Appendix H: Environment and Social Management Plan of Lumbini Agro Products and Research Center Pvt. Ltd.

Executive Summary

This Environmental and Social Management Plan (ESMP) has been developed for proposed large biogas construction and operation sub-project at Lumbini Agro Products and Research Center Pvt Ltd, Tikuligadh, Rupandehi in order to mitigate the likely environmental impacts predicted during Environmental Screening. The screening process indicated that the sub project intervention will not require any land acquisition as well as displacement of inhabitants. Similarly, as the sub project itself reduces wastes and use of waste in order to produce energy, the significant negative impacts are not envisaged. However, the screening process indicated negligible impacts during construction and operation phase. 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. Nevertheless, in order to reduce or mitigate thus identified adverse impacts, "Environmental and Social Management Plan (ESMP)" was recommended to prepare prior to sub project implementation.

Some of the impacts caused by the sub-project are: health and safety issues of construction workers, possible ground water contamination due to leakage from substrate and slurry storage, workers health during slurry handling, foul smell and increased noise level due to operation of generator. The possible mitigation measures have been proposed in this ESMP and shall be implemented by the contractor/Construction Company and developer. In addition, the monitoring as mentioned in this ESMP shall also be performed 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 farm was established on 2010 A.D in Tikuligad VDC, Rupandehi. The total land area is 20 Bigha and there are altogether 400 numbers of cows in the farm. From available 5,275 kg of dung, the detail feasibility recommends construction of 500m^3 biogas plant. The proposed design technology is floating drum model biogas plant. Thus generated biogas is proposed to be used in the form of electricity and cooking gas. The sub-project is under evaluation for AEPC/SREP support.

2. Description of Subproject and Location

The sub-project is located at Tikuligad VDC of Rupandehi district. The coordinate of the sub-project site is 27^0 35′ 30.53″ N, 83^0 26′ 20.96″ E with altitude of 119m. Tinau River is flowing about 1.7 km west of the sub project site. Figure 1 illustrates the location (Google Earth Map) of sub project intervention.

The landuse of the sub-project vicinity is moderately dominated by agricultural land with sparse settlement.

Figure 1: Sub-project Location Map

Figure-2 Google Earth Map: 27^0 35′ 30.53″ N, 83^0 26′ 20.96″ E

The proposed plant is 500 m^3 single unit floating dome digester (350 m^3 digester and 150m^3 gas storage) with 115 m^3 of biogas production per day. The generated biogas will be used primarily (95%) for electricity generation and remaining (5%) for cooking. 62.5 kVA biogas generator will generate maximum of 158 kwhr of electrical output each day. The 24 hour base load of the sub-project is 6.6kW. 5.75 m^3 of biogas will be used for cooking in 30 worker's residences within farm premises.

The major works that will be carried out during construction are excavation of earthwork for digester, cement aggregate works and installation of steel dome as gas storage. A generator will be installed in order to generate electricity from biogas. Once after the construction completion, 2865 kg of cow dung along with 3502 litres of dilution water will be fed into the digester daily. A total of 6,367 litres liquid slurry will be generated each day which will be dried to generate about 600 kg of dry manure in each day with the help of dewatering unit. The separated liquid slurry from dewatering unit is proposed to be used in the fodder plantation area within farm.

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

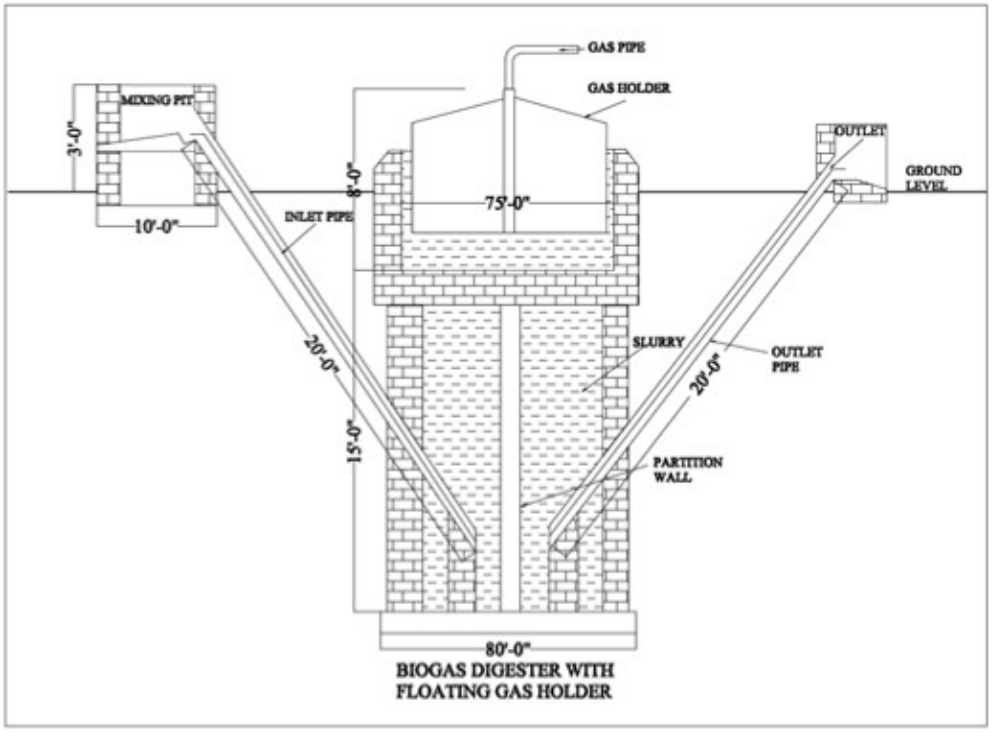

Figure 3: Schematic Diagram of the Proposed Biogas Technology

The figure 3 shows the schematic diagram of floating drum biogas plant. Floating-drum plants consist of an underground digester (cylindrical or dome-shaped) and a moving gas-holder. The gas-holder floats directly on the water jacket. The gas is collected in the gas drum, which rises or moves down, according to the amount of gas stored. The gas drum is prevented from tilting by a guiding frame. When biogas is produced, the drum moves up and when it is consumed, the drum goes down.

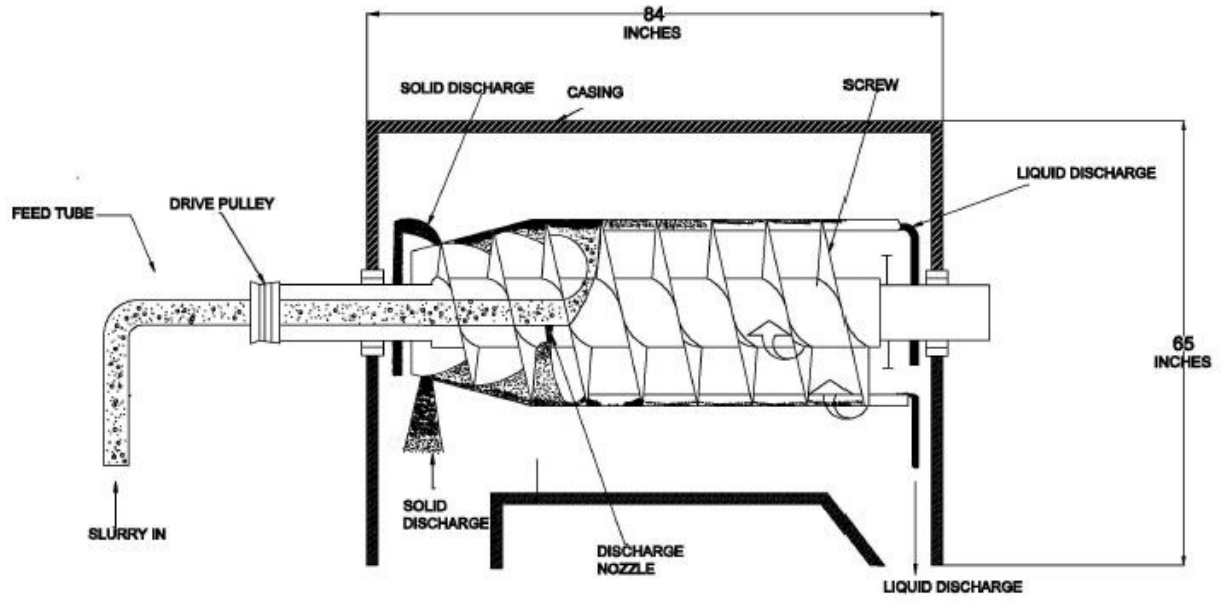

Figure 4: Schematic Diagram of Dewatering System

The figure 4 shows the schematic diagram of dewatering system. A screw based dewatering system will be installed to separate dry and wet slurry. The slurry which comes out from the Biogas tank is fed into the dewatering plant. It separates the slurry and water from the manure. The solid manure is discharged separately while the slurry water is dispensed from a different tube. The solid manure is highly efficient & natural nitrogen rich. It is odour less and since processed in a closed environment it retains the maximum organic values with composition of 30% of moisture. The solid manure will be directly loaded in sacks and store in the closed shed until it is sold as an organic fertilizer to the local market.

The slurry water still contains organic values. So, the water will be stored in an enclosed pit system. It will be further used as a fertilizer within the farm to grow high quality grass for cows. Alternatively, it can also be used to recharge the ground water through water recharge pits.

3. Relevancy of preparing ESMP

This Environmental and Social Management Plan (ESMP) has been done 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 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 Terai region of Nepal. The topography is flat land with altitude of about 70m above sea level. There is no any governmentally declared protected areas or any forest area within the 5 km radius from the sub project site. Regarding climatic condition, as it is situated in Terai region, sub-tropical climate with hotter summer and mild winter with occasional cold wave (during winter) prevails in the sub project area. The land use pattern of proposed sub project is fallow land within farm premise. In addition, most of the total land area owned by the developer is used for fodder plantation.

Developer owns 32,425 m2 of land within an enclosed compound. The biogas plant will be located in center of the land and will cover 1700 m2 area. Almost all land is being used for grass production for cows. The nearest settlement (about 15-20 scattered households) from the plant site is more than 300 meter away. Hence, there will not be any significant negative affect to neighboring settlement. The black topped agricultural link road on the west, about 200 m from the proposed site. In addition, there is a small scale seasonal irrigation cannel in eastern part which is about 150 m from the plant site. Besides, there are no other water resources, public and private buildings nearby. Regarding water availability within farm, the deep boring source is within the farm premise.

The sub-project location is dominated by Tharu, Magar and Brahman-hill. The settlement pattern is sparse. An all weather gravel road exists to reach the sub-project location from Patthardanda of Butwal-Bhairahawa 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 in environment is management of waste within farm and conversion of organic waste into biogas energy and dry slurry. Socially the sub-project will demonstrate the renewable energy 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 farm obviously reduce the foul odour which is 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.

5.2 GHG emission reduction as beneficial impact

Cow manure is rich in organic substances so significant quantity of methane is released to the atmosphere during manure storage with anaerobic condition inside the dump. Methane is highly potent greenhouse gas than CO_2 with global warming potential 28- 36 over 100 years time period. The installation of biogas plant will directly reduce the emissions of methane gas from cattle manure. In addition, the biogas will also replace fossil fuels such as LPG and diesel that is being consumed in the farm thereby further contributing in greenhouse gas reduction. 44.66 t CO2 e from replacing diesel fuel to generate electricity and 4.18 t CO2 e from replacing LPG giving at total of about 48.84 t CO2 e of GHGs shall be reduced from the implementation of the sub-project annually.

5.3 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:

Construction Phase

- **Construction related accidents:** There are several processes which will be involved in the site during its construction. Excavation work, use of machineries, welding etc which could lead accidents, but would be exceptional. It is projected that some 18 skilled and unskilled human resources will be involved in construction process. T*he impact is envisaged as site specific, low in magnitude, short term in duration, construction workers as receptor.*
- **Respiratory problems due to dusty environment:** During construction phase, there will be regular vehicle movements for transportation of construction materials which can generate large volume of dust from gravel road. The dusty environment can directly affect the health of construction workers as well as local people of surrounding vicinity. *However, the impact is envisaged to be a low in magnitude, short term duration and construction workers as receptor.*
- **Increased noise due to construction activity:** The noise will be created due to vehicular movement and construction activities such as loading and unloading of construction

materials and activities such as drilling and wielding at site. This will mainly affect construction workers and partly to resident living close to the construction site. *The impact will remain for short duration i.e. construction period only and magnitude is projected to be low.*

Operation Phase

- **Health and safety issue due to haphazard disposal and mismanagement of digested slurry**: 11,167 litres liquid slurry will be generated each day from the plant. If the slurry is not well managed, this can result vector borne diseases. This can affect farm workers as well as local resident living in near vicinity. *The impact can be area specific, with moderate magnitude and for long term duration. Farm workers and community as receptors.*
- **Foul odour from substrate storage area:** If not properly managed, the slurry can generate foul odours which can be nuisance to farm workers (some 30 workers) as well as local residents. However, the developer plans to install a dewatering system to manage slurry. *The magnitude is expected to be low, long term in duration and farm workers as the main receptor.*
- **Over extraction of ground water for meeting water requirement (mixing dung, drinking water for livestock, flushing and cleaning):** The plant will be require 6,142 litres of water on daily basis only to feed into the plant. In addition water will be required for drinking and other farm activities. Ground water will be the main supply source. This can create stress on ground water availability. However, since the plant is in terai region where ground water availability is not a major issue. *Hence, the magnitude will be low, site specific and farm workers as the main receptor.*
- **Ground water pollution due to seepage and leakage from substrate storing area, digester and slurry storage yard**: The seepage of water from manure and slurry can pollute ground water decreasing its quality. This can affect not only workers but also people living nearby who rely on same source of water. *So the magnitude can be moderate to high with long term impact and farm workers and local resident as the main receptor.*
- **Occupational health and safety issues including accidents associated with firing and explosion**: The biogas is highly flammable. The open firing or electrical shorts can cause huge fire and explosion. Also, many mechanical and electrical devices such as generators, tractors, pumps will be in use during the operation which could lead to fire or accidents. *The impact is envisaged as site specific, low in magnitude, occasional but the risk is long term in duration, farm workers as receptor.*
- **Noise from operation of generators**: Generators will be used for electricity generation. It can generate loud noise and can be nuisance to people residing within farm. *The impact is envisaged as site specific, low in magnitude, long term in duration, farm workers as receptor.*

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 floating drum model from wide range of technologies like modified GGC 2047, floating drum type mode, up-flow sludge blanket, CSTR etc. which will have greater conversion efficiency than existing native technology with moderate cost.

There are different ways of management of digested slurry like composting, screw press for producing dry manure instantly, disposal of post digested without using it as manure etc. In this sub-project, a dewatering unit is proposed for producing dry manure from liquid slurry. Regarding timing, this ESMP prescribed to precede construction work only on 8:00 am to 6:00pm.

7. *Environmental and Social Mitigation Plan*

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9. S	10. Environmental/Social Impacts	11. Mitigation Measures	12. Time of Action	13. Estimated Mitigation Cost (NRs.)	14. Responsibility
15. 1.0 Construction Phase					
16. 1	17. Construction related accidents 18.	19. The construction premises shall be barricaded by rope or wire	20. During construction phase	21. -	22. Construction Company
		25. Provision of personal protective equipments (PPEs) like helmets, boots, gloves, etc for construction workers	26. During construction phase	27. -	28. Construction Company
		31. Provision of First Aid Kits at construction site	32. During construction phase	33. Minor	34. Construction Company/ Sub-project Developer
35. 1	36. Respiratory problem due to dusty environment/vehicular emission in construction site 37.	38. Spraying of water during excavation and vehicular use to reduce dust re-suspension	39. During construction phase	40. -	41. Construction Company/ Sub-project Developer
42. 1	43. Increased noise due to construction activity	44. Work will be conducted from 8:00 AM-6:00 PM. If	45. During constructio	46. -	47. Construction Company/

9. S	10. Environmental/Social Impacts	11. Mitigation Measures	12. Time of Action	13. Estimated Mitigation Cost (NRs.)	14. Responsibility
		additional times are needed, local residents will be informed prior to do so.	n phase		Sub-project Developer
48. 2.0 Operation Phase					
49. 2	50. Health and safety issue due to haphazard disposal and mismanagement of digested slurry	51. Installation of de-watering unit to separate dry and wet slurry	52. During operation phase	53. already provisioned in construction cost	54. Construction Company
		57. Use of separate pit with cover for slurry storage and composting in closed yard	58. During operation phase	59. -	60. Sub-project Developer
		63. Use of personal protective equipments during slurry handling process	64. During operation phase	65. 10,000	66. Sub-project Developer
		69. 20% slurry will be self-consumed as compost fertilizer	70. During operation phase	71. -	72. Sub-project Developer
73. 2	74. Foul odour from substrate storage area	75. Avoid storing substrate as far as possible	76. During operation phase	77. -	78. Sub-project Developer

9. S	10. Environmental/Social Impacts	11. Mitigation Measures	12. Time of Action	13. Estimated Mitigation Cost (NRs.)	14. Responsibility
		81. Covering of substrate by a polythene sheet, in case of storage of substrate required	82. During operation Phase	83. 10,000	84. Sub-project Developer
		87. Storage of dry manure/compost and wet slurry in closed yard/structure	88. During operation Phase	89. -	1.
90. 2	91. Over extraction of ground water for meeting water requirement (mixing dung, drinking water for livestock, flushing and cleaning)	92. Use of water from its own deep boring 98. Awareness to operators about conservation of water and instruct not to waste a water	93. During operation Phase	94. -	95. Sub-project Developer
102. 2	103. Ground water pollution due to seepage and leakage from substrate storing area , digester and dewatering facility for producing dry manure	104. Proper sealing of base of storage area as well as digester and outlet/dewatering unit/ manure storage area with sealing material or concrete casting	105. During Construction Phase	106. Already included in construction cost	107. Construction Company/Sub-project Developer
108. 2	109. Spreading of diseases due to increased disease vectors, flies, mosquitoes etc	111. Avoid storing substrate as far as possible	112. During Operation phase	113. -	114. Sub-project Developer

9. S	10. Environmental/Social Impacts	11. Mitigation Measures	12. Time of Action	13. Estimated Mitigation Cost (NRs.)	14. Responsibility
	110.	117. Covering of substrate by a polythene sheet, in case of storage of substrate required	118. During Operation phase	119. -	120. Sub-project Developer
121. 2	122. Occupational health and safety issues including accidents associated with firing and explosion 123.	124. Strictly avoid naked flames near digester	125. During operation phase	126. -	127. Sub-project Developer
		130. Awareness building of workers on safety practices	131. During operation phase	132. -	133. Sub-project Developer
		136. Installation of fire extinguisher close to digester	137. During operation phase	138. 12,000	139. Sub-project Developer
140. 2	141. Noise from operation of generators	142. Use of enclosure shed for generator	143. During operation phase	144. -	145. Sub-project Developer

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147. Monitoring

148. It is also necessary to monitor to ascertain implementation of mitigation measures mentioned as well as to perform impact monitoring to figure out the impacts of the project. The monitoring plan is provided in the table below.

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150. Environmental and Social Monitoring Plan

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152. S.	**153. Indicators**	**154. Methods**	**155. Frequency/Time**	**156. Place**	**157. Monitoring Authority**	**158. Monitoring Cost (NRs.)**
159.	***1.1 Construction Phase***					
160.1.	161. The construction premises shall be barricaded by rope or wire	162. Direct Observation	163. During construction	164. Project Site	165. Sub-project Developer	166. -
167.1.	168. Provision of personal protective equipments (PPEs) like helmets, boots, gloves, etc for construction workers	169. Direct Observation	170. During construction	171. Project Site	172. Sub-project Developer	173. -
174.1.	175. Provision of First Aid Kits at construction site	176. Direct Observation	177. Once prior to start of construction	178. Project Site	179. Sub-project Developer	180. -
181.1.	182. Spraying of water reduce dust re-	183. Records/ Photog	184. During construction	185. Project Site	186. Sub-project Developer	187. -

	suspension	raphs				
188. 1.	189. Compliance of construction activities performed only in designated time (8:00 to 6:00)	190. Intervie w with locals	191. Durin g construction	192. P roject Site	193. Sub-project Developer	194. -
195.	***1.2 Operation Phase***					
196. 1.	197. Provision of de-watering unit	198. D irect observa tion/ Photog raphs/r ecords	199. Durin g construction	200. P roject Site	201. Sub-project Developer	202. -
203. 1.	204. Provision of personal protective equipments (PPEs) during operation	205. D irect observa tion/ Photog raphs	206. Once prior to operation	207. P roject Site	208. Sub-project Developer	209. -
210. 1.	211. Avoid storing substrate as far as possible	212. D irect observa tion	213. Bi-weekly	214. P roject Site	215. Sub-project Developer	216. -
217. 1.	218. Cover substrate by a	219. D irect	220. Bi-weekly	221. P roject	222. Sub-project Developer	223. -

	polythene sheet, in case of storage of substrate	observation		Site		
224.1.	225. Proper sealing of base of storage area as well as digester and outlet/dewatering unit/ manure storage area with sealing material or concrete casting	226. Record of specification of constructed plant	227. During construction	228. Project Site	229. Sub-project Developer	230. -
231.1.	232. Storage of compost and wet slurry in designated area	233. Direct observation	234. Bi-weekly	235. Project Site	236. Sub-project Developer/Site manager	237.
238.1.	239. Avoid naked flames near digester	240. Direct observation	241. Daily	242. Project Site	243. Sub-project Developer/Site manager	244. -
245.1.	246. Build awareness of workers on safety practices	247. Direct observation/ verification of trainin	248. Once prior to operation	249. Project Site	250. Sub-project Developer	251. -

		g conducted by technology provider and/or construction company				
252. 1.	253. Install fire extinguisher close to digester	254. Direct observation	255. Once prior to operation	256. Project Site	257. Sub-project Developer	258. -
259. 1.	260. Use personal protective equipments during operation	261. Direct observation	262. Daily	263. Project Site	264. Sub-project Developer/Site manager	265. -
266. 1.	267. Provision of generator enclose shed	268. Direct observation	269. Once prior to operation	270. Project Site	271. Sub-project Developer	272. -

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274. Most of the mitigation costs are covered within total construction cost and others required minor costs. The monitoring part is assigned to developer and will require one human resource which will be assigned to existing subproject staff and other costs are minor.

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277. Conclusion and recommendation

278. 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.