is measured by thermocouple 3092-E-151 for flare 1 and thermocouple 3449-E-151 for flare 2. A second thermocouple higher up in the flare exhaust stack (3092-E-188 for flare 1 and 3449-E-188 for flare 2) is used as a check on the combustion temperature.
These values were not used in the emission reduction calculations, but the temperature is measured every 30 minutes and emission reductions are not claimed when the temperature is below a threshold value of 700 °C.</td></tr>
</table>

Data/Parameter	EL
Unit	kWh
Description	Electricity generated
Measured/Calculated /Default	Measured value
Source of data	NA
Value(s) of monitored parameter	NA
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	NA
Calculation method (if applicable)	NA
QA/QC procedures	NA
Purpose of data	NA
Additional comment	No facilities installed for the generation of electricity. No electricity generated during this monitoring period.

Data/Parameter	EL_{IMP}
Unit	kWh
Description	Electricity consumed by project (blowers)
Measured/Calculated /Default	Measured and calculated value
Source of data	kWh meter
Value(s) of monitored parameter	1,118,533 kWh
Monitoring equipment	kWh meter.
Measuring/Reading/ Recording frequency	Data is monitored continuously. Data is aggregated monthly and yearly.
Calculation method (if applicable)	NA
QA/QC procedures	
Purpose of data	Project
Additional comment	Not required in terms of AM0011 and AM_CLA_0028. It is however monitored to assess the significance of emissions.

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 formulae for calculating the baseline emission reductions are the following:

$BE_y = MDproject_y * GWP_{CH4}$

Symbol	Description	Units
BE_y	Emission reductions in the year	tCO_2e
$MDproject_y$	Amount of methane destroyed in the year	tCH_4
GWP_{CH4}	Global Warming Potential value for methane	tCO_2e / tCH_4

The methane destroyed by the project activity ($MDproject_y$) during a year is the sum of the methane flared, that used to evaporate leachate, generate electricity and for other applications.

During this monitoring period, all the gas collected from the landfill was flared. No gas was used for leachate evaporation, electricity generation or in other applications.

This means that:
- Landfill gas used for leachate evaporation ($LFG_{leachate,y}$) = 0
- Landfill gas used for electricity generation ($LFG_{electricity,y}$) = 0
- Landfill gas used for other application ($LFG_{app\ i,y}$) = 0
- Electricity generated (EL) = 0

Therefore, the total methane destroyed is given by the formulae:

$Q = LFG_{flared,y}$

and

$MDproject_y = CH_4flared_{,y}$

where:

$CH_4flared_{,y} = LFG_{flared,y} * W_{CH4} * D_{CH4} * FE$

Symbol	Description	Units
$CH_4flared_{,y}$	Amount of methane destroyed by the flare in the year	t CH_4
$LFG_{flared,y}$	Amount of landfill gas flared in the year	Nm^3
W_{CH4}	Methane fraction in the landfill gas	%
D_{CH4}	Density methane at normal conditions	tCH_4 / Nm^3CH_4
FE	Flare efficiency (combustion efficiency)	%

The calculation of the emission reductions that is carried out in the monthly emission reduction workbooks is summarised in the steps below:

1. The following raw data, recorded every 30 minutes, is incorporated into the monthly emission reduction workbooks:
   - The flow of landfill gas in Nm^3/h as measured by flowmeter tag 3092-FM-118 for flare 1 and tag 3449-FM-118 for flare 2. ($LFG_{flared,y}$).
   - The combustion temperature (°C) in the flare as measured by thermocouple tag 3092-E-151 for flare 1 and tag 3449-E-151 for flare 2. ($T_{Combust}$)
   - The concentration (% v/v) of the methane in the landfill gas going to the flare as measured by the on-line analyser tag 3092-E-172 for flare 1 and tag 3449-E-172 for flare 2. (W_{CH4})
   - Whether the source of the data is primary (given a value of 1), secondary (given a value of 2) or a combination of the two (given a value of 3).
2. The following operational check is then done:
   - The concentration of methane in the gas is greater than 25% v/v;

- The combustion temperature in the flare is greater than 700 °C;
- The flow of gas to the flare is greater than 200 Nm^3/h

If all parameters are Ok then this field is given a value of 1, which means that the emission reduction for the 30 minute time interval will be calculated. If any of the parameters are not Ok then this field will be given a value of 0 and the emission reduction for the time interval will be zero.

3. The frequency or time interval of the raw data is then determined by subtracting the date and time for the previous reading from that of the current reading.
4. This is then multiplied by the operational check value determined in step 2.
5. The quantity of gas (in Nm^3) is then calculated by multiplying the flowrate as measured in step 1 by the time interval (in hours) times the operational check as determined in step 4.
6. A correction factor is calculated for the gas quantity based on the methane concentration. This is because the flowrate as measured by a thermal mass flow meter is dependent to a small extent on the methane concentration of the gas.
7. The corrected gas quantity is then calculated by multiplying the gas quantity from step 5 by the correction factor determined in step 6.
8. The mass of methane ($MD_{flare,y}$) is then calculated by multiplying the quantity of landfill gas from step 7 by the methane concentration (W_{CH4}), the density of methane ($D_{CH4} = 0.0007168$) and the flare destruction efficiency (assumed to be 90%). The value of 90% of the destruction efficiency is the default value in the case when no flare efficiency testing has been done.
9. The quantity of emission reductions is then calculated by multiplying the methane determined in step 8 by the global warming potential for methane. ($GWP_{CH4} = 21\ tCO_2e/tCH_4$)
10. The emission reductions are then aggregated for each time period to give a total value for the month.
11. A monthly report is then produced as a sheet in the monthly emission reduction workbook giving the average landfill gas flowrate, the average methane concentration, the average combustion temperature, the downtime and average emission reductions for each day of the month. The quantity of landfill gas flared and the average flare temperature are calculated based on the measured data. Graphs of the methane flowrate and emission reductions for each day in the month are also produced.
12. The monthly report is then reviewed at the monthly management meeting to check that the emission reductions calculated in the workbook are correct.
13. The CD containing the workbooks and reports is given by Ener-G to Enviroserv who then archives the CD.
14. At the end of the monitoring period, the daily values for the average landfill gas flow, the average flare temperature, the average methane concentration, and the downtime hours are copied from the monthly emission reduction workbooks for each of the two flares into the annual emission reduction workbook. This workbook contains the daily landfill gas quantities, the total average monthly landfill gas flowrates, the average flare temperatures, the average methane concentrations and the total uptime and downtime hours, copied from the monthly emission reduction workbooks. It then calculates the total emission reductions for both flares. This annual workbook also reports the total electricity used by flares and reports it as tCO_2e and as a percentage of the emission reductions.

For the summary worbook see the file:
Chloorkop Workbook Summary Jan2010 – Mar2012 Rev4

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

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No project emissions are considered for this activity.

$PE_y = 0$

In response to a request for clarification (AM_CLA_0128), the answer from the Meth Panel was that project emissions (e.g. electricity from the grid or diesel generator set) would not have to be taken into account since no provisions for such emissions are included in the methodology AM0011 version 2.

E.3. Calculation of leakage

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The methodology assumes no leakages from the project activity.

$L_y = 0$

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

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
Total	326,017	0	0	326,017

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

Item	Values estimated in ex-ante calculation of registered PDD		Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	2010	187,615	326,017
	2011	254,042	
	Jan-Mar2012[1]	80,840	
	Total	522,497	

1. 25% of the value for 2012 of 323,360

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

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The actual emission reductions achieved were 34% less than those estimated ex-ante. The reasons were are follows:

- Downtime. This accounted for 4% of the discrepancy
- The ex-ante estimates of the landfill gas production were calculated using a multicomponent first order kinetic model based on the amount of biodegradable organic carbon in the landfill and the various waste fractions put to the landfill. This, in turn, was determined from the amount of domestic waste put to the landfill, and the fraction of this that was organic carbon. In the PDD, the volume of domestic waste for the years 2006 to 2012 was taken to be the same as that in 2005. The volume of domestic waste actually put to the landfill was considerably less than this, particularly in the years from 2007 onwards because of the reduced economic activity in South Africa as well as other business reasons. This accounted for the balance of the discrepancy.

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Form **Business Function**: Issuance		