Monitoring report form for CDM project activity
(Version 07.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	EnviroServ Chloorkop Landfill Gas Recovery Project	
UNFCCC reference number of the project activity	0925	
Version number of the PDD applicable to this monitoring report	05	
Version number of this monitoring report	01	
Completion date of this monitoring report	12/08/2020	
Monitoring period number	01	
Duration of this monitoring period	01/08/2014 to 18/01/2015 both days inclusive	
Monitoring report number for this monitoring period	06	
Project participants	EnviroServ Waste Management (Pty) Ltd	
Host Party	South Africa	
Applied methodologies and standardized baselines	Applied methodology: AM0011 version 02	
Sectoral scopes	Sectoral scope: 13 Waste handling and disposal	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	47774
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	130 650	

SECTION A. Description of project activity

A.1. General description of project activity

>>

(a) Purpose of the project activity and the measures taken for GHG emission reductions or net anthropogenic GHG removals by sinks:

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 25 times greater than CO2. Through the destruction of methane, the emissions of greenhouse gas are reduced.

(b) Brief description of the installed technology and equipment:

The installed technology consists of wells in the landfill, a gas collection system connecting the wells and two flare installations connected to the gas collection system. Each flare installation consists of a blower that draws the gas from the wells and the gas collection system, and the flare itself.

(c) Relevant dates for the project activity

The EnviroServ Chloorkop Landfill Site consists of six waste disposal cells. Construction of the wellfield was done in a phased manner. The first vertical wells were installed in cells 1, 2 and 3 in 2005 as a pilot trial. These were followed by additional vertical wells in cells 1, 2 and 3, and horizontal collectors 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 19/01/2008 (the start date of the project activity). 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.

The second flare was subsequently decommissioned when the flare compound facility was moved to another location on the site. The flare compound was originally located on the north-eastern corner of the Chloorkop facility. The flare compound was subsequently moved to the south-western corner of the facility and was recommissioned on 09/12/2019 with only one flare.

A.2. Location of project activity

>>

(a) Host Party(ies)

The host party is South Africa

(b) Region/ State/ Province

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

(c) City/ Town / Community

Ekurhuleni Metropolitan Municipality

(d) Physical/ Geographical location

The GPS coordinates are: 26° 02’ 30.35” S, 28° 10’ 04.58” E or latitude -26.0417, longitude 28.1679

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	EnviroServ Waste Management (Pty) Ltd - Private	No

A.4. References to applied methodologies and standardized baselines

>>

(a) Applied methodology

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.

(b) Tools and other methodologies applied

The tool applied is Methodological "Tool to determine project emissions from flaring gases containing methane". Reference: EB28, Annex 13.

(c) The applied standardized baseline(s), where applicable

No standardized baseline(s) were applied.

A.5. Crediting period type and duration

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The first renewable crediting period for the project is from 19/01/2008 to 18/01/2015.

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

>>

Status of the project activity during this monitoring period.

During the initial part of this monitoring period, both flares were in operation, with flare 1 operating at 66% of its design capacity and flare 2 at 58% of its design capacity. The design capacity of each flare is 2,000 Nm3/h. The throughput of the flares was dictated by the amount of landfill gas available from the wellfield. The move of the flare compound and decommissioning of one of the flares was undertaken during this monitoring period.

Description of the installed technology, technical process and equipment

Landfill site

The EnviroServ Chloorkop Landfill Site has been used for the disposal of municipal solid waste since 1997, receiving 396,000 to 448,000 tons of waste per annum. The waste accepted includes general (or domestic) waste, garden waste, soil and builder's rubble. To date, 5 cells have been constructed and are now full. Cell 6 started receiving waste in May 2010 and is still in operation with cell 7 now in construction.

Landfill Gas Collection System

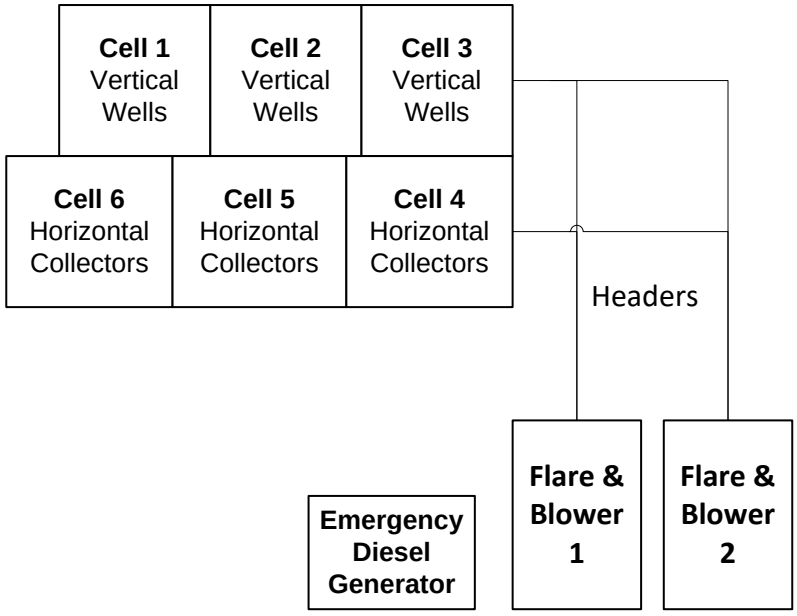
Vertical wells were installed in cells 1 to 3 by auguring into the existing waste body once the cell reached final grade. Horizontal collectors were installed in cells 4, 5 and 6 and involved the excavation of trenches into the waste at intermediate intervals before a cell reached final grade.

The vertical wells and the horizontal collectors were connected to a number headers leading to the flare installations.

Flare System

There are two flare installations at the start of this monitoring period. The flares used are high temperature enclosed flares.
The two flare installations are situated alongside each other. An emergency diesel fuelled 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:



It is worth noting that in the few week leading up to the 09/12/2019 the flare compound was relocated to the other side of the landfill site due to operational requirements and as a result of the steady decline in gas volumes from the site only one flare was installed at the new location and commissioned on the 09/12/2019.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

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

B.2.2. Corrections

>>
There were no corrections during this monitoring period.

B.2.3. Changes to the start date of the crediting period

>>
The first renewable crediting period for the project, as given in the PDD and project view page, was from 01/07/2007 to 30/06/2014 (i.e. for 7 years). A request was submitted to the Executive Board

that the start of the crediting period be changed to 19/01/2008, 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 19/01/2008 to 18/01/2015.

B.2.4. Inclusion of monitoring plan

>>
None for this monitoring period.

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>>
No changes have been applied for.

B.2.6. Changes to project design

>>
No changes have been applied for.

B.2.7. Changes specific to afforestation or reforestation project activity

>>
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).

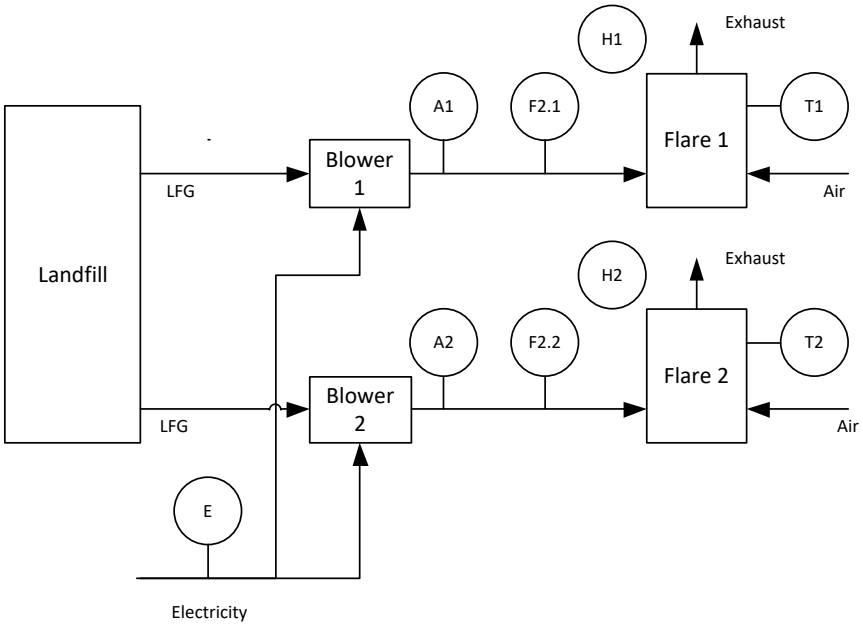
Primary data is defined as the data representing the main variables for the calculation of the emission reductions. This data is captured from the various sensors by a data acquisition system and is then stored on site in a data storage programme logic controller (PLC). The data is downloaded once a month for work book calculations.

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

The primary data 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 a secure 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 saved to the PLC in an electronic format, which can't be tampered with. Once the information is downloaded, it is backed up by ENERGY Systems. Access to the gathered data is only possible via a username and password, which is controlled by ENERGY Systems.

All the data is transferred via email and CD from ENERGY to EnviroServ on a monthly basis. The data and minutes of the meeting 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 has to approve access to this group by signing off the application form.
- The signed form is either scanned and e-mailed or faxed to the IT department.
- A call is logged with the service desk to request access to this group.
- One of the System Administrators then grants access to this group.
- For the access to take affect the user needs to log off and log back onto the system.

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

- Currently the 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 backup starts at 5:00pm in the afternoons
    - Backup Media is LTO4
    - Retention is 5 weeks off-site at MetroFile
    - Backup Schedule is Monday to Friday unless the daily backup falls within a monthly or yearly schedule
- Monthly backup 5:00pm in the afternoons
    - Backup Media is LTO4
    - Retention is 1 Year off-site at MetroFile
    - Backup Schedule is the last day of the month unless this day falls on a weekend or public holiday in which case it is 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 backup 5:00pm in the afternoons
    - Backup Media is LTO 4
    - Retention is Infinite off-site at MetroFile and is 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 is the day before the start of that weekend or public holiday.

Emergency procedures for the monitoring system

The calculation carried out by ENERGY Systems 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

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

Position	Responsibilities	Authorities
EnviroServ Waste to Energy General 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 ENERGY Chairs monthly review meetings between EnviroServ and ENERGY on the operation of the landfill gas system Stores and archives data received from ENERGY on the EnviroServ Chloorkop CDM folder on the server.	Provides and manages resources for operation of the landfill gas system
EnviroServ Depot Manager	Liaison between ENERGY and rest of landfill site. Advises ENERGY of aspects of landfill operation that may impact on operation of the landfill gas system.	
EnviroServ IT Manager	Manages the IT system in	Provides resources for data

Position	Responsibilities	Authorities
	EnviroServ. Provides data storage and archiving (backup) of data for the landfill gas system.	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.
ENERGY General Manager	Overall responsibility for managing the landfill gas system.	Manages resources for the landfill gas system.
ENERGY Production Manager	Operation of the landfill gas system. Reviews workbook data from site and comments if necessary. Advises of any comments on the workbook data. Approves monthly report	Controls the landfill gas system
ENERGY Site Technician	Day-to-day operation of the landfill gas system	Controls the landfill gas system
Jones & Wagener Civil Consultant	Reviews data on well field and flare performance. Submits comments to ENERGY General Manager & EnviroServ Waste to Energy General Manager Provides technical support to ENERGY and EnviroServ	Recommends changes to operation of landfill gas system to ENERGY and EnviroServ.

Regulatory Framework

The regulatory framework is monitored on an annual basis. In case upcoming regulations in South Africa mandate methane capture and destruction during the crediting period, the baseline scenario and emissions shall be adapted accordingly.

There were no changes to the regulatory framework during this monitoring period.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	**GWP_{CH4}**
Unit	tCO2e/tCH4
Description	Global Warming Potential of Methane
Source of data	Methodology AM0011 version 2
Value(s) applied	25
Choice of data or measurement methods and procedures	IPCC values. In line with values adopted by decision 4/CMP.
Purpose of data/parameter	Baseline emission calculations
Additional comments	

Data/Parameter	D_{CH4}
Unit	tCO2e/Nm3CH4
Description	Density of methane at 0 degree Celsius and 1.013 bar
Source of data	IPCC
Value(s) applied	0.0007168
Choice of data or measurement methods and procedures	In line with values adopted by decision 4/CMP.
Purpose of data/parameter	Baseline emission calculations
Additional comments	

Data/Parameter	Lo
Unit	Nm3 landfill gas / kg organic C
Description	Theoretical landfill gas generation potential based on the biodegradable organic carbon content of specific waste fractions.
Source of data	Van Zanten, B., and Scheepers, M., 1994, Modelling of Landfill Gas Potentials, Report prepared for International Energy Agency (IEA) Expert Working Group on Landfill Gas, published by Technical University of Lulea, Sweden.
Value(s) applied	1.87
Choice of data or measurement methods and procedures	As detailed in the approved PDD
Purpose of data/parameter	Used for the theoretical baseline emission calculations in the PDD
Additional comments	

Data/Parameter	K
Unit	1 / year
Description	Kinetic constant
Source of data	Pipatti, R., and Vieira, S., 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste, EXCEL spreadsheet IPCC_ Waste_Model_sb24.PDD for this project
Value(s) applied	0.07 for "rapidly" biodegradable putresible fraction of landfilled waste, or 0.04 for "slowly" biodegradable paper fraction of landfilled waste.
Choice of data or measurement methods and procedures	As per the tool.
Purpose of data/parameter	Used for the theoretical baseline emission calculations in the PDD
Additional comments	

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 and calculated

<table>
<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>3586208</td><td>2692261</td><td>6278469</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 time the flowmeter is taken into service after calibration.
There were no replacements of the flowmeters during this monitoring period.
<table>
<tr><td></td><td>Flare 1</td><td>Flare 2</td></tr>
<tr><td>Instrument tag number</td><td>3092-FM-176</td><td>3449-FM-176</td></tr>
<tr><td>Change in monitoring equipment</td><td>NA</td><td>NA</td></tr>
<tr><td>Serial number</td><td>99047602000</td><td>A309F902000</td></tr>
<tr><td>Last calibration</td><td>25/01/2013</td><td>04/11/2011</td></tr>
<tr><td>Taken into service</td><td>13/01/2014</td><td>07/06/2012</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>NA</td></tr>
<tr><td>QA/QC procedures</td><td>The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards by an external laboratory. The standard is for the “General requirements for the competence of testing and calibration laboratories”</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comments</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 flow measurement for Q is the same as that for LFGflared,y ,as there was no electricity generation and no leachate evaporation in this monitoring period and hence Q = LFGflared,y</td></tr>
</table>

<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 and calculated</td></tr>
<tr><td>Source of data</td><td>Flow Meter</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>3586208</td><td>2692261</td><td>6278469</td></tr>
</table>
</td></tr>
</table>

<table>
<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 time the flowmeter is taken into service after calibration.

<table>
<tr><td></td><td>Flare 1</td><td>Flare 2</td></tr>
<tr><td>Instrument tag number</td><td>3092-FM-118</td><td>3449-FM-118</td></tr>
<tr><td>Change in monitoring equipment</td><td>NA</td><td>YES</td></tr>
<tr><td>Serial number</td><td>A309FA02000</td><td>99047702000</td></tr>
<tr><td>Last calibration</td><td>26/07/2012</td><td>10/03/2011</td></tr>
<tr><td>Taken into service</td><td>22/11/2012</td><td>06/10/2011</td></tr>
<tr><td></td><td>There were no replacements of the flowmeter during this monitoring period.</td><td>Replaced on 03/10/2014
Thermal Mass flow meters
Type: E&H Proline T mass 65I
Acccuracy: is ±1.5% of reading, ±0.5 % of full scale.
Calibration frequency: every three years as per manufacturer’s specifications
Serial No: A604B902000
1st calibration date 09/05/2014
Valid from 03/10/2014 to 02/10/2017 as per manufacturer’s specifications</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>NA</td></tr>
<tr><td>QA/QC procedures</td><td>The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards by an external laboratory. The standard is for the “General requirements for the competence of testing and calibration laboratories”</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comments</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 flow measurement for Q is the same as that for LFGflared,y ,as there was no electricity generation and no leachate evaporation in this monitoring period and hence Q = LFGflared,y</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 and calculated
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/parameter	NA
Additional comments	No facilities are installed for the evaporation of leachate using LFG. No LFG was used for leachate evaporation.

Data/Parameter	**$LFG_{electricity,y}$**
Unit	Nm3
Description	Total amount of landfill gas used for electricity generation
Measured/calculated/ default	Measured and calculated
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/parameter	Na
Additional comments	No facilities are installed for electricity generation using LFG. No LFG was used for electricity generation

Data/Parameter	**W_{CH4}**
Unit	%
Description	Methane fraction in landfill gas
Measured/calculated/ default	Measured value
Source of data	Fixed Gas Analyser
Value(s) of monitored parameter	Flare 1: 46.54% / Flare 2: 50.38% / Weighted average: 48.46%
Monitoring equipment	Infrared continuous analyser The typical accuracy of the analyser is 2% full scale per month. Calibration frequency is at least once a week using a supply of span gas. The span gas has a methane concentration of 40%v/v.
Measuring/reading/recording frequency	Measured by continuous gas quality analyser.
Calculation method (if applicable)	NA

	Flare 1	Flare 2
Instrument tag number	3092-E-172	3449-E-172
Serial number	I-02177	I-04311

QA/QC procedures	The gas analyser is calibrated using a span gas that has been calibrated according to ISO/IEC 17025 standards by an external laboratory. The standard is for the "General requirements for the competence of testing and calibration laboratories". Span Gas Traceability Details: SITE: CHLOORKOP; SERIAL NUMBER: 11307-01; VALIDITY: 01/05/2014-30/05/2015
Purpose of data/parameter	Baseline emission calculations
Additional comments	

Data/Parameter	**FE**
Unit	%
Description	Flare efficiency (combustion efficiency
Measured/calculated/ default	Default value
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/parameter	Baseline emission calculations
Additional comments	No flare testing was done in this monitoring period. The value of 90% is used for the calculation of the emission reductions as this is the default value in the case where no flare efficiency testing is done.

Data/Parameter	**Flare hours**
Unit	Hours
Description	Flare working hours
Measured/calculated/ default	Measured value
Source of data	Control system clock
Value(s) of monitored parameter	Flare 1: 3 973; Flare 2: 3 941; Total: 7 914
Monitoring equipment	Control system clock
Measuring/reading/recording frequency	Data is monitored continuously
Calculation method (if applicable)	NA
QA/QC procedures	The clock is digital and is not a serviceable item
Purpose of data/parameter	Baseline emission calculations
Additional comments	The flare working hours are calculated from the control system clock, only taking into account those periods when the flare is operating within the manufacturer's limits. (The concentration of methane in the gas is greater than 25% v/v; the combustion temperature in the flare is greater than 350 °C and the flow of gas to the flare is greater than 200 Nm3/h). (See also point 2 in section E.1. below)

<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 the 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>948</td><td>898</td><td>923</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
There were no replacements of thermocouples on flare 1.
There were no replacements of thermocouples on flare 2.
<table>
<tr><td></td><td colspan="2">Flare 1</td><td>Flare 2</td></tr>
<tr><td>Instrument tag number</td><td colspan="2">3092-E-151 ($T_{Combust}$)</td><td>3449-E-151 ($T_{Combust}$)</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Serial number</td><td>T1-TEC-NSR60</td><td></td><td>T1-TEC-NSR60</td></tr>
</table>
Type: N type thermocouple
The typical accuracy of this type of thermocouple is ± 5 °C.
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.
Date 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/parameter</td><td>Baseline emission calculations</td></tr>
<tr><td>Additional comments</td><td>The measured values were not used in the emission reduction calculations. 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/parameter	NA
Additional comments	No facilities are installed for electricity generation. No LFG was used for electricity generation.

D.3. Implementation of sampling plan

>>
Not applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

>>
The formulae for calculating the baseline emission reductions are the following:

$BEy = MDprojecty * GWP_{CH4}$

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 (MDprojecty) 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 (LFGleachate,y) = 0
- Landfill gas used for electricity generation (LFGelectricity,y) = 0
- Landfill gas used for other application (LFGapp i,y) = 0
- Electricity generated (EL) = 0

Therefore, the total methane destroyed is given by the formulae:
Q = LFGflared,y

and

MDprojecty = CH4flared,y

where:

$CH4_{flared,y} = LFG_{flared,y} * W_{CH4} * D_{CH4} * FE$

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 Nm3/h as measured by flowmeter tag 3092-FM-118 for flare 1 and tag 3449-FM-118 for flare 2. (LFGflared,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. (TCombust)
- 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. (WCH4)

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 350 °C;
   - The flow of gas to the flare is greater than 200 Nm3/h

   If any of the above parameters are below the set points then the flare will automatically trip. 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 Nm3) 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 (WCH4), the density of methane (DCH4 = 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. (GWPCH4 = 25 tCO2e/tCH4)
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 ENERGY 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 landfill gas quantity, the average flare temperature, the average methane concentration and downtime hours are copied from the monthly emission reduction workbooks for each of the two flares into the summary emission reduction workbook. Values for any analyser calibration adjustment and flare efficiency values are then added. The summary emission reduction workbook then calculates the total emission reductions for both flares. This annual workbook also reports the total electricity used by flares and reports it as tCO2e and as a percentage of the emission reductions. It is the values from this summary emission reduction workbook that are reported on in the monitoring report.

For the emission reduction workbook see the file titled Chloorkop Consolidated report August 2014-January 2015 Final V1.

E.2. Calculation of project emissions or actual net removals

>>

PE*y* = PEEC,*y* + PEFC,,*j*,*y*

Where

PE_y	tCO_2/yr	Project emissions in year *y*;
$PE_{EC,y}$	tCO_2/yr	Emissions from consumption of electricity in the project case. The project emissions from electricity consumption $PE_{EC,y}$ will be calculated following the latest version of *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" defined in section B.2*.
$PE_{FCj,y}$	tCO_2/yr	The CO_2 emissions from fossil fuel combustion in case of grid failure during the year *y*. The project emissions from fossil fuel consumption $PE_{FC,y}$ will be calculated following the latest version of *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"* defined in section B.2.

As there is a standby generator at each of the sites and the fuel consumed to provide standby electricity is calculated to produce project emissions as detailed below:

PEFC,j,y = FCi,j,y * COEFi.y

Where

PEFC,j,y	CO2 emissions from fossil fuel combustion in process j during year
FCi,j,y	Quantity of fuel type i combusted in process j during year y [Mass or volume unit/yr] is 3091 lt;
COEFi.y	CO2 emission coefficient of fuel type i in year y [tCO2/mass or volume unit] is 3.24kg/lt;

COEFi,y = NCVi,y * EFCO2,i,y (4)

Where

COEFi.y	CO2 emission coefficient of fuel type i in year y [tCO2/mass or volume unit];
NCVj,y	Weighted average net calorific value of the fuel type i year y [GJ/mass or volume unit] is 0,0433 GJ/lt;
EF,j,y	Weighted average CO2 emission factor of fuel type i in year y [tCO2/TJ] 74.8tCO2/TJ;
I	Fuel types combusted in process j during year y is standard diesel

All of the above calculations are contained in the consolidated workbook titled "Chloorkop Consolidated report August 2014-January 2020 Final V1".

PEFC,,*j*,*y* = 434

Therefore

PE*y* = PEEC,*y* + *434*

And

$PE_{EC},y = \Sigma EC_{PJ},j,y * EF_{EL},j,y * (1 + TDLj,y)$

Where

Parameter	Unit	Description
$PE_{EC,y}$	tCO_2/yr	Project emissions from electricity consumption by the project activity in year *y*;
$EC_{PJ,j,y}$	MWh	Quantity of electricity consumed by the project electricity consumption source j in year y = 125 MW;
$EF_{EL,j,y}$	tCO_2/MWh	Emission factor for electricity generation for source j in year y (0.977 as per PDD);
$TDL_{j,y}$	-	Average technical transmission and distribution losses for providing electricity to source j in year y 8.79%.

ECPJ,j,y was recorded by a new electricity meter installed at each of the sites and the total reading was taken and recorded by the site technician on a monthly basis.

PE_{EC} =134

Therefore

PEy = 134+ 434

PEy = 568

All of the above calculations are contained in the consolidated workbook titled “Chloorkop Consolidated report August 2014-January 2020 Final V1”.

E.3. Calculation of leakage emissions

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The methodology assumes no leakages from the project activity.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	48342	568	0	0	47774	47774

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period ($t CO_2e$)	Amount estimated ex ante for this monitoring period in the PDD ($t CO_2e$)
47774	130 650

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

>>

From the below extract from the current PDD we have calculate the Ex ante volumes for the monitoring report period.

The value for 2013 in the PDD was 303 437 but there is no data beyond 2013. In the light of this it was assumed that the value for 2014 was the same as 2013. The number of days for the period 01/01/14 to 31/07/2014 was 275 and therefore the emission reductions for the period 01/01/2013 to 31/07/2014 was 303 437*(1+ 211/365) = 478 848

January 2015 to December 2015 303 437

1 August 2014 to 31 December 2014 = 303 437 / 365 * 153
=127194

Extracted from the New PDD for the period beyond 19 January 2015

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 2015	70 548	464	0	70 084
Year 2016	71 883	464	0	71 418
Year 2017	72 990	464	0	72 526
Year 2018	73 890	464	0	73 425
Year 2019	74 597	464	0	74 133
Year 2020	75 130	464	0	74 666
Year 2021	75 501	464	0	75 037
Total	514 538	3 249	0	511 289
Total number of crediting years	7			

January 2015 to December 2015 70 084
1 January 2015 to 18 January 2015 = 70 084 / 365 * 18
= 3 456

Total for this monitoring period = 127 194 + 3 456
= 130 650

The actual emission reductions achieved were 63% less than those estimated ex-ante. The reasons were are follows:

- Downtime. This accounted for 3% 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. Also, the actual fraction of the total waste that was domestic waste was believed to be less than that assumed in the model. These factors would have reduced the quantity of landfill gas generated in this monitoring period compared to that estimated in the PDD.

E.6. Remarks on increase in achieved emission reductions

>>
There has not been an increase in the emission reductions but rather a decrease which is in line with the waste input reductions and an aging waste mass that yields less gas per year.

E.7. Remarks on scale of small-scale project activity

>>
Not applicable

Annexure A

From the below extract from the current PDD we have calculate the Ex ante volumes for the MR.

The value for 2013 in the PDD was 303 437 but there is no data beyond 2013. In the light of this it was assumed that the value for 2014 was the same as 2013. The number of days for the period 01/01/14 to 31/07/2014 was 275 and therefore the emission reductions for the period 01/01/2013 to 31/07/2014 was 303 437*(1+ 211/365) = 478 848

January 2015 to December 2015 303 437

1 August 2014 to 31 December 2014 = 303 437 / 365 * 153
=127194

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 2015	70 548	464	0	70 084
Year 2016	71 883	464	0	71 418
Year 2017	72 990	464	0	72 526
Year 2018	73 890	464	0	73 425
Year 2019	74 597	464	0	74 133
Year 2020	75 130	464	0	74 666
Year 2021	75 501	464	0	75 037
Total	514 538	3 249	0	511 289
Total number of crediting years	7			

January 2016 to December 2016 70 084

1 January 2015 to 18 January 2015 = 70 084 / 365 * 18
= 3456

Total for this monitoring period = 127 194 + 3456
= 130 650

Document information

Version	*Date*	*Description*
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
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.

Version	*Date*	*Description*
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 (EB 70, 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).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: monitoring report