Environmental Management Plan

Pangea Green Energy Philippines, Inc. – Landfill Gas Energy Project

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APPENDIX

I. OVERVIEW OF THE PROJECT AND PURPOSE OF DOCUMENT

The Quezon City Controlled Disposal Facility is a controlled sanitary landfill, situated on a 22-hectare land located in Barangay Payatas, Quezon City. It started receiving municipal solid waste from Metro Manila, as an open dumpsite from 1973 until 2000 when it was prematurely closed due to a tragic trash slide. The landslide (of trash) tragedy struck the site in 2000, in which 218 people were killed, most of them scavengers in the area. The open-dumpsite mountain, which used to have a steep 70-degree slope, has since been bevelled down into a 40-degree slope. The open dumpsite was converted into a sanitary landfill in 2011. Concession for over-all operation of the Payatas sanitary landfill was granted to the Isabelita P. Mercado (IPM) Environmental Services, Inc.

To mitigate the anticipated impacts from methane production associated with the operation of a controlled sanitary landfill, the Quezon City government undertook a partnership with Pangea Green Energy Philippines, Inc. (PGEP) for the installation and operation of a Biogas Facility at the landfill site. In exchange for PGEP's investment in the project, PGEP was granted the rights to the methane gas generated or extracted from the site, for a minimum of 10 years. The memorandum of agreement was signed on February 14, 2007; on February 01, 2008, the project was registered as a Clean Development Mechanism (CDM) project by the executive board of the United Nations Framework Convention for Climate Change (UNFCCC).

PGEP provides the technical capability and advice for the operation of Biogas Facility installed at the landfill site. The said facility was put up to reduce methane emissions from the Payatas controlled dumpsite, and involves the capture, collection, processing, and flaring of landfill gas (LFG), including the conversion of methane into electricity. LFG is generated from the decomposition of solid waste in the landfill and is approximately 50% methane gas. Methane gas is a greenhouse gas established to have a global warming potential 25 times that of carbon dioxide.

This Environmental Management Plan is prepared as part of the requirements of the Safeguards Framework for CDM projects implemented under the Carbon Finance Support Fund (CFSF) of the Land Bank of the Philippines (LBP), under which this Landfill Gas Energy Project is to be applied. The Safeguards Framework was developed for ensuring establishment of protection, compliance, and mitigation measures for relevant environmental and social aspects for projects included, specifically for methane recovery from the livestock wastewater treatment and municipal solid waste management projects.

I.1 LOCATION AND AREA

The Quezon City Controlled Disposal Facility, or also known as the Payatas sanitary landfill, is located in Area 2, Brgy. Payatas, Quezon City. The said location is in the northeast portion of the city, near the boundary of Rodriguez Rizal. It is about two kilometers from the La Mesa Watershed and Eco-Park, an ecological nature reserve in Quezon City which forms part of the Angat-Ipo-La Mesa water system that supplies most of the water supply of Metro Manila. Both Manila Bay and the Laguna Lake are more than 20 kilometers from the site.

Over-all operation of Payatas landfill has been contracted to IPM Environmental Services, Inc. by the Quezon City local government since 2004.

Figure 1: Maps showing location of Payatas landfill area.

Figure 2: The Payatas sanitary landfill.

The location of the Landfill Gas Energy Project of PGEP is on a 1500-square meter land area within the Payatas landfill, covered by a lease agreement between PGEP and the local government of Quezon City. The given address of the Biogas Facility is No. 68 Zamboanga Street, Area B, Barangay Payatas, Quezon City.

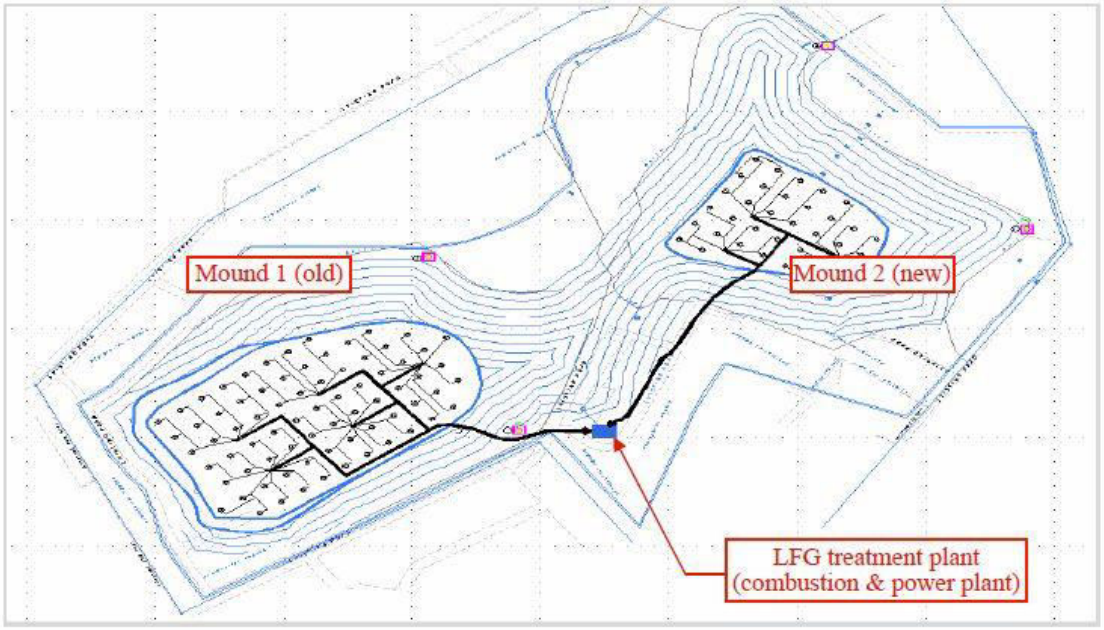

Figure 3: Location and layout of the Landfill Gas Energy Project, or the LFG recovery and treatment plant

I.2 PROJECT DESIGN

The main reason for undertaking the Landfill Gas Energy Project is the control and management of landfill gas (LFG) generated in the operation of a controlled disposal facility. PGEP provides the technical capability and advice for the operation of Biogas Facility installed at the landfill site. The said facility was put up to reduce methane emissions from the Payatas controlled dumpsite, and involves the capture, collection, processing, and flaring of LFG, including the conversion of methane into electricity. LFG is generated from the decomposition of solid waste in the landfill and is approximately 50% methane.

Figure 4 shows the process flow of this Project, components of which are then discussed in the next section.

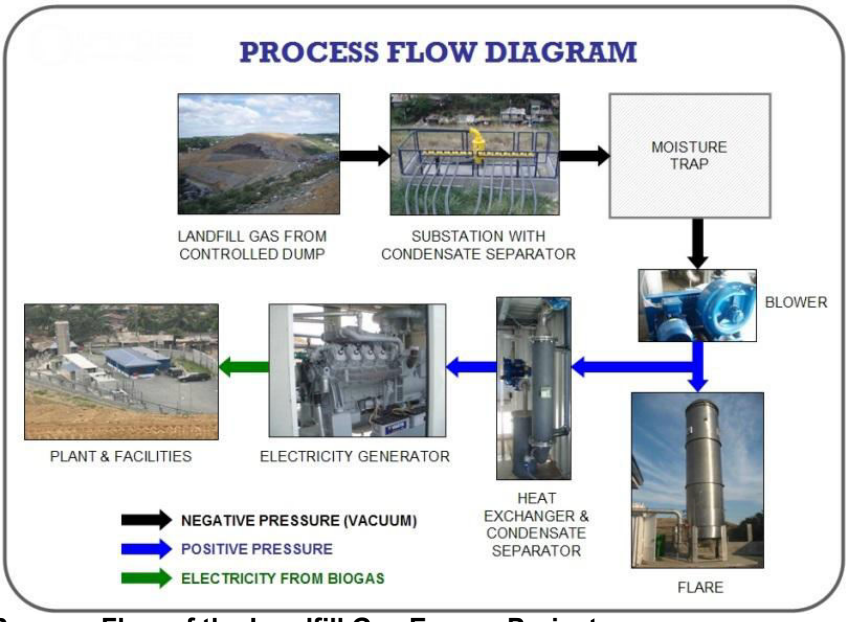

Figure 4: Process Flow of the Landfill Gas Energy Project.

I.3 PROJECT COMPONENTS

Biogas collection network. This network consists of extraction wells, pipes and gravel filter to allow the transport of the gas from the dump to the regulating substations as shown in **Figure 3**.

For the period covering 2007 to 2013, a total of 115 extraction wells have been installed within the old and new mound portions of the Payatas landfill: 52 wells in Mound 1 (old mound) and 63 wells in Mound 2 (new mound). As of July 2016, a total of 19 additional extraction wells have reportedly been installed within the area of Mound 2. These wells are also connected to a total of four (4) controlling substations; are around 15 to 21 meters deep; and are approximately 45 meters from each other to achieve optimum efficiency in LFG extraction.

A well head is force fitted onto the top of the well before the perimeters are sealed with clay to prevent the vacuum applied to the probe from causing inflow of air into the well. The well heads are equipped with: 3 m high carbon steel pipe with butterfly valve that enables the well to be connected/cut from the vacuum system; and two threaded unions to permit the installation of a submersible pump for the removal of the leachate contained in the well. One of the unions is equipped with ball valve to take samples of the gas and measure the physical/chemical parameters of gas flow.

The extraction wells are connected by HDPE *pipes* leading to larger header pipes that deliver gas to the regulating substations. The average diameter of the pipes - about 900 mm – allow placement of a submersible pump that removes leachate from the wells and keep them free of liquid to ensure regular outflow of biogas. The pipes are controlled by an electrical panel and are coated with a 200 mm thick sand to avoid contact with blunt instruments that could damage the pipe itself and the pipes are finally covered with compacted sand.

A flow element sensor is installed on the pipe that connects the blower to the flare to gauge the blown biogas. An on-off motorized valve of safety valve is explosion proof

that is hydraulically powered that is normally closed with slow opening and fast closing if an alarm occurs. The pipes are installed with instrumentation that supplies temperature control (measures the temperature of biogas), pressure control (to regulate rotational speed of the blower) and biogas flow and provides for diversion of biogas to energy exploitation or to vent.

Biogas aspiration and conditioning system consists of blowers and purification and dehumidification equipment to transport and clean gas of impurities that can damage the system.

Before being piped over to the electricity generator, the LFG from the primary lines is channeled to a carbon steel manifold with a cylindrical *condensate separator* equipped with stainless steel coalescence filter that are installed both in the main and in secondary biogas lines to remove remaining moisture and` leachate directly inside the landfill or in tanks for recirculation.

The *turbo exhauster/blower* creates the partial vacuum that sucks the LFG and causes it to migrate to the wells. An explosion proof solenoid valve is installed at the connection between the primary line and the manifold that allows the line to be cut off from the vacuum system if the oxygen content exceeds a critical threshold. The blower is mounted on a base-plate made of steel, electro-wielded, common to the machine and the motor. An inverter regulates the negative pressure to the blower that modifies the rotational speed of the motor.

Combustion unit/ Biogas flare consists of a flare for high temperature combustion (i.e., > 900ºC) designed for a flow rate of 2.250 Ncm/h (Newton-centimeter per hour). The flare is composed of a vertical cylindrical combustion chamber where biogas burns at settled temperature, and a multi-nozzle burner, at the bottom of the combustion chamber. The unit is made up of:

(i) Biogas inlet line equipped with security on-off electric valve, butterfly valve with hand lever and flame arrester;
(ii) Combustion chamber- a vertical, cylinder supported by four columns made of stainless steel;
(iii) Burner – consists of 10 nozzles that are connected to the flare
(iv) Ignition and flame control system – consists of a high tension igniter that ignites the pilot burner upon receiving the starting signal from the control panel. When the burner is on the UV detector connected to the signal amplifier is activated and allows the opening of the electric security on-off valve;
(v) Combustion system support – combustion air is regulated by a rolling shutter that is modulated by a damper electric actuator. The opening/closing of the rolling shutter assures the right combustion airflow to keep the combustion temperature higher than 900ºC.

Energy production. Aside from flaring, a major portion of the methane will be converted to electricity. The energy production component is composed of electricity generating equipment utilizing methane from biogas as fuel to produce electricity and distribution lines for delivery of electricity to end users (plant equipment and grid). The plant has an installed capacity of 236 kW but utilizes only a portion of that to run the plant and power the surrounding street and perimeter lights of the landfill.

Monitoring and control system for the measurement, monitoring and control of significant parameters. The control panel is mounted on a skid and contains all the fittings that control, order and protect the plant. It consists of: emergency remote

control switch, fuse, auxiliary transformer, power line push button, release emergency push button, inverter, Programmable Logic Control (PLC), model for data transmission, among others.

I.4 ENVIRONMENTAL SAFEGUARDS COMPLIANCE

The Landfill Gas Energy Project complies with relevant national and local environmental laws. As per the Philippine Environmental Impact Statement System (PEISS), the Project--- considered as a renewable energy project with less than 5MW capacity--- does not fall under the category of covered projects, and is therefore not required to secure an Environmental Compliance Certificate (ECC) prior to construction or operation. Also, under the PEISS, it is at the option of the Proponent to secure a Certificate of Non-Coverage, for due diligence or other purposes.

The Proponent has two documents, showing Project's CNC-status with the DENR:

(i) Letter issued by DENR dated 29 September 2005; in response to Proponent's application for CNC for the Landfill Gas Energy Project; affirming that "an Environmental Compliance Certificate (ECC) is not required prior to project implementation"; and
(ii) CNC document issued by DENR to PGEP, dated July 19, 2011, for Payatas Landfill Gas to Energy Project.

Table 1 lists the various permits and environmental documents obtained by the Proponent from the DENR and the environment-related offices or agencies under the local government of Quezon City, indicating Proponent's diligent compliance to existing environmental rules and regulations:

Table 1. Status of Permits

Permit	Permit Code/No.	Issuing Agency	Date of Issuance	Validity Period	Activity Permitted
1. Certificate of Non-Coverage under the PEISS	CNC-NCR-1107-0068	DENR	July 19, 2011		
2. Permit to Operate (Air Pollution Source Installations)	13-POA-B-137406-678	DENR-EMB-NCR	July 11, 2013	Feb 08 2018	To operate one (1) unit high temperature combustion and one (1) set Iveco Generator
	13-POA-B-137406-678 (A)	DENR-EMB-NCR	November 15, 2016	March 08, 2017 (**Note:** ongoing application for renewal as of February 08, 2017.)	To operate four (4) units 320 kW Methane Gas Engine Generator Sets
3. Certificate of Annual Operation-Internal Combustion Engine	16-0271 / 16-0272 / 16-0273	Quezon City Hall-Dept. of Building Official	Sept. 27, 2016	Sept. 27, 2017	To operate internal combustion engine
4. Certificate of Annual Operation-Machinery	16-0432	Quezon City Hall-Dept. of Building Official	Sept. 27, 2016	Sept. 27, 2017	To operate various machineries
5. Certificate of Annual Electrical Inspection	16-0754	Quezon City Hall-Dept. of Building Official	Sept. 27, 2016	Sept. 27, 2017	To operate electrical
6. Environ-mental Clearance	01-2017-00267	EPWMD-LGU of QC	Jan 11, 2017	Dec 31, 2017	Project operations

In compliance to one of the conditions relating to issuance of Permit to Operate (for Air Pollution Source Installations) with permit number 13-POA-B-137406-678 (see **Table 1**), the Proponent has been diligently submitting to the DENR-EMB Self-Monitoring Reports quarterly, for the past nine (9) quarters, as follows:

- Quarterly Self-Monitoring Report – 1st Quarter (January 01, 2017 to March 31, 2017);
- Quarterly Self-Monitoring Report – 4th Quarter (October 01, 2016 to December 31, 2016);
- Quarterly Self-Monitoring Report – 3rd Quarter (July 01, 2016 to September 30, 2016);
- Quarterly Self-Monitoring Report – 2nd Quarter (April 01, 2016 to June 30, 2016);
- Quarterly Self-Monitoring Report – 1st Quarter (January 01, 2016 to March 31, 2016);
- Quarterly Self-Monitoring Report – 4th Quarter (October 01, 2015 to December 31, 2015);
- Quarterly Self-Monitoring Report – 3rd Quarter (July 01, 2015 to September 30, 2015);
- Quarterly Self-Monitoring Report – 2nd Quarter (April 01, 2015 to June 30, 2015); and
- Quarterly Self-Monitoring Report – 1st Quarter (January 01, 2015 to March 31, 2015).

Copies of the abovementioned permits and environmental compliance documents are included in this report as attachments in the **Appendix Section**.

I.5 SOCIAL SAFEGUARDS COMPLIANCE

There are no indigenous peoples living in the area surrounding the Payatas landfill site or the immediate premises of the Biogas Facility. There were no resettlement issues that have to be dealt with during construction and the eventual operation of the Project.

The Payatas sanitary landfill site continues to be a major source of livelihood for more than 5,000 individuals, with about 2,000 classified as waste pickers/reclaimers[1] and the other 3,000 engaged in associated activities. Through institutional mechanisms such as the Quezon City government's Biodegradable Waste Processing Facility - where organic wastes are processed to become compost, - the Materials Recovery Facility (MRF) for recycling, storage and for primary, secondary and final sorting of wastes, - and Junkshop standardization program, among others, the community of informal sector is effectively integrated into a formalized waste management program in Payatas.

[1]Persons working and at disposal facilities by sorting recoverable materials. National Framework Plan for the Informal Waste Sector in Solid Waste Management, DENR-NSWMC 2009.

The informal sector comprises waste reclaimers who serve as members of various associations that have been created as formal and registered organizations (as shown in **Figure 5**). These are among those who decided to stay in Payatas after relocation was arranged for about 1,000 families who voluntarily agreed to be relocated following the July 2000 trash slide when a mountain of garbage collapsed in a slum community that buried many scavengers and left hundreds of families homeless.

Figure 5: Various organizations of scavengers in Payatas community.

Organizing the waste reclaimers is an integral component of the comprehensive program spearheaded by the Quezon City government to address the needs of the community with the eventual closure of the open dumpsite as mandated by Republic Act 2003 "Ecological Solid Waste Management Act of 2000." The creation of formal organizations for waste reclaimers ensures that:

(i) waste picking can be done safely and more efficiently within the landfill areas;
(ii) members are assigned into established trading areas that resulted in tripling of income and reduced fighting over scraps;
(iii) members are eligible to collective obtain available assistance such as financial educational and skills training opportunities;
(iv) members are able to build networks that can open business and livelihood opportunities and enable them to ultimately venture out of Payatas.

These formal and recognized organizations moreover provide the empowerment mechanism that makes them valuable partners in modernizing, upgrading and sustaining the government's waste management system and more importantly enables them to continually make their lives better.

I.6 PERMITS AND IMPLEMENTATION PLANS RELATED TO OPERATION OF PAYATAS LANDFILL

PGEP project scope is limited to implementation of the Landfill Gas Energy Project, one aspect of which is to provide the technical capability and advice for the operation of Biogas Facility installed at the landfill site. Over-all operation of Payatas landfill has been contracted to IPM Environmental Services, Inc. by the Quezon City local government since 2004. In compliance with the Safeguards Framework, with the environmental aspect in particular, environmental permits and issued to IPM Environmental Services, Inc. related to Payatas landfill operations, as well as post-closure management plans being implemented by the same, are also discussed and highlighted in this report.

Environmental Permits. An Environmental Compliance Certificate (ECC) was issued for the construction and operation of the then-proposed Quezon City Sanitary Landfill covering pre-construction, construction, and operations phases of the landfill. The ECC also covers for a daily disposal capacity not exceeding 800 tons waste materials in an area 32,000 square meters within a land area of 121,787 square meters, with transfer certificate title number (TCT No.) N-192489.

The ECC document, with reference number ECC-LLDA-2001-074-92001, was issued to IPM Environmental Services, Inc. by the DENR-LLDA (Department of Environment and Natural Resources – Laguna Lake Development Authority), dated October 20, 2005.

An amendment to ECC-LLDA-2001-074-92001 was applied for and granted to include in the ECC coverage “the construction and operation of [Quezon City Sanitary Landfill] expansion – a 1,200 MT (metric ton) total disposal capacity with an area of 39,178-square meter land parcel embraced by TCT No. N-192489 (lot 76D, 76E and 76G).

This amended ECC document, with reference number ECC-NCR-1407-0292, was issued to IPM Environmental Services, Inc. by the DENR, through the EMB-NCR (Environmental Management Bureau – National capital Region) office, dated August 22, 2014.

Also attached to this report is an LLDA (Laguna Lake Development Authority) Clearance, issued for the construction and operation of Quezon City Sanitary Landfill by IPM Environmental Services, Inc., with total disposal capacity and area of coverage consistent with that indicated in amended ECC document. LLDA Clearance was issued on October 30, 2014, with document reference number LX-25b-014-00056.

Post-Closure Management, Implementation Report Documents. IPM Environmental Services, Inc. produced and submitted to EMB-DENR a report/management plan document entitled ***Post-Closure Management – Q.C. Controlled Disposal Facility***. This document appears to detail the methodology and program of after-closure care and maintenance being adopted by the operator of the Payatas landfill. Aside from sections on Design Preparation, Maintenance Program, and Post Closure Land Use, the said document contains a section on Post Closure Management Implementation Plan, which features action plans pertaining to leachate management, to wit:

- Maintenance of properly engineered slope to prevent erosion, or ponding of rainwater run-on or run-off;

- Proper placement of containment systems (leachate collection, final cover);

- Continuous operation and maintenance of the leachate collection system, the surface water management system, and the groundwater monitoring system;

- Repair of any leachate outbreaks;

- Continuous leachate management program through:

    - Containment of the leachate and occasional application as irrigation medium to re-vegetated slopes;
    - If necessary, collect, treat, and dispose of the leachate following the contingency plan for leachate storage and disposal;
    - Minimize, control, or eliminate the conditions which contribute to any additional production of leachate;
    - Continuous inspection during the post-closure care period.

In another document entitled ***Q.C. Sanitary Landfill Project Implementation Report, January – March 2011***, also furnished by IPM Environmental Services, Inc. to EMB-DENR, the landfill operator detailed the various actions implemented for the operation of the controlled landfill facility, as indicated in the following section headings:

- 1 – Operation and Maintenance of Engineered Sanitary Landfill.

- 2 – Establishment, Operation and Maintenance of Materials Recovery and Processing Facility (MRPF).

- 3 – Monitoring Activities.

- 4 – Community Development Initiatives.

A reference to the Installation of a Leachate Collection System at the landfill facility was mentioned under Section 1 – Operation and Maintenance of Engineered Sanitary Landfill.

Copies of the abovementioned permits and implementation documents are included in this report as attachments in the **Appendix Section**, along with ***Authority to Close*** correspondence document from the EMB-NCR office addressed to the Quezon City government.

I.7 ENVIRONMENTAL MANAGEMENT PLAN OF THE LANDFILL GAS ENERGY PROJECT

As part of Environmental Management for the Landfill Gas Energy Project, **Table 2** below shows the Environmental Mitigation and Monitoring Plan (EMMP) for the Biogas Facility, based on relevant environmental impacts of activities associated with the current operations of the facility. A summary of EMMP applied during Construction Phase (which is already completed) is also included below.

Table 2. Environmental Mitigation and Management Plan for the Biogas Facility.

CONSTRUCTIONS PHASE								
Activity	**Potential Environmental Impacts**	**Mitigating Measures**	**Monitoring Method**	**Monitoring Parameters**	**Monitoring Frequency**	**Responsible Entity**	**Cost**	**Reporting To**
- Earth moving and area preparation for the Biogas Facility; - Drilling and construction of wells; - Construction of the biogas collection pipework; - Plant installation and assembly.	- Dust generation; - Noise generation from drilling operations; - Health and Occupational Safety issues related to construction works	- Work Management Plan as guide for tasks to be completed; - Required use of appropriate PPE (personal protective equipment) for employees involved in construction work.	Supervision by competent and authorized construction project supervisors and managers.	- Project phases/ tasks completed; - Record of work-related incidents/ accidents/injuries.	Daily	Project Supervisors	Included in contract for construction of Biogas Facility	Project Managers, Project Owners
OPERATIONS PHASE								
Activity	**Potential Environmental Impacts**	**Mitigating Measures**	**Monitoring Method**	**Monitoring Parameters**	**Monitoring Frequency**	**Responsible Entity**	**Cost**	**Reporting To**
Administrative	Generation of	- Development of	Recording of	As reported in	Quarterly	Pollution	No	Management

activities in operation of Biogas Facility	solid waste materials	a solid waste management program, to ensure proper handling, disposal, and management of solid waste generated according to type; - Coordination with the proper barangay or city authorities for the effective implementation of solid waste management program developed.	amount of solid waste materials generated	Quarterly Self-Monitoring Report, submitted to DENR: - Average/ Total quantity of solid wastes generated per quarter		Control Officer	implementation cost involved; solid waste recyclable materials generated from PGEP administrative functions (i.e. waste paper) are bought and collected junkshop operators selected by PGEP.	Officer
	Generation of domestic wastewater	- Toilet amenities of Biogas Facility connected to Septic Tanks, in accordance to the minimum requirements indicated in ***Sections 75 to 77 of PD 856 (Code of Sanitation of the Philippines)***.	Recording of volume amount of domestic wastewater generated	As reported in Quarterly Self-Monitoring Report, submitted to DENR: - Domestic wastewater generated, cubic meters per day	Quarterly	Pollution Control Officer	No implementation cost involved; septic tank siphoning services part of free services offered by correspond-ding local water concession-naire	Management Officer
Operation and Maintenance activities of the Biogas Facility	Fugitive leaks of methane from biogas collection network and biogas flaring	- Biogas collection network equipped with SCADA	- Monitoring through SCADA (supervisory control and	- Temperature, pressure, methane and oxygen concentration	Real-time monitoring (continuous)	Assistant Plant Manager	Allotment of Php100,000 per year for related equipment	Pollution Control Officer / Plant Manager

	system may lead to suffocation or explosion hazards within premises of Biogas Facility	system, for remote monitoring of parameters for advance determination of potential leaks in network. - Gas leak detector installed within plant facility premises (situated before flare), for odor management of background methane level, as well as control against explosion hazard.	data acquisition) system, for biogas collection network; - Gas leak detector, for monitoring methane and oxygen concentration levels within plant premises.	parameters monitored for determining leak in biogas collection network; - Methane and oxygen concentration levels monitored within plant, to prevent possibility of explosion.			repair, replacement, and maintenance costs (i.e. replacement, repair of equipment sensors).	
	Generation of Waste Oil from oil-change activities performed for various engines, generator sets employed in Biogas Facility operations Generation of used or spent containers (steel drums) from engine oils used for various engines/	- Regular monitoring and recording of equipment performance, effective implementation of change-oil activities; - Collection, proper storage, and disposal of waste oil material, in accordance with Implementing Rules and	Recording of volume amount of waste oil material generated; and frequency of hauling and disposal (per year) of waste oil collected and stored at the site. Monitoring of amount of spent containers (steel drums) generated from site operations,	- Average/ Total quantity of Chemical (waste oil) generated per quarter. - Frequency of hauling and disposal (per year) of waste oil collected and stored at the site. - Volume of waste oil material	- Monthly (Change-oil activities performed per 500 runhours of engine/ equipment, or approximately 20 working days); - Projected frequency of stored waste oil hauling and	Pollution Control Officer	Allotment of Php4.0M per year for related equipment repair, replacement, and maintenance costs (i.e. oil-replacement, spare parts for generators/ engine units at site). No related	Management Officer

	generator sets at the site. These spent containers considered as hazardous waste materials.	Regulations of RA 6969 (Hazardous Waste Management Act of 1990). - Projected frequency of stored waste oil hauling and disposal is at most once a year; to be contracted out to DENR-accredited hazardous waste material transporters/ treaters. **Note:** Spent containers (steel drums) also used as storage containers for waste oil material generated.	and hauled/ transported/ disposed with waste oil material.	transported and disposed offsite, thru accredited hazardous waste materials transporters/ treaters. - Number of spent containers (steel drums) generated vs. number of spent containers hauled/ transported/ disposed with waste oil material.	disposal is at most once a year; to be contracted out to DENR-accredited hazardous waste material transporters / treaters.		implementa-tion cost involved for hauling, transport, and disposal of waste oil generated from site and collected by accredited hazardous waste transporters/ treaters. Existing arrangement is that said accredited hazardous waste transporters/ treaters pay PGEP to obtain the waste oil volume.	
	Noise generation from operation of the blower system and the five (5) units of landfill gas generators	- Required use of noise protective equipment, for employees, contractors involved in work settings with high level of noise; - Each generator/ engine unit	Not applicable. No noise level measure being monitored, as not being required by concerned regulatory agencies (i.e. DENR, DOE, DOLE).	Not applicable	Not applicable	Safety Officer	Allotment of Php100,000 per year for related noise protective equipment; and repair/ maintenance of exhaust silencer/ muffler and sound-proofed	Pollution Control Officer

		housed in a soundproofed container, thereby substantially reducing noise level during operation. - Each generator/ engine unit equipped with exhaust silencer/muffler as additional measure for reducing noise level.					generator/ engine housing/container, as may be required.	
	Use of resources, specifically water consumption (for general operations use) and methane gas (generated from landfill decomposition processes and converted to electrical power through combustion processes)	- Conservation measures, for efficient use of water resource in general operation of Biogas Facility; - Effective operations and maintenance of Biogas Facility equipment, for optimum conversion of methane gas resource.	- Recording of total water consumption, in cubic meters; - Real-time monitoring of volume and concentration of methane being continuously extracted from landfill site.	- Total water consumption in cubic meters; - Methane gas being extracted in cubic meters per hour (volume) and percentage (concentration).	- For water consumption, monthly; - For methane gas extraction, real-time, continuous.	Assistant Plant Manager	No separate allotment needed; already part of general operations at Biogas Facility.	Pollution Control Officer / Plant Manager

The LBP-EPMD will monitor PGEP's compliance to the EMP on a quarterly basis. An environmental performance monitoring report will be submitted by LBP-EPMD to WB on a semestral basis.

II. DUE DILIGENCE ON THE SANITARY LANDFILL

II.1 OVERVIEW OF THE LANDFILL DESIGN

The Quezon City Controlled Disposal Facility is a controlled sanitary landfill, situated on a 22-hectare land located in Barangay Payatas, Quezon City. It started receiving municipal solid waste from Metro Manila, as an open dumpsite from 1973 until 2000 when it was prematurely closed due to a tragic trash slide. It gained prominence in 2000 when, after a period of heavy rains, the mountain of garbage collapsed burying homes that claimed an estimated 600 lives. It was closed but was subsequently opened in November 2000 to undertake conversion of the open dump to a controlled dump and making it an exclusive dumpsite of Quezon City (QC). The QC government created the Payatas Operations Group (POG) on 12 November 2000 specifically to manage, operate and secure the dumpsite.

From 2000, the Payatas landfill has received an average of 2.4 million cubic meters of municipal solid waste (MSW) per year. Composition of waste is shown in **Figure 6**.

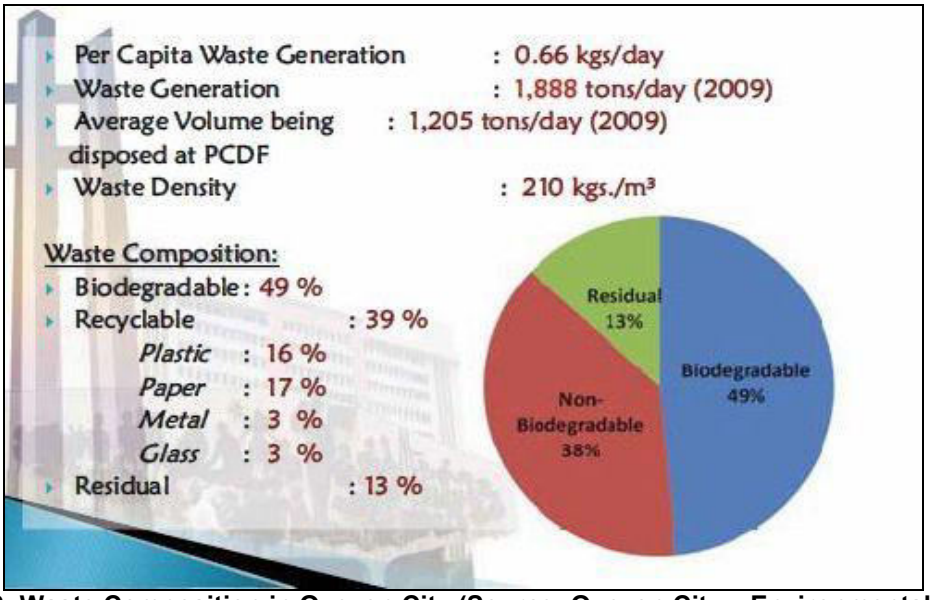

Figure 6: Waste Composition in Quezon City (Source: Quezon City – Environmental Protection and Waste Management Department).

The time line of the significant developments in the landfill site is shown below:

Timeline of developments in the QC Payatas Controlled Dumpsite

Year	Developments
1970	Start of waste dumping in Payatas
1993	Payatas became the main disposal site for Metro Manila's waste
1998	Approval of closure plan
2000	Payatas dumpsite trashslide
2001	QC resumed dumping operations in Payatas
2003	Approval of the plan for the conversion from open dump to controlled disposal facility
2004	Conversion to Controlled Disposal Facility
2008	Commissioning of the biogas collection, flaring and electricity generation plant
2010	Closure of Payatas Disposal Facility
2011	Opening of the Sanitary Landfill Facility,establishment of the Material Recovery Facility(MRF), and start of the Post Closure Care and Maintenance

II.2 IMPACTS IDENTIFIED AND MITIGATION OF IMPACTS OF THE SANITARY LANDFILL

The gradual process of conversion of the Payatas dumpsite from open dump to a controlled disposal facility entailed adoption of engineering interventions to restructure, upgrade and ensure the safety of the dumpsite, lessen the impact on the environment and ensure the safety of the communities surrounding the site.

These interventions include:

Slope stabilization/re-profiling. Dumpsites slopes were re-profiled from a 50°-70° steep to a more stable 23°- 25° steep range through side cutting and terracing. Proper grading of the dumpsite was necessary to improve surface run-off, prevent infiltration and leachate generation and ponding of water.

Soil capping. The re-profiled slopes were covered with 0.60 meter soil before compaction to improve stability and minimize or control erosion, migration of biogas and reduce the risks of another trash slide.

Greening of slopes. Crops such as mongo beans were used to enrich and condition the soil before Vetiver grass and shrub were planted on the re-profiled slopes. Vetiver grass has a high soil holding capacity and its root system is very effective in absorbing heavy metals extracts from the waste leachate. The plants also greatly improved the aesthetic view of the dumpsite.

Improvement of the integrated drainage system. This entailed: (i) separating the leachate collection system from the stormwater drain; (ii) widening and dredging of open canals and ditches along the periphery of the dumpsite to ensure free flow of water and serve as catch basin for surface water run-off from the dumpsite; (iii) construction of more open canals along the slope benches to catch the run-off from the upper benches.

Leachate collection and recirculation. The leachate drainage system was installed to collect the leachate generated at the landfill. The design allows for channeling of the leachate to the pumping stations where it is recirculated into the soil capped mounds to supply moisture to the vetiver grass and other shrubs. Recirculation helps boost biogas extraction rates and reduces the total leachate load in terms of quality and quantity that can potentially escape the landfill to adversely affect groundwater resources.

Landfill Gas Energy Project. The QC LGU signed a Memorandum of Agreement with Pangea Philippines on February 14, 2007 for the Biogas Emission Reduction Project for the extraction and utilization of biogas emitted by the dumpsite to prevent the occurrence of fire and explosion; reduction greenhouse gases, prevent release of unpleasant odor and minimize risks of groundwater contamination and damage to existing vegetation.

Composting and Materials Recovery Facilities. The landfill site likewise integrates a Biodegradable Waste Processing Facility where organic wastes are processed for compost production. It also has a Materials Recovery Facility (MRF) for recycling, storage and for primary, secondary and final sorting of wastes. These are helpful in reducing the risks environmental disasters.

Dumpsite Security and Safety. The disposal facility has sufficient security personnel and its own trained firefighting unit available twenty-four (24) hours a day. The latter unit aims to prevent widespread fire that may occur.

Construction of perimeter fence. The perimeter of the dumpsite was fenced for greater control and security of the landfill site.

The CDM project activity and hence the projected LFG production covers the waste that were deposited in the landfill following its reopening from January 2001 as a "controlled dumpsite" and when the landfill has been filled up with new waste dumped on the existing mounds, as illustrated in **Figure 7**, below:

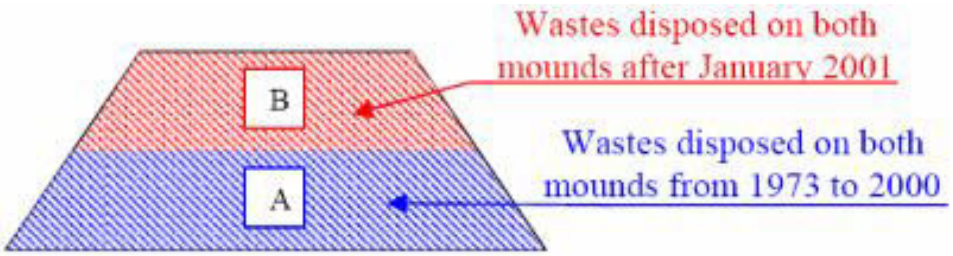

Figure 7: Illustration showing cross-section of landfill disposal area.

Regular dumpsite operations consist of the following activities: (i) waste truck inspection at the site entry; (ii) garbage is tipped at designated dumping area; (iii) residual waste is pushed and leveled at the final dumping area.

III. LANDFILL GAS ENERGY PROJECT

III.1 CONSTRUCTION PHASE

The construction of the Biogas Facility started in July 2007 and was completed and commissioned in March 2008. Construction activities were confined within the 10 hectare surface of the old and new mound portion of the landfill and included an area of around 1500 square meters within the boundary of the Payatas landfill site. The contractor for construction is a locally-based company named Mancilla Corporation. The construction of the plant required about 30 local workers.

Over 100 vertical wells were constructed in designated locations within the landfill area by drilling through the layers of solid waste. When the specified depth is reached, a slotted high-density polyethylene (HDPE) pipe was placed in the center of the hole. A submersible pump was then placed inside the pipe to remove the leachate from the wells and keep them free from liquid. This will ensure regular outflow of biogas volume. The remaining annular space was then filled up with cleansed siliceous river gravel of appropriate grain size up to approximately 3 meters from ground level. The well-head was force-fitted on top before the well perimeter was sealed with clay. Sealing is necessary to prevent the vacuum applied to the slotted pipes from causing ingress of air into the well.

Spoil returns from the boreholes were transferred back to the landfill area. Final soil cover was applied with thickness of approximately 600 mm.

Well drilling normally generates noise from power generators and releases unpleasant odors. Workers involved in construction activities were given and instructed to wear the appropriate Personal Protective Equipment (PPE) during execution of assigned tasks.

Each well-head was then linked to the regulating station by HDPE pipes. All pipes were laid directly on the dumpsite surface at the appropriate slants to ensure regular flow of the condensate to the collection points. The pipes were then butt-welded onsite.

The HDPE pipes were then connected to a carbon steel manifold equipped with condensate separator and coalescence filter. The interior surface of the manifold was passivated to protect against corrosion. Explosion-proof solenoid valves were installed at the connection between the collection pipes and the manifold. This valve automatically cuts off the line when the critical oxygen content of the biogas (within the wells; in the event of leaks) is reached.

Foundation for the pumping, regulating station and flare system were constructed according to design standards. After the whole system was installed, the plant was tested and commissioned in the presence of local counterparts.

Proper and sufficient training were provided for all personnel who will be involved in the operation and maintenance of the system.

Construction work did not result in significant changes in the immediate environment. The nature of works include the following: a) earth moving and area preparation for the

biogas facility; b) drilling and construction of wells; c) civil works for the entire plant and facilities; d) construction of the biogas collection pipework; and e) plant installation and assembly. The activities are depicted in **Figure 8**.

The construction of wells entailed drilling through the layers of solid waste to create boreholes with an average diameter of 900 mm and depth of 15 to 21 meters. Excavations were made at a suitable depth with adequate slope to avoid sinking. The release of unpleasant odor was temporary and mitigated with immediate and proper covering of exposed garbage.

First well was drilled in July 24, 2007 at the Old Mound

Construction of first well in July 24, 2007

Last well completed in October 2007

Construction of biogas collection pipeline started in November 2007

Figure 8: Activities during plant construction.

III.2 OPERATIONS PHASE

III.2.1 Safety and Emergency

The centralized burning and power plant is located in a safe area that is also secured by a 2-meter reinforced concrete fence. The Biogas Facility has 24 hours security service. All the necessary equipment for the evaluation of the methane captured and flared, the electricity produced (on the basis of the monitoring procedures that lead to the calculation of the produced CERs), are located in the said secured and fenced area.

The risk of fire from the formation of explosive mixtures due to leaks of biogas from the plant section downstream of the blowers is mitigated by means of the following:

(i) the blowers are equipped with a shutdown thermostat that is triggered when the temperature of the compressed gas goes above 70°C;
(ii) the high temperature combustion torch is equipped with fully shielded flame and flame trap filter;
(iii) the gas distribution pipes on the delivery side of the blowers are made of carbon steel;
(iv) the gas utilization area is equipped with gas presence-detection sensors that are connected to central analyzer with luminous and acoustic alarm devices; and
(v) the blower/suction section is installed with metallic cover with single slope to allow free flow of biogas into the air.

To ensure safe operation and maximize the amount of biogas emissions that can be reduced by the Project, the entire system has been equipped with efficient feedback and control system to monitor and identify technical problems in the system.

PGEP has also established an “Emergency List” that documents possible scenarios that may lead to emergency situations, in order to best prevent these from occurring; and the

appropriate response procedures and mitigation measures, in the even that emergency situations do actually occur. Emergency situations identified include among others: biogas dispersion in air; well fire explosion; and Biogas Facility fire or explosion. The Plant Manager is tasked with ensuring that personnel involved with the daily operation of the Biogas Facility are trained and oriented of the appropriate emergency procedure and response for a given emergency situation.

A strict safety and security policy is implemented on site by PGEP. Only authorized persons are allowed access to the site. Proper protective equipment (i.e. helmets, earplugs, etc.) are required for staff as appropriate for appointed tasks; and warning signs are in place in all potentially dangerous areas within premises of the Biogas Facility.

III.2.2 Combustion of Landfill Gas (LFG)

A typical composition of landfill gas from municipal solid waste is shown in **Table 3**. The uncontrolled migration and atmospheric release of harmful gases from the landfill are mitigated by the Project's gas recovery and flaring systems. When these flammable gases are burned, the risk of explosion is eliminated and the environmental impact of combustion is reduced. Exhaust gas produced from combustions consist primarily of carbon dioxide and water vapor. Compared with open flare system, an enclosed flare such as adopted in the Project provides means for combustion control and with the cylindrical enclosure insulation allows reduction of heat losses and operation at higher temperature.

Table 3. Typical composition of LFG from municipal solid waste

Component	Percent composition (dry volume basis)
Methane	45-60
Carbon Dioxide	40-60
Nitrogen	2-5
Oxygen	0.1-1.0
Sulfides, disulfides, mercaptans, etc	0-1.0
Ammonia	0.1-1.0
Hydrogen	0-0.2
Carbon Monoxide	0-0.2
Trace constituents	0.01-0.6

The operation of air pollution source installations that include the Project's high temperature enclosed flare and the 200 kW LFG generator is governed by Permit to Operate issued by the DENR that is valid until 08 February 2018. Requirements of the permit issuance include, among others, the preparation and submission of self-monitoring reports (SMR) on the operation and maintenance of the installations and implementation of precautionary measures to ensure that any emission of air pollutants from these permitted installations including fugitive or uncontrolled emissions and releases of air pollutants from abnormal or unexpected events do not cause air pollution

in the surrounding air environment or have adverse effects on the persons in that environment.

At present, application is ongoing for the Permit to Operate issued by the DENR for the two units (at 320-kW capacity) of LFG generator also being utilized at the Biogas Facility.

Mitigation measures undertaken by PGEP to ensure that the enclosed flare system and the operation of the generator comply with these air pollution source installations stipulations include: a) submission of self-monitoring reports (SMR) to the EMB and b) consistent measurement of stack emissions through continuous emission monitoring (CEM)..

III.2.3 Solid Wastes Generation

Domestic solid waste generation at the Biogas Facility estimated to be 50 kg/month. These are collected and disposed of in the landfill. Solid waste materials are mainly scrap paper and recyclable and biodegradable matter (i.e. water plastic bottles, food remains, etc.) generated from administrative aspects of operating the facility. Waste management practices include re-use of waste paper, collection of recyclables and collection of food wastes for animal food.

The amount of solid waste materials collected are monitored and reported in the quarterly SMR submitted to DENR.

III.2.4 Waste Oil Generation

Waste oil is generated when oil-change activities are initiated after every 500 runhours of the three units of LFG generators utilized at the Biogas Facility. Approximately 20 liters of waste oil is collected from each engine; the collected material is then stored inside covered steel drums and securely labeled and placed within an identified safe area within the facility premises.

As of June 24, 2013, PGEP has been issued a Hazardous Waste ID Number by the DENR, to account for the hazardous waste material associated with the Landfill Gas Energy Project, and the efforts being performed by PGEP to ensure proper handling and disposal of the said waste oil material. Collection by an accredited hauler is pending, dependent on reaching a minimum volume of waste oil material accumulated in storage. In the meantime, the volume of waste oil materials collected and stored is monitored and reported in the quarterly SMR submitted to DENR. Handling and storage performed is guided by implementing rules and regulations related to the applicable environmental regulation RA 6969, or the Hazardous Waste Management Act of 1990.

III.2.5 Noise Generation

Noise and vibration are generated during the operation of the blower system and the three units of LFG generators. The level of noise at 60 dBA (predicted and/or actual monitored data) does not reach the maximum permissible level.

IV. PUBLIC CONSULTATION AND DISCLOSURE

A Stakeholders' Consultation activity was organized by PGEP in coordination with the Payatas Operations Group (POG). Stakeholders identified including members of the local community, various local organizations and groups, officials of the POG, the Environmental Protection and Waste Management Department (EPWMD) of the Quezon City local government were issued invitation letters dated 16 February 2007. The activity was held on 23 February 2007 at the office of the POG at within the premises of the landfill area.

Community leaders representing twenty-one (21) groups from various sectors, associations and cooperatives--- with members coming from the urban poor, scavengers, recyclers, junk shops, transport, and school --- in Quezon City, were noted in attendance at the Stakeholders' Consultation activity. The event was conducted in both English and Tagalog, and commenced with presentations elaborating the Landfill Gas Energy Project, including its objectives and intended goals, a simplified explanation of the the technical aspects of the Project, and the expected benefits from the Project for the government and the immediate local community. The event also provided opportunity for the participants to express their opinions through an open forum session.

Most of the participants signified awareness of the Landfill Gas Energy Project, in light of their involvement in the then on-going conversion of Payatas landfill from an open dumpsite into a controlled sanitary landfill site. The stakeholders expressed support to the Project and understood the numerous benefits to the local community. The community participants were particularly interested in the Project's environmental, health, and safety impacts, participation of dumpsite workers (scavengers) and employment opportunities. No negative comments were raised on the Project during this Stakeholders' Consultation activity.

V. INSTITUTIONAL ARRANGEMENTS

V.1 INSTITUTIONAL PARTNERS

The Pangea Green Energy Philippines, Inc. (PGEP) is a Philippine company incorporated in 2006 primarily to develop, plan, construct, operate and manage renewable energy and environmental projects for the purpose of reducing greenhouse gas emissions and for the production, supply, distribution and of sale of electricity. The company specializes in the production of energy from renewable sources including biogas produced by landfills as well as by the anaerobic fermentation of animal manure, biomass and solar energy and including conduct of energy efficiency audits.

The Landfill Gas Energy Project was financed, planned designed and built by PGEP using Italian technology. PGEP also currently manages, operates and maintains the biogas extraction, collection and processing in the Biogas Facility pursuant to the Memorandum of Agreement (MOA) entered into with the local government of Quezon City. The 10-year MOA signed in 2007 grants PGEP the exclusive right to implement, manage and operate the Project activity. The following key terms are contained in the MOA:

a) PGEP shall provide the necessary financing for the Project;
b) The Quezon City local government continues to be the owner and operator, and to be responsible for the over-all management of, the Payatas sanitary landfill site in accordance with local laws, rules and regulations;
c) Quezon City local government ensures PGEP's uninterrupted utilization of the Payatas sanitary landfill site by, among others, allowing access to the said site to enable installation, operation and implementation of the Project;
d) CERs generated by the Project shall be issued to PGEP who may sell those CERs in their sole discretion; and.
e) PGEP will share with the Quezon City local government a portion of the gross revenues from the CERs generated, ranging from 15-32% corresponding to a CER price range of 6- 20.01 Euros. In addition, the Quezon City local government will get 5% of gross profit from the electricity sale to the Manila Electric Company. The revenues will be used to fund the said local government unit's environmental and socio-economic efforts. The local government has also engaged IPM Environmental Services, Inc. as contractor for the over-all management and operation of the Payatas sanitary landfill site.

The Quezon City local government is the owner and operator of the Payatas sanitary landfill site, responsible for the over-all management of the said landfill site in accordance with existing and applicable environmental laws, rules and regulations. The local government unit manages the operation of the landfill site through its Environmental Protection and Waste Management Department (EPWMD) and the Payatas Operations Group (POG).

The *Payatas Operations Group (POG)* was created by the Quezon City local government to oversee the management, operation and security of the dumpsite.

The *Environmental Protection and Waste Management Department (EPWMD)* began as a Task Force Clean and Green that was departmentalized in the year 2000 through City Ordinance No. SP 982, S-2000. Its mandates include: (i) implementation of an efficient garbage collection and disposal system; (ii) implementation of a pollution control program; and (iii) monitoring and enforcement of all environmental laws and city ordinances. An Environmental Clearance to operate the Project was issued by the EPWMD of the Quezon City local government.

The *Isabelita P. Mercado (IPM), Environmental Services, Inc*.[2] was contracted by the LGU of QC as early as 2004 to operate the dumpsite and implement the conversion program. Remediation measures were undertaken in consultation with several academic and governmental institutions such as the University of the Philippines and the Mapua Institute of Technology and the Philippine National Oil Company (PNOC).It is likewise at the forefront of solid waste collection and disposal and includes a number of local governments (i.e., the cities of Mandaluyong, Pasig, Muntinlupa, Marikina and others) as its clients.

[2] http://www.ipmgroup.com.ph/

V.2 INSTITUTIONAL SETUP OF MONITORING SYSTEM

The operation and management of the CFSF's Environment and Social Safeguard Framework (ESSF) will be led by LBP-EPMD, as follows:

- PGEP shall report to LBP-EPMD the progress on the implementation of the ESSF and EMP including any corrective and preventive actions on a quarterly basis. This shall form integral part of the safeguards monitoring report that will be reported by PGEP as part of its obligations under the terms of the Sub-Project Agreement for the purchase and sale of CERs of the Landfill Gas Energy Project.

- LBP-EPMD will submit safeguards monitoring report to the World Bank, on a semestral basis, as part of its obligation under the Emissions Reduction Purchase Agreement (ERPA).

LBP, being an ISO 14001 certified institution, established the EPMD to primarily implement the safeguards activities. Part of its functions is to exercise environmental due diligence by keeping records of project EA reports, feedbacks / technical information (which may include but not limited to environmental performance history, issuance of related environmental permits, notice of violations, dumpsite closure plan, etc.), and ECCs / CNCs. This is part of its oversight function and task enumerated in the LBP CPI 2009-002 to verify that projects are in compliance to environmental standards and regulations.

EPMD is currently manned by ten (10) regular personnel of LBP, whose primary function is to implement the LBP CPI 2009-002. As the LBP CPI 2009-002 primarily requires environmental assessment of the projects covered by the Philippine EIS system and collaterals which are part of the project or used as project site only, the environmental assessment will be extended and conducted to CDM projects (which are usually not covered by the Philippine EIS system) for this purpose. The review performed by EPMD and WB is entirely independent and does not conflict with the nature of evaluation the DENR performs.

VI. ACCOUNTABILITY STATEMENT

This is to certify that all the information in this Environmental Management Plan for the Landfill Gas Energy Project of Pangea Green Energy Philippines, Inc. are accurate and complete to the best of our knowledge, and that an objective and thorough assessment of the Project was undertaken in accordance with the dictates of professional and reasonable judgment.

All the commitments contained herein including the Environmental Management Plan shall be strictly complied. In case of any deviation, the same shall be of interest in environmental protection and sustainable development. Pangea Green Energy Philippines shall be held responsible for any liabilities and/or penalties arising from the Landfill Gas Energy Project.

In witness whereof, we hereby set our hands this JUN 05 2017 day of _____ at QUEZON CITY.

ANECITO P. SUMALO
Pollution Control Officer / Plant Manager

JENNIFER F. CAMPOS
President

SUBSCRIBED AND SWORN TO before me this JUN 05 2017 day of _____, affiant exhibiting his / her P14541564
No. issued at PCG NEW YORK on 1/03/2017.

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Book No. XXI
Series of 2017

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