Appendix : Environment and Social Management Plan of

Green Field Company Pvt. Ltd.

Executive Summary

This Environmental and Social Management Plan (ESMP) has been prepared for proposed large biogas sub-project at Green Field National Higher Secondary School operated under **Green Field Company Pvt. Ltd.**, Sitapaila-13, Kathmandu. This ESMP deals with possible environmental and social impacts associated with construction and operation of large biogas and prescribes respective mitigation measures of predicted impacts by environmental and social screening. The overall impact caused by the sub project intervention was classified as "Category C" with minimal environmental impact and hence there is no need of conduction of further environmental or social assessment.

Some of the impacts caused by the sub-project are: health and safety issues of construction workers, possible surface and ground water contamination due to leakage from digester, outlet and compost pit and haphazard discharge of separated liquid from sludge thickening unity. The practical mitigation measures have been proposed in this ESMP and shall be implemented by the Construction Company and developer. In addition, the monitoring mechanism is prescribed in this ESMP and shall also be accomplished accordingly. The likely impacts not identified during screening as well as in this ESMP, if perceived during construction and/or operation phase shall also be avoided or mitigated by the Construction Company and/or developer.

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1. Introduction

The School was established on 2003 A.D in Sitapaila-13, Kathmandu. The total land area available is 1335 sq. m. (2 ropani 10 ana) and there are altogether 1000 numbers of students and teachers in the school. From available 333 kg of feedstock waste, the detailed design recommends construction of 35m^3 biogas plant. The proposed design technology is fixed dome Modified GGC 2047 model. Thus generated biogas is proposed to be used in the school for cooking food in canteen. The sub-project is under evaluation for AEPC/SREP support.

2. Description of Subproject and Location

The sub-project is located at Sitapaila-13, Kathmandu district. The coordinate of the sub-project site is 27°42'14.32"N, 85°16'48.58"E with altitude of 1300m. The subproject location is situated within dense settlement of Sitapaila area.

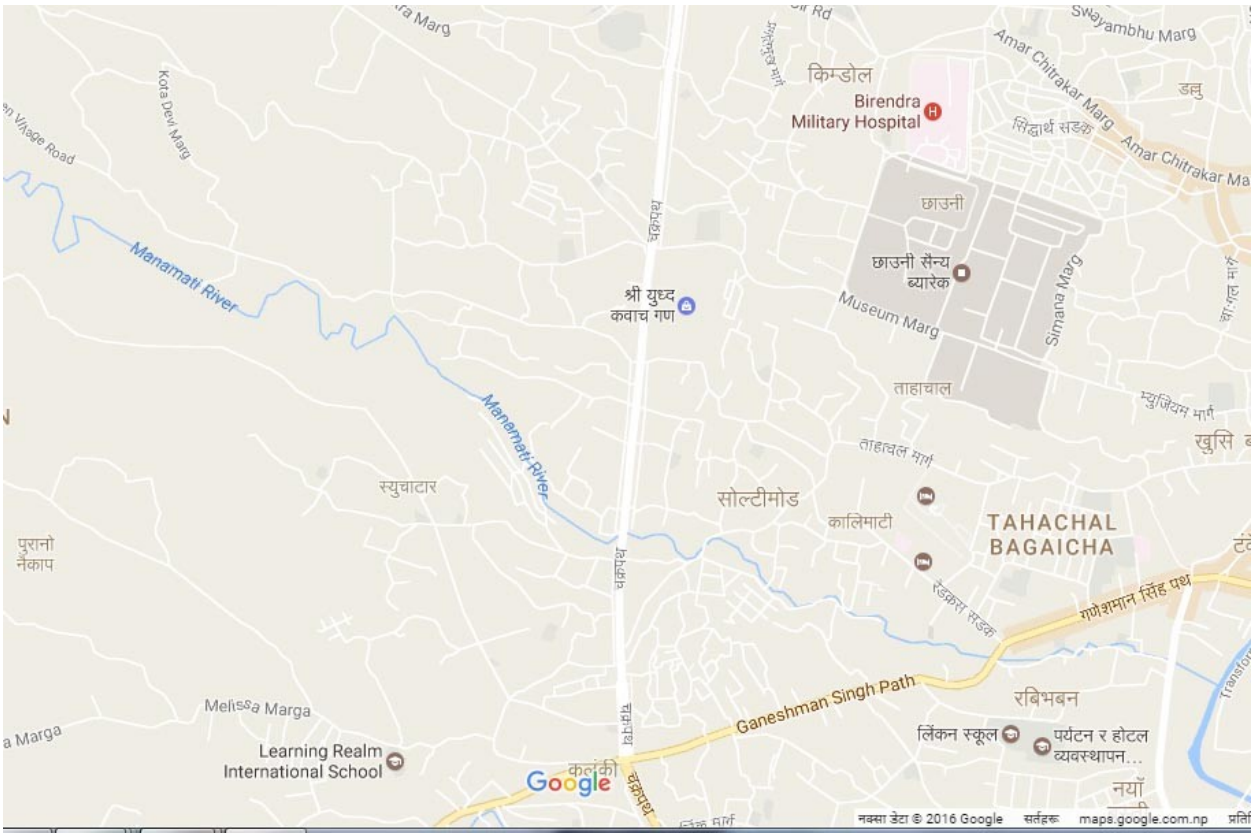

Figure 1: Sub-project Location Map

Figure-2 Google Earth Map: 27°42'14.32"N, 85°16'48.58"E

The proposed plant is 35 m^3 single unit fixed dome digester (35 m^3 digester and with 7.2 m^3 of biogas production per day). The generated biogas biogas will be used for cooking in Canteen for 500 students and teacher within school premises.
The major works that will be carried out during construction are excavation of earthwork for digester, cement aggregate works and installation of dome as gas storage. Once after the construction completion, 330 kg of waste (night soil and kitchen waste) will be fed into the digester daily with the help of sludge thickening unit. Similarly, a total of 2030 litres liquid effluent will be generated each day from sludge thickening unit which will be directly flow in to municipal sewer stream.

The schematic diagram and technology details of the biogas plant and dewatering unit are provided below:

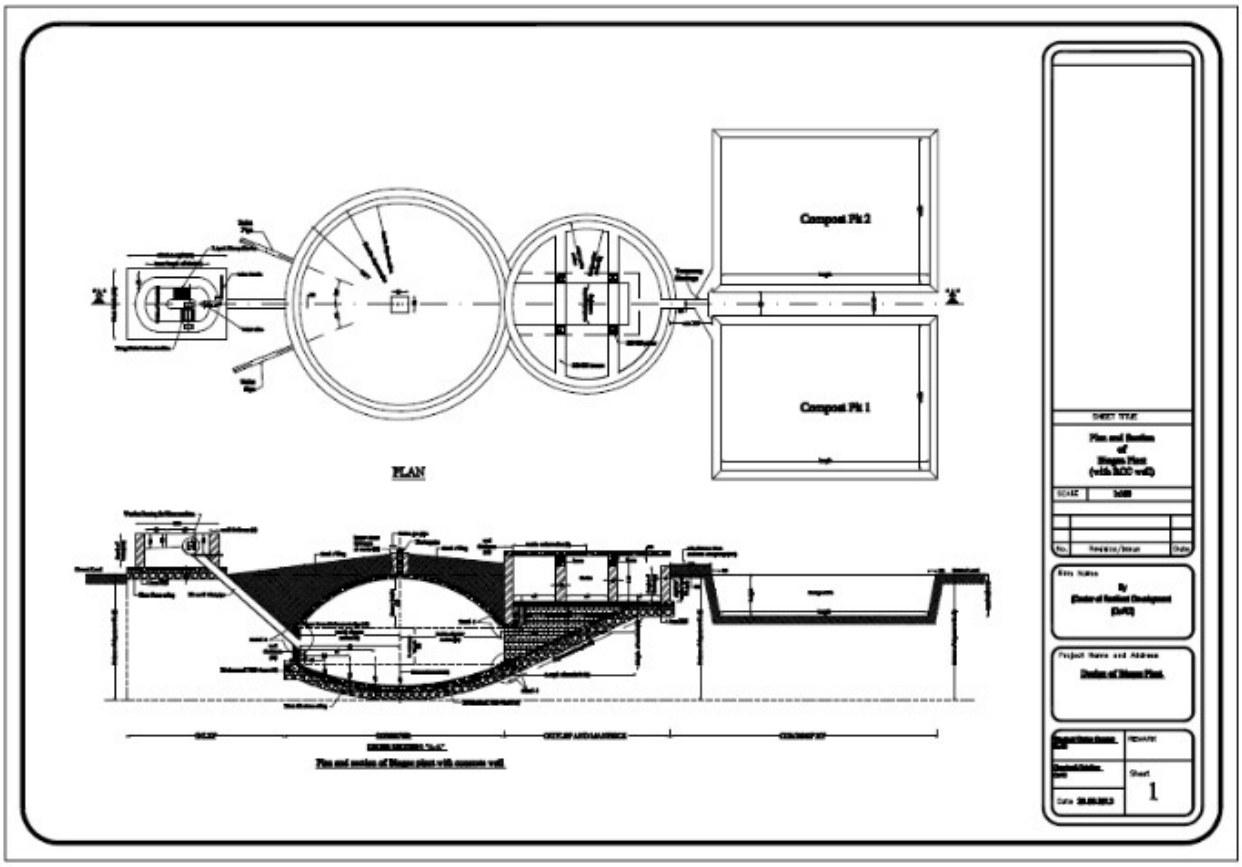

Figure 3: Schematic Diagram of the Proposed Biogas Technology

The figure 3 shows the schematic diagram of Modified GGC 2047 Model biogas plant. This plant consists of an underground digester (cylindrical or dome-shaped). The gas is collected in the dome according to the volume of gas stored. When biogas is

produced, the outlet slurry level moves up and when it is consumed, the outlet slurry level goes down.

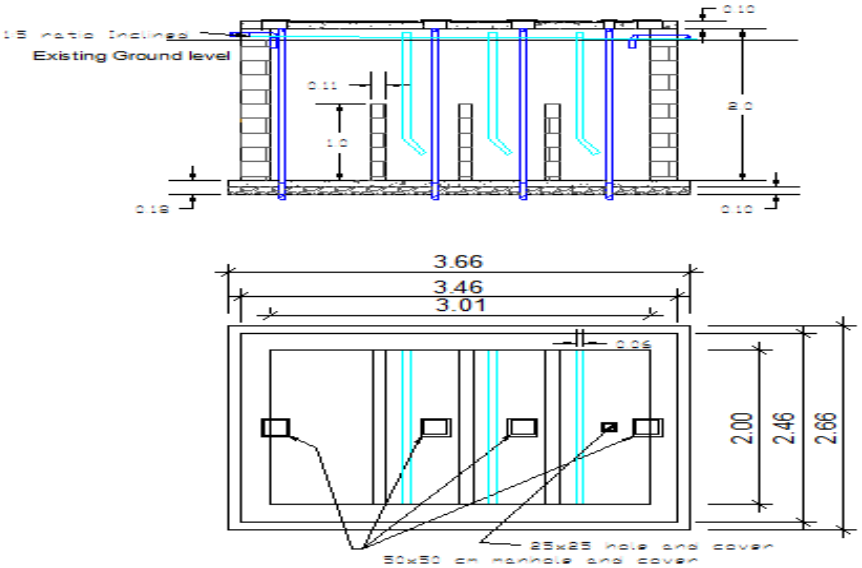

Figure 4: Schematic Diagram of Dewatering System (Sludge thickening unit)

The figure 4 shows the schematic diagram of dewatering system. A dewatering system will be installed to separate solid and water. The slurry which comes out from the toilet is fed into the dewatering plant. It separates the solid and water from the waste water. The solid waste is directly fed in to digester while separated effluent is dispensed from a different tube.

3. Relevancy of preparing ESMP

This Environmental and Social Management Plan (ESMP) is prepared for the proposed sub-project in order to mitigate the likely environmental impacts predicted during environmental and social screening. Any land acquisition or displacement of inhabitations will not be involved in this sub-project. The significant negative impacts are not predicted since the sub-project itself reduces wastes and converts into useful renewable energy. However, negligible impacts identified and might prevail during construction and operation phase. This sub-project is classified as **"Category C"**, with minimum environmental/social impacts and hence there is no need of conduction of further environmental or social assessment. This Environmental and Social Management Plan (ESMP) has been prepared in order to reduce thus identified adverse impacts prior to sub project implementation.

4. Environmental and Social Baseline

The sub project location is situated in the hilly region of Nepal. The topography is flat land with altitude of about 1300m above sea level. There is no any governmentally declared protected areas or any forest area near sub project site. Regarding climatic condition, Kathmandu valley is in the Warm Temperate Zone, and prevailing warm days followed by cool nights and mornings. The winter temperature can drop up to 1 °C. The land use pattern of proposed sub project is dense settlement and builtup area.

The school boundary is well fenced by wall. The biogas plant is proposed to be constructed nearly in center.. The school area is located within a city. However, the nearest household is about 30 meter away from the proposed plant location. The subproject site can be accessed through Ring Road (1.1 km from Kalanki Chowk toward Sitapaila). Regarding water availability within school, the deep well is present within the school premise.

The settlement near the subproject site is mixed type. An all weather blacktopped road exists to reach the sub-project location from Ring Road.

5. Environmental and Social Impacts

During feasibility study, considering environmental and social screening performed, it is not predicted to have significant negative environmental and social impacts.

The beneficial impact of this subproject would be management of toilet waste within school and conversion of organic waste including kitchen waste into biogas energy. Socially, there will be no any direct benefits however; the sub-project will demonstrate the renewable energy sub-project in the locality.

5.1 Beneficial Impacts

Considering the benefit to the nearby community, there seems no any direct advantage to nearby population however, management of the organic waste within the school obviously reduce the foul odour which could be the nuisance to nearby locality. During construction phase, there would be few numbers of employment opportunities. Nevertheless, the sub project will be present itself as a show case waste to energy subproject.

5.1.1 GHG emission reduction as beneficial impact

Human and kitchen waste is rich in organic substances and can be used as feedstock to generate biogas. Thus produced biogas will replace fossil fuels such as LPG that is being consumed in the school contributing in greenhouse gas reduction. A total of 5.23 t CO_2 e from replacing LPG of GHGs shall be reduced from the implementation of the sub-project annually.

5.2 Adverse Impacts

There will be no any significant adverse impact to the surrounding community and environment by the implementation of the proposed sub-project. However, during construction and operation phase, minor impacts have been predicted and provided as below:

5.2.1 Construction Phase

- **Construction related accidents:** There are several processes which will be involved in the site during its construction. Excavation work, use of machineries, excavators, mixers for preparing concrete etc could lead accidents, but could be minimized by adopting safety precautions. It is projected that some 18 skilled and unskilled human resources will be involved in construction process. The impact is envisaged as site specific, low in magnitude, short term in duration. The school students and construction workers are the main receptors of this impact.

- **Respiratory problems due to dusty environment:** During construction phase, there will be regular vehicle movements for transportation of construction materials could lead dusty environment. The excavation work and muck/soil generated from excavation could also generate large volume of dust during windy condition. The dusty environment can directly affect the health of construction workers as well as school students and local people of surrounding vicinity. However, the impact is envisaged to be a low in magnitude, short term duration and construction workers, students and nearby locals as receptor.

- **Increased noise due to construction activity:** The noise will be generated due to vehicular movement and construction activities such as loading and unloading of construction materials. This will mainly affect construction workers, students and partly to resident living close to the construction site. The impact will remain for short duration because these activities are only required for limited periods only and magnitude is projected to be low.

5.2.2 Operation Phase

- **Health and safety issue associated with digested slurry handling**: 333 litres of digested liquid slurry will be generated each day during operation. If thus produced slurry is handled without safety measures, this can cause health impact who involved in such work. As the main feedstock is toilet waste, there could be chances of presence of pathogens on digested slurry and can lead to diarrhoea and cholera etc. The impact is predicted as area specific, with moderate magnitude and for long term duration and involved staffs for management of slurry and composting part are the main receptors.

- **Intrusion of slurry into water source and thereby impacting community health**: The seepage of water from digester, outlet and slurry pit can pollute ground water decreasing its quality. The pathogenic contamination in drinking water sources could led to different diseases like diarrhoea, cholera etc. Such consequence can affect school students, staffs and nearby communities too. So the magnitude is predicted as moderate to high, long term in duration and school students, staffs and nearby residents as the receptor.

- **Impact associated with liquid effluent separated from sludge thickening unit**.: In order to maintain dissolved solid in substrate, a sludge thickening unit is proposed to be constructed. This unit will separate the excess flushed water avoiding entering into the digester. Thus separated liquid effluent has moderate BOD and also has high pathogens. The haphazard discharge of this effluent shall impact community health and pollute nearby water sources too. The impact is envisaged as site specific to local, moderate in magnitude, long term in duration and school students, nearby residents as receptor.

- **Occurrence of accidents associated with firing and explosion**: Biogas or methane is combustible gas and a naked flame can easily catch and fire if there is gas leakage. Such fire event or accident can cause loss of life and property. The envisaged impact is characterized as site specific, moderate in magnitude considering nature of impact and, long term in duration. However such event would be rare.

- **Spreading of disease due to increased disease vectors, flies, mosquitoes etc.** The growth of disease vectors such as flies, mosquitoes, rodents etc can mainly be observed near sludge thickening unit and outlet area of the biogas plant. The result could be spreading of disease to workers and could also propagate to students who

reside near plant site. The impact is assessed as site specific, low in magnitude and long term in duration

- **Foul odour in and around subproject site:** Decomposition of biodegradable substances in storage area or in open area cause foul smell. The anaerobic digestion can be taken as one of means to reduce foul odour. However, the separated liquid fro sludge thickening unit and undigested slurry discarded from outlet could cause foul odour and might be nuisance to workers, students as well as nearby community. Considering anaerobic digestion of waste inside closed digester and the distance between the subproject location and nearby community, the impact is considered as site specific, low in magnitude, long term in duration.

6. Mitigation Measures

The environmental mitigation measures with their time of action and responsibility are prescribed in the following matrix: Regarding alternatives, the developer has selected a fixed dome Modified GGC 2047 Model from wide range of technologies like floating drum type mode, up-flow sludge blanket, CSTR etc. The simple GGC model is selected because of lower quantity of feedstock and the technology can handle night soil and the technology is widely used in Nepal. Regarding management of post digested slurry, the storing of digested slurry in compost pit is proposed. Similarly, ESMP prescribed to precede construction work only on 8:00 am to 6:00pm.

Table 6.1: Environmental and Social Mitigation Measures

S.N.	Environmental Impacts	Mitigation Measures	Time of Action	Mitigation Cost (NRs.)	Responsibility
1.0 Construction Phase					
1.1	Construction related health risks like accidents	The construction premises specially dome area shall be barricaded by any means like corrugated sheets or ropes.	During construction phase	-	Construction Company

S.N.	Environmental Impacts	Mitigation Measures	Time of Action	Mitigation Cost (NRs.)	Responsibility
		Provision of personal protective equipments (PPEs) like helmets, boots, gloves, etc for construction workers	During construction phase	5000.00	Construction Company
		Provision of First Aid Kits in construction site	During construction phase	2000.00	Project Developer
1.2	Respiratory problems due to dusty environment	Provision of masks for construction workers	During construction phase	Already provisioned in 1.1	Construction Company
		Dusty areas (construction site) will be sprayed with water, particularly during hot, windy weather	During construction phase	Included in construction cost	Construction Company
1.3	Increased noise due to construction activity	Construction work shall be conducted from 8:00 AM-6:00 PM.	During construction phase	-	Construction Company
2.0 Operation Phase					
2.1	Health and safety issue associated with digested slurry handling	Workers involved in slurry handling shall be provisioned with personal protective equipments (PPEs) like gloves and masks	During Operation phase	5000.00	Project Developer
2.2	Intrusion of slurry into water	Digester, outlet and	During	-	Construction

S.N.	Environmental Impacts	Mitigation Measures	Time of Action	Mitigation Cost (NRs.)	Responsibility
	source and thereby impacting community health	compost pits shall be water tight and sealed	construction phase		Company
2.3	Impact associated with liquid effluent separated from sludge thickening unit	The separated liquid from effluent shall only be discharged through combined municipal sewer, not directly in surface water body.	during Operation phase	-	Project Developer
2.4	Occurrence of accidents associated with firing and explosion	As methane is combustible gas, naked flames shall be avoided strictly near digester	during Operation phase	-	Project Developer
		The produced gas shall be used on daily basis.	during Operation phase	-	Project Developer
		Assurance of installation of standard equipments and instruments only	During construction phase	-	Construction Company
2.5	Spreading of disease due to increased disease vectors, flies, mosquitoes near substrate storage area	Avoid storing substrate as far as possible. Substrate feeding must not be delayed i.e. daily feeding shall be practiced	During Operation phase	-	Project Developer
		Shall avoid formation of waste water ditches	During Operation phase	-	Project Developer
2.2	Foul odor from storage area	Avoid storing substrate as far as possible.	During Operation phase	-	Project Developer

S.N.	Environmental Impacts	Mitigation Measures	Time of Action	Mitigation Cost (NRs.)	Responsibility
		The recommended quantity of substrate shall only be fed into digester	During Operation phase	-	Project Developer

Table 6.2: Environmental and Social Monitoring Plan

S.N.	Indicators	Methods	Frequency/Time	Place	Monitoring Authority	Monitoring Cost (NRs.)
1.0 Construction Phase						
1.1	Provision of barricade of construction area during construction phase	Direct Observation	Once prior to start of construction work	Construction Site	Project Developer	-
1.2	Provision of PPEs to construction workforce	Direct Observation/ Records	Once during construction phase	Construction Site	Project Developer	-
1.3	Provision of First Aid Kits	Records	Once during construction phase	Construction Site	Project Developer	-
1.4	Proper sealing of base of substrate storage area and compost pit	Construction details; records	Once after construction phase	Construction Site	Project Developer	-
1.5	Installation of standard equipments and instruments only	Construction details/ records	Once after construction phase	Construction Site	Project Developer	-
1.6	Water spraying in dusty areas	Direct Observation/ Records	Once during construction phase	Construction Site	Project Developer	-
1.7	Construction work timing 8:00 to 6:00 pm	Direct Observation	Once during construction phase	Construction Site	Project Developer	-
2.0 Operation Phase						
2.1	Provision of PPEs to	Direct	Once in six	Project Site	Project	-

	staffs involved with slurry handling	Observation/Records	month		Developer	
2.2	Proper sealing and water tight while constructing digester sludge thickening unit, outlet and compost pits	Construction details; records	Once after construction phase	Construction Site	Project Developer	-
2.3	Safe discharge of effluent from sludge thickening unit	Direct Observation	Once in six month	Project Site	Project Developer	-
2.4	Appropriate feeding practice	Interview with operator	Once in six month	Project Site	Project Developer	-
2.5	Records of firing and accidents caused	Records	Once in a year	Project site	Project Developer	-
2.6	Presence of mosquitoes and other disease vectors	Direct Observation	Once in six month	Project Site	Project Developer	
2.7	Foul Odor	Observation/ Informal interview with nearby locals	Once in six month	Project Site	Project Developer	

Mitigation and Monitoring Cost: Most of the mitigation measures are part of the overall sub-project facility and hence included in the construction cost. In case of monitoring, the responsibility is assigned to developer/Developer, and will incur minor cost.

7. Conclusion and recommendation

The above mentioned mitigation measures shall strictly be implemented by the responsible individuals as mentioned in this ESMP. In addition, the monitoring as mentioned in this ESMP shall also be performed accordingly. The likely impacts not identified in this ESMP, if perceived during construction and/or operation phase shall also be avoided or mitigated by the Construction Company and/or developer.