Monitoring report form for CDM programme of activities (Version 03.0)

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

MONITORING REPORT		
Title of the PoA	City of Cape Town Landfill Gas Extraction and Utilisation Programme	
UNFCCC reference number of the PoA	10004	
Version numbers of the PoA-DD applicable to this monitoring report	17	
Version number of this monitoring report	1	
Completion date of this monitoring report	25/09/2019	
Monitoring period number	1	
Duration of this monitoring period	01/10/2014- 31/07/2019	
Monitoring report number for this monitoring period	First monitoring period	
Coordinating/managing entity	City of Cape Town	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	The Republic of South Africa	no
Applied methodologies and standardized baselines	ACM0001 Flaring or use of landfill gas, version 15 ASB0040-2018: "Standardized baseline: Grid emission factor for the Southern African Power Pool" (Version 01.0.)	
Sectoral scopes	13, Waste Handling and Disposal	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	132100
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	52456	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

>>

The main goal of the PoA is to establish a CDM framework to which landfill gas utilization projects can be added as CPAs to promote the recovery and utilization of this renewable resource over the Republic of South Africa. Other goals of the PoA are:

- Contribute to sustainable development within South Africa;
- Expand the use of renewable energy technologies in South Africa.
- Reduce uncontrolled emissions of greenhouse gas (GHG) to atmosphere;
- To recover renewable energy and reduce further the GHG emissions by displacing fossil fuels; and
- Reduce other potentially adverse environmental effects of uncontrolled LFG emissions.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Type 1: Flaring ONLY	17	13, Waste Handling and Disposal	ACM0001: “Large-scale consolidated methodology: Flaring or use of landfill gas” (Version 15.0) TOOL11: “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1); TOOL02: “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 05.0.0); TOOL03: “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 02); TOOL04: “Emissions from solid waste disposal sites” (Version 06.0.1); TOOL05: “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01) as well as associated ASB0040-2018:”Standardized baseline: Grid emission factor for the Southern African power pool” (Version 01.0); TOOL06: “Project emissions from flaring” (Version 02.0.0)”; TOOL08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0); TOOL09: “Tool to determine the baseline efficiency of thermal or electric energy generation systems” (Version 01); TOOL10: “Tool to determine the remaining lifetime of equipment” (Version 01).

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Type 2: Flaring with Electricity Generation	17	13, Waste Handling and Disposal	ACM0001: “Large-scale consolidated methodology: Flaring or use of landfill gas” (Version 15.0) TOOL11: “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1); TOOL02: “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 05.0.0); TOOL03: “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 02); TOOL04: “Emissions from solid waste disposal sites” (Version 06.0.1); TOOL05: “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01) as well as associated ASB0040-2018:”Standardized baseline: Grid emission factor for the Southern African power pool” (Version 01.0); TOOL06: “Project emissions from flaring” (Version 02.0.0)”; TOOL08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0); TOOL09: “Tool to determine the baseline efficiency of thermal or electric energy generation systems” (Version 01); TOOL10: “Tool to determine the remaining lifetime of equipment” (Version 01).

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Type 3: Flaring with Heat Generation in Boiler	17	13, Waste Handling and Disposal	ACM0001: “Large-scale consolidated methodology: Flaring or use of landfill gas” (Version 15.0) TOOL11: “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1); TOOL02: “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 05.0.0); TOOL03: “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 02); TOOL04: “Emissions from solid waste disposal sites” (Version 06.0.1); TOOL05: “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01) as well as associated ASB0040-2018:”Standardized baseline: Grid emission factor for the Southern African power pool” (Version 01.0); TOOL06: “Project emissions from flaring” (Version 02.0.0)”; TOOL08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0); TOOL09: “Tool to determine the baseline efficiency of thermal or electric energy generation systems” (Version 01); TOOL10: “Tool to determine the remaining lifetime of equipment” (Version 01).

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Type 4: Flaring with Heat Generation for use in Glass Furnace	17	13, Waste Handling and Disposal	ACM0001: “Large-scale consolidated methodology: Flaring or use of landfill gas” (Version 15.0) TOOL11: “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1); TOOL02: “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 05.0.0); TOOL03: “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 02); TOOL04: “Emissions from solid waste disposal sites” (Version 06.0.1); TOOL05: “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01) as well as associated ASB0040-2018:”Standardized baseline: Grid emission factor for the Southern African power pool” (Version 01.0); TOOL06: “Project emissions from flaring” (Version 02.0.0)”; TOOL08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0); TOOL09: “Tool to determine the baseline efficiency of thermal or electric energy generation systems” (Version 01); TOOL10: “Tool to determine the remaining lifetime of equipment” (Version 01).

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
Title: Landfill Gas Extraction and Utilisation at Coastal Park Landfill (CPA 01) Reference: 10004-0001	05	Type 2: Flaring with Electricity Generation	Crediting period type: Renewable crediting period 7 years Crediting period duration: 01/10/2014 to 30/09/2021	yes

A.2. Coordinating/managing entity

>>

City of Cape Town

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

>>

Information on how the management system described in the PoA-DD was implemented

Roles and Responsibilities

As the coordinating/managing entity, the City of Cape Town is responsible for the overall management of the PoA, collation of data and preparation of monitoring reports for verification purposes, and providing the interface with the DOE and UNFCCC EB. In order to deliver each CPA in the most effective manner, the CME has entered into contractual agreements with partner organisations and hired contractors and allowed waste operators to join the PoA subject to agreed terms and conditions. These respective entities are responsible for the implementation, management and monitoring of landfill gas flaring/utilisation.

The PoA involves a range of operational activities which are required to successfully implement and manage each CPA. As the CME, the City of Cape Town is responsible for the management and record keeping of each CPA. However, the a project developer, may either be:

- The City of Cape Town alone,
- The City of Cape Town in association with a 3rd party
- A third party alone in the Cape Town municipality or
- A third party through association with another municipality in South Africa

In the latter three cases, technical support and management/monitoring input is required for each CPA site from third parties (project implementers or their sub-contractors) within the PoA. Furthermore, technical support and management/monitoring input may be sourced from other authorities or entities engaged in waste management who may in the future contract with the City of Cape Town or such third parties to include their activities in the PoA.

The CME, through a clearly defined and structured procurement process or by way of contractual agreements, will ensure that all partner organisations and sub-contractors will satisfy the required standards of the PoA, ensuring the quality of the waste treatment processes and the management procedures are maintained at a consistently high level.

Records and Document Control Process

For each CPA, there will be a detailed monitoring plan and system of electronic data management (automated where practicable) in place prior to the commencement of the first crediting period. Each site will have its own installed data capture systems which will be accessible to the verifying Designated Operational Entity (DOE). All relevant monitoring data will be compiled in an electronic workbook, and will be supported by field notes/records and details of all instrument/equipment calibrations (including dates and copies of calibration certificates where available). All data collected on each site will be provided to the CME in an agreed format to provide a central point for the maintenance of all records applicable to the PoA. Roles and responsibilities will be arranged for each CPA under guidance from the CME manual.

The CME will be responsible for the regular collation, review and storage of monitoring data from each CPA.

Records of Arrangements for Training and Capacity Development

The PoA Management Manual includes the arrangements for recording the training and capacity development of all CME staff or staff of other entities operating CPAs. The contracts with third parties for the implementation of CPAs shall include the arrangements for recording the training and capacity development of all personnel working on the projects.

Technical Review of Inclusion

The PoA Management Manual will include procedures for the review of technology or measures to be employed by the CPA to ensure the CPA complies with this PoA.

CDM Projects in the Cape Town Municipal Jurisdiction Area

The registration with the UNFCCC of CDM projects for the PoA is a precursor to the final work necessary to assess the procurement options in respect of funding, viability, institutional arrangements and risks of projects. The realisation of CDM revenue will be an important consideration when generating the business cases that will be used to determine the financial viability of and the procurement method for projects aimed at climate mitigation. The procurement mechanism to be used may be that of a Public Private Partnership (PPP). Otherwise, the City will procure projects using its own capital. Based on a preliminary evaluation and decisions regarding

funding, the City has opted to develop its own landfill gas mitigation projects using its own resources.

For City projects, third parties will be contracted for the construction, expansion, repairs and maintenance activities, as well as the monitoring, and data management activities via Council tenders with terms and conditions aligned to conform to the PoA Management Manual provisions, since the operating viability is still dependent on specialist skills and resources that will be contracted in to ensure the integrity of the process due to the linked revenue implications.

Terms and Conditions of CoCT SDAs or Contracts in respect of 3rd Party Roles and Responsibilities

Estimates and information that have already been generated per the carbon emissions modelling calculations received from the CDM consultant employed by the CoCT for the project registration process, will likewise inform these contractual arrangements.

Other CDM Projects in South Africa outside the City of Cape Town municipal area

As the City of Cape Town Landfill Gas Extraction and Utilisation Programme's geographic boundary has been defined to span the Republic of South African municipalities other than the CoCT, and private sector waste management companies that are responsible for other potential CPA sites in the province, will be able to register projects under the PoA.

A strict contractual relationship will be used to determine responsibilities of such entities, especially for financial (cost and revenue), local management of infrastructure and data and for reporting obligations.

In principle, when a new CPA needs to be registered, the CME (CoCT) will:

1. Proceed to contact the UNFCCC EB and the SA DNA to determine whether a project has perhaps been registered.
2. If not registered, confirm with the applying entity, who will then be obliged to sign a legal agreement that will spell out the specifics this entity will be responsible and accountable for.
3. Establish that each CPA under the PoA will comprise the controlled extraction and collection of GHGs, which will subsequently be combusted via a combination of flaring and use for either electricity generation or as a source of heat.
4. Determine whether the entity has the necessary skills and resources available, either through an internal or through an externally contracted institutional arrangement (which includes verification activities) to:

    a. Develop a project from concept to design and procurement stage;
    b. Implement and commission the project for the extraction and collection, flaring, reticulation, control, instrumentation, data measurement and collection equipment and infrastructure;
    c. Operate, maintain and repair equipment and infrastructure;
    d. Monitor, collect, store, back-up, transfer or transmit data;
    e. Generate information for reporting and transmission of reports related to emissions, destruction of carbon, equipment availability and use (run time), costs
    f. Verify data, in order to comply with UNFCCC EB requirements.

5. If there are deficiencies, advise the entity how these can be overcome, to ensure that a project's outcomes will be compliant and eligible for registration under the CoCT PoA.
6. Where possible, assist the applying entity to conform.

Avoiding Double Counting

There will be no scope for double counting due to geographical dislocation and control by the CME or another local authority. In the case of those CPAs which fall within the geographical boundary of the City of Cape Town, these will be under control of the CME. Where CPAs are not being operated by the City of Cape Town, the CME shall require strict and verifiable adherence to these processes by the entities operating the relevant CPAs via contract stipulations as described in Section A.2 of the PoA-DD. Each CPA will be assigned a unique identification reference (including the site name, GPS co-ordinates and a numerical code) and data from each site will be managed and stored separately to facilitate the verification process. All waste will be weighed and recorded, and all quantities of landfill gas produced and utilized will be recorded.

System for Data Measurement, Capturing, Storage, Monitoring and Reporting

The system to ensure the validity and integrity of data will be implemented using standard processes and procedures. Standard operating Procedures will be developed along the lines of an ISO system.

Generally the data management system will consist of:

- Measuring, control and monitoring instruments (typically found in continuous process plants in the oil and gas industry, e.g. gas flow, volume, density, pressure, temperature and emissions measurement).
- On-site information system consisting of hardware and software to store, back-up, duplicate/replicate and transmit electronic data.
- Remote data storage and transmission system for disaster management purposes.
- If electrical power is generated, power generation and control instruments, including timing equipment to show equipment (generator set) run time as a means of predictive maintenance to keep plant and equipment in an optimal state of operation and availability.

The technical applications for the alternative treatment of waste streams means that gas flow meters and related instrumentation will be required to measure and register the amount of GHGs that will flow from extraction points via a reticulation system to the destruction equipment. Additional metering equipment may be necessary to determine the amount destroyed and to monitor flare/ exhaust emissions.

If power is generated, it will also be important to measure power output, as it will offset the bulk power purchased from the primary electrical grid network.

All meters will be connected to an electronic data capturing system, which will have off-site storage and back-up capacity to ensure continuity of data. Data and reports will be provided to the CoCT (the CME) in electronic format or hardcopy or both.

For CoCT-owned projects, the cost information related to CoCT operations, repairs and maintenance will be captured, stored and produced via the SAP system. If it is a third party owned

project, information will have to be provided by report that could be provided electronically or in hardcopy.

Other information systems are in use, on the Microsoft platform, such as Sharepoint. Training is provided to members of staff involved in administration, information management and reporting from time to time with system improvements and additions.

The CME will report to the UNFCCC Executive Board (EB) as required, in conjunction with the DOE once the verification of data is complete.

Measures for Continuous Improvement

The PoA Management Manual will include the arrangements for continuous improvement. All personnel shall have a Continuous Development Plan. The CME will arrange to undertake an annual assessment of each CPA and agree a plan for continuous improvement for the following year with the third party provider or shall require contractually that any operators of CPAs external to the City do so.

Subscription to the PoA

Each CPA will take place on SWDSs which are under the control of the local authority or a third party project implementer within South Africa. The CME will be directly aware of any CPA to be included the PoA. Thus, there is no potential for the CME to be unaware of the inclusion of a CPA.

Monitoring approach

No sampling is applied in the CPAs under this PoA.

Description of installed technologies, technical processes and equipment

Each CPA under the proposed PoA will comprise the controlled extraction and collection of LFG from new or existing SWDS, which will subsequently be combusted via a combination of flaring and use for either electricity generation or as a source of generating heat. These systems are proven in South Africa and also widely used in Europe, North America, and other parts of the world.

The measures to be employed by each CPA to collect and combust the LFG will include the following items of equipment:

- A network of vertical and/or horizontal landfill gas collection wells installed within the waste;
- Landfill gas collection pipework connected to the wells, which will draw the collected gas back to a single location (gas extraction compound);
- Blowers to apply suction to the pipework, allowing the landfill gas to be extracted;
- Condensate management systems to remove excess liquid from the gas collection pipework; and
- An enclosed compound area which will provide the focal point for gas collection and also house associated monitoring instrumentation and data recording systems as required to monitor the CPA.

Once the landfill gas has been captured, it will subsequently be combusted within the project boundary in a flare and/or engines to produce electricity which will be exported to the electrical grid supply network (offsetting the consumption of power which would otherwise have been predominantly generated by fossil fuel sources) or carried off-site by further pipework to an adjacent user for heat generation via a boiler or glass smelting furnace.

The four types of projects that will be eligible under this PoA are:

- Type 1: Flaring only
- Type 2: Flaring with electricity generation
- Type 3: Flaring with heat generation in a boiler
- Type 4: Flaring with heat generation in a glass furnace

This monitoring report outlines the implementation of CPA-01, a Type 2 project: flaring with electricity generation.

Post-registration changes to the PoA and CPAs

No post-registration changes are applied to the PoA DD.

Two post-registration changes are requested with reference to CPA-01: a correction to the name of the operating and maintenance contract and a request to amend the start date of the crediting period (discussed further on C.3 below).

B.2. Post-registration changes to PoA

B.2.1. Corrections

>>Not applicable

B.2.2. Inclusion of monitoring plan

>>Not applicable

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>>Not applicable

B.2.4. Changes to programme design

>>Not applicable

B.2.5. Changes specific to afforestation or reforestation activities

>> Not applicable

PART II Monitoring of CPAs

>>

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

>>

Landfill Gas Extraction and Utilisation at Coastal Park Landfill (CPA 01)

This is a Type 2: Flaring with electricity generation CPA.

The landfill gas (LFG) capture and utilisation project at Coastal Park Landfill in Cape Town, South Africa is implemented as part of the CDM PoA 'City of Cape Town Landfill Gas Extraction and Utilisation Programme'.

The Coastal Park Landfill has been operational since 1985 and is expected to serve a major role in the future disposal of the City's waste because of its strategic geographical location and relatively long lifespan, anticipated to be until at least 2020. The site receives approximately 450,000 tonnes of waste per year comprising general municipal waste, garden refuse and builders' rubble which is compacted in place.

The purpose of the CPA is to reduce greenhouse gas emissions by capturing a proportion of the landfill gas produced, combusting it and potentially generating electricity from the gas. Only the flaring component of the CPA has been commissioned thus far. Electricity generation is still at a feasibility stage.

The site is owned and operated by the City of Cape Town and therefore the rights to extract and utilise the landfill gas are already established. The sustainable development benefits of the scheme have been described at PoA level.

The project was constructed and has been operational since October 2017 in accordance with the Coordinating and Managing Entity (CME) Manual detailed in the PoA.

All landfill gas technology employed is in accordance with the requirements of the National Environmental Waste Act 59 of 2008 (NEMWA) and the site waste management licence

The CPA consists of controlled capture of landfill gas using the following items of equipment:

- A network of vertical and horizontal landfill gas collection wells installed within the waste;
- Landfill gas collection pipework connected to the wells, which draw the collected gas back to a single location (gas compound);
- Blowers to apply suction to the pipework, allowing the landfill gas to be extracted;
- Condensate management systems to remove excess liquid from the gas collection pipework; and
- An enclosed compound area which provides the focal point for gas collection and also houses associated monitoring instrumentation and recording systems as required to monitor the CPA.

Electricity generation: once the landfill gas has been captured, it will subsequently be combusted on-site to produce electricity which will be exported to the local grid supply network. The additional items of equipment to be provided will comprise:

- Landfill gas engines (e.g. Jenbacher JS320 or similar) sufficient to optimise utilisation of LFG for electricity generation. Ex-ante estimations suggest that this will equate to an installed capacity of 2MW; and
- Electricity transformers which will be required to transform the power and deliver it to the grid.

The gas flow to the engines and the operational efficiency of the engines will be continuously monitored to ensure compliance with testing certification.

The major equipment installed or still to be installed in the project is given in the table below, together with their average lifetimes based on manufacturer specifications.

Equipment	**Manufacturer**	**Operational lifetime**	**Installed capacity**	**Status**
Flare	Hofstetter	> 20 years	N/A	Operational
Engines	GE Jenbacher	15 years, which may be extended to 22.5 years	2 MW	Still to be installed

The following monitoring equipment are, or will be, installed in the project activity for the purposes of calculating emission reductions:

- Thermocouple for continuous monitoring of the exhaust gas from the flare (installed);
- Gas analyser to measure the methane concentration of gas to the flare and engines (installed);
- Flow meters to measure the flow rate of gas to the engines and flare (measured in Nm^3/hr);
- Electrical meters to measure the parasitic load of the plant and the electricity output of the engines (not yet installed).

The layout of the installation for the capture and utilisation of landfill gas is presented in Figure 1.

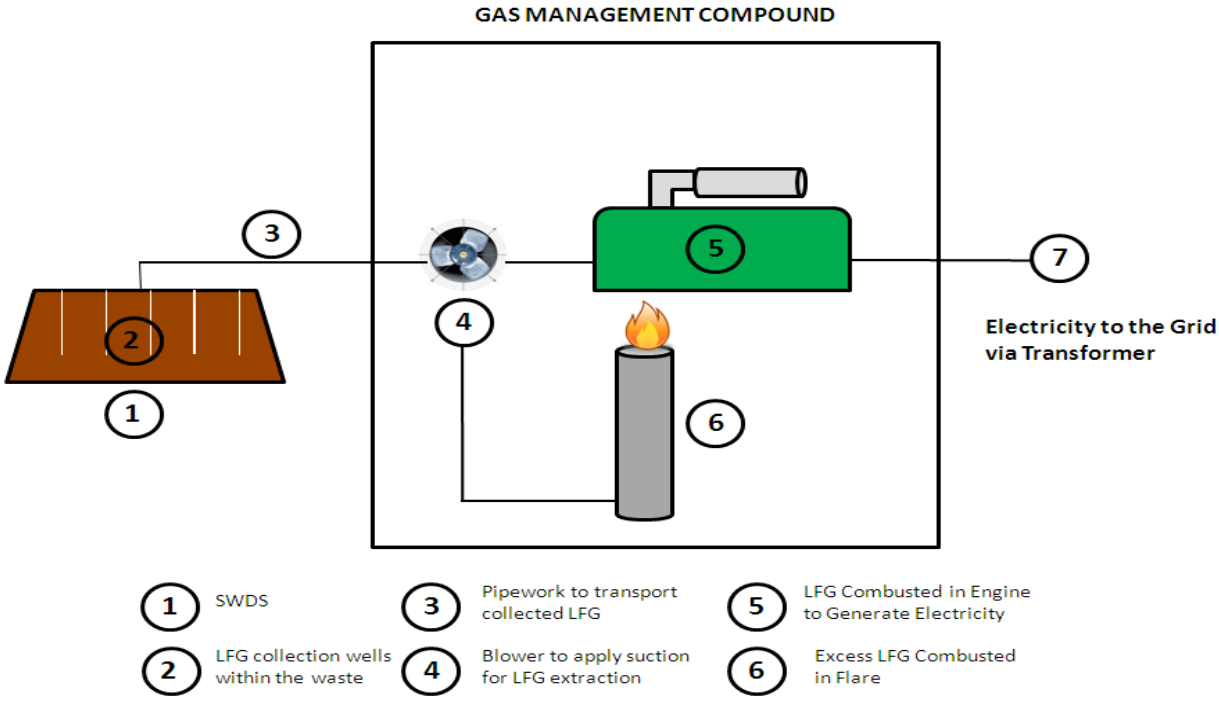


Figure 1: General Layout of the Installation (Type 2: Flaring with electricity generation**)**

C.2. Location of CPAs

>>

The Coastal Park Landfill is located in the Western Cape at:

Coastal Park Landfill
Baden Powell Drive
Strandfontein/Muizenberg

Figure 2: Location of Coastal Park Landfill

The landfill site is located west of Muizenberg in the South Peninsula Municipal Area. The site occupies approximately 62 ha. The Coastal Park Landfill serves the broader southern suburbs of the Cape Town municipal area and has GPS co-ordinates of 34.087025S 18.501445E. The location of the site is presented below. This is within the geographical boundary of the Western Cape as illustrated in PoA.

C.3. Post-registration changes to CPAs

C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents

>>Not applicable

C.3.2. Corrections

>>

Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration change - issuance track):

The registered CPA-DD refers to a thirdy-party, SLR, which was contracted for a period of three years to undertake various roles on CPA-01. Representatives from SLR fulfilled the following roles:

- Project Director
- Project Manager
- Site Technician
- CDM Manager

These roles are now fulfilled by a new, third party maintenance and operation team. The City may not engage in contracts that last more than three years. Therefore the correction to the monitoring report is to remove the company name of the entity responsible for the flare operations and maintenance because this is subject to change very three years.

Notification date: to be confirmed.

Reference number of the post-registration change: to be confirmed.

C.3.3. Changes to the start date of the crediting period

>>

Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration change - issuance track):

The CPA DD estimated that the start date of CPA-01 would be 01/10/2014. The CPA only commensed however on 26/01/2018, which is more that two years after the estimated date recorded in the CPA DD.

Demonstration that the CPA remains additional in accordance with the latest eligibility criteria for inclusion of CPAs in the PoA:

There has been no change to CPA-01's additionality because the activity applied the "Simplified procedures to identify the baseline scenario and demonstrate additionality" in accordance with ACM0001 (version 15.0). The baseline scenario for CPA-01 is remains the atmospheric release of the LFG and hence CPA-01 remains additional.

Demonstration that the original baseline scenario established in the included CPADD remains valid:

No changes have occurred to the CPA-01 that would result in a less conservative baseline because the "Simplified procedures to identify the baseline scenario and demonstrate additionality" have been applied in the registration of the CPA.

Notification date: to be confirmed.

Reference number of the post-registration change: to be confirmed.

C.3.4. Inclusion of monitoring plan

>>Not applicable

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>> Not applicable

C.3.6. Changes to project design

>> Not applicable

C.3.7. Changes specific to afforestation or reforestation CPA

>> Not applicable

SECTION D. Description of monitoring system of CPAs

>>

CPA-01 currently consists of controlled capture and flaring of landfill gas using the following items of equipment:

- A network of vertical and horizontal landfill gas collection wells installed within the waste;
- Landfill gas collection pipework connected to the wells, which draws the collected gas back to a single location (gas compound);
- Blowers to apply suction to the pipework, allowing the landfill gas to be extracted;
- Condensate management systems to remove excess liquid from the gas collection pipework; and
- An enclosed compound area which provides the focal point for gas collection and also house associated monitoring instrumentation and recording systems as required to monitor the CPA.

The design of CPA-01 allows for the generation of electricity from landfill gas. Only the flaring component of the CPA has been commissioned thus far. Electricity generation went out on tender on the 19/11/2018.

Once the electricity component of CPA-01 is successfully commissioned, the landfill gas will be captured and combusted on-site to produce electricity which will be exported to the local grid supply network. The additional items of equipment to be provided will comprise:

- Landfill gas engines (e.g. Jenbacher JS320 or similar) sufficient to optimise utilisation of LFG for electricity generation. Ex-ante estimations suggest that this will equate to an installed capacity of 2MW; and
- Electricity transformers which will be required to transform the power and deliver it to the grid.

The gas flow to the engines and the operational efficiency of the engines will be continuously monitored to ensure compliance with testing certification.

The major equipment to be installed in the project is given in the table below, together with their average lifetimes based on manufacturer specifications.

Equipment	Manufacturer	Operational lifetime	Installed capacity	Status
Flare	Hofstetter	> 20 years	N/A	Installed
Engines	GE Jenbacher	15 years, which may be extended to 22.5 years	2 MW	Not yet installed

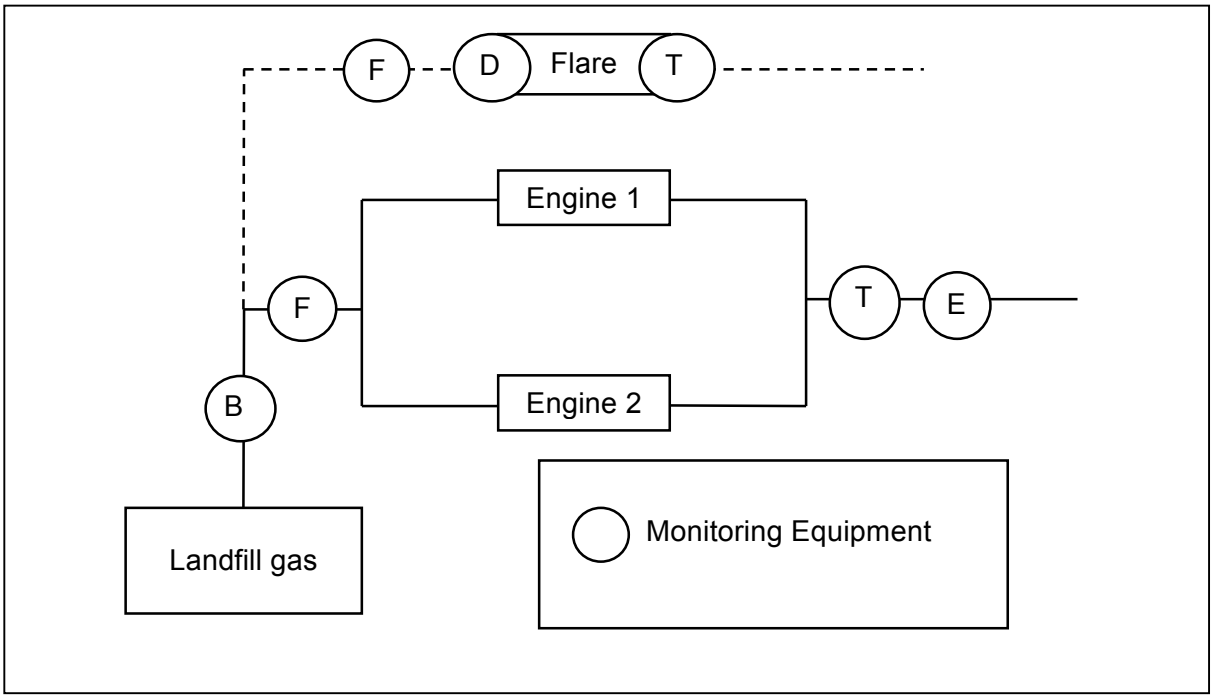
The following monitoring equipment has been installed in the project activity for the purposes of calculating emission reductions from flaring:

- Thermocouple for continuous monitoring of the exhaust gas from the flare;
- Gas analyser to measure the methane concentration of gas to the flare and engines;
- Flow meters to measure the flow rate of gas to the engines and flare.

The following monitoring equipment will be installed once the electricity generation component of the project is commissioned:

- Electrical meters to measure the parasitic load of the plant and the electricity output of the engines.

The location of metering equipment is shown in the figure below. A description of the symbols appears afterward.



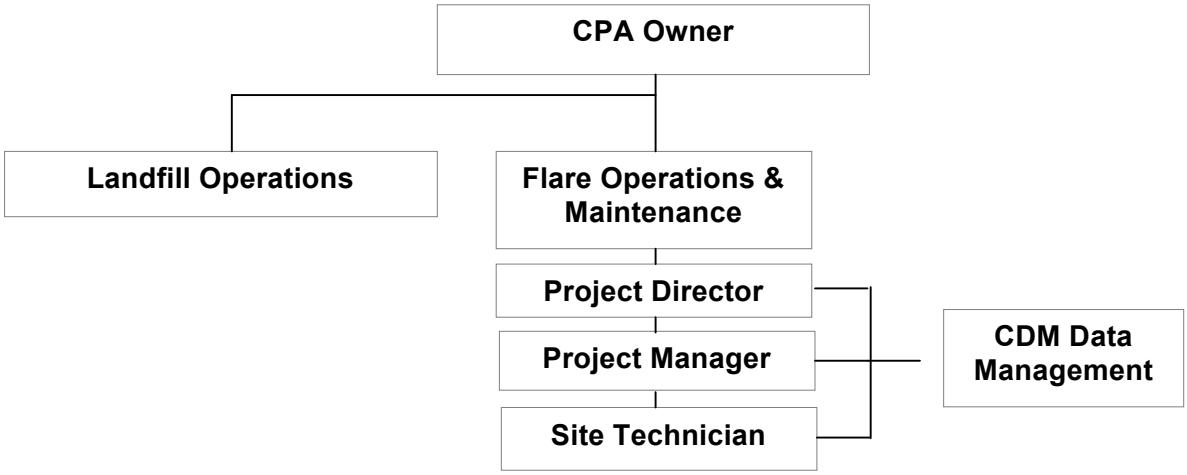
Symbol	Description	Function
B	Methane gas analyser	Measure CH_4 concentration of gas
F	Gas flow meter	Measure gas flow rate sent to engines and flares
T	Thermocouple	Measures the exhaust gas temperature of the flare
E	Electricity meter	Measures electricity consumption
D	Flame detector	To ensure the flare is operating

The parasitic load of the flaring infrastructure and engines will also be measured using another electricity meter.

Roles and responsibilities of personnel

Operational and management structure

The organogram below presents the operational and management structure, together with the roles and responsibilities of personnel at the landfill.



Project Owner (City of Cape Town)

- Overall responsibility for the landfill gas system
- Reviews performance data for the landfill gas system
- Stores and archives data
- Management of procurement (external service providers)
- Management of appointed landfill operations contractor
- Approves monitoring reports
- Approves monthly reports

Project Director

- Overall responsibility for management of the landfill gas system and management of resources
- Review data on flare performance on an ad-hoc basis
- Review monthly monitoring reports
- Submits comments to City of Cape Town and the project team
- Provision of technical support to the project team
- Recommendation of changes to the operation of the landfill gas system to the City of Cape Town and the project team

Project Manager

- Operation and control of the landfill gas system through the utilization of resources
- Attends monthly meetings with City of Windhoek to discuss operations and maintenance of the plant
- Management of internal procurement processes

Site Technician

- Day-to-day operation and control of the landfill gas system

CDM Manager

- Safe storage and archiving of data
- Review of workbook data and processing data in accordance with approved methodology and PoA
- Compilation of monthly O&M and CDM report and submission to Project Manager and Director for review
- Compilation of Monitoring Report and submission to Project Manager and Director for review
- Reviews comments from Project Manager and City of Cape Town and makes changes as necessary

Responsibilities and institutional arrangements for data collection and archiving

All meters will be connected to an electronic data capturing system, which will have off-site storage and back-up capacity to ensure continuity of data. Relevant monitoring data (outlined in section E.2) will be compiled in an electronic workbook, and will be supported by field notes/records and details of all instrument/equipment calibrations (including dates and copies of calibration certificates where available). All data collected on each site will be provided to the CME in an agreed format to provide a central point for the maintenance of all records applicable to the PoA.

All data collected in the CPA will be archived. All data will be kept for at least two years after the end of the crediting period, as per CDM requirements.

Calibration frequency

In accordance with the applicable methodology, all the relevant data is monitored as indicated in the table in section E.2. All measurements are conducted with calibrated measurement equipment according to relevant industry standards, which is specified in the tables in section E.2.

Maintenance

All meters will be maintained at a schedule specified by the technology provider. All repairs will be carried out timeously using the original supplier's components. Flares will also be kept on line to the greatest extent possible which will be monitored using parameter '$Flame_m$'. This will ensure that the flaring infrastructure's lifespan will exceed that of the crediting period.

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data / Parameter	$OX_{top\ layer}$
Unit	-
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	ACM0001 version 15.0
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	According to the applied methodology, this value is consistent with how oxidation is accounted for in the methodological tool 'Emissions from Solid Waste Disposal Sites'.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	ACM0001 version 15.0
Value(s) applied	25[1]
Choice of data or Measurement methods and procedures	25 for the second commitment period. Shall be updated according to any future COP/MOP decisions.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	η_{PJ}
Unit	-
Description	Efficiency of the LFG capture system that will be installed in the project Activity
Source of data	ACM0001 version 15.0
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Since the technical specifications are not available for the LFG capture system, a default value of 50% is applied for the purposes of ex-ante emissions estimation.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	EF_{EL}
Unit	tCO_2/MWh
Description	Emission factor for electricity generation
Source of data	ASB0040-2018:"Standardized baseline: Grid emission factor for the Southern African power pool" (Version 01.0)
Value(s) applied	0.9481
Choice of data or Measurement methods and procedures	Combined margin CO_2 emission factor for the project electricity system applicable to all project activities other than wind and solar for the first crediting period.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

[1] The Project Standard for Project Activities Version 1 (paragraph 254 and section 6.3) allows for the use of the GWP of 25 for CH4 in the second Kyoto commitment period which started on 1 January 2013.

Data / Parameter	f
Unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere
Source of data	Tool to calculate "Emissions from solid waste disposal sites" (version 06.0.1)
Value(s) applied	0
Choice of data or Measurement methods and procedures	In accordance with paragraph 38(a) of the applied methodology, 'f_y *in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology*'.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	φ_y
Unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	Application A is applied as all CPAs included under this PoA mitigate methane emissions from a specific existing SWDS. The CPA implementer shall justify whether the CPA site is located in dry or humid/wet conditions. The CPA site is dry[2].
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	OX
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

[2] Adelana, S. (2010). Groundwater Resource Evaluation and Protection in the Cape Flats, South Africa (University of the Western Cape).

Data / Parameter	$DOC_{f,default}$
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value applied since the project activity mitigates methane emissions from a specific existing SWDS.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MCF_{default}$
Unit	-
Description	Methane correction factor
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	The CPA implementer shall select the most appropriate factor based on the options provided on page 10 of version 06.0.1 of the 'Emissions from solid waste disposal sites'. The CPA site is an anaerobic managed solid waste disposal site. This is because there is a controlled placement of waste at the landfill (waste is specifically deposited in designated cells, and mining waste is deposited in a separate cell) and cover material and compacting equipment is used.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	DOC_j
Unit	-
Description	Fraction of degradable organic carbon in the waste type *j*
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	Wood and wood products: 43 Pulp, paper and cardboard (other than sludge): 40 Food, food waste, beverages and tobacco (other than sludge): 15 Textiles: 24 Garden, yard and park waste: 20 Glass, plastic, metal, other inert waste: 0
Choice of data or Measurement methods and procedures	The CPA implementer shall select the most appropriate fraction(s) based on the options provided on page 11 of version 06.0.1 of the 'Emissions from solid waste disposal sites'.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	k_j
Unit	l/yr
Description	Decay rate for the waste type *j*
Source of data	Version 06.0.1 of the 'Emissions from solid waste disposal sites'
Value(s) applied	<table><tr><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td></tr><tr><td>Wood, wood products and straw</td><td>0.02</td></tr><tr><td>Other (nonfood) organic putrescible garden and park waste</td><td>0.05</td></tr><tr><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td></tr></table>
Choice of data or Measurement methods and procedures	The CPA implementer shall select the most appropriate decay rate(s) based on the options provided on page 12 of version 06.0.1 of the 'Emissions from solid waste disposal sites'. In the case of this project activity, the landfill site is boreal and temperate[3], and dry[4].
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

[3] http://www.cape-town.climatemps.com/

[4] Adelana, S. (2010). Groundwater Resource Evaluation and Protection in the Cape Flats, South Africa (University of the Western Cape).

Data / Parameter	$W_{j,x}$
Unit	Tonnes
Description	Amount of solid waste type *j* disposed in the SWDS in year *x*
Source of data	Measured by the City of Cape Town
Value(s) applied	Landfill records (including mass and composition) between 2004 and 2013 were available for this analysis. Since the landfill has been operational since 1985, Cape Town census data was applied to back-date data. The landfill is also expected to be open until 2020, and therefore future population projects for the City were also applied. The references for the census and projections are: https://www.capetown.gov.za/en/stats/Documents/2011%20Census/2011_Census_Cape_Town_Profile.pdf https://www.capetown.gov.za/en/stats/CityReports/Documents/Population%20Projection/Population_Projection_for_Cape_Town_2001-2021_Full_Report_2192006105338_359.pdf The annual waste figures are as follows:

Year	Wood & Wood Products	Pulp,Paper & Cardboard	Food & Food Waste	Textiles	Garden, Yard & Park Waste	Glass, Plastic, Metal, Inerts
1985	3	-	110,245	-	2,113	137,957
1986	3	-	113,161	-	2,169	141,607
1987	3	-	116,078	-	2,225	145,256
1988	3	-	118,994	-	2,281	148,905
1989	3	-	121,910	-	2,337	152,554
1990	3	-	124,826	-	2,393	156,204
1991	3	-	127,742	-	2,448	159,853
1992	3	-	130,658	-	2,504	163,502
1993	3	-	133,575	-	2,560	167,151
1994	3	-	136,491	-	2,616	170,800
1995	3	-	139,407	-	2,672	174,450
1996	3	-	142,323	-	2,728	178,099
1997	4	-	145,524	-	2,789	182,105
1998	4	-	148,726	-	2,851	186,111
1999	4	-	151,927	-	2,912	190,117
2000	4	-	155,128	-	2,973	194,123
2001	4	-	158,330	-	3,035	198,129
2002	4	-	161,730	-	3,100	202,383
2003	4	-	165,129	-	3,165	206,638
2004	4	-	168,529	-	3,230	210,892
2005	5	-	212,883	-	4,709	221,852
2006	6	-	223,044	-	3,630	193,105
2007	-	-	245,313	-	2,876	173,906
2008	-	-	325,746	-	2,288	160,679
2009	-	2	293,015	-	3,625	140,894
2010	-	-	318,345	-	2,616	140,441
2011	-	-	312,707	-	3,432	134,263
2012	-	-	304,486	-	2,967	151,280
2013	-	-	357,864	-	2,309	151,760
2014	-	-	358,221	-	2,312	151,911
2015	-	-	358,578	-	2,314	152,063
2016	-	-	358,936	-	2,316	152,214
2017	-	-	359,079	-	2,317	152,275
2018	-	-	359,223	-	2,318	152,336
2019	-	-	359,366	-	2,319	152,397
2020	-	-	359,510	-	2,320	152,458
2021	-	-	-	-	-	-

Choice of data or Measurement methods and procedures	Data taken from historical records of landfill operation, aggregated into annual figures and provided by City of Cape Town.
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

E.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data / Parameter	**Management of SWDS**
Unit	-
Description	Management of SWDS
Measured/calculated/ Default	-
Source of data	Different sources of data: • Original design of the landfill; • Technical specifications for the management of the SWDS; • National regulations.
Value(s) of monitored parameter	Waste management licence: number 12/9/11/L334/9.
Monitoring equipment	-
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	-
QA/QC procedures	The waste management licence is granted by a governmental department (third party)
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$Op_{j,h}$**
Unit	-
Description	Operation of the equipment that consumes the LFG
Measured/calculated/ Default	Calculated
Source of data	Project participants
Value(s) of monitored parameter	

Period	Number of hours in the month where Opj,h = 1
Jan-18	116
Feb-18	608
Mar-18	660
Apr-18	656
May-18	726
Jun-18	670
Jul-18	728
Aug-18	714
Sep-18	704
Oct-18	733
Nov-18	659
Dec-18	739

	<table><tr><td>Jan-19</td><td>717</td></tr><tr><td>Feb-19</td><td>597</td></tr><tr><td>Mar-19</td><td>725</td></tr><tr><td>Apr-19</td><td>706</td></tr><tr><td>May-19</td><td>739</td></tr><tr><td>Jun-19</td><td>720</td></tr><tr><td>Jul-19</td><td>708</td></tr></table>
Monitoring equipment	For each equipment unit *j* using *the LFG* monitor that the plant is operating in hour *h* by the monitoring any one or more of the following three parameters: • Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment.; • Flame. Flame detection system is used to ensure that the equipment is in operation; • Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. (This option is not applicable to brick kilns)
Measuring/reading/recording frequency	Continuous (once every 5 minutes)
Calculation method (if applicable)	$Op_{j,h}$=0 when: • One of more temperature measurements are missing or below the minimum threshold in hour *h* (instantaneous measurements are made at least every minute); • Flame is not detected continuously in hour *h* (instantaneous measurements are made at least every minute); • No products are generated in the hour *h* Otherwise, $Op_{i,h}$=1
QA/QC procedures	N/A
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	Flame detection system is used to ensure that the equipment is in operation

Data / Parameter	**CAPEX and OPEX**
Unit	Rand
Description	Total investment to implement the project and total cost to operate the project
Measured/calculated/ Default	Measured
Source of data	Engineering, procurement and construction contracts; and maintenance contracts
Value(s) of monitored parameter	Capex R22,967,658.27 Opex R547,131.64 (April 2018 – October 2018)
Monitoring equipment	-
Measuring/reading/recording frequency	At the first issuance request after each phase of the project is fully implemented
Calculation method (if applicable)	-

QA/QC procedures	N/A
Purpose of data/parameter	In order to collect the information that is required for the update of the provisions in section 5.3.1 of ACM0001 (version 15). Project activities that are registered using these simplified procedures are required to report cost and revenue information at the first issuance request after each phase of the project is fully implemented.
Additional comment	The information provided for CAPEX shall indicate the investment made: (i) in the collection and flaring system; (ii) in the power plant and connection to the grid (if applicable); and (iii) in the purchase of the new boiler or refurbishment of the existing one and in the steam/hot air pipeline if steam/hot air is exported out of the project boundary (if applicable). The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the collection and flaring system; and (ii) staff and maintenance involved in the operation of the collection and power generation system. The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality

Data / Parameter	**Tariff of electricity exported**
Unit	Currency (USD, EUR, etc.)
Description	Tariff of the electricity exported
Measured/calculated/ Default	-
Source of data	Power purchase agreement
Value(s) of monitored parameter	n/a – only applied at the first issuance request after each phase of the project is fully implemented.
Monitoring equipment	-
Measuring/reading/recording frequency	At the first issuance request after each phase of the project is fully implemented
Calculation method (if applicable)	-
QA/QC procedures	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors.
Purpose of data/parameter	In order to collect the information that is required for the update of the provisions in section 5.3.1 of ACM0001 (version 15). Project activities that are registered using these simplified procedures are required to report cost and revenue information at the first issuance request after each phase of the project is fully implemented.
Additional comment	The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality No power purchase agreement is in place as the electricity generation facilities still need to be built.

Data / Parameter	**$EC_{PJ,y}$**
Unit	MWh/y
Description	Quantity of electricity consumed by the project electricity consumption source in year *y*
Measured/calculated/ Default	Measured

Source of data	Measurements by project participants
Value(s) of monitored parameter	<table><tr><th>Year y</th><th>Electricity consumption in year y ($EC_{PJ,y}$)</th></tr><tr><td>2018</td><td>111</td></tr><tr><td>2019</td><td>63</td></tr></table>
Monitoring equipment	Type: EMU32.x4 5(6)A Power consumption meter meter Accuracy: 0.02mA Serial number: 51691 Calibration frequency: replace after 10 years Factory calibration certificate: 17/08/2017 Valid until: 16/08/2027
Measuring/reading/recording frequency	Continuous (once every 5 minutes)
Calculation method (if applicable)	-
QA/QC procedures	Electricity meter will be subject to regular maintenance and testing (in accordance with the recommendations of the manufacturer/supplier) to ensure accuracy
Purpose of data/parameter	Calculation of project emissions
Additional comment	-

Data / Parameter	**$EC_{BL,y}$ or $EG_{PJ,y}$**
Unit	MWh/y
Description	Quantity of electricity that would be consumed by the baseline electricity consumption source in year *y*
Measured/calculated/ Default	Measured
Source of data	Measurements by project participants
Value(s) of monitored parameter	0
Monitoring equipment	-
Measuring/reading/recording frequency	Continuous (once every 5 minutes)
Calculation method (if applicable)	-
QA/QC procedures	Electricity meter will be subject to regular maintenance and testing (in accordance with the recommendations of the manufacturer/supplier) to ensure accuracy
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	Electrcity is not being generated yet

Data / Parameter	**TDL_y**
Unit	%
Description	Average technical transmission and distribution losses for providing electricity
Measured/calculated/ Default	-
Source of data	Eskom 2018 Integrated annual report
Value(s) of monitored parameter	<table><tr><th>Year</th><th>Value</th></tr><tr><td>2018</td><td>9.0%</td></tr><tr><td>2019</td><td>9.0%</td></tr></table>
Monitoring equipment	-
Measuring/reading/recording frequency	Annual.
Calculation method (if applicable)	-

QA/QC procedures	N/A: Third party information source
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	Calculated using 2018 Eskom Annual Report

Data / Parameter	$\eta_{flare,m}$
Unit	-
Description	Flare efficiency for the minute *m*
Measured/calculated/ Default	Default
Source of data	Methodological Tool "Project emissions from flaring" Version 02.0.0
Value(s) of monitored parameter	0.9
Monitoring equipment	-
Measuring/reading/recording frequency	Recorded once per minute
Calculation method (if applicable)	-
QA/QC procedures	N/A
Purpose of data/parameter	Calculation of project emissions
Additional comment	The flare efficiency for the minute m is 90% when the following two conditions are met to demonstrate that the flare is operating: 1.The temperature of the flare (TEG_m) and the flow rate of the residual gas to the flare (FRG_m) is within the manufacturer's specification for the flare (SPECflare) in minute m; and 2.The flame is detected in minute m ($Flame_m$).

Data / Parameter	$SPEC_{flare}$
Unit	None
Description	Indicates if the temperature, flow rate and maintenance schedule of the flare are within manufacturer's specifications
Measured/calculated/ Default	Calculated

<table>
<tr><td>Source of data</td><td>Flare manufacturer</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>When the following conditions are met SPECflare: is set to 1 otherwise the value is set to 0:

<table>
<tr><th></th><th>Value</th><th>Unit</th><th>Values on 26/01/2018</th></tr>
<tr><td>Flare combustion temperature</td><td>> 1,000 and < 1,200</td><td>°C</td><td>1,141</td></tr>
<tr><td>Maintenance schedule - number of days since last replacement of Thermocouple</td><td>< 365</td><td>Days</td><td>279</td></tr>
<tr><td>Flow rate</td><td>> 400 and < 2,000</td><td>m^{3}/h</td><td>1,271</td></tr>
<tr><td>Maintenance schedule - number of days for Flow meter</td><td>< 1,095</td><td>Days</td><td>279</td></tr>
</table></td></tr>
<tr><td>Monitoring equipment</td><td>Flow meter:
Type: Differential pressure flow measurement with Pitot tubes and Deltabar differential pressure transmitter
Serial number: M900A30109D
Accuracy: ±1.5 % of max (as specified by Hofstetter)
Calibration frequency: every two years
Date of last calibration (commissioning date): 26/01/2018
Validity: 25/01/2020

Temperature measurement equipment:
Type: Type-N Thermocouple
Accuracy: ±1.5°C
Calibration frequency: replaced once a year
Date of last calibration: 01/02/2019
Valid until: 01/02/2020</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Once at the start of the project activity</td></tr>
<tr><td>Calculation method (if applicable)</td><td>When the following conditions are met SPECflare: is set to 1 otherwise the value is set to 0:

<table>
<tr><th></th><th>Value</th><th>Unit</th></tr>
<tr><td>Flare combustion temperature</td><td>> 1,000 and < 1,200</td><td>°C</td></tr>
<tr><td>Maintenance schedule - number of days since last replacement of Thermocouple</td><td>< 365</td><td>Days</td></tr>
<tr><td>Flow rate</td><td>> 400 and < 2,000</td><td>m^{3}/h</td></tr>
<tr><td>Maintenance schedule - number of days for Flow meter</td><td>< 1,095</td><td>Days</td></tr>
</table></td></tr>
<tr><td>QA/QC procedures</td><td>N/A</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>The PDD requires that the thermocouple is replaced or calibrated annually. The flare combustion temperature and gas flow rate is provided by Hofstetter (manufacturer of the flare, as per drawing number P170627, and spec sheet).

Hofstetter requires that the flow meter be calibrated in three year intervals (Hofstetter OM manual calibration frequency).</td></tr>
</table>

Data / Parameter	$T_{EG,m}$
Unit	ºC
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Measured/calculated/ Default	Measured
Source of data	Measurements by the project participants
Value(s) of monitored parameter	

Period	Average temperature ºC
Jan-18	867
Feb-18	944
Mar-18	882
Apr-18	900
May-18	927
Jun-18	787
Jul-18	843
Aug-18	867
Sep-18	844
Oct-18	871
Nov-18	828
Dec-18	902
Jan-19	8
Feb-19	884
Mar-19	958
Apr-19	954
May-19	962
Jun-19	967
Jul-19	929

Monitoring equipment	Measured with appropriate temperature measurement equipment Type: Type-N Thermocouple Accuracy: ±1.5°C Calibration frequency: replaced once a year Date of last calibration: 01/02/2019 Valid until: 01/02/2020
Measuring/reading/recording frequency	Once per minute
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	Thermocouples will be replaced or calibrated every year.

Data / Parameter	$Flame_m$
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute *m*
Measured/calculated/ Default	-

Source of data	Measurements by the project participants
Value(s) of monitored parameter	

Period	Minutes Flare Operational
Jan-18	7,234
Feb-18	36,927
Mar-18	39,870
Apr-18	39,961
May-18	43,961
Jun-18	40,670
Jul-18	44,149
Aug-18	43,197
Sep-18	42,469
Oct-18	44,456
Nov-18	39,849
Dec-18	44,478
Jan-19	43,255
Feb-19	36,411
Mar-19	43,540
Apr-19	42,570
May-19	44,598
Jun-19	43,200
Jul-19	42,667

Monitoring equipment	Measured using a fixed installation optical flame detector: Type: Flame detector UV tube UVS10 Accuracy: spectral range: 190 – 270 nm, max. sensitivity: 210 nm ± 10 nm Serial number: 84315200 Calibration frequency: UV tube replacement every 10,000 hours (as per manufacturer specifications) Date of last calibration (replacement): 08/04/2019 Validity: 28/05/2020
Measuring/reading/recording frequency	Once per minute
Calculation method (if applicable)	-
QA/QC procedures	N/A
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$V_{i,t,wb}$ (also equivalent to $V_{k,t,wb}$)**
Unit	m^3 gas *i/k* / m^3 wet gas
Description	Volumetric fraction of greenhouse gas *i/k* (methane in both cases) in a time interval *t* on a wet basis
Measured/calculated/ Default	Measured

Source of data	Measured by project participants to identify: • Volumetric fraction of methane sent to flare and • Volumetric fraction of methane used for electricity generation As appropriate to the use of LFG in the CPA
Value(s) of monitored parameter	

Period	$V_{methane,t,wb}$
Jan-18	0.45
Feb-18	0.51
Mar-18	0.48
Apr-18	0.48
May-18	0.52
Jun-18	0.57
Jul-18	0.54
Aug-18	0.52
Sep-18	0.53
Oct-18	0.53
Nov-18	0.53
Dec-18	0.52
Jan-19	0.53
Feb-19	0.56
Mar-19	0.54
Apr-19	0.50
May-19	0.49
Jun-19	0.51
Jul-19	0.52

Monitoring equipment	Gas Analyser: Type: NUK NGA 5-CH4 -CO2 -O2 Accuracy ±1% Serial number: A2286 Calibration frequency: calibrated weekly Last calibrated: 31/07/2019 Valid until: 07/08/2019
Measuring/reading/recording frequency	Continuous (once every 5 minutes)
Calculation method (if applicable)	-
QA/QC procedures	N/A
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	Option F applied Calibration will include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases will have a certificate provided by the manufacturer and be under their validity period.

Data / Parameter	$M_{t,wb}$
Unit	kg/h
Description	Mass flow of the gaseous stream (LFG) in time interval *t* on a wet basis
Measured/calculated/ Default	Calculated

Source of data	Measured by project participants to identify: • Amount of methane sent to flare • Amount of methane used for electricity generation As appropriate to the use of LFG in the CPA
Value(s) of monitored parameter	
Monitoring equipment	Flow meter: Type: Differential pressure flow measurement with Pitot tubes and Deltabar differential pressure transmitter Serial number: M900A30109D Accuracy: ±1.5 % of max (as specified by Hofstetter) Calibration frequency: every two years Date of last calibration (commissioning date): 26/01/2018 Validity: 25/01/2020
Measuring/reading/recording frequency	Continuous (once every 5 minutes)
Calculation method (if applicable)	-
QA/QC procedures	N/A
Purpose of data/parameter	Calculation of baseline emissions
Additional comment	Option F applied Periodic calibration against a primary device provided by an independent accredited laboratory (mandatory). Calibration and frequency of calibration in accordance with the manufacturer's specifications. The values provided are for the flare only, as electricity generation has not commenced.

Period	$M_{flaret,wb}$	$M_{engine,t,wb}$
Jan-18	1094	0
Feb-18	633	0
Mar-18	1208	0
Apr-18	1244	0
May-18	1340	0
Jun-18	1150	0
Jul-18	1401	0
Aug-18	1581	0
Sep-18	1511	0
Oct-18	1517	0
Nov-18	1445	0
Dec-18	1589	0
Jan-19	1521	0
Feb-19	1109	0
Mar-19	1288	0
Apr-19	1312	0
May-19	1297	0
Jun-19	1154	0
Jul-19	1085	0

E.3. Implementation of sampling plan

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No sampling plan

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

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The baseline emissions are determined according to equation (1) of the applied methodology:

$$BE_y = BE_{CH_4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad \text{(ACM0001 equation 1)}$$

Where:

BE_y = Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$ = Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$ = Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

For the baseline no heat or natural gas are used simplifying equation to:

$$BE_y = BE_{CH_4,y} + BE_{EC,y}$$

Baseline emissions of methane from the SWDS are determined according to equation (2) of the applied methodology:

$$BE_{CH_4,y} = (1 - OX_{top\ layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} \quad \text{(ACM0001 equation 2)}$$

Where:

$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$OX_{top\ layer}$ = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$ = Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4} = Global warming potential of CH_4 (t CO_2e/t CH_4)

No LFG is flared in the baseline simplifying equation to:

$$BE_{CH_4,y} = (1 - OX_{top\ layer}) \times (F_{CH4,PJ,y}) \times GWP_{CH4}$$

The amount of methane in the LFG which is flared and/or used in the project activity in year *y* is calculated from:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad \text{(ACM0001 equation 3)}$$

Where:

$F_{CH4,PJ,y}$ = amount of methane in the LFG which is flared and/or used in the project activity in year *y*
$F_{CH4,flared,y}$ = amount of methane in the LFG which is destroyed by flaring in year *y*
$F_{CH4,EL,y}$ = amount of methane in the LFG which is used for electricity generation in year *y*
$F_{CH4,HG,y}$ = amount of methane in the LFG which is used for heat generation in year *y*
$F_{CH4,NG,y}$ = amount of methane in the LFG which is sent to natural gas network in year *y*

As there is no heat generation or LFG sent to a natural gas network this simplifies to:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$$

The methane destroyed in the flare is given by:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$ (ACM0001 equation 4)

Where:

$F_{CH4,sent\_flare,y}$ = Amount of methane in the LFG which is sent to the flare in year *y*

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y

GWP_{CH4} = Global warming potential of CH4

$$PE_{flare,y} = GWP_{CH4} \times \sum_{1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m})$$

and

$$F_{CH4,EL,y} = F_{CH4,flared,y}$$

The baseline emissions associated with electricity generation in year *y* ($BE_{EC,y}$) are calculated using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01).

$$BE_{EC,y} = EC_{BL,y} \times EF_{EL,y} \times (1 + TDL_y)$$ (Applied tool equation 2)

Where

$BE_{EC,y}$ = Baseline emissions from electricity consumption in year y (tCO_2/yr)

$EC_{BL,y}$ = Quantity of electricity that would be consumed in year *y* (MWh/yr)

$EF_{EL,y}$ = Emission factor for electricity generation in year *y* (tCO_2/MWh)

TDL_y = Average technical transmission and distribution losses for providing electricity in year *y*

Sample calculation of BE_y for period 26/01/2018 to 31/07/2019:

$$BE_y = BE_{CH_4,y}$$

$$BE_{CH4,y} = (1 - OX_{top\ layer}) \times F_{CH4,PJ,y} \times GWP_{CH4} = (1 - 0.1) \times 5879 \times 25 = 132280$$

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

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The project emissions are calculated in accordance with equation (22) of the applied methodology where there is no fossil fuel use and no distribution of gas and from the project emissions from flaring:

$$PE_y = PE_{EC,y}$$ (ACM00001 equation 22)

Where

PE_y = Project emissions in year *y* (t CO_2/yr)

$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr)

Sample calculation of PE_y for period 26/01/2018 to 31/07/2019:

$$PE_y = 180 tCO_2$$

F.3. Calculation of leakage emissions

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$PE_{EC,y}$ is calculated according to the "Tool to calculate baseline, project or leakage emissions from electricity consumption" (Version 01) using the following equation:

$$PE_{EC,y} = EC_{PJ,y} \times EF_{EL,y} \times (1 + TDL_y) \quad \text{(Applied tool equation 1)}$$

Where

$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr)

$EC_{PJ,y}$ = The amount of electricity consumed by the project activity in year *y*

$EF_{EL,y}$ = Emission factor for electricity generation in year *y* (tCO_2/MWh)

TDL_y = Average technical transmission and distribution losses for providing electricity in year *y*

Sample calculation of $PE_{EC,y}$

$$PE_{EC,y} = EC_{PJ,y} \times EF_{EL,y} \times (1 + TDL_y) = 174 \times 0.9481 \times (1 + 0.09) = 17 = 180 tCO_2$$

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

The emission reductions of the project activity are calculated using equation (25) of the applied methodology:

$$ER_y = BE_y - PE_y \quad \text{(ACM0001 equation 25)}$$

Where

ER_y = Emissions reduction in year *y* (t CO_2/yr)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

PE_y = Project emissions in year *y* (t CO_2/yr)

Sample calculation of ER_y

Data from 01/10/2014 to 31/07/2019

ER_y = 132280 – 180 = 132100

CPA UNFCCC reference number	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
10004-0001	132280	180	0	0	132100	132100
Total	132280	180	0	0	132100	132100

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
10004-0001	132100	52456
Total	132100	52456

F.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the CPA-DD"

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The calculation entails the use of the actual number of days in which credits accrued applied to the periods recorded in the ex-ante calculations. For example, the ex ante credits estimated for the full fifth year (365 days) of the project, in the date range of 01 January 2018 to 31 December 2018, amounted to 34766 tCO_2e. However the actual days during this period only amounted to 340 days (26 January 2018 to 31 December 2018) because the operation only commenced on 26 January 2018. Therefore the full annual figure of 34766 tCO_2e was divided by 365 days to get a daily figure which was then multiplied by the actual number of days (340 days) to get a figure of 32385 tCO_2e.

The first monitoring period extends in to the sixth ex ante year and therefore the same methodology was applied in calculating the ex ante emission reducitons in the sixth year. The ex ante credits estimated for the sixth year (365 days) of the project, in the date range 1 January 2019 – 31 December 2019, amounted to 34556 tCO_2e. However the actual days during this period only amounted to 212 days (1 January 2019 – 31 July 2019) because this monitoring period ended on 31 July 2019. Therefore the full annual figure of of 34556 tCO_2e was divided by 365 days to get a daily figure, which was then multiplied by the actual number of days (212 days) to get a figure of 20071 tCO_2e.

The sum of the two period (1 January 2018 – 31 December 2018 and 1 January 2019 – 31 July 2019) therefore amounts to 52456 tCO_2e (32385 tCO_2e + 20071 tCO_2e).

F.6. Remarks on increase in achieved emission reductions

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When the CDP-DD was developed a number of parameters were used to develop the ex ante calculations based on assumptions of waste composition and weather. These parameters have varied in the real world operating conditions compared to those in the CPA-PDD. The impacted paramaters include the global warming potential has changed from 21 to 25 tCO2e/tCH4(The Project Standard for Project Activities Version 1 (paragraph 254 and section 6.3) allows for the use of the GWP of 25 for CH4 in the second Kyoto commitment period which started on 1 January 2013), waste composition and weather conditions (Cape Town has experienced unusually hot conditions in the crediting period).

F.7. Remarks on scale of small-scale CPAs

>> Not applicable.

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Document information

Version	*Date*	*Description*
03.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for programmes of activities" (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
02.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for programmes of activities (CDM-EB93-A07-STAN); • Make editorial improvements.
01.0	1 April 2015	Initial publication.

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