ENVIRONMENTAL IMPACTS STATEMENT (EIS) OF GREENFIELD DEVELOPMENT OF BEVERAGE PROCESING PLANT (BEER, CARBONATED SOFT DRINK, AND MINERAL WATER) IN ULMERA, LIQUICA, TIMOR LESTE WITH ANNUAL CAPACITY OF 600,000 HL

2017

This Draft of Environmental Impact Statement (EIS) is prepared by PEC Consulting, Lda. on behalf of GOTA Bebidas e Alimentos, Lda. PEC Consulting is a national environmental and engineering consulting company headquartered in Dili. Comment, suggestion and input for this draft report can be forwarded to pec.dili.consulting@gmail.com

Table of Contents

1. EXECUTIVE SUMMARY 8
   1.1 Project Overview 8
   1.2 Environmental Impact Assessment and Management Plan 10
   1.3 Environmental Monitoring and Performance Indicators 38
   1.3.1 Effluent Guidelines 38
   1.3.2 Resource Utilization Guidelines 39
   1.3.3 OHS Guideline and Standard 40
   1.4 Public and Community Consultation 41
   1.5 Positive Social and Economic Impacts of the Project 44
2. DETAILS OF PROJECT PROPONENT 45
3. DETAILS OF THE EIA CONSULTANTS 46
   3.1 PEC – Consulting Summary 48
   3.2 Resume of Specialist Involved in this Project 48
   3.2.1 Krispin Fernandes, PhD 48
   3.2.2 Rosalyn Fernandes, S.T., MURP 50
   3.2.3 Mario Marques Cabral, S.Si, M.Sc 53
   3.2.4 Venancio Fernandes, S.T. 56
   3.2.5 Crisanto dos Santos 58
   3.2.6 Juvencio dos Santos 59
4. DESCRIPTION OF THE PROJECT 60
   4.1 Project Identification and Categorization 60
   4.2 Project Location and Boundary 60
   4.3 Area Potentially Affected by Development 62
   4.4 Description of Project Component and Scale 62
   4.4.1 Groundwater Extraction 64
   4.4.2 Water Treatment and Purification 67
   4.4.3 Brewing Processing Plant 68
      4.4.3.1 Raw Material Handling 69
      4.4.3.2 Wort Production 70
      4.4.3.3 Fermentation and Maturation 71
      4.4.3.4 Purification and Filtration 71
      4.4.3.5 Packaging and Pasteurization 72
   4.4.4 Carbonated Soft Drink Processing Plant 73

4.4.5 Wastewater Treatment and Disposal 74
4.4.5.1 Wastewater Characteristics 76
4.5 Justification and Need of Project 78
4.6 Other Development Related to Construction and Operation of Project 78
4.7 Proponent Endorsement of the EIS 79
4.8 Structure of the EIS 80
5. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK 81
5.1 Relevant Policy and Legislation 81
5.2 Relevant National and International Environmental Quality Standard 82
5.3 Guidelines in Measurement and Monitoring 83
5.4 Relevant Institutional Aspects 83
5.5 Institutional Constraint and Barriers 84
5.6 Procedure of Environmental License 84
6. DESCRIPTION OF EXISTINGENVIRONMENT 89
6.1 Physical Component 89
6.1.1 Climate 89
6.1.1.1 Rainfall 90
6.1.1.2 Temperature 93
6.1.1.3 Relative Humidity 94
6.1.1.4 Evaporation and Solar Radiation 95
6.1.1.5 Wind and Tropical Cyclone 96
6.1.2 Topography and Flooding Pattern 98
6.1.2.1 Catchment and Flooding Pattern 98
6.1.2.2 Erosion and Sedimentation 100
6.1.2.3 Natural Landslide 101
6.1.3 Geology and Hydro-Geology 102
6.1.4 Air Quality 104
6.1.5 Noise Level 108
6.1.6 Surface waters 109
6.1.7 Groundwater 110
6.1.8 Marine Water Quality 113
6.1.9 Seismicity and Earthquake 115
6.1.10 Soil 116
6.2 Ecological Component 119

6.2.1 Mangrove 121
6.2.2 Seagrass Beds 123
6.2.3 Corals 124
6.2.4 Fisheries 127
6.2.5 Marine Ecological Quality 130
6.2.6 Other Marine Flora and Fauna 131
6.2.7 Protected Area and National Parks 132
6.2.8 Wildlife (Including Endangered and Vulnerable Habitats) 133
6.3 Economic components 135
6.3.1 Employment Sectors 135
6.3.2 Poverty 137
6.3.3 Infrastructure facilities 137
6.3.4 Power Supply 138
6.3.5 Land use and Land Ownership of Facility 138
6.3.6 Existing Road and Traffic Condition 139
6.3.7 Use of Forests and Other Natural Resources 140
6.3.8 Fishing and Aquaculture 140
6.3.9 Agriculture 140
6.3.10 Tourism 140
6.3.11 Other industries 140
6.4 Social components 141
6.4.1 Population and Communities 141
6.4.2 Demographic and Population Characteristics 141
6.4.3 Ethnicity 142
6.4.4 Religion 143
6.4.5 Gender 143
6.4.6 Education and Literacy 144
6.4.7 Health profiles of communities 145
6.4.8 Institution, Schools and Health Facilities 146
6.4.9 Community and Family Structures 146
6.4.10 Land ownership 146
6.4.11 Any types of common or individual rights on natural resources 147
6.5 Cultural components 147
6.5.1 Archeological and Historical sites 147

6.5.2 Cultural and Sacred sites 147
6.5.3 Unique landscape 147
7. CLIMATE CHANGE 149
7.1 Risk from Sea Level Rise 150
7.2 Risk from Changing Rainfall Pattern 150
7.3 Groundwater Risk 150
7.4 Risk from Changing Temperature 151
8 ALTERNATIVES 152
8.1 Alternative of Project Location 152
8.2 Alternative on Choice of Technology 153
8.3 Scaling Alternative 153
8.4 No-Development Alternative 154
9 IMPACT ASSESSMENT AND MITIGATION MEASURES 155
9.1 Impact Assessment and Mitigation Measures during Pre-construction and Construction Phase 156
9.1.1 Pre-Construction Phase 156
9.1.2 Construction Phase 158
9.2 Impact Assessment during Operation and Maintenance of Facility 159
9.2.1 Impacts of Water Consumption and Mitigation Measures 160
9.2.1.1 Groundwater Extraction 160
9.2.1.2 Water Treatment 169
9.2.1.3 Distribution and Consumption within the system 169
9.2.2 Impacts of Energy Utilization 170
9.2.3 Impacts ofWastewater and Mitigation Measures 171
9.2.3.1 PH equalization 172
9.2.3.2 Physical treatment: Separation of solid waste from liquid waster 173
9.2.3.3 Biological Treatment of Anaerobic System 173
9.2.3.4 Biological treatment of Aerobic system 174
9.2.3.5 Sedimentation and Sludge Process system 174
9.2.3.6 Sand Filter and Disinfection 175
9.2.3.7 Discharge point of Drainage system 175
9.2.4 Impacts of Solid Waste and Mitigation Measures 176
9.2.4.1 Solid Waste – Brewing 178
9.2.4.2 Solid Waste – Packaging – Food Services 181
9.2.5 Impacts of Gas Emissionand Mitigation Measures 183

9.2.5.1 Estimation of Emission Rate 183
9.3 Occupational Health and Safety (OHS) 184
9.3.1 Explosion Risk 185
9.3.2 Exposure to Chemical 185
9.3.3 Physical Hazards 185
9.3.4 Exposure to Noise and Vibration 186
9.3.5 Community Health and Safety 186
9.3.5.1 Water Quality and Availability 186
9.3.5.2 Structural Safety and Facility 186
9.3.5.3 Exposure to Dust 187
9.3.5.4 Fire Safety 187
9.3.5.5 Traffic Safety 189
9.3.5.6 Disease Prevention 189
9.3.5.7 Emergency Preparedness and Response 191
9.4 Potential Impacts of Climate Change 194
9.4.1 Risk from Sea Level Rise 195
9.4.2 Risk from Changing Rainfall Pattern 195
9.4.3 Risk from Changing Temperature 197
9.5 Impact Assessment during Deactivation 197
9.6 Positive Impacts Assessment of Project 198
9.7 Residual Impacts 199
10 SOCIAL IMPACT ASSESSMENT 201
10.1 Purpose and Objectives 201
10.2 Description of the Socio-Cultural, Institutional, Historical and Political Context 202
10.3 Legislative and Regulatory Context 203
10.4 Analysis of Key Social Issues 203
10.5 Strategy to Achieve Social Development Outcomes and Implications for Analysis of Alternatives 205
10.6 Recommendations for Project Design, Implementation Arrangements and Monitoring Plans 205
11 ECONOMIC ASSESSMENT 207
11.1 Economic Loss Due to Environmental Impacts 207
11.2 Costs, Benefits and Cost-Effectiveness of Mitigation Measures 210
11.3 Positive Economic Impacts 210
12 SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN 212

12.1 EMP during the Pre-Construction and Construction Phase 212
12.2 EMP During the Operation Phase 214
12.2.1 EMP on Water Consumption 214
12.2.2 EMP of Energy Consumption 216
12.2.3 EMP in Managing the Solid waste 219
12.2.4 EMP in Managing the Wastewater 223
12.2.5 EMP in Managing Air emission 226
12.2.6 EMP in Managing Climate Changes Impacts 226
12.2.7 Resource Utilization Guidelines 228
12.2.8 EMP of OHS - Worker 229
12.3 EMP During the Decommission Phase 230
12.4 Monitoring and performance Indicators 230
12.4.1 Emission and effluent Guidelines 231
12.4.2 OSH Guideline and Standard 232
13 PUBLIC AND COMMUNITY CONSULTATION AND INFORMATION DISCLOSURE 234
13.1 Stakeholder Engagement for Environmental Scoping Study 235
13.2 Stakeholder Engagement on Results of EIA 237
13.3 Community Engagement Meeting (Focus Group Discussion) 243
14 DIFFICULTIES ENCOUNTERED 246
14.1 Process Description 246
14.2 Water Source 246
14.3 Lack of Information 247
15 CONCLUSIONS AND RECOMMENDATIONS 248
16 NON-TECHNICAL SUMMARY 250
17 APPENDIXES 255
18 REFERENCES 256

1. EXECUTIVE SUMMARY

1.1 Project Overview

GOTA e Alimentos LDA, a local Timorese company, which was established in 2012, would like to construct and operate the multi-purposes beverage development plant with the ultimate capacity of 50,000Hecto Liter (HL) of beer, 50,000 HL of carbonated soft drink, and 500,000 HL of mineral water, in Suco Ulmera, Posto adminsitrasaun Bazartete in the Municipio of Liquica. The project will occupy 7Hectares (HA) land that has been secured by the project owner through direct purchasing or acquisition.

The development of the project intends to seize on the growing business opportunity in Timor Leste while at the same time create job opportunity for many youth of Timor Leste. Every year, net import of beverage products such as Tiger, Bintang, ABC, and other brand names in Timor Leste is reasonably high at USS10 million (Statistic Data of MOF, 2014), which indicates a high demand of alcohol beverage in the country. This market demand data are an indication of the opportunity that can be fulfilled. Additionally, with cheap labor cost, ease of doing business in Timor Leste, and widely open market opportunity from adjacent countries such as Indonesia, PNG, Australia, makes this business a viable option. Although Heineken has already started its brewing to fulfill the mentioned demand gap, the propose development will focused on the premium quality of beer that has relatively fewer consumers but the product can be sold with higher unit price. While at the same time, the soft drink will be focused on other brands such as juice that has also a market demand in Timor Leste.Therefore, the project owner is trying to take this opportunity in development the project to produce beverages to fill the market demand and reduce the net import into the country.

Timor Leste on the other hand, is in the process of developing its socio-economic condition to increase overall living standards to its people. Currently, the country is heavily dependent on revenue from the oil and gas sector to run the country which may be a problem in the future, as the oil and gas are not renewable resources that will soon be running out. The country's economy should be diversifying into other non-oil sectors while using the oil money to leverage the process of diversification. Particularly, Timor – Leste needs more capital inflow through the foreign direct investment to invest in various productive sectors of economy. While at the same time, enhance the maximum participation from its citizen, particularly domestic investor to further re-invest their capital within the country to help recirculation economy of Timor – Leste.

The proposed beverage processing plant in Ulmera, Liquica, is a type of investment from local Timorese investor that the government of Timor Leste would expect to create jobs, other related business opportunities and provision of tax payment to the country.Moreover, as the owner or investor is local Timorese, the project will contribute more indirect benefits to the Timor – Leste's economy. However, the development of the above plant and facilities will also cause some negative temporary impacts that may arise during the construction of the facility and regular impacts during the operation of the production process. These impacts must be assessed in the conceptual and design phase of the project so that proper mitigation measures could be

proposed to minimize the impacts during each phase of project development. At the end, maximum benefit with minimum impacts will be realized by project owner, government, publics, and nearby community's members.

This EIS has been prepared by PEC –Consulting LDA, on behalf of GOTA Bebidas e Alimentos, LDA, in responding to the requirement of the Decree Law 5/2011 that makes it mandatory for every major development to go through the proper Environmental Impacts Assessment (EIA), where the result of the EIA is put into the EIS, before the permit was granted to commence the construction activity and the operation of the proposed facility. A total investment of US$12 million from GOTA e Alimentos, LDA willbe put mainly on the preparation and construction of the plants, where the majority of this investment goes to industrial buildings and equipment such as pressure vessels, reactors, tanks, etc. A wastewater treatment plant to treat wastewater produced from the facility will also be constructed.

The environmental impacts assessment (EIA) was carried out by reviewing all background information related to the nature of the project, necessary field data collection to measure baseline physical parameters of the environment, stakeholder engagement in order to socialize the proposed project to potentially affected community, and analyses of all the potential impacts that will arise during project execution. More importantly, an environmental management plan (EMP) was proposed to be implemented by the project owner in order to avoid, minimize or offset the impactsduring each phase of project implementation.

The proposed development project consist of several major components that inter-linkage in a series of operation:

- Groundwater extraction
- Water treatment system
- Beer processing plant
- Carbonated soft drink processing plant
- Wastewater treatment plant
- Support system (utilities)

Each component of the project will cause adverse impacts that need to be assessed and mitigated during the project implementation. The summary of each impacts and mitigation measures are presented in the following section.

1.2 Environmental Impact Assessment and Management Plan

Table 1.1 Summaries of Likely Impacts during each of Project Implementation

Environmental impacts or concern	Source Activities		
	Pre-Construction Activities	Construction Activities	Operation and Maintenance Activities
General Impacts			
Loss of vegetation on the site	v		
Noise and Vibration	v	v	v
Dust and spoil	v	v	
Oil spill	v	v	v
Climate change impacts (Greenhouse Gas Emission from Vehicle)	v	v	v
General health and safety hazard	v	v	v
Energy consumption (Esp. high during O&M)			v
Solid waste	v	v	v
Water Consumption (high during the operation)			v
Impacts from Groundwater Withdrawal			
Over Pumping of groundwater			v
Seawater intrusion			v
Potential land subsidence			v
Impacts from Water Treatment (Desalination) Plant			
Wastewater production			v
Impacts from Beverage Processing Plant			
Sludge production			v
Greenhouse Gas Emission from process			v
Impacts from Waste Water Treatment Plant and Disposal			
Handling of wastewater in the plant			v
Changes in physical parameters of coastal water			v
Changes in chemical parameters of coastal water			v
Eutrophication			v
Bottom contamination			v
Impacts from Solid Waste			
Handling of solid waste			v
Contribute to high BOD, COD, and other qualities of wastewater			v

Health and odor issue			v
Required space and potentially create other hazardous material			v
Valuable by product that could be re-utilize			v

The above impacts will be received by the surrounding environment, people who work within the processing plant, as well as communities living nearby or workers in the facility. The natural environments that will be affected by the project consist of the following:

- Coastal ecosystem, which consist of mangrove, seaweed, seagrass, coral, and other flora and fauna within the ecosystem. This ecosystem is the ultimate receptor of the waste load (both solid and liquid) that potentially discharges from the plant in the absence of employing proper mitigation measures.
- Groundwater aquifer system, where the water will be withdrawn from. As consequence of groundwater pumping for utilization within the plant (for processing and other uses), the aquifer environment will be affected. Potential risk due to over pumping of the water will create impacts that will affect the aquifer and soil on the top of the aquifer.
- Surrounding soil (as well as the aquifer) that can be potentially contaminated by pollutant from the plant. When no prevention is installed, surrounding soil will receive the effluent treated wastewater and over time the waste load will accumulate in soil and at the certain point the assimilative capacity of the soil gets saturated. Consequently, soil will be polluted an the pollutant will be transported downward during the percolation process and eventually contaminate the groundwater aquifer system
- Air/atmosphere that will receive the greenhouse gas emission and eventually contribute to the global climate change.

In order to minimize the above impacts to the existing environment, a proposed mitigation measures in the form of action plan would be necessary. The action plan is the environmental management plans (EMP). The EMP must be implemented by the project owner. The EMP of eachimpactduring each stages of the project implementation is provided in the following tables. The impacts and action plans proposed will be presented in the following tables, are separated based on the phases of the project:

- Pre-Construction Phase
- Construction Phase
- Operation Phase

Table. 1.2 Impacts and Management Plan during Pre-Construction and Construction

Phase	Type of Activity	Potential Impacts /factor of concern	Action Plan
Pre-Construction	Site preparation and grading	soil erosion	➢ Reducing or preventing erosion by: • Scheduling the site preparation such to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical • Contouring and minimizing length and steepness of slopes • Mulching to stabilize exposed areas • Re-vegetating areas promptly • Designing channels and ditches for post-construction flows • Lining steep channel and slopes (e.g. use jute matting)
		Sedimentation	➢ Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical ➢ segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release
		Slope Stability	➢ Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented ➢ Providing adequate drainage systems to minimize and control infiltration
		Loss of vegetation	Replanting in other area
		Air quality	➢ Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements ➢ Avoiding open burning of solid
		Disturbance of water body	➢ Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for road watercourse crossings ➢ Restricting the duration and timing of in-stream activities to lower low periods, and avoiding periods critical to biological cycles of valued flora and fauna (e.g., migration, spawning,etc.) ➢ For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water ➢ Consider using trenchless technology for pipeline crossings (e.g., suspended crossings) or installation by directional drilling
Construction	Construction Plants,	Noise and Vibration	➢ Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance

	Wastewater Treatment Plant, Office Building, Parking and Others		➢ Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines. ➢ Avoiding or minimizing project transportation through community areas
		Solid waste	Proper collection of solid waste from various sources such as concrete material, excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills, can be manage onsite
		Wastewater discharge from workers	Construction and decommissioning activities may include the generation of sanitary wastewater discharges in varying quantities depending on the number of workers involved. Adequate portable or permanent sanitation facilities serving all workers should be provided at all construction sites
		Hazardous Material	➢ Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids, ➢ Using impervious surfaces for refueling areas and other fluid transfer areas ➢ Training workers on the correct transfer and handling of fuels and chemicals and the response to spills ➢ Providing portable spill containment and cleanup equipment on site and training in the equipment deployment
		Land contamination	➢ Managing contaminated media with the objective of protecting the safety and health of occupants of the site, the surrounding community, and the environment post construction or post decommissioning ➢ Understanding the historical use of the land with regard to the potential presence of hazardous materials or oil prior to initiation of construction or decommissioning activities ➢ Preparing plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land
	OHS - Hazard	Over-exertion	➢ Training of workers in lifting and materials handling techniques in construction and decommissioning projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary ➢ Planning work site layout to minimize the need for manual transfer of heavy loads ➢ Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations ➢ Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks
		Slips and Falls	➢ Implementing good house-keeping practices, such as the sorting and placing loose construction

			materials or demolition debris in established areas away from foot paths ➢ Cleaning up excessive waste debris and liquid spills regularly ➢ Locating electrical cords and ropes in common areas and marked corridors ➢ Use of slip retardant footwear
		Work in Heights	➢ Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface ➢ Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds ➢ Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces
		Struck By Objects	➢ Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels ➢ Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable ➢ Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap ➢ Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged ➢ Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures ➢ Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes
		Moving Machinery	➢ Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic ➢ Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle ➢ Ensuring moving equipment is outfitted with audible back-up alarms ➢ Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job- site elevations.

		Dust	➢ Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements ➢ PPE, such as dusk masks, should be used where dust levels are excessive
		Confined Spaces and Excavations	➢ Controlling site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning ➢ Providing safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders ➢ Avoiding the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated
		Other Site Hazards	➢ Use of specially trained personnel to identify and remove waste materials from tanks, vessels, processing equipment or contaminated land as a first step in decommissioning activities to allow for safe excavation, construction, dismantling or demolition ➢ Use of specially trained personnel to identify and selectively remove potentially hazardous materials in building elements prior to dismantling or demolition including, for example, insulation or structural elements containing asbestos and Polychlorinated Biphenyls(PCBs), electrical components containing mercury ➢ Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection
	Community Health and Safety	General Site Hazards	➢ Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community ➢ Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials
		Disease Prevention	Similar action as during the operation site on the general OSH
		Traffic Safety	Refer to the traffic safety in the general OSH

Table 1.3 Summaries Occupational Health and Safety Impact Assessment and Environmental Management Plan (EMP) – During the Operation Phase

Type of Hazard	Potential Hazard Source/factor of concern	Action Plan and Mitigation Measures
General Hazard within Working Place	Integrity of work place structure	➢ Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds. ➢ Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions. ➢ Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls. ➢ Floors should be level, even, and non-skid. ➢ Heavy oscillating, rotating or alternating equipment should be located in dedicated buildings or structurally isolated sections.
	Severe weather facility shut down	➢ Work place structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate. ➢ Standard Operating Procedures (SOPs) should be developed for project or process shut-down, including an evacuation plan. Drills to practice the procedure and plan should also be undertaken annually
	Workspace and exit	➢ The space provided for each worker, and in total, should be adequate for safe execution of all activities, including transport and interim storage of materials and products ➢ Passages to emergency exits should be unobstructed at all times. Exits should be clearly marked to be visible in total darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time, and there should be a minimum two exits from any work area. ➢ Facilities also should be designed and built taking into account the needs of disabled persons.
	Fire precaution lavatory shower	➢ Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present. ➢ Provision of manual firefighting equipment that is accessible and simple to use Fire and emergency alarm systems that are both audible and visible
	Lavatory and showers	➢ Adequate lavatory facilities (toilets and washing areas) should be provided for the number of people expected to work in the facility and allowances made for segregated facilities, or for

		indicating whether the toilet facility is “In Use” or “Vacant”. Toilet facilities should also be provided with adequate supplies of hot and cold running water, hand drying devices. ➢ Where workers may be exposed to substances poisonous by ingestion and skin contamination may occur, facilities for showering and changing into and out of street and work clothes should be provided.
	Potable water supply	➢ Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking ➢ Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards
	Lighting	➢ Workplaces should, to the degree feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers’ safety and health, and enable safe equipment operation. Supplemental ‘task lighting’ may be required where specific visual acuity requirements should be met. ➢ Emergency lighting of adequate intensity should be installed and automatically activated upon failure of the principal artificial light source to ensure etc.
	Safe access	➢ Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access ➢ Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted ready access ➢ Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc. ➢ Openings should be sealed by gates or removable chains ➢ Covers should, if feasible, be installed to protect against falling items ➢ Measures to prevent unauthorized access to dangerous areas should be in place
	clean eating area	Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances
	First aid	➢ The employer should ensure that qualified first-aid can be provided at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work ➢ Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response ➢ Where the scale of work or the type of activity being carried out so requires, dedicated and appropriately equipped first-aid room(s) should be provided. First aid stations and rooms should be equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids

		➢ Remote sites should have written emergency procedures in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.
	Air supply	➢ Sufficient fresh air should be supplied for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process related emissions. Air distribution systems should be designed so as not to expose workers to draughts ➢ Mechanical ventilation systems should be maintained in good working order. Point-source exhaust systems required for maintaining a safe ambient environment should have local indicators of correct functioning. ➢ Re-circulation of contaminated air is not acceptable. Air inlet filters should be kept clean and free of dust and microorganisms
	Working environment temperature	The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.
Physical Hazard	Rotating and Moving and equipment	➢ Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions ➢ Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance, in conformance with a standard such as CSA Z460 Lockout or equivalent ISO or ANSI standard ➢ Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms
	Noise and vibration	➢ No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing . protection ➢ The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A) ➢ Further guideline on the noise and vibration is given in the section 8.1.2.3.
	Electrical	➢ Marking all energized electrical devices and lines with warning signs ➢ Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance
	Eye hazard	➢ Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should

		conform to standards published by organizations such as CSA, ANSI and ISO ➢ Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors. Provisions should be made for persons who have to wear prescription glasses either through the use over glasses or prescription hardened glasses
	Welding or hot work	➢ Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required ➢ Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hotwork on tanks or vessels that have contained flammable materials.
	Illumination	Using proper light illumination: ➢ Emergency light with the light intensity of 10 lux ➢ Outdoor non-working area should use the light intensity of 20 lux ➢ Simple orientation and temporary visit (machine storage, garage, warehouse) should use 50 lux ➢ Workspace with occasional visual task only (Corridors, stairways, lobby, elevator, auditorium, etc.) shall use 100 lux ➢ Medium precision work (simple assembly, rough machine work, welding, packing =) shall use 200 lux ➢ Precision work (reading, moderately difficult assembly, sorting, etc.) use 500 lux ➢ High precision work (difficult assembly, fine sorting, inspection, etc.) shall use 1000-3000 lux
	Vehicle and site traffic	➢ Training and licensing industrial vehicle operators in the safe operation of specialized

		vehicles such as forklifts, including safe loading/unloading, load limits ➢ Ensuring drivers undergo medical surveillance ➢ Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms ➢ Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures(e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction ➢ Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate
	Working at height	➢ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area ➢ Proper use of ladders and scaffolds by trained employees ➢ Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines ➢ Appropriate training in use, serviceability, and integrity of the necessary PPE ➢ Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall
Personal Protection Equipment (PPE)	Eye and face Protection	Safety Glasses with side-shields, protective shades, etc.
	Head Protection	Plastic Helmets with top and side impact protection.
	Hearing Protection	Hearing protectors (ear plugs or ear muffs).
	Foot protection	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
	Hand Protection	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
	Respiratory protection	➢ Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available. ➢ Portable or supplied air (fixed lines). On-site rescue equipment.
	Body/leg protection	Insulating clothing, body suits, aprons etc. of appropriate materials
Chemical Hazard	Refrigerant leaking	Breweries often have large refrigeration systems, typically using ammonia refrigerant which is toxic and can form explosive mixtures in air. Safety and other guidance offered by professional refrigeration institutions should be adopted in refrigeration system siting, design, maintenance, and operation.
	Asphyxiation	Carbon dioxide is produced during fermentation and maturation processes, carbon dioxide can be recovered, and carbon dioxide and / or nitrogen are stored and used in many brewery processes where inert atmospheres are required. Uncontrolled release of these gases or inadequate

		ventilation, particularly in confined or enclosed spaces such as fermentation and maturation rooms can result in accumulation of sufficient concentration to present asphyxiation risk. Appropriate safety measures should be developed based on a risk assessment, and may include enhanced ventilation, guidance on safe
Biological Hazard	Biological agent should be grouped into four. ➢ ***Group 1:*** Biological agents unlikely to cause human disease, and consequently only require controls similar to those required for hazardous or reactive chemical substances ➢ ***Group 2:*** Biological agents that can cause human disease and are thereby likely to require additional controls, but are unlikely to spread to the community ➢ ***Group 3***: Biological agents that can cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community, for which there usually is effective prophylaxis or treatment available and are thereby likely to require extensive additional controls ➢ ***Group 4:*** Biological agents that can cause severe human disease, are a serious hazard to workers,	➢ If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents cannot be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits. ➢ Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum ➢ The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs ➢ Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards

	and present a high risk of spreading to the community, for which there is usually no effective prophylaxis or treatment available and are thereby likely to require very extensive additional controls	

Table 1.4 Impacts Assessment and Mitigation Measures of Community Health and Safety – during the Operation Phase

Type of Hazard	Potential Hazard Source/factor of concern	Action Plan - EMP
Water availability and quality	Water Availability - over pumping of groundwater pumping will cause water availability problem	Company to provide access water to the community
	Water Quality - wastewater discharge into the groundwater system	➢ Community to drill bore near the project facility ➢ Proper discharge of wastewater
Structural safety of project infrastructure	Reduction of potential hazards is best accomplished during the design phase when the structural design, layout and site modifications can be adapted more easily	➢ Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions ➢ Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, tsunamis, wind, flooding, landslides and fire ➢ Application of locally regulated or internationally recognized building codes to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response ➢ Engineers and architects responsible for designing and constructing facilities, building, plants and other structures should certify the applicability and appropriateness of the structural criteria employed.
	Follow international best practice in design and construction of the facility and infrastructure	➢ Existing structures ➢ Soils and foundations ➢ Site grading ➢ Structural design ➢ Specific requirements based on intended use and occupancy ➢ Accessibility and means of egress ➢ Types of construction ➢ Roof design and construction ➢ Fire-resistant construction ➢ Flood-resistant construction ➢ Construction materials ➢ Interior environment ➢ Mechanical, plumbing and electrical systems

		➢ Elevators and conveying systems ➢ Fire safety systems ➢ Safeguards during construction ➢ Encroachments into public right-of-way
	Management action to reduce the hazardous material storage	➢ Reducing inventories of hazardous materials through inventory management and process changes to greatly reduce or eliminate the potential off-site consequences of a release Modifying process or storage conditions to reduce the potential consequences of an accidental off Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration ➢ Reducing the probability that releases will occur through improved site operations and control, and through improvements in maintenance and inspection ➢ Reducing off-site impacts of releases through measures intended to contain explosions and fires, alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public codes, local fire department regulations, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety (L&FS) standard.
	Follow proper compliance with the Life and Fire Safety objectives outlined in these guidelines	➢ Project sponsors' architects and professional consulting engineers should demonstrate that affected buildings meet these life and fire safety objectives. ➢ Life and fire safety systems and equipment should be designed and installed using appropriate prescriptive standards and/or performance based design, and sound engineering practices. ➢ Life and fire safety design criteria for all existing buildings should incorporate all local building codes and fire department regulations.
Life and fire safety	**Fire prevention**: Fire prevention addresses the identification of fire risks and ignition sources, and measures needed to limit fast fire and smoke development.	➢ Fuel load and control of combustibles ➢ Ignition sources ➢ Interior finish flame spread characteristics ➢ Interior finish smoke production characteristics ➢ Human acts, and housekeeping and maintenance
	Means of Egress : Means of egress includes all design measures that facilitate a safe	➢ Clear, unimpeded escape routes ➢ Accessibility to the impaired/handicapped

	evacuation by residents and/or occupants in case of fire or other emergency,	➢ Marking and signing ➢ Emergency lighting
	Detection and Alarm Systems: These systems encompass all measures, including communication and public address systems needed to detect a fire and alert:	➢ Building staff ➢ Emergency response teams ➢ Occupants ➢ Civil defense
	Compartmentation: Compartmentation involves all measures to prevent or slow the spread of fire and smoke, including	➢ Separations ➢ Fire walls ➢ Floors ➢ Doors ➢ Dampers ➢ Smoke control systems
	Fire Suppression and Control: Fire suppression and control includes all automatic and manual fire protection installations, such as:	➢ Automatic sprinkler systems ➢ Manual portable extinguishers ➢ Fire hose reels
	Emergency Response Plan	An Emergency Response Plan is a set of scenario procedures to assist staff and emergency response teams during real life emergency and training exercises. This chapter of the and Life Safety Master Plan should include an assessment of local fire prevention and suppression capabilities.
	L&FS Master Plan Review and Approval	➢ A suitably qualified professional prepares and submits a Life and Fire Safety (L&FS) Master Plan, including preliminary drawings and specifications, and certifies that the design meets the requirements of these L&FS guidelines. The findings and recommendations of the review are then used to establish the conditions of a Corrective Action Plan and a time frame for implementing the changes. ➢ The suitably qualified professional conducts a review as part of the project completion test at the time of life and fire safety systems testing and commissioning, and certifies that construction of these systems has been carried out in accordance with the accepted design. The findings and recommendations of the review are used as the basis for establishing project completion or to establish the conditions of a Pre-Completion Corrective Action Plan and a time frame for implementing the changes. ➢
	Specific Requirements for Existing building	➢ All life and fire safety guideline requirements for new buildings apply to

		existing buildings programmed for Renovation. A suitably qualified professional conducts a complete life and fire safety review of existing buildings slated for renovation. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes ➢ If it becomes apparent that life and fire safety conditions are deficient in an existing building that is not part of the project or that has not been programmed for renovation, a life and fire safety review of the building may be conducted by a suitably qualified professional. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.
Traffic safety	Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public	➢ Emphasizing safety aspects among drivers ➢ Improving driving skills and requiring licensing of drivers ➢ Adopting limits for trip duration and arranging driver rosters to avoid overtiredness ➢ Avoiding dangerous routes and times of day to reduce the risk of accidents ➢ Use of speed control devices (governors) on trucks, and remote monitoring of driver actions
	Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.	
	Managing future traffic increase in the project area	➢ Minimizing pedestrian interaction with construction vehicles ➢ Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns) ➢ Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents ➢ Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic ➢ Employing safe traffic control measures, including road signs and flag

		persons to warn of dangerous conditions
Emergency Preparedness and Response	Communication System : Worker notification and communication Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency	➢ Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations ➢ Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency
	Communication notification	➢ Audible alarms, such as fire bells or sirens ➢ Fan out telephone call lists ➢ Vehicle mounted speakers ➢ Communicating details of the nature of the emergency ➢ Communicating protection options (evacuation, quarantine) Providing advise on selecting an appropriate protection option
	Media and Agency Relation	➢ A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies ➢ Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed
	Fire Service	The company should consider the level of local firefighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster. If insufficient capacity is available, firefighting capacity should be acquired that may include pumps, water supplies, trucks, and training for personnel.
	Medical Service	The company should provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital
	Availability of Resource	➢ Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency ➢ Providing personnel who can readily call up resources, as required ➢ Tracking and managing the costs associated with emergency resources ➢ Considering the quantity, response time, capability, limitations, and cost of

		these resources, for both site-specific emergencies, and community or regional emergencies ➢ Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site
	Mutual Aid	Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers. Where appropriate, mutual aid agreements should be maintained with other organizations to allow for sharing of personnel and specialized equipment.
	Contact List	The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.
	Training and Updating	
Disease and prevention	Communicable Disease	➢ Providing surveillance and active screening and treatment of workers ➢ Preventing illness among workers in local communities by: • Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use • Training health workers in disease treatment • Conducting immunization programs for workers in local communities to improve health and guard against infection • Providing health services ➢ Providing treatment through standard case management in on-site or community health care facilities ➢ Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization
	Vector Borne diseases	➢ Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements ➢ Elimination of unusable impounded water ➢ Increase in water velocity in natural and artificial channels ➢ Considering the application of residual insecticide to dormitory walls ➢ Implementation of integrated vector control programs

		➢ Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites ➢ Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs ➢ Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread • Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects ➢ Educating project personnel and area residents on risks, prevention, and available treatment ➢ Monitoring communities during high-risk seasons to detect and treat cases ➢ Distributing appropriate education materials ➢ Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure

Table 1.5 Summaries of Environmental Impacts and Mitigation Measured during Operation Phase of Plant

Source of Issues /problem	Potential Impacts	Action Plan
Water Consumption		
Groundwater Extraction	Increase water stress in the area	➢ Propose water resource protection at upland catchment system ➢ Ensure the responsible discharge of effluent ➢ Water recycling to recharge the aquifer ➢ Reduce the amount of water use in the production (technology choice and conservation)
	Affect groundwater sustainability	➢ Pumping rate to be less than sustainable yield of groundwater ➢ Monitor and controlled pumping rate to be less than sustainable yield ➢ Reduce water consumption in the entire facility ➢ Water resource protection ➢ Water recycling and recharge the groundwater aquifer ➢ Enhance recharge program from the rain water at the upland catchment, such as micro DAM or rain harvesting to collect the store temporarily to allow the rain water to infiltrate into the groundwater
	Affect salt water intrusion	
	Susceptibility of groundwater contamination	
	Land subsidence	
	High energy cost of water pumping - contribute to greenhouse gases emission	➢ Water conservation to reduce rate of water consumption ➢ Work together with the government to find other water sources in the mountain area that will be used for brewing and community ➢ Apply energy alternative to complement the energy need (solar and wind energies)
Water treatment system	High cost of treatment	➢ Water conservation to reduce rate of water consumption

		➢ Apply energy alternative to complement the energy need (solar and wind energies)
	Wastewater - Brine disposal	➢ Applies proper dilution with sea water prior to discharging into the sea ➢ Reduce the brine discharge by reducing water consumption rate with water conservation program
Energy Consumption		
➢ Beverage processing plant ➢ wastewater Treatment Plant ➢ Water Treatment plant ➢ Pumping of groundwater ➢ Utility uses ➢ Beverage proc	High operating cost /expensive	➢ Monitor and measures the energy consumption within the facility (possible for each section) ➢ Using the data to perform the energy auditing system ➢ Reduce the usage per unit production of beverage by applying the energy conservation within the facility ➢ Switch to more renewable energy source
	Contribute to greenhouse gas emission	
		Energy conservation and Management: ➢ Energy management (optimizing the energy utilization) ➢ Energy efficiency in both cooling and heating system ➢ Energy conservation system
Solid waste Management		
Spent Grain	➢ Contributing to the high BOD/COD if discharge into wastewater stream ➢ Large quantity which required space to store ➢ Odor and create other problems ➢ Potentially becomes bio-hazard	➢ Reduce the quantity by increasing the efficiency of raw material conversion to product ➢ Reused by sending to farmer as cattle food ➢ Recycle via composting ➢ Convert to fuel (Bio-process) but it will required higher capital investment
Spent yeast	➢ Unpleasant odor ➢ Contribute to high BOD and COD if discharge into drain/wastewater stream ➢ Potential becomes bio-hazard	➢ Reduce the quantity by increasing the efficiency of raw material conversion to product ➢ Save and reused yeast ➢ Reused in in bakeries to make bread or cookies ➢ Recycle via composting ➢ Convert to bio-energy (required high cost on the capital

		investment)
General solid waste	➢ Need space to store (Space limitation) ➢ Create unpleasant environment ➢ Create unhealthy environment and may be generate illness	➢ Proper Collection of the general waste in every section of the unit processing ➢ Separate bio-degradable and non-biodegradable materials - identify the recyclable material ➢ Send the recyclable material to the recycle process ➢ Non-recyclable material to be sent to sanitary land fill in Tibar
Diatomaceous Earth (DE)	➢ Significant quantity which required space to store ➢ Dust problem	➢ Reduce the quantity by optimizing the efficiency of using the DE (for instance, optimizing the particle size) ➢ Work together with Brewing team to reduce the use of DE without compromising the quality of beer ➢ Explore the membrane process to filter the beer ➢ Recycle the material for other use such as additive to the construction material (concrete cement, brick, etc.) ➢ Always keep in wet condition to ovoid the danger associate with the airborne dust
Corrugated - Cardboard	➢ Space limitation ➢ Becomes hazmat ➢ End up in the sea and polluted the sea, city, and environment	➢ Reused – can be used for packaging ➢ Reprocess into compost ➢ Dispose into the proper sanitary land filling
Wood pellets	➢ Space limitation ➢ Becomes hazmat ➢ Unhealthy environment	➢ Reused - within the facility for other uses ➢ Recycle into table ➢ Composting
Shrink wrap , Bag, sack	➢ Space limitation ➢ Becomes hazmat ➢ Non-biodegradable material, took a long time to break the molecule ➢ Unhealthy environment	➢ Reuse ➢ Incinerate in the proper location
Aluminum cans	➢ Space limitation ➢ Unhealthy environment	Recycle the cans

Plastic bottles	➢ Space limitation ➢ Unhealthy environment ➢ It takes a long time to decompose the non-biodegradable material such as plastic	➢ Reuse the bottle for other purpose ➢ Collect the bottles and recycle if possible ➢ Incinerate in the proper location
Glass bottles	➢ Space limited ➢ Becomes hazmat ➢ Unhealthy environment	➢ Reused the bottle ➢ Recycle the broken one
Leftover food	➢ Odor ➢ High BOD/COD ➢ Bio-hazard ➢ Unhealthy environment and cause sickness and poisonous	➢ Send them for animal food ➢ Dry the food to avoid the process of decomposition that cause hazard ➢ Composting the food by mixing the leftover food within organic composting material
Corrugated - Cardboard	➢ Space limitation ➢ Becomes hazmat ➢ End up in the sea and polluted the sea, city, and environment	➢ Reused – can be used for packaging ➢ Reprocess into compost ➢ Dispose into the proper sanitary land filling
Wood pellets	➢ Space limitation ➢ Becomes hazmat ➢ Unhealthy environment	➢ Reused - within the facility for other uses ➢ Recycle into table ➢ Composting
Shrink wrap , Bag, sack	➢ Space limitation ➢ Becomes hazmat ➢ Non-biodegradable material, took a long time to break the molecule ➢ Unhealthy environment	➢ Reuse ➢ Incinerate in the proper location
Aluminum cans	➢ Space limitation ➢ Unhealthy environment	Recycle the cans
Plastic bottles	➢ Space limitation ➢ Unhealthy environment ➢ It takes a long time to decompose the non-biodegradable material such as plastic	➢ Reuse the bottle for other purpose ➢ Collect the bottles and recycle if possible ➢ Incinerate in the proper location

Wastewater Management System		
High solid material	➢ Contribute to high BOD/COD ➢ Blockage the instrument and drainage system if dump into drainage system	➢ Apply physical treatment process (screening to separate solid material) ➢ Improve efficiency of production by increasing high conversion factor ➢ Apply the fine raw material to reduce solid contain in the waste ➢ Control and monitoring the process
High COD	➢ Oxygen depletion ➢ Odor emission ➢ Greenhouse gases emission	➢ Apply proper biological treatment process to reduce the COD to the level where acceptable to environment ➢ Treatment in the closed system ➢ Final disposal at the percolation of downward ➢ Control and monitor the level of treatment
High BOD	➢ Oxygen depletion ➢ Odor emission ➢ Greenhouse gas emission	➢ Apply proper biological treatment process to reduce the BOD to the level where acceptable to environment ➢ Treatment in the closed system ➢ Final disposal at the percolation of downward ➢ Control and monitor the level of treatment
High Nutrient (Nitrogen based compound)	Eutrophication	➢ Biological treatment ➢ Advance chemical treatment process ➢ Control the level of treatment system
High Phosphors	Eutrophication	➢ Biological treatment ➢ Advance chemical treatment process ➢ Control the level of treatment system
PH issues	Affect all the living organism and ecosystem	PH equalization and neutralization to adjust the PH that is acceptable to the environment
High turbidity (TSS)	Cause high turbidity and block the sun penetration and hence disturb the photosynthesis with the marine ecosystem	Treatment process
Emission of gases Management		
By product of CO2 from brewing	Greenhouse gases emission - Carbon Footprint and contribute to the global climate change	➢ Using high efficiency of CO_2 process for carbonation

Methane from anaerobic wastewater treatment Steam loss from boiler Other emission of gas within the facility		process ➢ Recover CO_2 from the beer processing plant ➢ Reduce the steam loss within the boiler ➢ Burn the methane gas
High Energy consumption	Power/ fuel consumption	➢ Applying various methods of Energy Conservation ➢ Control and monitored the energy utilization ➢ Audit the energy consumption ➢ Using the latest technology that operate at high efficiency and less fuel consumption
Impact of Climate Change		
Sea Level rise	➢ Coastal flooding ➢ Damage of infrastructure/structure in the coastal area ➢ Change in ecosystem pattern	➢ Elevated the structure (particularly floor level) within the coastal area by considering the increasing sea level rise ➢ Construction of retaining fall to protect the structure/infrastructure from the coastal flooding ➢ The Proponent to elevate all the structures within their facility above the existing/natural ground by at least 1 meter.
Change of Rainfall Pattern	➢ More frequent flooding ➢ Potential prolong drought or drought hazard ➢ Production of food in Agriculture will reduce ➢ Increase the risk of groundwater vulnerability (both quality and quantity) ➢ Sea water intrusion to the groundwater	➢ Drainage system within the project facility should already considered the rainfall change due to climate change in the design prior to the construction, so that once it is constructed, the drainage will be able to convey the storm water runoff due rainfall regardless of condition ➢ Apply water conservation to consume less water ➢ Potential treatment of sea water into the fresh water (backup plan, in case the groundwater is no longer viable to be used due to various issues ➢ Monitoring the groundwater level and sustainability estimation
Change in Temperature (becomes higher)	➢ High evaporation rate and cause water loss ➢ Increase energy consumption (refrigeration, heating, cooling, etc.)	The project owner to adjust the design parameters of the system by considering the temperature increase so that the current design and construction will accommodate the future increase of temperature
OHS – Related to the Specific Beverage Processing Plant		

Exposure to Risk	Organic dust arising from grain storage, milling, and transport operations presents an explosion risk in the areas of the Brewery where these operations occur. In addition to the guidance in the General EHS Guidelines (IFC standard, 2007)	➢ Frequent sweeping to control dust accumulation, and use of dust extraction and recycling systems to remove dust from work areas; ➢ Provision of electrical grounding, spark detection and prevention, and, if necessary, quenching systems; ➢ Use of explosion proof electrical motors, lights, switches, and connections in high risk areas; ➢ Integration of explosion relief vents in facility design and construction; ➢ Elimination of external ignition sources; ➢ Implementation of hot-work permits; ➢ Control of all smoking materials; ➢ Prohibition of cell phone use.
Exposure to Chemical	Refrigerant leaking	Breweries often have large refrigeration systems, typically using ammonia refrigerant which is toxic and can form explosive mixtures in air. Safety and other guidance offered by professional refrigeration institutions should be adopted in refrigeration system siting, design, maintenance, and operation.
	CO_2	Carbon dioxide is produced during fermentation and maturation processes, carbon dioxide can be recovered, and carbon dioxide and / or nitrogen are stored and used in many brewery processes where inert atmospheres are required. Uncontrolled release of these gases or inadequate ventilation, particularly in confined or enclosed spaces such as fermentation and maturation rooms can result in accumulation of sufficient concentration to present asphyxiation risk. Appropriate safety measures should be developed based on a risk assessment, and may include enhanced ventilation, guidance on safe
Physical Hazard	➢ Level (falling) ➢ Slippery ➢ Use of machine and tools ➢ Collision (transport equipment such as forklift, truck, and containers, etc) ➢ Dust	See the general guideline on the OSH

	➢ Pressurize gas/water system ➢ Heat and Cold system/area	
Noise and Vibration	A variety of operations in food and beverage processing units generate substantial noise levels, for example the canning plant, bottling machines, conveyors and blanching applications	➢ Using PPE ➢ Latest technology that generate less noise and vibration ➢ Applying the general OHS

Table : 1.6 Summary of Impacts and Mitigation Measures during the Deactivation (Decommissioning) of Project

Impacts	Source of Impact	Mitigation /EMP
Noise and Vibration	From all the activity to decommission of the facility and equipment	Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are
Solid waste removal	From the office building, equipment, etc.	Proper collection and disposal
Contaminant or hazardous material	From special material such as PCB and the like	Proper handling of the hazardous waste
OHS	All the activity of decommission	Applies all the relevant standard
Loss Income and opportunity	All the activity of decommission	The local company to find other opportunity from the experience that they gain during the practice
Employment problem	All the activity of decommission	Company to compensate for certain period of time for the transition in finding the new job
Loss economic opportunity for the country	All the activity of decommission	Government may engaged other similar opportunity from other foreign type of investment

1.3 Environmental Monitoring and Performance Indicators

The monitoring program should focus on major issues that can cause major impacts related to processing activity especially effluent, gas emission, and resource (water and energy) utilization. Moreover, occupational health and safety standards should always be enforced by adhering with the best available standards in the industry that has a target to achieve zero rate accident and fatality.

1.3.1 Effluent Guidelines

Wastewater effluent standards for various parameters can be seen from the following table. These standards should be used as guidelines to determine the level of wastewater treatment prior to discharging into the marine environment. Measurement and monitoring program for effluent wastewater quality parameters should be conducted in the field and report should be produced by project owner and performance should be evaluated against the following benchmark values.

Table 1.7 Wastewater Effluent Standards (IFC, 2007)

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD_5	mg/l	25
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Temperature increase	°C	<3[b]
Total coliform bacteria	MPN[a] / 100 ml	400
Active Ingredients / Antibiotics	To be determined on a case specific basis	

Notes:
[a] MPN = Most Probable Number
[b] At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

The following table shows applicable standards for solid waste and liquid waste produced from beer processing plant.

Table 1.8 byproduct and Waste Generation (IFC, 2007)

Outputs per Unit of Product	Unit	Benchmark
By-products [a]		
Spent Grains	kg/hl beer	16-19
Yeast & Lees		1.7 - 2.9
Kieselguhr		0.4 – 0.7
Liquid Wastes		
Liquid Effluents	hl/hl beer	3 – 6
Beer Loss	%	1 - 5
Notes: [a] Input and Output Figures for Large German Breweries (capacity over 1 million hl beer) EC (2006		

1.3.2 Resource Utilization Guidelines

The sustainability of the proposed plant will depend on how well the resources are utilized efficiently. The more efficient in managing the resources, the better off the company in making profit on one hand and the better off the environment on the others waste will be reduced.

Two important resources are in use extensively at the facility are energy and water. To efficiently manage the use of these resources, mitigation measures should be implemented with clear indicators (following table).

Table1.9 Proposed Guideline of Resources Utilization (IFC, 2007)

Outputs per Unit of Product	Unit	Benchmark
Energy [a]		
Heat	MJ/hl	85–120
Electricity	kWh/hl	7.5–11.5
Total Energy	MJ/hl	100-160
Water [a]		
Water consumption	hl/hl beer	4 - 7
Notes: [a] Input and Output Figures for Large German Breweries (capacity over 1 million hl beer) EC (2006)		

1.3.3 OHS Guideline and Standard

The implementation of Occupational Health and Safety (OHS) measures should be monitored and evaluated based on international standards. The standards may refer to the US, European best practice standards or applicable ISO standards (ISO 18001).

Table1.10 Reference Standard of the OSH Implementation

Implementation	Guidelines
Proposed OHS - EMP	➢ Occupational Safety and Health Administration of the United States (OSHA) ➢ Indicative Occupational Exposure Limit Values published by European Union member states, ➢ ISO 18001 ➢ IFC performance standard
ISO	

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals, as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents,

diseases, and dangerous occurrences and accidents. Further detail on the action plan has been presented in the general OHS. The following table shows the safety parameters and indicators for GOTA's facility

Table 1.11GOTA Proposed Safety Parameters Indicator

Parameters	1. Fatal accidents	Fatalities of workers in the facility
	2. Accidents resulting in permanent disability	Permanent disabilities of workers
	3. Accidents resulting in absence from work	Accidents involving workers
	4. Lost days	Absence due to an accident
Performance Indicators	1. Accident frequency	Workers, numbers of accidents resulting in absence of work per 100 Full Time Equivalent (FTE)
	2. Accident severity	Workers, lost days per 100 FTE

1.4 Public and Community Consultation

The EIS process has been conducted by following each step as required in the Decree Law 5/2011. The community and public were engaged and consulted regarding the project in general and scope of environmental impacts to be carried out, where the summary of finding has presented earlier. The finding of this EIS study was consulted and verified with the relevant government agencies and NGOs who have direct interest and work correlation to the proposed project and area of interest. All the comment and suggestion have been elaborated in this report and can be found in the public and community consultation chapter.

In principal, the government agencies and NGOs provide positive view related to the project development, as the project will provide a lot of positive impacts to the economy and society but the government agencies and NGOs also hoped that the EMP will be implemented by the project owner. These agencies and NGOs will also involve actively in the monitoring program to ensure the result.

Moreover, the local community, nearby project location who are affected directly by the project was also engaged and consulted their opinion on the project. In general the community welcomes the development but raised some concern related to the land compensation to the project owner and hope that some of their men and women will be employed by GOTA in this facility.

The following table provides summaries of community and public consultations during the preparation of the EIS document.

Table 1.12: Summary of Public and Community Consultation During the EIS process

Date	Type of Consultation	Result and Issue
2014 - 2015	Meeting relevant line ministries and local authority in the project location	Government response positive to the investment and local also welcome their business to the site to create job and opportunities
14 June 2017	TOR - Scoping consultation with the public and relevant stakeholder in Hotel Dcity	The scoping study proposed in the environmental impacts assessment should cover the groundwater, solid waste, and marine water quality measurement. Issue to be considered: 1. Water pumping from the groundwater system that includes the sustainability, public access to the clean water, and mechanism of monitor groundwater utilization. 2. Effect of stream flow (flooding) to the nature of the project, given the location of the project within the proximity of the small creek 3. System transportation of raw material and product from /to the facility 4. The scale and size of the project and categorization 5. Wastewater and mechanism of the wastewater handling 6. Land title and the impact of the project to the community and monitoring of the quality (product and wastewater) should be informed other relevant government agency such as SAS and Ministry of Health 7. The impact of above groundwater activity to the underground system such as groundwater 8. The distance of the project location to the nearest community 9. Recommendation of the treatment of the wastewater The above issues have been addressed and clarified by project owner and consultant during the meeting and in this document of the EIS

26 August 2017	Consultation and socialization of the project and impacts of environment to community in the Suco Ulmera	The community nearby project location raised several issue related to the following: 1. Road access that has not improved 2. Water issue (community asked the company if they can provide water for community) 3. Solid waste handling 4. Impacts of dust and how to handle them 5. Groundwater utilization 6. Job employment to consult with the local authority in Ulmera and give priority to local people
20 October 2017	Consultation and presentation of result of the EIS to the relevant stakeholder and NOGs	Various issues and concerns were discussed related to the draft of Environmental Impacts Statement (EIS) that was presented. The following are the summary of concerns and issues raised: - Emergency management system - Design of drainage system that convey the treated wastewater - Groundwater pumping test data and groundwater sustainable yield estimation - The quantity of solid waste and management of solid waste system - How this proposed brewing system will compete the Heineken brewing plant in Hera All the above issue and question have been addressed by the representative from GOTA, PEC during the meeting and in the document of EIS

1.5 Positive Social and Economic Impacts of the Project

With the implementation of the project (operation) and decommissioning phases, there several key positive and negative impacts, which can be summarized in the following table.

Table 1.13 Summary of Positive and Negative Impacts of the project

Positive	Negative
Pre and Construction Phase	
1. Temporary job for Timorese in construction activity, feasibility study, EIA, and other related works 2. Positive effect to the investment grow in Timor Leste	1. OHS impacts 2. Negative impact due to dust, noise and vibration, loss of vegetation 3. More impervious land surface will cause more surface runoff
Operation Phase	
1. Reduce or eliminate the net import of beverage in Timor Leste 2. Create employment to youth of Timorese 3. Provision of tax payment to the government of Timor Leste 4. Social corporate responsibility that project owner is doing to the community 5. Good and viable business scale in Timor Leste 6. Potential technical skills transfer from the project owner to the local Timor – Leste, through the continuous training and involvement in the project implementation	1. Some potential environmental risk (air quality, groundwater contamination, wastewater, hazardous waste, etc.) that already presented in this document, the negative impacts could all be mitigated with the technical, as well as non-technical approaches 2. If disaster occurs such as fire and explosion, potential loss could be high
Decommissioning Phase	
1. Potential land availability 2. Potential new provider or business opportunity for other company, potentially, the local Timorese	- Provide negative contribution to the Timor – Leste's economy - Loss of income from the project owner - Loss job for Timorese, which create some social issue - Government loss the revenue from the income/service tax that the company will pay if the project close

Considering more positive impacts during the project operation and more negative impacts will be created if the project closed, then it is recommended to continue the project or any consideration to decommission the project should be assessed in detail in order to minimized the impacts and maximized the positive impacts

2. DETAILS OF PROJECT PROPONENT

The project is proposed by GOTA Bebidas e Alimentos LDA. Company's representative and his contact details are provided as follows:

Mr. Nilton T. Gusmao do Santos (Director)
Rua San Jose, Bairo Pite, Dom Aleixo
Dili, Timor Leste

Telephone: +670 3322336
Mobile: +670 77243585
Email: info@eto.tl

GOTA Bebidas e Alimentos Lda is a Timorese Company has already operating since 2013 that specializes in bottled water production and distributing in Dili and other places in Timor Leste territory.

3. DETAILS OF THE EIA CONSULTANTS

The Environmental Impacts Statement (EIS) and Environmental Management Plan (EMP) have beenprepared by PEC Consulting, Lda., a Timorese-own planning and engineering consulting company headquartered in Dili. PEC Consulting is headed by Sr. Krispin Fernandes, PhD., who has qualifications in Chemical Engineering, Hydrology and Environmental Planning and Engineering. PEC Consulting has experience in Timor Leste in the area of environmental and planning for developmental projects including - irrigation infrastructure, water infrastructure, drainage infrastructure, and environmental impact assessment for environmental licensing according to Timor Leste regulatory framework.

Staffs involved in the environmental assessment and preparation of the EIS are listed in the following table.

Table 3.1 Summary of Consultant Staff who prepared the EIS document

No	Staff	Expertise
	CONSULTANT STAFF	
1	Sr. Krispin Fernandes, PhD	He has more than 15-years of experience in environmental engineering, process engineering, and wastewater treatment and disposal into the deep ocean through a marine outfall. Sr. Krispin has undergraduate degree in Chemical Engineering, hence is qualified to understand the manufacturing processes involved in beer production
2	Sr. Mario Marques Cabral, S.Si, M.Sc	Mr. Mario has more than 15-years of professional experience in marine biology and fishery assessment including assessment of socio-economic characteristics of coastal community. He is a marine ecological specialist for PEC Consulting and has involved in most of the projects under PEC management.
3	Sr. Juvencio dos Santos	Trained Economist and social impacts assessment specialist. He has two year of experience in data collection and analysis of social and economic profile
4	Sra. Rosalyn Fernandes, S.T. MURP	Rosalyn has substantial professional experience in delivering small to large scale environmental impacts assessment documents, including for fuel storage development, University Campus development, Sanitation Improvement Schemes, etc. She has recently finalized a task as senior environmental specialist who writes the environmental assessment reports for ADB loan funded road project.
5	Sr. Venancio Rego Fernandes, S.T.	Trained in Industrial Engineering, Venancio has experience working as plant engineer in major manufacturing establishment in Indonesia, environmental officer and recently as a project engineer for stream flow and meteorology study in Timor Leste
6	Crisanto dos Santos	Graduated with a diploma in computer engineering, Crisanto serves as a logistic officer in the project.

The detailed descriptions of PEC profile, including various projects that have completed in the past can are presented as followed.

3.1 PEC – Consulting Summary

Since its establishment four years ago, PEC has involved in various development projects and has successfully delivered 15 projects (small – medium size of the projects). The company has a vision to support sustainable infrastructure development in Timor Leste through proper planning and engineering design that also adhere to the social and environmental safeguarding principals.

The areas of specialties of PEC consulting include:

(1). Hydrologic and Hydraulic Analysis for various infrastructure development
(2). Environmental Impacts Assessment (EIA) and Licensing for various infrastructure projects
(3). Survey - Topographic and Bathymetric data collection
(4). River flow estimation and Catchment Analysis
(5). Hydro-Meteorological Data Collection

Our client of the consultancy works includes private sectors and international agencies such as JICA, World Bank, and Asian Development Bank (ADB).

3.2 Resume of Specialist Involved in this Project

3.2.1 Krispin Fernandes, PhD

He has more than 15-years of experience in environmental engineering, process engineering, and wastewater treatment and disposal into the deep ocean through a marine outfall. Sr. Krispin has undergraduate degree in Chemical Engineering, hence is qualified to understand the manufacturing processes involved in beer production

A. Experiences:

1. ***2012- Present, Principle Environmental Engineer, at PEC – Consulting, that has completed all the environmental impacts Assessment (EIA) from Beverage processing plant, fuel storage development, quarry, and cement industry, and irrigation infrastructure development.***
2. *April 2013 – July 2013,* **Consultant for Aurecon, Pty., Ltd. On Water and Wastewater Treatment Design in F-FDTL Training Center, Metinaro, Timor Leste**
3. *November 2012 – July 2013,* **Consultant for Japan International Cooperation Agency (JICA) on Irrigation Rehabilitation and Improvement Project, Laleia, Manatuto, with primary duty on the hydrological survey and environmental baseline data collection**
4. *October 2011 –July 2012, Consultant for* **SKM Consulting, Australia, working on the Dili urban drainage and sanitation master plan, including training of GIS and Hydrological Modeling for GoTL staff**

5. *February 2011 – October 2011, consultant for* **Melbourne Water Corporation** , working on the Dili Hydrological Modeling and data collection for master plan development of Sanitation and Drainage system of Dii

6. *June- December 2010,* **Water Resource Research University of Hawaii at Manoa, Post-Doctoral Research Scholar working on the project of** : Survey and modeling analysis of Municipal Separate Storm Sewer System (MS4) at highway storm runoff network on Oahu, Hawaii, USA.

7. *July 2006 – August 2010, University of Hawaii at Manoa,* **Research Assistant at Water Resource Research Center, University of Hawaii at Manoa,**

8. *Summer 2002 and Summer 2003,* **Climate and Information System Project Intern, National Oceanographic and Atmospheric Administration (NOAA), Office of GlobaI Program (OGP), Silver Spring, Maryland, USA**

10. *November 1999 – January 2000* **, Staff at Oxfam International Australia in Timor Leste, working on the** Water supply and sanitation improvement project in Dili, Liquica, and Bobonaro

B. University Education

No	*University*	*Main Course of Study*	*Place*
1.	University of Hawaii at Manoa	Civil and Environmental Engineering (Completed Doctor of Philosophy)	Honolulu, Hawaii, USA
2.	University of Hawaii at Manoa	Civil and Environmental Engineering (Completed Master Degree)	Honolulu, Hawaii, USA
3.	Gadjah Mada University	Chemical Engineering (Completed Bachelor Degree)	Jogjakarta, Indonesia

C*. Computer Skill*

1. ArcGIS 9.3.1 : Mapping, data conversion, spatial analyst, 3D analyst, and other general GIS operation
2. ArcView 3.x: Mapping, spatial analyst
3. EPA-BASINS/MapWindow: GIS-based modeling, database management
4. HEC-HMS: Catchment hydrological modeling
5. HEC-RAS: River Hydraulic modeling
6. GEO-HEC-RAS: Flood plain modeling
7. EPA-SWMM: Hydraulic modeling for urban drainage system
8. EPANET: Drinking water distribution modeling
9. MS. Office: Excel, words, power point, front page

D. Publications

1. **Fernandes K**, Liu C.C.K.,Moravcik, P. 2010. GIS-Based Linear Systems Modeling of Watershed Sediment Transport Process. (*presented at 2010 AWRA Annual Conference in Philadelphia, USA*)
2. Liu C.C.K, **Fernandes K**. 2009. Linear Systems Modeling of Watershed Hydrology and Sediment Transport. *The 3rd IWA-ASPIRE Conference, International Water Association (IWA), October 188211;22, 2009, Taipei, Taiwan*
3. **Fernandes K**, Liu C.C.K. 2005. Flood Hydrograph Analysis for Manoa Watershed, Oahu, Hawaii. *Proceedings of AWRA 2005 Summer Specialty Conference.* Honolulu, Hawaii, American Water Resources Association, Published in CD-ROM
4. Liu C.C.K., **Fernandes K**. 2006. Natural-Energy-Driven Brackish Water desalination: Field testing and mathematical modeling. *Technical Report, water resources research center, University of Hawaii at Manoa*, Honolulu, HI, USA

3.2.2 Rosalyn Fernandes, S.T., MURP

Rosalyn has substantial professional experience in delivering small to large scale environmental impacts assessment documents, including for fuel storage development, University Campus development, Sanitation Improvement Schemes, etc. She has recently finalized a task as senior environmental specialist who writes the environmental assessment reports for ADB loan funded road project.

A. Experience

1. *January 2014 – Present, PEC – Consulting,* **Environmental Specialist,**
   Working on Simplified Environmental Impact Statement (SEIS) and full scale EIS under contract from PEC Consulting. Responsibility including desk review of relevant document, field investigation, document write ups, presentation and coordination of other specialist.

2. *October 2012– October 2013***Consultant for Timor Leste Greenhouse Gas (GHG) Inventory,** Contracted service at UNDP Timor Leste for the national GHG Inventory and Mitigation Options Analysis. Duties include conducting research, analysis, workshop and training for stakeholders from different agencies. Stakeholders include ALGIS, SOL, DNMA, DNAAI, Forestry, Fisheries, DNSSB, EDTL, and others.
3. *June – July 2012,* **Environmental Specialist,** Part of the team that put together the Environmental Impact Assessment document for development of UNTL Hera facility on 365 ha land. Responsible for baseline write up on socio-economic condition and waste management. Responsibilities include report writing, analysis, map making, community consultation, client liaison. Contracted service by Oasis, Sustainable Projects.
4. *January – May 2012,* **Community Engagement Specialist**,Contracted by SKM International, coordinated and implemented Sanitation Willingness to Pay Survey (600 samples), coordinated and implemented Flooding Damage Survey (50 samples), and coordinated and implemented community consultation (qualitative survey) covering topics:

environmental cleanliness, sanitation, hygiene, solid waste, flooding, and kangkung management.

5. *February – June 2012,* **Consultant for State Secretary for the Environment,**
   Consultant for Timor Leste State Secretary for the Environment (SEMA) working on compilation and analysis of SEMA's activities between 2007 – 2012 to articulate achievements and recommend ways to improve weaknesses. Purpose of project was preparation of three documents – SEMA activities 2011, SEMA activities 2007-2012 for the government, SEMA activities 2007 – 2012 for the general public. The documents concluded on SEMA achievements as well as opportunities for future improvements towards environmental sustainability in Timor Leste. Works included interviewing with SEMA employees, desk review of documents, and report writing.
6. *July - December 201,* **National Environmental and Safeguard Specialist**,
   Contracted by ADB Timor Leste, working as the national environmental and safeguard specialist for the district capital water supply specialist. The project includes three components – rehabilitation of the Debo Lehumo Lake weirs, rehabilitation of the water supply system in Pante Makassar, Oecusse and rehabilitation of the water supply system in Manatuto. Engaged by Aurecon, Inc., the main contractor for the PPTA. Responsible for:

7. *2008 -2010,* **Environmental Specialist/Planner,** Staff planner at Townscape, Inc. in Hawaii, USA, **for Preparation of Koolau Poko Watershed Management Plan,**

8. *2008-2010,* **GIS Specialist for Ala Wai Drainage Project,**The Ala Wai Drainage Project was an urban drainage upgrade with two main thrusts: flood control and improvements to the natural conditions of Honolulu urban streams.
9. **Graduate Assistant for Community Consultation for the Transit Oriented Development Project,** *2006-2008*

B. University Education

No	*University*	*Main Course of Study*	*Place*
1.	University of Hawaii	Urban and Regional Planning (Completed Master Degree)	Honolulu, Hawaii
2.	University of Gadjah Mada	Chemical Engineering (Completed undergraduate level)	Jogjakarta, Indonesia

C. International Seminar

- Participant at the East West Center International Graduate Student Conference, 2007.
- Participant at the UH Manoa International Graduate Student Conference, 2008
- Participant at the Xian Urban Planning Practicum at Xian, China, 2006. The Practicum involved a collaboration between students from NorthWestern University in Xian, China; students from the National Taiwan University in Taiwan and students from the Urban Planning Department, University of Hawaii. All students travel to Hawaii, Taipei and Xian for research, discussion and presentation.

D. Certificate of Competencies:

- Basic and advance security in the field of the United Nations system

E. Organization:

- American Planning Association (APA), Hawaii Chapter

3.2.3 Mario Marques Cabral, S.Si, M.Sc

Mr. Mario has more than 15-years of professional experience in marine biology and fishery assessment including assessment of socio-economic characteristics of coastal community. He is a marine ecological specialist for PEC Consulting and has involved in most of the projects under PEC management.

A. Experiences

1. **Agriculture Specialist/Consultant,***November – December 2012:*
   Contract service with JICA Study Team for the Project for Rehabilitation and Improvement of Buluto Irrigation Scheme (Laleia and Vemase) in Baucau and Manatuto Districts. Agriculture survey, interview to government and farmers, interpretation, reporting.
2. **Marine Biology Specialist/Consultant,** *July – August 2012:*
   Contracted service at Ministry of Marine Affairs and Fisheries, Directorate General of Marine, Coastal and Small Islands (Indonesia). Review and Profiling the Potential of Ecological and Social Economical for Marine Protected Area in Gunungkidul and Bantul Districts of Yogyakarta Province.
3. **Natural Resources Management Specialist/Consultant,** *October – December 2011:*
   Contracted service at Forestry Ministry, Directorate General of Watershed Management Building and Social Forestry, Watershed Management Center of Benain Noelmina, Strengthening Community-Based Forest and Watershed Management (SCBFWM) Project Region of East Nusa Tenggara. Cooperation among Ministry of Forestry (Indonesia), UNDP and GEF.

4. **Extra ordinary lecturer,** *September 2011 – August 2012:* Employed as extra odinary lecturer at Faculty of Fisheries and Marine Science of Artha Wacana Christian University Kupang (East Nusa Tenggara Province-Indonesia).

5. **Coastal and marine resources management specialist**, *August - December 2011:*
   Act as volunteer service at fish hatchery unit of Marine Affairs and Fisheries Services of East Nusa Tenggara Province (Indonesia).

6. **Manager Program,** *August 2011– until now:*
   Founder and member of Talitawan (a local NGO with core development mission in agriculture, forestry, marine affairs and fisheries), coverage areas of East Nusa Tenggara Province (Indonesia).

7. **Natural resources management specialist, volunteer**, *July - December 2011:*

8. **Natural resources management specialist, volunteer,** *February –July 2011:*

9. **National Project Manager,** *January – December 2010,* Personnel service agreement at Regional Fisheries Livelihoods Programme (RFLP) for South and South East Asia (GCP/RAS/237SPA), FAO Indonesia. Project location: Kupang Municipality, Kupang

District, Alor District and Rote Ndao District of East Nusa Tenggara Province. Cooperation between FAO and AECID.

10. Coastal and marine resources management specialist, *April - October 2009:*
Contracted service at PT.Nusa Karimun Divers, Semarang-Central Java Province (Indonesia).

11. Coastal and marine resources management specialist, *March-April 2008*:
Acted as Freelance Consultant service at CV. Rekayasa Jati Mandiri, Semarang-Central Java Province to provide technical assistance for coastal habitat degradation study in Pulau Panjang (Jepara District) as conservation and ecotourism basis development.

12. Natural resources management specialist, *May- July 2007:*
Contracted service at PT. Puri Aji Buana, Semarang-Central Java Province to provide a technical assistance for Detail Engineering Design (DED) of picnic park Kalianyar river basin-Solo project..

13. Fisheries Consultant, volunteer, *January- March 2007:*
Volunteer service at National Directorate for Fisheries and Aquaculture Timor Leste to provide a technical assistance for National Consultant under the project of Strengthening the Capacity in Fisheries Information Gathering for Management. The main assignment was to design a pilot project cycle for Community Based-Marine Sanctuary (CB-MS) in the coastal areas of Batugade and AtauroAnd as Resource Person to advise the Director of the Fisheries Directorate and staff and provide assistance to develop an enhance the capability and achieve respective objectives.

.

14. Resource Person/Fisheries Consultant/Fisheries Information Management Specialist,
April 2005 – December 2006, Contracted service at Ministry of Agriculture, Forestry and Fisheries, National Directorate of Fisheries and Aquaculture Timor Leste cooperate with FAO (GCP/RAS/199/SWE)"Strengthening the Capacity in Fisheries Information Gathering for Management Project." Project location: 11 coastal districts of Timor Leste.

15. Part time lecturer, *March 2005 – November 2006:*
Contracted service at University of National Timor Lorosa'e, Faculty of Civil Engineering, Dili-Timor Leste.

16. Fisheries expert staff, *September – December 2004:*
Contracted service at *(PT. Swakon, Semarang-Central Java Province)* cooperate with Coastal Community Development and Fisheries Resource Management Project. Posted at Tegal Municipality, Central Java Province (Indonesia).

17. Research and development staff, *July up to August 2003:*
Contracted service at *(LPPSP, Semarang-Central Java Province)* a Local NGO of Research, Improvement and Development Resources Institute cooperate with Central Java Development Planning Agency including Strategic Planning of Central Java Province.

B. University:

No	*University*	*Attended from/to*	*Main Course of Study*	*Place*
1.	University of Gadjah Mada	2000 – 2003	Environmental Science (Post graduated – S2)	Yogyakarta (Indonesia)
2.	University of Diponegoro	1992 – 1999	Marine Science (Bachelor graduated – S1)	Semarang (Indonesia)

C. International Seminar Experiences:

- Participant on APFIC the third Regional Consultative Forum Meeting on balancing the needs of people and ecosystems in fisheries and aquaculture in the Asia Pacific, in Jeju – Republic of Korea, 1 – 4 September 2010;
- Speaker on international workshop at field study of fisheries which sponsored by Regional Asia and the Pacific of FAO with title *Second Regional Transfer Workshop on Gathering Information for Fisheries Management* in Halong Bay – Viet Nam, 24 – 27 October 2006;
- Participant on the Third Biannual International Conference and Exhibition on Energy 2002 "Energy for Sustainable Development." Yogyakarta – Indonesia, 29 – 31 July 2002;
- Participant on Indonesian in Transition. Yogyakarta, 22 – 23 November 2001;
- Participant on International Seminar and Exhibition on Information Technology for Sustainable Management of Natural Resources. Bogor – Indonesia, 2 October 2001; and
- Participant on Linggarjati Environmental Meeting "Towards Decentralized Environmental Management" Kuningan, West Java – Indonesia, 9 – 13 November 2000.

D. Trainer Experiences:

- Coastal community-based and fisheries resources management;
- Performance, Improvement and Planning (PIP);
- Logical Framework Approach (LFA);
- Participatory Approach-Ranking, Scoring and Map/Diagram Design;
- Social Impact Assessment (SIA);
- Socio-economic monitoring;
- Learning to lead: An approach of managerial and leadership test score;
- Fishery extension planning: Bottom-up development planning;
- Basic fishery statistics of data collection and analysis;

- Participatory problems ranking and SWOT analysis; and
- Problem solving and decision making.

E. Certificate of Competencies:

- Basic of procurement of FAO;
- Basic and advance security in the field of UNDSS; and
- Environmental management specialist.

F. Publication:

- The study of unconfined groundwater quality distribution based on the types of non-irrigated rice field and fish pond land uses in Karimunjawa Island. Journal of People and Environment. Vol. 12, No. 2, July 2005. Center for Environmental Studies of Gadjah Mada University.

G. Organization:

- Founder of local NGO "Talitawan" (Community Care for Agriculture, Forestry, Marine Affairs and Fisheries) located at Kupang-East Nusa Tenggara Province;
- Association of sustainable forestry for people of Indonesia, East Nusa Tenggara Province;
- Indonesian Fishers Union of Kupang District, East Nusa Tenggara Province;
- Founder of Sumawis Entreprise, an event organizer for environmental education, located at Semarang-Central Java Province;
- Member of student regiment, Diponegoro Universitity, Semarang-Central Java Province.

3.2.4 Venancio Fernandes, S.T.

Trained in Industrial Engineering, Venancio has experience working as plant engineer in major manufacturing establishment in Indonesia, environmental officer and recently as a project engineer for stream flow and meteorology study in Timor Leste

A. Experience

1. **Project Engineer, Timor Leste,** *February 2014 – Present,* Contracted by PEC Consulting to provide services as follows:

- Planning, design and installation of automatic meteorological data collection equipment
- Through PEC Consulting, contracted by Seeds of Life (SOL) to repair and maintain SOL's automatic meteorological data collection equipment already in the field
- Manage a team of 4 personnel for field installation, equipment checking and data collection monitoring
- Coordinate for recruitment of field assistants at each thirteen locations of weather station installation. Recruitment was conducted through consultation and close collaboration with

chefi de suco and/or *chefi de aldeia*.

- Responsible for payment of services to district field assistants.

2. **Agricultural Census Coordinator, Indonesia,** *March 2011 –December 2011*

   Contracted service at P.T. Tanjung Buyu Perkasa Timur in East Kalimantan, Indonesia to coordinate for palm tree census at Tanjung Buyu's plantation. Responsible for:
   - Coordination of field assistance
   - Random sampling of palm fruit trees about to be harvested. Sampling was conducted for each block of the palm fruit trees.

3. **Foreman, Indonesia,** *January 2010 – December 2012*

   Contracted service at P.T. Tanjung Buyu Perkasa Timur. Responsible for checking employees' presence and work quality.

4. **Administrative Staff at Ticketing Agency in Timor Leste,** 2009

   Staff at a local ticketing agency (LGX Tour and Travel) in Timor Leste. Responsible for keeping of reservation document and delivering deposit money to the bank.

5. **Distribution Staff at P.T. Diamond Ice Cream, Jogjakarta,** 2006 – 2007

   Staff at P.T. Diamond Ice Cream in Jogjakarta, Indonesia. P.T. Diamond Ice Cream is a supplier of ice cream to McDonalds Indonesia as well as a large processed food producer in the country with products ranging from frozen meat to frozen vegetables. Previously recruited as intern in the company branch in Jogjakarta and later on recruited as permanent staff. Responsible for delivering frozen food to hotels and restaurants including to McDonald's in Jogjakarta.

6. **Assistant Trainer at Computer Laboratory at Akprind College in Jogajakarta,** 2006
   Professionally paid as lab assistant at the Computer Laboratory at Akprind College in Jogjakarta, Indonesia. Responsible for preparation of computers, student organization and filling in for the lecturer when he is absent.

B. . Education

No	***University***	***Main Course of Study***	***Place***
1.	Institute of Science and Technology Akprind	Industrial Engineering (Completed Bachelor Degree)	Jogjakarta, Indonesia
2.	Escola Vocational de Dom Bosco Fatumaka, Baucau	Majoring in Mechanical Engineering	Baucau, Timor Leste
3.	SMP Negri 1, Lospalos		Lospalos, Timor Leste

4.	SD Negri 19, Cacavei		Lospalos, Timor Leste

E. Trainings

No	*Training Course of Subject*	*Organized by*	*Year/Month*	*Place*
1.	Water Treatment for Industrial Application Training	Institute of Science and Technology Akprind and P.T. Ipal	2004	Jogjakarta, Indonesia
2.	Environmental Impact Assessment Training	Institute of Science and Technology Akprind	2005	Jogjakarta, Indonesia
3.	Verification and Data Analysis for Statistical Purposes	Institute of Science and Technology Akprind	2005	Jogjakarta, Indonesia
4.	Sugar Production Processing and Fabrication	Institute of Science and Technology Akprind in collaboration with P.T. Madu Baru	2005	Jogjakarta, Indonesia

F. Computer and Other Skills

- Corel Draw for Engineering Application
- SPSS
- QSB
- Microsoft Office 2003 and 2007

3.2.5 Crisanto dos Santos

Graduated with a diploma in computer engineering, Crisanto serves as a logistic officer in the project.

A. Experience

1. **Logistic Support,***February 2013 – December 2013*

   For the JICA funded Buluto Irrigation System data collection. Contracted through PEC Consulting. Responsible for river flow data collection, equipment purchase and assisting of the Japanese team members.

2. **Logistic Support for Dili Drainage System Survey,** *January – April 2012*

   Field assistant to the Australian and Timor Leste team. Equipment purchase at stores in Dili for use in project.

3. **Enumerator for Sanitation Willingness to Pay Survey,** *May 2012*

   Survey to several neighborhoods around Dili to ask about their existing sanitation system in their house and how much fee money they are willing to pay for new sanitation system. Followed training to survey people and businesses, do survey by questionnaire to people and enter data to Excel.

4. **Intern at Ministry of Economic Development,** January – June 2011

   Internship part of school Instituto Professional de Canossa. Enter data to computer, type letter, checking absent, photo copy, etc.

5. **Assistant Trainer at Computer Laboratory,** 2009

B. University Education

No	*University*	*Main Course of Study*	*Place*

C. Trainings

No	*Training Course of Subject*	*Organized by*	*Year/Month*	*Place*
1.	Microsoft Windows Operation System 98 SE, 2000 Professional, XP	Instituto Professional de Canossa (IPdC)	2010	Dili, Timor Leste

3.2.6 Juvencio dos Santos

Trained Economist and social impacts assessment specialist. He has two year of experience in data collection and analysis of social and economic profile

A. Experience

2013 – Present, PEC – Consulting, LDA, as project assistant and economist of the EIA

B. Education

B.A degree from the National University of Timor Leste (UNTL), 2013

C. Training

Attend the business development training with the Government of Timor Leste

4. DESCRIPTION OF THE PROJECT

4.1 Project Identification and Categorization

The project owner identified the proposed project in 2014 by mobilizing a team to conduct market potential assessment in Timor Leste. It was concluded that the market size was reasonable for the development of beverage processing plant to produce alcoholic and non-alcohol beverages. The idea was consulted with the government on Timor Leste and Government responded positively as the project is the foreign type of investment that will contribute to the Timor Leste's economic diversification in the future.

Based on project document submitted to and approved by DNPCEI, the project is categorized as category "**A**" project that potentially has adverse impact to the environment. Various components of the project, as will be elaborated further in detail in the following sections, potentially generating major impacts to the existing environment that will require proper assessment and implementation of mitigation measures to eventually control and minimize them during the operational phase of the facility.

4.2 Project Location and Boundary

The proposed construction is located along the national road connecting Dili to Liquica. Administratively, the project is located within Suco Ulmera, Postu Administrasaun Bazartete, Liquica Municipal. Project location can be reached by about thirty minutes (30 min) driving from Dili town center. The following figure is the location of the development in reference to Dili. GPS coordinates of the project location are 125.452112° longitude / -8.587683° latitude (longitude/latitude).

Figure 4.1 Locations of New site of Beverage Processing Plant Relative to Dili

Figure. 4.2 Project Location

Activities during the study including site visit for terrestrial environment, ecological assessment for marine environment as well as interview with local community for socio-economic study and compiling of the information into a report. The duration of the study take about 5 months period.

Study area includes all areas within and surrounding project location that are potentially affected by pollution or other alterations from the development. Potentially affected areas are soil, surface and ground water, marine ecosystem, safety of the nearby communities and their properties and the socio-economic characteristics of Suco Ulmera. The following figure contains illustration of the potentially affected area due to project location.

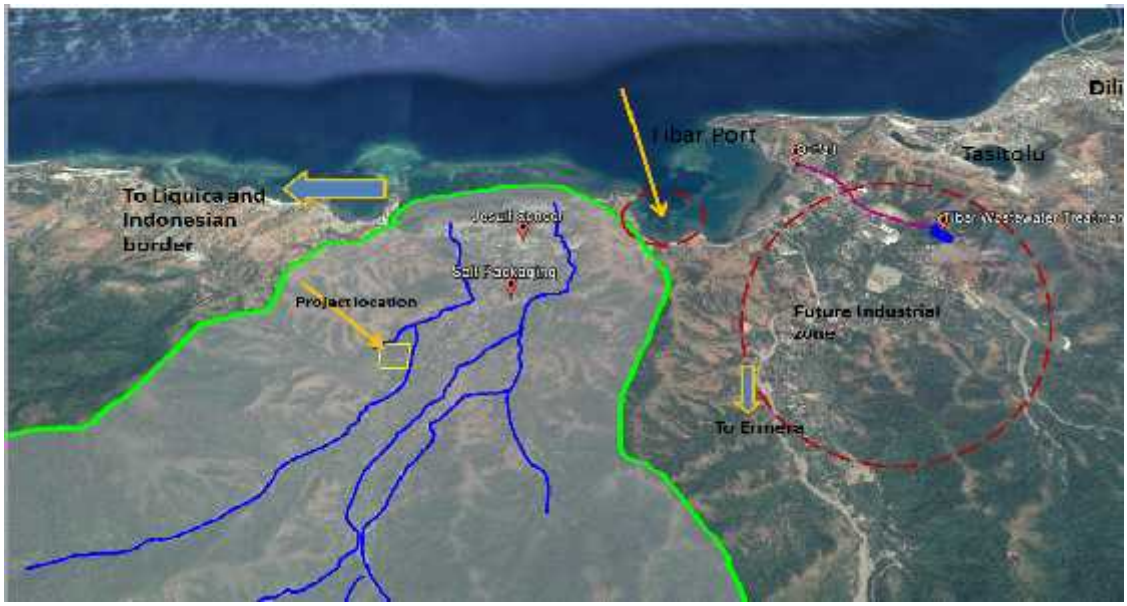


Figure 4.3 Potentially Affected Terrestrial Area and Marine Environment

4.3 Area Potentially Affected by Development

Areas potentially affected by the proposed development consist of:

- Marine/coastal water near Ulmera as final receiving environment
- Sensitive environmental receptors nearby includes coral beds immediate by the project site, marine water quality and other marine flora and fauna such as bottom fauna, fish, phytoplankton and zooplankton.
- Groundwater aquifer
- Local communities in Suco Ulmera
- National government properties (school, soon to be constructed Tibar Port, road, etc.)
- Existing and future expansion of infrastructure

4.4 Description of Project Component and Scale

The project development consists of several major components that will be placed in sequences (series) and will take total investment of $12.68 million to finance the following components from the feasibility assessment, process design and equipment installation, utility design and installation, and up to trial of the system production.

(1).Ground water extraction
(2). Water treatment (Reverse Osmosis process to further purify the groundwater)
(3). Beer processing plant
(4). Soft drink processing plant
(5). Wastewater treatment plant and disposal

This processing plant will utilize a substantial amount of water that will be extracted from groundwater in the site. As the quality of groundwater may not meet the requirement for the proposed process, water treatment and purification will be required. Reverse Osmosis (RO) Plant will be proposed to remove contaminant in the raw water into pure water for industry. Treated water from the RO plant will be used as feed to the process, which are the beer plant and carbonated soft drink. Large portion of this treated water will be packed directly as final product of bottled and gallon water to enter the market. The general process flow diagram of the proposed manufacturing plant can be seen in the following figure.

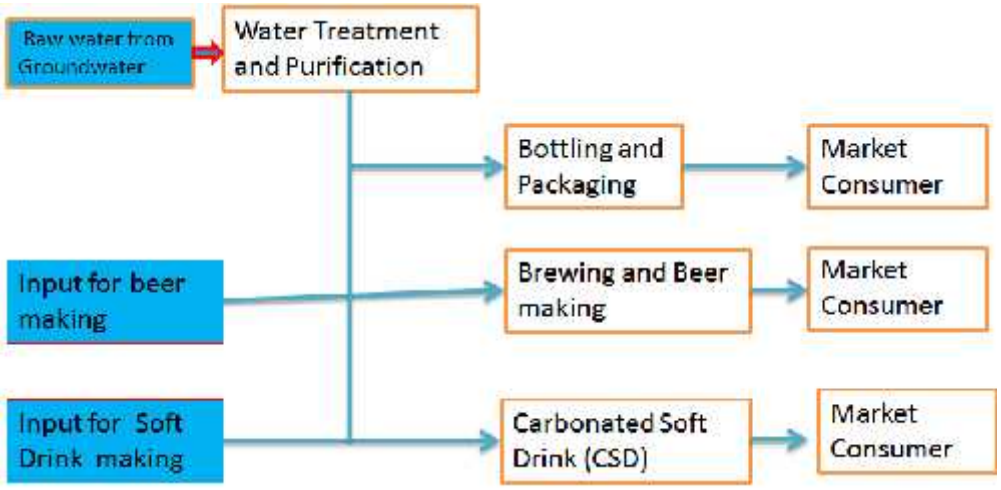


Figure 4.4 Flow Diagram Process of Proposed Project

Total investment is around 12.68 million to finance the project that will be arranged through equity (35. 5%) a debt capital (64.5%). The overall cost figure of each of the above components can be roughly estimated in the following table.

Table 4.1 Indicative Figure of the Investment cost of project Component

No	Component	Initial Investment Cost ($M)	
1	Preparation (study, EIA, pre-drill water, etc.)	$	1.73
2	Construction and Land preparation	$	1.95
3	Equipment	$	8.54
4	Office equipment and other	$	0.45
5	Operating cost (1 year)	TD	
	Total Capital (Capex + 1 yr Opex)	$	12.68

Processing plant building will also be constructed in the facility the design of which is shown in the figure below.

Figure 4.5 Design of the Proposed Processing Plant

The scale of each component of the project is presented in the following table.

Table 4. 2. Summary of Project Component and Scale of Each Component

No	Project Component	Scale and Concerns
1	Groundwater Extraction	Extraction capacity: 210 L/minutes This rate is considered moderate amount but required further detailed study on the pumping test to provide information on the water availability and sustainability of the aquifer.
2	Water Treatment via RO plant	The analyze of water quality via laboratory has indicated that the quality of extracted groundwater is pure but some parameters may not meet the specification for drinking and further use as water processing
3	Brewing Processing Plant	The Scale of this component is 75,000 HL. Issue that will become a major concern during the operation of the plant are: water consumption, energy consumption, wastewater, solid waste, and by product that will required comprehensive management system
4	Soft Drink Processing Plant	The Scale of this component is 75,000 HL. Issue that will become a major concern during the operation of the plant are; water consumption, energy consumption, wastewater, solid waste, and by product that will required comprehensive management system
5	Wastewater Treatment Plant	Wastewater will be designed and operated at maximum capacity of 100 L/minutes. Wastewater will become a major environmental concern due to the effluent quality that contain high BOD, COD, low/high pH, TSS, and other characteristics that are harmful to the receiving environment. The comprehensive assessment on the choice of process, level of treatment, and disposal mechanism would be important to minimize the impacts of wastewater to the environment.
6	Wastewater Disposal System	About 100 L/minutes will be disposed. There are two disposal mechanisms: (1) Treated with the Best Available Technology and use the treated water as irrigation water; (2) Treatment and discharge the treated water into marine water. The calculation of economic cost will determine the most optimum option.

Detailed information of each of project components is presented in the following sub-section of this section.

4.4.1 Groundwater Extraction

Water is main component of the beverage product (roughly 95%). Water is also being used in cleaning, packaging, washing and sanitation needs in the facility. The following figures show the average distribution of water consumption within the beer processing plants and ratio of water usage in the beer processing plants in various beverage processing plants.

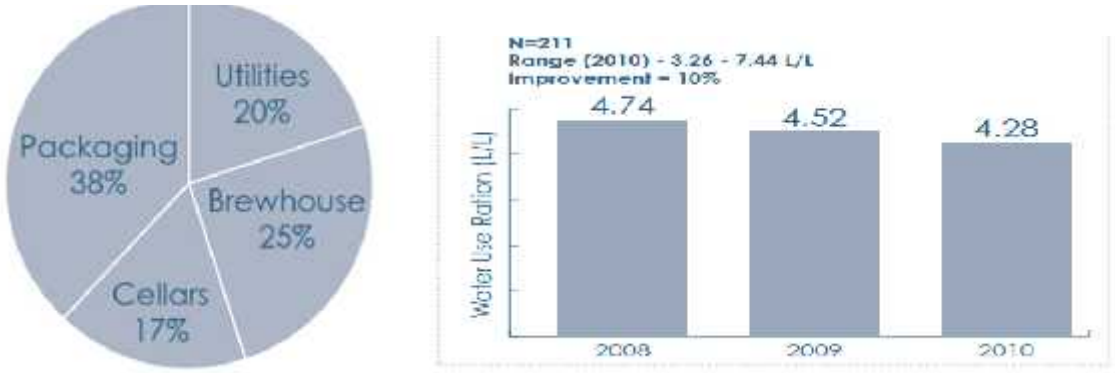


Figure 4.6 Distribution and Consumption Rate of Water within Beverage Processing Plants (Source: Brewing Association, 2013)

According to available data of water consumption from various beverage plants, the rate of water consumption to produce 1 liter of beer and 1 liter of beverages are in the range of 3- 10 L water/1 L beer and 2- 5 L water/1 L soft drink. By taking these average values, the rate of water consumption can estimated based on the capacity of production of beer, carbonated soft drink, and packed mineral water.

The above ratio of water demand in producing the unit volume of the product could be used in this study to approximate the water needed within the factory. The assumptions made were:

1. As the plant will be new, the ratio of water used to produce 1 liter of beer is assumed equal to 6 liter of water
2. To produce 1 liter of soft drink, will require 2.5 liter of water
3. To produce 1 liter of packed water will require 1.1 liter of raw water

Total water consumption for the proposed beverage processing plant in Hera can be estimated with a simple formula:

W = Water consumption for beer production + Water Consumption for CSD + Packed mineral water

Using the above number and assumption, the total annual capacity of water consumption in GOTA facility in Timor Leste would equal to1 million HL. This rate would be equivalent to 210 L/min of raw feed entering the production system. This volume rate water consumption is reasonably medium size and required a comprehensive assessment on the availability of the water (source), quality, and mechanisms to ensure sustainability of water production from the aquifer or any water source that shall be utilized.

Situational investigation in the project site suggested that only groundwater is the feasible option to provide the water in the proposed proposal and as the groundwater investigation and exploration has suggested that quantity and quality of groundwater in project area meets with the requirement of the beverage processing plant. Total pumping rate from the production well is estimated based on the proposed capacity of the beverage products by using the ratio of product and water requirement in many practices around the world. The initial capacity of the plant would around 50,000 HL of beverage but the ultimate capacity would be equal to 600,000 HL of beverage product. Using this capacity, the water demand can be calculated. The following table is used as guide in this estimation.

Table 4.3 Estimation of Pumping Capacity with ultimate Capacity of the Plant

Type of Product	Capacity , HL	Ratio Water /Products (HL/HL)	Selected Ratio	Water Requirement,HL
Beer	50000	4 - 8	6	300000
Soft Drink	50000	2-4	3	150000
Water	500000	1.25	1.1	550000
Total	600000			1000000

Total water requirement for the production of the beverage with the capacity of 650,000 HL per year would be equal to 1,000,000 HL per year. This capacity is the highest capacity of the plant that was proposed by the company. This volume of water needs is equal to pumping rate of 210 L/min or equal to 3.3 L/s. Another scenario would be using the initial capacity, which 300,000 HL of total beverage product volumes. Using this initial capacity, the total volume of water requirement would be equal to 500,000 HL or equivalent to 1.75 L/s.

Table 4.4 Estimation of Pumping Capacity with initial Capacity of the Plant

Type of Product	Capacity , HL	Ratio Water /Products (HL/HL)	Selected Ratio	Water Requirement,HL
Beer	25000	4 - 8	6	150000
Soft Drink	25000	2-4	3	75000
Water	250000	1.25	1.1	275000
Total	300000			500,000.00

The pumping of groundwater with the initial proposed capacity of consider small and may not create any concern related to the groundwater sustainability. However, with the pumping capacity at the rate of ultimate capacity, the analysis of groundwater pumping test and sustainability of groundwater in responding to the pumping would be needed to be conducted as part of the EIA study. The following figure shows the increasing pumping rate, which is proportional to the capacity of the beverage processing plant.

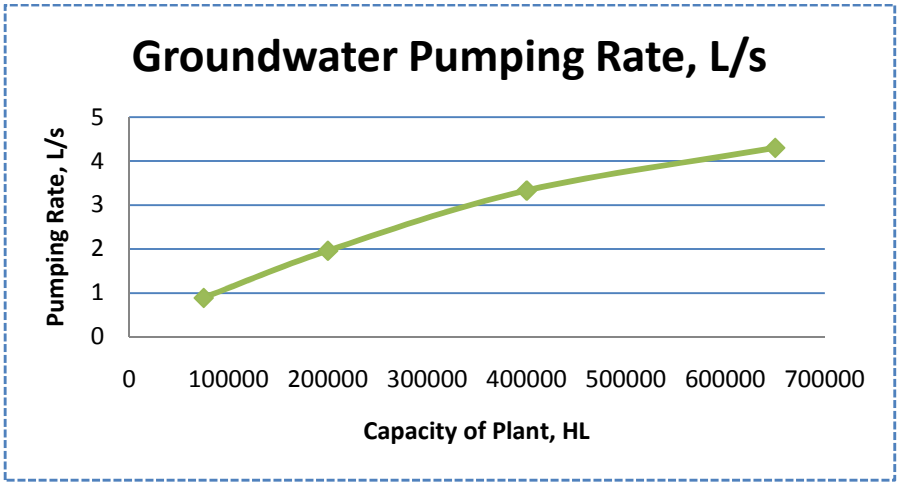


Figure. 4.7 Trend of Groundwater Pumping Rate and Capacity of Plant

Should it is later proved that groundwater will not be sustainable, then project owner can select to desalinate sea water source or operate by downscaling the capacity of the production plant to be within the range of sustainability. The analyze of section will further discussed more on the groundwater pumping test data and how that test suggest the sustainability of groundwater in responding to the capacity of the plant.

4.4.2 Water Treatment and Purification

Despite the good quality of groundwater as discussed in the previous section, the treatment of the raw water from groundwater is necessary to meet industrial specification. In general the process can be represented in the following diagram.

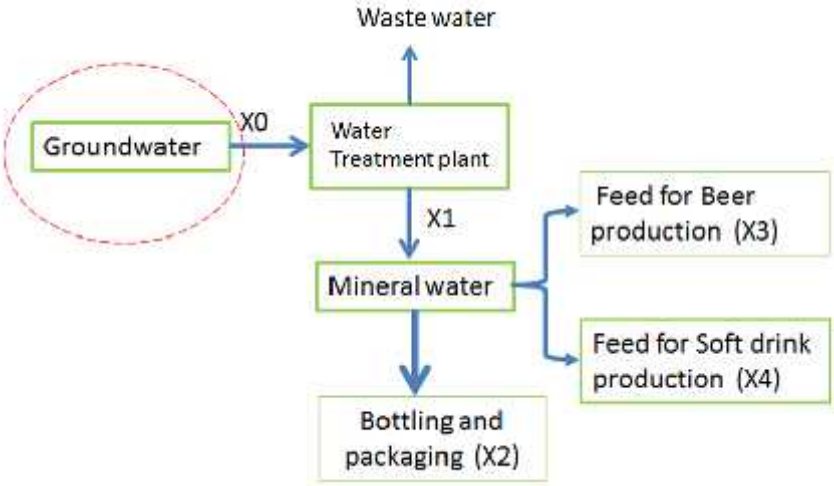


Figure 4.8 Schematic of Water Resources Utilization in the GOTA Processing Plant

The proposed method of treatment unit will be the Reverse Osmosis (RO) system.

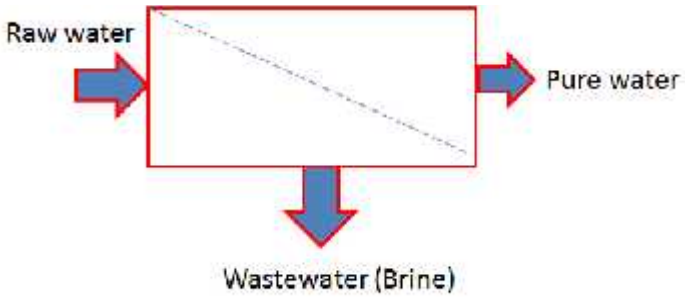


Figure 4.9 Simplified Process of RO Unit

The RO module usually has a very high refection rate (up to 99%) of contaminant with 95% of the feed will converted into product water with the rest discharged as effluent (wastewater). The product water or pure water has very low salt content (less than 50 mg/L) while wastewater would have very high salt concentration (up to 100,000 mg/L). Disposal of wastewater can be done by dumping into the sea through the marine outfall with the provision of perfect dilution such that impact of high concentration of brine in

the sea water will be very small. The water product will then go through further treatment to remove odor or taste prior to entering the beer and soft drink plants

There a unit processing within the water treatment system, such as pre-treatment, RO, and post treatment which involve disinfection processes such as ozone process prior to the packaging or entering to the further process such as beer and soft drink production. The main environmental concern to be considered would the energy consumption that will contribute indirectly to the carbon footprint.

4.4.3 Brewing Processing Plant

The beer process plant is a complex process but the simplification can be represented with a box diagram as follows, where large volume of water is processed with the raw material to produce beer and wastewater.

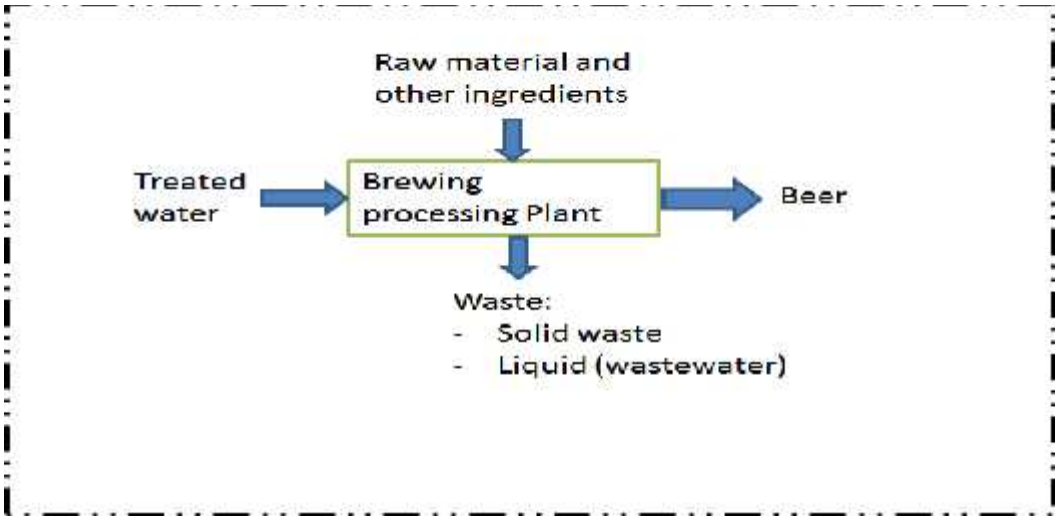


Figure 4.10. Simplification of Beer Processing Plant

The annual production rate of beer is estimated to be 75,000 HL (Hecto litter) and subsequently, the annual wastewater rate is equal to 1,200,000 HL. The wastewater from a beer manufacturing plant has high BOD, COD, and other physical and chemical parameters, therefore require proper treatment before discharge into the drainage system or disposed into the ocean.

In general, the process production of beer involves five main steps, where each has its own sub-process:

(1). Raw material handling
(2). Wort Production
(3). Fermentation and Maturation
(4). Purification
(5). Packaging and Pasteurization

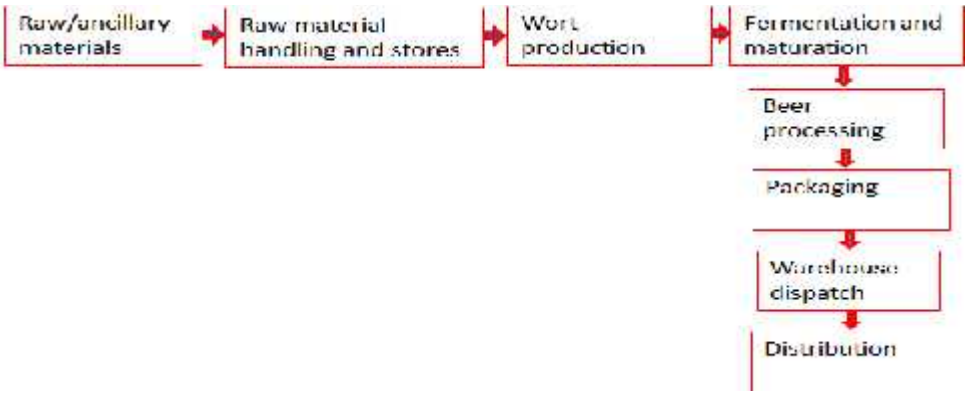


Figure 4.11 Main Processes Component of Beer Processing

4.4.3.1 Raw Material Handling

Four natural ingredients are used as main raw material to produce beer, which are (i) water, (ii) barley, (iii) hops and (iv) yeast. Water, as discussed earlier, is the major component of beer, which takes up to 90% volume in the final product of beer. Pure water from the water treatment is stored in huge water tank before entering the processing unit.

Figure 4.12 Storage of Purified Water and Malt

Figure 4.13 Main Raw Material for Beer Making

The barley is imported from neighboring countries and will arrive in Timor Leste as raw grain. The raw grain is then processed via malting process to convert it into starch and then the barley into fermentable sugar. Malted barley is ready to enter the beer processing unit which is normally stored in the malt storage. Other raw material that provides natural bitterness and aroma to the beer is hops. It is also a natural preservative to the beer and normally only use the female flower. By cooking the hops, the bitterness and preservative substance is extracted and used in the mix of beer processing. The fermentable sugar in the malt and water can be converted into alcohol (beer) with specific operating condition, only in the presence of enzyme or yeast through the fermentation process.

4.4.3.2 Wort Production

Malt that is stored is weighed and milledto produce a mixture of flour and husks, known as grist. Grist is ready to be mixed with hot water to form mash. The purpose of mashing process is to obtain a high yield of fermentable malt grist, which will be the extracted into brewing water. The mixture of mash is then filtered to separate the solid part, which is known as wort and spent grain from the liquid mash.

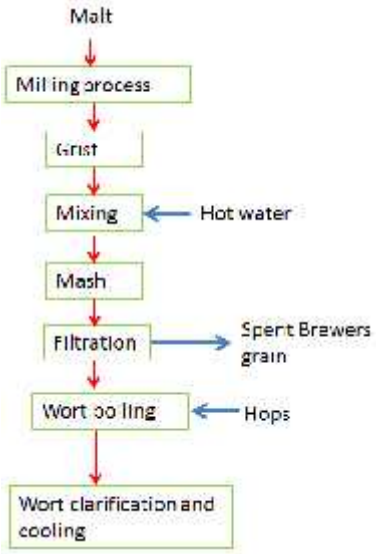


Figure 4.14 General Steps of Wort Production

The spent grain (by product)is then sent to farmer as animal food. Liquid mash is going through further process -boiled in the kettle and added to the hops. The mixture of wort boiling is then going through the process of cooling and separation of solid that are part of the hops. After the cooling process, oxygen is injected into the wort and it is ready to enter fermentation vessel.

Figure 4.15 Spent Grain after Worth Filtration (Animal Feed)

4.4.3.3 Fermentation and Maturation

Worth already mixed with oxygen is pumped to the Fermentation Vessel (FV) and adds the yeast to start the fermentation process. Bio-chemical reaction involved in the process is the enzyme from yeast that convert sugar and oxygen into alcohol and carbon dioxide as follows:

$$sugar + O_2 \xrightarrow{yeast} Alcohol + CO_2$$

As the enzyme is only effective at certain temperature, it is highly controlled to reach high conversion factor for the above chemical reaction. The carbon dioxide produced in this process is collected for internal use such as carbonation within the brewing process and also at the carbonated soft drink process. The duration of fermentation is between 1 to 2 weeks, depending on the product type or product recipe. Fermentation is stopped through a rapid cooling, in which yeast is harvested and immature beer is pumped into the storage tank. As the yeast that was originally added has grown, which resulted in more yeast than the quantity required for the process, some part of the yeast will be disposed or sent out as animal food. The maturation of the young beer will take several weeks by storing the young beer in the storage tank under control temperature.

4.4.3.4 Purification and Filtration

After the maturation process for several weeks, matured beer is then filtered to remove solid material and remaining yeast to obtain lighter colored beer. The filtration takes place in a “kieselguhr” (diatomaceous earth) filter using frame, candle, or mesh filters. Spent kieselguhr can be used in farming, reprocessed, or

used as building material. Following filtration beer is stored in “bright beer tanks” and is ready for packaging in the bottling hall.

Figure 4.16 Micro-Filtration unit that Filter the Mature Beer

The bright beer from the filtration process is stored in the storage tank for further process, which is packaging and pasteurization.

4.4.3.5 Packaging and Pasteurization

Bright beer from the storage tank is carbonated by injecting CO_2 and a small quantity of nitrogen to enhance foam performance prior to entering the packaging process. In the case of beer processing plant in Timor Leste, only can is used. So packaging means to fill the can with the bright carbonated beer from the storage tank.

Figure 4.17 Process of Filing the Cans and Packaging Process

A detailed technical drawing of the main process of beer making is provided in the Annex_1 Technical drawing of beer processing flow diagram

4.4.4 Carbonated Soft Drink Processing Plant

The carbonized soft drink plant will utilize large volume of water and sugar to produce soft drink and wastewater.

Figure 4.18 Flow diagram Process of CSD

It is assumed that the ration of feed water to product CSD is 2 while the average of this value was used to calculate the rate of feed and rate of wastewater. Total water required for producing the above figure is 150,000 HL and subsequently, 75,000 HL waste water will be produced

Processing steps can be summarized briefly as follows:

1. Sugar is dissolved in hot water
2. Cooling down of sugar solution
3. Mix with the natural flavor and malt extract
4. Dilute the concentration of mixture with water (based on the product specification)
5. Carbonization by adding the CO_2
6. Process filtration
7. Filling the cans
8. Process of pasteurization and packaging

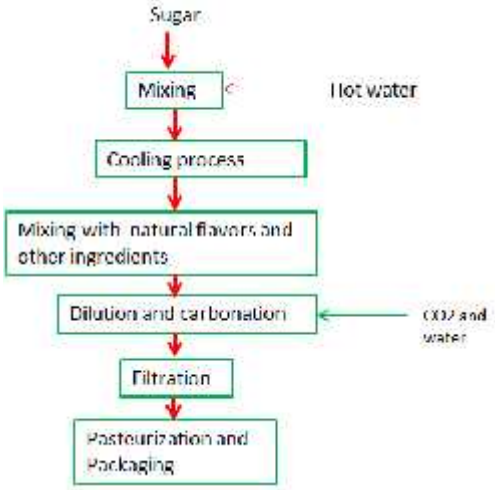


Figure 4.19 Conceptual Drawing of Carbonated Soft Drink

4.4.5 Wastewater Treatment and Disposal

The annual production of wastewater in the overall processing plant is 100,000 – 300,000 HL or equal to 0.4 L/s and 1 L/s with high BOD, COD, high nutrient (Nitrogen), low pH, high temperature and other pollutant content that requires proper treatment before being discharged into the marine water body. To address this problem, international best practice generally utilize two types of approaches – (i) technological approach that address emission and (ii) ambient water quality approach that focus on changes in ambient quality of receiving water.

Project proponent proposed to implement technological approach using optimum technology in the market to treat the wastewater into the level that is acceptable by environment and local or international standard of effluent discharge. The selection method will depend on the technical and economic feasibility. Comprehensive assessment of these two options will lead to cost-saving to the project owner.

If the disposal is to the nearest drainage system, then the wastewater will need to be treated to remove BOD into 50 mg/L, total nitrogen into less than 5 mg/L, TSS into 100 mg/L. In order to reach this desire water quality condition, the level of wastewater treatment will be comprehensive, which means that the cost of wastewater treatment will be reasonably high. On the other hand, if the disposal is into the marine ocean outfall, the level of treatment in the wastewater unit shall not be comprehensive. However, the investment in the piping system and construction of marine outfall will significant. The comprehensive assessment would be required in order to select one of these methods, concerning the limited water availability in the project site, length of the piping system, cost of technology, and water reuse system, etc. Comprehensive analysis on the cost and benefit of the option taken would be required in order to provide information on the best option to be selected.

Figure 4.20 potential route of wastewater pipe:

Two options for wastewater solution will be proposed:

1. Discharge treated wastewater into the existing creek
2. Pipe the treated wastewater into the ocean marine outfall

Analysis of the impacts of these two options will be conducted to know the risk of this each option in term of cost and benefit. International best practices for treatment of wastewater can be used which generally based on the following three approaches:

- Technological approach
- Ambient water quality approach
- Usability of the receiving environment approach

The technological approach by means of using the best available technology (BAT) in the market to treat the wastewater into the level that is acceptable to the environment. Ambient water quality approach on the other hand, means, that disposal of the wastewater into the environment must look into the overall ambient water quality after discharge. If the pollutant contribution from the plant is within the assimilative capacity of environment, then the discharge is acceptable. If not, then the treatment will be required up to the level that is acceptable. The last but not least, is the usability of the receiving environment, which would be important to be considered in determining the waste loading to the receiving environment.In many practical applications, the above three approaches were combined in order to comply with standard regulations of effluent discharge on one hand and without losing the usability of the receiving environment on the other hand.

For the proposed plant in Ulmera, project owner has proposed to treat the wastewater prior to discharging effluent into receiving water environment. Project owner also planned to "test" quality of effluent by constructing a manmade pond with fish in it that will receive the effluent. Changes in the chemical and physical characteristics of the pond will be monitored including the health of the fish in the pond. Overflow of the pond will be discharge into the nearest drainage system that will eventually be discharged through marine outflow. Conceptually, the proposed wastewater treatment system can be represented by the following flow diagram.

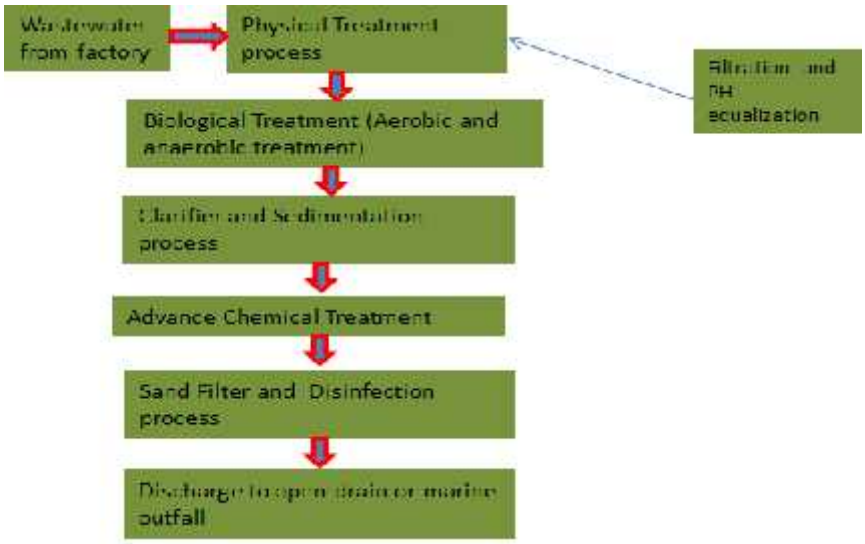


Figure 4.21Conceptual Proposal of Wastewater Treatment Plant

The drainage system such as road drainage and ditch and curvet are mainly dry most of the time, except during heavy rainy days, where the system receive storm runoff from surrounding location. Especially, the discharge point at the project location has no drainage and only river that mainly dry most of the time, except only during the heavy rain, has river flow. In this sense, receiving environment, accept the

discharge from the end of the treatment system within the plant without any further dilution process. In this case, effluent discharge from the plant shall be at a level that will not be influence the ambient quality of receiving environment.

Wastewater from the drainage system will eventually discharge to the open space, which is permeable and has very high permeability rate in transporting the water into the percolation downward. Thus, for the long-term impact, the treated effluent will contribute re-charge of water into the aquifer.

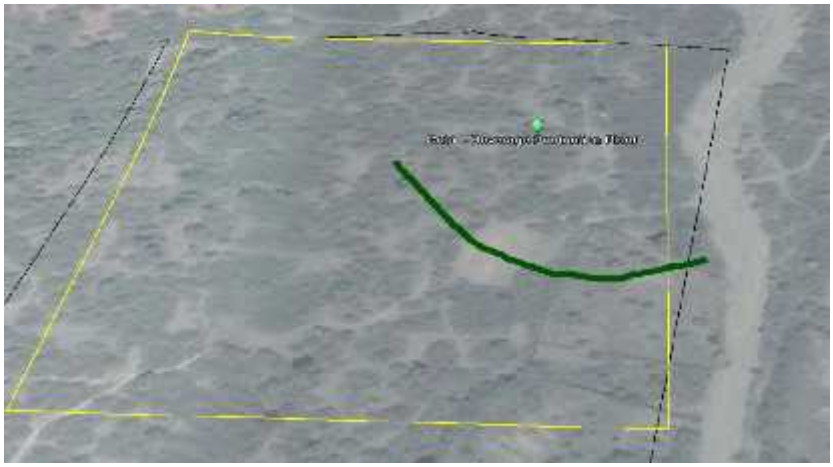


Figure 4.22 Discharge Pipe of Wastewater systems

Receiving environment, consist of mangrove, marine aquaculture, where the loading of the waste from fish pond to the environment will not contribute the long-term effect to the mangrove and marine aquaculture, as treated wastewater will eventually move downward as percolation loss. Except however, during the heavy rainy seasons, where high runoff would further dilute the wastewater prior to entering the marine ecosystem.

4.4.5.1 Wastewater Characteristics

The choice of wastewater treatment technology depends on the wastewater characteristics produced by the plants. The following table shows effluent characteristics of wastewater from the beverage process plant.

Table 4.4 Characteristics of Untreated Effluent from Beer Processing Plant
(Source: American Brewing Association, 2014)

Parameter	**Typical Range**
Water to beer ratio	4-10 liter/liter
Wastewater to beer ratio	1.3 – 2 liter/liter lower than water to beer ratio
BOD	600 – 5,000 ppm
COD	1,800 – 5,500 ppm
Nitrogen	30 – 100 ppm
Phosphorus	30 – 100 ppm
pH	3 – 12
Total Suspended Solids	200 – 1,500 ppm

Components produced and source of the equipment/process are given below.

Table4.5 Source of Wastewater within aBrewing Process Plant

Source	Operation	Characteristics
Mash Tun	Rinsing	Cellulose, sugars, amino acids, ~3,000 ppm BoD
Lauter Tun	Rinsing	Cellulose, sugars, spent grain, SS ~3,000 ppm, BoD ~10,000 ppm
Spent Grain	Last running and washing	Cellulose, nitrogenous material, very high SS (~30,000 ppm), up to 100,000 ppm BoD
Boil Kettle	Dewatering	Nitrogenous residue, BoD ~2,000 ppm
Whirlpool	Rinsing spent hops and hot trub	Proteins, sludge and wart, high in SS (~35,000 ppm), BoD ~85,000 ppm
Fermenters	Rinsing	Yeast SS ~6,000 ppm, BoD up to 100,000 ppm
Storage Tanks	Rinsing	Beer, yeast, protein, high SS (~4,000 ppm), BoD ~80,000 ppm
Filtration	Cleaning, start up, end of filtration, leaks during filtr.	Excessive SS (up to 60,000 ppm), beer, yeast, proteins, BoD up to 135,000 ppm
Beer spills	Waste, flushing, etc	1,000 ppm BoD
Bottle washer	Discharges from bottle washer operation	High pH due to chemical used, also high SS and BoD especially through load of paper pulp.
Keg washer	Discharges from keg washing oprtn.	Low in SS (~400 ppm), higher BoD
Miscellaneous	Discharged cleaning and sanitation materials, floor washing, flushing water, boiler blow down, etc.	Relatively low on SS and BoD. Problem is pH due to chemicals being used

With the above effluent characteristics, widely applied wastewater treatment processes include, pH equalization, physical, biological, and chemical treatments, including disinfection before disposal to the drain or receiving waterbody.

Figure 4.23 Typical Aerobic Treatment of Wastewater Effluent in the Brewing Process

As for carbonated soft drink treatment plant, typical characteristics of effluent can be seen in the following table.

Table 4.6Typical Wastewater Characteristics from Soft Drink Effluent

Parameter	**Value**
Total CoD (mg/L)	33,000
Soluble CoD (mg/L)	27,000
TKN (mg/L)	54
Total P (mg./L)	2.5
TSS mg/L	250
pH	5.4

These two wastewater streams (from brewery and CSDproduction) are combined, prior to entering the treatment unit. Combined characteristic can be determined from the ratio of the volume rate.

4.5 Justification and Need of Project

The proposed development has an objective to seize business opportunity in Timor Leste in the provision beverage product processing plant that has high market demand in Timor Leste. Every year, Timor Leste imports a significant amount of the aforementioned beverage products valued at US$10 million (MOF – External Trade Statistics, 2014). Investment in the proposed project will take over import of a significant portion of the above types of products therefore Timor Leste can realize many economic benefits from domestic manufacturing such as employment creation, tax contribution and capacity building. Moreover, this investment is coming from a local Timorese-owned company as the project owner, which will ensure the sustainability and continuity of this proposed manufacturing process plant even further.

Moreover, Timor Leste is in the process of developing its economic and social conditions to increase living standards of its people. Currently, the country is heavily dependent on revenue from the oil and gas sectors which may present a problem in the future, as the oil and gas resources are non-renewable resources. Moreover, above 90% of the real expenditure in Timor Leste has come from the Government general budget, as the private sectors investment is in early development stage. The country has to continue to push for private sector participation in the economy taking advantage of basic infrastructure that has been built so far. The proposed beverage processing plant is the type of productive investment from private sector, particularly the local Timorese company that the government of Timor Leste should support.

4.6 Other Development Related to Construction and Operation of Project

The following map shows that, there are other development in the proposed project location that affects the project during the construction and operation of the project.

Figure 4.24 Other Development Projects in the Area

The existing project in the area that identified are:

- National road of Dili – Liquica
- Soon to be constructed Tibar Port
- Projected Industrial zoning area
- Tibar Dumpsite development
- Road developed of Tibar – Gleno
- Tibar septage/wastewater treatment plant

The proposed project development and listed projects will contribute some effect that need to be managed in an integrated manner from each project owner with close coordination.

4.7 Proponent Endorsement of the EIS

There have been discussions with the proponent regarding the contents of the EIS and hereby, the proponent endorses the EIS and EMP.

Mr. Nilton T. Gusmao do Santos (Director)
Rua San Jose, Bairo Pite, Dom Aleixo
Dili, Timor Leste

Telephone: +670 3322336
Mobile: +670 77243585
Email: info@eto.tl

4.8 Structure of the EIS

The structure of EIS, as presented in the table of content, follows standard guidelines released by DNCPIA, as provided in the Expert 101 package:

- Detail of project Proponent
- Detail of EIA Consultant
- Description of project which cover the location, justification and rationale of the project, and detail component of the proposed project
- Legal framework and institutional arrangement of environmental protection in Timor Leste
- Description of existing environment
- Alternative options considered in the project development
- Environmental, social, and economic analysis related to the project development
- Environmental Management Plan (EMP)
- Public consultation and stakeholder engagement during the project development and implementation
- Difficulties and problems that may occur during the project development
- Conclusion and recommendation

5. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

Introducing the environmental impact Assessment (EIA) in every development project, especially at the early stage (design phase) is necessary to be able to anticipate negative impacts that may occur during the site preparation, construction, and operation. These negative impacts can be mitigated with the proper mitigation measures that will be implemented by the project owner and monitored by the relevant government agencies. When impacts are managed well, it can lead to cost effective operation, which is preferable to the project owner. Therefore, the environmental impact assessment in every project development is a strategic investment that should be pursued by the project owner.

However, policy and legal framework, as the important instrument to regulate the step of the process is important to be in place during the phases of the project implementation would be the key to start implementing the safety safeguard policy such as environmental compliance. Moreover, good policy and strong legal framework should be supported by the competence institutional such as regulator, executing, and implementing agencies should be in placed to ensure the effective implementation.

Though, it was only started in 2011, the Timor Leste legal framework and policy have started to regulate the major project implementation to follow the best practice of the environmental protection of the nature and people. The following review provides the relevant government policy and legal framework relevant to the nature of the project (beverage industry) and environmental protection and compliance in Timor Leste.

5.1 Relevant Policy and Legislation

Decree law 5/2011- Environmental Licensing provides a technical guideline on how to exercise the constitution mandate in securing environmental permit to start development activities. According to this decree law, every major development should go through proper environmental impacts assessment (EIA) in order to get the environmental licensing prior to the commencement of the development to ensure that the impacts of the proposed development is identified and mitigation measures are proposed in order to minimize the environmental and social impacts.

The guidelines for the formulation of required documents to prepare for environmental license have been developed through the Expert101 system that contains checklist and other necessary documents for the preparation of Project Document, Environmental Impact Statement (EIS) for category A projects and Simplified EIS (SEIS)for category B projects. Other relevant environmental laws and their objectives are listed in Table 5.1.

Table 5.1. Relevant Laws and Regulations

Agency	Relevant Laws
Ministry of Commerce, Industry, and Environment (MCIA)	Decree Law No.5/2011
	Decree Law No. 26/2012 on Environmental Base Law
	(Draft) Law on Biodiversity (March 2012)

	Draft Decree Law of Noise and Vibration Standard 2017 (under discussion)
Ministry of Agriculture and Forestry (MAF)	Decree Law No. 5/2016 on National Protected Area System
Ministry of Agriculture and Forestry (MAF)	Law No. 12/2004 on Crimes Related to Fisheries
	Law No.6/2004 on Legal Basis for Management and Regulation of Fisheries and Aquaculture
Ministry of Health	Sanitation and wastewater system Drinking Water Standard
Ministry of Finance	Registration and taxation system
International	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Protocol)

Other important government decree law to be complied during the project implementation is the decree law 28/2011 that regulates the food industry and market regulation. This government decree law, mandate the private entity who provide food and beverage service to comply with the health and safety standard. Other government law that may be relevant to the proposed industry is listed as followed.

- Decree law 5/2009 is related to the sales of drinking water quality and distribution
- Decree law 23/2009 is related to the food safety and the business administration offences
- Decree law 24/2011 is related to the licensing and commercial activity

The above law should be complied by the project proponent and by doing so the project owner will entitle to various advantageous such as protection of business property in Timor Leste, the project owner would be able to conduct export and import of products, just to name a few.

5.2 Relevant National and International Environmental Quality Standard

The environmental licensing and protection laws that were enacted in 2011, has already provided a legal framework to protect the environment by controlling through the licensing system and monitoring program during the project implementation. However, standards and best practices for environmental quality in Timor Leste are still limited. However, in the absence of local regulation, the government of Timor Leste always refers to the best international practices. The following are standard best practices that Timor Leste has derived from various international best practices are provided in Table 5.2.

Table5.2. Applicable International Standards in Absence of Timor Leste's Standards

Environmental Standard	TL National Standard	International Standards
Drinking Water Quality Standards	Adopted WHO standards	WHOs
Waste water effluent	None	WHO/USEPA
Ambient Air Quality Standards	None	IFC/WHO
Heavy Metal Standards	None	WHO
Noise	Leq55dB(A) per UNTAET Regulation	World Bank
Vibration	None	USEPA
Soil	None	IFC/World Bank
Ambient receiving water quality standard		IFC/WHO
OHS	None	IFC/ISO -81001

5.3 Guidelines in Measurement and Monitoring

Several guidelines are applicable for measurement and monitoring of the environmental and social parameters. These guidelines included those guidelines published by NDPCEI such as the Expert101 Guidelines as well as applicable international guidelines such as the Head of BAPEDAL Diploma No. 113/2000 on General and Technical Guidelines for Environmental Laboratory tests.

Some international best practice in the industry that can be used as guideline in the absence of the national standard:

1. Drinking water quality standard, according the WHO
2. Air quality standard guideline and monitoring, IFC, 2007
3. Wastewater effluent standard guideline, IFC

5.4 Relevant Institutional Aspects

There are several institutional aspects related to the implementation of Decree Law 5/2011 on Environmental Licensing that are relevant to the proposed development. The first one is institutions responsible for general environmental protection (marine, coastal and terrestrial). The second one is institution responsible to regulate and monitor downstream petroleum industry including large scale fuel storage. The third one is institutions responsible for the protection of public health and safety. These institutions are identified in Table 5.3.

Table 5.3 Government Responsibility and Relevant Institutions

No	Responsibility	Relevant Institutes
1	Environment and Nature Protection (Terrestrial)	Ministry of Commerce, Industry, and Environment (MCIA)
2	Marine and Coastal Environment	Ministry of Agriculture and Fishery (MAF)
3	Water and Sanitation System , Power and energy consumption	Ministry of Public Works - Water and Sanitation
4	Public Health and Safety	Ministry of Health
		National Directorate for Civil Protection
5	Worker Health and Safety	State Secretary for Professional Training (SEPFOPE – Portuguese Acronym)

5.5 Institutional Constraint and Barriers

To materialize the objectives of Decree Law No.5/2011, the implementation of environmental licensing system also requires monitoring of the implementation of proposed measures as well as monitoring of environmental impacts resulted from the development. Monitoring is the responsibility of project proponent with compliance inspected by the above mentioned institutions.

It should be noted though that several institutional weaknesses hinder a more effective implementation of the law:

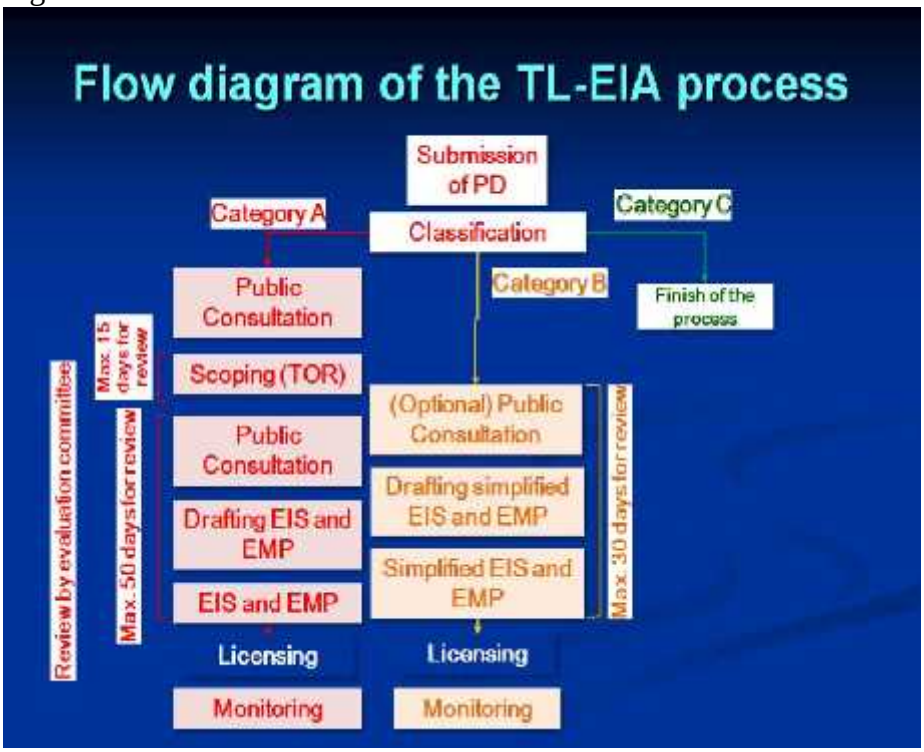
1. Lack of national standards for environmental health parameters
2. Lack of regulations related to zonation for the purpose of development of infrastructure, residential and industrial facilities as well as zonation for the purpose of environmental protection
3. Lack of capacity to implement monitoring of the private sectors' and government's projects for compliance
4. There is a need to broaden knowledge and strengthen the capacity of local private sectors related to the issue of environmental protection and health and safety of workers.
5. Coordination for integrated planning is needed related to disaster prevention especially for industrial facilities

5.6 Procedure of Environmental License

Decree Law 5/2011 provide a specific guideline on how to issue environmental license and urge to follow several in order to ensure a duly implemented classification, review and monitoring of the environmental impacts. These steps include screening, scoping, preparation of an EIS/Simplified EIS and monitoring of the implementation of Environmental Management Plans (EMPs) contained in the EIS/SEIS.

The process for issuance of environmental permit according to Decree-Law No 5/2011 is shown in the figure below.

Figure 5.1. Processes for Issuance of Environmental Permit



The environmental licensing process starts with screening of the project based on project document (PD) and application form submitted by the project proponent. The result from screening is a classification of projects into either Category A, B or C (No EIA required). For Category A projects, screening is followed by scoping, where project coverage is defined. Opinion on the environmental scope of the project is issued by NDPCEI within 15 days of the receipt of the project documentation such as application form, project document, and any feasibility assessment document. For Category B projects, no scoping is required and project proponents can proceed to preparing the SEIS.

EIS for category A or SEIS for category B as well as the application document is then prepared by project proponent and submitted to NDPCEI for review. Upon duly submission of all required documentation, technical review process commenced. As shown in Figure 2.1, Category A projects are required to go through lengthier review process through the formation of an evaluation committee and conduct of public consultation. The evaluation committee usually consists of representatives from several relevant entities.

The evaluation committee has a duty to carry out technical evaluation of the document, review public input and recommend the approval or denial of application for environmental permit. Public consultation has to be conducted starting 10 days after the formation of the evaluation committee. The public is given 24 days to submit comments, recommendations or proposals on the EIS and EMP.

To complete technical evaluation and decide on the recommendation for approval or denial of the project, the Evaluation Committee has 50 days, counted from 5 days after the formation of the Evaluation Committee. During the review period, the Evaluation Committee may request additional information from project proponent, local communities where the project is going to take place or government agencies that have interest on the project. The 50 days allowance to come to decision is suspended until all required

information is received. The Environmental License Law also allows 10 days for review of additional information submitted by proponent.

After the technical review, the Evaluation Committee will write a report that contains recommendation for approval or denial of the application. The report is then submitted to the Superior Environmental Authority that will issue final approval. Environmental permit should be released within 15 days from the time the Evaluation Committee report is received. When an application is not approved, the proponent will be notified of the decision.

Decree Law No. 5/2011 makes provision for an Impact Benefit Agreement between project proponent and local communities affected by the development. Negotiation for Impact Benefit Agreement can start at the time the approval for environmental permit is published.

For Category B projects, after an SEIS which contains and EMP and the application are submitted, the Environmental Authority has 30 days to complete technical evaluation of the application. Similar to the EIS process, the Environmental Authority may ask for additional information from project proponent, affected communities or government agencies with interest on the project. The 30 days period will be suspended until all required information is submitted. The Environmental Authority has 10 days to review additional information and may require a public consultation be conducted on the project.

Once the evaluation is completed, the Environmental Authority then submit to the Superior Environmental Authority the approval or denial recommendation. The Superior Environmental Authority, within 10 days of receipt of the evaluation, shall then issue an order for issuance of environmental permit.

For projects that do not require preparation of an EIS/SEIS (Category C projects), the Environmental Authority would recommend that the projects implement certain measures to protect the environment and maintain an environmental management plan.
The Decree Law No.5/2011 categorizes projects according to the potential impacts to the environment.
There are three categories of projects:

1. Category A – to include projects that potentially cause significant environmental impacts. These projects are subject to Environmental Impact Statement (EIS) developed based on Impact Analysis and Environmental Management Plan (EMP) in accordance with the Decree Law No. 5/2011.
2. Category B – to include projects that potentially cause environmental impacts and are subject to the procedure of Simplified Environmental Impact Statement (SEIS) developed based on the EMP in accordance with the Decree Law No. 5/2011.
3. Category C – to include projects where environmental impacts are negligible or nonexistent and not subject to any procedure for Environmental Assessment in accordance with Decree Law No.5/2011.

Annexes I & II of Decree Law No.5/2011 spelled out in more detail the type and scale of projects within mining, oil, energy, general industry, transport, civil, water, sanitation, agriculture, tourism and defense sectors that belong to Category A and B projects. It also makes stipulations that those developments that happen within environmentally, socially and geographically sensitive areas should fall under Category A projects.

With support from the Asian Development Bank (ADB), the Decree Law No.5/2011 has recently been going through review for the purpose of clarification and ascertain the meaning and intent of relevant provisions that require inclusion, and those provisions that require clarification/amendment, to arrive at a

common understanding of all issues that must be addressed in these laws and in the implementing regulations.

The following Table contains recommendations produced from the ADB experts.

Table 5.4. Recommendation to Existing Guidelines for the Implementation of Decree Law No. 5/2011

	Recommendation
Draft-3 Ministerial Diploma (Ministry of Commerce, Industry and Environment/MCIE) and Guidelines on Regulation on the Detailed Requirements for Screening, Scoping and the Terms of Reference, EIS, and EMP for Environmental Assessment	Clarification on general provisions, screening of projects, objectives and contents of: (1) EIS; (2) Simplified EIS; and (3) Environmental Management Plan (EMP)
Draft-3 Ministerial Diploma (MCIE) and Guidelines on Procedures and Requirements during the Environmental Assessment Process	Clearer definition on project affected people and vulnerable groups, notice of classification of proposed projects, public consultation on the proposed ToR, during the study phase and public consultation on the submitted EIS and EMP, record keeping and public access to documents.
Draft-3 Ministerial Diploma (MCIE) and Guidelines on Regulations on Impacts and Benefit Agreements (IBA)	Scope of the IBA, traditional land use, customs, and Tarabandu's role in IBA, negotiation process, conditions in any IBA and complaints and grievance mechanisms.
Draft-3 Ministerial Diploma (MCIE) and Guidelines on Regulations on the Status and Rules of Procedures for the Evaluation Committee for Managing the EIA Procedure for Category A Projects	Composition of the Evaluation Committee, working principles (including quorum, decision making, technical analysis, etc.), and expertise from entities outside the environmental authority.

In addition to recommendations to existing guidelines, the ADB team also makes recommendation on the use of several terms in the Decree Law No.5/2011 for the purpose of clarification and to reflect international best practice on aspects covered in EIS laws (Table 5.4).

Table 5.5. Proposed Amendments to the Use of Several Terms in the EIS Laws

	Proposed Amendments
Article 1 (k)	Definition of “environmental impacts”
Article 1 (w)	Addition of “women” and “affected people” to the definition of “public”
Article 1 (y)	Use of term “Environmental Assessment”
Article 4 (1)	Use of term “Environmental Impact Assessment” and “Simplified Environmental Impact Statement”
Article 4 (3)	Replacement of the article to reflect international best practice on aspects covered in EIS definition

Articles 18, 21, 22, 25,	The use of the term “proponent”, “Simplified EIS”, etc.
Article 19	The deadline for the technical analysis of the Simplified EIS and EMP and others
Article 33 (1)	Addition of the obligation to keep record on monitoring
Article 38 (1)	Clarification on record and information access to show that the register should also include EIA, EIS and EMP for any project
New Chapter XII	Insertion of a new chapter to cover procedures applicable for proposed projects that may have significant cross border environmental impacts
Article 42	Addition of a “catch all” phrase to account for the emergence of other issues that may require regulations

6. DESCRIPTION OF EXISTINGENVIRONMENT

Understanding the nature and existing condition of the natural environment is important to provide background information, prior to the commencement of the project. As the presence of the project will affect the existing environment (bio-physical, ecological, socio-economic, culture, etc.), the review of the existing condition becomes a critical part of the environmental impact assessment (EIA). Particularly, during the project implementation (pre-construction, construction, and operation), some major activities will contribute to the change of environmental parameters.

Therefore, it is necessary to collect the baseline information and documented prior to the commencement of the project, where the impacts from the project have not existed yet. By documenting the baseline information, it is possible for project owner and regulatory agencies to monitor the magnitude of impacts from the proposed project during operational phase once the project shall be constructed. Baseline data would also be useful for project owner to adjust plans and design parameters of the development so that impacts would be minimum and controllable. The following description of existing environment composed of physical, ecological, social, and economic component.

6.1 Physical Component

6.1.1 Climate

Any project development, particularly in the coastal region, such as in Ulmera bay, as project location, required a comprehensive understanding the climate parameters during the project preparation and throughout the implementation (pre-construction, construction, and operation), as the climate condition will affect the project implementation. For instance, designing of structures that will be free from flooding would need rainfall information and other climate parameters to come up with the proper design parameters. Moreover, designing an energy efficient processing plant also need information on air temperature and rate of evaporation. The best method to provide analysis of any natural event including the climate is to use historical data, which describes actual phenomena that have occurred. From historical record, any future trends can be predicted based on various reasonable assumptions. Availability of historical climate data in Timor Leste is a challenge, as records come in short period of time or in many locations they simply do not exist. Consequently, data from the nearby stations could be used.

Important climate variable related to infrastructure development are:

1. Rainfall
2. Wind
3. Evaporation
4. Air temperature
5. Solar radiation
6. Wind speed

Therefore the following discussion of the above-mentioned climate parameters will be focused on the subject and historical data available near the project location, how the parameters will affect the project in

what way and what could be done during the project implementation to help minimize some of the climate related risk that maybe occurred.

6.1.1.1 Rainfall

Rainfall is one of the most important climate parameters as rain is the main input to the any water resources system in any natural environment. The rainfall would normally translate into various form hydrological system or water resources system such as surface water, groundwater, seawater, and sub-surface water systems. The present or absence of rainfall in any location could affect many living organism fulfilling or unfulfilling the needs. The extreme condition of rain could become an issue related to the balance of natural environment. For instance too much rainfall will causes flooding risk though water resource availability is abundant and else too little rain (drought) will cause failure in crop production. Therefore knowing the amount of rainfall in the time variation is very important information for various purposes of human life, including the project development such as beverage process plant.

Historical recordshows that northern part of Timor Island receives less rain than the southern part. Ulmera or Tibar area is similar to Dili,where average annual rainfall ranges from 800-1200 mm, which is considered small and typical along the northern part of Timor Leste. Analysis of rainfall pattern this document was taken from two stations nearby the project location in Dili/Liquica at sea side and upper part of Liquica (Figure 6.1).

Figure 6.1 Meteorological Stations nearby Project Location

Table 6.1 Annual Rainfalls Recorded during Portuguese Administration in Liquica

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1916	217	82	121	17	29	25	97	8	56	13	88	214	977
1917	146	57	70	179	111	284	28	10	74	90	112	197	1354
1918	94	217	32	46	26	0	24	6	22	0	31	105	700
1919	30	156	213	330	105	0	17	0	31	0	12	146	1037
1927	48	18	0	0	0	0	0	0	0	0	65	78	206
1928	79	69	110	34	167	28	8						
1932	140	107	111	125	293	156	0	0	0	0	134	76	1138
1933	259	69	69	100	66	125	0	7	30	27	133	134	1058
1934	81	216	77	56	143	10	6	0	0				
1936									39	4	187		
1937		51	312	155	95	26	0	0	14	25	13	97	
1938	309	103	51	34	240	28	47	0	0	60	171	97	1144
1939	152	216	121	120	570	147	72	0	0	1	32	171	1600
1940	171	127	83	40	99	47	20	0	0	0	34	96	709
1941	106	55	21	146	210	7	86	2					
1956					29	433	69	144	10	26	38	208	
1957	49	180	93	58	125	164	189	1	18	0	45	202	1130
1959	139	78	113	112	119	118	56	1	6	29	27	252	1110
1960	230	150	91		110		61	15					
1961			65	118	96	0	40	0	3	2	131	148	
1962	140	245	59	87	270	220	11	11	0	0	144	190	1309
1963	202	156	369	236	249	0	0	0	0	21	4	130	1417
1964	156	81	221	254	127	238	0	2	7	90	211	182	1582
1965	340	190	135	47	13	105	25	0	0	0	0	29	889
1966	272	317	361	71	170	77	10	30	0	56	114	287	1745
1967	316	245	235	276	58	0	0	0	9	0	48	32	1220
1968	277	416	147	83	232	334	175	21	31	0	1	227	1944
1969	206	256	150	41	274	107	121	153	0	0	111	341	1850
1970	371	139	215	136	396	98	0	0	41	22	98	127	1641
1971	120	150	102	41	232	1	21	1	25	45	118	132	936
1972	143	123	104	134	118	54	0				43	143	
1973	351	182	89	107	222	39	47	25	117	22	75	201	1577
1974	168	44	205	106	42	24	15	75	24	22	142	82	949
Mean	189	153	134	112	151	93	38	17	20	20	81	155	1175
n	29	30	31	30	32	31	32	30	29	28	29	25	24

Table 6.2 Historical Record of Rainfall Data in Upper Ermera during Portuguese Administration

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1968	396	345	217	183	297	173	124	14	11	110	82	479	2431
1969	381	190	327	80	53	12	1	2	36	101	35	386	1604
1970	337	278	292	233	148	31	4	0	13	192	327	86	1941
1971	200	194	252	157	121	51	50	29	24	67	223	162	1530
1972	238	231	192	53	43	14	0	10	0	0	89	208	1078
1973	445	228	308	245	116	23	0	22	23	68	151	257	1886
1974	261	74	284	190	168	25	16	105	32	107	383	216	1886
Mean	325	220	267	163	135	47	28	26	20	92	185	256	1765
n	7	7	7	7	7	7	7	7	7	7	7	7	7

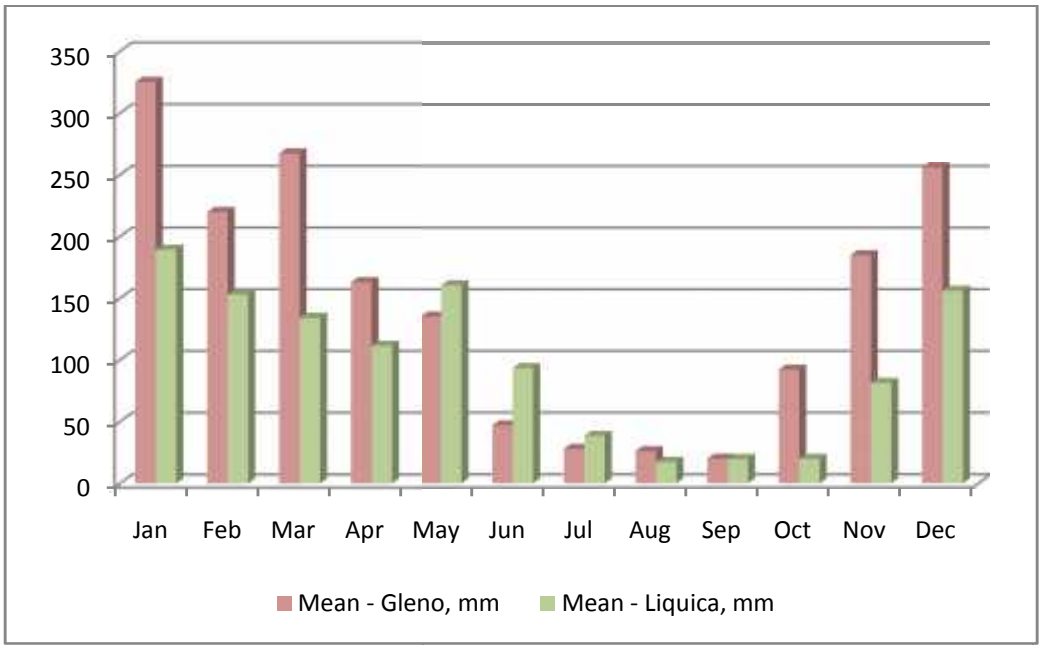


Figure 6.2 Monthly Average Rainfall Distributionin Aileu and in Dili

The above tables and graph suggested that the wet seasons around project location is roughly 7 months from November –May, where average monthly rainfall ranges from 100-150 mm. The amount of monthly rainfall at this range is reasonable low compares to adjacent rainfall station such as at the higher altitude at Gleno, which ranges from 120-300 mm. Low rainfall affects water availability within the area that affects plants and other living condition.

With the advancement in the instrumentation technology, the climate and weather conditions can be monitored almost at the real time basis. The following map shows the weather data collection with the latest effort with the automatic weather station with the satellite based technology.

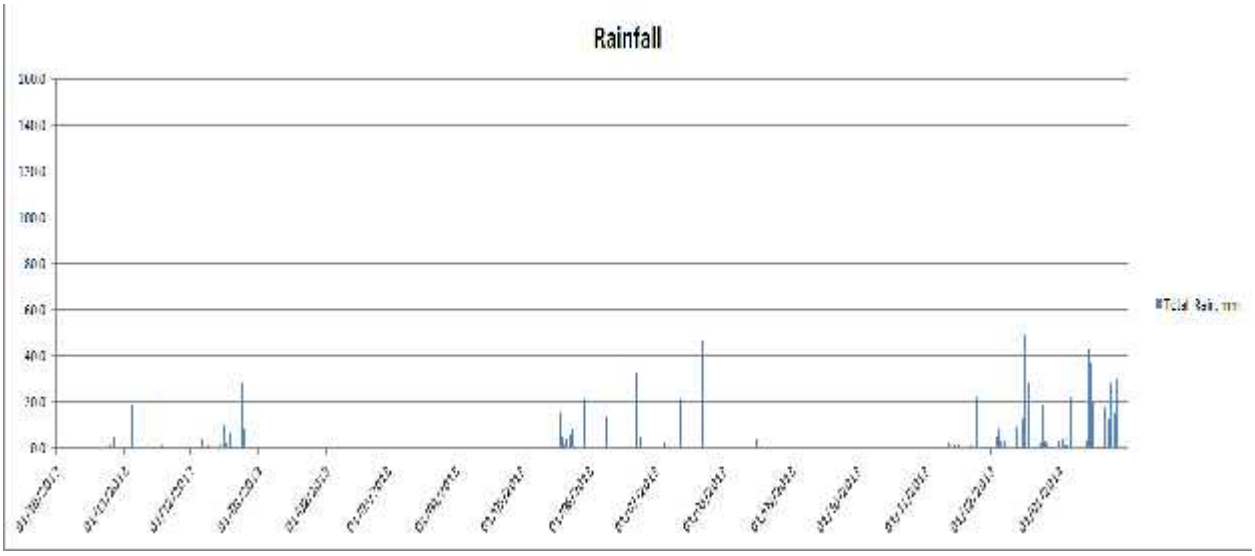


Figure 6.3 Automatic Weather Data Collected at Upper Catchment System near Fazenda Algarve

The data indicated that in any given year, only few storms occur bringing in 40-120 mm of rain. This amount of rainfall in a storm basis is reasonably high and could produce localized flooding issue at low laying area near the coastal. This historical rainfall data provide valuable information to the project owner to design properly the system (structure) that may be free from localized flooding. The rainfall data in term of volume (monthly average) and daily average shall provide a valuable information to the water resource planning related to the proposed project development, as the consumption of fresh water would be reasonably high, which will be fulfilled from the groundwater. On the other hand, the rainfall data also indicated the short duration with intense rain that could potentially produce flash flood in the localized area. So the proper drainage infrastructure design based on the frequency of rainfall would be necessary to prevent any risk related to the high water flow in the river or Greek nearby the project location.

6.1.1.2 Temperature

The impact of temperature aspect of climate is also important parameters in designing various systems such as refrigeration, heat exchanger, etc. As the project is located near the coastline with the limited vegetation cover, temperature is reasonably high during day time and getting lower during the night time. The following data show temperature variation collected in the upper reach of project location, where the temperature can as high as 35 degree C during the day time and can go as low as 10 degree C during the night time.

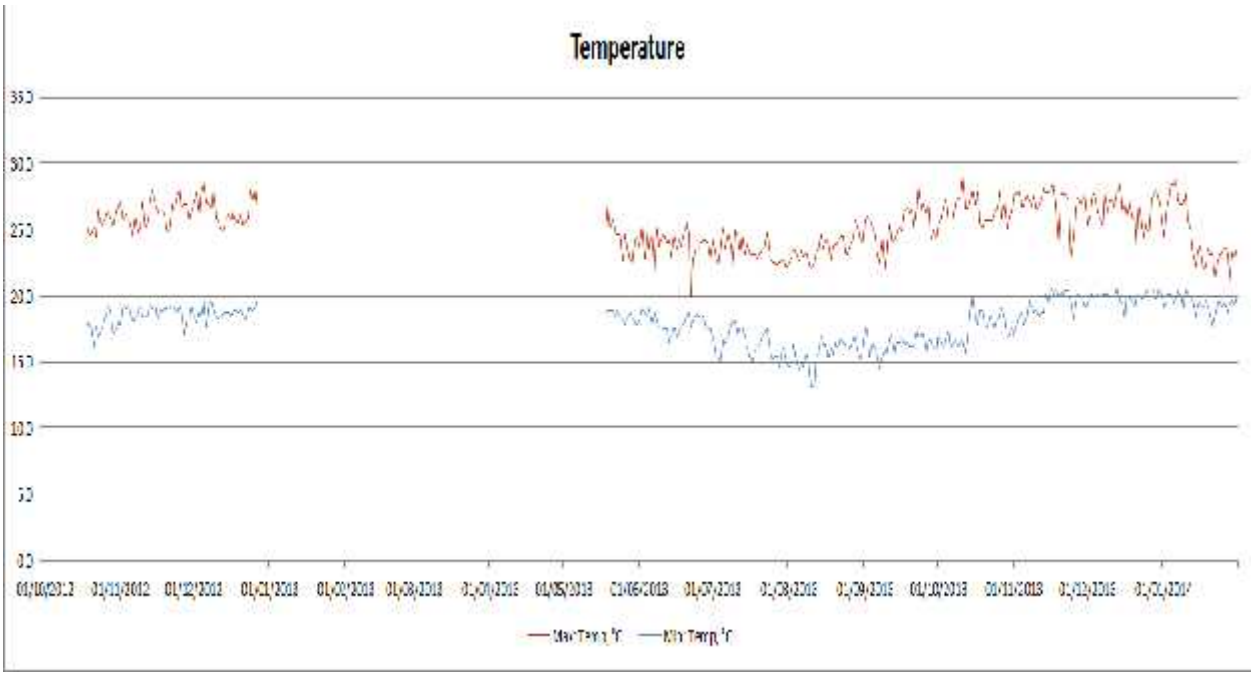


Figure 6.4 . Temperature Variation of Recorded at Upland of the Catchment

6.1.1.3 Relative Humidity

Relative humidity shows the water content in the air, depending on temperature and air pressure. The lower the temperature, the more water content in the air. Therefore during night time, RH is reasonably high. As humidity is the function of temperature and pressure, where the recoded data in the upper catchment indicated that value of Relative Humidity (RH) approaches 100% in the night time and reach the lowest point at 10% during the daytime.

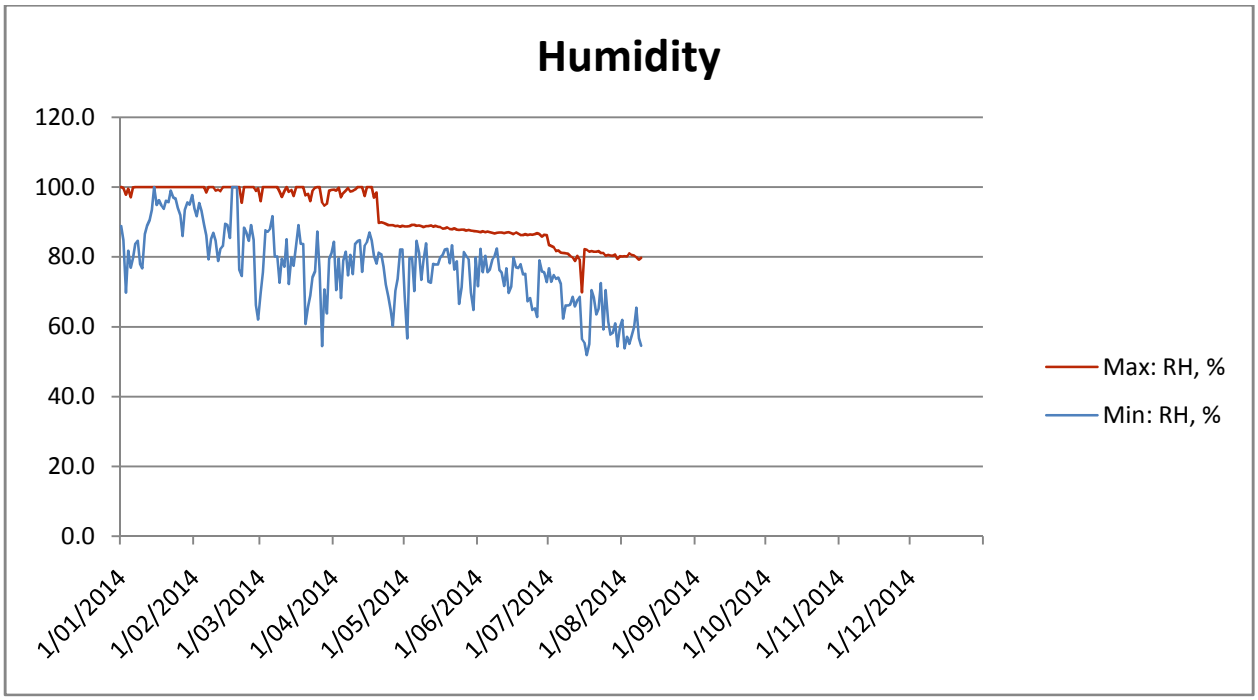


Figure 6.5 Variation of Relative Humidity during Day and Night Time

Understanding relative humidity surrounding project area would provide important information to design building and necessary control instrument that make condition more comfortable for working while reducing the need for air conditioner.

6.1.1.4 Evaporation and Solar Radiation

Other important factors of the climate aspect are solar radiation and evaporation, which relates to the amount of sunshine during the day time. With high solar radiation and evaporation rate (roughly at 3 mm/day), the amount of rainwater that is available is limited, which will affect water resources in the project site.

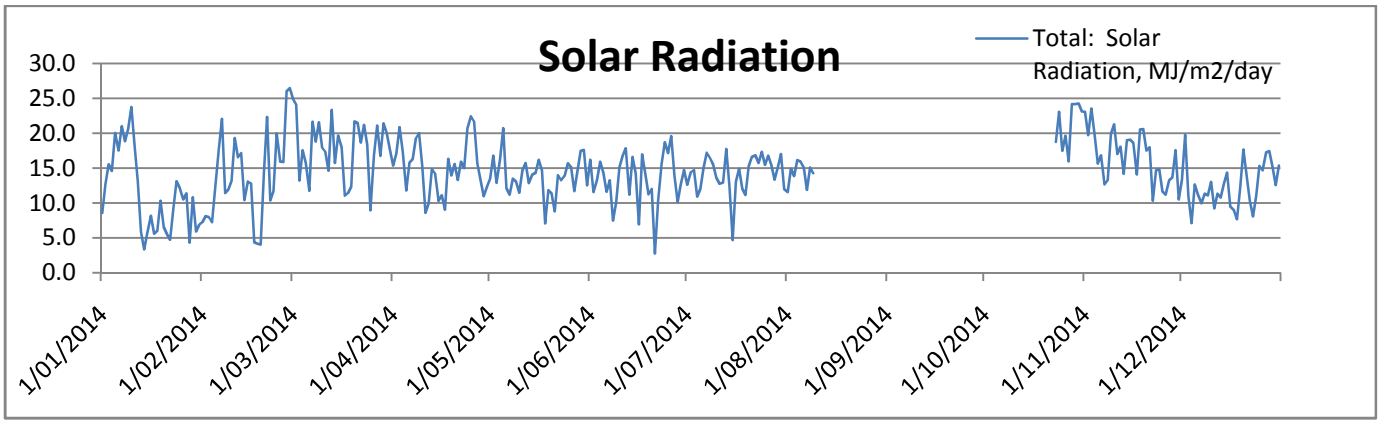


Figure6.6 Total Solar Radiation Recorded in the Upper Catchment System (near Fazenda)

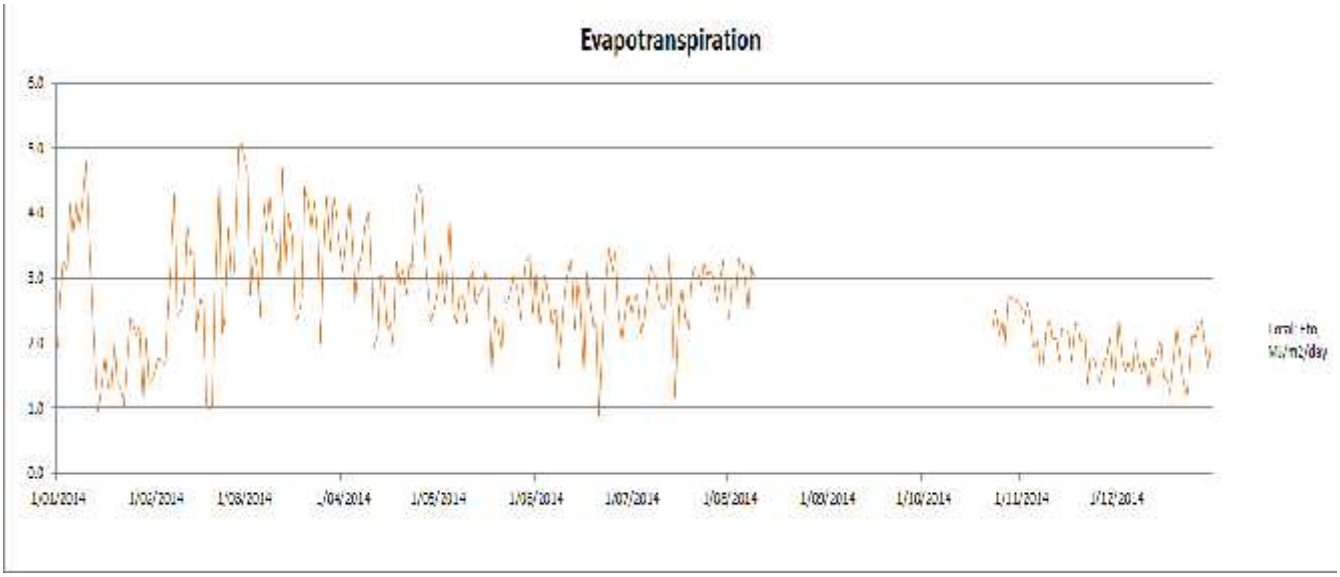


Figure 6.7. Total Daily Evapotranspiration Rate (data Measured at Fazenda)

6.1.1.5 Wind and Tropical Cyclone

Wind speed and direction are also important variables to be considered in project design and development aswind condition affect various aspects during construction and operation in terms of safety. High gust wind brought by extreme conditions such as cyclones is often time dangerous as it may damage structures and hazardous to people in the area. High speed wind will also particularly become a driving force in transporting particular matter, particularly dust and pollution matter from one location to the other. Therefore, understanding the wind condition from the historical data would be necessary to adjust any factor into the design and operation in order to anticipate significant impacts.

The historical record, as showing in the following figure, suggest that the wind speed is relatively calm, except for temporary high gust which may take up 50 Km/hour, which could be a concern. However, this condition is normally temporary and localized so in many cases it is manageable.

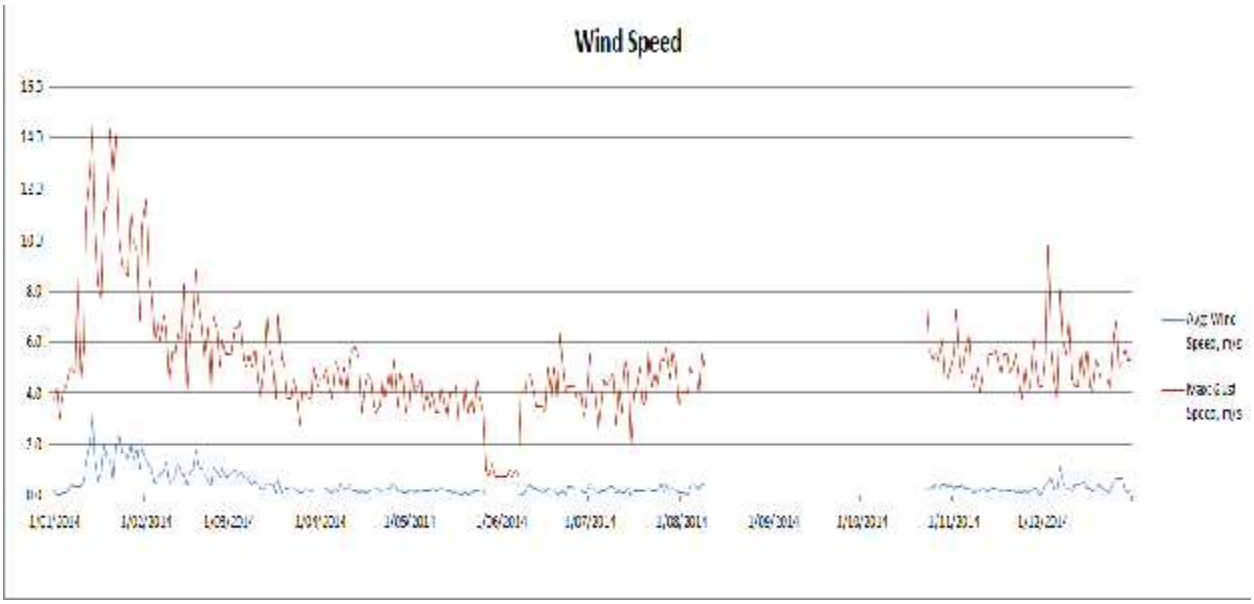
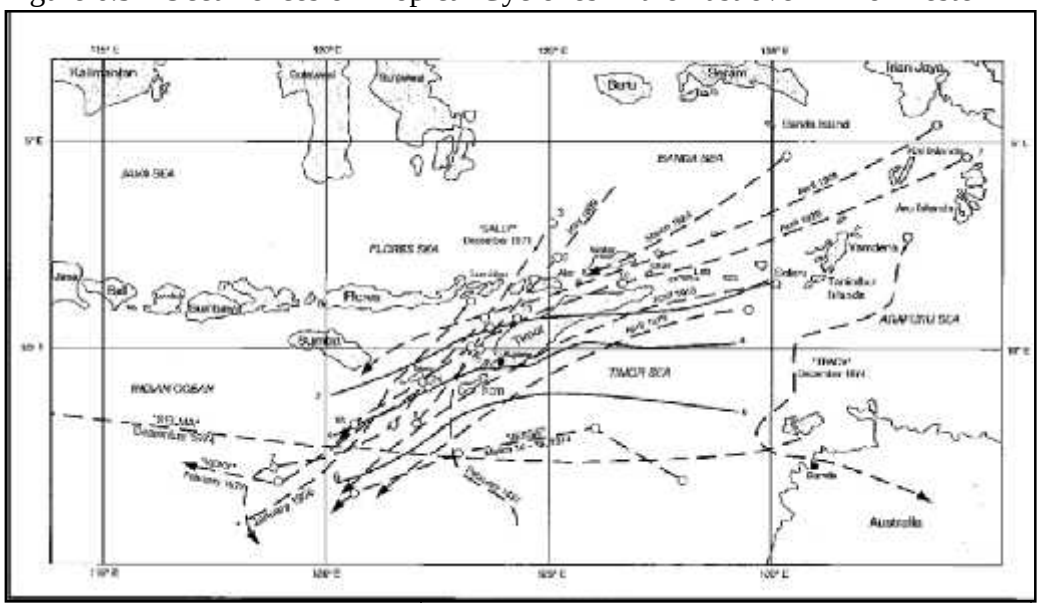


Figure 6.8 Wind Speed Recorded in the Upper Catchment

The important parameters of wind to be considered in any project development would the wind speed and direction. Long-term historical wind data collected at Dili airport suggested that no extreme condition will occur in the foreseeable future. Tropical cyclones typically bring heavy rain and strong winds. In the Banda - Sawu Region, tropical cyclones may develop during the April – May period and move south – west (Figure 6.10). Abbs (2010 in Kirono 2010) noted that tropical cyclone mean occurrence over Timor Leste region is around 0.2 per year, meaning that there is two out of ten chances that tropical cyclone happens in the country in a year.

Figure 6.9 - Occurrences of Tropical Cyclones in the Past over Timor-Leste



Source: Crippen International, cited in Kirono 2010.

6.1.2 Topography and Flooding Pattern

Elevation difference in the project site ranges from 180 m at mountain to the 20 meter near the propose facility site. The mountains, valleys, and low-lying area form the general catchment system in Timor Leste in general and also in the project location.

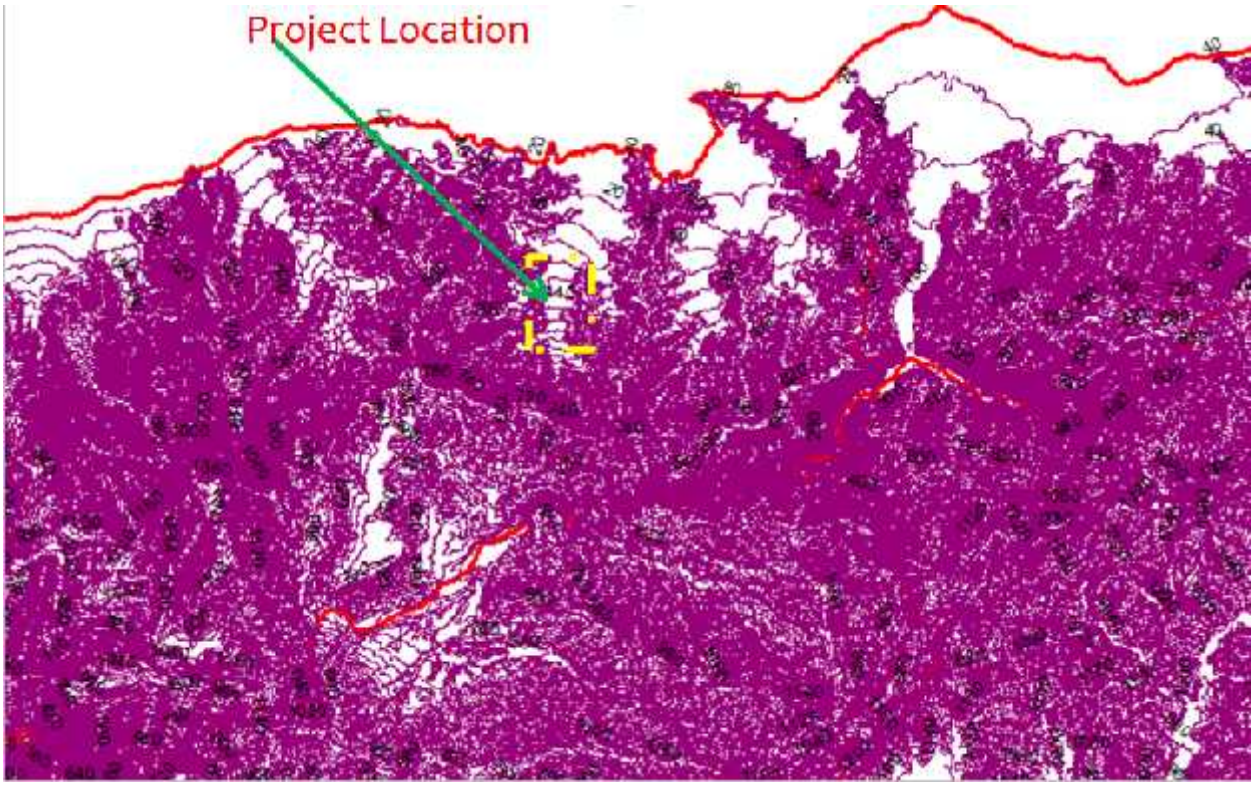


Figure6.10 Topographic Representation in the project location

It is important to provide an analysis and the implication of this topographical variation to proposed project development. Particularly, the topographic condition will affect the following three natural events that should be considered in to the reduced the implications.

6.1.2.1 Catchment and Flooding Pattern

By using the topographic data, the catchment system can be derived. The following catchment system was extracted from the topographic information where small catchment exists in the site that contributes natural flow into the proposed project site.

Figure 6.11 Catchment System

The area of contributing the storm runoff into the downstream of the location was estimated to be 900 HA, with an average slope factor of 40% at the upper reach and nearly flat at the project location. Natural stream that normally conveys storm runoff is located within 1 km east of the project site. Riverine flooding does not exist as the size of the catchment is too small to be producing sizeable flood.

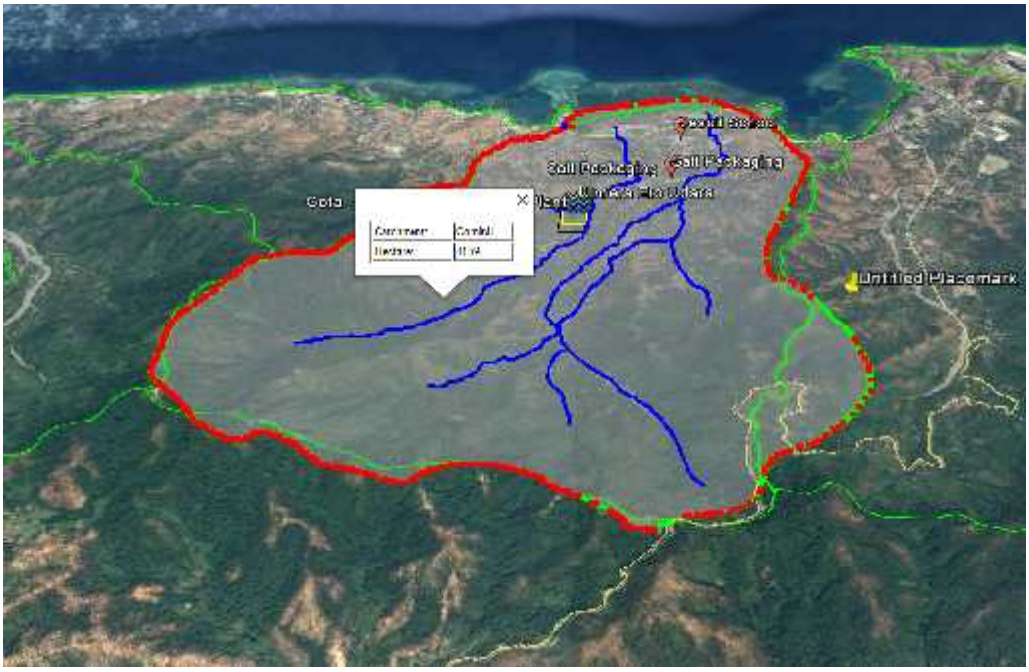


Figure 6.12 Adjacent Larger River Basins to the Project Location

Understanding of this catchment pattern and flow line within the project location and surrounding will provide valuable information to the project owner in order to construction a necessary flood protection structure to reduce the risk to the future business. Considering the project location in the low-lying area that may have elevation less than the elevation of the stream/Greek nearby, the project owner may opt to construct the necessary flood retaining wall around the facility. This idea will required some detail assessment on the hydrological analysis that is not part of this environmental impacts assessment project.

Figure 6.13 Identification of Potential Requirement of Flood Retaining Wall

6.1.2.2 Erosion and Sedimentation

Erosion and sedimentation are reasonably high in Timor Leste due to natural terrain, which are steep and naturally has little covers. This creates condition for high soil erosion to occur during the rainy season.

Figure 6.14High Turbidity of runoff flow as proof of sedimentation

Figure 6.15 Soil Type that Susceptible to Erosion

With the steep slope also accelerates the natural flow of runoff from mountain to the sea and at the same time the runoff also carries highly suspended material from soil erosion that will end up in the river but ultimately contribute sediment load to the coastal area.

Rainfall factor is not high (only few storms in any given year), but storm intensity is reasonable high that could initiated high soil erosion and transport to the downstream area.

6.1.2.3 Natural Landslide

Another natural hazard that may occur due to the terrain condition is the natural landslide during the thunderstorm. Soil is susceptible to erosion and mud will be deployed from upland. However, the low rainfall intensity with the gradual slope from the mountain to the project location, the landslide hazard may not be a major concern. According the investigation done by the UNDP in 2010, the proposed project development is located not within the landslide hazard areas.

Figure 6.16 Landslide Hazard Map (produced by UNDP, 2012)

6.1.3 Geology and Hydro-Geology

Although the geology of Timor Leste is complex in both composition and tectonic influence, many scientists have largely agreed that, Timor Island is part of Banda Arc, marked by a string of islands and underwater formations that are thought to be the results of collision of the Indo-Australian Plate, the Pacific and the Eurasian Plate. Timor Island, according to Hamilton (1978) and other expertsare formed from fragments from the Australian plate, deep marine sediment thrusted upward by the collision, oceanic crust and Quarternary sediments brought by the collision.

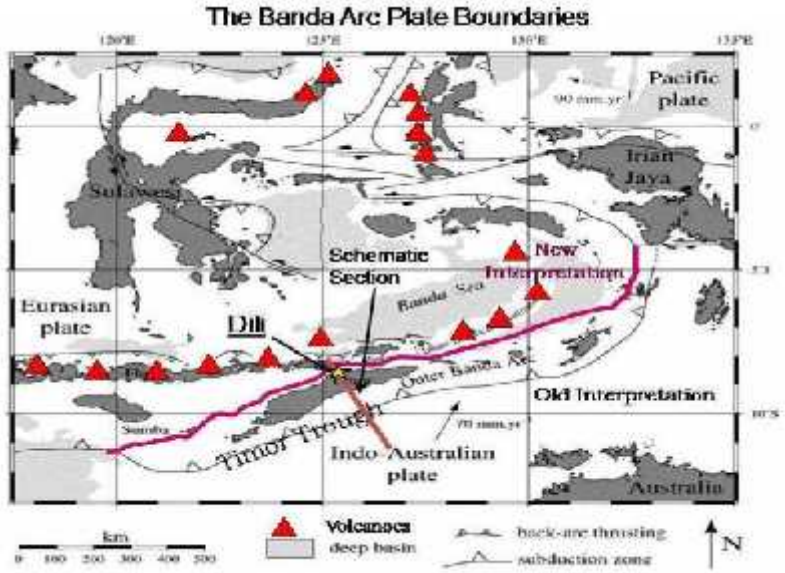


Figure 6.17 Location of Timor Island in Respect to Major Geological Formation

The geological condition (rock type and properties) will control groundwater storage and flow. Therefore, hydro-geological investigation in terms of lithology and aquifer type is important. According to the Australian Geoscience, the lithological type of Timor Island is dominated by carbonate, intergranular, and "***Metamorphic"*** rock types, where each type of rock has different characteristics in storing and transporting the water.

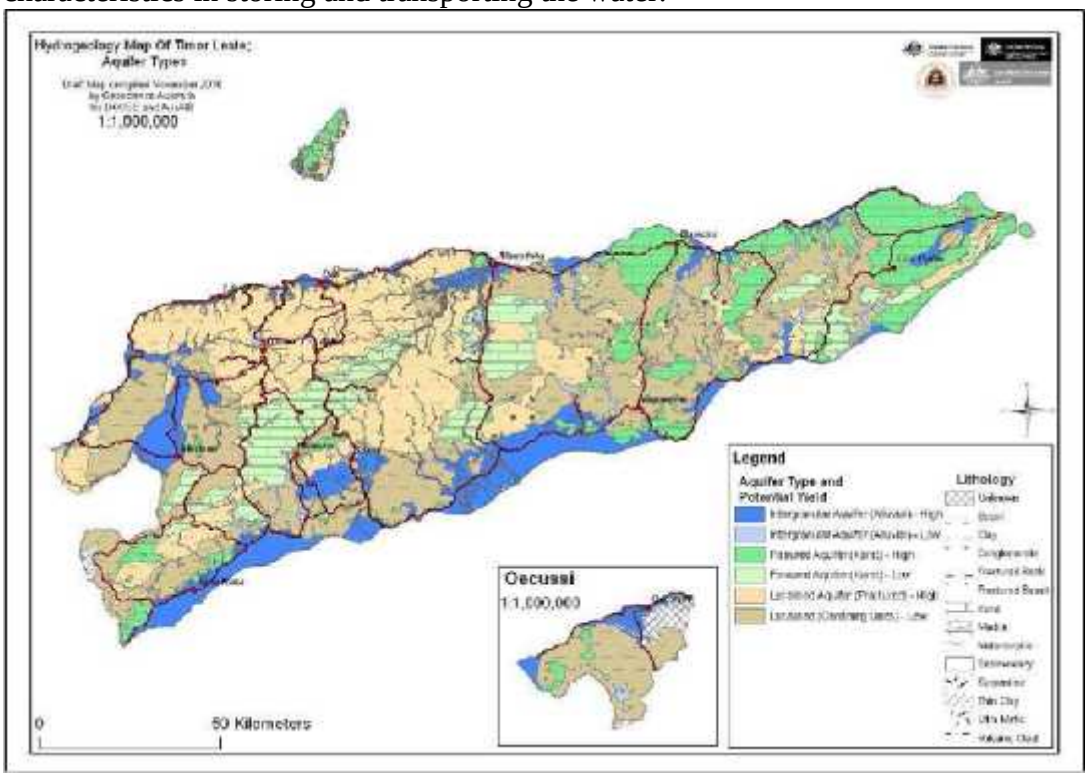


Figure 6.18 Hydro-geological Condition of Timor Leste

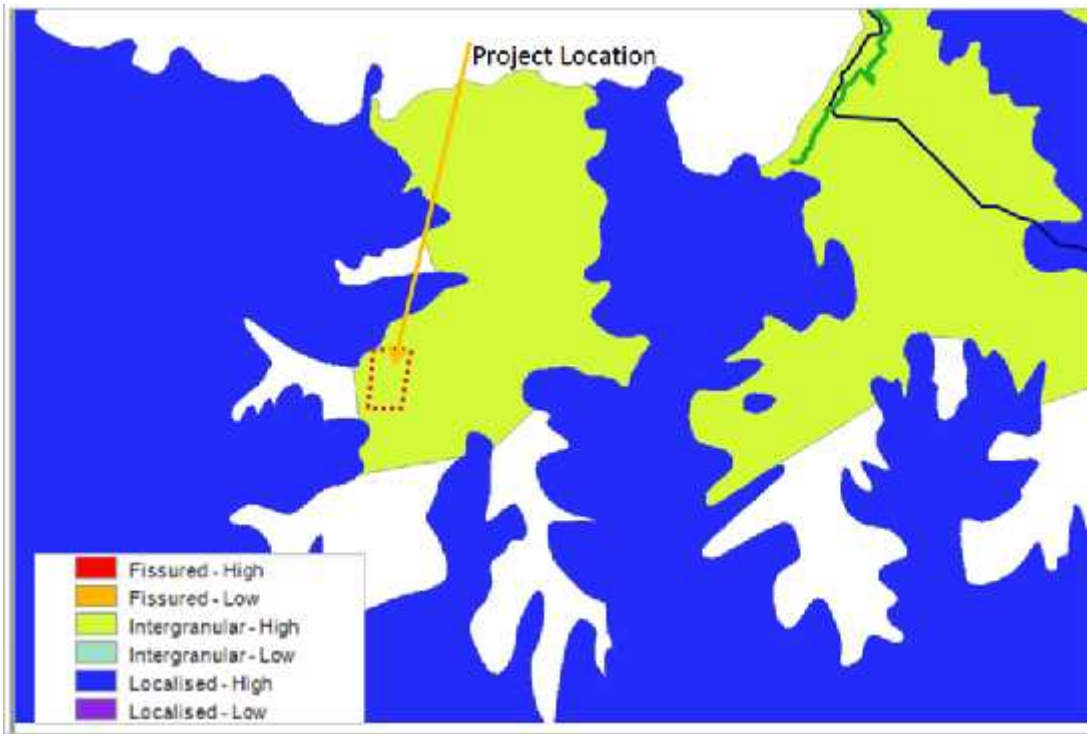


Figure 6.19 Lithological and Hydro-Geological Characteristics of the Project Site

Aquifer is underground storage of the water formed from different types of rocks. According to the Australian Geoscience study for Timor Leste, aquifer type identified in the proposed project location is "Intergranular high", where the type of aquifer is confined and normally has very high groundwater yield, similar to the aquifer in Dili. As aquifer and recharge area is reasonably large, fresh water availability in the groundwater system is substantially large and can fulfilled the demand for the proposed development industry and beyond.

6.1.4 Air Quality

The World Bank assessment on outdoor air pollution in Timor Leste (2009) noted air pollution is currently not a major concern and usually it is only localized and temporary problem relevant to an activitythat may be completed at the certain period of time. Sources of air pollution in Timor Leste are typically:

1. Particulate Matter (PM) from construction activity, lack of road maintenance and clean-up program, forest fire.
2. Gas emission from vehicular movement and operation of power plant

As the nature of the propose project will contribute gas emission to the atmosphere, such as SO_x, NO_x, CO_2 and CH_4 (Methane), baseline data collection on these mentioned gases would be important. Baseline data would provide important information as reference prior to the commencement of project. Air pollution from vehicle combustion starting to be of concern in the Capital Dili and other main roads due to the increasing number of cars, trucks and other vehicles.Air quality is commonly measured in terms of concentrations of NO_2, SO_2 , Particulate

Matter (PM_{10}, $PM_{2.5}$) and ozone. The following table contains WHO ambient air quality guidelines.

Table 6.3 WHO Ambient Air Quality Guidelines

Parameter	**Average Period**	**Guideline Value (µg/m^3)**
Sulfur dioxide (SO_2)	24-hour	20
	10 minute	500
Nitrogen dioxide (NO_2)	1-year	40
	1-hour	200
PM_{10}	1-year	20
	24-hour	50
$PM_{2.5}$	1-year	10
	24-hour	25
Ozone	8-hour daily maximum	100

Source: IFC, http://www.ifc.org/

Existing air quality will generally be affected by vehicle movement and soon to be sheet road that has not improved. The impact due to dust should only be reduced with the road improvement which the project owner has to coordinate with the relevant line ministry within the Government of Timor – Leste. However, air quality problem is only temporary during the road construction and it expected to be much better during the operation of the road. Source of air quality problem comes from road construction, vehicular movement, and the construction activity within the propose project location, and wind which become an active agent to transport the pollutant (particulate matter) from the location where the dust being generated to the other location that has lower concentration of particulate matter.

Figure 6.20 Existing Source of Dust in Project Area

Dust is dispersed over the near area before larger particulates settle down and smaller particle sizesare getting blown to other areas that have lower concentration. Baseline data of waterquality condition was measured in the proposed project location providing that baseline information on the water quality condition before the project is commenced. Air quality parameters in terms of particular matters (PM_{10} and $PM_{2.5}$) and gaseous emission in terms of NO_x and So_x were measured continuously in 24 hour duration.

Figure 6.21 Data collection of Particulate Matter and Gaseous Emission in the Project site

Table6.4 Results of Air Quality measurement in Ulmera (project location- May 2017)

No.	Parameter	Method	Unit	Sampling duration (Jam) [1)]	Analysis Result	Accuracy
1	Weather				Clear	
2	Wind direction		From		South	
3	Average wind speed		m/s		1,0 - 1,8	
4	Humidity		%		58 - 88	
5	Temperature		^{o}C		23 - 31	
6	Oxide Nitrogen (NO_2)	SNI 19 - 7119.2 - 2005	$\mu g/Nm^3$	1	8	± 0.277
7	Sulfur Dioxide (SO_2)	SNI 19 - 7119.7 - 2005	$\mu g/Nm^3$	1	< 3.081 [2)]	± 16.662
8	Carbon Dioxide (CO_2)	MU – LKU/TL.ITB - 3	ppm	-	373	± 40
9	PM_{10} (Particle < 10µm)	MU – LKU/TL.ITB - 1	$\mu g/Nm^3$	22	53	± 0.023
10	$PM_{2,5}$ (Particle < 2,5µm)	MU – LKU/TL.ITB - 1	$\mu g/Nm^3$	22	22	± 0.053

The above measured baseline data suggested that the particulate matter was higher than the average guideline allowable standard by IFC. However, this may be temporary due to the generate dust during the on-going construction activity during the data collection. The particulate matter issue should reduce during the operation of the factory. On the other, the carbon dioxide is average high, due to the fact that the project is located nearby the Tibar landfill dumpsite that during the day, the solid waste is incinerated, which emits variouspollutants such as CO, CO2, Sox, and NOx. These data will be used as baseline information for future reference, particularly, to be ploted against the future ambient air quality condition when the plant is already in

operation and contribute gaseous emission into the air. The proposed plant will emit the Methane, CO_2, and NO_x, which will require regular monitoring in the future.

6.1.5 Noise Level

Noise factors observed in the proposed project site mainly comes from machinery from heavy duty equipment as part of the pre-construction within the project site and vehicular movement along the national road. Similar to air quality, noise pollution, at the moment is only temporary and the degree of noise is generally at the acceptable level by human being. The following table shows the general guideline of the noise sources and magnitude.

Figure 6.22Heavy Duty Equipment on the Site

Table 6.5 Noise Level Produced by Heavy Duty Equipment (Source: IFC – Performance Standard, 2007)

Type of System	**Noise Level, db**
Belt Conveyor	small
Elevator	small
Fan	70-90
Compressor	91-100
Rotary blower	80-95
Ring Blower	80-95
Hopper	60-85
Elevator	small

Belt Conveyor	small
Fan	70-90
Compressor	74-84
Rotary Blower	80-95
Truck	83-94
Concrete mixer	76
Power Generator	70-91
Pump	82-99

As source of noise is reasonable far from concentration of population, except from the road, the impact should be minimum and can be managed during construction and operation.

6.1.6 Surface waters

Water resource availability seems to be the problem in the site. Surface water does not exist, except during heavy rainfall, where storm water is full with mud (high turbidity). The groundwater system is the only option of fresh water resources observed in project location.

Field observation conducted around project site indicated that the public water supply to local community near project location is provided by the government that extracted groundwater that is located about 5 km upstream from project site. The following map shows the location of spring that has been used as main water source near project location.

Figure6.23 Location of Spring Water

An intake tank was constructed a few years back and pumping system was constructed to convey the fresh water from the spring to the community.

Figure 6.24Water Supply System to Nearby Community

The quality of water from the spring is visually good, except that volume rate of spring is small therefore only sufficiet for the small community. Particularly, volume becomes much smaller in the dry season. Consequently, nearby groundwater source and perhaps other cfreative ways need to be investigated for the future in order to provide water in the area for both domestic and commercial uses.

6.1.7 Groundwater

Field reconnaissance during site visit to the project location and surrounding areas suggested that currently no groundwater utilization in the project location, except toward Westside of the Hera power plant, where community members utilize groundwater from the privately developed bore. The data/study from Australian Geoscience indicated that aquifer type within the project location only contain water with the brackish characteristics.

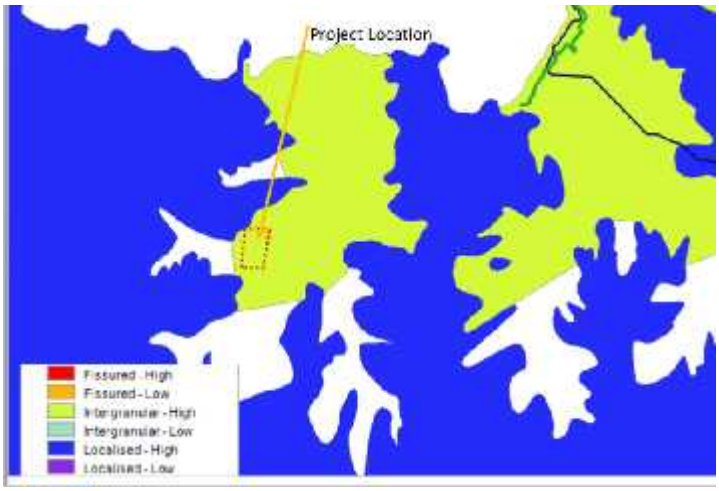


Figure 6.25 Map of Groundwater in Project Location

According to the study, intergranular high type of aquifer that has very high capacity in storing the water, as material forming the aquifer is mainly clay and confined material, and therefore water easily stored the water.

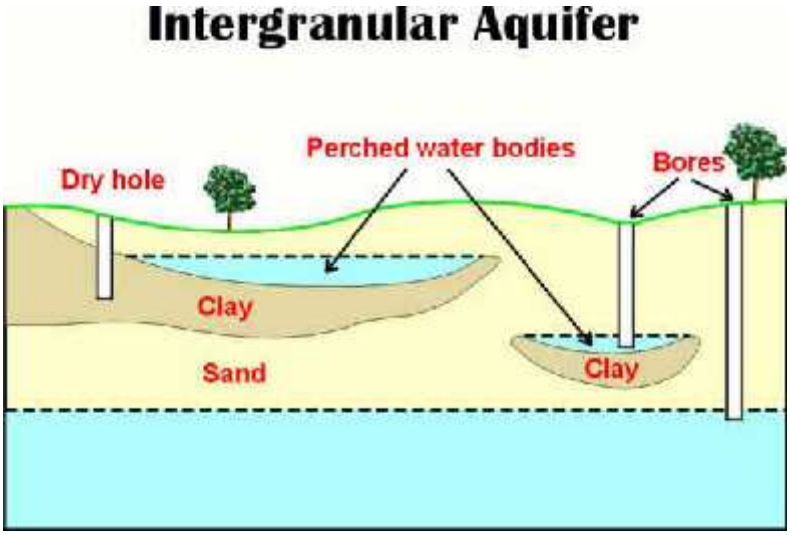


Figure 6.26 Aquifer Type of Water Storage in Ulmera

Project owner has made an attempt to investigate and explore groundwater system within the project location and found that groundwater quality in several bores are clean and fresh with salt content inthe range of 600 mg/L. This quality is not suited to the proposed industrial use therefore further treatment is needed.

Figure 6.27 Photos of groundwater Exploration and Constructed Bores

Table 6.6 of groundwater quality Parameters Tested in the project site

Request for Water Quality Testing

Sample analysis reference : 000005424
Requesting Organization : ETO
Description of the organization: ESPERANÇA TIMOR OAN
Contact Person : Mr. NILTON GUSMÃO | Telephon : 77243585
On behalf of organization, I agree to pay the cost of test request below: Signature: √
Data and time sample was taken : 27 / 03 / 2017 | Date and Time sample was received: 27 / 03 / 2017
Sample location specification : ALDEIA NERAN / SUCO ULMERA
Water Source: River | Mountain stream | Spring | Well √ | Others
Sampled by : - | Received in laboratory by: MARIO SOARES
Approved to test by: ESTELA SALDANHA

Cost (US$)	Parameter	Unit	Request test	Result	WHO/East Timor Guideline	Testing method
Physical test						
1.00	pH value	-	√	7.2	6.5-8.5	pH Meter
1.00	E.Conductivity	(µs/cm	√	1125	NS	Conductivity meter
1.00	TSS	(mg/L)	√	0.04	NS	Gravimetry
1.00	TDS	(mg/L)	√	563	1000	Gravimetry
1.00	Salinity	(‰)	√	0.6	NS	Conductivity meter
1.00	Temperature	(°C)	√	32.0	NS	Conductivity meter
1.00	Turbidity	NTU	√	4.5	5 (NTU)	Turbidity meter
Chemical test						
2.00	NH_3-N	mg/L	√	0.2	1.5	Spectrophotometer
2.00	NO_2-N	mg/L	√	ND	10 (as NO_3-N)	Spectrophotometer
2.00	NO_3-N	mg/L	√	0.008	1 (as NO_3-N)	Spectrophotometer
1.00	Iron (Fe)	mg/L	√	0.1	0.3	Spectrophotometer
2.00	Manganese (Mn)	mg/L	√	0.1	0.5	Spectrophotometer
1.00	Fluoride	mg/L	√	1.0	1.5	Spectrophotometer
2.00	Free chlorine	mg/L	√	ND	0.5	Comparator,
2.00	Ca.hardness	mg/L	√	200	NS	Titration
2.00	Arsenic	mg/L	√	ND	0.01	Comparator
2.00	T. Hardness	mg/L	√	215	200	Titration
2.00	Total alkalinity	mg/L	√	205	NS	Titration
2.00	Sulphate (SO_4^{2-})	mg/L	√	29	250	Spectrophotometer
Bacteriological test						
16.00	Total Coliform	CFU/100mL	√	3	0	Membrane filtration
16.00	E.Coli	CFU/100mL	√	0	0	Membrane filtration

Total cost: **$.61.00 USD**

Remark:
- **Total Coliform is problem !**
- **Total Hardness is high !**

Inspected by:

Head of DNSA Laboratory

Legend: 1. **NS**: not set; **ND**: not detectable; **NT**: not tested; **NR**: not result; **CFU**: Colony Formed Unit; **TNC**: too numerous to count.

There are other bore that produced water within the project location. The following map shows the distribution of the map of the deep bore well identified in the project location.

Figure 6.28 Existing Groundwater Utilization

6.1.8 Marine Water Quality

Other water sources observed in the project location that potentially can be utilized as water source after treatment and purification is marine water. Measurement of marine water quality was carried out to provide baseline data on the quality prior to the commencement of the project (following table). The table shows that marine water is relatively natural and healthy, except that the salt concentration is high at roughly 30,000 mg/L, which would require extensive treatment and purification process before the water can be utilized for production and utility.

Marine water quality was measured by taking the marine water sample near the location where the outfall discharge will be located and sent the sample to the accredited laboratory in Indonesia. The following map shows existing creek or river that linked directly to the marine water body. The wastewater from the factory could potentially, coming to the marine water body through this river during the high runoff flow.

Figure 6.29 Sampling Points of Marine Water Quality

With this sampling program, baseline data are compiled for future reference when the plant already discharges the wastewater into existing ecosystem.

Table 6.7 Marine Water Quality Testing inUlmera Bay

No	Parameter	Unit	Test Results	Standard*
Physical				
1	Turbidity	NTU	1.83	>3
2	Smell	-	No smell	-
3	Suspended Solid	mg/L	10	80
4	Solid Waste	-	Negative	0
5	Temperature	^{0}C	29.8	Natural
6	Oil Layer	-	Negative	0
Chemical				
1	pH	-	7.4	6.5 – 8.5
2	Salinity	$^0/_{00}$	34.4	Natural
3	Total Amonia	mg/L NH_3-N	0.008	0.3
4	Sulfida	mg/L H_2S	<0.001	0.03
5	Total Hydrocarbon	mg/L	<1	1.00
6	Total Fenol	mg/L	0.034	0.002
7	PCB (polychlor biphenyl)	mg/L	<0.005	0.01
8	Surfactan (deterjen)	mg/L LAS	0.406	1.00
9	Oil and Fat	mg/L	1.2	5.00
10	TBT (tri butyl tin)	mg/L	<0.001	0.01
Soluble Heavy Metal				
1	Mercury	mg/L Hg	0.009	0.003
2	Copper	mg/L Cu	0.102	0.05

3	Zinc	mg/L Zn	0.086	0.1
4	Cadmium	mg/L Cd	<0.001	0.01
5	Lead	mg/L Pb	<0.01	0.05
Bacteriology				
1	Total Coliform	MPN/100 mL	240	1000

No major contaminant from nitrogen compound or indication of existing eutrophication detected in the marine water and the turbidity of the marine water is relatively in good condition except for S4 location. In general the marine water quality parameters as measured indicated that the marine water quality is in good condition, except the soluble heavy metals have been found to be elevated in value in the sampling location.
These elevated values of heavy metal can suggested several possibilities:

1. Heavy metal is naturally occurring leading to naturally higher content in ambient environment.
2. There is existing pollution of heavy metal coming from sources in the western location of the sampling – several existing activities salt industry and other type of human activity

This collected and measured marine water quality data will be recorded as baseline information for the future monitoring program during the project implementation (operation of the factory).

6.1.9 Seismicity and Earthquake

Earthquake and tsunami are natural phenomena that needto be assessed and considered in the planning and development of a project, so that any future event that may affect the existence of the project may be anticipated earlier. According to USGS study, Timor Island is prone to earthquake as it is being located in a tectonically active region, along the collision zone of the Australian plate and the Eurasian Plate. Compilation of major shallow earthquakes in Indonesia from 1897 to 1984 by the Southeast Asia Association of Seismology and Earthquake Engineering (SEASEE, 1985) showed a number of earthquakes (magnitude 6 to 6.9) with epicenters located offshore north of Timor Island. A magnitude 8 or greater has been recorded in 1963 with epicenter located offshore southwest of Timor Island. Recently, a very shallow (depth of 1.1 km) earthquake with magnitude of 5.6 and epicenter located on-shore south of Dili occurred last 26 April 2011.

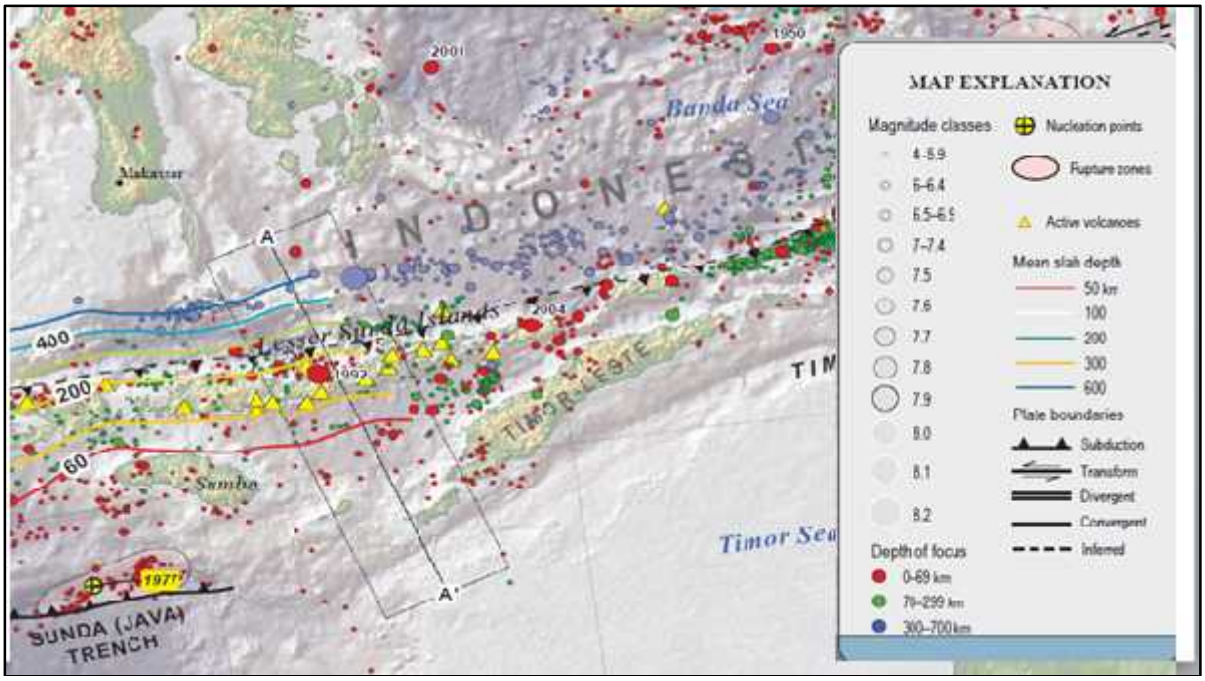


Figure 6.30Historic Earthquakes in the region of Timor Island from 1990 to present (Source: USGS).

Even though no major structural damaged to large infrastructure happened due to earthquake in past several decades, it may be important to apply structural codes that prevent or minimize any major damaged should major earthquake occur in the future.

6.1.10 Soil

Visual observation suggested that the upper part of soil in the project location is dominated by the fine sand, which is highly susceptible to getting washed by run-off during the rainy seasons. At the upper catchment, however, the soil type is dominated by rocky soil.

Figure.6.31 Mixed of Sandy-Loam Soil in the Upper Part of the Catchment

The site investigation also verified the reported soil texture data collected during the Portuguese administration (following figure). The soil type is dominated by silt loam and sand clay with various fractions in vertical direction.

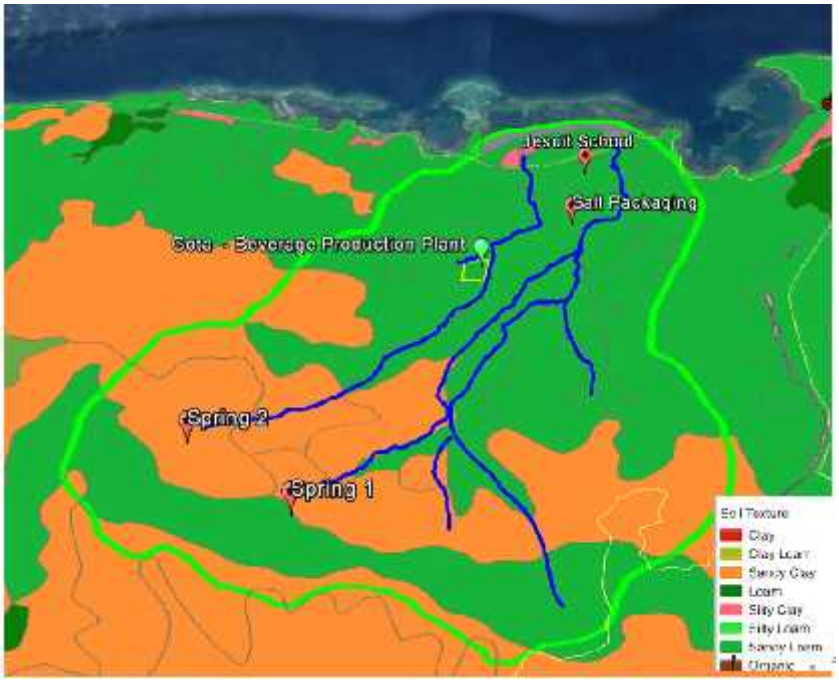


Figure 6.32 Soil Type and Texture (Source: Os Solos de Timor Leste)

Table 6.8 Soil Texture Analysis in Project Location during Portuguese Administration(published in SOL website: www.seedsoflife.org/climatechange

Soil type of fine material tends to have low permeability in transporting water.

6.2 Ecological Component

Ecological component identified in the project location could be split into terrestrial and coastal ecologies, where living organism interact to each other. The description of each component and particularly the baseline information is necessary to know the quality and quality of ecology prior to the commencement of the project. In the future, any change of the quality and quantity of eco –system due to the presence of the project could be easily understood by comparing the field observation. As part of the environmental impact assessment study for the development of beverage processing plant in Ulmera, the ecological assessment was conducted to identified the important ecological component, especially the one that can potentially become a sensitive receptor to the proposed development project.

The government of Timor Leste on the other hand, has been pro-active in improvingthe status of environmental protection in Timor Leste through the enactment of the National Biodiverstiy Strategic and Action Plan (NBSAP), National Adaptation and Planning Action (NAPA), Millennium Development Goals (MDG) and Sustainable Development Goals (SDS). Timor-Leste has also ratified a number of international Conventions such as Kyoto Protocol to the United Nations Framework Convention on Climate Change *(January 12, 2009);* Convention on Biological Diversity *(January 8, 2007)*; United Nations Framework Convention on Climate Change (*January 8, 2007*); United Nations Convention to Combat Desertification.

Coral reefs, seagrass, seaweed beds and mangrove ecosystems are dominant ecosystems found in tropical coastlines. These ecosystems can thrive on their own but where all of them are found in adjacent location, they form ecological linkages that support considerable biological, physical and chemical interactions that support high productivity and rich biodiversity which in turn provide a myriad of ecosystem services that are ecologically and socio-economically important.

Figure 6.36 gives an illustration of typical arrangement of the four ecosystems and some of their functions and linkages identified within the project area and surroundings. Each section performs its own function in the ecological linkages, for instance, fish lives in the coral, but if coral is heavily contaminated by sediment, then the fish population will be in jeopardy. Therefore, sediment trapping by mangrove and further filtering by seagrass are an important function to the habitat of fish and other living organism that are sensitive to sediment. Mangrove, on the other hand, is a sensitive ecosystem that only thrives where the complex physical and biochemical environment are available.

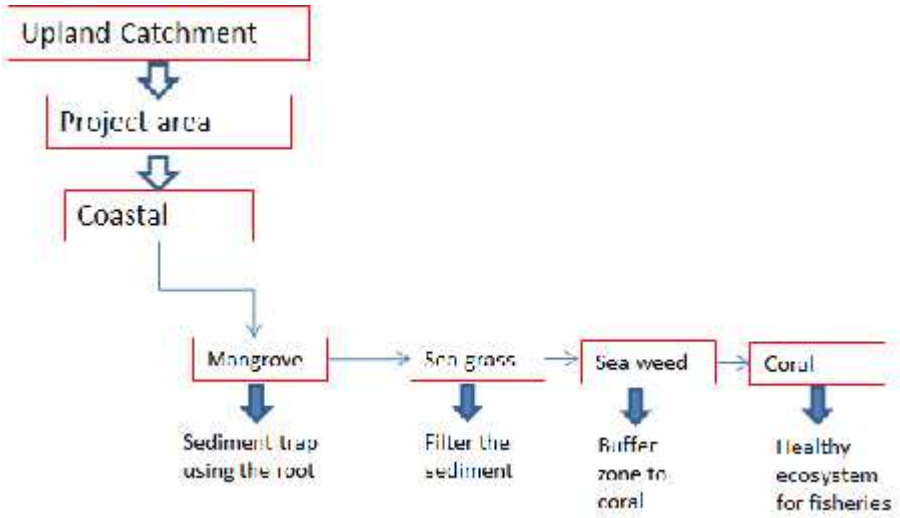


Figure 6.33 Typical Ecological Pattern/Sequences

The following figure presents the actual spatial representation of the above conceptualization of the ecological pattern that interlinkage one from the other ecosystem near project location.

Figure 6.34 Marine Ecological Components and Interlinkages within the Ecosystem

It will be important from scientific perspective to see how this inter-linkageecological system will respond to waste loading from wastewater treatment plants. Practically, changes in the physical environment should be monitored to ensure that any sign of severe alteration to the existing ambient characteristics will be able to be anticipated with proper measures.

6.2.1 Mangrove

In Timor Leste in general, seven genera of mangroveshave been observed in the coastal area dominated *byAvicenia alba, Avicenia marina, Brugueira cylindrica, Ceriops tagal, Lumnitzera littorea, Rhizophora apiculata, Rhizophora mucronata, , Soneratia alba, Xylocarpus granatum*.However,only 2 species dominated the mangrove communities in Hera - namely *Rhizophora apiculata* and *Sonneratia alba. It was observed during the field work that per 7.5 HA, which is dominated by two species*

Figure 6.35 Mangrove Communities Near Project Site

The following figure and table show the breakdown of mangrove genera/species found in the mangrove forests near project location (in 75,000m^2 area). As shown by the figure, species of mangrove observed in the project location is dominated by *Sonneratia Sp.*, which composed of 87% of the total area of the mangrove. Other species that has significance area of coverage is Rhizopohora sp. that covers about 13% of the total population.

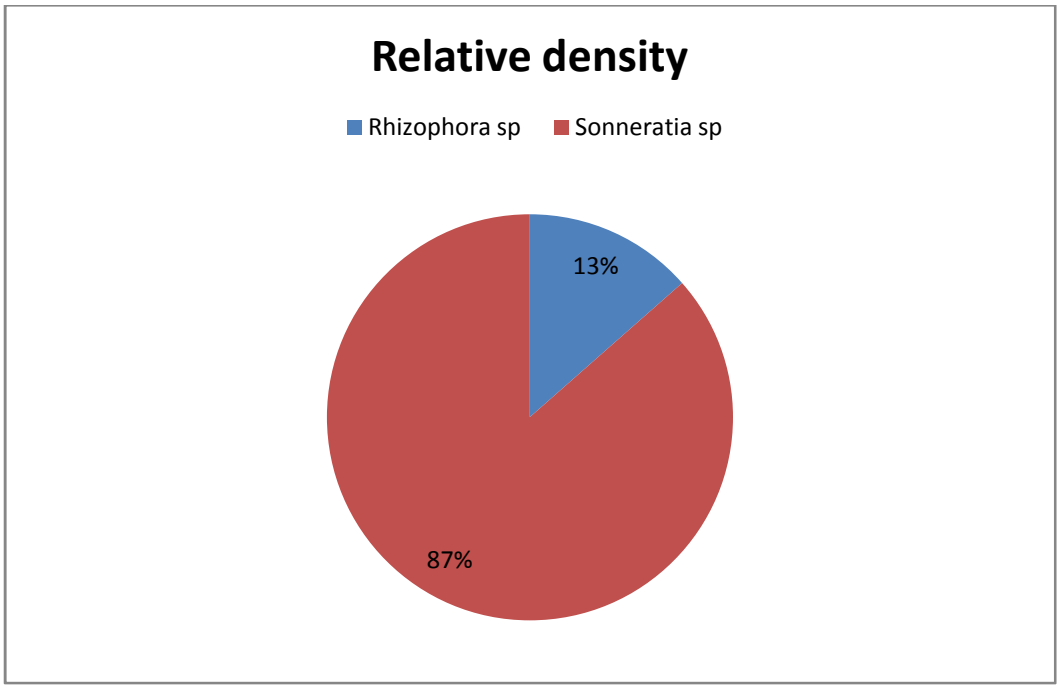


Figure 6.36 Number of Mangrove Individu Observed by Species

Figure 6.37 Mangrove Species (dominated by *Sonneratia sp*) in the Ulmera Bay

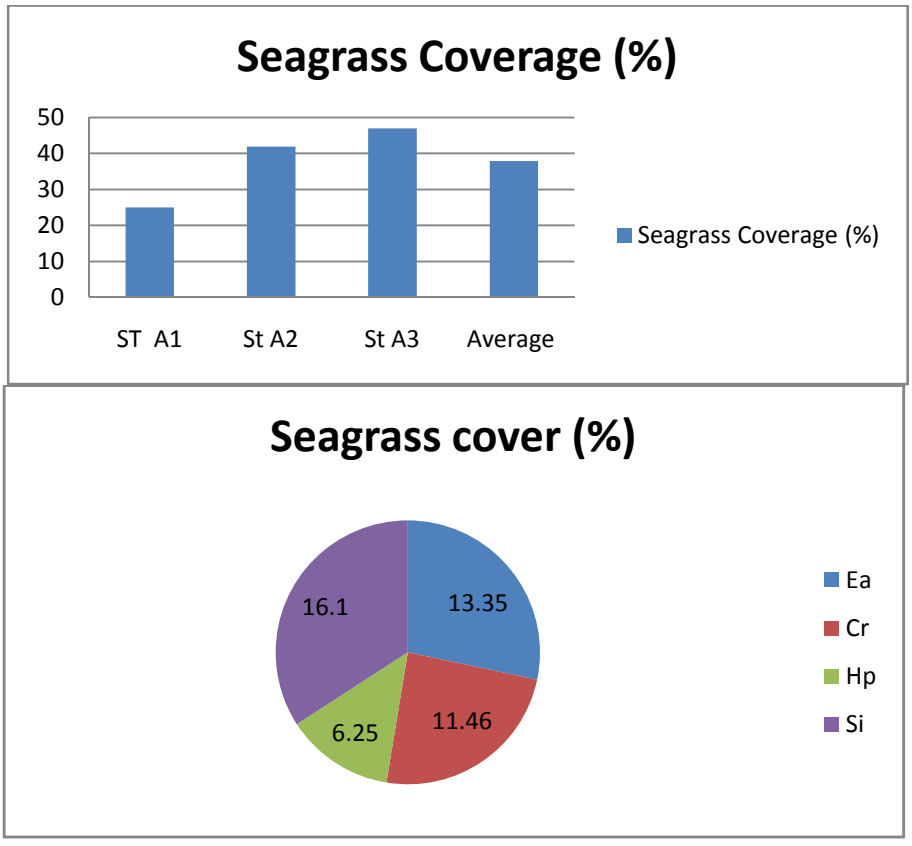
In Timor Leste, illegal harvest and loss of mangrove remains a critical coastal management issue with total mangrove cover has been found to decrease significantly (80%) between 1940 and 2008 (Boggs *et al.* 2009). Currently, mangrove communities are classified as protected area in Timor Leste.

6.2.2 Seagrass Beds

Similar to mangroves, seagrass beds have high rate of primary production, ability to filter sediment and organic nutrients and harbor a rich food chain. Tropical seagrasses are important foraging area for dugong and turtle as well as critical nursery and feeding area for certain types of shrimps, commercial fish and crabs. In the Arafura and Timor Sea region, extensive seagrass beds are typically found in shallow, sheltered waters. In Timor Leste, in a recent survey of the northern coast, a total of 5 species has been identified in an estimated area of 2,200 ha.

The average percentage cover of seagrass is 12 -14 %, which meansthat the relative density is relatively small (less than 25%) in this particular location. The species observed were *Thalasia hemprichii (Th), Enhalus acoroides (Ea), Syringodium isotefolium (Si), Halophila ovalis (Ho), Cymododcea serrulata (Cs), and Halimeda sp (Hm).*For individual species was dominated by *Syringodium isotefolium with 13.35%* (Fig 6.38).

Figure 6.38 Percentage of Sea grass Cover by Transect (at East Coast)



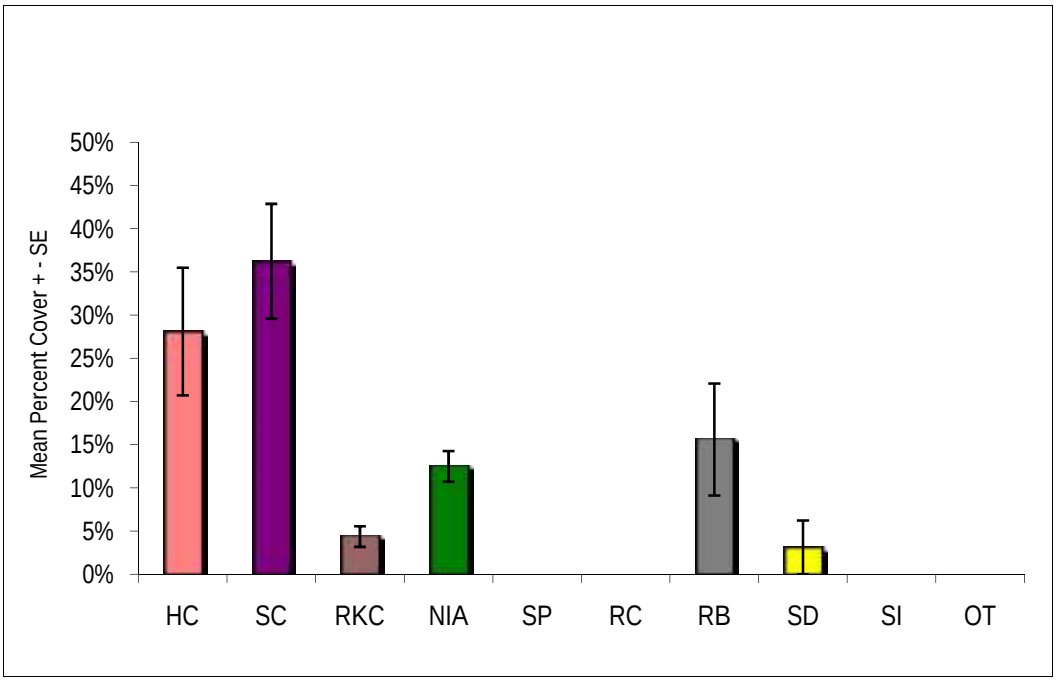
The following figure shows some pictures of seagrass beds observed near project location.

Figure 6.39 Sea grass Observed near Project Site

6.2.3 Corals

Five distinct coral reef systems along the south coast of Timor- Leste are considered to be at medium to high risk of impact from the combined effects of coastal development, marine-based pollution, sedimentation, overfishing and destructive fishing. Coastal villages rely heavily on seafood from the nearby coral reefs; thus, there is a strong risk that reef degradation or over-harvesting could result in ecological collapse. Reef degradation and over-harvesting occurs throughout the country. Other human impacts include: blast fishing introduced by migrant fishermen along the northern coast (especially rampant during Indonesian occupation); spear fishers destroying corals in attempts to increase fish catches; damage during the construction of fish traps; mining of coral for lime for chewing betel nut; domestic debris that entangles the reef framework; cyanide fishing; and fishing with *Acanthua* tree branches which contain a toxin to stun fish. The chronic nature of anthropogenic disturbance in many parts of this region is being compounded by the effects of climate change (Governance-ATSEA, 2011).

Field observation through diving indicated a coral coverage that is widespread from the coastal line to 100 m off the coast.The percentage cover of corals were dominated by soft coral by 35% (Figure 6.40).



Obs: HC= Hard Coral; SC=Soft Coral; RKC=Recently Killed Coral; NIA, Nutrient Indicator Algae; SP= Sponge; RC= Rock; RB= Rublle; SD= Sand; SI= Silt/Clay & OT= Other

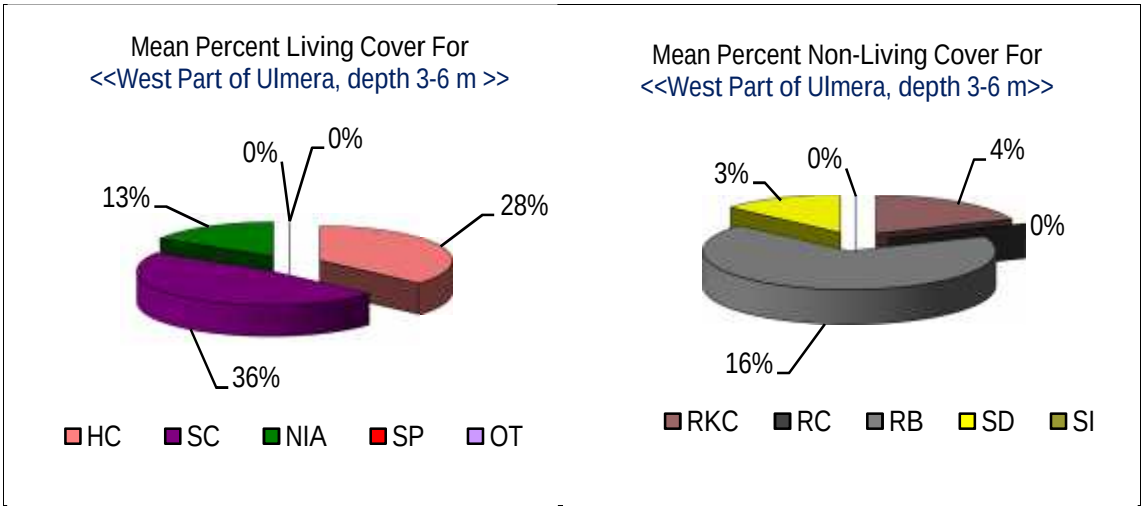


Figure 6.40 Mean Percentage Cover of Coral Reef

Figure 6.41 Common Coral TypesObserved Near Project Location

Figure 6.42 Common Coral Types Observed Near Project Location

6.2.4 Fisheries

Total area of Timor-Leste is 16,000 km^2 with a coast line around 706 km length and marine economical jurisdictions area of approximately 75,000 km^2. The Government has established control of a fishing zone five times larger than the national land area of the country. It consists of the eastern half of the Timor Island, 265 km in length and 92 km of maximum width. It also includes the enclave of Oecussi on the north coast, 70 km to the west and is surrounded by Indonesian West Timor. Also part of East Timor is Atauro Island which is 144 km2, located just 23 km north of the capital Dili and the tiny islet of Jaco with 8 km2, located on the eastern most tip of East Timor (Thematic Report-ATSEA, 2011).

The waters of Timor Leste are defined as all surrounding waters off the north and south coast of the country. These waters extend out to the edge of the off shore Fishing Zone (200 nautical miles). Allocation of use rights were divided into 5 zones i.e. A= 200 m for artesian; B = 3 nm for semi-industrial, C = 12 nm for National Industrial at southern coast of Viqueque; D = 6 nm for foreign semi-industrial at southern coast of Viqueque; E = 18 nm for foreign industrial at southern part facing sahul bank (SHC, February 2009). The artisanal reef fishery on the north coast of East Timor is largely exploited by subsistence fishermen (Thematic Report-ATSEA, 2011).

Gill nets and hand lines are the most popular type of fishing gear in the coastal fisheries because they are easy to use and the equipment is relatively cheap to buy and maintain. Timor Leste's National Directorate of Fisheries & Aquaculture (NDFA) provides nets and hand nets to local fishers as part of a Fishermen Assistance Program. Trammel nets are commonly used by small-scale fishers in southern coastal areas to catch shrimp and traditional spear guns are popular among Atauro fishers. Bottom longline and Fish Aggregation Devices continue to be popular in the coastal fisheries.

Lack of marketing infrastructure, particularly ice-making and transport facilities continues to restrict sale of fresh fish in supplying limited local demand. Such observations reinforce the anecdotal evidence of a limited and small-scale Timorese cultural and economic engagement with their coastal waters and marine resources. They also highlight the likelihood that the extent and elaboration of customary marine tenures will be culturally variable and probably weakly articulated in terms of defined property rights and obligations, given the dispersed geography of coastal settlements and the low pressure on fishing resources in the contemporary environment.

Timorese fishers use various types of fishing gear, and the fish species caught varies depending on the gear used. Handlines and gill nets are commonly used to catch demersal species such as snapper, croaker and bream, and pelagic species like tuna, mackerel, scad and sardines. Other species frequently caught include prawns, crabs, lobsters, bivalves and cephalopods. Women's fisheries activities tend to focus on the collection of molluscs, crabs, small fish, varieties of seaweed and other edible plants within the inter-tidal zone.

The international data base of fish species reported that there are 196 marine fish species in 50 families for Timor-Leste waters, with four species listed as Threatened, the Bigeye Tuna (*Thunnus obesus*), Whale shark (*Rhincodon typus*), honeycomb stingray (*Himantura uarnak*) and

the Celebes medaka (*Oryzias celebensis*). Nine of fish species are listed as deep water species. Many of the species listed for Timor-Leste are found throughout the tropics and are important commercial species such as the tuna, mackerels and snappers.

It is estimated that over 80% by weight of local marine fish consumed in Timor-Leste belong to 15 main Families and 128 species. The most abundance fish families in Timor Leste waters are as follows: Labridae (Wrases), Pomacentridae (Damselfishes), Gobiidae (Gobies), Serranidae (Groupers), Apogonidae (Cardinalfishes), Chaetodontidae (Butterflyfishes), Acanthuridae (Surgeonfishes), Lutjanidae (Snappers), Scaridae (Parrotfishes) and Blenniidae (Blennies). This fish fauna of Timor Leste consists mainly of species associated with coral reefs (CTI, 2013). Based on the result of survey (visual census) there was only dominated by Damselfishes of 351 individu (Fig. 6.45.

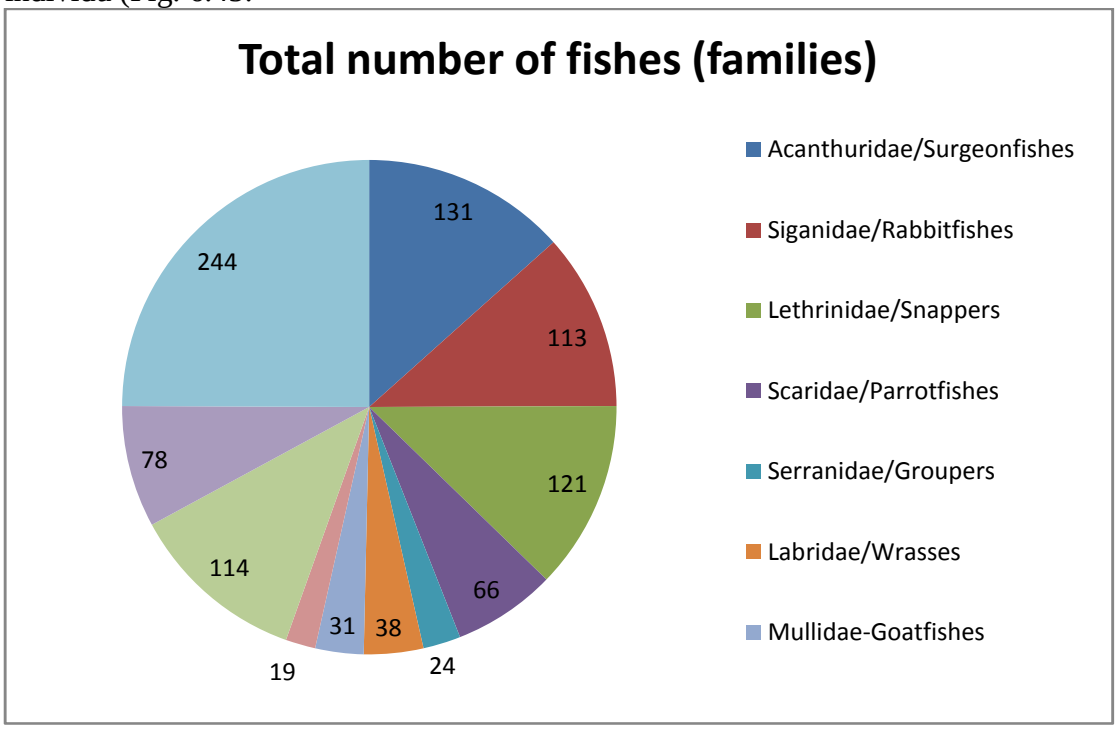


Figure 6.43 Visual Census of Fish Families near Project Area

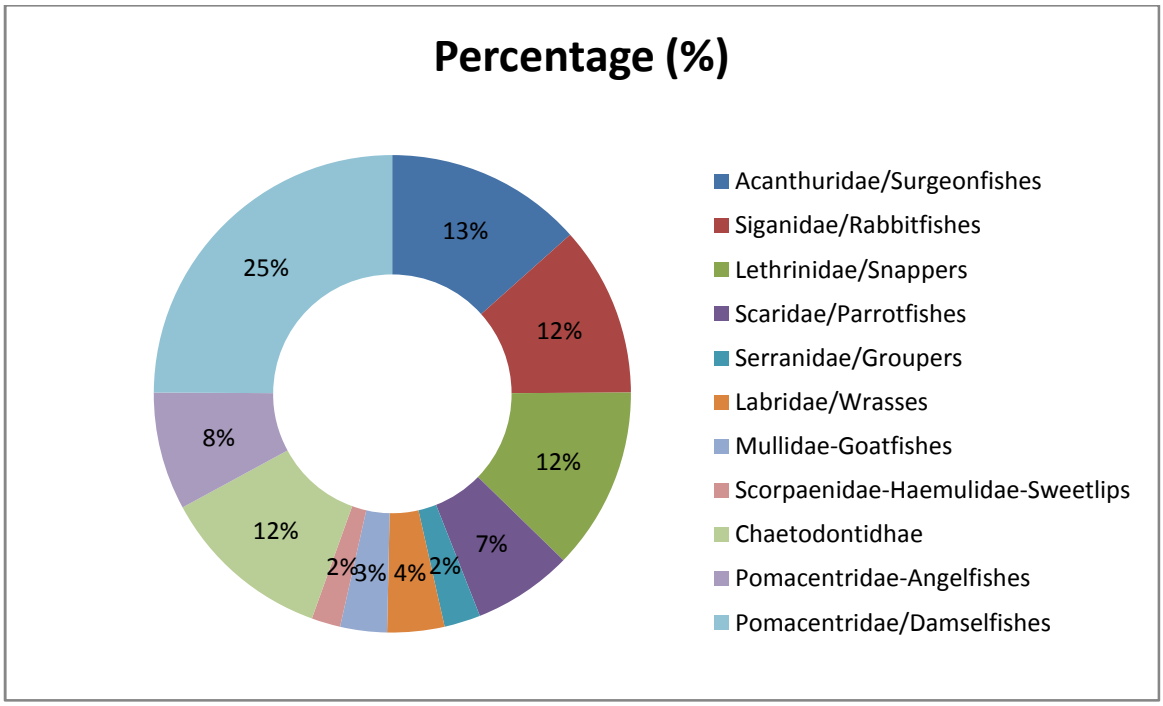

Percentage (%)
13%
12%
12%
7%
2%
4%
3%
12%
8%
25%
Acanthuridae/Surgeonfishes
Siganidae/Rabbitfishes
Lethrinidae/Snappers
Scaridae/Parrotfishes
Serranidae/Groupers
Labridae/Wrasses
Mullidae-Goatfishes
Scorpaenidae-Haemulidae-Sweetlips
Chaetodontidhae
Pomacentridae-Angelfishes
Pomacentridae/Damselfishes

Figure 6.44 Varieties of Fishes Observed within the Ulmera Bay

6.2.5 Marine Ecological Quality

Macro benthos has been used widely as bio-indicator for marine ecological quality assessment[1]. As part of the effort to establish baseline data for marine ecological quality of the surrounding area, a sample of marine water was tested in the Laboratory of Institute Technology Bandung (ITB) in Bandung, Indonesia in 2017.It was found that the indexes of these respective species composition ranges from 0.744 to 0.900 (Simpson Index) and 1.53 to 2.3 (Shannon-Wiener Index) in the four different sampling locations.

Table 6.9 Measurable Indexes of Bottom Sediment

Location	ID Simpson (D)	ID Shannon-Wiener (H')
Ulmera	0.8	1.3

Simpson index ranges of 0 to 1. As the value of D (Simpson Index) approach one, the condition becomes less diverse or a specific flora or fauna is dominating that particular ecosystem. On the

[1]N. Simboura and A. Zenetos (2002), Benthic indicators to use in Ecological Quality classification of Mediterranean soft bottom marine ecosystems, including a new Biotic Index. Journal of Mediterranean Marine Science Vol. 3/2, 2002, 77-111.

other hand, if the value is approaching to zero, then the ecological condition is very diverse or no species is dominant in the ecological. The Shannon-Wiener index (H), on the other hand, shows stable ecological condition where H =1 and above and not stable is the value of H is less than 1. The results indicating a consistent pattern in the four different locations where the composition of the benthic organism is stable or relatively healthy marine ecological system, however, with less diversity.

6.2.6 Other Marine Flora and Fauna

It is estimated that over 80% by weight of local marine fish consumed in Timor-Leste belong to 15 main Families and 128 species. The most abundance fish families in Timor Leste waters are as follows: Labridae (Wrases), Pomacentridae (Damselfishes), Gobiidae (Gobies), Serranidae (Groupers), Apogonidae (Cardinalfishes), Chaetodontidae (Butterflyfishes), Acanthuridae (Surgeonfishes), Lutjanidae (Snappers), Scaridae (Parrotfishes) and Blenniidae (Blennies). Based on the result of survey (visual census) there was only dominated by Damselfishes of 351 individu (Fig. 6.46).

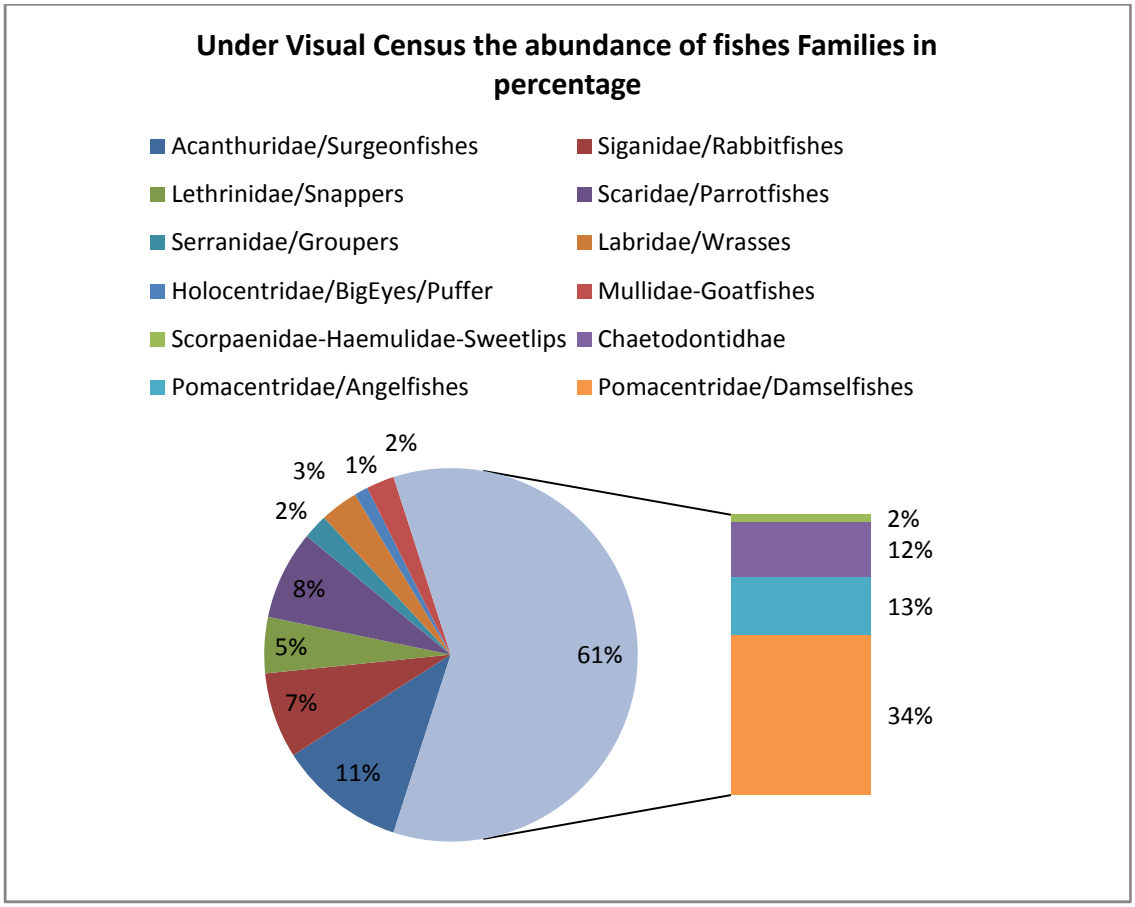


Figure. 6.45 Census of Fisheries Family

6.2.7 Protected Area and National Parks

Proper identification and effective management of protected areas that cover a wide range of natural habitats for birds well as other fauna are keys to the protection of wildlife in Timor Leste. Officially, there are 15 protected wildlife areas in Timor Leste based on UNTAET Regulation No. 19/2000. A recently discussed and potentially approved in very near future of PA lawhas been developed by the State Secretary of Forestry and Protection of the Natural Environment with support from Conservation International in Timor Leste. The official protected areas are listed in the following Table.

Table 6.10 Protected Areas in Timor Leste (Based on UNTAET Regulation No.19/2000)

No	Protected Area	Description	District
1	Jaco Island	Total land area of the island with surrounding rocks, reefs and other surface and subsurface features	Lautem
2	Tutuala Beach	Cover the beach as well as the adjacent forest	Lautem
3	Lore Reserve	Forest and Iralalaru Lake	Lautem
4	Cristo Rei Beach	Cover the Cristo Rei recreational park and adjacent mountain range all the way to the back of Area Branca Beach.	Dili
5	Summit of Tatamailau Mountain	All elevations above 2,000 m and the surrounding forests	Aileu
6	Summit of Saburai Mountain	All elevations above 2,000 m and the surrounding forests	
7	Summit of Talobu Mountain	All elevations above 2,000 m and the surrounding forests	
8	Summit of Mount Diatuto	Including surrounding forests	
9	Summit of Mount Fatumasin	15 restricted-range species have been identified on the site	Liquica
10	Mount Mundo Perdido	Including surrounding forests	Viequeque
11	Summit of Mount Matebian	All elevations above 2,000 m and the surrounding forests	Baucau and Viqueque
12	Mount Cablaque	Including surrounding forests	
13	Lake Tasitolu	15 restricted-range species have been identified on the site.	Dili
14	Lake Maubara	13 restricted-range species have been identified on the site.	Liquica

The proposed beverage plant is not located within any of the above Protected Areas (PA). The closest PA is the Tasitolu, Cristo Rei Beach area, about 5 and 10 km to the west, respectively.

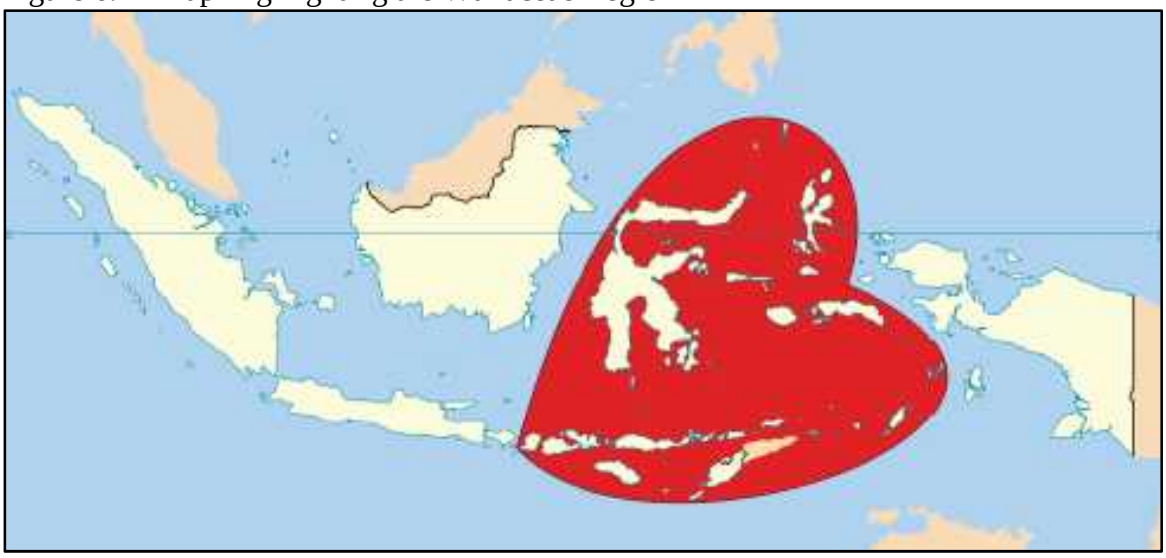
Figure 6.46 Protected Area near Project Location

Marine Protected Areas are established with the primary purpose of protecting the ecosystems, preserve cultural and archaeological sites and sustain fishery production. Mangrove communities located nearby of the coastal part of project site are also protected as stipulated in UNTAET Law No.19/2000 (Section 5, Articles 5.1 and 5.2).

6.2.8 Wildlife (Including Endangered and Vulnerable Habitats)

The island of Timor is part of the Wallaceae(Figure 6.45), a region comprises of thousands of oceanic islands at the merging of the Eurasian and Australasian continental plates. The region has been identified as biological hotspot, harboring one of the richest concentrations of endemic birds in the world. Timor Leste is a major part of the Timor and Wetar Endemic Bird Area identified by BirdLife International.

Figure 6.47 Map Highlighting the Wallaceae Region



In addition to endemic birds, Timor Leste also provides important staging (feeding and resting) habitats for millions of migratory birds en route to Australia and New Zealand. Many of the migratory birds are shorebirds fleeing the cold northern winter period from August to May. The Hera-Metinaro region near Dili are important host area for migrant waders including Far Eastern Curlew (*Numenius madagascariensis*) and the occasional Asian Dowitcher (*Limnodromus semipalmatus*)[2].

The natural environment of Timor Leste is highly subjected to human exploitation and resource use. Within this context, the forests of the country are mostly non-pristine in nature. Pristine forests are found only in the eastern part of the country or high on top of the mountain where human influence is hindered by difficult access. Firewood collection, shifting cultivation and land clearing for residential purposes are several types of resource consumption that put tremendous pressure on the forest and wildlife. Within the changed landscape, however, natural habitats still flourished although land fauna in Timor Leste have been poorly studied until recently[3]. Bird fauna, on the other hand, have been better studied and identification of main habitats as well as areas of importance has recently been made.

Where the project is located (within the northern coastal region of Timor Leste), main bird habitats found are woodland and savannas as well as coastal/beach. No wetland has been identified within or near facility, therefore it is not included in the discussion. The following table presents information on these main habitats and the associated bird species.

Table 6.11 Main Habitats and Bird Species on Areas near Project Location

Main Habitat	Common Types of Vegetation	Bird Species
Woodland and savannas	*Eucalyptus alba*, palm, acacia, *Eucalyptus urophylla* on the hills, and	*Saxicola gutturalis* (White-bellied Chat), *Padda fuscata* (Timor Sparrow). Seasonal

[2] Trainor, C., Coates B.J. and Bishop K. D. (2007). *As Aves the Timor Leste*. BirdLife International and Dove Publications.

[3] Recent studies have discovered new species of bats, frogs, geckos and skinks (source: As Aves de Timor Leste).

	other species of trees common to areas that have been historically affected by swidden agriculture.	birds included *Trichoglossus iris* (Iris Lorikeet) and *Trichoglossus euteles* (Olive-headed Lorikeet). Especially in lowland savannas, *Mirafra javanica* (Australian Bushlark) and *Philemon buceroides* (Helmeted Friarbird) are common.
Coastal/beach	At the northern coast, typical coastal vegetation are spinifex grass and beach morning glory.	*Artamus cinereus* (Black-faced woodswallow), *Lanius schach* (Long-tailed Shrike), *Geopelia maugei* (Barred Dove), *Taeniopygia guttata* (Zebra Finch) and *Lonchura punctulata* (Scaly-breasted Munia).

In addition to the above general description of main habitats, Important Bird Areas (IBAs) have been identified for Timor Leste. IBA are sites of international biodiversity significance which support globally threatened birds, restricted-range birds, biome-restricted birds or globally important populations of congregatory birds (e.g. waterbirds). There are 16 IBAs in Timor Leste, and the closest of them to the project site is Mount Curi (at approximately 70 km east from the project site).

6.3 Economic components

Currently Timor Leste is heavily dependent on revenue from the oil and gas sector. Every month, the country receives royalty from the gas and oil exploration in Timor Sea. The fund has been managed under the Timor Leste Petroleum Funds to finance the country's development. At the moment, the economy is driven mainly by government expenditure while the private sector is still developing. However, the participation of private sector in the development is very important to help diversify the country's economy into other sectors that are more sustainable. Review of economic indicators as presented in the following provides information on the existing condition in both national and local level, where the project will be located.

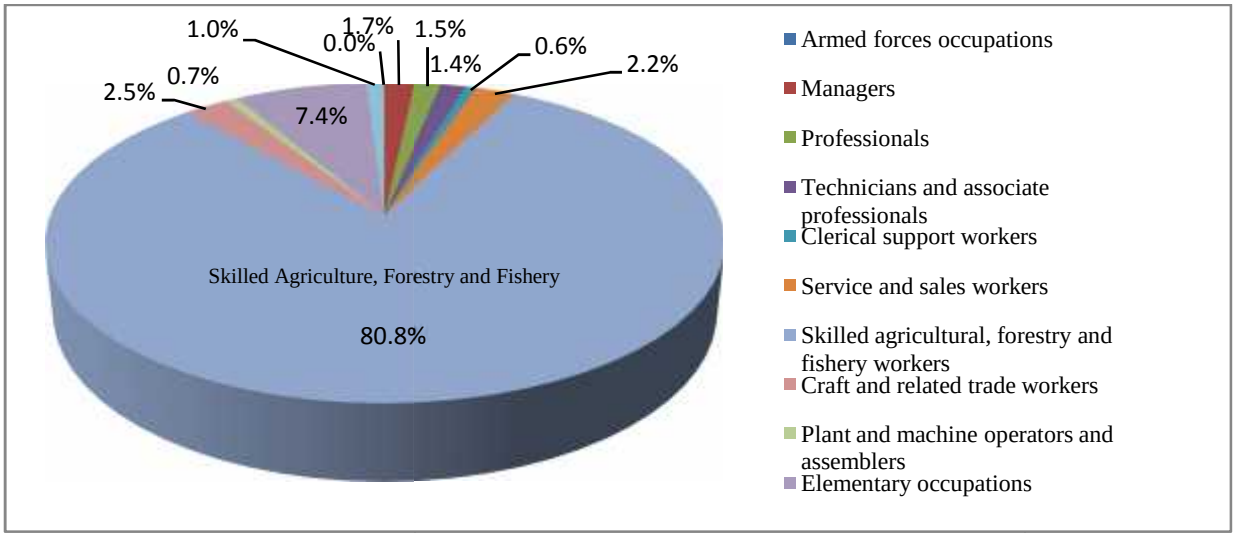
6.3.1 Employment Sectors

The latest Labor Force Survey conducted for Timor Leste was in 2013 incorporating the new international standards concerning measurement of employment and labor underutilization. It was estimated that for Liquica, close to 50% of population 15 years old or over are in labor force meaning that they are working for pay or profit[4]. Of the working age population, many are employed (44.7%) and only 0.5% have been found to be unemployed. Liquica's employment profile is also better than the aggregate employment profile at the national level where it was found that more than 10% of the working age population to be unemployed.

[4]For the LFS 2013 study, working age population (those 15 years old or over) has been categorized into – (i) those in labor force or economically active; (ii) those producing foodstuff for subsistence purpose and (iii) those outside of labor force. The first group is further divided into employed and unemployed groups. This distinction is in line with the new international standards concerning the statistics of work, employment and labour underutilization adopted by the 19th International Conference of Labour Statisticians (Geneva, October 2013).

Different than previous survey, this employment profile does not take into account those working exclusively to produce subsistence food items, which has been estimated to absorb about 29% of working age population nationally.The main source of employment for people residing in Liquica is "Agriculture, Forestry and Fishery" sector while the next largest employment generation sectors have been found to be "Elementary Occupation[5]" and "Craft and Related Trade." These three largest employment sectors are absorbing about 90% of the employed population suggesting an overall lack of skills or employment opportunity in sectors that require higher educational attainment and skill level.

Figure 6.48 Source of Employment for Population in Liquica
Source: Labor Force Survey, 2013



Most HH in Liquica grow maize, cassava and coconut (Census 2010). More expensive cash crops such as fruit and coffee are also produced from the mountainous area. Large livestock includes cattle, buffalo, ponies, pigs, goats and sheep. A field survey conducted as part of the environmental impact assessment to community living in two aldeias[6] that are closest to the project location found a generally consistent employment profile. Of the households interviewed, about 72% of the respondents (head of households) are farmers with the rest reporting a variety of jobs including seaweed gatherer, daily laborer, teacher and fish trader. Working members of the households are reported to be working as farmers, seaweed gatherer, laborer at the salt making facility, fishermen, construction worker, shopkeeper, teacher, security guard, policemen, civil servant and migrant worker in South Korea. There are an average of 6.6 members of households with average fixed HH income about USD 160 per month and additional income ranging from USD 30 to USD 80 per month. Fixed income include income from government subsidy in the form of elderly pension and veteran transfer. The survey also observed materials for house construction in the area, it was found that permanent houses[7] are about 36% while semi-permanent[8] are about 50%. All houses have their own sanitation facility.

[5]Defined in the ILO International Standard Classification of Occupation (2012) to involve the performance of simple and routine tasks which may require the use of handheld tools and considerable physical efforts.
[6]Aldeias Naren and Nau Ner
[7]Defined as houses with 100% concrete wall, floor and zinc roof

6.3.2 Poverty

A poverty assessment was conducted in Timor Leste in 2007 based on data from the Survey of Living Standards (2007). The study found that poverty in Timor Leste is disproportionally rural with local studies found that more than 70% of the poor live in rural areas while the rest live in urban areas. Poverty incidence in the Municipality of Liquica is close to 50%, which is the fifth lowest poverty rate in the nation (the lowest being Lautem District at 21.3%). The study also finds that the depth of poverty, that is, how far below the poverty line the poor fall is 11.9% for the Municipality of Liquica. There has been progress since 2007, however, with the more recent analysis of poverty in Timor Leste conducted by the Asian Development Bank (ADB)9 noted that along with the country's economic expansion, incidence of poverty has decreased. The ADB report recommends that along with the expansion of the economy, living standards improvement and more inclusive growth should continued to be pursued for the country through increased in access to basic infrastructure and improvement in education and health care systems.

6.3.3 Infrastructure facilities

Water and Sanitation

Data from Census 2015 for source of drinking water is only available at administrative post level and urban/rural category for each municipality. It was found that a significant percentage of population (26%) are getting their drinking water from sources other than piped, well or protected spring/well. The following table provides a breakdown of the source of drinking water within Bazartete Administrative Post.

Table 6.12 Source of Drinking Water at the National, District, Sub-District and Suco Level (Census 2015)

	Private HH	Main Source of Drinking Water					
		Piped*	Public Piped/Tap	Tube well/borehole	Well or Spring**	Rainwater Collection	Other***
Timor Leste		35,432	84,366	13,529	33,466	562	37,242
		17%	41%	7%	16%	0%	18%
LIQUIÇA	11,885	3,934	4,680	362	752	6	2,151
		33%	39%	3%	6%	0%	18%
Bazartete	4,585	1,219	1,474	189	520	3	1,180
		27%	32%	4%	11%	0%	26%

*Including piped and pumped indoor and outdoor
**Including water coming from protected/unprotected well or spring
***Including those getting their drinking water from bottled water, water vendor or tanks, river or lake stream and irrigation channel and other.

[8]Defined as houses with 50% concrete wall only
[9] The ADB study was released in 2011 based on both the 2007 Poverty in Young Nation study and 2009 Living Standards Assessment conducted by the Timor Leste Directorate of Statistics with support from donor organizations.

Similar to drinking water supply data, data from Census 2015 for type of sanitation facility is only available at administrative post level and urban/rural category for each municipality. It was found that sanitation facility in the Administrative Post of Bazartete where Suco Ulmera is located remains the reflection of the whole country where sanitation facility is available, however, remains basic consisting mostly of pit latrine (with/without slab) or hanging toilet.

Table 6.13 Type of Sanitation Facility at the National, District and Administrative Post Level (Census 2015)

	Private HH	Human Waste Disposal Facility						
		Pour/flush to septic tank/pit	Pour/flush to elsewhere	Pit Latrine*	Pit latrine without slab/Open pit	Hanging toilet/latrine	Public latrine	Other**
Timor	204,597	58,378	15,697	42,838	15,891	22,400	5,394	43,999
	100%	29%	8%	21%	8%	11%	3%	22%
LIQUIÇA	11,885	2,448	1,109	3,101	2,498	260	283	2,186
	100%	21%	9%	26%	21%	2%	2%	18%
Bazartete	4,585	1,326	217	1,241	613	862	120	728
	100%	29%	5%	27%	13%	19%	3%	16%

*Consisted of “Ventilated Improved Pit (VIP) Latrine” and “Pit Latrine with Slab”
**Consisted of “No Facility or Bush” and “Other”

6.3.4 Power Supply

The number of households supplied with electricity has rapidly increased since the operation of Hera and Betano Power Plants in 2011 and 2014 respectively. It is estimated that about 90% of HHin urban Dili has been connected to the grid while the district and sub-district towns have an electrical power supply of 85%. Rural population has also enjoyed benefits from the completion of the power plant with the population in Ulmera especially those residing near the main roads are currently connected to the grid.

6.3.5 Land use and Land Ownership of Facility

The proposed development is to be located about 1.5 km from the coastal area. It is surrounded by vacant land to the north, south and east sides while the west side is bounded by hills. Access to the facility is through the empty land on a path generally defined by vehicles going to through it. No well-defined road is currently available into the facility yet.

Generally speaking, the coastal area of Ulmera (seaside from the national road) is home to residential, robust salt making operation and small yet functional fishery community. The upper land areas are generally used for dry land agriculture producing corn and others.

Land ownerships present in the area are either state lands, private land, community land and institutional lands. State lands are all land 50m from the highest water point along the coast, private lands are lands

owned by individuals, communal lands are lands owned by family or clans while institutional land are lands owned by institutions for example the Church. All lands for the proposed development are privately-owned land belong to the facility.

Figure 6.49 Land Uses near the Project

6.3.6 Existing Road and Traffic Condition

Ulmera Suco is passed by the national road network connecting Dili and Liquica (National Road A03-02). The road is 6m wide of asphalt with 1m road shoulders on the left and right sides of the asphalt. The road is currently in good condition having been constructed in the last few years and provided efficient connection between Liquica and the national capital.

The traffic survey and assessment were conducted as part of the EIA study indicated that the average traffic flow is 2000 vehicles per day, which is considered still low by international standard of traffic analysis. The peak load traffic occurred during the weekday from 8 AM to 7 PM, which is the time when people make their travelling time.

Table 6.14 Summary of Traffic Survey (2017)

Day	Car	Motor cycle	Total	Remark
1	254	359	613	4 hours observation from 3 PM to 7 PM

Survey conducted by PEC – Consulting, LDA

Although the proposed improvement is located far from the national road or high volume traffic, proper traffic management including construction of adequate access and alternative roads need to happen. The development of the access road should take into consideration potential future uses in areas surrounding the proposed development.

6.3.7 Use of Forests and Other Natural Resources

There is no primary forest in or around the project site. The area is sparsely covered by tamarind and palm trees, shrubs, herbaceous and wild flowers that may be considered weed. There was no sign of succession present in the area of study. Local community reporting agricultural activities mostly in the hilly area away from project location and only occur during the rainy season. During the dry season, no agriculture activity was found in the project area due to water limitation. Other forest resources such as firewood would also commercialized in the project area, particularly during the dry season, when the activity in the agriculture sector stops due to water shortage.

6.3.8 Fishing and Aquaculture

Despite its long coastline, fishery is deemed an underdeveloped sector in Timor Leste. Currently, there are only a few large-scale commercial activities, however, smaller scale fishing communities are robust especially along the northern coast of the country including in the Municipality. The Ministry of Agriculture, Fishery and Forestry identifies more than 10 boat launching sites along the northern coast of Liquica.

6.3.9 Agriculture

Agriculture activities in Suco Ulmera takes place particularly in the southern (hilly) area of the Suco, albeit only available during the rainy season. The main product of the agriculture mainly consists of vegetable, sweet potato, corn, and rice.

6.3.10 Tourism

The beauty of beach, coral, various biodiversity in the sea, hills (for hiking), and natural beauty of forests are the main tourist attractions in Timor Leste. However, support infrastructure and tourism facilities need to be developed fully in order to rapidly materialize the tourism potential in the country.

In Ulmera, the coastal area are mostly used for salt making, place for fishermen to launch and park their boats and as conservation (mangrove, seagrass) areas. No active tourism area or facility is located within the suco.

6.3.11 Other industries

Ulmera is about 30 minutes away from central Dili area. It was traditionally a fishing and salt making area. Recently, along with the growth of Timor Leste economy, the area is transforming into an industrial area starting from the nearby Tibar suco where warehouses and the national port will be located.

At the moment, while no other large industry is going to be developed in Ulmera in the near future, the traditional salt making operations has been transformed through private investment into a more modern mass production utilizing large ponds and mechanized equipment.

6.4 Social components

6.4.1 Population and Communities

The proposed beverage plant is located in Suco Ulmera, Administrative Post of Bazartete, Municipality of Liquica. Suco Ulmera is bounded to east by Suco Tibar, to the west by Suco Mota Ulun, to the south by the district of Ermera and to the north by sea. Both sucos Tibar and Mota Ulun are within the Admistrative Post of Bazartete. Field survey conducted as part of the environmental impact assessment found that Suco Ulmera consists of nine aldeias with population reported in the following table. The facility is located in Aldeia Neran, listed in the table as consisted of 41 households and a total of 214 population.

Table 6.15 Aldeia and Number of Population in Suco Ulmera (Source: Field Survey, August 2017)

No	Aldeia	Household	Population		
			Men	Women	Total*
1	Ermera	90	237	245	482
2	Essirat	68	178	163	341
3	Fatubesi-Lolo	48	119	128	247
4	Mane-Muno	130	290	253	543
5	Mane-Mori	86	215	202	417
6	Neran	41	108	106	214
7	Nau-Ner	119	254	258	512
8	Terlau	86	249	216	465
9	Tetesari	117	252	241	493
	TOTAL	**785**	**1902**	**1812**	**3714**

*Note that the total number of population is higher than the number reported in Census 2015, however, with relatively consistent proportion of men to women (51% to 49%).

The Suco of Ulmera has been identified as “rural suco” for census purpose, meaning that more than 50% of the population is employed in agriculture/fishing activities and they generally lack access to basic services such as medical care and recreational facilities.

6.4.2 Demographic and Population Characteristics

According to Census 2015, the suco of Ulmera has a total of 3,527 population, consisting of 1,798 men and 1,729 women. This is a rapid increase of 21% from the number or population reported by Census 2010.

Table 6.16 Population and Gender Ratio (Source: Census 2010 and Census 2015)

Suco	Population				
	Total	Male		Female	
		Number	%	Number	%
Ulmera (Census 2010)	2,916	1,521	52%	1,395	48%
Ulmera (Census 2015)	3,527	1,798	51%	1,729	49%

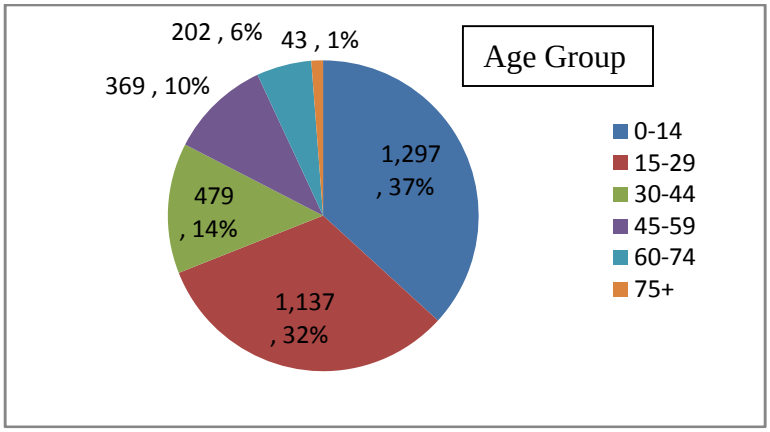
At 6.4 persons per household (HH), the suco of Ulmera has more population within a household compared to the national average (5.7 persons per HH). There are only 48 women headed households out of a total 544 HH in Ulmera (8.8%).

Table 6.17 Household and Average Population in a Household (Source: Census 2010, 2015)

Suco	Household	Average Population in a HH
Ulmera (2010)	465	6.3
Ulmera (2015)	544	6.4

The Suco of Ulmera has a young population structure and more than 50% of population within the age bracket of 0 - 30 years old.

Figure 6.50. Number of Population in Different Age Group - Suco Ulmera (Census 2015)



6.4.3 Ethnicity

In addition to the national language, Tetum (Prasa), population in Ulmera speaks mainly Mambae or Tokodede to a lesser degree, a composition that is also reflected in the portion of population speaking the languages in the sub-district of Bazartete and in the nearby Ermera district. In the District of Liquica, however, there is more Tokodede-speaking population than the Mambae-speaking population.

Table 6.18 Percentage of Mambae and Tokodede Speaking Population in Ulmera
(Source: Census Atlas 2010 and Census Fo Fila Fali, 2010)

Administrative Area	% of Mambae Speaking Population	% of Tokodede Speaking Population
Ulmera Suco	35%	15%
Bazartete Sub-district	39%	35%
Liquica District	16%	63%
Ermera District	36.38%	0.24%

6.4.4 Religion

The population of Timor Leste is overwhelmingly Catholic with Census 2004 reported that 96.5% percent of the population to be affiliated to the church. Other religious groups including the Protestant Church (2.24%), Islam (0.33%), and Buddhist (0.07%). Recent field work[10] conducted as part of the EIA found that those reporting to be affiliated with the Catholic church to be 94%, Protestant church at 1% while the rest are reporting affiliation with other faith.

6.4.5 Gender

Timor Leste Country Gender Assessment (2014) published by the Asian Development Bank (ADB) and the UN Women noted that Timor Leste is a largely patriarchal society and that social norms and cultural values still influence gender roles. Men are largely responsible for decision making in the family and are the bread winners involving more in the formal sector of the economy. Women are socially expected to focus more on domestic affairs, small trade and businesses as well as social affairs.

Since the country's independence in 2002, gender equality has been promoted especially with support from development partners and the United Nations agencies. Recently, analysis on gender inequality in the country noted that considerable progress has been made toward women's empowerment. This is shown through improvement in several social indicators including rapid increase in girls' school enrollment, female participation in national politics and the passage of law on domestic violence.

Gender-based vulnerability remains, however, as shown from further socio-economic indicators as such:

1. Despite gain in enrollment rates, repetition and dropout rates remain high although the number is relatively similar between boys and girls; there are fewer girls than boys making the transition from secondary to tertiary schools. Latest data showed that only 41% of women make up the 27,010 tertiary level students enrolled since the year 2000. Of this number, 8000 students have graduated and women only made up 37% of the graduated classes.
2. Sexual harassment and violence in schools remains an issue although reported cases of both sexual harassment and violence have significantly decreased between 2010/2011 school year and 2011/2012 school year.
3. High rate of maternal and child mortality remain key issues for women while traditional attitudes and lack of economic opportunities encourage women to marry and have children at younger age.

[10]Data collected from Chefi de Suco (August 2017).

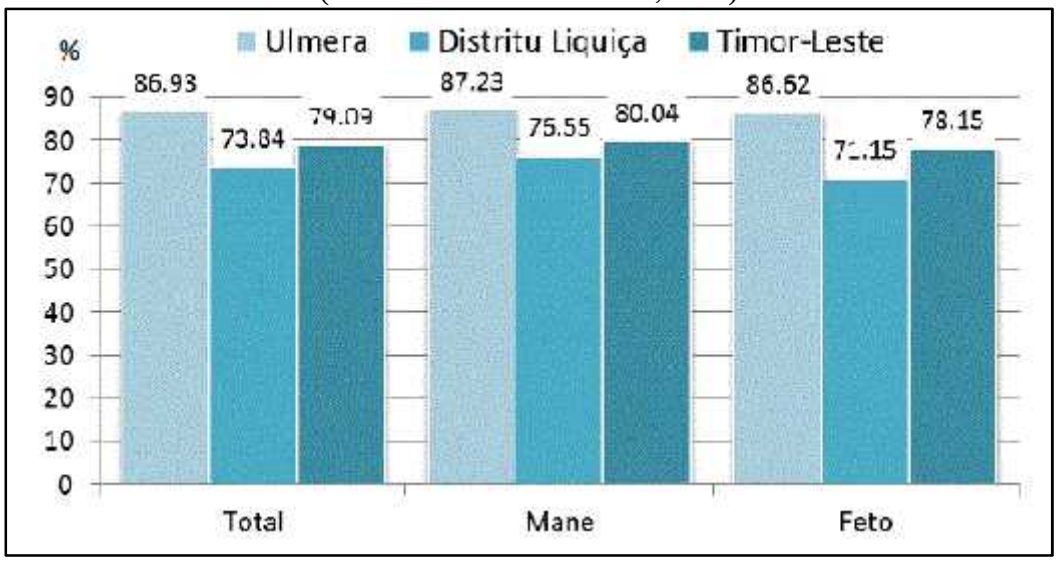
4. There are still fewer women employed in wage-earning jobs. While this type of employment has tripled over the last ten years, only 19% of employed women are actually in wage-earning jobs.

6.4.6 Education and Literacy

The United Nations Children and Education Fund (Unicef) defined adult literacy as percentage of persons aged 15 and over who can read or write. The Unicef reported that Timor Leste has an adult literacy rate at 58.3% (2008) meaning that almost 1 out of 2 adults are illiterate[11]. Illiteracy is also affecting more women than men, consistent with the generally lower educational attainment of women in the country.

Because no information has been found for literacy rate in published data of Census 2015, data from Census 2010 is used to show the literacy status of a portion of adult population in the country. For population in the age bracket of 15 to 24 years old, literacy is generally higher in Ulmera Suco compared to the national average (following figure). This is most likely due to the close location of the sucoto urban Dili, making education more accessible for the residents.

Figure 6.51Literacy Rate in Suco Ulmera, District of Liquica and Timor Leste
(Source: Census Fo Fila Fali, 2010)



In terms of educational attainment, Census 2015 found that in Ulmera Suco, population aged 5 years old and over that received education up to diploma level is generally comparable in proportion to those of the national profile. At the university level, however, there are less population receiving university education compared to the national number. This low tertiary educational attainment is generally consistent with the low tertiary level educational attainment at the Municipality of Liquica. The following table contains educational attainment at Ulmera, Bazartete, Liquica and Timor Leste.

[11] Unicef Country Statistics At a Glance: Timor Leste. Retrieved on June 12, 2017 from https://www.unicef.org/infobycountry/Timorleste_statistics.html

Table 6.19. Population Aged 5 y.o and Over that Received Education (Source: Census 2015)

Administrative Level	Total Pop. Aged >= 5 y.o That Received Education	Level of Education						
		Pre-Primary	Primary	Pre-Secondary	Secondary	Polytechnic/ Diploma	University	Non - Formal
Timor Leste	748,726	50,512	331,531	146,926	138,632	7,478	66,611	7,036
Percentage		6.7%	44.3%	19.6%	18.5%	1.0%	8.9%	0.9%
Liquica Mun.	41,242	2,219	21,156	8,165	7,043	326	1,917	416
Percentage		5.4%	51.3%	19.8%	17.1%	0.8%	4.6%	1.0%
Bazartete Sub Municipality	17,409	1,052	8,164	3,711	3,224	151	873	234
Percentage		6.0%	46.9%	21.3%	18.5%	0.9%	5.0%	1.3%
Ulmera Suco	2,109	231	889	420	424	15	120	10
Percentage		11.0%	42.2%	19.9%	20.1%	0.7%	5.7%	0.5%

6.4.7 Health profiles of communities

Several indicators are being used to paint the profile of community's health utilizing data and analysis available especially from the 2003 and 2009 Demographic and Health Survey, conducted by the National Directorate of Statistics under the Ministry of Finance. Due to the absence of *suco* or even district level data, national data are being used paying particular attention to rural data due to Ulmera's rural characteristics.

Infant and child mortality: there is a substantial improvement in Timor Leste's child survival rate. The decline in the neonatal, post neonatal, infant, child and under-5 mortality rates as reported in DHS 2009 indicated clearly that Timor Leste is on track to reach the target for Millennium Development Goal (MDG) Four[12].

Maternal mortality: As pointed by DHS 2009, Maternal Mortality Rate (MMR) in Timor Leste remains one of the highest in the world.

Child health: Combined with data on child mortality, information on child health paints the picture of the welfare of children, a vulnerable sub-group in the community. Children's health remains a great concern for both urban and rural children in Timor Leste (see table below). Of particular concern is the high rate of no-vaccination to children in rural area (25%).

Table 6.20 Health Indicators of Children in Urban and Rural Area (Source: DHS 2009)

Type	Health Indicator	Urban	Rural
Children's weight and size at birth	% of all live births found to be very small or smaller than average at birth	15.2 %	15.7 %
Vaccination	% of children age 12 -23 months who have received no vaccination at any time before the survey.	14.5 %	25.3 %
Prevalence of Acute Respiratory Infection (ARI)	% of children < 5 y.o.who had ARI in the 2 weeks preceding the survey	2.8 %	1.8 %

[12] MDG 4 goal is to reduce under-5 mortality by two thirds by 2015.

Prevalence of fever	% of children < 5 y.o.who had fever in the 2 weeks preceding the survey	24.1 %	17.6 %
Prevalence of diarrhoea	% of children < 5 y.o.who had diarrhoea in the 2 weeks preceding the survey	18.9 %	14.5 %

Nutrition status of children: Data from 2003 and 2009 indicate that there has been a slight increase in the level of stunting (height for age), wasting (weight for height) and underweight among children. Stunting increased from 49 to 53%, wasting increased from 12 to 17%, while underweight is reported to have increased from 46 to 52%. Additionally, malnutrition was reported to remain high in general with the proportion of children who have chronic malnutrition increased between 54 to 58%.

Malaria: Malaria remains a leading public health problem in Timor Leste with 80% of the cases concentrated especially to only 4 of the 13 districts in the country – Dili (at the western boundary of Tibar *Suco*), Viqueque, Covalima and Lautem. As reported in DHS 2009, the number of confirmed cases of malaria has risen three folds between the year 2000 and 2008, however, caution should be taken as some of the increase could be due to a case of better diagnostic capacity, monitoring and surveillance on the field.

6.4.8 Institution, Schools and Health Facilities

Several important institutions are present in Ulmera, namely the Jesuit Middle and High School Colegio St. Ignatius de Loyola, Jesuit Teacher Training Institute (Colegio St. John de Brito) among others. Public primary educational facilities (grade K-9) are present in the community, however, there is no facility for students grade 10-12, either public or private. As such, students have to commute or move to other places to obtain high school education.

Health facility in and around Ulmera consists of a health post, providing primary health care with no capability to treat major accidental injuries. The next health care facility is in Dili (National Hospital and Community Health Center.

6.4.9 Community and Family Structures

The size and composition of households and the sex of the head of household considered as important factors affecting the welfare of the household. In Timor-Leste, more than four in five households are headed by males and only one-eight of households are headed by females (DHS, 2010).

6.4.10 Land ownership

Much of lands in Ulmera are privately owned although the Catholic Church (Jesuit Order) owns a significant parcel of lands developed into institutional education for secondary and tertiary levels education. The Tibar Bay Port development is located at the western boundary of the suco, sharing land boundary with Tibar Suco. The national port will be developed on 27 ha reclamated area.

6.4.11 Any types of common or individual rights on natural resources

Understanding common and individual rights to natural resources is important in predicting potential impacts from diverting the use of certain resources in a community. In suco Ulmera, as in other coastal communities in Timor Leste, the beach area is a common resource that are well utilized by local fishermen and community as access point to the sea, place to park boats as well as providing source of food from gathering.

6.5 Cultural components

Archaeological sites are generally defined as sites where there is evidence of past activities, usually from a relatively distant past while historic sites are places where politically or socially important activities have taken place. Cultural sites, on the other hands, are sites that are important to local or national level of population because they are places where cultural events take place or places deemed sacred by the locals' system of belief.

Archaeological, historical as well as cultural sites are important sites to protect and preserve because they provide a sense of continuation between today generation and those living in the past and it provides means and place to express the cultural identity of certain communities. Technically, protection of archaeological, historical and cultural sites are done through an official designation of certain sites that afforded the sites legal protection from activities that will alter, destroy or otherwise negatively impact the archaeological, historical or cultural values of the sites.

6.5.1 Archeological and Historical sites

The government of Timor Leste has yet to issue any listing of archaeological or historical protected sites in Timor Leste and there is not information available on archaeologic or historic sites in Ulmera.

6.5.2 Cultural and Sacred sites

Ethnically speaking, the Bazartete Sub-district where Ulmera is located, has a significant Mambae-speaking population. _____

6.5.3 Unique landscape

The unique landscape observed in the project location was high, spring water at the hill, and landscape that provide a good panorama of the view.

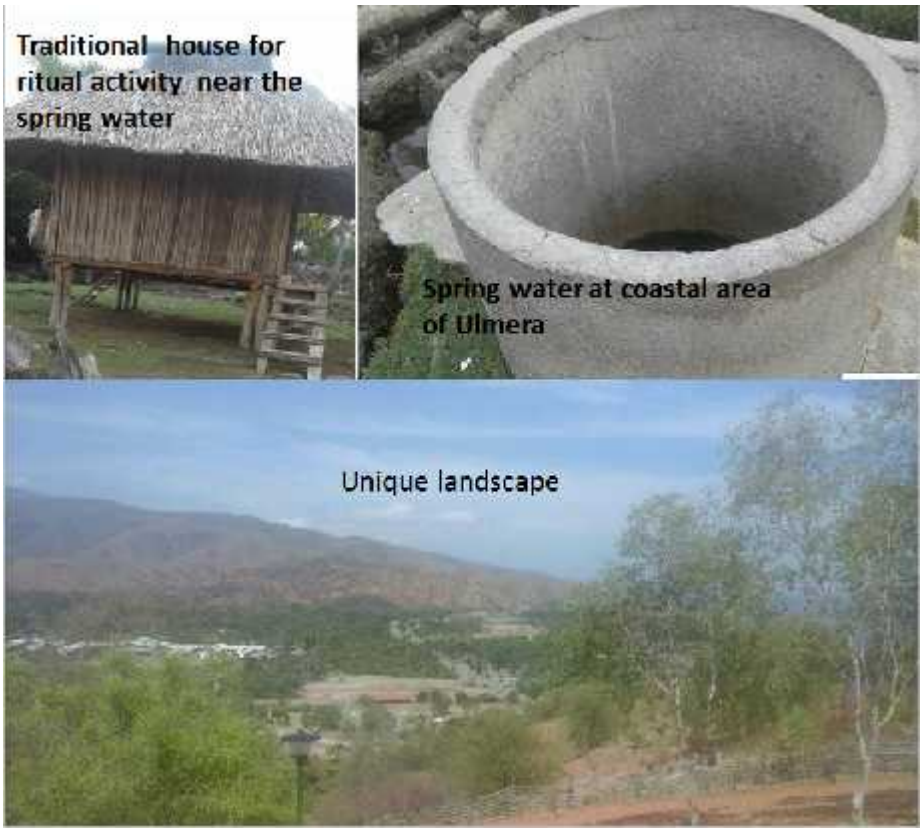


Figure 6.52. Unique and beautiful landscape observed around the project area

7. CLIMATE CHANGE

Climate Change is an important consideration in the preparation of any project. There are two general approaches to analyze the impacts of Climate Change. The first one is the Mitigation related impacts and the second one is the Adaptation related impacts.

Mitigation impacts are the impacts that will influence the ability of the project to:

(i) Mitigate the increase in the Greenhouse Gas (GHG) emission;
(ii) Stop the loss of carbon pool (loss of trees and other vegetation); and
(iii) Increase the potential for carbon sequestration.

The adaptation impacts on the other hands, are impacts that will influence the ability to adapt to changes in physical characteristics of the environment such as sea level rise, change in rainfall pattern, raising temperature, acidification of seawater and other climate change induced impacts.

Given the continuous rising of the global GHG content in the atmosphere, it is thought that the most urgent impacts are the adaptation impacts and that country has to work hard to anticipate or adapt to the impacts described above. At the project level, such as the proposed facility, the potential for both types of impacts should be assessed, however, except for large scale projects that are producing significant GHG (e.g. power plant) or leading to significant loss of carbon pool (e.g. loss of trees and other vegetation), the most relevant climate change impacts are adaptation impacts.

To understand better how climate change potentially impact the facility, it is important to be familiar with expert projections on the changing climate in Timor Leste. The International Climate Change Adaptation Initiative, Pacific Climate Change Science Program (ICCAI PCCSP) has concluded that for Timor Leste, air temperature has increased by a comparable amount to the increase in sea surface temperature (between 0.15-0.2^{0}C) per decade over the period of 1950-2009. In terms of rainfall, the ICCAI PCCSP noted that there is a decrease in annual and dry season rainfall from 1952 to 2009. In the future, rainfall has been projected to shift toward the wet season with dry season rainfall projected to decrease although not much change is expected in the annual mean rainfall. Confidence in rainfall projection is low because 10 years of historic data is missing. As for intensity and frequency of days of extreme rainfall it is confidently projected that the intensity and frequency of days of extremely high rainfall will increase with not much change projected in the incidence of drought.

Study of satellite data and nearest tidal gauge concluded that sea level has risen near Timor Leste by about 9mm per year since 1993 and that the rise is larger than the global average of 2.8-3.6mm per year. A higher rate of rise in Timor Leste may be related to natural periodic fluctuations caused by phenomena such as the El Niño-Southern Oscillation. It is confidently projected that this trend in sea level rise will continue.

Since the proposed project is not located near the coastal area, only changes in climatic parameters and its associated impacts that are the most relevant climate change impacts to the facility.

7.1 Risk from Sea Level Rise

To assess the risk of a facility in the coastal location from sea level rise, one has to know distance of the facility from the coastline and the elevation of the facility. In Timor Leste, it is generally accepted that those facilities (especially the national roads) that are located within 1500 distance and 100 m altitude from mean average sea level are no exist vulnerability to the effect of sea level rise.

7.2 Risk from Changing Rainfall Pattern

The proposed development is located in the mean average annual rainfall at 1100 mm. Historic rainfall data between 1957 and 1974 presented in Table 3.1 show that the area has a prolonged dry period that lasts between April and November. Rainfall pattern has been projected to shift the rain from dry to wet season with relatively consistent mean average annual rainfall.
The climate change according to various studies suggested that the change may occur with duration and intensity of rain, while the volume of the rainfall is nearly constant. This change may cause more frequent rain in a short duration that cause localized flooding effect.

7.3 Groundwater Risk

The climate change will also put the groundwater in the risk, in term of quantity and quality. The prolong drought will cause the volume of groundwater in the storage (aquifer) to decline significantly and in some case the production well may get dry that will further affect the people's living who consume the water source from groundwater system. With reducing the volume of water in the aquifer, it would be easy for the contaminant to get into the groundwater aquifer. Particularly, for well that located near the coastline is prone to sea water intrusion which will damage the well or difficult to getting back to the healthy production well. Although, the groundwater map indicated that proposed location in Ulmera, has sufficient groundwater volume to serve the need of population grow, the demand grow could be high in the future and if the demand grow and prolong dry season due to climate change are combined, some serious affect may be occur in the future. Nevertheless, the nature of the project is not exploring the groundwater system, so impact to the volume of groundwater could be negligible. However, the monitoring water quality of groundwater would be required as some pollutant could potentially leach into the groundwater aquifer.

7.4 Risk from Changing Temperature

Recent data available suggested that the annual average temperature is 27.3^{0}C with highest monthly average recorded at 32.6^{0}C. Relative humidity is approximately 73%, making the weather humid but still generally pleasant. Temperature projections noted that temperature in the country is going to increase comparable to the increase in sea surface temperature. A temperature of 32.6^{0}C is generally considered a moderate to high mid-day temperature. Given the profile for relative humidity of 73%, the mid-day temperature in the region can be considered moderate to high with some effect to the health and safety of workers working in the open area. Moreover, change in temperature will also affect the refrigeration system. The following table shows the projection of trend of climate variation in Timor – Leste.

Table 7.1 Summary of Climate Variation in the future in Timor Leste

Variable	Season	2030	2055	2090	Confidence
Surface air temperature (°C)	Annual	+0.7 ± 0.4 +0.8 ± 0.4 +0.7 ± 0.3	+1.1 ± 0.6 +1.5 ± 0.6 +1.4 ± 0.4	+1.5 ± 0.7 +2.3 ± 0.9 +2.8 ± 0.7	High
Maximum temperature (°C)	1-in-20-year event	N/A	+1.0 ± 0.6 +1.4 ± 0.6 +1.5 ± 0.5	+1.4 ± 0.8 +2.2 ± 1.1 +2.8 ± 1.5	Low
Minimum temperature (°C)	1-in-20-year event	N/A	+1.3 ± 1.6 +1.6 ± 1.8 +1.6 ± 1.7	+1.7 ± 1.6 +2.2 ± 1.8 +2.5 ± 1.8	Low
Total rainfall (%)*	Annual	+1 ± 9 +1 ± 8 0 ± 11	0 ± 15 -1 ± 16 0 ± 16	0 ± 13 0 ± 19 +1 ± 23	Low
Wet season rainfall (%)*	November-April	+1 ± 7 +1 ± 7 0 ± 8	+1 ± 10 +1± 14 +3 ± 10	+2 ± 9 +2 ± 15 +5 ± 16	Moderate
Dry season rainfall (%)*	May-October	+1 ± 20 +3 ± 18 0 ± 23	-2 ± 31 -4 ± 35 -3 ± 31	-4 ± 28 -3 ± 40 -4 ± 51	Moderate
Sea-surface temperature (°C)	Annual	+0.6 ± 0.4 +0.7 ± 0.4 +0.6 ± 0.4	+1.0 ± 0.5 +1.3 ± 0.6 +1.2 ± 0.4	+1.4 ± 0.7 +2.1 ± 0.8 +2.5 ± 0.7	High
Aragonite saturation state (Ωar)	Annual minimum	+3.3 ± 0.2 +3.2 ± 0.1 +3.2 ± 0.2	+3.0 ± 0.2 +2.9 ± 0.2 +2.8 ± 0.2	+2.8 ± 0.2 +2.5 ± 0.2 +2.3 ± 0.2	Moderate
Mean sea level (cm)	Annual	+10 (6–15) +11 (6–15) +10 (6–15)	+18 (10–27) +21 (12–30) +20 (12–29)	+32 (17–47) +40 (21–59) +42 (22–62)	Moderate

Source: SoL Research Program, 2011

8 ALTERNATIVES

Alternative analyses of proposed project development consist of alternative location, alternative technology, scale and the no-development alternative. The purpose of alternative analysis is to provide various options that are potential and feasible from different point of perspectives to come up with an optimal choice that will be beneficial to the economy, profitable to project ownerall the while technically, environmentally and socially feasible.

8.1 Alternative of Project Location

The current proposed location was selected based on various factors that considered important to the main processing plant. Good quality of supporting infrastructure such as power supply, soon to be upgraded national road of Dili – Liquica, nearby soon to be constructed Tibar Port, that are required to support in constructing the plant as well as reducing transportation cost in delivering products/raw material via Tibar Port.

However, alternative location can be considered regarding the availability of abundant fresh water (economically cheaper) and to avoid the discharge of wastewater into an ecological sensitive area such as current chosen location, where mangrove community will be a receptor directly to the waste loading from the processing plant.Nevertheless, the analysis of cost and benefit conducted by GOTA has led to the option that the current location is the most suitable one due to abundant of fresh water and protected industrial zoning location in Tibar area. In return, the best available technology is used to treat water and wastewater, which would reduce/eliminate the risk of waste loading into the mangrove community.

Table 8.1 Factors Considered in Choosing Location

Parameter	Current Location	Alternative Location
Available infrastructure	➢ Near the already improved national road ➢ Available power supply ➢ Nearby the consumers to future transportation cost will be minimized	Other alternative project location within Dili and adjacent areas were investigated but all the land is occupied except in the other district which may be available.
Proximity to the Port	Close proximity to port (cheaper in transportation cost on raw material and product delivery, easier for export later on	If it is in other district, then cost of transporting both raw material and products will be costly
Available Water Source	Water quality of groundwater is available with good quality	If alternative location is within the area where fresh water source is sufficiently available, then treatment cost could be small and reduce the potential risk of groundwater problem.
Waste loading to ecological sensitive receptor	The capacity of waste loading is small and only a concern during the rainy day, where waste could be washes off by the runoff and carries to the marine water. With the dilution factor the concentration of the	The ultimate discharge location will be at marine water body. So the treatment of wastewater with the best available technology is the only option.

	waste would be reasonably small	
Required Approval	The trade and invest already approved the chosen location and if required any further revision to the project location, it will delay the process.	Required re-approval

With the above analysis and comparison to the project location, the current selected location has become the most favorable one for the project owner, if other factors such as waste loading and water sources will be handled by the project owner.

8.2 Alternative on Choice of Technology

Various technologies may be available and GOTA has made a selection on the type of technology that is most efficient while still environmentally sustainable from Europe. For a beverage plant that is producing beer, carbonated soft drink and mineral water, there are a variety of technologies available.

Two technologies have been considered for implementation in Timor Leste – (i) Germany – based technologies and (ii) Chinese – based technologies. The cost and benefits of these technologies are provided in the following table.

Table8.2 Comparison on the Choice of Technology

Technology	Advantageous	Drawback
China - based	➢ Cheap to be constructed ➢ Lower initial cost	➢ Less efficient in water and energy consumption ➢ Shorter life time ➢ High in maintenance cost
Germany - based	➢ More expensive ➢ Higher initial cost	➢ More energy and water efficiency during the operation ➢ Low maintenance cost

Currently, GOTA will be implementing the German-based technology for reason of sustainability and durability, which will have lower operation and maintenance cost.

8.3 Scaling Alternative

The nature of the development project is to take on business opportunity in Timor Leste. As such, production capacity has been calculated on an economy of scale that will ensure optimal margin of profit proportional to existing price of the same type of products currently in the market, domestic and export market opportunity. Other consideration is availability and price of important raw material such as water.

Larger capacity means larger needs for raw material as well as larger production of waste meaning that the potential environmental impacts will also be greater. The opposite is true for smaller capacity. The project owner proposed the initial capacity at the smaller rate and gradually increase the capacity up to the ultimate one once the market demand increase. The technology will be designed in such as that it will be easy to upgrade and scale up into the larger capacity of the plant.

8.4 No-Development Alternative

No development alternative means a lost opportunity to develop a manufacturing industry based in the country that is serving the country's domestic demand. This will replace the need to import and create economic activities domestically that will otherwise be happening in another country.

Timor Leste should continue to diversify its economy away from dependence in the oil and gas industry alone. Having a large scale investment such as GOTA, a local company is believed to be beneficial for the country because it will create jobs, contribute tax, transfer technology and build capacity locally.

9 IMPACT ASSESSMENT AND MITIGATION MEASURES

Various impacts that arise during site preparation, construction, operation and maintenance of this proposed beverage processing plant are analyzed and presented into three groups for each phases of the development:

- Temporary impacts during the pre-construction and construction
- Major impacts during operationand maintenance phase
- Minor impacts during operation and maintenance phase including - occupational health and safety

The impacts were assessed in each process and component of the plant during construction and operation. By analyzing each activity, the quantity of each impact can be determined/measured, as any specific impact would attach directly to the scale and process being proposed.The impacts during the construction are temporary which will stop once the facility is ready for operation. All impacts prior to the O&M phase will be a minor and temporary while some impacts during the O&M phase potentially be significant in the absence of good mitigation and monitoring measures. Impacts during the operation are related directly to the process of production, which means that the impacts would be unavoidable as long as there is production.

However, with the mitigation measures, with both technical and non-technical approaches, all impacts could be managed such that the effect of the impacts could be minimized.The following table provides a summary of impacts that may arise during each phase of implementation.

Table 9.1 Summary of Likely Environmental Impacts from the Proposed Project

Environmental impacts or concern	Source Activities		
	Pre-Construction Activities	**Construction Activities**	**Operation and Maintenance Activities**
General Impacts			
Loss of vegetation on the site	v		
Noise and Vibration	v	v	v
Dust and spoil	v	v	
Oil spill	v	v	v
Climate change impacts (Greenhouse Gas Emission from Vehicle)	v	v	v
General health and safety hazard	v	v	
Energy consumption (Esp. high during O&M)			v
Impacts from Groundwater Withdrawal			
Over Pumping of groundwater			v
Seawater intrusion			v
Potential land subsidence			v
Impacts from Water Treatment (Reverse osmosis) Plant			
Wastewater production and disposal			v

Contribution to greenhouse gases			v
Impacts from Beverage Processing Plant			
Sludge production			v
Greenhouse gas emission from process (CO_2)			v
Solid waste and byproduct			v
Hazardous material waste			v
OHS			v
Impacts from Waste Water Treatment Plant and Disposal			
Handling of wastewater in the plant			v
Climate change related (Greenhouse Gas Emission – CH_4 - from anaerobic wastewater treatment)			v
Changes in physical parameters of coastal water			v
Changes in chemical parameters of coastal water			v
Potential Eutrophication in the bay			v
Bottom contamination			v

9.1 Impact Assessment and Mitigation Measures during Pre-construction and Construction Phase

Impacts are general and temporary just like other regular construction as no special civil work is involved. This temporary impact is directly related to the general occupational health and safety (OHS).

9.1.1 Pre-Construction Phase

Pre-construction work will involve site clearance, grading and well testing and construction. Additionally, retaining wall was constructed to the back of the facility to stabilize creek that would normally eroded during the rainy season. Impacts during this period include loss of vegetation, generation of dust and spoil that can be washed by run-off during the rainy season, OHS, production of green-house gas from vehicle emission and noise and vibration (Table 8.2).

Table 9.2 Potential Impacts during Pre-Construction

Activity	Potential Impacts
Site clearance	➢ Air emission ➢ Loss of vegetation ➢ Dust and air quality issue ➢ Noise and vibration ➢ Erosion and sedimentation during the rainy season ➢ General OHS
Grading and Foundation Works	➢ Air emission and Ambient water quality ➢ Erosion and sedimentation during the rain ➢ Noise and vibration

	➢ General OSH
Groundwater Exploration	➢ Noise and vibration ➢ General OHS

The above impacts would be generated in the project site that is around 7 HA so magnitude of impacts could be generated. However, during the pre-construction, the magnitude is minor and impacted people will be only the worker and surveyor. The following table presents the mitigation measures on each impact presented in the previous table.

Table 9.3: Mitigation Measures during Pre-Construction Phase

Impacts	Magnitude	Mitigation Measures
Dust and Air quality	Minor	- Workers and visitor in the project location to use masker - Frequently spray the water to re-suspended the broken oil - Project owner to utilize the latest equipment or vehicle that emit less gas emission
Erosion and Sedimentation	Site that clear where the vegetation already removed and foundation work	- Site Detention basin to collect the storm runoff from the local site erosion
Noise and Vibration	From heavy duty equipment (loader, excavator, truck, etc.)	- Worker and visitors to the project sit to utilize the ear protection equipment - Only allows the later version of equipment that only produce less noise and vibration - Arrange the proper schedule of work, especially do not work at night time
OHS	From all the activity	- Application of all the standard OHS for constriction work - PPE - Proper operating procedure of each work item - Proper training prior to work execution by the new worker to avoid the major problem

9.1.2 Construction Phase

Once the site is ready, the construction phase started by the building of office complex, brew house, wastewater treatment plant, installation of utilities system, office building, pavement, and other work items. Equipment installation (beer and soft drink processing plant), installation of utilities and other miscellaneous items of works need to be completed. The following table shows activities during the construction phase and potential impacts from the activities.

Table9.4 Construction Activities' Impact Assessment

Activity	Potential Impacts
Construction of office building (including water, electricity, and telephone)	➢ Noise and vibration ➢ General OHS ➢ Air emission ➢ Solid and liquid wastes
Equipment Installation (Beer and Soft drink)	➢ Noise and vibration ➢ General OHS ➢ Air emission ➢ Solid and liquid wastes
Utility Installation (piping system, refrigeration, heating, cooling, steam, boiler)	➢ Noise and vibration ➢ General OHS ➢ Air emission ➢ Solid and liquid waste
Water Treatment Plant	➢ Noise and vibration ➢ General OHS ➢ Air emission ➢ Solid and liquid waste
Wastewater Treatment Plant	➢ Noise and vibration ➢ General OHS ➢ Air emission ➢ Solid and liquid waste

The mitigation measures of each impact is presented and discussed further in the following table:

Table 9.5. Mitigation Measures of Impact during the Construction Activity

Impacts	Magnitude	Mitigation Measures
Air emission	Minor	- Workers and visitor in the project location to use masker - Frequently spray the water to re-suspended the broken oil - Project owner to utilize the latest equipment or vehicle that emit less gas emission
Solid and liquid waste	From the unpacking of construction material	- Proper collection of solid waste and deploy to Tibar landfilled
Noise and Vibration	From heavy duty	- Worker and visitors to the project

	equipment (loader, excavator, truck, etc.)	sit to utilize the ear protection equipment - Only allows the later version of equipment that only produce less noise and vibration - Arrange the proper schedule of work, especially do not work at night time
OHS	From all the activity	- Application of all the standard OHS for construction work - Applies PPE for the work - Proper operating procedure of each work item - Proper training prior to work execution by the new worker to avoid the major problem - Prepare first aid for minor issue

9.2 Impact Assessment during Operation and Maintenance of Facility

Environmental impacts that will arise during the operation and maintenance phase of the proposed beverage plant are directly related to the nature of the activity that utilize large volume of water coupled with high energy consumption that will also produce large quantity of solid and liquid waste. The processing plant also produces greenhouse gas emission into the atmosphere, albeit at a level that is low compared to what is estimated to be released from the country, annually.

Table: 9.6 Summary of Impact Assessed during the Operation Facility

Activity	Potential Impacts
Water consumption (groundwater pumping, water treatment, distribution)	➢ Land subsidence ➢ Salt water intrusion ➢ General OHS ➢ Air emission ➢ Solid and liquid wastes
Energy utilization	➢ Greenhouse gas emission ➢ Increasing carbon footprint ➢ Potential explosion and other hazard
Beverage processing	➢ Solid waste ➢ Wastewater ➢ OHS ➢ Noise and Vibration
Water Treatment Plant	➢ Noise and vibration ➢ General OHS ➢ Air emission ➢ Solid and liquid waste
Wastewater Treatment Plant	➢ Noise and vibration

	➢ General OHS ➢ Air emission ➢ Solid and liquid waste

The description of each major impact and proposed mitigation measures are further discussed detail in the following sub-sections.

9.2.1 Impacts of Water Consumption and Mitigation Measures

As described earlier that large volume of water will be extracted from groundwater and treated via reverse osmosis to produce pure water that will be used in beer brewing, soft drink making and bottled water production. Fresh water will also be used for other water demand such as sanitation, washing, etc. Moreover, breweries use water extensively in the equipment for heating and cooling, cleaning packaging vessels, production machinery and process areas, cleaning vehicles, and sanitation. Also water is lost through wort boiling and with spent grains.

9.2.1.1 Groundwater Extraction

Total volume rate of water extraction is equal to 200L/min, which will be pumped out from the groundwater. This volume rate of extracted groundwater will be used in beverage making, equipment process and associated activities. The rate of extraction at 3.3 L/s is considered moderate and analysis of the water availability in the aquifer should be conducted to ensure the safety. When withdrawal is higher than what can be sustainably provided by the aquifer, continuous withdrawal at this rate will result in the following impacts:

- Potential land subsidence from rapid diminishing volume of water
- Potential seawater intrusion into the groundwater
- Structural damage and risk on the structure above the ground
- High cost of pumping and treatment

The following figure presentthe summary of impacts and mitigation measures to be taken in order to office, minimize, and or offset the impact.

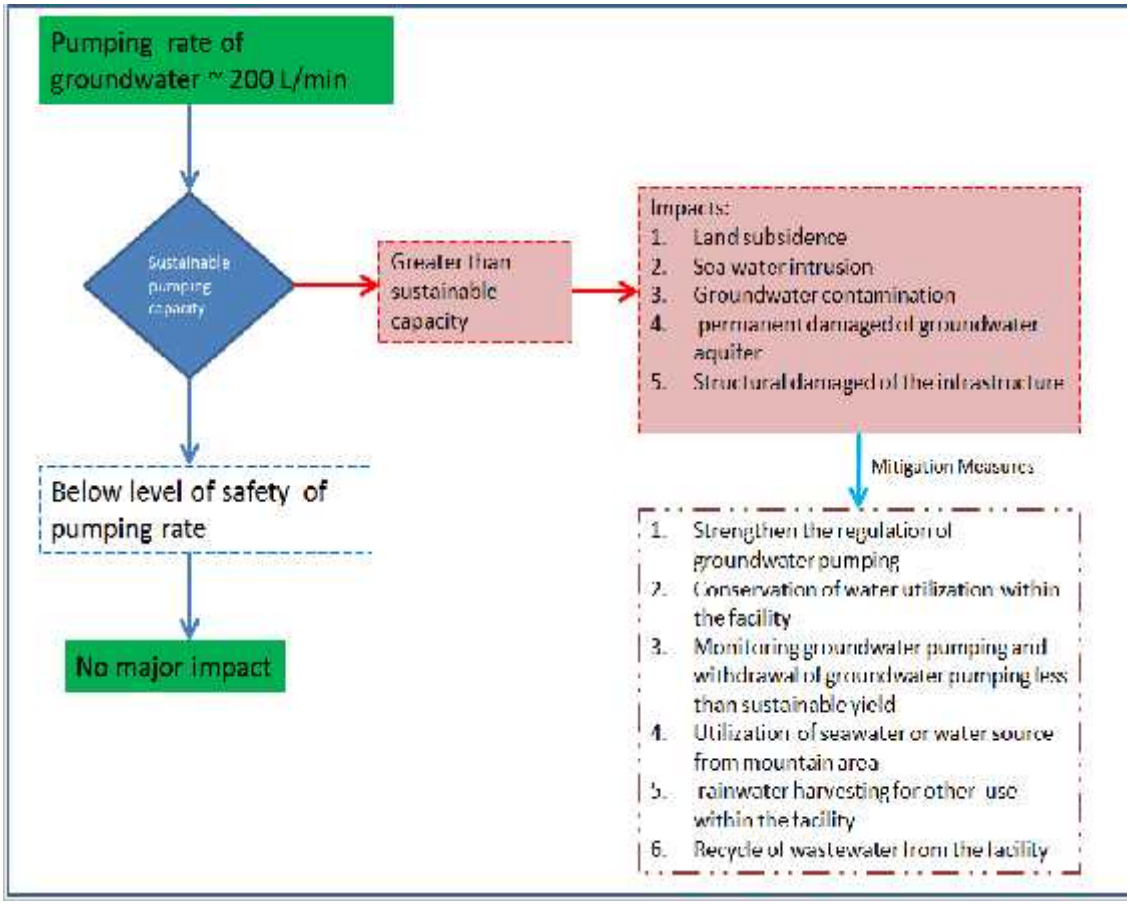


Figure 9.1. Impacts Assessments of Groundwater Utilization and Mitigation Measures

In order to understand the magnitude of the impacts and proposed mitigation measures, the analysis of groundwater pumping and relation to the aquifer level dropdown may be necessary by understanding the nature of aquifer and rate of groundwater pumping. As can be understood in many groundwater books that aquifer is underground storage, where water is stored. Therefore, in theory the storage or volume of groundwater within the aquifer can be estimated. The pumping rate on the other hand, is a given parameters, as volume to be taken out to fulfill the demand of water by design is known.The properties of aquifer (storage and transmitivity) can be estimated indirectly from the pumping test data of the production and monitoring wells. The project owner has conducted the pumping test to collect the data on the pumping rate and level of aquifer drawdown.Summary of potential impacts assessment and proposed mitigation measured are provided in the following table.

Table. 9.7 Summary of Impacts and Mitigation Measures of Groundwater Extraction

Capacity Extraction, L/Min	Sustainable Capacity, L/Min	Potential Impacts	Mitigation Measures
		Land Subsidence	➢ Pumping rate should below the sustainable yield ➢ Monitor the pumping rate ➢ Reduce the water utilization or water conservation ➢ Reduce the pumping rate from the bore by using the water source from upland catchment system
		Sea water intrusion	
		Structural Damage	
		Groundwater Contamination	
		Water stress in the community	Provide water to the community
		High Pumping cost	Water meter and control the water pumping
210	2857	OHS	See OSH section

The pumping testing was conducted by the project owner to collect the data on the storage sustainability of the groundwater. The result of the testing can be seen in the following table.

Table 9.8: Result of the Groundwater Pumping Test

Pumping Rate, L/S	Duration Test, Hr	Drawdown, m	Time of Recovery, min
2.5	24	0.45	10
3	24	0.5	10
3.5	24	0.65	15

The above table indicated that the groundwater pumping rate test was conducted for the rate of 2.5 L/s to 3.5 L/s, only produced the maximum drawdown of 65 cm of water table in a duration of relatively small (15 minute). The result shows the good quantity of groundwater volume in the aquifer for the given pumping rate.

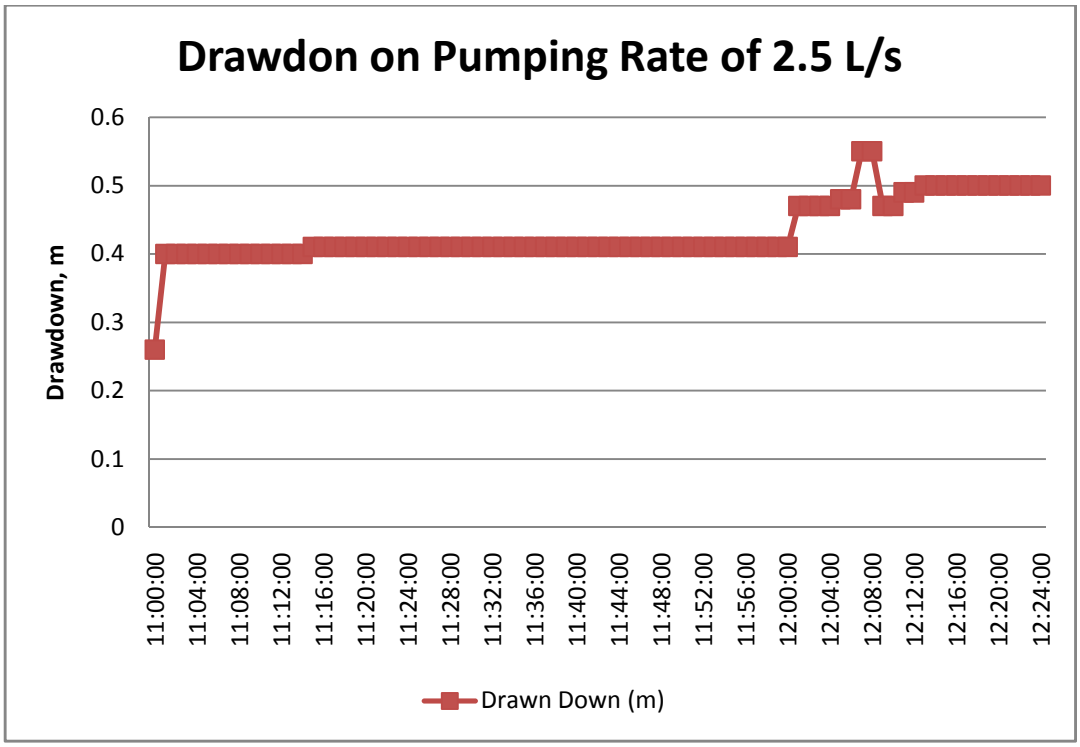


Figure. 9.2. Drawdown Profile of Pumping test at Rate 2.5 L/s

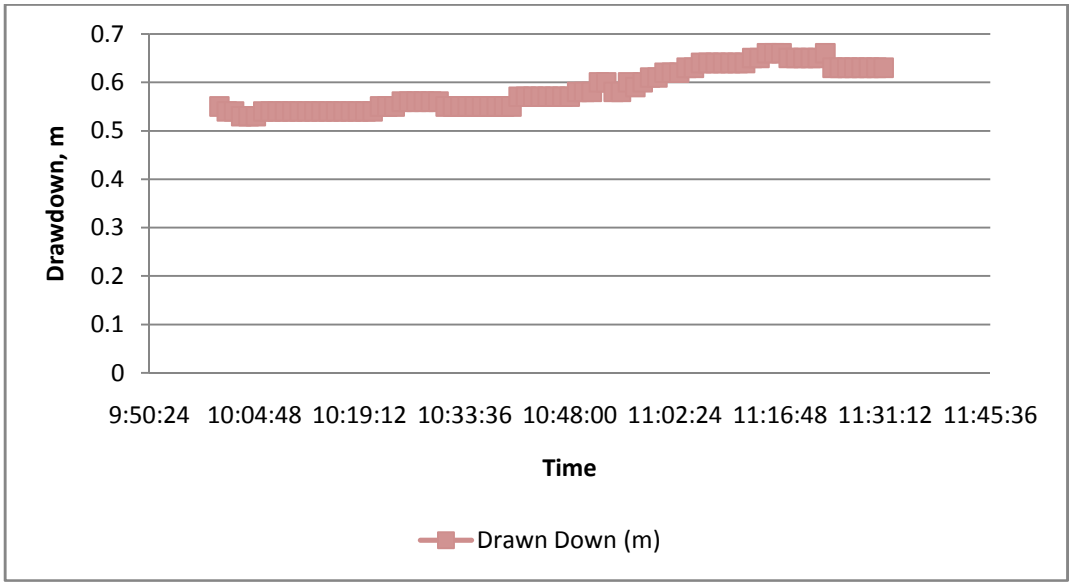
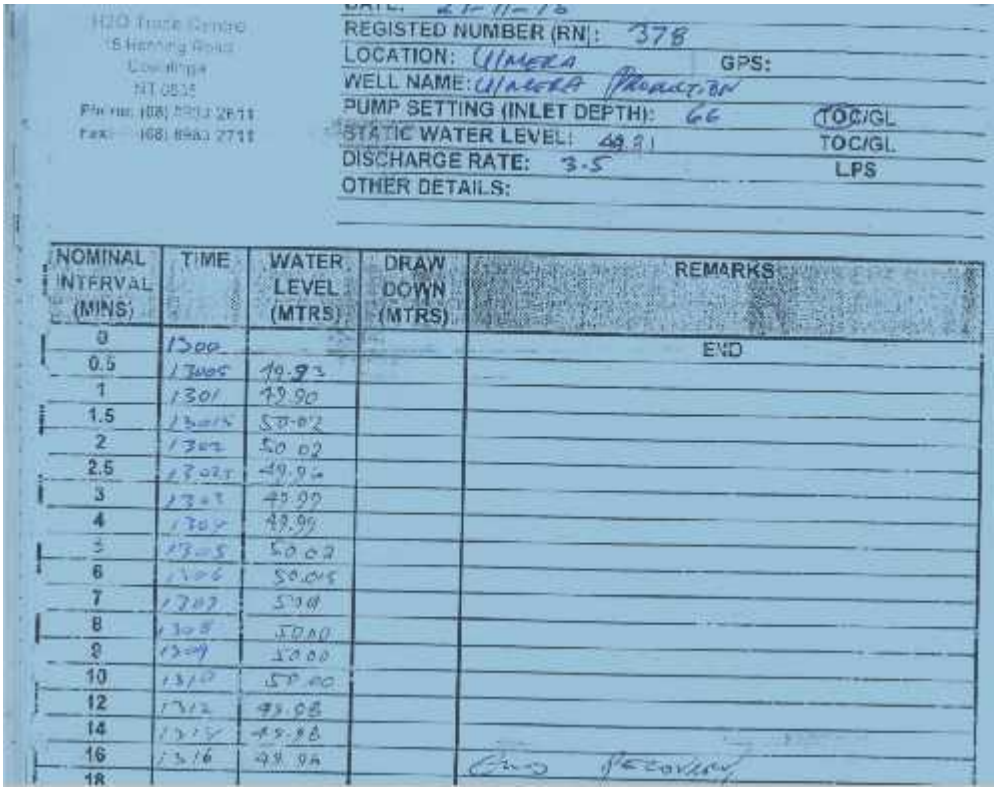


Figure 9.3. Drawdown Profile of Pumping Test at Rate 3 L/s

Table 9.9 Recovery Test data on the Borehole - Ulmera



REGISTED NUMBER (RN): 378
LOCATION: ULMERA GPS:
WELL NAME: ULMERA PRODUCTION
PUMP SETTING (INLET DEPTH): 66 TOC/GL
STATIC WATER LEVEL: 49.21 TOC/GL
DISCHARGE RATE: 3.5 LPS
OTHER DETAILS:

NOMINAL INTERVAL (MINS)	TIME	WATER LEVEL (MTRS)	DRAW DOWN (MTRS)	REMARKS
0	1300			END
0.5	1305	49.93		
1	1301	49.90		
1.5	1301½	50.02		
2	1302	50.02		
2.5	1302½	49.96		
3	1303	49.99		
4	1304	49.99		
5	1305	50.02		
6	1306	50.045		
7	1307	5018		
8	1308	5000		
9	1309	5000		
10	1310	50.00		
12	1312	49.98		
14	1314	49.98		
16	1316	49.98		End Recovery
18				

Future groundwater modeling shall be developed by collecting more comprehensive data to understand the property of aquifers and potential storage yield of groundwater within the area. Particularly to understand the relationship between the pumping rate and recharge rate to judge sustainable yield as the maximum threshold of pumping. Very preliminary estimation of recharge rate from average rainfall volume, which is around 1,100 mm within the catchment area of 40 km^2 of potential recharge area

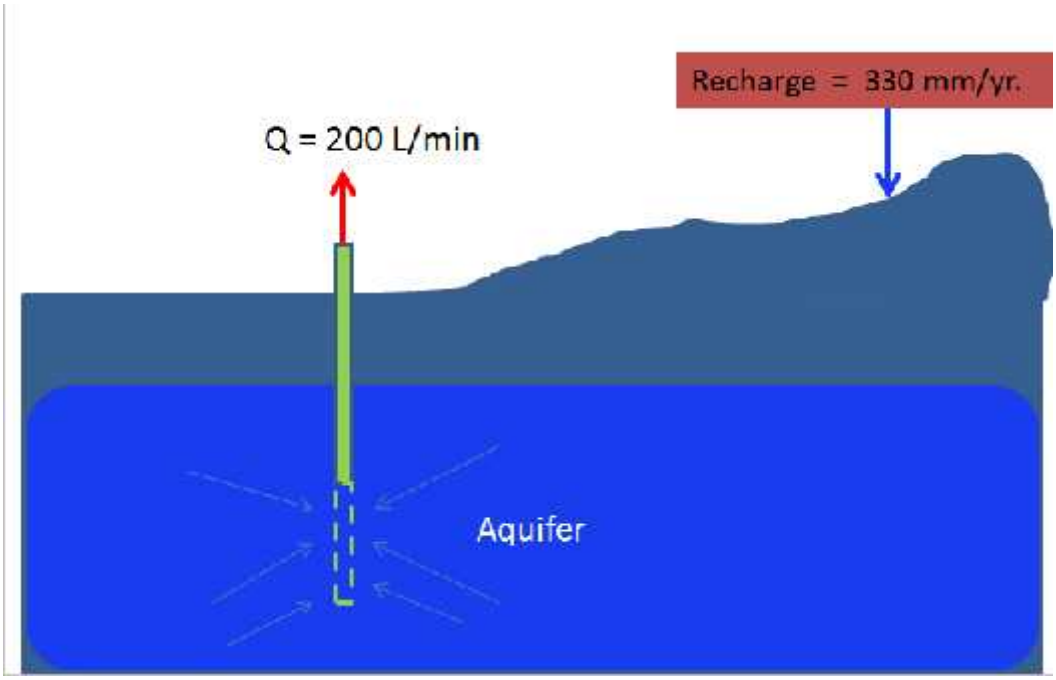


Figure. 9.4 Conceptual Representation of Groundwater Pumping and Recharge System

The recharge rate mainly coming from the rainfall, which occurs during the rainy season and assuming that the average annual rainfall within the project location is around 1,100 mm and by assuming that average 30% of annual rate will contribute to infiltration process and eventually recharge to the groundwater. This means that the average annual recharge rate of groundwater around project location is roughly 330 mm per year. The total pumping rate for this proposed development project in the aquifer area of 4.2 Km^2, with the annual rate of 100 million litters.

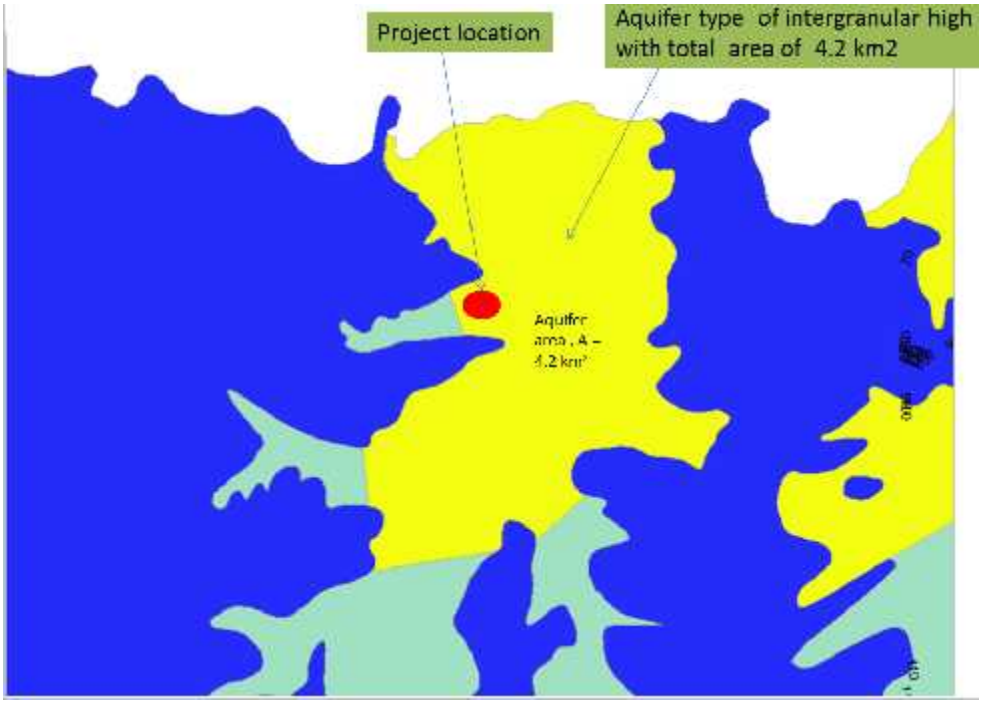


Figure 9.5. Estimation of Aquifer Area

The annual pumping rate is equal to 100 million litters or equal to 24 mm, which is only around 7% of total annual recharge rate. Event, the demands grow at the project area for 200% in the future, will only utilize less than 20% of the groundwater volume. Therefore, the extraction of the groundwater for the development project shall not create any significant issue in the future.

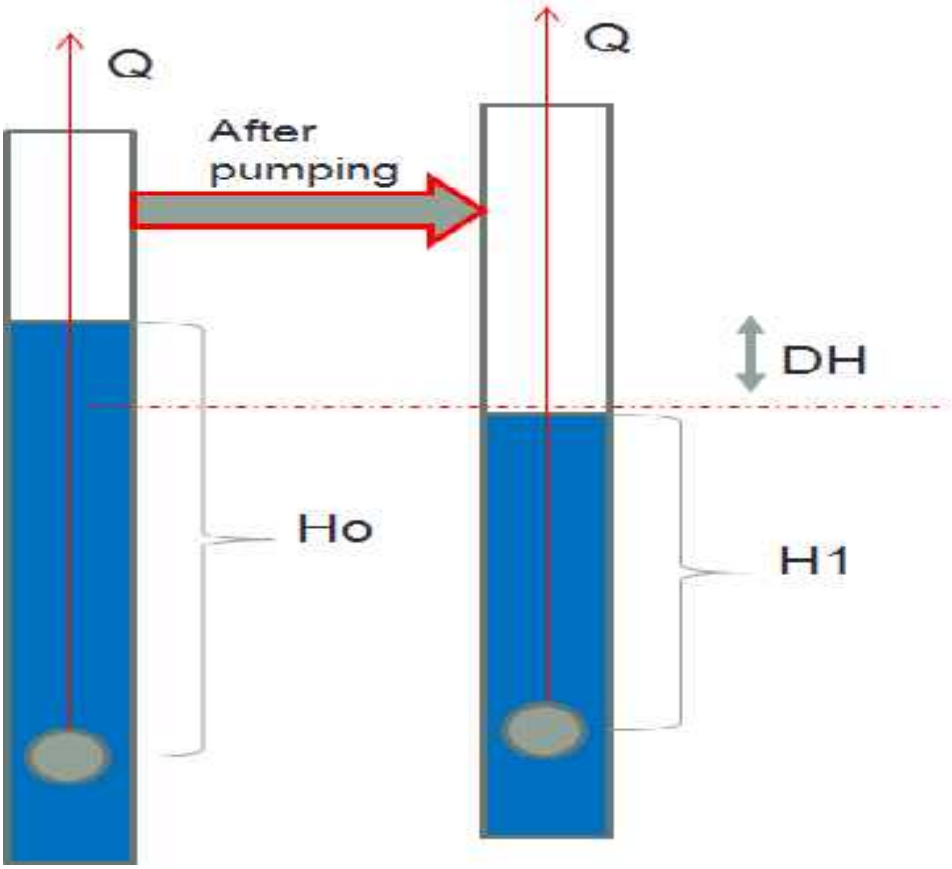


Figure 9.6. Profile of Pumping Test

The pumping rate greater than 3.5 L/second would be required to further investigate in detail with the pumping testing data for greater pumping rate. Impact of groundwater pumping, especially over the limit can cause environmental and community issue that can be summarized as followed:

- Land subsidence if the pumping over the sustainable capacity
- Permanent damaged of groundwater aquifer
- Seawater intrusion
- Groundwater contamination
- Community water resources, especially utilization of spring water at the upper reach of catchment system

The mitigation measures should be necessary, which generally aiming to avoid, minimized and compensate the impacts.

Option 1: Avoidance:

The environmental impacts of groundwater can be simply avoided by using the following option in fulfilling the water demand within the proposed beverage facility.

- Use Seawater; the operating cost of transportation and treatment process to convert the seawater into fresh water to be used in the industry will reasonable high. However, using this method, the environmental problem related to groundwater extraction can be avoided. The company has an option also to combine the seawater and groundwater that is half of the demand can be fulfilled from the seawater. The cost-benefit analysis would be required in order to select best scenario that would be economically viable and environmentally sustainable.
- Water source from upland river, especially in Railako and Gleno; this option is also possible for the future expansion as it will required time to further investigate and develop the option into the technical detail of the implementation. The project owner should have to work together with the government in investigating this option in term of cost sharing and cost saving by GOTA if this option will be considered

Option 2: Minimize:

As the mitigation measures through the avoidance may not be feasible due to cost and technical constraint, the minimization of the impact can be the solution to the groundwater issue. To minimize the environmental impacts due to groundwater extraction, the following solution can be taken:

- Minimize and reduce the rate of water utilization
- Enhance the upland groundwater recharge
- Applies water conservation within the entire facility to reduce the rate of water consumption
- Proposed backup plan from seawater source to the current need
- Monitor the pumping rate and drop of groundwater level and stop the pumping from the groundwater and switch to seawater in case the drop of water level is extreme condition such as greater than 1 meter

Option 3: Compensate/offset:

Compensation or offset may also be needed in order to help reduce further impact, in addition to the avoidance and minimization options. The following option of compensation will be implemented by the project owner in order to offset or remedy in the presence of impacts due to groundwater extraction.

- Provide water to the community; potentially the water scarcity in the project area will increase that provide a problem to the community in having access to groundwater and existing spring water. In this case, the company is obligate the compensate the community with water from their facility
- Recharge the groundwater aquifer with treated wastewater; this is an option that can be taken as the treated wastewater is relatively clean and therefore the water could be used to recharge the groundwater system.

9.2.1.2 Water Treatment

As the quality of extracted groundwater does not meet the requirement by the beverage industries, the water treatment to purify the extracted groundwater would be essential. As presented earlier, that RO option for the water purification will be used and potential impacts that could arise during the operational of the RO units are related to high pumping cost, as RO operate at high pressure and therefore energy utilization will be high.

The summary of impact assessed related to the water treatment system using the reverse osmosis system is presented in the following table.

Table9.10. Summary Impacts from Water Treatment System

Impact of water treatment	Mitigation Measures
Contribute to the high rate of greenhouse gas emission (high energy consumption of pumping)	- Reduce water consumption rate
Wastewater	Proper treatment of the wastewater prior to discharging to the receiving environment
OHS	See action to be taken in OHS part

The major impact of water treatment is related to wastewater disposal to the existing environment. The raw water has very good quality; the wastewater expected from the water treatment plant would be minor.

9.2.1.3 Distribution and Consumption within the system

Various section of the beverage facility will consume the water with the total rate as presented earlier. The impacts of this consumption will affect the groundwater, wastewater, and energy cost, and other related environmental health and safety.

Table 9.11 Impacts and Mitigation in Water Distribution and Consumption within the process

Impact of water Consumption	Mitigation Measures
High volume of water consumption	- Reduce water consumption rate
Increase water stress area	- Proper water conservation within the entire facility - Automatic switch off when not using the water - Optimize the water consumption within the entire system
OHS	See action to be taken in OHS part

The only option to mitigate the impacts is to minimize it, as the nature of the project needs substantial amount of freshwater. Various conservation actions can be applied within the lines of distribution and end-use of water to minimize the impacts.

9.2.2 Impacts of Energy Utilization

Beverage processes are intensive users of both electrical and thermal energy. Thermal energy is used to raise steam in boilers, which is used for wort boiling and water heating in the brew house, dissolving sugar, and in the bottling hall. Refrigeration system is typically the largest single consumer of electrical energy, but for this facility, the brew house, bottling hall, and wastewater treatment plant account for substantial electricity demand. Energy consumption of a beverageplant is heavily influenced by utility system and process design; however, site-specific variations can arise from differences in product recipe and packaging type, the incoming temperature of the brewing water and climatic variations. Specific energy consumption in a brewery can vary from 100-200 mega joules per hectoliter (MJ/HL), depending on size, sophistication, and the factors listed above.

The following table provides average energy consumption for beverage plant that was reported in 2004. As energy conservation in this type of processing plant is one of the key performance indicators that must be applied, this ratio of energy consumption per unit production rate may have dropped down. However, for the new plant, the calculation should use conservative approach by using the upper bound of statistical average in the calculation of energy demand.

Table 9.12 Summary of Energy Consumption and Requirement (Source: Brewer Association, 2004)

Year 2004	Unit	Soft drinks only	Breweries only	Average all bevarage sites
Electricity	Kwh/hl	4.5	9.7	9.5
Thermal	Kwh/hl	5.2	29.5	27.4
Total energy	Kwh/hl	9.7	39.2	36.9

The proposed capacity of beverage plant in Ulmera, Timor Leste, estimated that the total annual energy consumption will be about 6 MWh, which is the medium level of the consumption of the energy. The following piechart is the breakdown of distribution of energy consumption in each part within the beverage processing plant.

Table 9.13. Calculation of Total Energy Consumption

Total Energy Need	Unit	Beverage, kwh/HL	GOTA's Capacity of Plant, HL	Energy Requirement for GOTA, Kwh
Electricity	Kwh/HL	9.5	150000	1425000
Thermal	Kwh/HL	27.4	150000	4110000
Total	Kwh	5535000		

The distribution of utilizationof energy within the factory can be seen in the following figure, where the largest would have in refrigeration, air compression, pump, and lighting.

Figure 9.7. Energy Consumption Distribution within the Beverage Processing Plant

The high demand of energy consumption within the facility provides positive and negative consequences during the operation of the plant that must be taken into consideration. The positive impacts including absorbing excess capacity of EDTL power plants while the negative impacts are high energy consumption that iscontributing to greenhouse gas emission.

The impacts of energy consumption assessed from each of the above component are elaborated in the following table.

Table 9.14Impacts Assessedon High Energy Consumption

No	Impact of Energy Consumption
1	Expensive/costly
2	High Rate Green House Gas Emission
3	Contribute to the carbon footprint

The following tables provide the summary of sub-section within the factory that consumes powers (both energy and thermal) that could be concerned to the environment.

9.2.3 Impacts ofWastewater and Mitigation Measures

Roughly 50% of total water used in the beverage processing will eventually end up as wastewater. The volume rate as indicated above was significant, not only because of the quantity but also the poor quality that will cause environmental problem without any treatment prior to discharge into the receiving water body.

- The rate of wastewater that will be produced is assumed to be roughly 3 times of the production volume (ratio per HL of product is between 2 and 5 times)
- Annual wastewater= 500,000 HL or 105 L/min (or equal to 50% of total water used)

- Medium size of volume of wastewater with high BOD, COD, low pH, high TSS, bad odor and high turbidity
- No municipal wastewater treatment is currently available in Dili, except for septage treatment in Tibar, which is a long way from the plant and will substantially increase cost should wastewater be disposed in Tibar.
- Therefore, the company will have to have wastewater treatment plant to treat the wastewater
- The final discharge point will be at Ulmera Bay, where valuable ecological resources are presented (mangrove, coral, seaweed, fisheries, and other flora and fauna)

The impact of wastewater disposal to the environment, people, and health is presented in the following table as well as the proposed mitigation measures.

Table 9.15. Summary Impacts to Wastewater

Wastewater Parameters	Impacts
High solid material	➢ Contribute to high BOC/COD ➢ Odor ➢ Aesthetical
High COD	➢ Oxygen depletion ➢ Odor emission ➢ Greenhouse gases emission
High BOD	➢ Oxygen depletion ➢ Odor emission ➢ Greenhouse gas emission
High Nutrient (Nitrogen based compound)	➢ Eutrophication
High Phosphors	➢ Eutrophication
PH issues	➢ Affect all the living organism and ecosystem ➢ Can kill living organism
High turbidity (TSS)	➢ Cause high turbidity and block the sun penetration and hence disturb the photosynthesis with the marine ecosystem

As the condition in the project location very dry, the treated wastewater can be reused, as irrigation system within the project location. With, this solution, the treated wastewater will not reach the marine water body.

9.2.3.1 PH equalization

PH treatment is a very first treatment to be conducted in order to neutralize the PH level of the effluent before going through other treatment processes. The range of PH at effluent is range from 3- 12 and the range of the PH acceptable to the ambient environment is at the range 6-9. Therefore, the objective of PH equalization is to bring the PH of the effluent to the normal range

(6-9) by adding the acid or base depending on the exact value of PH effluent. The online measurement should be conducted to measure and know the PH level of the effluent so that decision on acid or base reagent would be taken. The equalization of PH of effluent is conducted by using the tank which should be a complete mix system and fully control to achieve good result of PH adjustment.

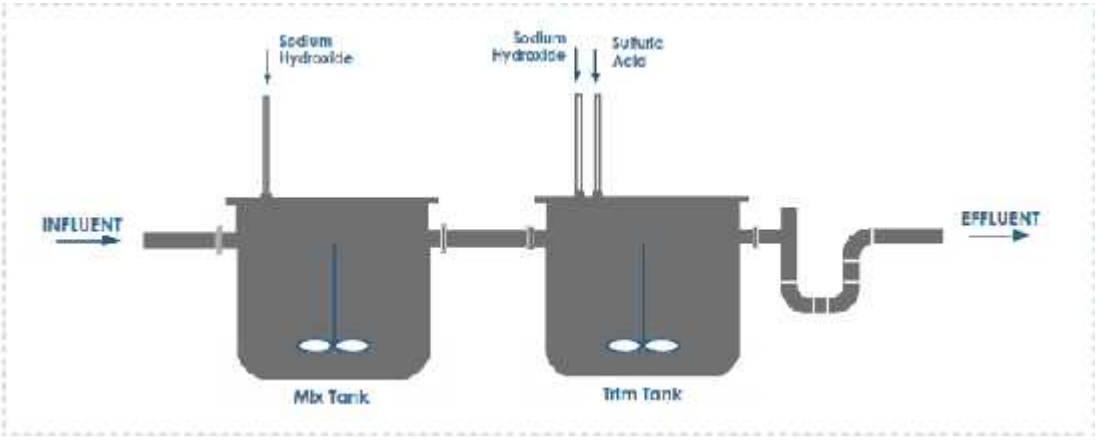


Figure 9.8 Typical PH neutralization process within the plant

9.2.3.2 Physical treatment: Separation of solid waste from liquid waster

The outflow of PH equalization should enter the physical treatment process, where the solid particle is separated from the liquid one. The solid waste such as cans, plastics, cup, etc., will always be part of the wastewater. To remove the solid waste, simple screening device can be used and if necessary sedimentation tank can be used to settle solid material before entering the biological treatment.

9.2.3.3 Biological Treatment of Anaerobic System

Anaerobic wastewater treatment is the biological treatment of wastewater without the use of air or elemental oxygen. Anaerobic treatment is characterized by biological conversion of organic compounds by anaerobic microorganisms into biogas. Biogas is mainly methane (55-75 vol%) and carbon
dioxide (25-40 vol%) with traces of hydrogen sulfide.

Anaerobic Treatment in the Brewing Industry
- Suited for brewery wastewater
- Generally soluble organics and medium to high strength
- Produces low amounts of sludge
- Requires small amounts of chemicals
- Produces valuable biogas and sludge
- It is a ‘tried & true’ technology

Smallest entry-level anaerobic system

- The smallest is a 50 kl UASB system
- Equivalent to a brewery size of between 118,000 –
- 236,000 bbl per year production
- Installed cost: $700,000 - $1,200,000 U.S.

Aerobic biological treatment is performed in the presence of oxygen by aerobic microorganisms (principally bacteria) that metabolize the organic matter in the wastewater, thereby producing more microorganisms and inorganic end products. Aerobic treatment utilizes biological treatment processes, in which microorganisms convert non-settleable solids to settleable solids. Sedimentation typically follows, allowing the settleable solids to settle out.

9.2.3.4 Biological treatment of Aerobic system

As, the removal of BOD/COD, and other contaminant are not fully meet the standard effluent discharge that required, further treatment by using the aerobic treatment would be the option. Aerobic system of biological process is relatively expensive. However, it should be part of the treatment process to remove BOD, COD, and nutrient, which are otherwise harm the environment. Particularly, the COD was not reduced efficiently in the anaerobic process. The following table presented the comparison of aerobic and anaerobic processes, where these two processes perform different function in term of BOD and COD removal.

Comparison Of Two Pre-Treatment Options

	AEROBIC TREATMENT	ANAEROBIC TREATMENT
CONS	Higher energy use	80+% COD reduction
	Generates biomass (sludge) requiring disposal	
	High operating costs	
	Larger Footprint	
PROS	99+% BOD reduction	Provides renewable energy (biogas) and low biomass
		Low operating costs
		Smaller Footprint
		Capital equal or slightly lower than aerobic

The effluent from both aerobic and anaerobic process, which has high solid contain material, will enter the sedimentation process, to settle the solid waste from the liquid waste.

9.2.3.5 Sedimentation and Sludge Process system

Size of sedimentation tank or settling tank or clarifier will receive the effluent from aeration tank to settle the solid material from the liquid one. The liquid that has already low BOD, COD, nutrient, and phosphor, but high in microorganism will go to further treatment process, that are sand filter, and disinfection processes before enter the final pond.

Figure 9.9 Sludge that are ready to be used as fertilizer

9.2.3.6 Sand Filter and Disinfection

The sand filter is used to remove the fine particle material as part of top product in the sedimentation tank. The size of sand filter is designed such that it will be handle the effluent capacity. The disinfection via chlorination process will be applied to kill microorganism within the effluent before the treated waste water will be discharge into the final tank, which is fish pond and the overflow of fish pond will enter the drainage ditch.

9.2.3.7 Discharge point of Drainage system

The treated effluent after disinfection will enter the multiple pipe outlets around 10 pipes, to equally distribute the flow into smaller amount, which is 10 L per minutes. With the rate 10 Liter in each minutes discharge, the treated wastewater will be disappearing into percolation downward. The permeability soil test in the project area indicated that the percolation downward of the topsoil around the project area is equal to 0.5 cm/hr, which indicated how fast the water moves downward to the aquifer. The natural waterway with the size of 10 meter width the depth proximately 1 meter will be the receiving point. As the distance from the project location to the mangrove is roughly 1500 meters and additional 200 m to the marine water body. The design of the effluent discharge from the beverage plant was design such that the treated wastewater is percolate downward. Conceptually, the discharge points to the downward can be achieved through the multiple discharges via multiple piping systems as represented in the following conceptual drawing.

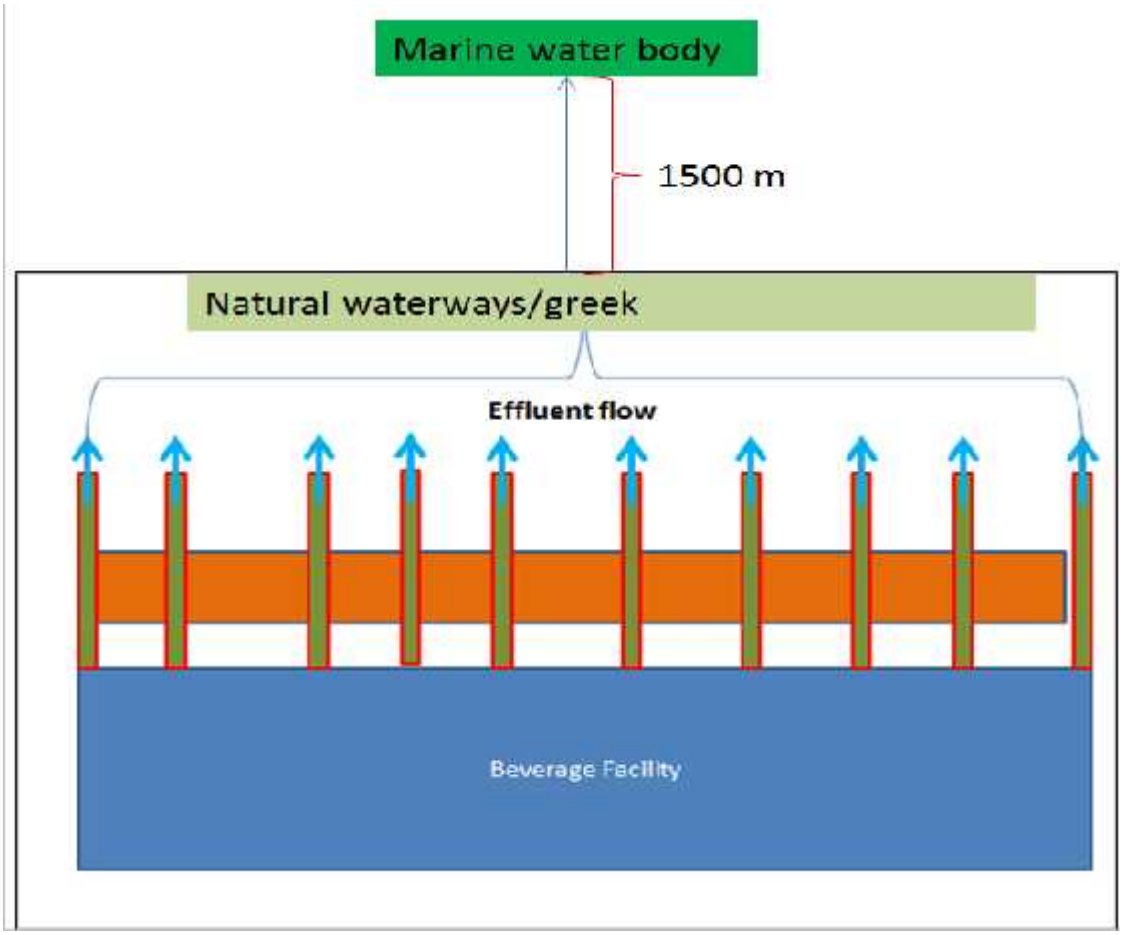


Figure 9.10. Proposed Disposal Treatment plant to Drainage Ditch

With this arrangement the discharge of 10L/min is distributed into the 10 discharge pipes so that rate of discharge is less than the percolation rate. With this arrangement, all the treated wastewater will re-charge the groundwater in the groundwater aquifer. This method however, only be applied within the proper treatment in the wastewater treatment plant.

9.2.4 Impacts of Solid Waste and Mitigation Measures

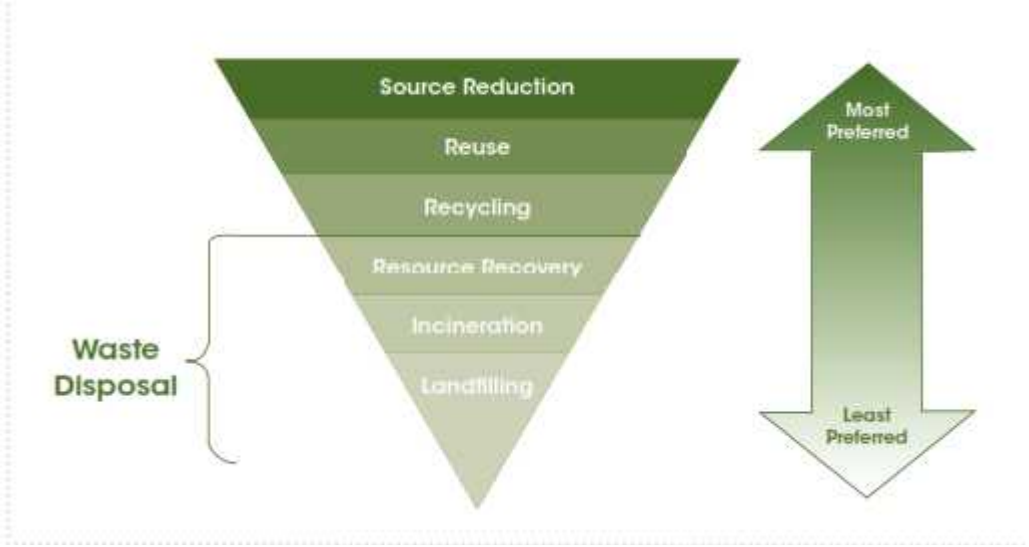
Besides beverage as the main commodity of the product to be sold in the market, there are solid waste and other by products that need to be taking cared of properly. Otherwise, it will become a problem to the environment, heath, and safety of people and community. The solid waste composed of both organic and non-organic material, which required different methods of handling. In order to come up with the plan on how to mitigate the solid waste material associated with the beverage processing plant, the quantity and quality of the solid waste would need to be assessed.

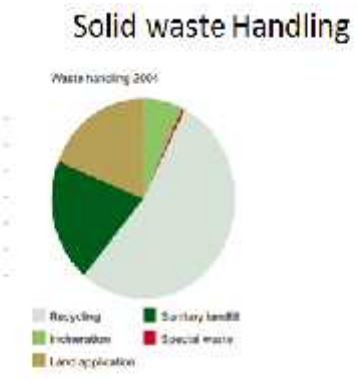
The following flow diagrams provide a figure on the type of solid water from several sub-component of within the brewing plant.

Figure 9.11. Origin and Source of Solid Waste

A comprehensive handling of solid waste over the years in various industries has adopted the concept of 3R and D (Reduce, Reused, Recycle and Disposal). It would be environmentally beneficial to society and economically rational to the project owner; if the waste generated by the process is reduced therefore less handling efforts will be required.

Figure 9.12 Solid Waste Handling with Green Concept





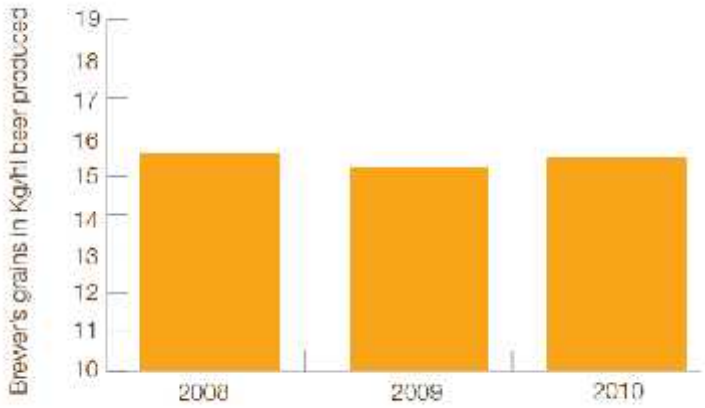
Total estimation of solid watse produced by the proposed development plant would be around 1000 ton/year. More than half of this solid waste is coming from by-product of spent grain that has high economic value because it can be used as animal feeding. However, the handling should be proper so that the impact would be minimized.

9.2.4.1 Solid Waste – Brewing

Solid waste generated directly from the brewing process (both physical and chemical) consists of spent grain, spent yeast, and diatomaceous earth, with the significant quantity that require proper handling to reduce the risk and impact to the environment and local community. Fortunately, information on the rate generated for the proposed plant is widely available.

Overtime, the average rate of waste generated has been well documented and recognized by the planner and practitioner. The following figures shows the average rate of solid waste generated related to the spent and yeast.

Figure 9.13 Spent Grains as Byproduct from the Brewing Process



The average rate of spent grain and yeast was 15 kg/HL of beer, and this ratio can be used to calculate the total spent grain that will be produced by the plant. The estimated annual spent grain for GOTA facility in Timor Leste is around 750 ton, which will become a problem, if no handling is applied to this byproduct.Spent grain is byproducts of malting and lautering processes and the largest source of waste for most brewery operations. Although spent grain cannot be repurposed in the brewing process, they are still rich in protein, fiber and other nutrients and are a valuable resource that can be reused in many areas.Fortunately for brewers, there are many businesses and groups who are also willing to pay for and remove this ‘waste’ from the brewery.Animal feed is one of the most popular ways breweries reuse spent grains. Breweries donate or sell spent grains to local farmers and livestock owners, which results in less waste to landfill, less virgin grain that needs to be grown or delivered to farmers, and more support for local agricultural businesses.

Yeast is added during the fermentation process to aid in the chemical conversion of sugar from wortinto carbon dioxide and alcohol. Most brewers, if not all,have excess yeast from the brewing operations. Effectivemanagement of yeast can reduce costs and increaserevenue, without compromising the quality of the finalproduct.A common practice in both breweries and bakeries is to save and reuse yeast to reduce the amount of new yeast that must be purchased from a vendor and can improve yeast qualities from generation to generation. Note that techniques of yeast storage will vary by brewery process and size. When reusing yeast, brewers should be mindful of two important factors: temperature and time.

Diatomaceous earth (DE) is a naturally occurring siliceous sedimentary rock that is used during the filtration process of brewing to clarify beer and remove particulates. If a brewery uses a significant amount of DE, disposal of the material can become problematic if not managed well. Filtering of cold conditioned beer is usually done with a plate and frame filter. Plate and frame filter presses are dewatering machines that utilize pressure to remove the liquid from slurry. Beer

is mixed with a filter aid such as DE or perlite. Solids remain in the void between the plates, until the plates discharge the filtered solids. At the end of filtration, the solid filter cake is removed and typically disposed in a landfill. The total solid waste associate with the brewing processing plant is summarized in the following table.

Table 9.16 Estimation of Solid waste from Brewing Based on Capacity of 75,000 HL

Type of Solid Waste	Amount, ton/year, ton
Spent Grain	750
Spent Yeast (dry matter 10%)	7.5
DE	1

The following table provides the summary of solid waste generated directly from brewing process and common mitigation measures that have been applied in the industry.

Table9.17 Summary of Solid Waste Impact and Mitigation Measures

Brewing Waste	Impacts	Mitigation Measures
Spent Grain	➢ Contributing to the high BOD/COD if discharge into wastewater stream ➢ Large quantity which required space to store ➢ Odor and create other problems ➢ OHS	➢ Valuable product for animal feeding ➢ Proper handling of the spent grain from the brewing facility to drying facility prior to utilization of spent grain ➢ proper application of PPE in handling the spent grain due to odor and if not drying quickly the spent grain can become a bio-hazard
Spent Yeast	➢ Unpleasant odor ➢ Contribute to high BOD and COD if discharge into drain/wastewater stream ➢ If eaten directly by animal can cause animal die (fermentation process inside animal body) ➢ OSH	➢ Use for land/soil improvement ➢ Proper handling from brewing facility to the land improvement area (land improvement should be controllable ➢ Kill the yeast prior to discharge from the factory ➢ Proper application of PPE by workers in handling the yeast
Diatomaceous Earth (DE)	➢ Significant quantity which required space to store ➢ Dust problem ➢ Fine particle is commonly hard to be removed from the tank and dispose	➢ Use the DEM for the concrete material though the quantity is significantly small ➢ If not reused, the send to controlled landfilled area in Tibar ➢ Proper handling when collecting the DE and proper application of PPE to avoid the risk to OHS

9.2.4.2 *Solid Waste – Packaging – Food Services*

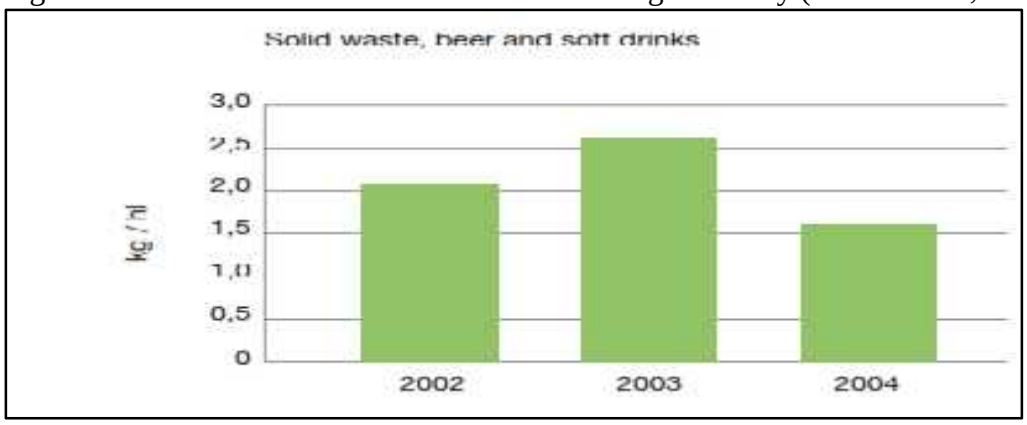
Raw materials and other supporting material within the production facility from outside will soon become solid waste. Also the final product of beverage such as beer, soft drink, mineral water will be packed prior to distributing to the market system and solid waste will also generate in this process. The type of solid waste associated with the beverage processing plant includes:

- Cartoon/cardboard
- Wood
- Bottle
- Plastics
- Leftover food
- General solid waste
- Sludge (from wastewater treatment plant)

Figure 9.14 Summary of Solid Waste Produced within the Beverage Processing Plant

All the above solid waste sources were generated from non-related processing such as plastic, cartoon, wood, etc. are approximate to fall into the following figure. Average solid waste related to the beverage industry (both alcoholic and non-alcoholic) would be around 2 kg/HL.

Figure 9.15. Solid Waste Results from the Beverage Industry (Source: BA, 2013)



The total capacity of beverage (both beer and soft drink) equals to 100,000 HL and therefore, the annual solid waste generated by the proposed plant is estimated to be around 200 tons/year. The quantity of solid material would need proper handling in order to reduce the impact (both short and long-term) to the environment.As described earlier that 3R and D must be applied in order to manage the solid waste within the facility to reduce impacts and risk. The following table provides a summary of solid waste sources, impacts, and proposed mitigation measures.

Table 9.18. Solid Waste Impact and Proposed Mitigation Measures

Solid Waste	Impacts
General waste	➢ Need space to store (Space limitation) ➢ Create unpleasant environment ➢ Create unhealthy environment and may be generate illness
Corrugated - Cardboard	➢ Space limitation ➢ Becomes hazmat ➢ End up in the sea and polluted the sea, city, and environment
Wood pellets	➢ Space limitation ➢ Becomes hazmat ➢ Unhealthy environment
Shrink wrap , Bag, sack	➢ Space limitation ➢ Becomes hazmat ➢ Non-biodegradable material, took a long time to break the molecule ➢ Unhealthy environment
Aluminum cans	➢ Space limitation ➢ Unhealthy environment
Plastic bottles	➢ Space limitation ➢ Unhealthy environment ➢ It takes a long time to decompose the non-biodegradable material such as plastic
Glass bottles	➢ Space limited ➢ Becomes hazmat ➢ Unhealthy environment
Leftover food	➢ Odor ➢ High BOD/COD ➢ Bio-hazard ➢ Unhealthy environment and cause sickness and poisonous

The mitigation measures of the above quantity of solid waste, can be done in-line with the above 3R as discussed. The following flow diagram process should be used as guideline in handling the solid waste impacts as identified.

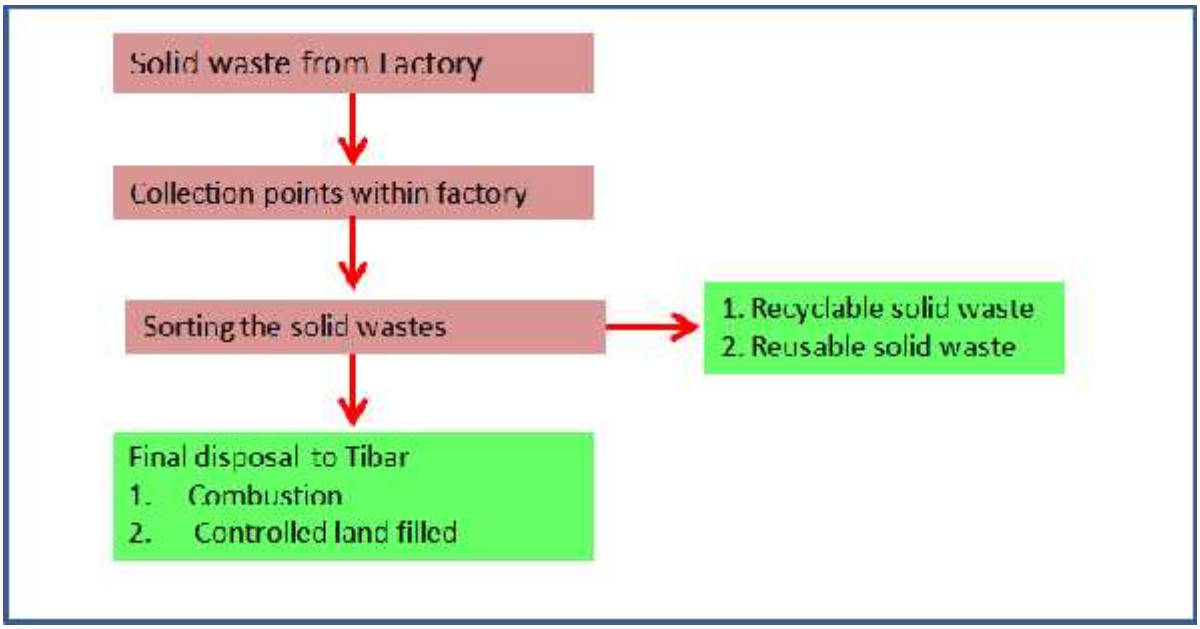


Figure 9.16. General Approach of the Solid Waste Handling

9.2.5 Impacts of Gas Emissionand Mitigation Measures

Beverage industry is an established industry, where negative and positive outcomes are well recorded. Major emission to the air is directly related to gases that are produced. Fourmain gases are detected as the main gas that will contribute to greenhouse gas emission:

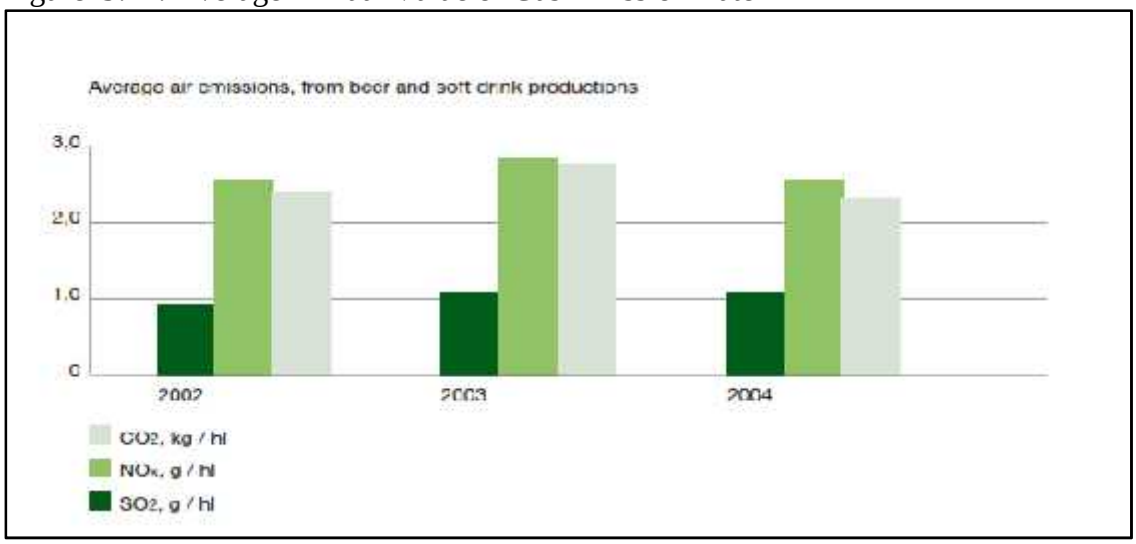
- Nitrogen base compound (NOx)
- Sulfur based compound (Sox)
- Carbon dioxide (CO_2)
- Methane (CH_4)

Over many years of practice in beverage industry, the quantity of emission gas generated per production rate has been derived empirically. This empirical method of estimation can provide a valuable tool for estimation of the rate of emission in other locations based on production capacity. However, the calculation of emission rate from these gases, are relatively small compare to the emission as a result of energy consumption.

9.2.5.1 Estimation of Emission Rate

The emission of various gases to the atmosphere would contribute the global climate change that affect globally. Essentially, the major emission rate by this project is indirect from the consumption of fossil fuel. However, there are also direct contributor from the gases as by product of the proposed development plant. The following figure shows the empirical result of emission gas rate per unit production of beverage.

Figure 9.17. Average Annual Value of Gas Emission Rate



The following table summarized the estimated quantity of each emission parameters.

Table 9.19 Emission Rate and Projection of Emission for Beer and Carbonated Soft Drink

Emisison Paramter	Rate, kg/HL	Capacity plant, HL	Amount/year, Ton
CO_2	2.4	100,000.00	240.00
Nox	0.0028	100,000.00	0.28
Sox	0.001	100,000.00	0.10

Methane gas will be burned directly and already accounted to the above CO_2 calculation (methane emission has been converted to CO_2 equivalent). There are however, still emissions that indirectly contribute to the air due to high energy consumption from the power generation. The total energy consumption of GOTA in Timor Leste is projected to be 6 Million Kwh and this is equivalent 2 Million liter diesel fuel or equivalent to 1720 ton diesel fuel per year of operation (the density of diesel fuel is equal to 0.86 ton/m^3). Using the equivalent values, which about 3.4 kg CO_2/kg diesel fuel, the carbon footprint was estimated to be around, 5,848ton Carbon/year. Therefore, the total carbon footprint from the GOTA processing plant was estimated to be 6088 Ton/year. The carbon footprint from direct contribution of CO_2 is only composed of 4% from the total carbon footprint or 96% of the carbon footprint is due to energy consumption.

9.3 Occupational Health and Safety (OHS)

Occupational Health and Safety (OHS) is also an important aspect to be assessed during project O&M. The following description of potential OHS issues has focused on activities that will generate risk for the specific industry (beverage processing) as presented in IFC (2007) guidelines on the Occupational Health and Safety (OSH) and ISO – 18001 that will be used by

GOTA. The following sub-sections presented the OHS that related directly to the operational aspect of the beverage industry with alcoholic and non-alcoholic products.

9.3.1 Explosion Risk

Organic dust arising from grain storage, milling, and transport operations presents an explosion risk in the areas of the brewery where these operations occur. In addition to the guidance in the General EHS Guidelines (IFC standard, 2007), the following mitigation measures should be taken to reduce dust explosion hazards:

- Frequent sweeping to control dust accumulation, and use of dust extraction and recycling systems to remove dust from work areas;
- Provision of electrical grounding, spark detection and prevention, and, if necessary, quenching systems;
- Use of explosion proof electrical motors, lights, switches, and connections in high risk areas;
- Integration of explosion relief vents in facility design and construction;
- Elimination of external ignition sources;
- Implementation of hot-work permits;
- Control of all smoking materials;
- Prohibition of cell phone use.

9.3.2 Exposure to Chemical

The process involves chemical processes that may cause hazard and risk to the workers within the facility and other community members who live nearby the project location. Chemical hazard and exposure related to beverage processing plant include:

Table9.20Source of Impacts for Chemical Hazard

Source of Chemical Hazard	Impacts
Refrigerant leaking	
Carbon dioxide is produced during fermentation and maturation processes present asphyxiation potential	- Greenhouse gas emission - Air pollution

Exposure to other chemicals typically due to chemical handling activities related to cleaning,disinfection andmaintenance of process areas, pipe work and vessels. Recommendations for the management of exposure tochemicals are presented in the General EHS Guidelines.

9.3.3 Physical Hazards

Physical hazard associated with beverage industry may consist of:

- Level (falling)

- Slippery
- Use of machine and tools
- Collision (transport equipment such as forklift, truck, and containers, etc)
- Dust
- Pressurize gas/water system
- Heat and Cold system/area

Mitigation measures for all these hazards were presented in the general occupational health and safety.

9.3.4 Exposure to Noise and Vibration

A variety of operations in food and beverage processing units generate substantial noise levels, for example the canning plant, bottling machines, conveyors and blanching applications. Mitigation measures proposed are:

1. Use of Personal Protection Equipment (PPE)
2. Latest technology that generate less noise and vibration
3. Applying the general OHS

9.3.5 Community Health and Safety

As the plant is locatedin close proximity to local community (closest residential within 200m), Community members will be exposed to risk associated with the operational plant. In general, health and safety risk that may occur during project implementation include the water quality and availability, structural or safety of the facility, life and fire safety, traffic safety, transport and hazardous material, disease & presentation, and emergency response and preparedness plans. All these community health and safety guidelines are a standard procedure that is commonly available.

9.3.5.1 Water Quality and Availability

Community members who live around project location utilize water from springs located about 1Km downstream of project location. As during the operation of facility, the project owner has proposed to extract groundwater resources, the water spring will not be affected. As long as the community does not need to construct well near project location, no severe impacts will be felt to the community.

9.3.5.2 Structural Safety and Facility

Hazards posed to the workers while accessing project facilities include:

- Physical trauma associated with failure of building structures
- Burns and smoke inhalation from fires Injuries suffered as a consequence of falls or contact with heavy equipment

- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials

To avoid that problem to happen, physical structure of the facility should be designed and constructed based on International Standard building code, which adheredto all of the following design and construction parameters:

- Existing structures
- Soils and foundations
- Site grading
- Structural design
- Specific requirements based on intended use and occupancy
- Accessibility and means of egress
- Types of construction
- Roof design and construction
- Fire-resistant construction
- Flood-resistant construction
- Construction materials
- Interior environment
- Mechanical, plumbing and electrical systems for conveying systems
- Fire safety systems
- Safeguards during construction
- Encroachment into public right-of-way

By considering all these proper standard design and criteria in the construction of the facility, it is expected that the probability of failure related to structural defect and damage that affect health and safety could be reduced.

9.3.5.3 Exposure to Dust

The access road to the project location is from the community center and currently the road is sheet road which can easily generated the dust and fume that could be hazardous to the community. Improvement of access road would be required in order to minimize the impacts of the dust to the health and community.

9.3.5.4 Fire Safety

Fire safety measures will ensure that fire accidents are prevented and risk to lives and properties are minimized. The following guidelines should be used to achieve the objective and intention of fire safety:

- Project sponsors' architects and professional consulting engineers should demonstrate that affected buildings meet these life and fire safety objectives.

- Life and fire safety systems and equipment should be designed and installed using appropriate prescriptive standards and/or performance based design, and sound engineering practices.
- Life and fire safety design criteria for all existing buildings should incorporate all local building codes and fire department regulations

The impacts life and fire safety are assed and mitigation measures were prepared as general guideline on what to do to minimize the risk.

9.3.5.5 Traffic Safety

Accident related to traffic has become one of the most significant sources of injuries and fatalities worldwide. Particularly, most of traffic accident is related to alcohol consumption. While traffic safety depends on many factors including road condition, regulation and road users, the behavior of driver control most of accidents in the road. Data collected from PNTL in Timor Leste suggested that most of roadside accident in Timor Lesteis related to alcohol consumption. The following table presents traffic assessment and mitigation measures in general to be considered.

Table 9.21 Traffic Assessment and Mitigation measures

Traffic Safety Concern	Impacts
1. Heavy vehicle coming in and out of the facility 2. Increase traffic volume	➢ Congestion and increase travel time ➢ Traffic accident
Regular maintenance of vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure	➢ Minimizing pedestrian interaction with construction vehicles ➢ Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. ➢ Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns) ➢ Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents ➢ Using locally sourced materials, whenever possible, to minimize transport distances. ➢ Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions

9.3.5.6 Disease Prevention

Prevention and mitigation measures of potential disease within project site consist of communicable diseases and vector borne diseases. Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Reducing the impact of vector-borne disease on the long-term health of workers on the other hand, is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease.

Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.Recommended interventions at the project level include on both communicable diseases and vector borne diseases are presented in the following table.

Table 9.22Proposed Diseases Prevention Action Plans

Type of Disease Prevention	Recommended intervention
Communicable diseases	➢ Providing surveillance and active screening and treatment of workers ➢ Preventing illness among workers in local communities by: o Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use o Training health workers in disease treatment o Conducting immunization programs for workers in local communities to improve health and guard against infection o Providing health services ➢ Providing treatment through standard case management in on-site or community health care facilities ➢ Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization
Vector borne diseases	➢ Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements ➢ Elimination of unusable impounded water ➢ Increase in water velocity in natural and artificial channels Considering the application of residual insecticide to dormitory walls ➢ Implementation of integrated vector control programs ➢ Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites ➢ Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs ➢ Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread ➢ Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects ➢ Educating project personnel and area residents on risks, prevention, and available treatment ➢ Monitoring communities during high-risk seasons to detected treat cases ➢ Distributing appropriate education materials ➢ Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure

9.3.5.7 Emergency Preparedness and Response

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety. It is important to prepare an emergency plan and be prepared to respond the unexpected event. All projects should have an Emergency Preparedness and Response Plans that is commensurate with the risks of the facility and that includes the following basic elements:

- Administration (policy, purpose, distribution, definitions, etc)
- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities
- Communication systems
- Emergency response procedures
- Emergency resources
- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

In addition to the above basic elements, there are important key components of the emergency plans, that should be seriously into consideration as noted in the following table.

Table 9.23. Important Aspects of Emergency Plan Components

Action Plans of Emergency plan	Mitigation action
Worker Notification	Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Related measures include: ➢ Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations ➢ Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency
Community Notification	If a local community may be at risk from a potential emergency arising at the facility, the company should implement communication measures to alert the community, such as: ➢ Audible alarms, such as fire bells or sirens ➢ Fan out telephone call lists ➢ Vehicle mounted speakers ➢ Communicating details of the nature of the emergency ➢ Communicating protection options (evacuation, quarantine) ➢ Providing advice on selecting an appropriate protection option
Media and Agency Relation	Emergency information should be communicated to the media through: ➢ A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies ➢ Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed
Fire service	The company should consider the level of local firefighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster. If insufficient capacity is available, firefighting capacity should be acquired that may include pumps, water supplies, trucks, and training for personnel.
Medical Service	The company should provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital.
Emergency resources	Appropriate measures for managing the availability of resources in case of an emergency include: ➢ Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency ➢ Providing personnel who can readily call up resources, as required ➢ Tracking and managing the costs associated with emergency resources ➢ Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies

	➢ Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site
Mutual Aids	Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers. Where appropriate, mutual aid agreements should be maintained with other organizations to allow for sharing of personnel and specialized equipment.
Training and updating	Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs should: ➢ Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency ➢ Develop a training plan to address needs, particularly for firefighting, spill response, and evacuation ➢ Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated ➢ Provide training exercises to allow personnel the opportunity to test emergency preparedness
Checklists (role and action list and equipment checklist)	The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.
Business Continuity and Contingency	➢ Identifying replacement supplies or facilities to allow business continuity following an emergency.For example, alternate sources of water, electricity,and fuel are commonly sought ➢ Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity. ➢ Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

9.4 Potential Impacts of Climate Change

It has been widely understood that climate change is mainly caused by global warming, a result of rapid rise in the concentration of greenhouse gasses in the atmosphere. The proposed facility will contribute a limited amount of greenhouse gases through direct emission from operation and indirect emission from power generation and consumption in the facility. As previously described, the facility will directly emit CH_4, CO_2 and other potent greenhouse gasses. Measures to mitigate these direct and indirect emissions have been proposed.

Moreover, on the adaptation side of Climate Change especially for an industrial facility in coastal location, several climate change impacts are relevant to the facility. These are – (i)sea level rise, (ii) changes in rainfall pattern and (iii) changes in temperature. These climate change impacts are important factors in Health, Safety and Environment (HSE) because it has the potential to exacerbate existing impacts. Moreover, climate change might induce unexpected and costly failure of the facility itself due to direct impacts from sea level rise especially during storm surge, increase of extreme weather events that induce erosion, flooding, changes in groundwater profile, and prolong the dry weather seasons that can affect the water source availability.

To understand better how climate change potentially impact the facility, it is important to be familiar with expert projections on the changing climate in Timor Leste. The International Climate Change Adaptation Initiative, Pacific Climate Change Science Program (ICCAI PCCSP) has concluded that for Timor Leste, air temperature has increased by a comparable amount to the increase in sea surface temperature (between 0.15-0.2^{0}C) per decade over the period of 1950-2009. In terms of rainfall, the ICCAI PCCSP noted that there is a decrease in annual and dry season rainfall from 1952 to 2009. In the future, rainfall has been projected to shift toward the wet season with dry season rainfall projected to decrease although not much change is expected in the annual mean rainfall. Confidence in rainfall projection is low because 10 years of historic data is missing. As for intensity and frequency of days of extreme rainfall it is confidently projected that the intensity and frequency of days of extremely high rainfall will increase with not much change projected in the incidence of drought.

Study of satellite data and nearest tidal gauge concluded that sea level has risen near Timor Leste by about 9mm per year since 1993 and that the rise is larger than the global average of 2.8-3.6mm per year. A higher rate of rise in Timor Leste may be related to natural periodic fluctuations caused by phenomena such as the El Niño-Southern Oscillation. It is confidently projected that this trend in sea level rise will continue.

The following table shows the indicative figure of various measurable climate parameters that may change in the future.

Table 9.18 Summary of Climate Variation in the future in Timor Leste

Variable	Season	2030	2055	2090	Confidence
Surface air temperature (°C)	Annual	+0.7 ± 0.4 +0.8 ± 0.4 +0.7 ± 0.3	+1.1 ± 0.6 +1.5 ± 0.8 +1.4 ± 0.4	+1.5 ± 0.7 +2.3 ± 0.9 +2.8 ± 0.7	High
Maximum temperature (°C)	1-in-20-year event	N/A	+1.0 ± 0.6 +1.4 ± 0.6 +1.5 ± 0.5	+1.4 ± 0.8 +2.2 ± 1.1 +2.8 ± 1.5	Low
Minimum temperature (°C)	1-in-20-year event	N/A	+1.3 ± 1.6 +1.6 ± 1.8 +1.6 ± 1.7	+1.7 ± 1.6 +2.2 ± 1.8 +2.5 ± 1.8	Low
Total rainfall (%)*	Annual	+1 ± 9 +1 ± 8 0 ± 11	0 ± 15 -1 ± 16 0 ± 16	0 ± 13 0 ± 19 +1 ± 23	Low
Wet season rainfall (%)*	November-April	+1 ± 7 +1 ± 7 0 ± 8	+1 ± 10 +1 ± 14 +3 ± 10	+2 ± 9 +2 ± 15 +5 ± 16	Moderate
Dry season rainfall (%)*	May-October	+1 ± 20 +3 ± 18 0 ± 23	-2 ± 31 -4 ± 35 -3 ± 31	-4 ± 28 -3 ± 40 -4 ± 51	Moderate
Sea-surface temperature (°C)	Annual	+0.6 ± 0.4 +0.7 ± 0.4 +0.6 ± 0.4	+1.0 ± 0.5 +1.3 ± 0.6 +1.2 ± 0.4	+1.4 ± 0.7 +2.1 ± 0.8 +2.5 ± 0.7	High
Aragonite saturation state (Ωar)	Annual minimum	+3.3 ± 0.2 +3.2 ± 0.1 +3.2 ± 0.2	+3.0 ± 0.2 +2.9 ± 0.2 +2.8 ± 0.2	+2.8 ± 0.2 +2.5 ± 0.2 +2.3 ± 0.2	Moderate
Mean sea level (cm)	Annual	+10 (6–15) +11 (6–15) +10 (6–15)	+18 (10–27) +21 (12–30) +20 (12–29)	+32 (17–47) +40 (21–59) +42 (22–62)	Moderate

Source: SoL Research Program, 2011

9.4.1 Risk from Sea Level Rise

To assess the risk of a facility in the coastal location from sea level rise, one has to know distance of the facility from the coastline and the elevation of the facility. In Timor Leste, it is generally accepted that those facilities (especially the national roads) that are located within 100m distance and 2m altitude from mean average sea level are deemed vulnerable to the effect of sea level rise. The proposed facility is about 50 -100 m in elevation and1500 m from the coastline. Therefore, it is found to be generally not vulnerable to sea level rise.

9.4.2 Risk from Changing Rainfall Pattern

The project is located in dry region with mean average annual rainfall at 1100 mm. Historic rainfall data between 1957 and 1974 presented in Table 6.1 and 6.2 show that the area has a prolonged dry period that lasts between May and November. Rainfall pattern has been projected to shift the rain from dry to wet season with relatively consistent mean average annual rainfall. Intensity and frequency of days of extremely high rainfall will increase with not much change projected in the incidence of drought. The change of the rainfall pattern particularly affect the groundwater resources in the area as the type of aquifer is localize high, where the vulnerability of sea water intrusion could increase due to the change of the rainfall pattern. It is therefore very important to prepare in finding alternative source of fresh water including sea water desalination.

Other climate change parameter to be considered in the design of the system is changes in rainfall pattern. As indicated in the above table that, the change of annual rainfall volume (increase) is relatively small, which presented in the following figures.

Figure9.19. Existing rainfall Map describe the year of 2000

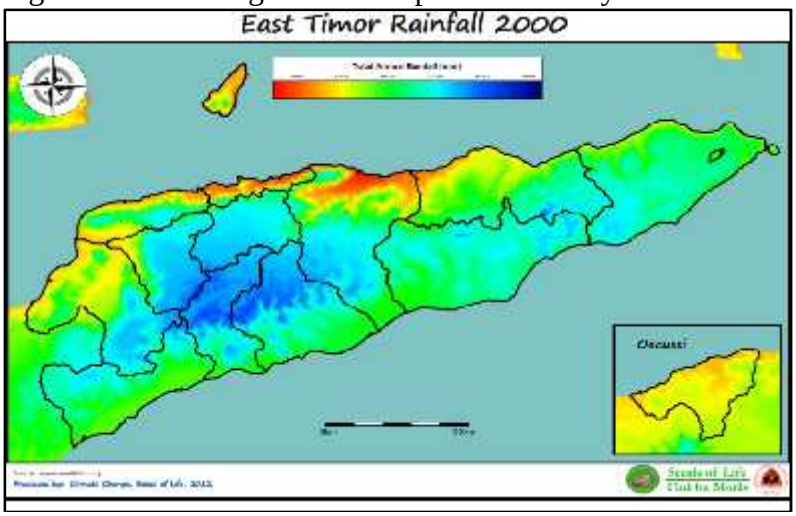
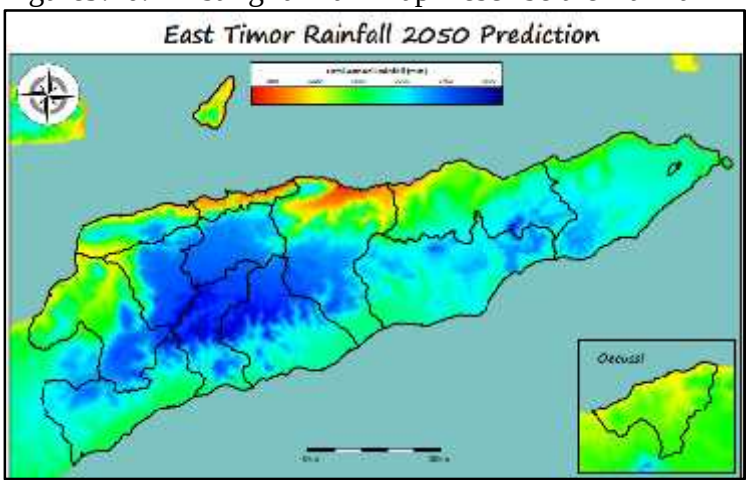


Figure9.20. Existing rainfall Map Describe the Rainfall Prediction for the Year of 2050

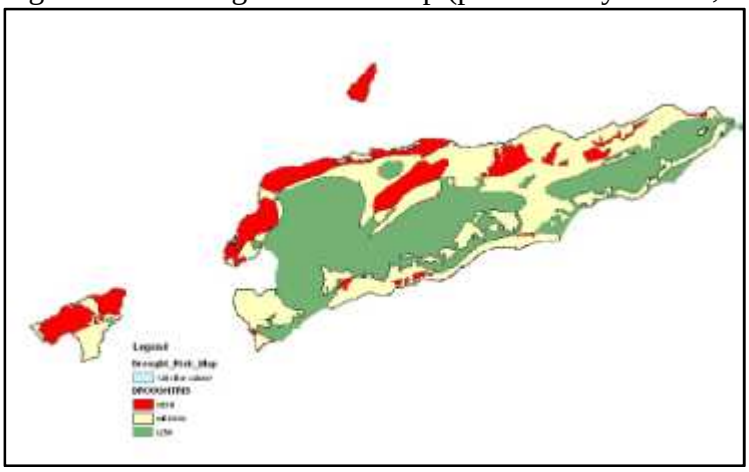


According to the prediction, by year 2050, the annual rainfall in the proposed project location will increase by 10% (from 1170 mm to roughly 1280 mm). This change may be considered small. However, the change may be significant from storm, as the rainfall may occur more frequent and the intensity may increase that will affect the coastal flooding and cropping in the agriculture production. The variation of storm rainfall should be considered in the drainage system design, as the project is located in the coastal area, so that the flashflood impact due to storm could be anticipated.

The drainage improvement should be conducted in order to avoid the future flooding in the project area. By elevating the floor level at the proposed project area, the future flooding and inundation could be minimized.Other potential hazard that may occur due to climate change is drought hazard due to prolong dry season that will affect the fresh water availability. The

following map shows the study produced by the UNDP in 2010 that indicated that the project location is prone to the drought hazard.

Figure 9.21. Drought Hazard Map (produced by UNDP, 2010)



9.4.3 Risk from Changing Temperature

Recent data available suggested that the annual average temperature is 27.3^{0}C with highest monthly average recorded at 34^{0}C. Relative humidity is approximately 80%, making the weather humid but still generally pleasant. Temperature projections noted that temperature in the country is going to increase comparable to the increase in sea surface temperature. A temperature of 34^{0}C is generally considered a moderate to high mid-day temperature. Given the profile for relative humidity of 80%, the mid-day temperature in the region can be considered moderate to high with some effect to the health and safety of workers working in open area. With the high temperature and potential increasing trend in the future, the temperature will affect the cooling and refrigeration system.

9.5 Impact Assessment during Deactivation

Deactivation or decommissioning of the project is a situation where the company has s to stop the operation of the facility for various reasons, which are not expected. The impacts during this stage of project are summarized in the following table.

Table 9.25 Impacts Assessment during Deactivation of Project

Impacts	Source of Impact
Noise and Vibration	From all the activity to decommission of the facility and equipment
Solid waste removal	From the office building, equipment, etc.
Contaminant or hazardous material	From special material such as PCB and the like

OHS	All the activity of decommission
Loss of job and opportunity	From other related activity and project
Loss of income from the company and government	No production causes no income and no tax payment
Land pollution	From wastewater and solid waste

9.6 Positive Impacts Assessment of Project

Regardless of the impacts, assessed related to the project implementation, which could be mitigated, there are many positive impacts that can be generated during the project implementation for government, project owner, community and public that include job creation and positive sense of sign of stability and condition for the large investment from Timorese own company to Timor Leste. The following table provides the summary of positive impacts of the project during the pre-construction and during the construction phases.

Table 9.26. Summary of Positive Impacts during the Pre- and Construction Phases

Activity	Potential Positive Impacts
Feasibility and Environmental Impacts Assessment	➢ Create opportunity for local ➢ Increase level of understanding of the nature of environment by thorough investigation ➢ Share knowledge sharing to the community, government, and company ➢ Positive sign and hope for strategic investment from the foreign company ➢ Local people and company were employed in various sub-project such as drilling, water exploration, security, delivery good and services, and other related works that impacted positively to the economy
Transportation of good and service	➢ Employment creation ➢ Contribute to national tax (custom duty, etc.,) ➢ Create opportunity for local ➢
Construction of facility	➢ Employment for the young people ➢ Training of the staff who are Timorese ➢ Provide opportunity for local content and local company to develop in order to have future opportunity with GOTA such as intermediate in their service delivery

The positive impacts and benefit will be realized during the operation of the proposed facility, as during this time, company will generate positive cash flow and achieve sustainable in operation of the facility. By having positive net cash flow, other real positive impacts such as tax payment, job security for employees, and other social corporate reasonability can be realized. The following table provides the list of positive impacts during the operation of the proposed facility.

Table 9.27 Summary of Positive Impacts during the Operation of Plant

Activity /	Potential Positive Impacts
Operation	➢ Job creation for Timorese (GOTA already employed 50 local to assume the roles and reasonability as operator), marketing staff, and other blue color jobs that will be generated during the operation of the facility and number of job will increase in the future with upgrading the capacity of factory, product, and gain trust from domestic and exports market. ➢ Tax payment to the government ➢ Social corporate responsibility by the company to local community ➢ Create opportunity for other business (supply chain). For instance, enhance agriculture sectors to grow, and other business such as service delivery of product
Spent grain	➢ Enhance cattle raising such as pig, cow, and other with the presence of spent grain as food source ➢ Increase the production of meat and other protein sources

9.7 Residual Impacts

It is anticipated that some residual impacts will still exist even after mitigation measures have been implemented. These impacts should be in a level that can be assimilated by the environment. This is especially important for wastewater load going into the environment where pollutant contained in the effluent should not cause degradation in ambient quality of the receiving marine water. More importantly, waste load into the environment must not cause the receiving environment to lose its functions prior to the development. For instance, marine coastal water that currently use for fisheries, navigation, diving, marine aquaculture, must not lose these functions as a consequences of wastewater loading from the brewing plant.

In the absence of national regulations related to effluent load and ambient water quality, this impact study has suggested that international best practice of effluent disposal standard can be used. Moreover, the usability of the receiving environment must also be used as a guideline in conserving the level of wastewater treatment prior to disposing in the specific environment.

The following table summarized the list of residual impact and potential during the operational phase of the project.

Table 9.28 List of Indicative figure of Residual Impacts during Operation

Parameters	Quality /quantity	Limiting value
Liquid waste		
TSS	50 mg/L	
NOx	<5 mg/L	
BOD	< 100 mg/L	
COD	<100 mg/L	
Phosphor		
Air quality issue		
CO_2	Negligible	
NO_2	Negligible	
SO_2	Negligible	
Methane	Negligible	
Noise and Vibration		

The above pollutant concentration will enter the receiving environment (soil and marine water body. Overtime, the cumulative amount of pollutant may increase and affect the usability of a particular environment. Nevertheless, it is expected that the natural environment will have a natural ability to purify the wastewater the above level of treatment process and at the same time, the pollutant will also decay overtime. Therefore, the overall residual impact is significant small.

10 SOCIAL IMPACT ASSESSMENT

Social impacts that may occur during the construction and operation of the proposed facility including – (i) potential disruption to social cohesion due to unruly workers' behavior and (ii) spread of disease due to the concentration of new workers in the area, this is especially the case during construction period and (iii) local community's protest over perceived unfair allocation of social benefits brought by the facility. The following table shows potential social impacts that may occur during project implementation and its phases in the development.

Table 10.1 Summary of Likely Social Impacts from the Proposed Development

Social impacts or concern	Source Activities		
	Pre-Construction Phase	Construction Phase	O & M Phase
Potential disruption to social cohesion due to unruly workers' behavior	V		
Public health and safety impacts		v	v
Local community's protest over perceived unfair allocation of social benefits		v	v

10.1 Purpose and Objectives

The International Association for Impact Assessment[13] defined Social Impact Assessment to include the processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, and projects) and any social change processes invoked by those interventions. Its purpose is to bring about a more sustainable and equitable biophysical and human environment.

Important features of the above definition are:

1. The goal of impact assessment is to bring about a more ecologically, socio-culturally and economically sustainable and equitable environment. Impact assessment, therefore, promotes community development and empowerment, builds capacity, and develops social capital (social networks and trust).
2. The focus of concern of Social Impact Assessment is a proactive stance to development and better development outcomes, not just the identification or betterment of negative outcomes. Assisting communities and other stakeholders to identify development goals, and ensuring that positive outcomes are maximized, can be more important than minimizing harm from negative impacts.
3. Social Impacts Assessment contributes to the process of adaptive management policies, programs, plans and projects. It also builds on local knowledge and utilizes participatory processes to analyze the concerns of interested and affected parties.

[13] Retrieved from the International Association for Impact Assessment website www.iaia.org on September 2, 2017.

4. Good practice of SIA accepts that social, economic and biophysical impacts are inherently and inextricably interconnected. Change in any of these domains will lead to changes in the other domains.

For this particular study, potential social impacts from the proposed development is assessed based on socio-economic baseline profile of the community which was described based on the most recent census available and other secondary information available from desk review of existing reports as well as primary data collection done in the community. The scope of this assessment is local communities that are living within Suco Ulmera, especially within aldeia Neran , that is the closest to the development. Future workers at the facility, whether they come from within the Suco or other places are also included in the scope as any negative or positive impacts of the facility will be felt by them. Both desk review and field work were done during project preparation (pre-construction) phase.

10.2 Description of the Socio-Cultural, Institutional, Historical and Political Context

Besides Tetum which is a national language, a significant portion (35%) of the community members in Ulmera speaks Mambae, indicating a strong cultural ties with the nearby Ermera region. Suco Ulmera has a total population of 3,527(Census 2015) people. Compared to the results from the previous Census in 2010, the number of population in Suco Ulmera has gone up by 21%[14]. This substantial increase in a short period of time suggested that should the current rate hold, by the year 2020, the Suco's population would have reached about 4,300 people[15].

The Suco of Ulmera, due to its close proximity to Dili, has seen a lot of investment, e.g. in the form of large Jesuit education facility and others. In the future, as the economy of Timor Leste continue to expand, this rapid urbanization trend will shape the area further resulting in denser residential and commercial facilities especially along the national road. The increase in the number of population in the area and the urbanization trend bring about opportunities and challenges in social terms. For example, there is opportunity to shape the area in accordance with good urban planning practices to ensure that as the area urbanize, it happens in an orderly fashion. Other opportunities that comes with the increase in population is the existence of more labor pool, some of which will likely be of higher education compared to the current population. This more educated local labor pool can be absorbed into the development. On the other hand, high rate of population increase will put pressure into currently vacant area around proposed development. These areas could be developed in the near future, creating a nearby population concentration that could negatively impact the facility or become immediate affected people should any large scale accident happened in the facility.

[14] 2004 Census reported a total population of 5,606 people.
[15] At the time of writing, results from Census 2015 has not been published by the Directorate of Statistics.

10.3 Legislative and Regulatory Context

Several legislation and other regulatory contexts are relevant to the effort to social safeguard project's implementation, as described in the following table. Because the development will not affect local population directly (for example, when there is a need to relocate population out of the area), the following table does not include those laws and regulations that are relevant to relocation of communities out of the area. No crops will also be affected from the proposed development.

Table 10.2 Social Safeguarding Laws and Regulation

Social Safeguarding Issue	Relevant Laws	Objectives
Affected surface and groundwater	Decree Law No. 26/2012 – Chapter IV Art. 24	Guaranteeing access to and sharing of water resources among users; Guaranteeing participation of local community especially vulnerable groups in water management.
Access to environmental information	Decree Law No. 26/2012 – Chapter VII Art. 49	Establishing open access to environmental information system and the need to develop a specific mechanism for public consultation for programs, plans and projects.

In addition to the above laws, provisions in other laws are also relevant for the safeguarding of community interests in the development, including Decree Law No.5/2011 on Environmental Licensing - (i) Provision on public participation (Chapter IV, Article 11); and (ii) Provision on Impacts and Benefits Agreement (Chapter V, Articles 15 and 16).

10.4 Analysis of Key Social Issues

General Social Context

Previous Section[16] has informed on relevant social indicators of Suco Ulmera. As reported by Census 2015, the total population of the Suco is 3,527 with population in a household average 6.4 per HH. The Suco is a rural suco, noted in the Timor Leste Labor Force Survey (2013) to have quite a high rate of unemployment at 10%[17].

The community's health profile is believed to be similar to Timor Leste's rural health profile in which there is a need for further improvement in terms of children and women's health status. Health facility remains basic in the community while educational infrastructure gets a boost from the existence of Jesuit Junior High and High School Facility in the area.

[16] Section 4.4 Description of Social Component

[17] Against population 15 years old and older that were working for pay or profit or were available and actively looking for work.

Social diversity and gender are two key social issues that influence the overall well-being of the society. In Timor Leste in general, the ADB and the UN Women noted that the country is a largely patriarchal society and that social norms and cultural values still influence gender roles. With gender equality promoted extensively, especially with support from development partners and the UN agencies, considerable progress has been madeshown through improvement in several social indicators including rapid increase in girls' school enrollment, female participation in national politics and the passage of law on domestic violence. Vulnerability remains, however, shown from further socio-economic indicators including fewer girls making the transition from secondary to tertiary schools; sexual harassment and violence in schools; high rate of maternal and child mortality and the persistence low participation of women in non-agriculture formal economy. One of the implications of this gender relation for the project is the opportunity to improve the above situation by giving preference for women workers either for skilled or unskilled types of jobs in the facility and social contribution to local schools that will directly benefit female students.

Important social institutions in Timor Leste localities in general constitute of local authority, representative of national agencies such as educational and health officers, the Catholic Church and church-related institutions such as convents, dormitory and others. Civil society groups can also be found in the form of national or international NGOs having activities in the area as well as locally-based cultural groups.Specifically in Ulmera, the Catholic educational institution has a prominent presence in the community.

Site Specific Potential Social Impacts

An analysis of potential social stress and shocks from the proposed development to affected population and vulnerable groups in the community concluded on the limited and mitigatable nature of the social impacts (Table 10.3).

Table 10.3. Potential Social Impacts

No	Social Impact	Analysis
1	Impacts on Land Ownership	No impacts on land ownership, land for the project has been purchased by project proponent from a private owner.
2	Impacts on Immovable Property	No impacts on immovable property as no households were residing in the project site.
3	Impacts on Movable Property	No specific impacts on movable property as well.
4	Impacts on Crops and Productive Trees	No impacts on crops and productive trees as the proposed location are not a productive agricultural area.
5	Impacts on Community Used Surface and Ground Water	No surface water body near project location including creek or spring. No impact to the ground water use (at least in the medium term). Nearby communities also do not appear to have wells as domestic water is supplied through a gravity system from the springs at an upstream location.
6	Impacts on Access to Natural Resources	No direct impacts are foreseen in terms of access to natural resources as the project is not taking away or block access any natural resource (e.g. coastal and marine resources).

Throughout the preparation of the EIS, public participation is actively sought out and several stakeholders are specifically contacted to participate in public community meetings held. A detailed account of the stakeholders, their input, comments and questions are provided in Public in the Transparency and Consultation Section.

Vulnerable groups in the community include widows, women-headed households, disabled and elderly people. These groups exists in the community, however, they are not being specifically consulted as they will not be directly affected by the proposed development.

When the construction phase start, local community complaints to the project should still be opened through several mechanisms as follows:

1. The direct mechanism where citizen or affected community member can come and logged their input or complaint directly to the management during office hours
2. Indirect mechanism where affected community provides any complaint to local authority, be it *chefi de aldeia* or *chefi de suco.*
3. The third one is through outreach by project owner where the management routinely conducts an outreach meeting, at least once a year with local community. A gathering can be organized by facility management through local authority. This routine community gathering will ensure good relationship between the facility and local community although community expectation should be properly managed and the facility management should not make promises beyond their capacity.

10.5 Strategy to Achieve Social Development Outcomes and Implications for Analysis of Alternatives

Reasonable social development outcomes to be expected from the project include:

- ✓ Higher level of skills for those working in the facility
- ✓ Job creation for local community
- ✓ Absorption of some women into non-agricultural jobs in the facility
- ✓ Routine annual social contribution toward advancing social causes in the local community.

Temporary negative outcomes could also happen including potential disruption from concentration of workers in and around the facility especially during construction phase. This concentration of workers, while temporary, has the potential to create tension in the community from unruly behavior, alcohol abuse and others.

10.6 Recommendations for Project Design, Implementation Arrangements and Monitoring Plans

Given the above potentially positive and negative social impacts, several recommendations are put forward as follows:

1. Absorption of local labor into the facility: this should start right from the beginning phase of the development/site preparation to construction phase and O&M phase.
2. Preference to women labor during O&M phase: it is believed that certain percentage of labor in the facility should be made open for women, preferably for permanent position. Permanent position carries with it more benefits in the form of opportunities for education and training that not only increase the skill level but provide with positive learning and working experience.
3. Education and training for facility's employees during O&M phase: this should be pursued in a continuous basis with tangible results. For example, upper level management that will be filled with foreign employees at the start of the employment should be filled with Timor Leste citizens within several years.
4. Social contribution: routine social contribution should be made to local community and should contribute to meeting long term social needs of the community. For example, contribution into local schools and health care center, scholarship for students in need and others. This routine social contribution can be coordinated with the church and local authority as the prominent social institutions in the community.
5. Effective environmental mitigation and monitoring programs as not to indirectly impact local community's livelihood due to environmental damage.

Monitoring plans for social impacts will be discussed further in the Environmental Management and Monitoring (EMMP) Section. A long term relationship based on mutual respect should be forged between the management and local authority to anticipate any negative social consequences from the development.

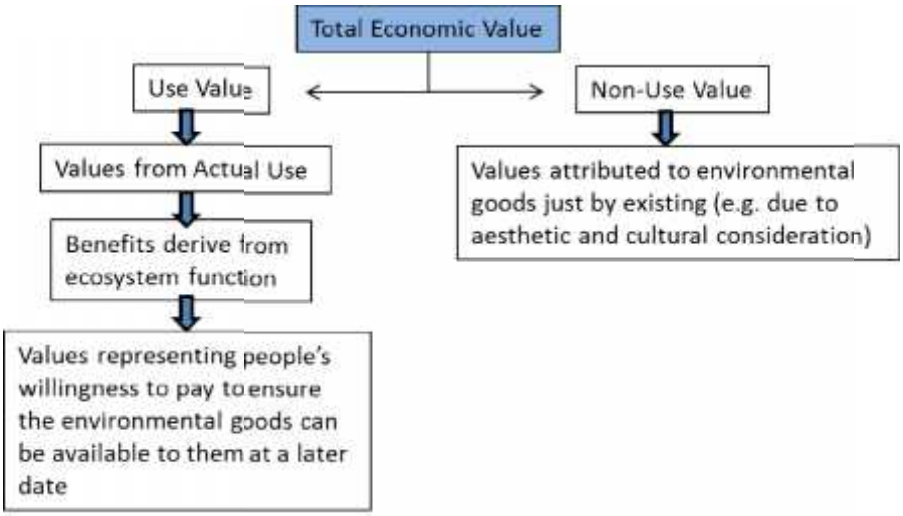
11 ECONOMIC ASSESSMENT

11.1 Economic Loss Due to Environmental Impacts

Timor Leste Environmental Impact Assessment Checklist provides guidelines on the preparation of the components in the Environmental Impact Statement (EIS). For the preparation of the economic impact chapter, the focus should be on the assessment of economic loss due to environmental impacts.

In the environmental economy literature[18], economic loss due to environmental impacts can be assessed using several tools, the most widely used of them is the Total Economic Value (TEV) methodology. Components that make up the TEV analysis are explained in simple terms as shown in the following chart.

Figure 11.1 Total Economic Value Methodology



For the proposed development, potentially the most significant environmental impact is aquifer damage which can result from over withdrawal of the groundwater. Groundwater is without a doubt a valuable resource due to the following reasons:

- It provides a source of clean and fresh water that can be used for drinking water and other domestic water supply with minimal treatment and minimum infrastructure.
- It provides source of water for river and stream flow during periods of dry season, which in turn maintains aquatic life and recreational use.
- It supports wetland areas and the ecological resources at the wetlands
- It provides stable ground surface, over drafting of groundwater beyond could result in surface subsidence.

[18]Ledoux and Turner, 2002.

The European Union Water Framework Directives provide definitions for “groundwater”, “aquifer” and “groundwater body” as shown in the following table.

Table 11.1 Key Definitions

Term	**Definition**
Groundwater	All water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Groundwater body	A distinct volume of groundwater within an aquifer or aquifers.

Use values

- **Direct Use Value**: including consumptive use such as groundwater use for domestic, public, commercial, agricultural and industrial supply. This is the component of groundwater benefits that is, to some extent, directly traded and the part of TEV that may be quantifiable using data from the market.
- **Indirect Use Value**: this is derived from the ecological services provided by the resource. An example of indirect use value is removal of nutrients/provision of clean water to those withdrawing groundwater from the downstream location, flooding prevention, etc.

Non-use values

- **Existence value**: derived simply from the satisfaction of knowing that the resource continues to exist, whether or not this might also benefit others. Groundwater as a resource on its own and through its function as a recharge of surface water is likely to be assigned existence values.
- **Bequest value**: this is associated with the knowledge that the resource will be passed on to the next generations. Groundwater is likely to attract bequest value as a resource and through its contribution to surface water bodies and the ecological services it provides.

To assign appropriate values to the Use and Non-Use Values described above, users and non-users of the resources should be identified. Users (direct or indirect) may possess both use and non-use values while none users will only hold non-use values.

As clearly shown from Figure 11.2, the waterbody where groundwater is extracted from is located within the boundary of Suco Ulmera. This particular waterbody is part of the larger intergranular aquifer. The aquifer supports a range of uses within the area, include:

1. Domestic water supply (from spring water),
2. Domestic wells (shallow wells owned by the population especially in the coastal location near the mangrove and a deep well owned by Colegio St. Inacio de Loyola)

Figure 11.2 Water Resource Utilization in the project Area

It is believed that no other **direct use** from the groundwater body is present in the area as there is no agriculture or other industrial complex utilizing groundwater from the groundwater body is currently present in the area.

To simplify the analysis, **indirect users** can be assigned to the population of the Ulmera Suco. It is assumed that the suco populations are those that benefits from the removal of nutrients/ provision of clean water and prevention of flooding in the downstream locations.

Non-Use Values include the existence and bequest values which are most likely also held by the residents of Ulmera Suco.

The most direct methods to estimate the value of water is the market price proxy methodology, meaning assigning market price of the commodity and the services it provides to the users. Clean water are sold at different prices per liter. The municipal system's water supply tariff is USD 0.24/cbm while private vendors supply 5,000 liter of water for USD 50 or USD 10/cbm. The price of the bottled water, on the other hand is USD 1 per 19 liter or USD 0.05/l.

It is conservatively estimated that the sustainable yield of the groundwater body in Ulmera to be approximately 2,857 l/min or 1.357 million cbm per year (assuming 330 days of continuous production - see Chapter 10). Using the price range of water between USD 0.24/cbm to USD 10/cbm, the direct use value of water can be estimated to range between USD 326,000 to USD 13,577 million per year. It is more likely that the value of direct use of water be close to the upper range since the government water supply tariff is a subsidized tariff.

Other values of the groundwater body are the ecosystem service it provides in the form of the removal of nutrients/provision of clean water and the prevention of flooding in the downstream location. It is hard to assign value for these services as it will require a deeper analysis of cost of water treatment and costs related to flooding. It is sufficient to say, however, that damage to the groundwater body will result in a loss of significant economic resources benefiting especially the population in the respective suco.

11.2 Costs, Benefits and Cost-Effectiveness of Mitigation Measures

Estimation of costs of the mitigation measures to protect the environment is discussed in detailed in Chapter X on Environmental Management and Monitoring Plan. This part will discuss the cost and benefits of several important mitigation measures including information on cost effectiveness of the measures.

The total cost required by project proponent to implement the proposed EMP is about USD of 4.8 Million during the pre-construction and construction phases. During the O&M phase, the total cost for mitigation measures is predicted to be about USD 320,000 per year. A detailed breakdown of the costs are provided in the following table.

11.3 Positive Economic Impacts

The proposed development will also generate positive economic impacts in the form of employment, income for the workers and tax contribution to the government. In terms of employment, it is estimated that the facility will generate 53 permanent employments during Operation phase with more than 100 estimated to work temporarily during construction.

The number of permanent employees during O&M phase is estimated to consists of 2 expatriates and 51 national employees. The breakdown of the total employees at the facility is provided in the following table.

Table 11.2 Employment Generated at the Facility during O&M Phase

Category	**Number of Jobs**
Expatriates	
1. General Manager	1
2. Chief Engineer	1
TOTAL	2
Nationals	

1. Administration	2
2. Finance	2
3. Marketing	2
4. Production	33
5. Cleaning/security	12
TOTAL	51

Total salary to be paid is estimated to be in excess of USD 200,000 for the national and expatriate officers.

A total private investment of USD 4.8 million is projected for the first phase of the development which most likely only consists of bottled water facility. First year revenue is projected at USD 5.855 million at 60% of production capacity. Productivity is projected to continue to increase to 100% capacity by three years.

12 SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN

The summary of environmental management plan (EMP), as presented in the EMMPS document, for each stages of the project implementation is presented as followed, the format of impact, management plan, and monitoring program.

12.1 EMP during the Pre-Construction and Construction Phase

As presented earlier that most potential impacts that may arise during the pre-construction and construction activities are temporary and related to the occupational health and safety (OHS) that can be mitigated on project sites by implementing various proposed environmental management plan (EMP), except few social impacts such as loss of house/jobs, and other livelihood that may considered as permanent impacts that required long-term solution by integrating into the proposed plans. The following tables presented, the impacts and action plans to be implemented in order to reduce the risk/impacts related to the construction activity.

Table 12.1. Summary of the impacts and mitigation action plans - During the pre- and construction phases

Impacts	Environmental Management Plan	Monitoring plans
Noise and Vibration	➢ Schedule the operation of the machine on the day time only ➢ Use ear protective equipment ➢ Utilize the latest heavy duty equipment that produce less noise and vibration	- Community control - Employee - Regulatory agency
Air Emission and Ambient Air quality	➢ Regular spry (re-suspend) the broken soil to reduce susceptibility of dispersed by air ➢ Use the mask and other personnel protective equipment	➢ Community control ➢ Employee ➢ Regulatory agency
Soil erosion and Sedimentation	➢ Create sedimentation basins ➢ Cover the soil ➢ Grade the site and perform the soil compaction ➢ The arrange the construction schedule and activity	Control within the project area by the project owner
Loss of vegetation	➢ Vegetation has limits economic value but could be a good vegetation coverage ➢ Re-plant the loss in other area at the mountainous area	Project owner to project a report on the replanting program in the upland from the project area
Loss of livelihood and houses	➢ Proper resettlement and compensation ➢ Land lease with the government ➢ Re-build the house of the community	Proof of payment of compensation
Workers and Community (OHS)	Applies the proper OHS standard during the all the construction activities related to	Regular monitoring program by project owner and regulatory agency

12.2 EMP During the Operation Phase

The environmental and socio-economic impacts during the operation of the plant on other hand would always exist as long as the plant operates. The following tables shows the proposed action plans in responding to the given impacts identified during the phases of the development. The likely impacts that arise during the operational of the proposed facility, as already elaborated detail in the previous chapter, are directly related to the nature of the activity that utilize the substantial amount of water and energy to produce the product (beer and soft drinks) from the raw materials. The large volume of wastewater, solid waste, and gases emission, are the major direct discharge from the plants to environment and they are the main environmental problems that required solution. The impacts of each sub-component of the plants, as presented earlier, and proposed action plan (EMP) are further summarized, in the following tables. Moreover, the during the operational of plant, the works and community will be impacted from the occupational health and safety (OHS), which required proper action plan to reduce the risk.

12.2.1 EMP on Water Consumption

As presented earlier that substantial amount of water is extracted from the groundwater and treated before using in the processing plant and other utility usage. The objective of the water conservation or environmental management plan (EMP) is to reduce the rate of water consumption on one hand but production rate will be met. By reducing the water consumption is not only good for the environment but also save money and energy so the company must have a lot of interest and motivation to apply various strategic management program to achieve the goal of water reduction. As is the case in many other places, at the beginning of the operation (when the plant start-up) , the rate of water consumption, as determined in the previous sections is reasonably high, where 1 liter beer required 7 liter water and 1 liter soft drink, required 3 L water. This ratio should reduce overtime, as the plant already reached the steady state operation, where the environmental management plan (EMP) has already implemented and the company already has several years of experiences. The following table shows the trend of the reduction of water consumption within the beverage processing plant.

Table12.2 ProposedReductionsof Water Consumption Trends of GOTA in Timor Leste

Year	Ratio	Water extraction, HL	Pumping rate, L/min	% reduction
2018	7	500000	105	0
2019	6	570000	120	57%
2020	5	630000	133	52%
2021	4	670000	141	49%
2022	3.9	720000	152	45%
2023	3.9	879500	185	33%
2024	3.9	905000	190	31%
2025	3.9	905000	190	31%

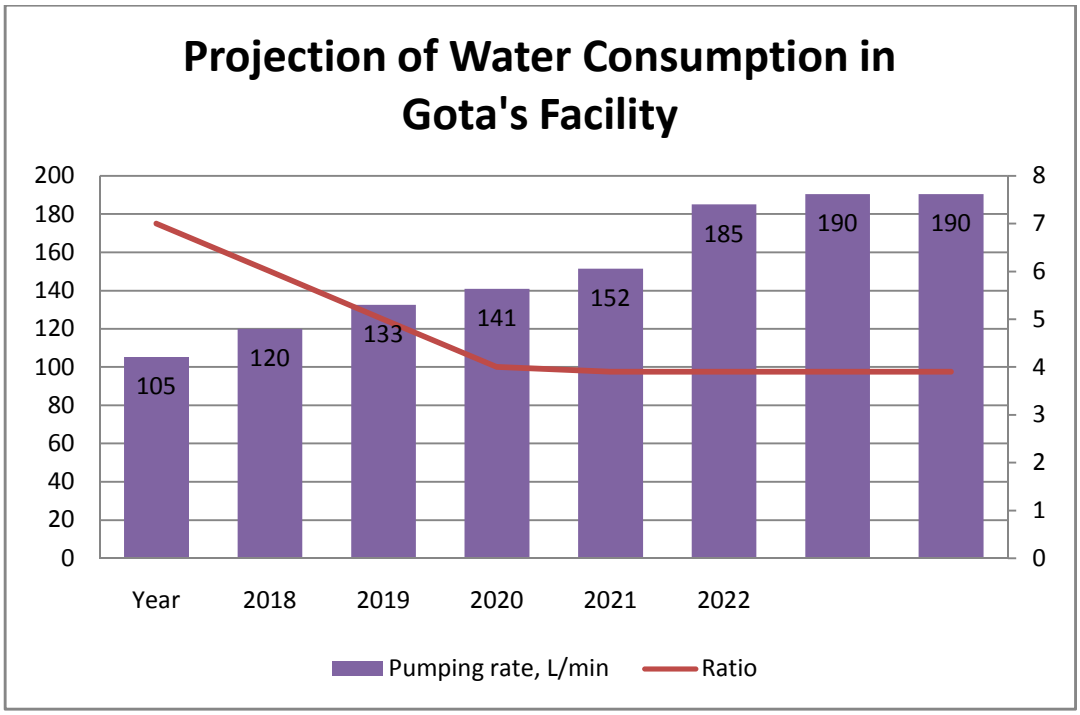


Figure 12.1. Relationships of pumping Rate and Ratio of water Consumption

The latest best practice in industry suggested that the ratio of water consumption only reach 3.9 or 3.9 liter of water required to produce 1 L of beer. The reduction of ratio further lower than 3.9, would depend on the choice of technology. The above figure suggested that after 2-years of operating, the facility should be able to reduce the rate of water consumption up to 4 Liter/1 L of beverage. This target can only be achieved by applying various strategic management programs, which is summarized in the following table.

Table 12.3 Impacts and Action Plan of Water Consumption

Impacts of Water Consumption	Mitigation Measures - EMP	
Increase water stress in the area	➢ Reduce water consumption per unit production ➢ Apply water conservation ➢ Monitor water consumption ➢ Provide target of water consumption reduction	
Affect groundwater sustainability	➢ Pumping rate to be less than sustainable yield of groundwater ➢ Monitor and controlled pumping rate ➢ Reduce water consumption ➢ Provide water for the	➢ Pumping rate to be less than sustainable yield of groundwater ➢ Monitor and controlled pumping rate ➢ Reduce water consumption

	community ➢ Potentially seawater utilization that is more abundant source ➢ Recharge the groundwater with treated wastewater ➢ Investigate the potential water source from the upland catchment ➢ Investigate and study the water conservation	
Affect salt water intrusion		
Susceptibility of groundwater contamination		
Land subsidence		
High cost of treatment and pumping cost	Reduce the water consumption	Reduce the water consumption

The reduction of water consumption rate will provide a lot of benefits for the project owner and the environment as the reducing the water consumption will also means,

- Reduction of water withdrawal from the aquifer or lower rate of pumping rate
- Lower pumping rate means lower energy cost and prolongs the lifetime of pump
- Reduce the risk of land subsidence and salt water intrusion to the groundwater aquifer
- Lower cost of water treatment at the RO unit and also lower rate of brine to be disposed
- Lower rate of wastewater from the plant and that means also lower treatments cost and prolong the lifetime of the industrial equipment. The lower rate of wastewater effluent means also that the receiving environment such as marine water body and surrounding soil will be able to accept as the incoming loading rate is lower than the assimilative capacity of the environment.

The monitoring program would be necessary to be enforced within the processing plant so that the water consumption can be monitored and controlled.

12.2.2 EMP of Energy Consumption

Energy consumption is another important factor that the company should be managed in order to conserve as much as energy utilization as possible with the whole facility in making the desire production rate. The objective of the energy management is to reduce the energy used by optimization of the existing energy consumption. As the impacts of the energy consumption is to the cost and environment, the company has very strong commitment to manage the energy utilization in order to reach energy efficiency program within the plant.The previous sections on the impacts already presented the nature of the impacts and cost that the company will pay from the energy consumption. The action plan required to achieve the energy conservation system:

Table: 12.4 Energy Management and Conservation System

No	Impact of Energy Consumption	Mitigation /action plans	Monitoring System
1	Expensive/costly	➢ Monitor and measures the energy consumption within the facility (possible for each section) ➢ Using the data to perform the energy auditing system ➢ Reduce the usage per unit production of beverage by applying the energy conservation within the facility ➢ Switch to more renewable energy source ➢ Follow various best practice in the industry to save energy	Monitor over time the rate of energy consumption and perform internal audit
2	High Rate Green House Gas Emission		

The following table shows the ten best practices that were applied in the related processing units that will lead to the energy reduction.

Table 12.5 Top list of Best Practice in Brewery Plant to Reduce the Energy Consumption

ITEM	TOP 10 BREWERY RELATED ENERGY BEST PRACTICES
(1)	Turn off equipment when not in use
(2)	Engage employees on how to conserve and use energy more efficiently
(3)	Replace air filters on air handlers, HVAC units etc. on regular intervals
(4)	Identify and repair compressed air, steam and water leaks
(5)	Repair or Replace damaged or missing insulation
(6)	Eliminate the use of compressed air for cleaning, cooling or other applications
(7)	Review all energy set points on a regular basis
(8)	Upgrade incandescent, T-12 Fluorescent to more efficient lighting types
(9)	Collect steam condensate
(10)	Purchase and install energy efficient equipment

In additional to the above best practice to be implemented would be specifically assessed and presented for each component within the facility, there is still other mitigation measured to be taken in various sections in order to reduce the energy consumption, without sacrificing the production of the beverage. Overall the energy management program is very important to be

implemented within the facility in order assure the efficiency of the system by identifying the energy utilization in the process production (heating, cooling, lighting, utility, etc.).

Table 12.6: Proposed Good Approach in Energy Sustainability

Proposed Good Practice and target	What to do to achieve target
Energy Management	➢ Identification, and regular measurement and reporting of principal energy flows within a facility at unit process level ➢ Preparation of mass and energy balance; ➢ Definition and regular review of energy performance targets, which are adjusted to account for changes in major influencing factors on energy use ➢ Regular comparison and monitoring of energy flows with performance targets to identify where action should be taken to reduce energy use ➢ Regular review of targets, which may include comparison with benchmark data, to confirm that targets are set at appropriate levels
Energy efficiency	➢ Demand/Load Side Management by reducing loads on the energy system ➢ Supply Side Management by: • Reduce losses in energy distribution • Improve energy conversion efficiency • Exploit energy purchasing opportunities • Use lower-carbon fuels
Cooling system	➢ Load reduction ➢ Energy Conservation ➢ System design ➢ Minimizing temperature difference ➢ Reduce Condensing temperature ➢ Elevating evaporation temperature
Heating System	➢ Heating load reduction ➢ Heating distribution system ➢ Energy Conservation
Energy Conservation	

More detail the option of energy conservation program in each sub-system within the processing plant can be seen in the section of energy impacts assessment.

12.2.3 EMP in Managing the Solid waste

The impact assessment as presented earlier has already elaborated that for so many reasons, the solid waste would always be part of the production system. Various reasons, why solid waste exist

- Raw Material is solid and Conversion of raw material to the end product is normally not 100%.
- Domestic waste is commonly resulted from the operation of the plant by the workers
- Packaging system applies the solid material that will eventually become waste

The estimation of the rate of the solid waste within the processing plant facility as presented earlier will required management plan to reduce the risk and impacts. Without proper management of the solid waste, the environmental problem, health and hazard will occur and which will be costly to be handled later on. The following table shows, the EMP proposed to reduce the overall solid water impacts to the environment.

Table12.7 Proposed EMP on Solid waste management Related to Processing Plant

Type of Solid waste - Brewing	Impacts	Mitigation Measures	Monitoring program
Spent Grain	➢ Contributing to the high BOD/COD if discharge into wastewater stream ➢ Large quantity which required space to store ➢ Odor and create other problems	➢ Reduce the quantity by increasing the efficiency of raw material conversion to product ➢ Reused by sending to farmer as cattle food ➢ Recycle via composting ➢ Convert to fuel (Bio-process) but it will required higher capital investment ➢ Remove from the plant as soon as possible to avoid further problem ➢ Contract the local vendor to take care of the spent grain	Internal monitoring system by project owner
Spent Yeast	➢ Unpleasant odor ➢ Contribute to high BOD and COD if discharge into drain/wastewater stream	➢ Reduce the quantity by increasing the efficiency of raw material conversion to product ➢ Save and reused yeast ➢ Reused in in bakeries to make bread or cookies ➢ Recycle via composting ➢ Convert to bio-energy (required high cost on the capital investment) ➢ Proper packaging of the spent yeast to reduce the odor	Internal monitoring system
Diatomaceous Earth (DE)	➢ Significant quantity which required space to store ➢ Dust problem	➢ Reduce the quantity by optimizing the efficiency of using the DE (for instance, optimizing the particle size) ➢ Work together with Brewing team to reduce the use of DE without compromising the quality of beer ➢ Explore the membrane process to filter the beer ➢ Recycle the material for other use such as additive to the construction material (concrete cement, brick, etc.) ➢ Always keep in wet condition to ovoid the danger associate with the airborne dust	Internal Monitoring system

Table 12.8Proposed EMP for General Solid Waste Related to the facility

Solid Waste	Impacts	Mitigation Measures	Monitoring Program
General waste	➢ Need space to store (Space limitation) ➢ Create unpleasant environment ➢ Create unhealthy environment and may be generate illness	➢ Proper Collection of the general waste in every section of the unit processing ➢ Separate bio-degradable and non-biodegradable materials - identify the recyclable material ➢ Send the recyclable material to the recycle process ➢ Non-recyclable material to be sent to sanitary land fill in Tibar	Monitoring internally and apply certain penalty
Corrugated - Cardboard	➢ Space limitation ➢ Becomes hazmat ➢ End up in the sea and polluted the sea, city, and environment	➢ Reused – can be used for packaging ➢ Reprocess into compost ➢ Dispose into the proper sanitary land filling	
Wood pellets	➢ Space limitation ➢ Becomes hazmat ➢ Unhealthy environment	➢ Reused - within the facility for other uses ➢ Recycle into table ➢ Composting	
Shrink wrap , Bag, sack	➢ Space limitation ➢ Becomes hazmat ➢ Non-biodegradable material, took a long time to break the molecule ➢ Unhealthy environment	➢ Reuse ➢ Incinerate in the proper location	
Aluminum cans	➢ Space limitation ➢ Unhealthy environment	Recycle the cans	
Plastic bottles	➢ Space limitation ➢ Unhealthy environment ➢ It takes a long time to decompose the non-biodegradable material such as	➢ Reuse the bottle for other purpose ➢ Collect the bottles and recycle if possible ➢ Incinerate in the proper location	

	plastic		
Glass bottles	➢ Space limited ➢ Becomes hazmat ➢ Unhealthy environment	➢ Reused the bottle ➢ Recycle the broken one	
Leftover food	➢ Odor ➢ High BOD/COD ➢ Bio-hazard ➢ Unhealthy environment and cause sickness and poisonous	➢ Send them for animal food ➢ Dry the food to avoid the process of decomposition that cause hazard ➢ Composting the food by mixing the leftover food within organic composting material	

12.2.4 EMP in Managing the Wastewater

About 50% of total water that enter the system will eventually become wastewater and with high BOD, COD, low/high PH, TSS, and high in other contaminant parameters, it will become a problem to the environment, as the natural environment has limitation of assimilative capacity to purify or clean waste. If the waste that enter the environment is greater than the assimilative capacity, then the nature will not able to clean waste that enter the environment. Therefore, managing the wastewater has an objective to limit/control the amount of waste that enter the environment to be less than the natural ability to perform the self-cleaning. Controlling the waste-loading to the environment can be achieved by reducing quantity (volume of wastewater) that enter the system and or improve the quality of wastewater prior to discharging to the receiving environment.

$$W = C \times Q$$

Where WL = waste loading, unit mass/time
C = Concentration, mass/volume
Q = volume rate of wastewater , volume/time

From this equation, it is clear that waste load reduction can be achieved by using two approaches, which is to reduce the volume rate and or reduce the concentration. The type of actions or EMP will be focused on these two options:

Table:12.9Environmental Management Plan on waste loading reduction from wastewater

Method of waste load reduction	Actions Plan - How to do	Monitoring Plan
Reducing the volume rate	➢ Reduce water consumption that will lead to less volume of wastewater ➢ Improve water conservation system to conserve water ➢ Apply CIP (Cleaning In Place) to save water for cleaning that will lead to less water consumption ➢ Urge/encourage employees to help conserve water	Monitor and measure the volume rate of wastewater and compare with the water consumption rate
Improved quality	By using best available technology to treat and reduce the concentration of the wastewater (BOD, COD, NOx, etc.)	➢ Control and monitoring program within the treatment plant ➢ Place the sensor within end-pipe discharge to the ambient environment to detect the quality and quantity of wastewater

Further Impacts of each wastewater quality parameters to the environment and mitigation action plan can be seen in the following table.

Table 12.10 Wastewater Problem and Proposed Mitigation plan and Monitoring Program

Wastewater Parameters	Impacts	Mitigation Measures	Monitoring requirement
High solid material	➢ Contribute to high BOD/COD that will affect the receiving environment such as less oxygen, odor, eutrophication, etc.	➢ Apply physical treatment process (screening to separate solid material) ➢ Improve efficiency of production by increasing high conversion factor ➢ Apply the fine raw material to reduce solid contain in the waste ➢ Control and monitoring the process	Monitoring of the treatment process within the wastewater treatment plant
High COD	➢ Oxygen depletion ➢ Odor emission ➢ Greenhouse gases emission	➢ Apply proper biological treatment process to reduce the COD to the level where acceptable to environment ➢ Treatment in the closed system ➢ Final disposal at the percolation of downward ➢ Control and monitor the level of treatment	Monitoring of the treatment process within the wastewater treatment plant
High BOD	➢ Oxygen depletion ➢ Odor emission ➢ Greenhouse gas emission	➢ treatment process to reduce the COD to the level where acceptable to environment ➢ Treatment in the closed system ➢ Final disposal at the percolation of downward ➢ Monitor and control the level of treatment	Monitoring of the treatment process within the wastewater treatment plant
High Nutrient (Nitrogen based	Eutrophication	➢ Biological treatment ➢ Advance chemical treatment process	Monitoring of the treatment process within the wastewater treatment plant

compound)		➢ Control the level of treatment system	
High Phosphors	Eutrophication	➢ Biological treatment ➢ Advance chemical treatment process ➢ Control the level of treatment system	Monitoring of the treatment process within the wastewater treatment plant
PH issues	Affect all the living organism and ecosystem	PH equalization and neutralization to adjust the PH that is acceptable to the environment	Monitoring of the treatment process within the wastewater treatment plant
High turbidity (TSS)	Cause high turbidity and block the sun penetration and hence disturb the photosynthesis with the marine ecosystem	Treatmentprocess	Monitoring of the treatment process within the wastewater treatment plant

12.2.5 EMP in Managing Air emission

Reducing the emission rate to air is very important; as it is proven scientifically that the greenhouse gas emission is the main cause of the global climate change. As described earlier that there are two component of emission contribution from the proposed beverage plant, namely directly from the plants (gas emission discharge from the plant) and indirect contribution, which mainly due to energy consumption that is purchased from EDTL.

Table 12.11: EMP – Greenhouses gas emission

Impacts	Sources	Mitigation Measures	Monitoring program
Greenhouse gases emission - Carbon Footprint	➢ CO_2 from the brewing processing plant as by product ➢ H_2O from the steam generation and use ➢ Methane	➢ Using high efficiency of CO_2 process for carbonation process ➢ Recover CO_2 from the beer processing plant ➢ Reduce the steam loss within the boiler ➢ Burn the methane gas	Control and monitor rate of Recovery of CO2
	Power/ fuel consumption	➢ Applying various methods of Energy Conservation ➢ Control and monitored the energy utilization ➢ Audit the energy consumption ➢ Using the latest technology that operate at high efficiency and less fuel consumption	Control and monitor the energy consumption

12.2.6 EMP in Managing Climate Changes Impacts

Although the climate change scale and potential impacts that have been estimated by various studies, is estimation for the future event, it is the benefit to the project owner to take this information into their design and construction of the facility that will be able to sustain. It will provide the benefit mainly to the provide owner. The impacts and changes that have been predicted by various scientific studies shall provide a valuable information to decide the type of mitigation and action plan to be implemented in order to reduce the risk if the impacts will occur. The following table presented the local impact and management plan in responding to the potential climate changes effect.

Table12.12 : Impacts and Management Plans from Potential Climate Changes

Climate Variable	Local Impacts	Management Plan	Monitoring Program
Sea Level rise	➢ Coastal flooding ➢ Damage of infrastructure/structure in the coastal area ➢ Change in ecosystem pattern	➢ Elevated the structure (particularly floor level) within the coastal area by considering the increasing sea level rise ➢ Construction of retaining fall to protect the structure/infrastructure from the coastal flooding ➢ The Proponent to elevate all the structures within their facility above the existing/natural ground by at least 1 meter.	Project owner to monitor this action as they will benefit from this management plan
Change of Rainfall Pattern	- More frequent flooding - Potential prolong drought or drought hazard - Production of food in Agriculture will reduce - Increase the risk of groundwater vulnerability (both quality and quantity) - Sea water intrusion to the groundwater - Water volume in the aquifer	➢ Drainage system within the project facility should already considered the rainfall change due to climate change in the design prior to the construction, so that once it is constructed, the drainage will be able to convey the storm water runoff due rainfall regardless of condition ➢ Apply water conservation to consume less water ➢ Potential treatment of sea water into the fresh water (backup plan, in case the groundwater is no longer viable to be used due to various issues ➢ Monitoring the groundwater level and sustainability estimation ➢ Enhance recharge of groundwater with the treated wastewater	➢ Inspection from the project owner on the drainage construction ➢ Monitor and control water consumption ➢ Monitor the groundwater level
Change in Temperature (becomes higher)	- High evaporation rate and cause water loss - Increase energy consumption (refrigeration, heating, cooling, etc.)	The project owner to adjust the design parameters of the system by considering the temperature increase so that the current design and construction will accommodate the future increase of temperature	Proper reviewed by the project owner to the contractor

12.2.7 Resource Utilization Guidelines

The sustainability of the proposed plant will very much depend on how well the resources that utilized being managed efficiently. The more efficient in managing the resources, the better off the company in making profit on one hand, and better off the environment on the other, as the waste such as wastewater and energy consumption would be reduced. Therefore the impacts to the environment will be reduced subsequently.Two important resources that use extensively in the process of production, namely energy and water that should be managed wisely. To do so, the benchmark or indicator should be used and by applying the various management plan that proposed earlier, this benchmark can be achieved or achieved lower level of benchmark value. The benchmark indicator in the table provides the standard guideline on best practice in the beverage related industry from high value or upper bound to the lower bound. The benchmark suggested that by implementing various management options to conserve the resources being utilize in processing related activity, the company would approach the lower limit of the benchmark. For instance, by applying proper water conservation within all the processing related activity, the water ration of beer making can reach 4.0, or 1 liter beer will only require 4 liter water. By reducing the water consumption rate to 4, a lot of benefit will be realized such as cost saving of water treatment, cost saving of wastewater treatment as load to the treatment plant is being reduced. By achieving this target, the environmental consequences can be reduced.

Opposite to this is that if the resource is not being conserved, then the rate of resource utilization would reach the upper limits or higher beyond. This means also that the operating cost of the processing plant will likely to be high and environmental burden will increases subsequently. Consequently, the sustainability of the proposed processing plant will be questionable and the existence to the processing plant for long-term will be in jeopardy.

Table 12.17: Proposed Guideline of Resources Utilization

Outputs per Unit of Product	Unit	Benchmark
Energy [a]		
Heat	MJ/hl	85–120
Electricity	kWh/hl	7.5–11.5
Total Energy	MJ/hl	100-160
Water [a]		
Water consumption	hl/hl beer	4 - 7
Notes: [a] Input and Output Figures for Large German Breweries (capacity over 1 million hl beer) EC (2006)		

12.2.8 EMP of OHS - Worker

The occupational health and safety related to the beverage processing plant, as described detail in the impacts assessment. Monitoring of the OHS is very important to ensure that the plans have been implemented properly within the facility during the construction and operation in order to verify the effectiveness of the implemented plans in preventing and control mechanism. The monitoring of the OHS includes:

- *Safety inspection, testing and calibration:* This should include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.

- *Surveillance of the working environment:* Employers should document compliance using an appropriate combination of portable and stationary sampling and monitoring instream Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

- *Surveillance of workers health:* When extraordinary protective measures are required (for example, against biological agents Groups 3 and 4, and/or hazardous compounds), workers should be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.

- *Training:* Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

Moreover, the employer/project owner, must establish the system and procedure for recording and reporting the accident and diseases that will provide a valuable information for auditing and provide a recommendation for any future improvement.

Table 12.14 System Reporting and Recoding of Accident and Injuries within Project Facility

Monitoring of accident and disease	Type accident and disease
Procedures for reporting and recording	➢ Occupational accidents and diseases ➢ Dangerous occurrences and incidents These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger

	to life or health
System and Employer to enable works to report to management	➢ Occupational injuries and near misses ➢ Suspected cases of occupational disease ➢ Dangerous occurrences and incidents
Report all occupational accident, occupational disease, dangerous occurrence	➢ Establish what happened ➢ Determine the cause of what happened ➢ Identify measures necessary to prevent a recurrence

12.3 EMP During the Decommission Phase

The average lifetime of the plant is 20-years and perhaps after the proposed plant reaches its life time, the facility should be decommissioned or in other cases some major rehabilitation in order to replace the aging industrial equipment. For the given both scenarios, the major impacts and action plan , as presented earlier would be the occupational health and safety hazard, where the EMP is summarized in the following table:

Table 12.15. Impacts and EMP during the decommission plans

Impacts	Source of Impact	Mitigation /EMP
Noise and Vibration	From all the activity to decommission of the facility and equipment	Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are
Solid waste removal	From the office building, equipment, etc.	Proper collection and disposal
Contaminant or hazardous material	From special material such as PCB and the like	Proper handling of the hazardous waste
OHS	All the activity of decommission	Applies all the relevant standard

12.4 Monitoring and performance Indicators

The EMP only effective with strong monitoring program by providing the performance indicators to be achieved by applying the action plans as presented earlier. The major component of the monitoring program should be focused on the major issues that cause major impacts related to the processing activity such as emission and effluent from the facility that will be received by the environment and resources utilization that will trigger the major environmental impacts during the operation of the proposed facility. Moreover, the occupational health and

safety standard should always be enforced by comparing with the best available standard in the industry that has a target to achieve zero rate accident and fatality.

12.4.1 Emission and effluent Guidelines

The wastewater effluent standard for various parameters can be seen from the following table. This standard should be used as guideline to determine the level wastewater treatment prior to discharging into the marine environment. The measurement and monitoring program for effluent wastewater quality parameters should be conducted in the field and report should be produced by the project owner and performance should be evaluated against the following benchmark values or other benchmark value that is more stringent than the international standard of best practice.

Table 12.16. Benchmark of Wastewater Effluent (IFC, 2007)

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD_5	mg/l	25
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Temperature increase	°C	<3[b]
Total coliform bacteria	MPN[a] / 100 ml	400
Active Ingredients / Antibiotics	To be determined on a case specific basis	

Notes:
[a] MPN = Most Probable Number
[b] At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

The waste (both solid and liquid wastes) should also be guided in order to control the waste that coming out from the processing plant. The following table shows the benchmark value of solid waste and liquid waste produced during the processing plant.

Table12.17. Benchmark of Byproduct and Waste Generation

Outputs per Unit of Product	Unit	Benchmark
By-products [a]		
Spent Grains	kg/hl beer	16-19
Yeast & Lees		1.7 - 2.9
Kieselguhr		0.4 – 0.7
Liquid Wastes		
Liquid Effluents	hl/hl beer	3 – 6
Beer Loss	%	1 - 5
Notes: [a] Input and Output Figures for Large German Breweries (capacity over 1 million hl beer) EC (2006		

12.4.2 OSH Guideline and Standard

The implementation of occupational health and safety should be monitored and evaluated based on international standard. The standard may refer to US standard or European best practice standard or ISO standard. The indicator to evaluate the OSH would be the rate of accident and fatality within the project implementation.

Table 12.18 Reference Standard of OHS Implementation

Implementation	Guideline
Proposed OHS - EMP OHS -	➢ Occupational Safety and Health Administration of the United States (OSHA) ➢ Indicative Occupational Exposure Limit Values published by European Union member states, ➢ ISO 18001 ➢ IFC performance standard

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities.The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals, as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupationalaccidents, diseases, and dangerous occurrences and accidents. Further detail on the action plan has been presented in the general OHS. The following table shows the safety parameters and indicator (Sustainabilityreport of main brewing system, 2013).

Table 12.19.GOTA proposed safety parameters in Indicator to achieve the goal

Safety parameters and indicators		
Parameters	1. Fatal accidents	Fatalities, own staff and contractor personnel
	2. Accidents resulting in permanent disability	Permanent disabilities, own staff
	3. Accidents resulting in absence from work	Accidents, own staff and contractor personnel
	4. Lost days	Absence due to an accident, own staff in calendar days
	5. Workforce	Expressed in Full-Time Equivalents (FTE)
Performance indicators	1. Accident frequency	Own staff, number of accidents resulting in absence from work per 100 FTE
	2. Accident severity	Own staff, lost days from work per 100 FTE

13 PUBLIC AND COMMUNITY CONSULTATION AND INFORMATION DISCLOSURE

Public and community consultation are important part of the environmental licensing process according to Decree law no. 5/2011 on environmental licensing in Timor Leste to ensure the transparency and accountability of the environmental impacts assessment process. The purpose of the consultation is to inform the public and community on the development of the project, so that public stakeholders and the community are aware of the upcoming activities, especially to the impacts that may affect negatively to the public and community.

Particularly, the relevant public agencies will familiar and understand the nature of the project and potential impacts that may arise and related to their roles and responsibility. The awareness of the impacts are very important not only at the institutional level, but also at the individual level, and by sharing the proposed scoping study and potential result, the personnel involve will elevate his/her capacity of understanding the nature of the proposed industry and associate impacts that may arise during each stages of the project implementation. This knowledge built-up will eventually help the relevant agency to conduct better monitoring and evaluation after project is operating in many years.

On the other local community, that may be affected directly must be also informed and consulted. In addition to share knowledge information, as like the public consultation, the community consultation will inform the member of the community on the negative and positive impacts that they may encounter as a consequences of the proposed development in their location. The public and community consultation by nature also has an objective to negotiate and solve any issue that may be a concern during the project implementation, such as land title, water uses, and any other government plans related to the proposed project.

Take into consideration of the objectives and target agencies and community, the public and community consultation process, as part of this proposed EIA study will be conducted as followed:

1. The meeting of project proponent with the high level of government on the proposed investment project, local leader of municipio, and other relevant line ministries such as Ministry of Commerce, Industry, and Environment (MCIA).
2. Follow up this meeting with more technical level in the field to resolve any issue related to the project site
3. Consultation to the local and community leader on the proposed project
4. Consultation to government agencies on the proposed scoping study of the environmental impacts assessment
5. Consultation to government agencies on the result/finding of study of the environmental impacts assessment
6. Focus group discussion with the local community affected directly by the proposed project

The consultation and engagement are type of communication between the project owners, the public entity and community members on every step of the development. The EIS process is also one step, which required to be consulted with the relevant stakeholder and community. Relevant stakeholders to the development consist of government agencies, private sector and Non-Governmental Organizations (NGOs) especially those that are actively involved in environmental programs. A list of stakeholders has been prepared as follows:

- National Directorate for Environment
- National Directorate for Biodiversity Protection
- National Directorate for Road, Bridges and Flood Control
- National Directorate for Fisheries and Aquaculture
- Chefi de Suco ofUlmera
- Chefi de Aldeia Neran
- National Directorate for Civil Protection
- NGOs

To ensure a transparent EIS development process as well as on-going consultation with relevant stakeholders and affected community, this EIS formulation process will take several necessary steps as follows:

- Conduct of stakeholder workshop – the first stakeholder workshop with the purpose of discussing draft Terms of Reference has been conducted. The workshop generated meaningful input and suggestions from stakeholders to the scope of environmental impacts assessment. These input and suggestion will be incorporated in the development of draft EIS and any necessary field measurement.
- One-on-one consultation will be conducted for the formulation of the EIS after the stakeholder workshop
- Community consultation in Ulmera to discuss the concern from the community and informed the potential impacts to the environment.
- Upon completion, draft EIS will be made available for public comments and input. Draft EIS has also being presented to the relevant lineministries of the Government of Timor Leste.

13.1 Stakeholder Engagement for Environmental Scoping Study

The first stakeholder consultation was conducted on June 14, 2017 to consult the scope of study of environmental impacts statement (EIS). The invited government agencies and NOGs took part in the stakeholder meeting in providing their opinion on the scope of the study the proposed by the consultant on behalf of the project owner. The following photos show the situational of the stakeholder workshop meeting of the TOR.

Figure 13.1 Photos of Workshop of Stakeholder Engagement Meeting of TOR in Hotel Dcity

Several important points of discussions made during the session of question and answer of the workshop was summarized as followed:

10. Water pumping from the groundwater system that includes the sustainability, public access to the clean water, and mechanism of monitor groundwater utilization.
11. Effect of stream flow (flooding) to the nature of the project, given the location of the project within the proximity of the small creek
12. System transportation of raw material and product from /to the facility
13. The scale and size of the project and categorization
14. Wastewater and mechanism of the wastewater handling
15. Land title and the impact of the project to the community and monitoring of the quality (product and wastewater) should be informed other relevant government agency such as SAS and Ministry of Health
16. The impact of above groundwater activity to the underground system such as groundwater
17. The distance of the project location to the nearest community
18. Recommendation of the treatment of the wastewater

The question and suggestion were clarified and answered by both consultant and representative from GOTA. The groundwater pumping test has been conducted to provide an overall idea of the groundwater sustainability in relation to the pumping rate of water supply for the processing plant. Hydrologic modeling could be optionally conducted as part of the study to understand the river flow (during the heavy rainy season) and impacts to the existence of the project. The project owner will construct the retaining wall within the creek to prevent the high water flow coming into the facility.

As become standard practice, in other places, that wastewater will be treated with the technological approach prior to discharging the effluent into the receiving environment (creek or marine water body). The combination of biological, physical, and chemical treatment processes will be used to treat the wastewater from the factory. Detail will be provided in the EIS and EMP. Regarding the project implementation, it is very important to control and monitor the project by both governments as regulatory agencies on one hand and GOTA on the other to ensure that plans written in the EMP (Environmental Management Plan) will be implemented effectively. GOTA has very strong commitment to safety and environment and all the processing units, including the wastewater treatment plant will be controlled and monitoring worldwide to ensure that all standard and best practice has been properly complied. The company applied the KPI (key Performance Indicator) at each processing plant around the world to ensure that anywhere the processing will used the same standard of operating system, same standard of wastewater treatment, same standard of safety.

13.2 Stakeholder Engagement on Results of EIA

The second stakeholder engagement meeting as part of the environmental impact assessment study was conducted on October20, 2017. The objective of the meeting was to present and share the findings of the EIA to relevant stakeholder or agencies where the impacts will affect their daily activity. The following agencies were invited and actively participated in the discussion on potential impacts and mitigation measures proposed in order to enhance implementation the EIS.

Table13.1. List of Relevant Stakeholder Attended the meeting

Agency	Relevancy to Project
GOTA	Project Owner, who should know very well the impacts and mitigation measures
National Directorate of Water and Sanitation (DGAS)	Related to the water utilization and sanitation issue relate to the development project
National Directorate of Road and Flood Control	National road of Dili – Liquica and other rural roads that will be improved to support the private investment program.

National Directorate of pollution control and Environmental Impacts Assessment	Environmental Licensing
National Directorate of Industry and Commercial	Industrial development, as the proposed development is a type of industry
NGO	Non-government that has a concern in development and environmental
EDTL	Power consumption of GOTA is substantial and potentially can be fulfilled from power plant operated by EDTL
National Directorate of Forestry	Land clearance may take a way forest and required de-forestation
Directorate National of Fisheries	Marine fisheries will be affected by the project from the pollutant loading

GOTA

Rua San Jose, Bairo Pite
Dom Aleixo Dili, Timor Leste

LISTA PRESENSA BA CONSULTA PUBLIKU KONABA DRAF SEIS COMPANHA **GOTA BEBIDAS E ALIMENTOS Lda.**

Dili 20/10/2017

No	Naran	Institusau/profisaun	Asina tura
1	VALERIA E G DE JESUS	MOPTC/DNEPCC	
2	Mario Lobo da Cruz	NI - BNPC - Bombeiros	
3	ANTONINHO DA SILVA	Gab DG Comercio	
4	DIVINA M MARQUES	STAFF DNCPIA - AIA	
5	Salvador S X	STAFF DNCPIA - AIA	
6	Terezinha [illegible]	-//- -//- IPA	
7	Vinerio [illegible]	[illegible]	
8	Mario M. Cabral	PEE Consultant	
9	Venancio Jorge F.	— / —	
10	Tomeo Mariz [illegible]	MCI EDCIC. ASSOR	
11	Eva Marita Maggmo	MdS	
12			
13			

LISTA FAHE CONVITE BA CONSULTA PUBLIKU KONABA DRAF SEIS COMPANHA **GOTA BEBIDAS E ALIMENTOS Lda.**

No	Naran	Intisusaun	No contaktu	Asinatura
1	Ana da C Araujo	DNPC	77429190	
2	Justina	DNSSA	78476207	
3	Felix Milton	DGA	3311473	
4	Odete F. Victor	DNCPIA	77041068	
5	Veronica Sonca	GDBC	77442076	
6	Lalia Gpereira	Gab DG Ind e coop.	3310985	Lalia → DG
7	Juvencia	DNTPSC	3331389	
8	Zeferino	Gab - DGAS	3311539	
9	Deolinda Maria	GDGP	77880081	
10	Beatriz	MDRI	3311408	
11	Olimpia G. da Rosa	Floresta	3310052	
12	Pascoela Fatima	DNAC	3310394	
13	Aliança F. Maia	DNPPR DNPRD	77327067	
14	Eva Merita Magno	MdS	7817170	
15				

Figure. 13.2 List Agencies Invited and Attendances of the Public Consultation on October 20, 2017

Figure 13.3 Public Consultation Meeting to socialize the Finding of EIA study

The meeting took a place in Hotel Vila Verde, where the 8 agencies were sent each representative to the presentation and raise various question related to the project development and impacts to the environment. Particularly, the following issues and concerns were discussed related to the draft of Environmental Impacts Statement (EIS) that was presented. The following are the summary of concerns and issues raised:

- Emergency management system
- Design of drainage system that convey the treated wastewater
- Groundwater pumping test data and groundwater sustainable yield estimation
- The quantity of solid waste and management of solid waste system
- How this proposed brewing system will compete the Heineken brewing plant in Hera

The following table summarized the comment/questions raised during the stakeholder consultation meeting.

Table 13.2 Comment/Question and Response during the Meeting

Representative/Agency	Comment/Question	Response
Sr Mario Lobo da Cruz, Bombeiros, Timor Leste	1. How is the design of the drainage system that convey the treated wastewater to the sea 2. could the company provide the layout of the emergency plan to Bombeiros	PEC – Consulting, expressed that the design and construction of the drainage system will be part of the project, with the facility and the improvement of the natural – open drainage system. The project owner will provide the layout of emergency plan to the Bombeiros, further the realization of the construction
Sra. Devina M. Marque Devina M. Marques, DNCPIA	1. Advise to provide the information of the soil test, pumping test data, and other standard safety and environment in the EMP document 2. Required also to provide the groundwater modeling to know the sustainable yield of the groundwater aquifer	1. PEC – Consulting, LDA, that provide the consultancy service for the EIA has already all the necessary basic data such as groundwater pumping test, soil test, and water quality, as well as air quality, which are used to prepare the EIS and EMP 2. The sustainable yield will be estimated has been conducted and the result will be provided in the EIS and EMP document
Sr. Salvador, DNCPIA	1. Solid waste with the capacity of 5000 ton/year is large and required proper management system 2. How is the treated wastewater discharge to the environment	The solid waste will be managed through 3R (reused, recycle, and disposal). 1. Solid waste that can be used will be reused 2. Some solid waste such as can, plastic, can be recycle 3. Composting for soil/land improvement 4. The wastewater will be treated prior to discharge into the recieveing environment

Sr. Tanco Moryond, advisor to MCI	How this proposed development will compete with Heineken brewing in Hera	The beer that will be produced from this factory is the one that has premium quality. While other soft drink will be slightly different from the one with Heineken.

13.3 Community Engagement Meeting (Focus Group Discussion)

Local community consultation and engagement is very important and required by law of environmental license to know the concern and any input from the local community regarding the proposed development project. The purpose of the community consultation is to inform to the local community, local leaders, land owner, and community who live nearby the proposed project. Moreover, the community and local leaders will also have a formal opportunity to raise any concern or suggestion in relation to the project development. The meeting was held on August 26, 2017 from 9:00 AM to 12:00 PM local time and attended by local leader (chief of Suco, and leader of 9 aldeais, with all the representatives), local police offices, community's members, mean and women that considered as vulnerable but affected by the current proposed development. The local communities were very active and happy to know that the presence of the beverage processing plant in their community. The total participation of this consultation is equal to 75 people, including the consultant and representative from GOTA.

Figure 13.43Photos of community meeting

During the community meeting in Ulmera, the members of the community raise a lot of concern and expectation related the project.

- Road access

The community member, raised road access that connect the main road to the project location, which is too narrow that cannot accommodate the larger vehicular that will deploy the construction material and others.

- Water issue

Currently, the community access water from spring water in the upland catchment system, where the volume of water declined significantly during the dry season. Therefore the community members and leaders of Suco and respective aldeais have asked the project owner, to potentially help their water issue.

- Job employment issue

The community members, include the chief of Suco and aldeais, proposed to project owner to give the first priority in job opportunity that available due to presence of the beverage processing plant. The project proponent should contact the local chief (Suco, Aldeia, and youth group) to find out the potential worker from the community to be part of the beverage processing plant.

- Impact of solid waste

The community members also concerned the issue of solid waste and declared GOTA to have proper solid waste management. The Environmental Impact Assessment team responded that the mitigation measures of solid waste has been proposed to reduced, reused, recycle, and dispose the solid waste that will be generated within the proposed facility.

- Wastewater to the mangrove, coral, and fisheries

The marine water and coastal ecosystem is valuable resources to the community and they are concerned with the wastewater that contains various chemicals that will affect the ecosystem. It was responded that the best available technology will be used to treat the wastewater prior to discharge into the multi-disposal pipes into the soil. The soil will retention as much treated effluent as possible, except during the rainy seasons, where the runoff will convey the diluted treated waste water into the marine ecosystem.

- Impact of dust

Community also raised issue of dust and air quality, especially during the construction activity.

- Environmental Impacts from groundwater Utilization

The local community was also raised the question related to the potential environmental problem, as a result of groundwater utilization.

The above issues were addressed by the project owner, as well as from the consultant team members of the environmental impact assessment. The response to the above mentioned issue and concern can be summarized as followed:

- The project owner is so happy to learn the active participation of the community members in the discussion of the issue and will be happy to discuss with community regarding what can be done by the project owner, which in-line with the social corporate reasonability of the company to give back to the community. According the representative from project owner, GOTA, as local company has always put more priority in the engagement of local worker, community, and local leader.

- Water issue can be solved later during the project implementation and the decision maker in GOTA will decide the help to the community in relation to the water need within the project location.

- The project owner, agrees that all the recruitment will become the local leader and trying to find the workers locally first prior to engaging outside

The following table show the question and concern from the community and response to the issue from project owner and respective consultant team.

14 DIFFICULTIES ENCOUNTERED

After having experiences of 5-years in the water production, that is located Fatuhada, Dili, Timor Leste; the company is trying to upgrade this existing facility into multi-beverage processing system. This past years of experiences have provided a good foundation for the upgrading the existing system.Successful construction and operation of its processing facilities around the world has been made possibly by highly capable management team and a strong policy related to environmental and social sustainability.

Therefore,difficulties encountered during preparation of this EIS have all been resolved through resources provided by GOTA. The difficulties and how they were resolved were described below.

14.1 Process Description

Production of beverage involves a complex process that needs to be described clearly including determination of the right parameters for impact assessment. For example, there is a need to do estimation on the water consumption per litter of beer produced, there is a need to also estimate for the amount of wastewater produced based on industrial standards. Moreover, in conducting the assessment of potential environmental impacts, there is a need to understand clearly the components of the manufacturing process to be able to assess impacts related to worker's health and safety, climate change, waste production (type and potential use as by-product) and others.

The PEC – Consultant team members, have an experience in the EIS/EMP preparation for the similar process in the past, notably with the Heineken brewing process in Hera, where the process of production would be relatively similar in the configuration, equipment setting, process involve, and impact arise. Additionally, some information on the subject has been easy to find from secondary resources based on what is available from best practices in the public website as well as information from industrial standards.

14.2 Water Source

Water resources investigation was conducted pretty much by trial and error in finding the best location for production wells. Study of Australian Hydro-geological study was used as guide, which shows that the freshwater is not available in the project designated area. The project owner was then drilled sevens bore to potentially use as production wells that provide the water supply to the proposed plant. However, only three are considered viable and recommended to be used for the production of water to fulfill the water demand.

The pumping test has been concluded that GOTA can extract water from this production well to fulfill the water demand for the beverage processing plant. As the water quality is not met the proposed industrial specification, the project owner will need to treat the raw water into the fresh water by using the reverse osmosis technology.

14.3 Lack of Information

The basic information of design drawing, plant layout, and other basic physical data were difficult to be given by the project owner or may not be available at the start of environmental impact assessment. At the late stage of the study, the data was made available for the EIA consultant to be integrated into the EIS/EMP document. Moreover, the environmental data was collected as part of the information gathering process that eventually fills the information gap that originally the project team encountered.

15 CONCLUSIONS AND RECOMMENDATIONS

The analysis of environmental and socio-economic impacts of the proposed beverage processing plant has focused primarily on the nature of the project, receiving environment, available local resources while taking references from the similar type of industry elsewhere. The review of existing environment provide a baseline information for the analyzing the impacts that may arise during the project implementation.

It is concluded that the major impacts of the project is related directly to the resources utilization such as groundwater extraction, energy utilization, wastewater from the plant, solid waste, and other hazardous waste that will impact the existing environment in the absence of a proper mitigation measures. The mitigation measures to each impact suggested that with the proper mitigation measures and monitoring system should minimize the impacts to the environment, people, and health. Several important Conclusion and recommendation for the proposed project can be drawn as follow:

1. The proposed beverage processing plant will be the second beverage manufacturing plant in Timor Leste after Heineken in Hera, which is funded from domestic direct investment from GOTA Bebidas e Alimentos, LDA with total initial investment of $12.8 million that will be used to construct the facility, provide equipment and for first year operational cost. This investment will contribute positively to the economics of Timor Leste with the provision of tax payment, EDTL excess power absorption, and generation of jobs.

2. The nature of the proposed project is an extensive utilization of water and energy. This is unavoidable, as 90% of the beverage is water and so water use is extensive and to covert the water into beverage required a substantial amount of energy. This extensive resource use should be monitored well as not to cause significant environmental damage to the aquifer as well as rapid increase in cost for production, as well as contribution to the carbon foot print.

3. Analysis of existing environment indicates that the proposed project will have some effect to the ambient quality of the surrounding environment, particularly the nearby coastal water. Existing use of the marine water is fishery, navigation, mangrove, coral which may be sensitive to the pollutant loading. Therefore, treatment of wastewater should use best available technology and coupled with careful monitoring at both the effluent and the receiving environment (ambient quality). In the absence of national standards to both effluent discharge and ambient quality for the type of use, it is important that GOTA implement a good mitigation and monitoring program.

4. Energy utilization as well as the process itself will contribute to the greenhouse gas emission in both direct and indirect ways. While best industrial practices are available for both, it is important that GOTA actually implement these practices in its operation in Timor Leste, therefore, its carbon print can be minimized. Purchasing energy from EDTL, however, will give incentives for the project owner to conserve to bring down cost of operation.

5. Other potential major environmental impact is related to solid waste production that needs to be disposed-off properly. Solid waste in the form of spent grain and spent yeast can be reused as animal feed. Project owner can later decide to collaborate with local cattle grower for this purpose. With this concept, it is expected that proposed facility will encourage the growth of other businesses.

6. Analysis of potential climate change impacts found that the most relevant climate change impact would be changes in rainfall pattern that influence the intensity of rain events, which will affect the quality and quantity of water resources. Given this situation, it is important to design adequate drainage facility to accommodate larger volume of rains. More importantly, control the water utilization and wastewater treatment system and further use as recharge of groundwater aquifer

7. A major social impact of the project during the operation is related to the public health and safety of due to alcohol consumption. The project owner must this serious issue as part of its social responsibility in its operation in other countries. This practice should be continued here in Timor Leste and responsible drinking campaign through different media should be pursued with relevant institutions such as PNTL.

8. Existing socio-economic condition in SucoUlmera points to a rural community that is undergoing a rapid urbanization. Yet community in the area still has low educational attainment, high unemployment while basic infrastructure such as water supply, health and educational facility remain at rudimentary level. It is recommended that GOTA fulfill its corporate social responsibility through measures that will contribute to the betterment of the society in the long-run.

To mitigate the above impacts, several management and monitoring measures have been proposed. Implemented properly, the management and monitoring measures will reduce impacts to surrounding environment and communityto a point that is acceptable. It should be noted though that effectiveness of the proposed mitigation measures depend on regular monitoring by project owner, regular inspection from relevant regulators and support from local community. Therefore, in the future, good working relationship between project proponent, relevant authority and local community should continue to be pursued. The implementation of the EMP will only be effective with the proper monitoring system with the clear indicator, which were also recommended by this study.

16 NON-TECHNICAL SUMMARY

The proposed development of beverage production facility, with the annual capacity of 50,000 HL of beer, 50,000 HL of carbonated soft drink, and 500,000 HL of packaged mineral water, is a 100% of domestic investment from GOTA Bebidas e Alimentos, that will take 7 HA land in Ulmera, Postu administration of Bazartete, Municipio of Liquica, Timor Leste. The land was secured by the project owner with direct purchasing between the project proponent and the original land owner.

The component of the project with the scale and concern are presented in the following table.

Table.16.1 Project Component and Scale

No	Project Component	Scale and Concerns
1	Water Resources and Consumption	Capacity of extraction is equal to 200 L/minutes. This rate is considered moderate and the monitoring of groundwater table suggested that the pumping rate with the capacity of 200 L/min, would not cause a significant drop on the groundwater table that may cause various environmental issue such as land subsidence, salt intrusion, groundwater contamination, and potential water crisis in the project area. The analysis of groundwater data and rainfall recharge, as well as pumping rate suggested that the above rate of pumping shall not cause any major issue of the groundwater.
2	Water Treatment	The measurement of groundwater quality from the constructed groundwater production well indicated that the quality is nearly pure and only required minor treatment to remove certain contaminant such as harness, heavy metal, etc. The capacity of the water treatment plant is at 110% of the total volume of water requirement, which is 1.2 million HL
3	Brewing Processing Plant	The Scale of this component is 50,000 HL. Issue that will become a major concern during the operation of the plant are; water consumption, energy consumption, wastewater, solid waste, and by product that will required comprehensive management system

4	Soft Drink Processing Plant	The Scale of this component is 50,000 HL. Issue that will become a major concern during the operation of the plant are; water consumption, energy consumption, wastewater, solid waste, and by product that will required comprehensive management system
5	Wastewater Treatment Plant	Wastewater will be designed and operated at the capacity of 100 L/minutes. Wastewater will become a major environmental concern. Since this plant will become a largest plant that discharge the wastewater into marine water in Timor Leste, a comprehensive assessment on the choice of process, level of treatment, and disposal mechanism would be important
6	Wastewater Disposal System	Capacity of 100 L/minutes and disposal to the marine water and level of treatment prior to disposal would be monitored comprehensively by the relevant regulator bodies

As each component of the project, as presented in the table, is a major one, then proper environmental impact assessment must be conducted in order to detect any potential environmental and social impacts. By knowing the environmental and social impacts, the proper environmental management plans (EMP) can be proposed to mitigate the negative impacts of environment and people.This environmental impacts assessment has been prepared and reported in the EIS report by PEC – Consulting, LDA on behalf of GOTA Bebidas e Alimentos, LDA, as the project owner and operator of the proposed plant.

The environmental impacts assessment was conducted based on guideline as presented in the decree law 5/2011 on the environmental licensing requirement and other relevant regulatory framework such as industrial and business development, food and beverage industry, and other relevant international law and best practice that are relevant and applicable to the project development activity.The environmental impacts assessment was conducted first by reviewing the existing environmental condition, which include, physical environmental such as climate, topographic, hydro-geology, and soil condition and marine ecological that will eventually become a recipient of the of the environmental discharge from the proposed development. Moreover, the existing socio-economic condition of Timor Leste in general and community that affected by the proposed project was reviewed. This background information of the existing will provide valuable information to formulate the scope of environmental impacts assessment and necessary field measurement. Secondly, by using the data and information related to the nature of the projects and the scale that were collected, the impacts assessment relative to the project was conducted.

The environmental and social impacts from the propose development were assessed ineach stage of project development, namely the pre- and construction phases, operation stage, and decommission stage. While, the environmental impacts during the pre- and construction as well

as decommission stages, are temporary impacts which can be managed effectively onsite during the implementation, the impacts during the operation of the proposed facility is adverse and therefore required prospered mitigation measured to reduce the impacts, avoid, or prevent them. The major environmental impacts related to the operational of the beverage processing plant are related to the resource utilization such as water, energy, and raw material, and other supporting utilities of the processing plant.

Water Utilization

The water demand was fulfilled by pumping the groundwater from the groundwater aquifer. Though, the quality of groundwater is reasonable, for general consumption purposes, further advance water treatment system would be required to produce water that meet the specific requirement of the industry such as beverage and end-product mineral water. The process of the groundwater pumping, treatment, and distribution, would generate the environmentalimpactsthat would need to be assessed and mitigated.

- Environmental Impacts on the aquifer
- Environmental impact related to treatment process (high energy consumption)
- Occupational Health and Safety

Various mitigation measures from these mentioned impacts have discussed in the impact analysis and mitigation measured, which should help minimize the impacts to the environment and while at the same time maximize the benefit gain from the development project. The mitigation measures as summarized and presented in the form of environmental management plan (EMP) would need to be implemented and monitored by the project owner and supervised by the government agencies. The monitoring and supervision of the implementation of the EMP would need the standard and performance guideline such as national or and international in case the national standard is not available.

Energy Utilization

Energy requirement to support the processing plants is substantial amount which can be fulfilled within the facility and purchased from the third party. Regardless of the sources, the consumption of energy will contribute to the greenhouse gas emission, which will contribute to the global climate change. Moreover, uncontrollable consumption of energy will be expensive and without conserving the energy, the sustainability of the proposed project will be in jeopardy. The environmental impacts and mitigation measured as presented earlier in the EMP suggested that by conserving the energy utilization, the contribution of the greenhouse gas emission can be reduced. The summary of Environmental Impacts due to energy utilization:

1. Energy is expensive
2. Greenhouse gas emission will contribute to the global climate change
3. Air quality

The impacts due to energy consumption that can be minimized by various mitigation measures as proposed.

Processing Related

The process related impacts would be the waste as byproduct that is generated during the process conversion of raw material into desired product. The potential impacts related to the process consist of process conversion of raw material into product, where other by product, solid waste, and liquid waste are also generated. The following table presented the major impacts and mitigation measure to control the impacts and minimized the risk.

Wastewater Treatment

Wastewater treatment as discussed is an important solution to the environmental issue related to the project implementation. The treatment system will help reduce the waste load that will enter the environment at the level, where the waste load enter the receiving environment will be at the rate below the assimilation capacity of environment. Moreover, the with the good quality of treated wastewater, the effluent can be used to irrigate the surrounding land or recharge the groundwater aquifer.

Solid waste management

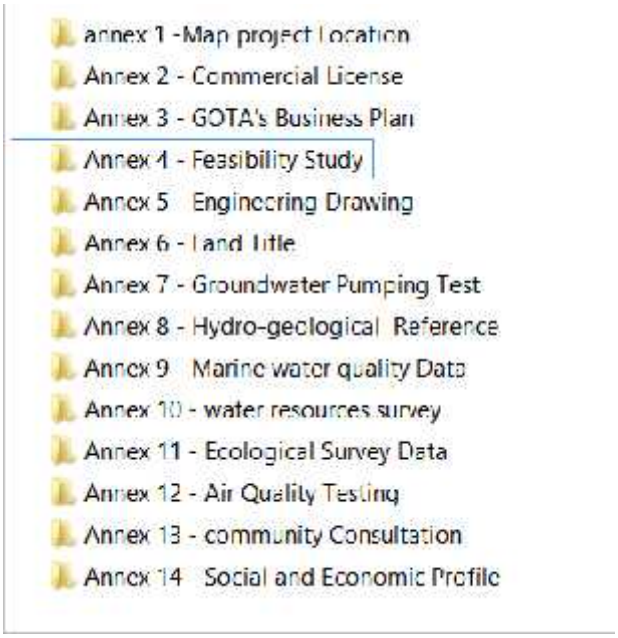
Various types of solid wastes as discussed from the previous sections should be managed property in order to support the production system. There are several solid wastes classifications which are economically valuable so they can be recycle and reuse and solid waste that has not economic value which will be disposed to Tibar dumpsite area.

Table 16.2 . Summary of Major Environmental Impacts and EMP Requirement

Sources	Impacts	Environmental Management Plans
Water utilization	➢ Groundwater aquifer problem (potential land subsidence, sea water intrusion, groundwater contamination, potential irreversible damaged of aquifer) ➢ Increase water stress area ➢ Contribute to the greenhouse gas emission ➢ High energy cost for treatment process and pumping from the aquifer	• Monitoring the groundwater pumping and rate of pumping to be always below the sustainable yield • Reduce the ratio of water consumption by implementing various water conservation program • Perform water source protection in the upland catchment system to keep good storage for sustainable water resource • Apply rain harvesting system within the project location to harvest water during the rainy days
	Water Treatment process - high cost	Monitor and control the rate of water utilization
	Wastewater (brine disposal) – high contaminant	Proper treatment system
Energy Utilization	➢ Expensive ➢ Greenhouse gas emission contribution	➢ Measure the rate of energy utilization ➢ Apply the energy conservation program within the whole facility to reduce the rate of energy consumption ➢ Recover the energy within the system (boiler, cooing system, heating system)
Process related	Solid waste	Applies 3RD (reduce, Reused, Recycle, and Dispose) to manage the solid waste
	Wastewater	➢ Reduce volume of wastewater by reducing water consumption ➢ Applies the best available technology to treat the wastewater prior to discharging into the marine environment
	Greenhouse gas emission	➢ Recover the CO2, as much as possible ➢ Recovery the steam loss in the boiler ➢ Proper burning of methane
	OHS	Applies the proper OHS

17 APPENDIXES

List of appendix (provided in the digital format)



18 REFERENCES

1. IFC , 2007, OHS for specific Industry of brewing , http://www.ifc.org/wps/wcm/connect/a1b1ce8048855d0e8dc4df6a6515bb18/final+-+breweries.pdf?mod=ajperes
2. IFC 2007, General OHS, www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines
3. Heineken sustainability report 2014, http://secure.theheinekencompany.com/~/media/Websites/TheHEINEKENCompany/Downloads/PDF/Sustainability%20Report%202014/Heineken_SR_080415.ashx
4. Australian Geoscience, 2012, TL Hydro-geology of Timor Leste, Government of Timor Leste
5. Ministry of Infrastructure, on Climate Data
6. Decree Decree law 5/2011 – Environmental Licensing Law
7. Decree law 1/2012 – Basic law of Environmental Protection
8. TL Constitution
9. Decree law on the Investment
10. Decree law on food and beverage